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Title: Is Fintech Reshaping the Financial System at the Cost of Stability?

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Abstract

Financial technology is unbundling the vertically integrated bank. Liquidity provision, screening, monitoring and risk transformation were once performed together under a single license, they are now distributed across specialized firms. How that redistribution effects incumbent banks determines both how credit is supplied and how it should be regulated.

The fact that fintech has grown is not in dispute, but the impact of its growth is. A fintech substitutes for the bank, credit migrates outside a perimeter built over a century of crisis and reforms. If it complements the bank, the same grows strengthens the incumbent. It doesn't stop here with new wave of innovation comes new risk types and effect over systemic risk of the financial system.

The thesis answers the question in three stages. At first compares the economic functions of traditional banking with the mechanisms of fintech. Then follows an empirical study examining a panel of 10,167 financial institutions across 57 countries over the 2012-2020 period, Relating fintech credit volumes to bank margins, fee income, costs and returns. It finally tests the European regulatory regime against the activities that the framework should capture about this new wave of innovation, so it doesn't lead us to a financial and economic collapse.

Three findings emerge, first, the dividing line in the locus of credit exposure rather than the technology. Platforms that match lenders with borrowers without holding the loan complement the bank and raises its returns. Firms that retain credit on their own balance sheet compress those margins and returns. Second, cooperative banks absorb most of the shock and the sign reverses for commercial banks that are placed in a high quality regulatory environment.

Fintech does not remove risk from credit intermediation it relocates it. Systemic risk falls as claims leave backstop balance sheets, and consumer risk takes its place. Born by savers and borrowers who neither price the exposure nor hold capital against it. Authorization should attach to the retention of credit exposure, and algorithmic underwriting should be regulated by testing outcomes instead of prohibiting inputs.

1 Introduction

The history of banking is one of the oldest institutional forms of the modern economy, traceable to the merchant houses of renaissance Italy, from the 17th century onward and to the state backed institutions that still key to financial governance today.[1] What gave the sector its present shape was not this gradual accumulation but crisis, the vulnerabilities built up through decades of unrestrained credit expansion in the 19th and early 20th centuries culminated in the Great Depression which demonstrated what a banking system produces when it grows without a framework capable of containing it.[2]

The banking model we call traditional today is the answer to the demonstration, a centralized and vertically integrated structure emerge in which a limited number of institutions performed the full range of intermediation functions. from deposits to granting credits, payment systems, screenings, monitoring borrowers and maturity transformation, While bearing the results on their own balance sheet.[3] That is what the present innovation puts in question, since the core banking once performed together are being unbundled and redistributed among several intermediaries that were never designed to be a bank and are not regulated as such. This decentralized financial institutions increasingly are taking place beyond the boundary that a century of crisis and reforms was built to define, with the record that shows the consequences of a financial system unobserved that expands faster than the framework governing it.[4]

Yet despite its historical refinement, the traditional banking model is characterized by a number of structural imperfections that have become increasingly apparent over time. The concentration of financial intermediation within a small number of vertically integrated institutions generates significant barriers to entry the market which limits competitive pressure and creates persistent informational inefficiencies. The proprietary and relationship based nature of bank lending further restricts access to financial services for underserved segments of the population and economy which created a new wave of financial innovation. The Great Depression the 2008 crisis acted as a systemic shock that disrupted incumbent institutional arrangements and opened space for new entrants and new models. The contemporary wave of financial technology commonly referred to as fintech accelerated in the post crisis. Coinciding with the rapid diffusion of mobile connectivity, cloud computing and

[1] Raymond de Roover, "The Medici Bank: Organization and Management," The Journal of Economic History 6, no. 1 (1946): 24–52; Raymond de Roover, The Rise and Decline of the Medici Bank, 1397–1494 (Cambridge, MA: Harvard University Press, 1963).

[2] Bank for International Settlements — Financial Stability Institute, "Bank Failure Management: The Role of Deposit Insurance" (FSI Insights on Policy Implementation No. 17, 2019). This report documents the evolution of deposit protection frameworks from the post-Depression era onward, demonstrating how the systemic fragility revealed by early twentieth-century bank failures shaped the post-war institutional settlement.

[3] Douglas W. Diamond and Philip H. Dybvig, "Bank Runs, Deposit Insurance, and Liquidity," Journal of Political Economy 91, no. 3 (1983): 401–419; Xavier Freixas and Jean-Charles Rochet, Microeconomics of Banking, 2nd ed. (Cambridge, MA: MIT Press, 2008).

[4] Hennie Penikas, "History of Banking Regulation as Developed by the Basel Committee on Banking Supervision in 1974–2014," Financial Stability Journal (Bank of Russia) 28 (2015): 19–48. Penikas provides a comprehensive account of the progressive elaboration of international banking regulation through successive Basel Accords, illustrating how the capital adequacy framework evolved in response to globalisation, financial innovation, and recurrent crisis episodes

advanced data analytics. This technological capabilities enable new actors to provide financial services with greater efficiency, broader accessibility and lower cost targeting the frictions and exclusions that the traditional model had failed to resolve. As economic theory suggests financial innovation typically arises in response to unmet demand and unresolved market inefficiencies.[5] This decentralization doesn't imply the absence of regulation or institutional governance rather that signals a fundamental reorganization of how financial intermediation are delivered and supervised.

This thesis analysis the economic and financial implication of the ongoing shift from centralized banking toward a more decentralized technology driven system, what motivates the subject is how easy it has all become. Financial services that once carried real cost and real delay are now delivered almost in moments and since the market imperfections that made them costly have not disappeared the question worth asking is: whether fintech firms operate as functional substitutes for incumbent banks displacing core intermediation activities or whether they function as complements improving and transforming these activities within a more pluralistic institutional framework.

The second line of inquiry concerns the regulatory and financial stability consequences of this transformation, questions arise if existing set of rules can manage to govern the resulting landscape, how systemic risk is redistributed when financial activity migrates outside the traditional banking perimeter and current supervisory tools remain sufficient to protect consumers and maintain market integrity.

The questions set out above cannot be answered within a single mode of analysis since each requires an approach, in case fintech is a substitutes or complements to the bank it's a question about economic function which is why we address it theoretically. Whether the substitution has in fact occurred and its impact on the incumbent is a question of magnitudes its therefore addressed quantitatively. The resulting distribution of risk falls within the boundary designed to hold a question of legal scope, only settled by adapting the regulations, the thesis accordingly proceeds sequentially each step of the strategy supplying the criterion by which the next is conducted.

2 Methodology

This chapter sets out the methodological approach adopted in the present thesis its purpose is to explain the analytical procedure through which the research questions will be addressed and to justify the selection of methods in light of the theoretical and empirical objectives of the study. The methodology is organized as a sequential multilayered analytical framework that moves from conceptual definition through theoretical comparison, to empirical analysis and finally to structure evaluation of regulatory adequacy. Each layer builds upon the preceding one and together they constitute the argumentative chain through which the thesis seeks to answer its central question: whether the structural transformation currently underway in the financial sector represents a genuine advance toward a more resilient

[5] Peter Tufano, "Financial Innovation," in Handbook of the Economics of Finance, ed. George Constantinides, Milton Harris, and René Stulz, vol. 1A (Amsterdam: Elsevier, 2003), pp. 307–335.

financial system or whether it reproduces in a new institutional form the dynamics that have historically preceded the systemic crisis.

2.1 Banking vs. Fintech

Traditional banking refers to the model of financial intermediation that emerged from the post-depression regulatory settlements and reach its institutionally mature form in the later decades of that century. under this model, a relatively small number of large vertically integrated institution perform the full range of financial intermediation functions internally from taking deposits, extending the credit, payments processing, maturity transformation and risk management. The theoretical foundation of this model rests under resolution of two fundamental market frictions, the first is information asymmetry between lenders and borrowers which bank address do delegated monitoring on behalf of depositors[6] and the second one is the maturity mismatch between the short term liquidity needs of depositors and the long-term capital requirements of borrowers which banks resolve through maturity transformation and liquidity provision.[7] Both functions depend critically on the centralization of financial activity within institutions that accumulate proprietary information over time and maintain long-term customer relationships.

Fintech that refers to technology enabled financial innovation that produces new business models, applications or the processes with a material effect on financial markets, institutions and service provision. What distinguishes fintech from earlier waves of financial innovation is the disaggregation of the financial functions previously bundled with an integrated banking institutions into specialized modular service providers. Following Thakor, It is analytically useful to distinguish two axes of the disaggregation, horizontal disintegration refers to the migration of specific bank activities particularly those that do not require a balance sheet such as payment processing, foreign exchange conversion and financial advice to specialized non-bank providers, leaving the banks balance sheet functions intact but stripping away the peripheral revenue streams that had historically cross subsidized them. Vertical disintegration refers to the layered decomposition of the bundled bank by digital platforms and to modular service layers identification and onboarding, credit scoring, matching, payment execution and the record keeping each of which can in principle be provided by a distinct entity.[8] The two forms of disintegration have different implications for systemic risk horizontal disintegration erodes bank profitability without directly transferring credit risk, whereas vertical disintegration alters both the location of credit risk and the identity of the entity that performs credit quality screening.

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[6] Freixas, X. and Rochet, J.-C. (2008). Microeconomics of Banking, 2nd ed. MIT Press; Diamond, D.W. and Dybvig, P.H. (1983). Bank Runs, Deposit Insurance, and Liquidity. Journal of Political Economy, 91(3), pp. 401–419. Together these works constitute the foundational framework for bank intermediation theory.

[7] Diamond, D.W. (1984). Financial Intermediation and Delegated Monitoring. Review of Economic Studies, 51(3), pp. 393–414. Diamond demonstrates that banks exist because they can monitor borrowers on behalf of depositors at lower total cost than decentralised monitoring.

[8] Anjan V. Thakor, "Fintech and Banking: What Do We Know?" Journal of Financial Intermediation 41 (2020), 100833.

2.2 Fintech, Banking and Market Imperfections

the second component of the framework involves a systematic comparison of the economic theories that underpin traditional banking and fintech business models, what is the specific purpose of identifying where and how fintech redefines the market imperfections that banks have historically resolved. This comparative analysis draws on the bodies of theory summarized in the accompanying literature reviews and serves as the theoretical bridge between the definitional framework and the empirical analysis.

The theoretical analysis of traditional banking is organized around 4 core functions identified in the intermediation literature: delegated monitoring, maturity transformation, risk transformation and information production.

Fintech firms demonstrate strong advantages in areas that depend on data processing and algorithmic decision-making were there intensive use of big data analytics reduces both search costs and information asymmetries relative to tradition and bank based lending.[9] The two sided platform model explains the rapid scaling of fintech services, as platforms benefit from network externalities that reduce marginal costs and increase value for each additional participant.[10]

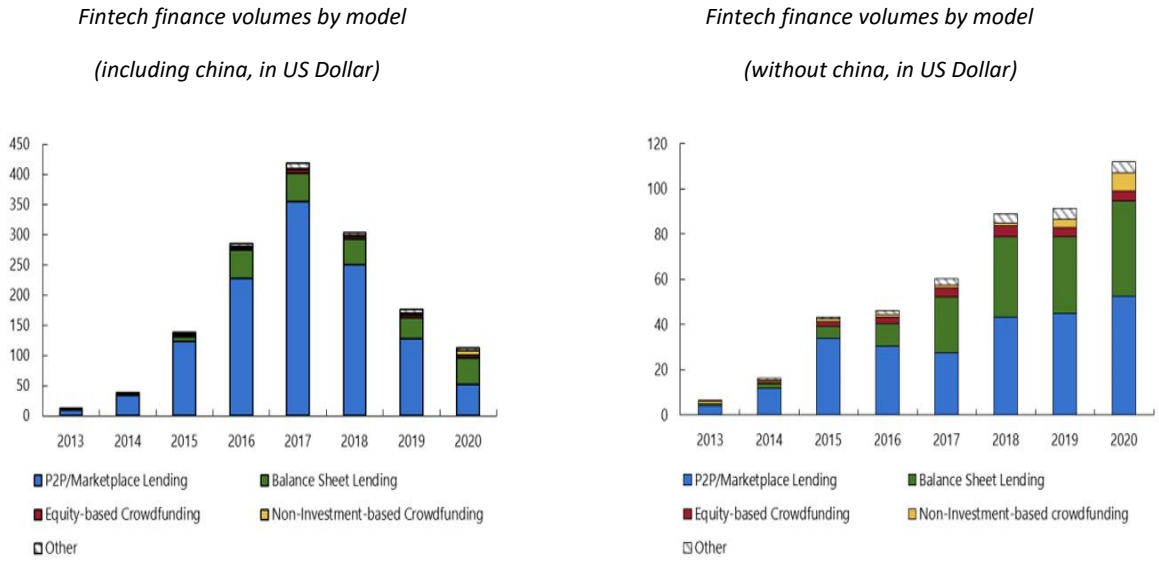

Figure 2.2. Fintech Finance volumes by business model, 2013-2020

Source: Elekdag, Emrullahu and Ben Naceur (2024), IMF WP/24/17, using CCAF (2021) Database.

Figure 2.2. illustrates the Rapid growth of fintech transaction volumes across business models from 2013 to 2020, drawing on the CCAF global data set used in the IMF study. The dominance of P2P/marketplace lending and balance sheet lending as the two primary fintech credit models is clearly visible, as is the effect of Chinese regulatory tightening on global volumes

[9] Vives, X. (2019). Digital Disruption in Banking. Annual Review of Financial Economics, 11, pp. 243–272; Fuster, A., Plosser, M., Schnabl, P. and Vickery, J. (2019). The Role of Technology in Mortgage Lending. Review of Financial Studies, 32(5), pp. 1854–1899.

[10] Rochet, J.-C. and Tirole, J. (2003). Platform Competition in Two-Sided Markets. Journal of the European Economic Association, 1(4), pp. 990–1029.

after 2017. Excluding China, the data revealed a sustained upward trajectory that directly motivates the quantitative analysis in the following section.[11]

The trajectory of this magnitude warrants explanation rather than mere description, financial innovation does not arise spontaneously it emerges where the incumbent arrangement leaves a friction unresolved and sustain the expansion on this scale is therefore evidence that something in the traditional banking system was not working. This is what makes the theoretical analysis necessary identifying what fintech contributes to the intermediation function requires a framework in which it its arrangement can be assessed against the banking configuration function by function rather than judge and the aggregate.

2.3 Fintech Growth

The third component of the methodological framework is a quantitative analysis of banking sector balance sheet data, designed to establish the empirical reality of the structural shift from regulated banking to fintech-driven intermediation and to assess its implication for risk distribution within the financial system and its impact on the revenue stream of banking. This component addresses two of the core empirical questions of the thesis: How far the entry of financial technology firms has affected incumbent revenue streams and in which direction, since an effect that expands those streams identifies fintech as complementary to the banking sector adding value and resolve friction for the banking sector while one that compresses them identifies it as substitutive.

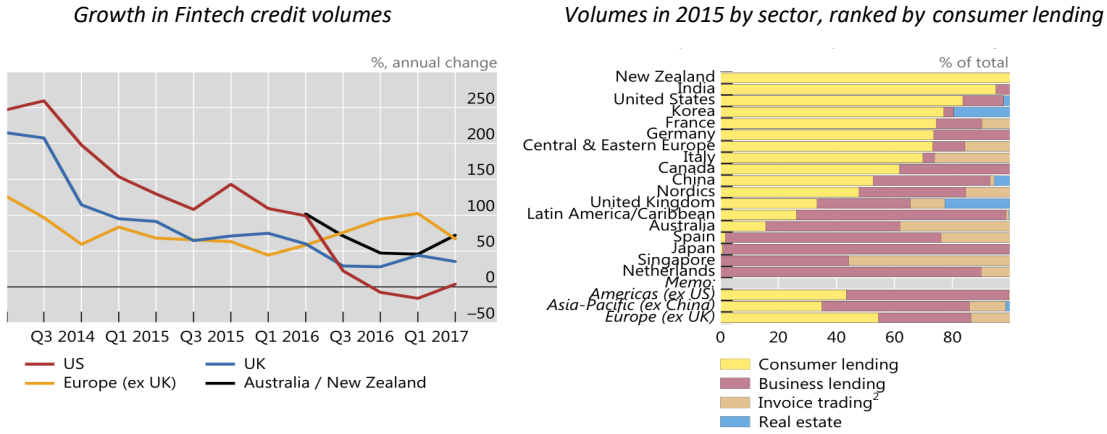

Figure 2.3. Fintech credit volumes: annual gross rates and composition by sector across jurisdictions.

Source: FSB/CGFS (2017), op. cit.,Graph 1. Sources: AltFi Data (left panel); Cambridge Center for alternative finance and research partners (right panel).

