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Monetary policy transmission through cross-selling banks

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Challenges for Monetary Policy Transmission in a Changing World Network (ChaMP)

This paper contains research conducted within the network "Challenges for Monetary Policy Transmission in a Changing World Network" (ChaMP). It consists of economists from the European Central Bank (ECB) and the national central banks (NCBs) of the European System of Central Banks (ESCB).

ChaMP is coordinated by a team chaired by Philipp Hartmann (ECB), and consisting of Diana Bonfim (Banco de Portugal), Margherita Bottero (Banca d'Italia), Emmanuel Dhyne (Nationale Bank van België/Banque Nationale de Belgique) and Maria T. Valderrama (Oesterreichische Nationalbank), who are supported by Melina Papoutsi and Gonzalo Paz-Pardo (both ECB), 7 central bank advisers and 8 academic consultants.

ChaMP seeks to revisit our knowledge of monetary transmission channels in the euro area in the context of unprecedented shocks, multiple ongoing structural changes and the extension of the monetary policy toolkit over the last decade and a half as well as the recent steep inflation wave and its reversal. More information is provided on its website.

We show theoretically how the anticipated cross-selling of loans incentivizes banks to offer lower deposit spreads to attract and retain depositors, more when policy rates are lower and future cross-selling is more valuable. Utilizing comprehensive data on every Norwegian bank household relationship, we then establish empirically how banks facing identical loan demand respond to policy rate cuts with greater deposit spread reductions for clients with higher cross-selling potential, thereby raising both deposit and loan growth. Cross-selling constitutes a complementary, novel channel for monetary policy transmission through banks, elucidates loss-making deposit pricing in low-rate periods, and connects banks' deposit and loan franchises.

Keywords: monetary policy transmission, deposits channel of monetary policy, cross-selling, multi-product banking, bank franchise

JEL Classification: D14, D43, E52, G21, G51

Non-Technical Summary

To achieve their mandate of consumer price stability, central banks typically respond to inflation above (below) their target by raising (reducing) monetary policy rates and so the interest rates at which banks can borrow from or lend to other banks or the central bank. To the extent to which this change in interbank rates is then passed through to the deposit and loan rates and volumes between banks and their clients, it may affect consumption and investment in the real economy and thereby consumer prices.

More specifically, when central banks raise policy rates as in the post-pandemic years, banks typically pass through these changes only partially and so manage to expand the *deposit spread* between policy and deposit rates, the margin banks earn on their deposits. This phenomenon, observed across currency areas including the euro area and the United States, has so far been explained by the so-called *deposits channel*: mortgage market concentration limits the price elasticity of clients' supply of deposits to their bank and so allows banks to raise the deposit spread when policy rates increase. As a response to this price increase, the average depositor replaces not all but some deposits with other financial assets, leaving the bank with less refinancing and thereby reducing bank lending and so consumer price growth.

While this existing paradigm can explain a lot of the link between policy rate changes, deposit rate changes and deposit and loan volumes, it cannot explain why banks often pay deposit rates *above* policy rates—resulting in *negative deposit spreads*—when interest rates are low. It also does not fully capture the multi-product nature of banking whereby banks may attract a client for one product and then sell other banking products to that client.

This paper proposes a new explanation. We show that banks may be willing to pay more for deposits than standard models predict because deposits are a gateway to future business including both future deposits and other products. Specifically, many banks can anticipate that depositors will also take up other financial products—most importantly, mortgages. The promise of future earnings from such *cross-selling* makes deposit relationships more valuable, especially when interest rates are low and future profits are worth more in today's terms. As a result, banks reduce deposit spreads more strongly for customers with high cross-selling potential when policy rates are cut.

Our empirical analysis confirms that banks offer more favourable deposit rates to clients who are more likely to take out loans in the future, and that this behaviour becomes more pronounced when policy rates fall. This boosts both deposit and loan growth, providing a new and complementary channel through which monetary policy influences the economy.

Our analysis uses tax data that include for every single bank household relationship in Norway and every year the deposit volume, the loan volume, deposit interest and loan interest. This allows us to link deposit and loan business within each relationship, including its timing over the years, the price of each product and the resulting volume, a data granularity not so far available for either the euro area or the US. At the same time, complementary analyses with less granular data for the euro area suggest the same regularities to matter also here.