Figure 2.3 shows the growth and fintech credit volumes across major jurisdictions and the composition of fintech lending by sector, the left panel illustrates that annual growth rates exceeded 100% for several years across the US, UK and European markets, it should be read as a rate of change rather than a level so that the declining lines indicate deceleration from a very low base rather than a contracting market. The right panel reveals substantial cross country heterogeneity in the sectoral composition of fintech credit, with some markets

[11] Elekdag, S., Emrullahu, D. and Ben Naceur, S. (2024). Does FinTech Increase Bank Risk Taking? IMF Working Paper WP/24/17.

dominated by consumer lending and others by business lending and invoice trading. This variation is methodologically important because it implies that the displacement effect On traditional bank balance sheet cannot be assumed uniform: it depends on the structure of the market in which it occurs, which is why the empirical analysis rests on the multi country panel and test explicitly whether the estimated effect varies with the depth, concentration and regulatory quality of the national banking system.

The analysis that follows this aggregates fintech not by credit segment but by business model distinguishing peer-to-peer intermediation from balance sheet lending. These are the two configurations that account for the bulk of fintech credit volumes, they are separated by the criterion the theoretical framework identifies as decisive, whether the platform retains the credit exposure or passes it to a partner bank. Determining the direction resulted from our approach settles whether fintech operates as a substitute for incumbent or as a complement to it.

2.3.1 Data and Sample

The empirical component adopts a panel design covering 57 countries over the period 2012-2020, bank level accounts are drawn from the Bureau Van Dijk Orbis database which supplies 10,167 financial institutions numerically dominated by cooperative banks (7151) relative to commercial banks (1409), country level fintech transactions volumes are taken from the CCAF global alternative finance market benchmarking datasets and macroeconomic and governance indicator are drawn from the IMF and the World Bank.[12]

The dependent variables are the components of bank profitability, the return on equity and return on assets serve as the two summary measures and return on assets decomposes along the income and expense axis into 3 operating ratios:

ROE=ROA x (Total Assets/Total Equity) (1)

NIM=(Interest Income-Interest Expense)/ Interest earning assets (2)

NONIC= Non-interest income/average assets (3)

CTI= operating expenses/(net interest income+ non interest income) (4)

The baseline specification is estimated separately for each of the five dependent variables:

$$PER_{\beta,}{}^{c}{}_{,t} = \alpha + \beta_1\, FinTech^{c}{}_{,t} + \gamma\, X_{\beta,}{}^{c}{}_{,t} + \delta\, W^{c}{}_{,t} + Other_{\beta,}{}^{c}{}_{,t}. \quad (5)$$

$PER_{\beta,}{}^{c}{}_{,t}$ is one of ROE, ROA, NIM, NONIC, or CTI for bank b in country c in year t, each at the one per cent level. The vector $X_{\beta,}{}^{c}{}_{,t}$ holds bank fundamentals constant through size and capitalisation, so that the fintech coefficient does not simply recover the fact that large or well-capitalised banks differ from small or thinly capitalised ones; $W^{c}{}_{,t}$ holds the environment constant through GDP growth, inflation, the policy rate, and five-bank asset concentration, so that it does not recover the business

[12] Ben Naceur, S., Candelon, B., Elekdag, S. and Emrullahu, D. (2023). *Is FinTech Eating the Bank's Lunch?* IMF Working Paper WP/23/239.

cycle or the pre-existing competitive structure of the market. $Other_{\beta,^{c},t}$ contains a bank fixed effect and a residual.[13]

There exists no route from the bank's operation and to return on assets other than through the three operating ratios and none into return on equity other than through return on assets and the leverage multiple. Any effect of fintech competition on an incumbent must therefore register in one of these components and the five measures together guarantee that no transmission channel has been omitted from the specification. The specification is presented here in outline, it's identifying assumption but the further specifications derived from it and the robustness check that supports it are developed in chapter 4 later on.

2.4 Regulatory Scope

The fourth component of the methodological framework, is a qualitative analysis of the regulatory and governance landscape which serves as the analytical bridge between the empirical findings and the teachers concluding assessment of systemic risk. The analytical framework draws on the concept of the governance gap, the degree to which the pace of regulatory adaptation has lagged behind the pace of financial innovation. Regulatory coverage and the calibration of regulatory requirements applied to fintech activities relative to their risk profiles. This framework is informed by the post-basel lll regulatory literature, documenting how the international capital adequacy framework was extended in response to the 2008 crisis and several European regulatory coverage.

The three components of the methodological framework are designed to be read as a cumulative argumentative chain rather than as a dependent analytical exercises.

3 Theoretical Assessment

Having established in section 2.2 the upward trajectory of fintech volume relatively to banking, the present chapter turns to the question that no expansion of this order occurs without being flagged and this is what the theoretical Foundation of the two intermediation model will determine. The purpose is to identify the improvements fintech introduces to the economic function and the outcome that follow.

3.1 Theoretical Foundations of Traditional Banking

3.1.1 The Diamond Dybvig Model: Banks as Liquidity Providers

The Diamond-Dybvig model of 1983 Dive theoretically in the banking as a liquidity provision arrangement, banks as institutions that transform long term illiquid assets into short-term liquid liabilities.[14] A series of ex ante agents each endowed with one unit of good at date t=0, learn at date t=1, whether they are of impatient type (consuming only at date 1) or of patient type (consuming only at date 2). The storage technology returns 1 unit if liquidated at date 1

[13] Ben Naceur and others (2023), p. 12, equation (1). Dependent variables are at the 1 per cent level, which is necessary in a sample that mixes microfinance institutions with large commercial banks. The specification follows the established bank-performance literature; see Asli Demirgüç-Kunt and Harry Huizinga, "Determinants of Commercial Bank Interest Margins and Profitability," World Bank Economic Review 13, no. 2 (1999): 379–408.

[14] Douglas W. Diamond and Philip H. Dybvig, "Bank Runs, Deposit Insurance, and Liquidity," Journal of Political Economy 91, no. 3 (1983): 401–419.

and R>1 units if held to date 2,the ex ante planner's problem is to allocate (c_1,c_2) to the two types to maximise utilitarian welfare:

$$\max t\, U(c_1) + (1 - t)\, U(c_2) \quad (6)$$

Subject to the resource constraint:

$$t \cdot c_1 + (1 - t) \cdot c_2 / R \leq 1. \quad (6.1)$$

The first order condition equates the marginal utilities across dates:

$$U'(c_1^*) = R \cdot U'(c_2^*) \quad (6.2)$$

The solution satisfies $1< c_1^*< c_2^*<R$. The demand deposit contract offered by the bank replicates this allocation, impatient depositors withdraw c_1^* at date 1 and patient depositors receive c_2^* at date 2 this is what we call a maturity transformation.

This same transformation can generate a self-fulfilling run equilibrium in which the expectation that all depositors will withdraw at date 1 precipitates the outcome since $c_1^*>1$.

The bank cannot honor the promised payment if all depositors withdraw simultaneously because the long term asset must be liquidated at last to provide liquidity to the depositors which drive the average payoff to fall below unity. The Diamond-Dybvig theory does two things, it Grounds the maturity transformation function of banks in an optimality argument, and it identifies the fragility that this function introduces which can be resolved only by a creditable public backstop (deposit insurance or the Lender of last resort).

A natural response to the vulnerability would be to modify the deposit contract itself, for instance, by introducing a withdrawal fee at date 1 by suspending convertibility once a threshold has been reached. Both alternatives fail to reproduce the welfare properties of the public backstop, for two distinct reasons:

The risk sharing argument is the analytical core of the objection, it's a feature that makes the bank socially valuable and it's the same one that generates the run vulnerability. Impatient depositors receive $c_1^* > 1$ at date 1 only because the patient accept $c_2^*< R$ at date 2, This transfer of consumption between the two types is what implement the ex ante insurance against the timing uncertainty each depositor faces. The withdrawal fee large enough to eliminate the run must reduce the effective date 1 payment to at most 1 unit, Which returns the impatient depositor to the autarkic outcome and dissolves the insurance that made the bank welfare improving in the first place.

The signaling argument identifies a second failure mode of implementing a withdrawal fee, which is a visible restriction to depositors it can carry an informational content of its own. Depositors observing this fee and implies that the bank is under liquidity shortage and this inference can accelerate rather than restrain the run, So the mechanism designed to deter the run becomes the signal that triggers it. A public backstop operates in the opposite direction,

because it is silent and normal times and only becomes visible in the extreme case of an actual run when the guaranteed payments are made directly to depositors.[15]

What does this framework imply, being backed by the public safety net is what allows the bank to function in the first place, offering a claim redeemable on demand against assets of longer maturity so it doesn't have to liquidate them at a loss. And can do so without deploying any visible mechanism to reassure its depositors which is precisely what makes the arrangement effective. Both properties requires a license, since credit institution is conditional on requirements for holding credit on its own balance sheet, and performing maturity transformation, so central banks are required to deviate from systemic risk.

The position of fintech depends on its model either it's a peer-to-peer platform matching lenders with borrowers, without originating the loan, not carrying credit exposure of its own or holding it on its balance sheet. It's not protected by a central bank what it has instead is a client money safeguarding against the failure of the platform itself.

what this means for systemic risk follows from the asymmetry rather than from the matching arrangement itself, a platform that merely introduces the two sides makes no promise the safety net would need to stand behind. On the other hand, balance sheet model of fintech that begins to perform the functions attributed to banks, by originating and retaining credit on its own balance sheet without having a license. It does so outside the prudential requirements to which a bank performing the identical activity would be subject. This is the distinction on which the whole analysis turns and returns at later stages during the estimation of what each business model does to incumbent profitability and then in the assessment of what European law does and does not capture.

3.1.2 Information Asymmetries

A second friction of the intermediation environment is asymmetric information over borrower type, in the Akerlof, Private information over the quality of the traded goods leads high-quality types to withdraw from the market so that only “lemons” remain offered and the market unravels.[16] When applied to credit markets, this means that pooling borrowers with different risk levels at a common interest rate shifts value from safer borrowers to riskier ones, prompting safer borrowers to exit the market. The response to this shift, by Bhattacharya and Thakor, distinguishes two channels: adverse selection ex ante, resolved through screening, and moral hazard ex post, resolved through monitoring.[17] The present subsection develops the ex ante channel with the classical formalization by Stiglitz and Weiss, Who show that the

[15] **Goldstein and Pauzner (2005)**, "Demand Deposit Contracts and the Probability of Bank Runs," *Journal of Finance*

[16] George A. Akerlof, “The Market for ‘Lemons’: Quality Uncertainty and the Market Mechanism,” Quarterly Journal of Economics 84, no. 3 (1970): 488–500. Akerlof’s framework establishes that asymmetric information over the quality of the traded good can lead to the unravelling of the market, with the higher-quality types withdrawing and only the “lemons” remaining offered. Applied to credit markets, the framework predicts adverse selection whenever borrower types are private information.

[17] Sudipto Bhattacharya and Anjan V. Thakor, “Contemporary Banking Theory,” Journal of Financial Intermediation 3, no. 1 (1993): 2–50. Bhattacharya and Thakor provide the canonical synthesis of the two channels through which information asymmetries motivate intermediation.

loan interest rate is not a pure price but also a screening device changing the borrower pool it attracts.[18]

Let y denote the borrower's realized project return, L the loan size, and θ(r) the (endogenous) average riskiness of the borrower pool that self-selects at rate r. The bank's expected return per loan is:

$$\rho(r) = \int \min\{y, (1 + r)L\} \cdot f(y \mid \theta(r))\, dy, \quad (7)$$

With θ(r) decreasing in r because higher rates cause safer borrowers to withdraw. A safe borrower undertakes a project with a modest and reliable return if the interest rate rises above the level at which the project remains profitable he's gonna rationally quit the market. A risky borrower instead undertaking a project with a large upside but the probability of failure means that a higher interest rate is manageable in the success state. Because the profitability is large enough to absorb it and irrelevant in case of failure because the borrower does not repay anything under limited liability regardless of the contracted rate. This mechanism describes the adverse selection effect of the interest rate which arises because limited liability Shields the borrower from losses while the interest rate only affects the returns and profitable scenarios. As r rises, the mechanical income effect dominates but eventually the adverse selection effect on θ causes ρ(r) to fall. Beyond the critical rate the composition effect on θ Becomes decisive: the pool deteriorates faster than the additional interest can compensate and expected returns fall. This non monotonic relationship between the rate and the expected return is what breaks the standard supply and demand logic of credit markets, in which a higher price would be expected to increase the lender surplus.

The bank chooses the rate r* that satisfies: $\rho'(r^*) = 0, \quad (7.1)$

Should demand at r* exceed the bank's supply, the excess is left unsatisfied rather than priced away: credit rationing emerges endogenously from the informational friction itself.

Stiglitz and Weiss identify the friction but do not solve it, Leland and Pyle address it with a complementary solution in which the intermediary signals borrower quality by retaining a stake in the project, thereby making the informed party bear a share of the residual risk.[19]exposing the borrower to the outcome generate a signal for the lenders from the size of the stake and willingness of approval, mechanism working through incentive compatibility.

[18]Joseph E. Stiglitz and Andrew Weiss, "Credit Rationing in Markets with Imperfect Information," American Economic Review 71, no. 3 (1981): 393–410.

[19] Hayne E. Leland and David H. Pyle, "Informational Asymmetries, Financial Structure, and Financial Intermediation," Journal of Finance 32, no. 2 (1977): 371–387. Leland and Pyle model the intermediary as an entity that signals borrower quality by retaining a stake in the financed project, thereby resolving adverse selection through incentive-compatible signaling rather than through direct information production.

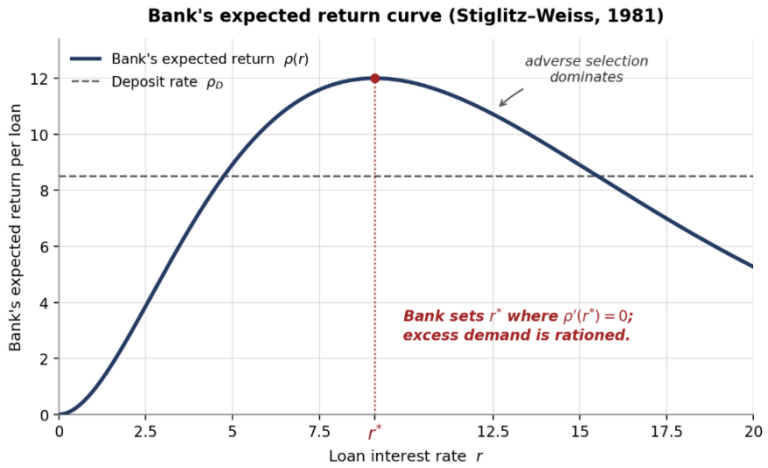

Figure 3.1.2. The bank's expected return per loan ρ(r) as a function of the loan rate. Below r, the mechanical income effect dominates; beyond it, adverse selection erodes the quality of the borrower pool faster than the higher rate compensates, so expected returns fall. The bank therefore sets r* rather than the market-clearing rate, and excess demand is rationed.*

Source: Own elaboration based on Stiglitz & Weiss (1981)

Rationing is an informational outcome, and any technology that improves ex ante discrimination between borrower types operates directly on the friction the model identifies.

It all begins one step before the rationing result, the model assumes a single rate applied to all and the obvious question is, why the bank does not avoid the problem altogether by charging each borrower a different rate that matches their own risk. This way raising the rate would no longer drive the safer ones out and θ would stop deteriorating, credit would clear like any other market. The bank doesn't proceed this way for a specific reason which is not that it has failed to think of, but individual pricing requires information the bank does not have and acquiring that data cost more than it is worth.

3.1.3 Costly State Verification

The Stiglitz–Weiss framework of previous section identified an ex ante informational friction so the lender's inability to observe borrower type at the moment of origination and derived credit rationing as its consequence. Townsend theory identifies an ex post imperfection which is the lender's inability to observe the borrower's realized return after the project has run its course.[20]

The costly state verification model of Townsend (1979) explains why the standard debt contract has dominated the bank firm relationship. A borrower undertakes a project who's realized return y is observed only by the borrower, but can be verified by the lender at a cost γ > 0. Any incentive compatible contract must specify A repayment schedule R(y) together with a verification decision. Townsend Shows that the constrained optimal contract minimizes expected verification cost by verifying only in states in which it announces default, to the

[20] Robert M. Townsend, "Optimal Contracts and Competitive Markets with Costly State Verification," Journal of Economic Theory 21, no. 2 (1979): 265–293. See also Stephen D. Williamson, "Costly Monitoring, Financial Intermediation, and Equilibrium Credit Rationing," Journal of Monetary Economics 18, no. 2 (1986): 159–179, who extends the Townsend framework to derive the intermediary as a general equilibrium outcome.

requirement that the borrower has no incentive to misreport. the repayment schedule takes the form of a standard debt contract with face value D:

$$R(y) = \min\{y, D\} \qquad (8)$$

with verification occurring if y < D. The ex ante expected verification cost by the intermediary is:

$$E[\text{verification cost}] = \gamma \cdot \Pr(y < D), \qquad (8.1)$$

Announcing default triggers verification and once y As observed the lender seizes the entire amount rather than the fixed payment D the borrower would otherwise have paid, so truth telling is the dominant strategy. Overstating y in the bad states is pointless, because the contract only requires the borrower to pay what they have.

In other words Townsend identifies verification cost as the specific imperfection whose reduction would rationalize a departure from the debt centric contractual environment, if γ → 0, state-contingent contracts that were previously infeasible become optimal.

Further outcomes follows from the same result, concerning not what the lender learns but when. If verification occurs only in default then default is the only moment at which the bank produces hard information. Everything between origination and failure is inference drawn from indirect signals rather than observation. Once verification occurs only at default and defaulting across a portfolio of loans are driven in part by a common shock, data arrives not as a stream but as a cluster. Earlier data is in itself a stability gain, The incumbent's difficulty is not that it observes too little but that it cannot be used. Its advantage would lie in converting that observation into codified, real-time information on a loan while it is still performing rather than once it has failed.

3.1.4 Delegated Monitoring Diamond (1984)

Diamond's 1984 paper on financial intermediation as delegated monitoring formalises the argument that banks exist because they possess a comparative advantage in the monitoring of borrowers.[21] Consider an economy with N projects, each requiring monitoring at a fixed cost K, without it borrowers can misbehave or misreport which leads to credit allocation collapses. If each depositor were to monitor the borrower funded by that depositor's share, the cost incurred would be:

$$C_e^{EPREc} = N \cdot K. \qquad (9)$$

If instead, a single intermediary is delegated monitoring function, the cost will be:

$$C^{delegated} = K + \delta(N), \qquad (9.1)$$

Where δ(N) is the delegation cost that comes from the residual need of the intermediary's liability holders to assure monitoring. Delegation is optimal if $C^{delegated} < C_e^{EPREc}$, that is:

[21] Douglas W. Diamond, "Financial Intermediation and Delegated Monitoring," Review of Economic Studies 51, no. 3 (1984): 393–414.

$$K + \delta(N) < N \cdot K. \qquad (9.2)$$

The decisive result of Diamond's analysis is that the delegation cost δ(N) vanishes as N grows large: with a sufficiently diversified portfolio, the residual risk borne by the bank's own liability holders becomes negligible under the law of large numbers, and the intermediary can credibly commit to monitor without itself being monitored. For any nontrivial N, condition (9.2) is therefore satisfied and delegation dominates. Delegation works not because the intermediary is inherently trustworthy but because the mechanics of diversification makes it rational from the intermediary's balance-sheet structure.

According to the model, delegated monitoring option outperforms the alternatives because it reduces the overall cost of monitoring. This is credible because portfolio diversification within the intermediary replaces external monitoring.[22]

Balance-sheet fintech platforms that pool loans and issue standardized claims to institutional investors reproduce both conditions and inherit the delegated-monitoring logic in substance if not in regulatory label. Pure peer-to-peer platforms, by contrast, do not perform the delegation at the platform level: the platform matches individual investors to individual loans, and each investor holds a claim on specific borrowers rather than on a diversified portfolio managed by the intermediary. The diversification that Diamond identifies is not present at the platform level in this configuration, it is either absent, or transferred to the individual investor. who on his own need to diversify their portfolio.

The transfer of losses from the bank's balance sheet to the investors of the platform alters the systemic risk profile of intermediation at small scales. Idiosyncratic losses of the individual investor do not impact the financial ecosystem as much as traditional bank run.

3.1.5 Risk Transformation and Diversification

the Diamond–Dybvig theory in section 3.1.1 Analyze the maturity transformation performed by the bank, the present transformation is a distinct one along the risk dimension. Which is the conversion of individually risky assets into safe liabilities. between the risk profile that the underlying economy generates (idiosyncratic and credit risk on a large number of individually risky loans) and the risk profile that savers demand (riskless, fixed-nominal claim). The bank fill this gap not by removing the risk of any individual loan but by pooling many loans together and exploiting the mathematical fact that the average of many imperfectly correlated risky outcomes is much less volatile than any individual outcome.[23]

Boyd and Prescott derive the intermediary endogenously as a coalition of agents who pool their capital to fund a portfolio of projects, so that the aggregate claim they hold is a function of the collective outcome rather than of any single project.[24] Let y_i denote the return on loan

[22] Bengt Holmström and Jean Tirole, "Financial Intermediation, Loanable Funds, and the Real Sector," Quarterly Journal of Economics 112, no. 3 (1997): 663–691.

[23] The mathematical foundation of this diversification result is the classical portfolio-selection framework of Markowitz, who showed that the variance of a portfolio of imperfectly correlated risky assets is strictly less than the weighted variance of the individual assets. Harry Markowitz, "Portfolio Selection," Journal of Finance 7, no. 1 (1952): 77–91.

[24] John H. Boyd and Edward C. Prescott, "Financial Intermediary-Coalitions," Journal of Economic Theory 38, no. 2 (1986): 211–232.

i, with common mean μ and variance σ^2. For a portfolio of N loans, the variance of the average return is:

$$\mathrm{Var}((1/N) \cdot \Sigma y_i) = \sigma^2 / N + ((N - 1)/N) \cdot \mathrm{Cov}(y_i, y_j). \quad (10)$$

The first, σ^2/N, is the diversification effect: it shrinks toward zero as N grows large, so that a sufficiently large portfolio of purely idiosyncratic risks has essentially no residual variance at the aggregate level. The second term is what survives diversification: as N grows large, the coefficient (N − 1)/N approaches one, and the residual variance is bounded below by the average covariance across loans. This is the risk-transformation function of the traditional bank, formalized most explicitly by Boyd and Prescott, who derive the intermediary endogenously as a coalition that pools idiosyncratic risks and improves on the market outcome.[25]

Allen and Gale place the same result in a broader systemic perspective by distinguishing between two forms of risk-sharing: Cross-sectional risk-sharing, at a point in time, is the principal function of markets, which allow agents with different risk preferences to trade exposures. Inter-temporal risk-sharing, across states of nature, is the principal function of intermediaries, which build up buffers in good states and draw down these buffers in bad states, so that outcomes are smoothed across time as well as across agents.[26]

Savers want a claim that is safe and fixed in nominal terms, while the economy claims that are individually risky, indivisible, illiquid and expensive to assess. The saver cannot do it because loans don't come in units small enough to be spread across, they cannot be sold on their demand. The market in which an individual could assemble a diversified credit exposure or investment for themselves does not exist yet. Which is a problem of market incompleteness distinguishing this section from the two previous ones.

The pooling performed by the banks on behalf of the savers is invisible to them, The buffer absorbing the covariance term is funded out of the intermediation margin, so any competition on that margin erodes the reserve rather than the asset quality. This is why the empirical evidence examined later shows loss absorbing capacity while the loan book itself appears unchanged.

3.2 Theoretical Foundations of the Fintech Model

The present section develops the theoretical foundations of the fintech model in parallel to the traditional banking foundations, Each sub-subsection isolates one channel through which fintech reshapes the resolution of a specific market imperfection, and each is tied back to the corresponding banking theory so that the two analytical lines can be compared directly.

3.2.1 Screening vs Monitoring

A first analytical distinction is between ex ante screening and ex post monitoring. Screening is the assessment of borrower creditworthiness at the moment of origination and relies on hard,

[25] Boyd and Prescott derive the intermediary endogenously as a coalition that improves on the market outcome by producing information and diversifying the resulting portfolio, thereby transforming risky idiosyncratic projects into a safer aggregate claim.

[26] Franklin Allen and Douglas Gale, Comparing Financial Systems (Cambridge, MA: MIT Press, 2000), chs. 3–4.

verifiable information. Monitoring is the assessment of borrower behavior over the life of the loan and relies on the accumulation of soft information within a long-term relationship.

Following Vives, the traditional bank holds a comparative advantage in monitoring, the persistence of the bilateral relationship generating soft, non-codifiable information and while the fintech firm holds a comparative advantage in screening, where the algorithmic processing of large volumes of structured and unstructured data reduces the ex-ante information asymmetry between lender and borrower more effectively than the point-in-time credit assessment traditionally performed by a bank officer.[27]

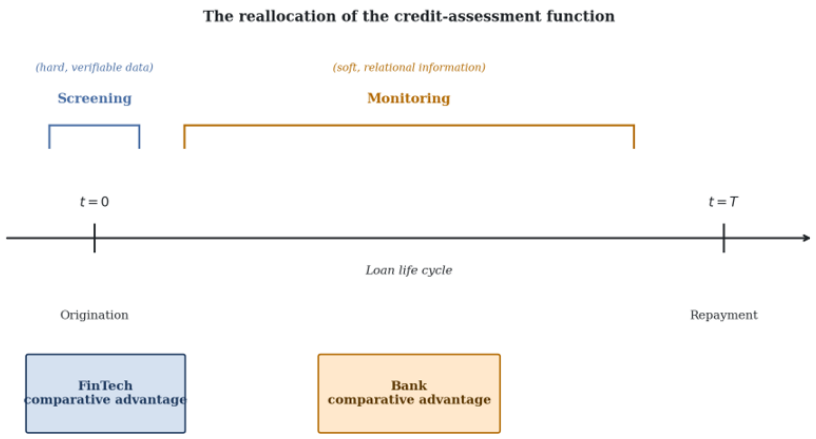

Figure 3.2.1. The reallocation of the credit-assessment function over the loan life cycle.

Source: Own elaboration based on Vives (2019).

Empirical support for this analytical proposition is provided by Fuster, Plosser, Schnabl, and Vickery, who document that fintech mortgage lenders in the United States process applications approximately twenty per cent faster than traditional lenders without generating higher default rates, evidence consistent with a genuine screening advantage.[28]

[27] Xavier Vives, "Digital Disruption in Banking," Annual Review of Financial Economics 11 (2019): 243–272. Vives distinguishes analytically between hard information, in which fintech firms hold a comparative advantage and soft information which continues to favor the incumbent bank.

[28] Greg Buchak, Gregor Matvos, Tomasz Piskorski, and Amit Seru, "Fintech, Regulatory Arbitrage, and the Rise of Shadow Banks," Journal of Financial Economics 130, no. 3 (2018): 453–483.orth

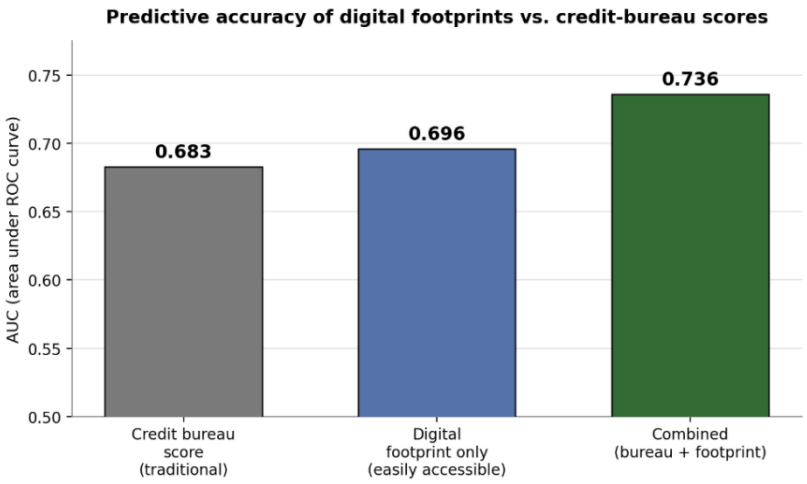

Figure 3.2.1.1. Predictive accuracy of digital-footprint variables versus traditional credit-bureau scores. Area-under-the-curve (AUC) statistics, Digital-footprint variables alone device type, operating system, time-of-application, and email provider exceed the discriminatory power of the proprietary credit-bureau score.

Source: Berg, Burg, Gombović, and Puri (2020), Table 3.

A parallel and more striking argument is advanced by Berg, Burg, Gombović, and Puri, who show that easily accessible digital-footprint variables predict consumer default at least as well as traditional credit-bureau scores. Their receiver-operating-characteristic (ROC) analysis reports area-under-the-curve (AUC) statistics of 0.696 for a model using digital footprints alone, 0.683 for a model using the credit-bureau score alone, and 0.736 for a combined model, so that digital footprints alone exceed the discriminatory power of the credit bureau.[29]

Fintech expands the segment of the population for which screening at an acceptable risk-return tradeoff is feasible, which is addressing one dimension of the adverse selection problem originally analyzed in section 3.1.2. Digital footprints complement rather than substitute for credit Bureau data, fintech screening advantage is not a matter of superior information but of incremental information because fintech and banks exploit different regions of the borrower's risk profile.[30]

Fintech makes hard information cheap, the algorithm has only to process it and does so at a depth and speed no officer could match. The friction it addresses is the one identified in section 3.1.2 The bank could not price borrowers individually because assessing each one carried a fixed cost that the small loan could not justify. Instead, it priced categories and refused everyone whose risk fell outside the scope. This is where the added value lies, since assessment is now cheap enough to be performed on applicants for whom it was previously refused (Financial Inclusion). The bank strengths during the life of alone is knowing when to acquire a hard information which creates verification for the institution so it can act on it. Fintech supplies precisely what was missing, so now we can say each is strong where the other is weak and the arrangement is complementary.

[29] Tobias Berg, Valentin Burg, Ana Gombović, and Manju Puri, “On the Rise of FinTech: Credit Scoring Using Digital Footprints,” Review of Financial Studies 33, no. 7 (2020): 2845–2897.
[30] Julapa Jagtiani and Catharine Lemieux, "The Roles of Alternative Data and Machine Learning in Fintech Lending: Evidence from the LendingClub Consumer Platform," Financial Management 48, no. 4 (2019): 1009–1029.

The business model is what determines whether it stays that way, a peer-to-peer platform that matches lenders with borrowers is complementary in the sense just described. Balance sheet platform is a different proposition since it assesses the risk and originates the loan on its own account and what follows from that difference is developed in the sections below.

3.2.2 Reduction of Informational Asymmetries

The second efficiency channel addresses two of the frictions identified in Stiglitz-Weiss (Section 3.1.2) and the delegated monitoring of Diamond (1984) (Section 3.1.4). In his 2016 paper, Philippon identifies three institutional features that have shielded the finance sector from competitive pressure:

the regulatory barriers to entry that restrict who may perform intermediation, the informational asymmetries that locks borrowers into incumbent bank relationship and the network effects that make it costly for savers and borrowers to migrate to alternative providers.

Philippon mention this in terms of economic significance of the unit cost of financial intermediation in the US has fluctuated around 2% for the past 130 years despite dramatic advances in information technology.[31]

Unit cost = (Income of finance sector) / (Assets intermediated) ≈ 2%. (11)

The financial sector became much more technologically efficient, but instead of passing all those gains to customers through lower prices it used them to create and manage complex financial services (sophisticated credit products, derivatives, automated portfolio management etc.) which preserved the 2%. It may facilitate the expansion of the financial sector but it may also increase interconnectedness and risk taking so potentially new channels of systemic risk. The screening-cost reduction lowers the per-loan cost, the platform economics permit the same volume of intermediation to be performed by an institution that carries no branch network and no relationship-management infrastructure, which reduces the numerator through elimination of fixed costs, and the network externalities identified in the two-sided platform generate an expansion of the denominator.

Two specific institutional mechanisms operationalize this compression, first is the mandated portability of banking data, Open-banking regimes such as the second Payment Services Directive in the European Union[32] require incumbent banks to provide, at the customer's consent, standardized access to the customer's transaction data for authorized third-party providers.[33]

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[31] Thomas Philippon, “The FinTech Opportunity,” NBER Working Paper No. 22476 (2016); Thomas Philippon, “Has the U.S. Finance Industry Become Less Efficient? On the Theory and Measurement of Financial Intermediation,” American Economic Review 105, no. 4 (2015): 1408–1438.

[32] Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market, amending Directives 2002/65/EC, 2009/110/EC and 2013/36/EU and Regulation (EU) No 1093/2010, and repealing Directive 2007/64/EC, Official Journal of the European Union L 337 (23 December 2015): 35–127.

[33] Zhiguo He, Jing Huang, and Jidong Zhou, "Open Banking: Credit Market Competition when Borrowers Own the Data," Journal of Financial Economics 147, no. 2 (2023): 449–474.

The Stiglitz–Weiss friction is not eliminated by this reallocation but the informational monopoly that the incumbent bank had enjoyed over its own customers (soft information), is dissolved because competing lenders can now build credit assessments on the same underlying data.

Application-programming interfaces, standardized protocols through which one software application requests and receives data or services from another, reduce the fixed cost of assembling a financial-service offering from third-party components and permit the modular business models.[34] Data portability dissolves the informational asymmetry that shielded the margin, and APIs dissolve the fixed cost of building the modular alternatives that would exploit the newly portable data.