Our findings have at least three important policy implications. First, they show how the transmission from changes in monetary policy rates via changes in deposit rates to deposit and loan volumes may depend on bank business models. Bank business models therefore matter for the size of monetary policy actions required. Relatedly, heterogeneity in bank business models may result in the same monetary policy action transmitting differentially across population segments, banks and bank borrowers. Second, our new paradigm helps explain why negative deposit spreads—seemingly loss-making for banks—are observed in low-interest-rate environments, an issue that may again gain in importance to the extent to which central banks choose lower policy rates in the coming years. Third, we highlight how the value of a bank's deposit and loan business is interconnected, and how this linkage may affect financial stability when bank profitability is under strain.

1 Introduction

The pass-through from monetary policy to deposit rate changes is typically incomplete. This implies that banks widen deposit spreads between policy and deposit rates when policy rates are raised and narrow them when policy rates are cut. A first explanation for on average positive deposit spreads is bank market power, formalized in the "Monti-Klein model" of banking (e.g. Freixas and Rochet 2008) where banks act as monopolistic price setters in deposit markets. Going a step further, Drechsler, Savov, and Schnabl (2017) established the Deposits Channel in which deposit market power, empirically captured as deposit market concentration, allows banks not only to earn on average positive deposit spreads, but leads them also to adjust deposit rates less than 1-for-1 with policy rates, implying a *deposit beta (DB)* below 1 and a positive *deposit spread beta (DSB)*. This positive Deposit Spread Beta has also been argued to be one of the key ways in which banks can hedge against the decreases of their fixed-rate asset values following policy rate hikes (Drechsler, Savov, and Schnabl 2021; Drechsler et al. 2023).

At the same time, a framework in which banks price deposits only to maximize current deposit profits cannot explain why banks frequently choose negative deposit spreads when policy rates are negative[1] or even just below about 1.5 percentage points (see e.g. ***Figure 1*** for Norway, or Figure I in Drechsler, Savov, and Schnabl, 2017, for the US). Furthermore, recent research (Basten and Juelsrud, 2023) suggests that at least cross-sectionally banks may set deposit prices to maximize the lifetime profits per client relationship, rather than current deposit profits alone, thus also providing a new, explicit link between a bank's deposit and loan franchises.

In this paper we explore how bank market power based on cross-selling potential can explain both incomplete pass-through and negative deposit spreads, as well as explicitly link deposit and loan franchise. By cross-selling, we refer to banks selling future services, such as future mortgages, to existing depositors due to a depositor preference for having bank products at the same bank. Diverging from the Monti-Klein benchmark, this makes banking a multi-product and multi-period business.[2] We explore both theoretically and empirically the implications of this form of market power for the transmission of monetary policy. We show that in some

[1] See e.g. Basten and Mariathasan (2023), Eggertson et al (2024), or the extensive list of references in both.

[2] Such cross-selling was initially explored in Basten and Juelsrud (2023), who showed that an existing deposit relationship makes a household about 20 percentage points (pp) more likely to later cross-buy a mortgage from the same bank, compared to an otherwise comparable household with no deposits at that bank. Basten and Juelsrud (2023) also showed that depositors' hesitance to switch banks allows their banks to charge a premium on such cross-selling, and that this is driven by depositor demand rather than bank supply. In addition, the presence of a mortgage may further reduce clients' willingness to switch banks for their deposits. Therefore, beyond linking deposit and loan franchise, cross-selling increases the value of the former.

setups cross-selling can explain quantitatively at least as much of the Deposit Spread Beta (DSB), Deposit Growth Beta (DGB) and Loan Growth Beta (LGB)[3] as measures of deposit market concentration. Our analysis consists of five steps.