3.2.3 Two Sided Platform Model and Network Effect

The scalability of fintech intermediation is explained analytically by the theory of two-sided platform markets developed by Rochet and Tirole. A two-sided platform serves two distinct user groups whose value to one another is linked by cross-side network externalities, the value of the platform to a member of one side rises with the number of participants on the other side.[35]

Let q_a and q^b denote the volumes on the two sides, and let p_a, p^b and c_a, c^b denote the corresponding prices and per-user marginal costs. The platform's profit-maximization problem is:

$$\Pi = q_a(p_a - c_a) + q^b(p^b - c^b), \qquad (12)$$

The Rochet–Tirole discovery is that the specific split of the total price between the two sides determines the participation levels on each side, and that the asymmetric pricing patterns observed in such markets are efficient equilibrium outcomes under competition rather than evidence of monopoly power.[36] In a standard one-sided market, the profit-maximizing price is set by the Lerner rule: the mark-up over marginal cost, as a fraction of the price, equals the inverse of the elasticity of demand.[37] In a two-sided market this rule breaks because raising the price on one side reduces participation on that side and, through the cross-side externality, reduces the value of the platform to the opposite side.

The Rochet-Tirole Optimality condition modifies the standard Lerner mark-up on each side by a term internalizing the externality that side exerts on the other. One side maybe subsidized

[34] Christoph Frei, "Open Banking: Opportunities and Risks," in The Palgrave Handbook of Technological Finance, ed. Raghavendra Rau, Robert Wardrop, and Luigi Zingales (Cham: Palgrave Macmillan, 2021), ch. 24.
[35] On the analytical category of two-sided markets and the specific competitive dynamics that distinguish them from one-sided markets, see Marc Rysman, "The Economics of Two-Sided Markets," Journal of Economic Perspectives 23, no. 3 (2009): 125–143.
[36] Jean-Charles Rochet and Jean Tirole, "Platform Competition in Two-Sided Markets," Journal of the European Economic Association 1, no. 4 (2003): 990–1029; and Jean-Charles Rochet and Jean Tirole, "Two-Sided Markets: A Progress Report," RAND Journal of Economics 37, no. 3 (2006): 645–667.
[37] the rule presupposes that the firm's demand depends only on its own price, which is the assumption two-sided markets violate. See Lerner (1934).

in order to build the base that makes the platform valuable to the other, and equilibrium prices need not equal marginal cost on either side even under free entry.

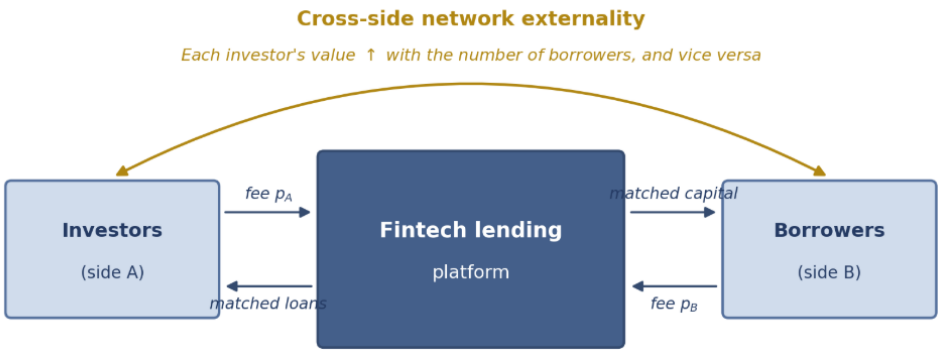

Figure 3.2.3. Two sided platform structure of fintech credit markets.

Source own elaboration based on Rochet & Tirole (2003,2006).

The bank is a one-sided institution, it faces depositors on the liability side and borrowers on the asset side, but the two sides are not linked by cross-side externalities. The two sides of the bank's balance sheet are linked by the bank's internal management of maturity, risk, and information, not by an externality that flows directly from one customer group to the other.

Two – sided platform Represent the strongest form of the complementarity case available in this chapter, because they complete the market in idiosyncratic risk and do so at the cost no balance sheet institution could match. What threatens the arrangement is not the coexistence of the two forms but the drift already identified. A platform that acquires a balance sheet to be the market and becomes an intermediary, and from the moment it holds the loan it no longer complements the bank but competes with it. It carries the capital appropriate to a matchmaker and the exposure appropriate to a lender.

The systemic risk question that follows is either platforms are allowed to grow into bank-like configurations without carrying the safety net the bank bears for holding the same risk, or their growth is constrained as to preserve the pure matching form.

3.2.4 Tokenization and Market Liquidity

Related to the reduction of verification cost is the process of tokenization: the representation of a financial claim as a digital record on a distributed ledger, where ownership, transfer, and settlement are executed directly.

In over-the-counter (OTC) markets corporate bonds, government bonds, foreign exchange, interest-rate swaps, structured products trading is conducted bilaterally: the customer requests a quote from a dealer, who prices the trade against the dealer's own inventory and manages the resulting position on the balance sheet until it can be laid off. OTC market-making is where large banks dominate,[38] because the activity requires committed capital to fund the inventory, a specialised risk-management to price and hedge the positions, and the

[38] The specific dominance of large dealer banks in OTC market-making is documented in Tobias Adrian, Nina Boyarchenko, and Or Shachar, "Dealer Balance Sheets and Bond Liquidity Provision," Journal of Monetary Economics 89 (2017): 92–109.

institutional infrastructure to sustain both, all at a scale that only the balance sheet of a major bank can support.[39]

Tokenization alters several frictions that surround the trading of a financial claim, tokenized asset can:[40]

- Traded continuously rather than during exchange hours
- settled automatically through the Ledger
- fractionalized into small units
- transferred at lower transaction cost
- accessible to a broader investor base
- programmed with embedded ownership rules without the need of intermediary enforcement

Automated market-making takes a distinct approach: rather than a dealer quoting prices against committed capital, users deposit assets into a shared liquidity pool, and trades are priced automatically by a pre-programmed algorithm. The dealer's function is decomposed and distributed across the pool's contributors, who earn a share of the trading fees in exchange for bearing the price risk of the pool's composition changing as trades occur. The prerequisites of OTC market-making are thereby dissolved, the market-making function is performed by dispersed liquidity providers rather than by a bank dealer.[41]

Schär analyses how tokenized representations of underlying claims underpin the continuous market-liquidity properties of decentralized-finance protocols, permitting the fractionalization of previously indivisible assets and the establishment of automated market-making arrangements, A tokenized commercial building can be sold in ten thousand fractional units to ten thousand small investors. A tokenized painting can be jointly owned by hundreds of people. This is the mechanism by which previously illiquid asset classes can be brought into liquid markets.[42]

In credit the saver at least add an indirect route, the deposit gave them exposure to a loan portfolio they could not have assembled themselves, The bank did not supply a diversified version of these exposures to small savers so we had a total market incompleteness.

Fractionalization dissolves it in a way that deserves to be stated, what the saver acquires is not simply access but discretion. The bank never offered the portfolio match to the saver's

[39] The economic structure of OTC market-making, and the role of dealer inventory in bilateral bond and derivative markets, are analysed in Darrell Duffie, "Presidential Address: Asset Price Dynamics with Slow-Moving Capital," Journal of Finance 65, no. 4 (2010): 1237–1267.

[40] The economic significance of tokenisation for the fractionalisation of previously indivisible assets, and the specific mechanisms through which programmable ownership rules substitute for intermediary enforcement, are surveyed in Raphael Auer, Giulio Cornelli, and Jon Frost, "Rise of the Central Bank Digital Currencies," International Journal of Central Banking 19, no. 4 (2023): 185–214. See also the broader analysis in the BIS Annual Economic Report 2023, chapter III, on the tokenisation of financial assets.

[41] Campbell R. Harvey, Ashwin Ramachandran, and Joey Santoro, DeFi and the Future of Finance (Hoboken, NJ: Wiley, 2021), ch. 5.

[42] Fabian Schär, “Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets,” Federal Reserve Bank of St. Louis Review 103, no. 2 (2021): 153–174.

risk profile just the deposit, the fixed claim on its liability side identical for everyone and determined by the bank's own portfolio choices. A market and fractional claims allows the saver to select the asset, the size of the position and the degree of diversification constructing its own exposure corresponding to their own tolerance. This is completion of the market in the strict sense so the set of positions available to a household has expanded.

The market is now complete along the dimension of idiosyncratic exposure since the individual can spread as finely as they wish remaining empty along the dimension of aggregate risk. It is more considered as a substitution because the incumbent's balance sheet is no longer required to perform the pooling. As for the systemic risk it depends on where the exposure now sits, the residual the risk that polling couldn't remove is held now by households rather than by capitalized institution.

3.2.5 Robo-Advising

The extension of algorithmic decision-making to the investment-advisory function introduces a principal–agent problem, that agency theory identifies at the heart of financial intermediation. D'Acunto, Prabhala, and Rossi document that robo-advising replaces the human advisor with an algorithm delivered through an app. The client answers questions about goals and risk tolerance, the algorithm recommends a portfolio, the platform manages it at a fraction of the cost and time of human advice. Built by the advisory firm, which retains its own economic incentives, these incentives can be embedded in the optimization function without being visible to the client. The recommendation raises the question of internal biases of the advising firm instead of the optimal risk return of the clients.[43]

In the classical Jensen–Meckling framework, the client is the principal and the advisor is the agent, the client relies on the advisor's superior market knowledge, while the advisor faces incentives (commissions, revenue-sharing arrangements, higher margins on complex products) that may affect advisory away from the client's optimum.[44] The traditional response is regulatory fiduciary standards, conflict-of-interest disclosures, and fee reporting make the misalignment observable to the client.

The digitalization of the advisory function does not solve the friction but it relocates it from the human advisor that is subject of regulatory constraint to an algorithm that the client cannot access the code to detect any bias.[45]

Global advising is substitutive because it performs the same function as banks but at a lower cost through a different institution. The systemic risk outcome doesn't operate through the

[43] Francesco D'Acunto, Nagpurnanand Prabhala, and Alberto G. Rossi, "The Promises and Pitfalls of Robo-Advising," Review of Financial Studies 32, no. 5 (2019): 1983–2020.
[44] Michael C. Jensen and William H. Meckling, "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure," Journal of Financial Economics 3, no. 4 (1976): 305–360.
[45] Alberto G. Rossi and Stephen P. Utkus, "Who Benefits from Robo-Advising? Evidence from Machine Learning," Working Paper, University of Maryland and Vanguard (2020). The authors show that clients who adopt robo-advising services generally cannot articulate the specific optimisation logic behind their recommended portfolios, and that engagement with the platform's transparency features is heavily skewed toward the small subset of financially sophisticated adopters.

substitution itself but through the correlated exposure of household portfolios to an algorithmic code that can't be regulated yet.

4 Quantitative Analysis of the shift from banking to fintech

The question is not whether fintech has grown, which is not in dispute, but if that growth has impacted institutional rents the incumbent bank has historically captured from interest margin, fee income and the return on assets against which fintech competes (section 2.3).

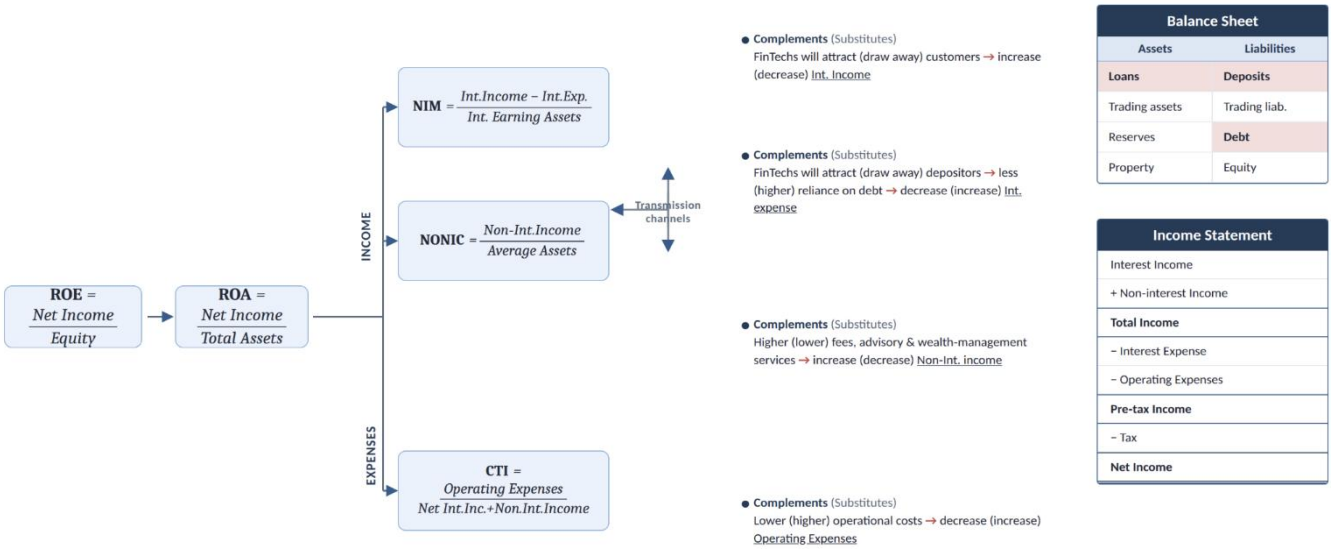

Figure 4. Transmission channels through which the presence of fintech reaches bank profitability.

Source: Ben Naceur, Candelon, Elekdag, and Emrullahu (2023), Figure 2.

4.1 Conceptual Framework

Figure 4. Composes bank profitability following the logic of the DuPont decomposition adapted to a leverage intermediary, return on equity is return on assets scaled by leverage and return on assets decomposes along the income and expense access into 3 operating ratios NIM,NONIC and CTI (section 2.3.1). The right hand side of the figure records the accounting primitives these ratios are built from, the balance sheet and income statement.

More importantly the center of the figure connects the two sides through 4 transmission channels along which fintech competition can act the first two channels operate on the net interest margin, the third one operates on non interest income ratio and the fourth on cost to income ratio.

Under complementarity, fintech attracts customer and depositors toward the incumbent through partnerships market expansion into borrowers the bank could not profitably serve on its own or through the bank's own adoption of the technology. Under substitution, fintech draws them away As interest income falls since auto generation migrates off the banks balance sheet, interest expense rises as lost deposits are replaced by debt funding and non interest income is compressed by competition. The qualitative debate developed in the preceding chapter collapses into a set of sign restrictions on a single estimated coefficient which makes the empirical study useful.

4.2 Two Fintech Business Models

In the preceding sections it delivers a sign restriction without saying which sign to expect because it depends on which of the two dominant business models in fintech credit provision is in question. Peer-to-peer lending in which the platform matches lenders to borrowers or balance sheet lending in which the platform funds the loan itself. The distinction is the one on which the complementarity hypothesis stands or fall and it carries the systemic risk question with it.

The criterion separating the two models is the credit exposure, which party advances the funds, retains the loan and absorbs the loss on default. That party also earns the interest the loans generates add a classification follows from it.[46]

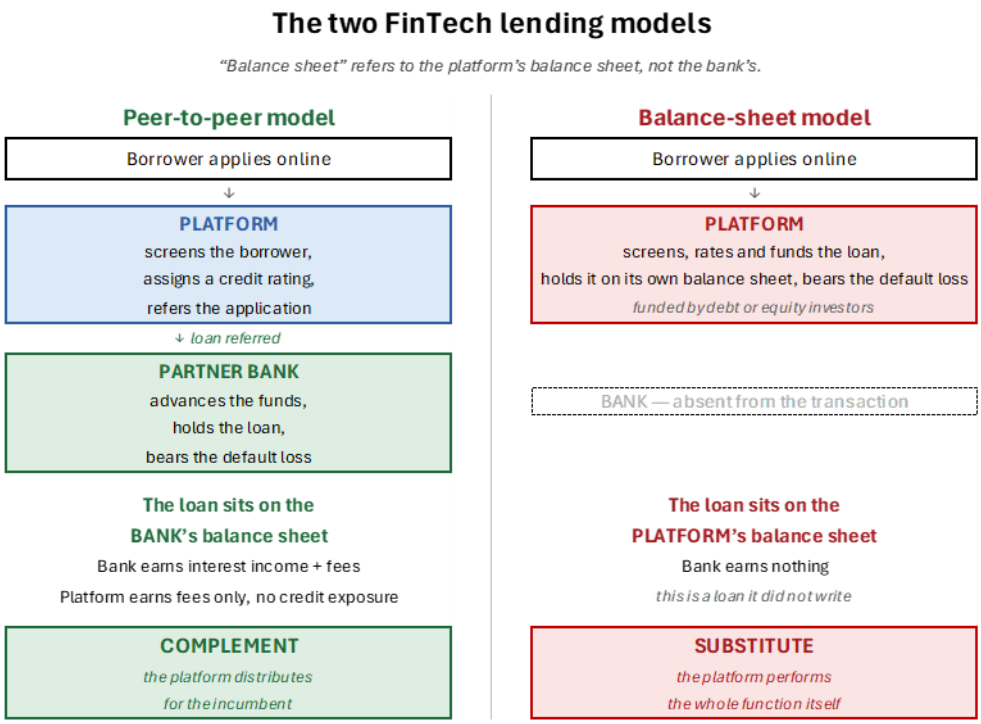

Figure 4.2 The two fintech lending models and the locus of credit risk.

Source: CGFS-FSB (2017), pp. 3–7, and Ben Naceur, Candelon, Elekdag, and Emrullahu (2023), pp. 10–11.

Under peer-to-peer model the platform is a front end, it attracts the borrower verifies the information, assign a credit rating and refers the completed application to a partner bank, which originates and funds the loan holding it on its own balance sheet. The platform carries no credit exposure and earns fees from both sides, Explicitly enters a customer acquisition and screening service delivering a loan to the bank that otherwise would have not originated. For the balance sheet model the platform perform everything on its own and hold the loan on its own balance sheet.

[46] Committee on the Global Financial System and Financial Stability Board, FinTech Credit (Basel: Bank for International Settlements, 2017), pp. 3–7, and Ben Naceur and others (2023), pp. 10–11. The classification follows the Cambridge Centre for Alternative Finance taxonomy, which distinguishes platforms by whether the operator retains the credit exposure.

The two models are stages of evolution more than a fixed types, consistent with the argument implied in section 3.2.3 that network dynamics push toward bank like activities.

4.3 Econometric Approach

The data, the estimating equation and the interpretation of its coefficients have already been set out in section 2.3.1 and are not restated here. Some specification of our approach or that bank performance is measured institution by institution, but the fintech variable is not. Every bank operating in the same country in the same year is assigned an identical value, the natural logarithm of that countries digital lending and capital raising volume. It follows that the coefficient measures the average effect of a country's fintech growth across all its banks alike, whether or not any given institution actually competed with platforms. What the variable counts is credit extended by platforms so it captures competition arriving from outside the banking system rather than technology adopted within it.

The bank fixed effect absorbs everything time-invariant about each institution (business model, governance) so identification comes from changes within a bank over time as fintech activity in its market grows. The residual is assumed to carry no cross-sectional correlation and standard errors are reported without clustering, that assumption sits uneasily with the construction of the regressor which takes an identical value for every institution operating in the same country and year.

Two extensions of the baseline follow each relaxing one of its assumptions, the first replaces the aggregate regressor with the volume of a single business model so that prediction of section 4.2 can be tested directly. The second retains the measure and adds A median split indicator $\omega_{\beta,}{}^{c}{}_{,t}$ Together with its interaction relaxing the assumption that fintech effects every institution identically and allowing the estimated effect to differ between the two samples. The marginal effect becomes $\beta_1 + \beta_3\omega_{\beta,}{}^{c}{}_{,t}$ Rather than a single coefficient revealing heterogeneity.

Those specifications would admit country by year fixed effects absorbing, every shock common to banks operating in the same market and identifying the differential effect net of national conditions.

Endogeneity is treated separately since fintech entry may be attracted to markets that are already competitive and such markets have thinner margins for reasons unrelated to fintech. The baseline is re-estimated by instrumental variables, each specification carrying a single instrument

Two instrumental specifications are introduced because the baseline cannot resolve the problem on its own. The first is two stage least squares, adapted because fintech does not enter markets at random, platforms are drawn toward banking systems that are already competitive profitable and thinly intermediated, so a negative coefficient may be recording the conditions that attracted the entrants. The estimator replaces observed fintech volume with the portion of it that cannot be a response to local banking conditions, instrumented by the average volume across all other countries.

The second is the generalized method of moments, added because bank profitability is persistent: this year's return on equity is largely explained by last year's, and a specification ignoring that inertia will attribute to fintech variation that belongs to the past. the first tests whether the causality runs from fintech to banks rather than the reverse, the second whether the relationship survives once the dynamics of profitability are accounted for.

4.4 Results

	(1) ROE	(2) ROA	(3) NIM	(4) NONIC	(5) CTI
FinTech	−0.0903***	−0.0246***	−0.0277***	0.0111***	0.136***
	(0.0113)	(0.00233)	(0.00340)	(0.00338)	(0.0292)
Observations	79,523	79,701	79,438	79,666	79,384
rho	0.680	0.776	0.910	0.912	0.757
Sample median (%)	4.25	0.49	3.13	0.99	78.40

Table 4.4 Baseline effect of fintech presence on bank performance.

*Source: Ben Naceur and others (2023), Table 2 and Annex II, Table 1. Standard errors in parentheses; *, **, *** denote significance at 10, 5, and 1 per cent. All specifications include bank fixed effects and control for size, capitalisation, GDP growth, inflation, the policy rate, and bank concentration.*

The net interest margin falls by 0.028 percentage points, that ratio measures what a bank retains on each euro of interest-earning assets once it has paid for its own funding. A decline can only mean that the intermediation spread itself has narrowed, either loan rates have been competed downward, or deposits have given way to costlier market funding. Figure 4 traced both of these routes and their compression is the movement most directly attributable to platforms writing loans that would otherwise have been written by banks. Against a medium margin of 3.13 percent, the expansion observed between 2012 and 2019 imply the narrowing of roughly one tenth of a percentage point of the spread even though substitution predicted the direction the magnitude is modest.

What the margin concedes on the revenue side, the cost-to-income ratio compounds on the other, rising by 0.136. Because that ratio expresses operating expenditure per euro of income earned, an increase denotes deterioration rather than expansion, the incumbent is spending more to generate the same revenue. technology expenditure undertaken to match the service standards of new entrants, made more expensive still by the legacy systems that raise the cost of undertaking it.[47] Here too the estimate falls on the side substitution anticipated, Measured against its own median of 78.4 percent the implied deterioration over the observed expansion is roughly significant.

Only the third channel moves in the opposite direction. Non-interest income rises by 0.011, This is the one estimate in the table that behaves as complementarity requires, and the explanation is not difficult to see: as the interest margin narrowed, incumbents pushed harder

[47] Ben Naceur and others (2023), Table 2, p. 16. Because the cost-to-income ratio is a cost measure, its positive coefficient denotes deterioration.

into the businesses that do not depend on it, and the coefficient records that shift. What it cannot support is a strong reading. A typical bank in this sample earns around two per cent of its assets in non-interest income, so a movement of 0.011 is an order of magnitude smaller than the changes recorded in the margin and in the cost ratio.[48] The banks did diversify, in other words, and the diversification did not come close to covering what the other two channels took away.

Return on assets and return on equity confirm rather than extend the channel results, the first being assembled from those same three ratios and the second that first scaled by leverage. Both fall, by 0.025 and 0.090 percentage points, each significant at the one per cent level. That significance settles the direction of the effect but not its importance, in a panel of this size it establishes only that the coefficients are distinguishable from zero, and whether the movements matter is a separate question.[49]

		ROE	ROA	NIM	NONIC	CTI
All institutions	FinTech	−0.0903***	−0.0246***	−0.0277***	0.0111***	0.136***
Cooperative banks	P2P lending	−0.333***	−0.128***	−0.111***	0.0192	0.676***
	Balance-sheet lending	−0.192***	−0.0910***	−0.142***	0.0177*	−0.0944
Commercial banks	P2P lending	−0.0489	−0.0153	0.00653	0.0611***	0.286**
	Balance-sheet lending	−0.0749	−0.0120	−0.0612***	0.0225	0.449***

Table 4.4.1 effect of fintech business models on bank performance, by institution type

*Source: Ben Naceur and others (2023), Table 3. *, **, *** denote significance at 10, 5, and 1 per cent.*

Consider the net interest margin. Under peer-to-peer lending the coefficient is 0.0065 and statistically indistinguishable from zero: the lending spread is untouched, which is exactly what should happen when the platform screens the borrower and refers the file while the bank originates and books the loan. Under balance-sheet lending the same coefficient is −0.0612 and significant at the one per cent level: the spread is compressed, because the loan has been written by the platform and never reaches the bank. the bank either prices its credit lower to retain the borrower or funds itself more expensively, and in either case retains less on each euro it lends.

Non-interest income mirrors the same division. Under peer-to-peer lending it rises by 0.0611 for commercial banks, more than five times the aggregate estimate of Table 4.4.1: origination,

[48] Ben Naceur and others (2023), p. 17. A discrepancy in the source is worth recording: the text describes 1.99 per cent as the median non-interest income ratio, whereas the paper's own descriptive statistics report a median of 0.99 per cent and a mean of 1.97 per cent.

[49] This point of interpretation requires correction because the source paper is imprecise on it. The regressor is the natural logarithm of fintech volume, so a coefficient of −0.0903 is the change in return on equity associated with a one-unit increase in log volume, approximately an e-fold, or 172 per cent, increase in the underlying volume and not with a one percentage point increase in fintech activity, as the paper's text describes it. In elasticity terms, a 1 per cent rise in volume is associated with a movement of roughly 0.0009 percentage points in return on equity. The correction alters no sign or significance, but it materially changes the apparent magnitude. Global fintech volumes rose from $4 billion in 2012 to $217 billion in 2019; see Ben Naceur and others (2023), Figure 1, drawing on CCAF (2021) and Statista (2022). The increase equals ln(217/4) = 3.99 log units, and each entry in the table is the corresponding baseline coefficient of Table 4.1 multiplied by the stated change in log volume.

servicing and referral fees per euro of assets increase, which is the partnership being paid for. Under balance-sheet lending the coefficient falls to 0.0225 and loses significance, since a platform that funds and retains its own loans requires no partner and therefore pays no partnership fee. Each of the two models moves the line of the income statement that its economic structure predicts, and leaves the other alone.

Two further features of the commercial-bank results, The cost-to-income ratio deteriorates under both models by 0.286 under peer-to-peer lending and 0.449 under balance-sheet lending, both significant, meaning that operating expenditure per euro of income rises regardless of which competitor the bank faces.

For commercial banks no profitability coefficient is significant −0.0489 and −0.0749 on return on equity, −0.0153 and −0.0120 on return on assets. The channels move the bottom line does not.

Cooperative banks absorb nothing, return on equity falls by 0.333 and 0.192, return on assets by 0.128 and 0.0910, the margin by 0.111 and 0.142, all at one per cent, while fee income rises by only 0.0192 and 0.0177 and the cost ratio deteriorates by 0.676 under peer-to-peer lending. A cooperative bank earns almost all its income from the local deposit-and-loan spread, so its compression strikes the whole business, whereas the commercial bank absorbs the same shock across corporate lending, payments and asset management. Nor is the small bank eligible for the partnership that makes peer-to-peer lending complementary, lacking the balance-sheet capacity and technological interface that make an institution worth choosing, it is not the platform's partner but its target.[50]

Read together, these four coefficients are the complementarity and substitution hypotheses appearing side by side in the same table. Peer-to-peer lending leaves the incumbent's margin intact and adds fee income, it is a complement, and the mechanism is visible in which line of the income statement moves. Balance-sheet lending removes margin and adds nothing: it is a substitute, and again the mechanism is identified rather than assumed. That commercial-bank profitability is statistically unaffected by either model reflects the fact that the fee gains and the cost increases approximately offset one another.

The adverse effect on incumbents is larger where credit is deep and banking profitable, Yet with high regulatory quality and government effectiveness the sign of the effect reverses which means that greater fintech presence is associated with higher incumbent profitability, the net coefficient on return on equity reaching + 0.2235 and +1.4175 respectively (Table 4.4.2). What remains is competition on cost and service to which the incumbent can respond by partnering. Because if not partnership banks will face a disadvantage it cannot close by becoming more efficient, complementarity is a property of well-regulated markets and not just wealthy ones.

[50] Ben Naceur and others (2023), Table 3, p. 19. Median cooperative-bank return on equity is 3.8 per cent, so the estimated effects are substantial in proportional terms.

	ROE: interaction	ROE: net effect	ROA: interaction	ROA: net effect
FinTech × low concentration	−0.0704***	−0.1041	−0.0021	−0.0258
FinTech × high credit depth	−0.140***	−0.2079	−0.0196***	−0.0428
FinTech × high banking-sector ROE	−0.0592***	−0.1274	−0.0164***	−0.0378
FinTech × high regulatory quality	0.316**	0.2235	0.0878*	0.0629
FinTech × high government effectiveness	1.513***	1.4175	0.144***	0.1188
FinTech × low non-performing loans	−0.157***	−0.2386	−0.057***	−0.0784

Table 4.4.2 effect of fintech conditional on selected country and bank characteristics

*Source : Ben Naceur and others (2023), Table 4. Moderators are median-split dummies; the net effect is the sum of the fintech coefficient and the interaction coefficient. *, **, *** denote significance at 10, 5, and 1 per cent.*

4.5 Robustness Check

Specification	ROE	ROA	NIM	NONIC	CTI
Baseline	−0.0903***	−0.0246***	−0.0277***	0.0111***	0.136***
2SLS: leave-one-country-out	−0.136***	−0.0308***	−0.0227***	0.00622***	0.0719***
Two-step GMM	−0.274***	−0.0631***	−0.0623**	0.0228*	0.190**
Balanced panel	−0.0674***	−0.00705** *	−0.0143***	0.00106	0.114***
Excluding China, US, and UK	−0.0984**	−0.0550***	−0.0732***	0.0608***	0.648***
Time fixed effects, no macro controls	−0.0108	−0.0442***	−0.147***	0.0342***	0.592***

Table 4.5 Robustness of the fintech coefficient across specifications

*Source: Ben Naceur and others (2023), Table 5. *, **, *** denote significance at 10, 5, and 1 per cent.*

The baseline includes bank fixed effects but not year fixed effects, and a bank fixed effect controls for everything permanent about an institution but for nothing common to all institutions in a given year like the global low-rate environment, the pandemic. Fintech volumes also increased year after year, while bank profitability was falling over the same. For reasons unconnected to fintech, And a bank fixed effect does not help since it removes only what is constant within each institution and not what is common to all of them in a given year.

In table 4.5, is designed to settle this imperfection adding a year dummies removing everything come into all institution in a given year (common shocks), so that the fintech coefficient is identified only from the differences between countries within the same year rather than from movement along a shared trend. The estimates are separated into two groups, Return on equity falls to -0.0108 and loses significance So the profitability result was substantially a matter of two series trending together rather than one acting on the other. The channel estimates in the opposite direction with strengthening, net interest margin from −0.0277 to −0.147, the cost-to-income ratio from 0.136 to 0.592, and non-interest income from 0.0111 to 0.0342, all significant at one per cent confirming the baseline.

Excluding the three largest markets points the same way as table 4.4.1 by strengthening every coefficient, which is what should be observed if fintech press harder where banking systems are smaller and less diversified.

limitations constrain what these estimates can support, the first is proportionality fintech credit represented approximately 2% of credit in the major markets and an effect of this magnitude cannot come from volume displacement at that scale alone.[51] Which means that the coefficient is capturing competitive repricing induced by the threat of entry or a correlate of fintech growth.[52]

The second limitation is aggregation, because every bank in a given country and year is assigned the same fintech value, so banks whose customers are being shifted towards platform and another that is not facing competition they are treated identically. What the coefficient reports is the average effect across all institutions in the country.

The third limitation concerns what the variable counts, it measures the volume of credit extended by platform that are the competition arriving from outside the banking system. But it does not measure what banks did in response by adopting technology, digital capacity, partnerships. Complementarity can still be detected where it takes the form of partnership and table 4.4.1 does detect it included in the fee income of commercial banks, but where it operates through the incumbents is invisible because the design is better equipped to observe the threat then the response.

5 Regulatory framework

5.1 PSD2, ECSPR, CCD2, DORA

The second Payment Services Directive required banks to open customer account data to licensed third parties, and in doing so dismantled the informational barrier Chapter 3 identified as a source of the incumbent's advantage.[53] Which opened barrier to entry and increased competition in the market that was more centralized in fewer institution dominating the financial sector. The union did not permit the erosion of that advantage but required it, which indirectly lowered entry barriers under law and not competition.

The same directive holds the only permission in union law for a non-bank to lend under a European license with conditions. The credit must be attached to a payment transaction and repaid within 12 months, it cannot be funded from the money the firm holds to settle its customer payment, own funds must be proportional to the amount lent and without the right

[51] Fintech credit is estimated to have amounted to approximately 2 per cent of total credit in the major fintech markets over the sample period; see World Bank, Fintech and the Future of Finance (Washington, DC: World Bank Group, 2022). In the United Kingdom it was equivalent to roughly 1.4 per cent of the outstanding stock of bank lending to consumers and small businesses at end-2016 (CGFS-FSB, 2017, p. 7).

[52] That a small entrant can discipline the pricing of a much larger incumbent is a standard proposition in industrial organisation, following William J. Baumol, John C. Panzar and Robert D. Willig, Contestable Markets and the Theory of Industry Structure (New York: Harcourt Brace Jovanovich, 1982), in which the credible threat of entry constrains incumbent margins irrespective of the entrant's realised market share. Applied to banking, the implication is that the relevant quantity is not the volume of lending fintech has captured but the rate at which its capacity to capture more is growing

[53] Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market, applicable from 13 January 2018. Articles 66 and 67 establish the access-to-account rights of payment initiation and account information service providers.

to take any deposits. Each condition removes one of the things that make lending a banking activity, preventing from credit business, maturity transformation, deposit funding and a capital requirement behind the risk that remains.[54] The union did not authorize non-bank lending and then hedge it with conditions, it authorized this one form of lending that could be made safe. For the entrant, it is access without a balance sheet and without the means to lend at scale. Credit that repays itself within the year, funded by no one who can withdraw, so there is nothing here that can run. New service for the consumer rather than a source of systemic risk.

This directive does not reach the firm in question, it was drawn to fit credit that is short small and self-liquidating. Doesn't apply to a platform holding a multi-year book on its own balance sheet satisfying none of the five conditions and stands outside the license entirely.

The crowdfunding regulation of 2020 does what no other European instrument do for lending by granting a single authorization to a firm arranging it with disclosure, conflict of interest and prudential requirements attached applicable in all member states.[55] Offers that exceed €5 million 12 months are not included in this regulation, So borrowers who are outside of this framework will be left with the consumer peer-to-peer lending of the national law.[56] Crowdfunding regulation covers only platforms with a business model of a peer-to-peer lending connecting investors and borrowers, excluding company that simply uses its own money to make loans like balance sheet platforms as mentioned in previous chapters.

The main protection of the law focuses on the relationship between the investor and the crowdfunding platform including tests to assess the investor knowledge, and to check if he's able to afford a 10% lost, but also works as an awareness under risk taken and the reconsideration of investment and disclosure of default rates. By contrast it regulate the risks and information problems created by the platform itself, while leaving the original information problem between lenders and borrowers largely unchanged, so it governs the second order asymmetry structure leaving the first one to be solved by the bank. For the case that includes the framework it's safe to say that it cannot fail expensively since the loss falls on the investor rather than a leverage intermediary that affect the systemic risk.

The evolution of EU financial regulation reflects a growing shift toward activity-based regulation for non-bank entities. Applicable from 20 November 2026, the second consumer credit directive (CCD2) represent the first regulatory instrument to govern consumer lending

[54] Article 18(4) and (5) of Directive (EU) 2015/2366. The credit must be “ancillary and granted exclusively in connection with the execution of a payment transaction”, must be “repaid within a short period which shall in no case exceed 12 months”, may not be granted “from the funds received or held for the purpose of executing a payment transaction”, and the institution's own funds must “at all times … be appropriate in view of the overall amount of credit granted”.

[55] Regulation (EU) 2020/1503 of 7 October 2020 on European crowdfunding service providers for business, applicable from 10 November 2021.

[56] Article 1(2) ECSPR excludes offers exceeding EUR 5 000 000 over a rolling twelve-month period; Article 1(2)(a) excludes “crowdfunding services that are provided to project owners that are consumers”.

by activity and not by entity type.[57] By removing the previous 200 euro minimum threshold the directive extends its reach to interest free and buy now pay later (BNPL) products, Which is more focused on the consumer status instead of the lenders. Unlike 2008 law which required general oversight the reform forces member states to subject all creditors to a formal admission process and ongoing supervision.[58] Its consumer facing provisions are robust, creditworthiness assessment, caps on borrowing rates or the total cost of credit and access to debt advisory services. This requirements establish a conduct floor carrying no capital, liquidity our resolution requirement leaving the gap compounded.

The Digital Operational Resilience Act governs a different risk, not who bears the loss on a loan but what happens if the technology fails. Requiring the firm to cover manage information and communication technology risk, to report incidents and test their resilience. Allowing supervisors to choose and oversee cloud and data providers on which the sector depends. It reaches those firms through a list, and a firm that lends its own money and holds no other license appears on none of its lines.[59]

5.2 The Gap : Balance sheet lending

Every activity for which the Union has created a European license is an activity performed for a fee: executing payments, granting access to data, matching lenders with borrowers (P2P business model and decentralized financial services). The structure for which it hasn't created a safety regulator is the one that involves balance sheet activities, holding an asset, credit exposure and bearing the loss if it fails. There is no European authorization regime for a non-bank firm that originates loans onto its own balance sheet, and the point is not contested.

The European Banking Authority reported in 2022 that non-bank lending remains largely unharmonized across the EU, that entity-based requirements apply in some Member States and not others, and that in some cases the activity is unregulated altogether.[60] It repeated the finding in 2024 and again in 2025, identifying the results as itself a source of consumer risk.[61]

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[57] Directive (EU) 2023/2225 of 18 October 2023 on credit agreements for consumers, repealing Directive 2008/48/EC. Article 48 sets transposition at 20 November 2025 and application at 20 November 2026. Article 2(2)(c) excludes agreements above EUR 100 000; the former EUR 200 floor is removed and interest-free credit brought within scope.

[58] Article 20 of Directive 2008/48/EC required only that "creditors are supervised by a body or authority independent from financial institutions, or regulated". Article 37 of Directive (EU) 2023/2225, headed "Admission, registration and supervision of non-credit institutions and non-payment institutions", requires Member States to subject creditors and credit intermediaries to an adequate admission process and to supervision by a competent authority

[59] Regulation (EU) 2022/2554 of 14 December 2022 on digital operational resilience for the financial sector, applicable from 17 January 2025. Article 2(1) lists the financial entities in scope, crowdfunding service providers among them at point (s); no category captures a non-bank lender holding no other financial licence. Chapter V establishes the oversight framework for critical ICT third-party service providers.

[60] European Banking Authority, Report on Response to the Non-Bank Lending Request from the CfA on Digital Finance, 4 May 2022, p. 12.

[61] European Banking Authority, Report on the Fact Finding Exercise on Creditworthiness Assessment Practices of Non-Bank Lenders, 7 August 2024; and Consumer Trends Report 2024/25, EBA/REP/2025/08, 26 March 2025, which identifies "a regulatory perimeter that remains unclear" as a source of consumer risk.

The guarantee of nominal value and access to central bank liquidity attach to the licence, as the preceding chapter established, because the state stands behind the claim. A firm issuing no such claim needs no backstop, and on that logic its exclusion is correct. The consequence reaches the estimates of Chapter 4. Where the perimeter triggers on deposits, the platform's cost advantage over the bank is a difference in funding structure rather than in efficiency. Part of the spread compression measured under balance-sheet lending is that difference passed to the borrower. Balance-sheet lending sits outside prudential regulation by design, and the design is blind on precisely the side of the balance sheet where Chapter 4 found the risk.

The architecture that produces this is coherent instrument by instrument. Authorisation under the Capital Requirements Directive triggers on deposit-taking, crowdfunding Regulation triggers on the act of matching, consumer credit directive triggers on the agreement with the consumer. Each is drawn on the liability side of the balance sheet, and none of them asks what the firm holds. The single express prohibition in the field makes the point plainly: Member States must forbid any undertaking that is not a credit institution from taking deposits or other repayable funds from the public, no provision anywhere forbids such an undertaking from lending.[62] Three consequences follow:

The first is that the gap sustains itself, two firms make the same loan and only one must hold capital against it, the unregulated firm is cheaper for a reason that has nothing to do with efficiency. The American literature puts 60% of the growth of shadow banking in the United States mortgage market down to regulatory burden on banks, and about thirty per cent down to lending technology.[63]

When macroprudential requirements tighten, banking groups do not lose the lending to a rival. They move it to their own non-bank subsidiaries, which lend two per cent more than the bank subsidiaries of the same group.[64] Same group, same management, same borrowers just a smart arbitrage way to get out of the regulatory scope. Regulatory arbitrage is not a transfer between the bank and the platform but between the borrower to both of them.

The second one, When a balance-sheet lender fails, the risk to the borrower is operational not financial. Unlike bank depositors, who face the loss of savings when an institution collapses, borrowers holding loans from balance-sheet lenders retain their exact debt obligations, which are simply sold and transferred to a new creditor. It reveals a significant regulatory complexity within European consumer protection rules, existing rules mandate plans for peer-to-peer platforms and intermediaries that carry zero credit risk. Yet, regulators impose no equivalent recovery our solution requirements on balance sheet lenders managing credit portfolios. Which means entities imposing the highest operational risk to borrowers during insolvency remain the least regulated regarding business and loan servicing.

[62] Article 9(1) of Directive 2013/36/EU, headed "Prohibition against persons or undertakings other than credit institutions from carrying out the business of taking deposits or other repayable funds from the public".
[63] Buchak, Matvos, Piskorski and Seru (2018)
[64] Bruno Albuquerque, Eugenio Cerutti, Melih Firat and Benedikt Kagerer, "Banking on Nonbanks", IMF Working Paper WP/26/23 (2026). Identification is within banking group, comparing the lending of a group's non-bank subsidiaries with that of its bank subsidiaries after a tightening of macroprudential requirements.

The third is stability, A run requires a claim that can be demanded, and a firm that takes no deposits it shows none it doesn't owe anything to anyone. When such a firm fails the last falls first on its shareholders and then on its wholesale lenders, this is the distinction the safety net was built around. Were the funding as equity, the condition doesn't arise at all and Brazil shows what that looks like written as a rule. The direct credit company may lend only with its own capital and may raise money only by issuing shares.[65] This restriction a firm whose liabilities are shares has no creditor who can decline to renew, so this firm cannot make a new way of maturity transformation, I will call it debt transformation by using leverage money to credit borrowers and the difference of interest rates will be the revenue stream, through arbitrage. The policy is funding restrictions.

Fintech has not taken risk out of the credit market it shifted the risk of the institution and on to the customer who holds no capital against it and had no part in pricing it and still the law has followed the old shape. Looking into banks and imposing more and more restrictions through capital, liquidity end resolution, it does not protect the borrower against a lender that ceases to exist.

5.3 Algorithmic Bias: what regulation cannot catch

The second question arises from the technology rather than the balance sheet. If platforms screen borrowers with machine learning, and machine learning distributes its gains unevenly, then the shift from bank to platform credit is also a distributional event.

Fuster and others, estimating default models on approximately ten million United States mortgages, confirm that machine learning predicts default significantly better than logistic regression, and then show that the improvement is not shared. A large fraction of majority group borrowers are assessed as less risky under the new technology, Black and Hispanic borrowers do not gain to the same degree, and in equilibrium the dispersion of rates rises both between and within groups.[66]

What makes this regulatory problem instead of empirical is what the author explained about two mechanisms. Triangulation is the recovery of a prohibited characteristic from combinations of permitted ones, so that a model excludes race as an input and reconstructs it from the data it is allowed to see. Flexibility is the capacity of a richer functional form to fit the true relationship more closely, which generates dispersion even where no prohibited characteristic is reconstructed at all. The authors attribute at most thirty per cent of the predictive gain to triangulation and the remainder to flexibility.[67]

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[65] Articles 3 and 5(I) of Resolution CMN No. 4,656 of 26 April 2018 (Banco Central do Brasil): the sociedade de crédito direto carries out lending "exclusively through an electronic platform, operating with its own capital", and may raise funds only through the issue of shares. See further section 5.6.

[66] Andreas Fuster, Paul Goldsmith-Pinkham, Tarun Ramadorai and Ansgar Walther, “Predictably Unequal? The Effects of Machine Learning on Credit Markets”, Journal of Finance 77, no. 1 (2022): 5–47. The sample comprises approximately ten million United States mortgages originated between 2009 and 2013, with default outcomes tracked for up to three years.

[67] Fuster and others (2022), pp. 7–8.

The implication is quite harsh because the rule that forbids the use of protected variables is addressing the smaller of the two mechanism without affecting the larger one. European law approaches the problem from three directions, the General Data Protection Regulation gives a right not to be subject to decisions based solely on automated processing and a right to meaningful information about the logic involved. The Court of Justice has given both real content, scoring by a credit bureau is itself an automated decision and a controller may not refuse to explain its logic by asserting trade secrecy but must submit the material for judicial or supervisory balancing.[68]

The Consumer Credit Directive goes further in one respect that matters. Its rights to human intervention, to an explanation of the logic and risks involved, and to a review of the decision are triggered wherever the assessment involves automated processing, not only where the decision is based solely upon it.[69]

The third instrument is the Artificial Intelligence Act, and it addresses the problem most directly. Annex III classifies as high risk any system intended to be used to evaluate the creditworthiness of natural persons or establish their credit score, subject only to a carve-out for fraud detection.[70]

6 Discussion

This research not only attempts to study whether financial technology operates as a substitute order complement to traditional banking, but also to understand the role of the credit exposure end of the regulatory framework as conditions of that relationship. Departing from the idea that fintech resolves the market imperfection that banks historically exist to address (Philippon, 2016; Vives, 2019; Thakor, 2020), It may also be true that it relocates some of these frictions instead of resolving them (Stiglitz & Weiss, 1981; Diamond, 1984), So the observed transformation produces a redistribution of risk and not just concentrated in one systemic risk.

The first set of results, obtained from the theoretical comparison show that the division between substitution and complementarity does not run between technologies only but between business models too. Fintech improves the ex ante screening of borrowers and the

[68] Regulation (EU) 2016/679, Article 22(1): "The data subject shall have the right not to be subject to a decision based solely on automated processing, including profiling, which produces legal effects concerning him or her or similarly significantly affects him or her." Article 22(3) requires safeguards including human intervention, the right to express a point of view and the right to contest the decision. Articles 13(2)(f), 14(2)(g) and 15(1)(h) require "meaningful information about the logic involved".

[69] Article 18(8) of Directive (EU) 2023/2225 confers, where the creditworthiness assessment involves automated processing, rights to human intervention on the part of the creditor, to a clear and comprehensible explanation of the assessment including the logic and risks involved, to express a point of view, and to request a review of the assessment and of the credit decision. Article 18(3) restricts the data that may be used, excluding data on health and data collected from social networks.

[70] Regulation (EU) 2024/1689 of 13 June 2024 laying down harmonised rules on artificial intelligence, in force from 1 August 2024. Annex III, point 5(b) classifies as high risk "AI systems intended to be used to evaluate the creditworthiness of natural persons or establish their credit score, with the exception of AI systems used for the purpose of detecting financial fraud".

matching of lenders with borrowers, whereas maturity transformation and pooling of credit risk remain with the incumbent. Different explanation can justify this asymmetry, First, the two arrangement exploit different information sets one uses hard information and the other the users soft information accumulated in a bilateral relationship (Vives, 2019), So the advantage a fintech is located at origination and the comparative advantage of banking is during the life cycle of the loan. Second, The fixed cost of assessment does not scale with the size of the loan, so the friction that fintech removes is the one that bound on small borrowers, which is why the gain appears as inclusion rather than a reallocation. However, The third apparently more understandable explanation is that the functions that shifts are those that can be performed without holding the assets on a balance sheet which is the decentralization of the financial system.

This interpretation is consistent with Fuster and others and with Berg and others, who find that algorithmic and digital-footprint screening adds predictive power to credit assessment. It also extends Philippon's finding, that the unit cost of intermediation has remained close to two per cent despite advances in information technology. Suggesting that the rent was protected by the incumbent's informational monopoly over its own customers.

The second set of results regards the empirical effect of fintech presence on incumbent profitability and the role of the business model in determining its direction. In line with Ben Naceur and others, the results show that the aggregate effect on the intermediation margin is negative, but the disaggregated estimates reveal that the two models act on different lines of the income statement. Peer-to-Peer lending leaves the margin intact and raises fee income, and balance-sheet lending compresses the margin and generates no fee. Two reasons, first one Is displacement in which loans that would have been written by banks are now held by platforms. The second is repricing in response to the entry threat, Implying that the competitive effect of fintech is transmitted through prices well before the volume.

Cooperative banks, rather than large commercial institutions, absorb the largest share of the adverse effect. Because they earn almost all of their income from a single local deposit-and-loan spread, so compression of that spread reaches the whole business And they lack the balance sheet capacity and technological innovation that would make them worth selecting as a partner. Extending the literature on regulatory arbitrage in the United states mortgages mark it, attributes the majority of shadow bank growth to regulatory burden rather than to lending technology. The study suggests that the same mechanism operates in Europe, were under the restriction institutions transfer lending to their own non bank subsidiaries to make the loan.

The effect on return on equity loses significance once year fixed effects absorb variation common to all institutions in a given year, while the estimates on the individual channels strengthen. The implication says that the aggregate profitability result was was substantially a matter of two series trending together over the period.

The research main finding regards the conditions under which fintech complements the incumbent. First, the criterion that separates the two outcomes is the locus of the credit

exposure. Every function that can be unbundled without moving the exposure proves complementary, and every arrangement in which the exposure moves proves substitutive. Second, the sign of the effect reverses in jurisdictions with high regulatory quality and government effectiveness, which means that regulation is not merely a constraint on entry but a determinant of the outcome. Complementarity is observed where it takes the form of a partnership, because the partnership is paid for and the payment appears in fee income, but where it operates through the incumbent's own digital investment it leaves no trace in the specification. It is somewhat surprising that a transformation so frequently described as an adoption story should be measurable in this data only from the side of the threat, and this asymmetry should be borne in mind when reading the magnitudes. Further research is required to separate the two, and a measure of bank-level technology investment would be the natural instrument for doing so.

6.1 Financial Regulation and Policy

The findings of the study are relevant for financial regulation and in particular for the question of what triggers the requirement of a license. A balance sheet has two sides, the liability side to check how the firm found itself and the assets that records what it is holding. European law decides if a firm requires authorization by asking about the first of these two and never about the second. The deposits require a banking license, matching lenders was borrowers require crowdfunding authorization. A firm that funds itself from equity or from wholesale markets, lands directly instead of matching so it might require to hold the loan book of any size bearing the whole of the credit risk attached to it without any European authorization.

This study finds that the effect of fintech depends on which party ends up holding the loan. A firm that originates and retains credit on its own balance sheet should require authorization on that ground alone irrespective of the manner in which it founds itself. The Brazilian settlement demonstrates that it's a matter of drafting and not doctrine. A firm permitted to land only with its own capital and today's funds only by issuing shares, has no creditor who can decline to renew which decreases the consumer risk that fintech introduced as a new type of risk, this way a run will not be triggered and no prudential framework is required to prevent it. The funding restriction of this kind is a proportionate alternative to full capital requirements for small lenders and it reaches the stability concern of the systemic risk without imposing on a new entrant the cost of regulations designed for deposit taking institution.

With the regulation that the European set in place for the peer-to-peer business model is more than just safe the risk too low because fintech is a complementary to banking through partnerships it's helping solving the frictions of the market and financial inclusion.

The results on algorithmic underwriting suggest that the regulatory approach should shift from the prohibition of inputs to the testing of outcomes. Since only a minority of the predictive gain from machine learning is attributable to the reconstruction of prohibited characteristics functional flexibility. A rule forbidding the use of protected variables addresses the smaller of the two mechanisms and cannot reach the larger one. The architecture already in place is appropriate, but what is missing is an obligation to test the distribution of outcomes

rather than the composition of inputs. More generally, the finding that the sign of the effect depends on government effectiveness rather than on regulatory quality alone implies that supervisory capacity, and not only the quality of drafting, should be treated as a policy instrument, which is a particular concern for a Union that legislates centrally and enforces through twenty-seven national authorities.

6.2 Limitations and further research

The estimates used here come from a published cross country panel study, where the baseline was re-run with year fixed effects, with a lagged regressor, instrumental variables and scaling. The results relied on survived that treatment, what could not be done because it required the underlying data is to add two specifications of our own.

The first would estimate the moderator interactions and the year fixed effects in the same regression they both appear in the results but not together. The combination of those two would show if the weak pulled effect on return on equity is a common trend or the average of two groups of countries moving in opposite directions.

The second would recompute the standard errors, robustness checks change what enters the regression but not the way the errors are calculated. So every column assumes that the residuals of different banks are unrelated. Correcting this would most likely widen the intervals without changing the signs which is why the direction of the effect can be trusted. The second limitation concerns the explanatory variable, that is measured by country and year and assigned identically to every institution in the market regardless of whether it faced platform competition. What follows is the volumes involved, since fintech credit remains a small share of total credit the coefficient cannot record displacement and must be read as repricing or as a correlate of digitalization more broadly.

7 Conclusion

The research question of this thesis was set by the history of banking itself. The modern framework is the product of successive crisis and reforms, each of which followed a period in which credit expanded faster than the arrangement meant to contain it. The question is if financial technology resolves the friction that the banking system was built for, in which case it complements the incumbent or merely performs the same functions outside the regulatory framework. In which case the exposure to systemic risk is not removed but relocated leading to another financial crisis.

The answer is conditional and the condition is legal more than it is technological. The criterion that separates the two outcomes is the location of the credit exposure. Fintech complements the bank whenever it performs a function that can be carried out without holding the asset. The technology does so by improving screening of borrowers and matching Lenders with borrowers. Open banking data portability and standardized interfaces may this function welfare improving by dissolving the informational advantage the incumbent held over its own customers. The peer-to-peer configuration is the clearest way, since the platform screens and

refers the borrower while the bank originates and holds the lawn, each party performs the part of the operation for which it is better equipped. The econometric evidence confirms this division, by showing the negative effect of fintech presents on banks. Commercial banks show no significant effect on profitability, because the fee is earned from partnership so complementarity of fintech offset the cost incurred in competing but rather toward a repricing. Cooperative banks absorb mainly the shock on every measure and at the highest level of significance. The reason is structural because it earns almost all of its income from a single local deposit and loan spread and it lacks the balance sheet capacity and the technological interface that would make it worth it selecting as a partner instead of a target.

Above the median of regulatory quality and governance effectiveness the sign of the effect reverses altogether, and greater fintech presence is associated with higher incumbent returns, confirming complementarity. The distinction between fintech business models produces attention, peer-to-peer lending are complementary and riskless due to the regulatory framework imposed by the European law. So the systemic risk associated with this wave of innovation is On the contrary decreasing because fintech is improving and increasing bank profitability and resolving frictions. The balance sheet lending platform entering such a market and performing an activity economically identical to banking should meet requirements equal to the banking sector for fair competition. In this case substitution is dominating But the fact that regulation framework doesn't include them create an arbitrage opportunity. Even banks that cannot accept loans anymore shift towards their non subsidiary institution to perform the loan.

The decentralization of financial institution is mainly a gain, services are delivered faster at a lower cost, financial inclusion and the saver acquires A transparency over their own position that the deposit contract never offered.

Even though systemic risk is reduced, this movement introduces a new category of risk that the classical account does not contain and which this thesis calls consumer risk. The saver who now selects assets, sizes and degrees of diversification for himself has taken on the portion of risk that no amount of spreading removes and holds no capital against it. The borrower for this part now contracts with a platform instead of a licensed institution and if that platform fails his loss is operational and not financial. It means that risk has not been eliminated but move to the parties least equipped to price it and least equipped to bear it.

The evidence does not support the expectation of a new financial crisis since systemic risk is not present and the mandible claim are outside the banking system. The direction the sector takes will be settled by what platforms become capable of doing then by where the law decides the boundaries of supervision falls, and that boundary is presently drawn around how a firm finds itself and not what it holds.

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9 Appendix

Fintech finance volumes by model (including China, in US dollars) — Fintech finance volumes by model (without China, in US dollars)

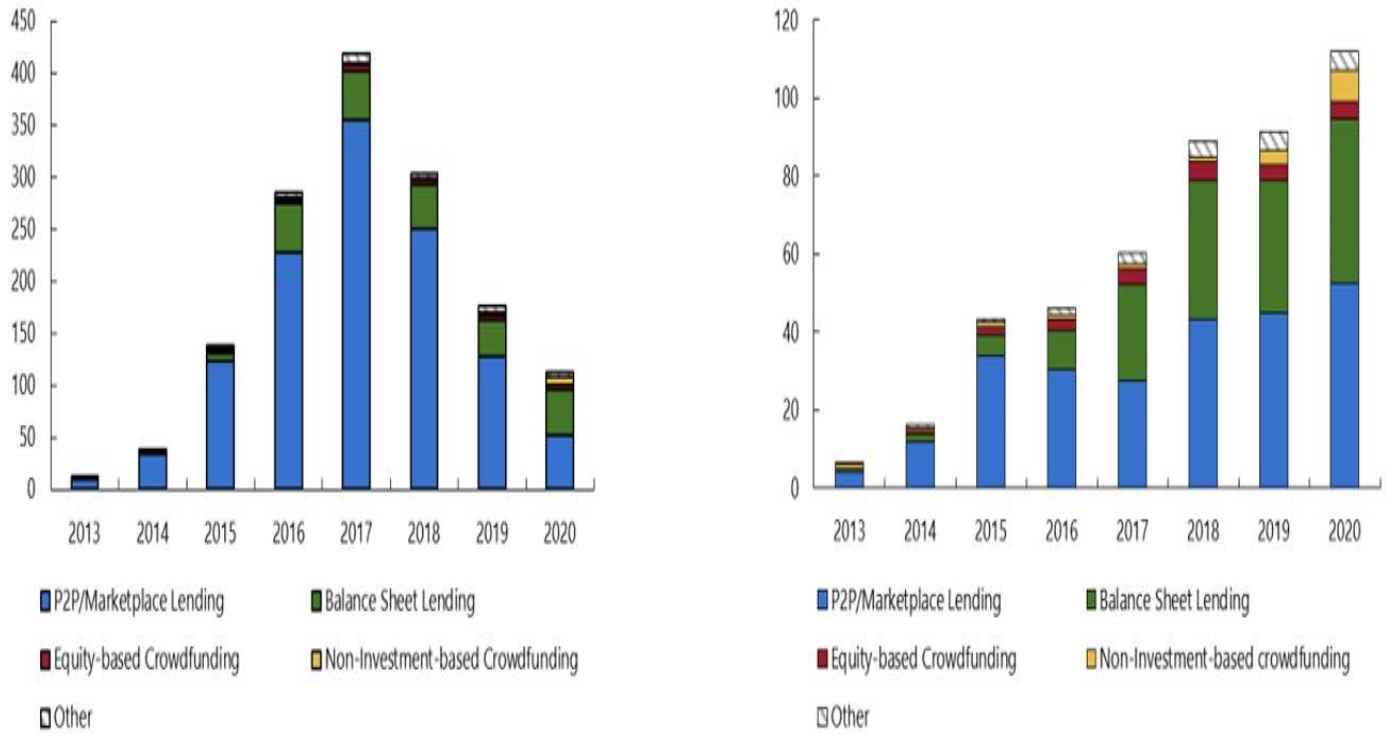

Figure 2.2. Fintech Finance volumes by business model, 2013-2020

Source: ELEKDAG, EMRULLAHU and BEN NACEUR (2024), using ZIEGLER and others (2021).

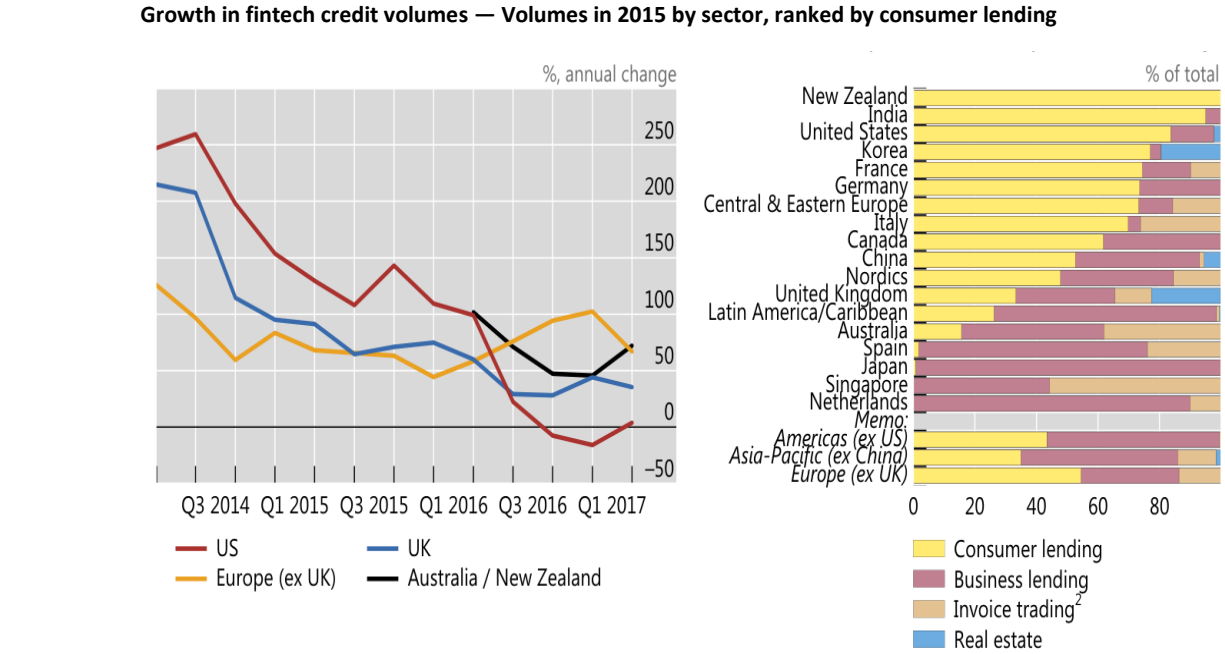

Figure 2.3. Fintech credit volumes: annual gross rates and composition by sector across jurisdictions

Source: COMMITTEE ON THE GLOBAL FINANCIAL SYSTEM and FINANCIAL STABILITY BOARD (2017), Graph 1, drawing on AltFi Data (left panel) and the Cambridge Centre for Alternative Finance and research partners (right panel).

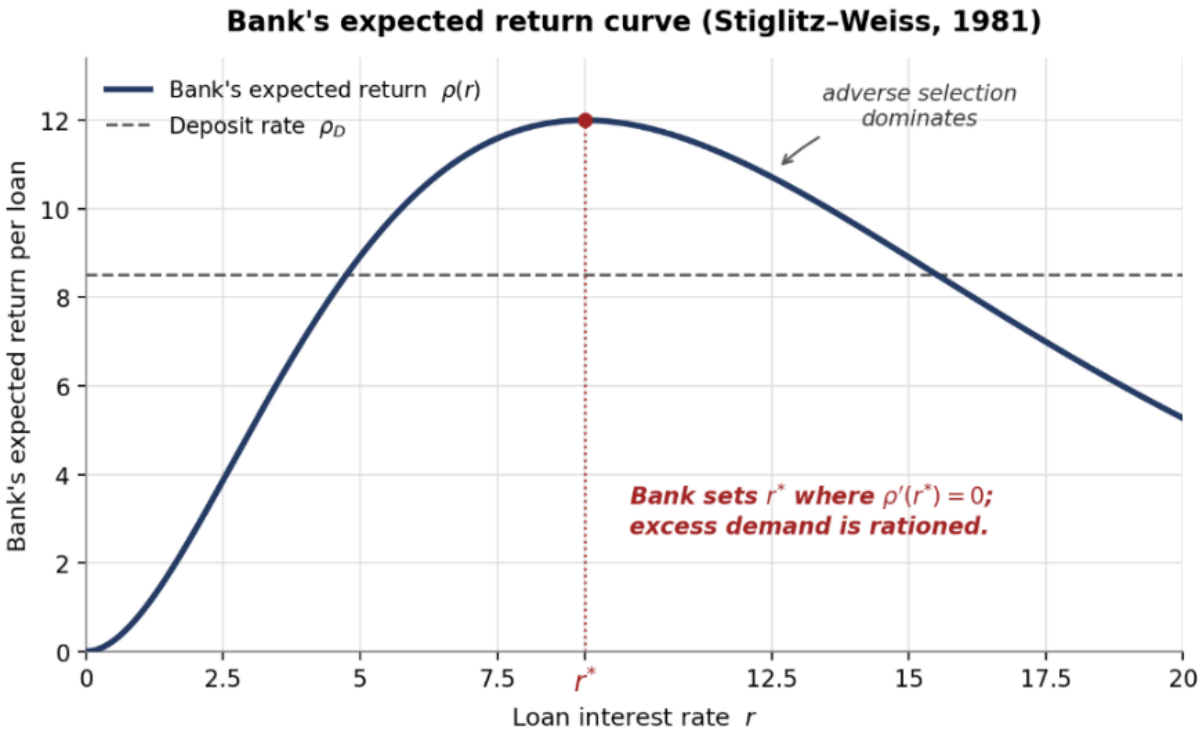

Figure 3.1.2. The bank's expected return per loan ρ(r) as a function of the loan rate

Source: Own elaboration based on STIGLITZ and WEISS (1981).

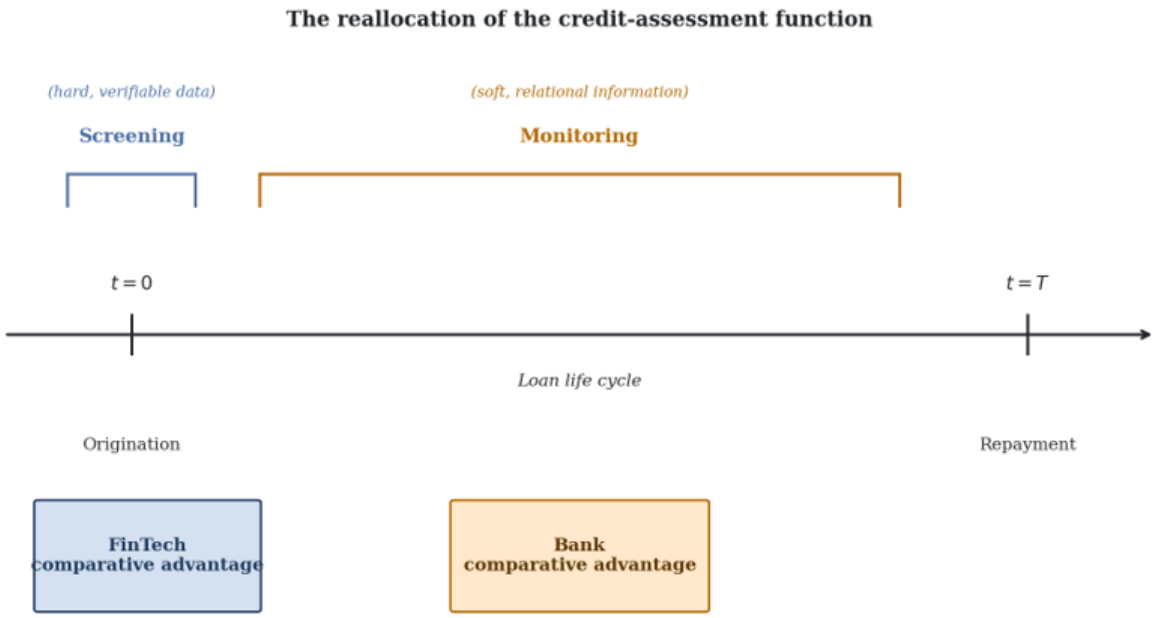

Figure 3.2.1. The reallocation of the credit-assessment function over the loan life cycle
Source: Own elaboration based on VIVES (2019).

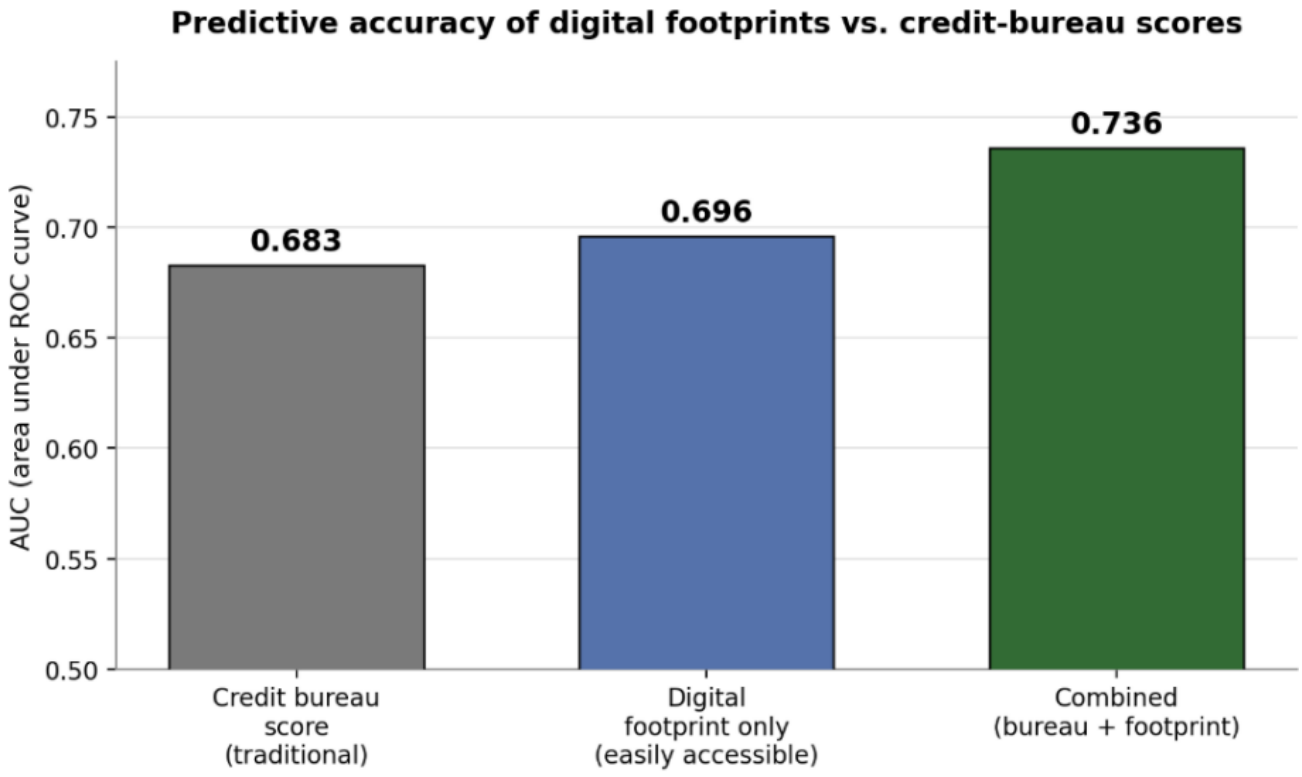

Figure 3.2.1.1. Predictive accuracy of digital-footprint variables versus traditional credit-bureau scores
Source: BERG, BURG, GOMBOVIĆ and PURI (2020), Table 3.

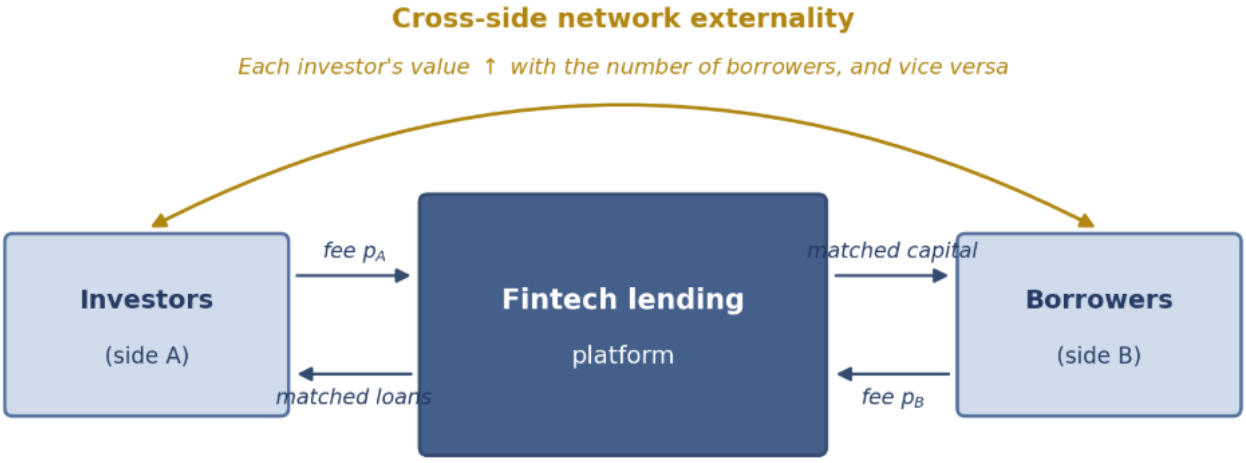

Figure 3.2.3. Two-sided platform structure of fintech credit markets
Source: Own elaboration based on ROCHET and TIROLE (2003, 2006).

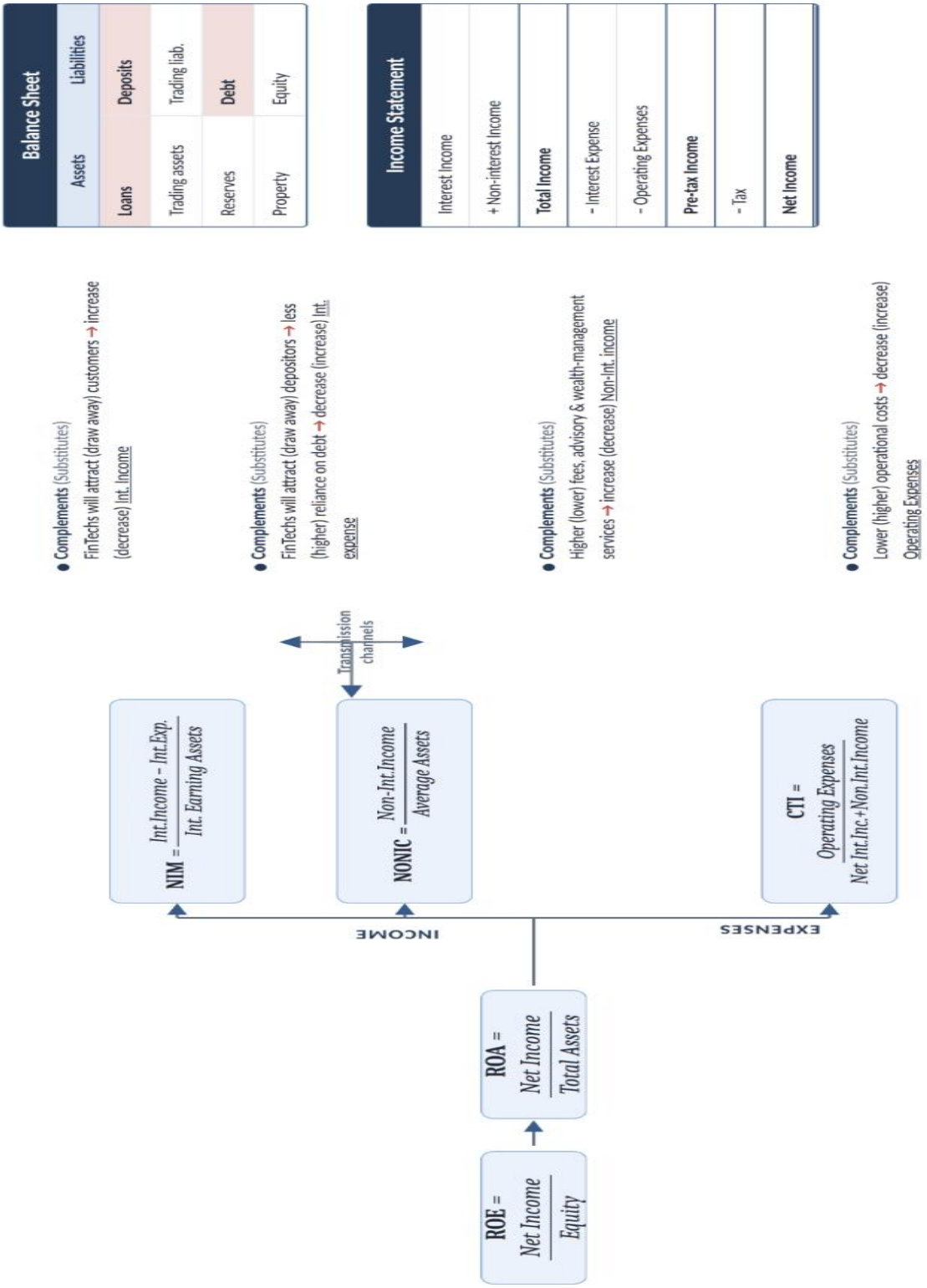

Figure 4. Transmission channels through which the presence of fintech reaches bank profitability
Source: BEN NACEUR and others (2023), Figure 2.

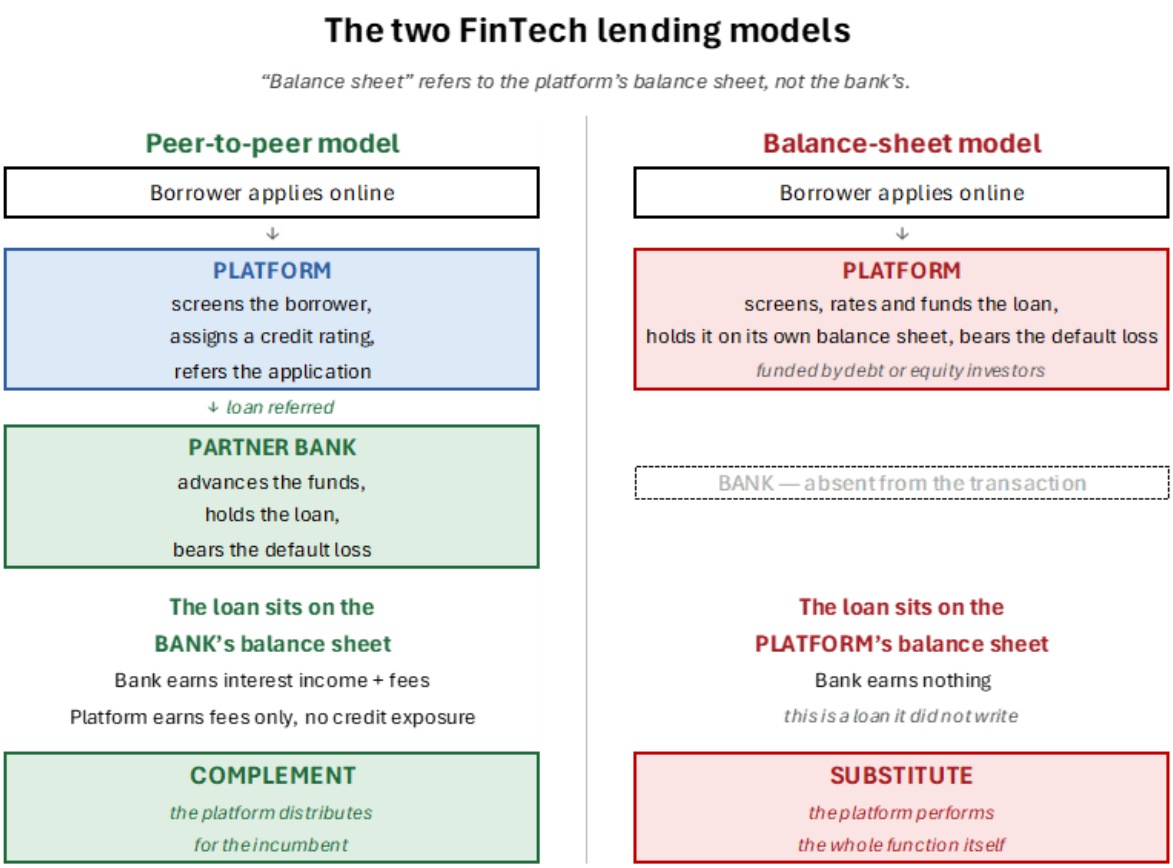

Figure 4.2. The two fintech lending models and the locus of credit risk

Source: COMMITTEE ON THE GLOBAL FINANCIAL SYSTEM and FINANCIAL STABILITY BOARD (2017), pp. 3-7, and BEN NACEUR and others (2023), pp. 10-11.

9.1 Tables

	(1) ROE	(2) ROA	(3) NIM	(4) NONIC	(5) CTI
FinTech	−0.0903***	−0.0246***	−0.0277***	0.0111***	0.136***
	(0.0113)	(0.00233)	(0.00340)	(0.00338)	(0.0292)
Observations	79,523	79,701	79,438	79,666	79,384
rho	0.680	0.776	0.910	0.912	0.757
Sample median (%)	4.25	0.49	3.13	0.99	78.40

Table 4.4. Baseline effect of fintech presence on bank performance

*Source: BEN NACEUR and others (2023), Table 2 and Annex II, Table 1. Standard errors in parentheses; *, **, *** denote significance at 10, 5 and 1 per cent. All specifications include bank fixed effects and control for size, capitalisation, GDP growth, inflation, the policy rate and bank concentration.*

		ROE	ROA	NIM	NONIC	CTI
All institutions	FinTech	−0.0903***	−0.0246***	−0.0277***	0.0111***	0.136***
Cooperative banks	P2P lending	−0.333***	−0.128***	−0.111***	0.0192	0.676***
	Balance-sheet lending	−0.192***	−0.0910***	−0.142***	0.0177*	−0.0944
Commercial banks	P2P lending	−0.0489	−0.0153	0.00653	0.0611***	0.286**
	Balance-sheet lending	−0.0749	−0.0120	−0.0612***	0.0225	0.449***

Table 4.4.1. Effect of fintech business models on bank performance, by institution type

*Source: BEN NACEUR and others (2023), Table 3. *, **, *** denote significance at 10, 5 and 1 per cent.*

	ROE: interaction	ROE: net effect	ROA: interaction	ROA: net effect
FinTech × low concentration	−0.0704***	−0.1041	−0.0021	−0.0258
FinTech × high credit depth	−0.140***	−0.2079	−0.0196***	−0.0428
FinTech × high banking-sector ROE	−0.0592***	−0.1274	−0.0164***	−0.0378
FinTech × high regulatory quality	0.316**	0.2235	0.0878*	0.0629
FinTech × high government effectiveness	1.513***	1.4175	0.144***	0.1188
FinTech × low non-performing loans	−0.157***	−0.2386	−0.057***	−0.0784

Table 4.4.2. Effect of fintech conditional on selected country and bank characteristics

*Source: BEN NACEUR and others (2023), Table 4. Moderators are median-split dummies; the net effect is the sum of the fintech coefficient and the interaction coefficient. *, **, *** denote significance at 10, 5 and 1 per cent.*

Specification	ROE	ROA	NIM	NONIC	CTI
Baseline	−0.0903***	−0.0246***	−0.0277***	0.0111***	0.136***
2SLS: leave-one-country-out	−0.136***	−0.0308***	−0.0227***	0.00622***	0.0719***
Two-step GMM	−0.274***	−0.0631***	−0.0623**	0.0228*	0.190**
Balanced panel	−0.0674***	−0.00705** *	−0.0143***	0.00106	0.114***
Excluding China, US, and UK	−0.0984**	−0.0550***	−0.0732***	0.0608***	0.648***
Time fixed effects, no macro controls	−0.0108	−0.0442***	−0.147***	0.0342***	0.592***

Table 4.5. Robustness of the fintech coefficient across specifications

*Source: BEN NACEUR and others (2023), Table 5. *, **, *** denote significance at 10, 5 and 1 per cent.*