First, we show theoretically how cross-selling affects the Deposit Spread Beta. We build a simple model of a monopolistic bank similar to the Monti-Klein model and the Deposits Channel model and focus on the determinants of deposit spreads set by that bank. In line with the empirical results in Basten and Juelsrud (2023), we define cross-selling potential as a positive relationship between a current deposit relationship and a future loan relationship between the same bank and household. On these grounds, we model not only deposit volumes as an increasing function of deposit rates or decreasing function of the deposit spread, in line with Drechsler, Savov, and Schnabl (2017), but also model the volumes of future cross-sold loans as a decreasing function of deposit spreads. When setting deposit spreads, the bank then trades off the marginal cost of lower deposit spreads today against the marginal benefit of a greater deposit volume (today and tomorrow) *and* greater future cross-selling profits. As a result, the optimal deposit rate is a mark-down over the policy rate that depends not only on current deposit market power, but also on the net present value of expected future cross-selling profits – potentially at the level of each individual bank client relationship. The key theoretical result is that cross-selling dampens the impact of policy rate changes on deposit rate changes, thus increasing the response of deposit spreads and therewith of deposit and loan growth to policy rate changes, i.e. it increases the sizes of a bank's Deposit Spread Beta.

Conceptually, cross-selling can affect the Deposit Spread Beta through two distinct channels. First and most clearly, when the policy rate increases, future cross-selling profits are discounted more heavily. Second, policy rate changes may affect also the flow profits of loan cross-selling if they change the (risk-adjusted) loan volumes or spreads, given imperfect competition also in loan markets. Whether and how this is the case is an empirical question, which we address below, and find lower policy rates associated also with greater flow profits from cross-selling.

In the second step, we assemble a rich annual dataset on the population of household depositors and borrowers for Norway for the period 2004 – 2018 with the purpose of testing the theoretical predictions from the first step, i.e. whether cross-selling potential affects Deposit Spread Beta and Deposit Growth Beta both qualitatively and quantitatively. The data allow us to link also

[3] Deposit Spread Beta, Deposit Growth Beta and Loan Growth Beta are estimated by regressing respectively deposit spread changes, deposit growth and loan growth on policy rate changes.

a rich set of demographics, balance sheet and income statement variables for all households. This is crucial, as key determinants of cross-selling potential are demographics. For instance, younger households are associated with higher potential to cross-sell mortgages to them (Basten and Juelsrud, 2023).[4] This enables us to estimate for each individual bank household relationship the probability that the bank can later cross-sell a loan to that same household (cross-selling at the extensive margin), as well as the expected loan volume and loan spread (cross-selling at the intensive margin). We can hence investigate how the same bank in the same year, and hence with the same refinancing needs, chooses a different pass-through from policy to deposit rate changes for clients with different cross-selling potential.

Third, we show that the Deposit Spread Beta increases by about 1bp for each standard deviation (SD) higher cross-selling potential at the extensive margin. Accounting also for the intensive margin, we find that a 1SD increase in cross-selling potential has an even 50% larger effect on the Deposit Spread Beta.

Fourth, we show that variation in deposit spread changes and resulting variation in deposit growth leads also to variation in loan growth. Comparing loan growth responses to monetary policy changes across banks with different bank level cross-selling potential but within the same municipality and year, or alternatively within the same sector (at different levels of granularity) and year to control for loan demand, we find that a 1SD higher cross-selling potential is associated with 2.22pp lower Loan Growth Beta at the bank municipality level and with a 1.83pp lower Loan Growth Beta at the bank sector level. Overall, our findings imply that variation in cross-selling potential across banks arising from different clientele ultimately explains a sizable part of variation in Deposit Spread Betas, as well as how responsive deposit and loan growth are to monetary policy.

Fifth and last, we explore empirically the sub-channels through which cross-selling potential affects the Deposit Spread Beta. In line with our conceptual framework, we focus on two channels: the flow profits from future cross-selling of loans, and their discounting. We find empirically that policy rate cuts do not only reduce the discount factor on future cross-selling profits but tend to also increase expected loan volume and spread.

[4] Depositors may also cross-buy other products like wealth management, but we do not see profits thereof for each bank client relationship, and the profits thereof would seem quantitatively less important than those from cross-selling mortgages.

Contributions to the Literature

We contribute chiefly to five strands of the literature. First, a large literature has explored the transmission of monetary policy. Recently, an influential part of this literature is the strand on the Deposits Channel of Monetary Policy including Drechsler, Savov, and Schnabl (2017), Drechsler, Savov, and Schnabl (2021), Begenau and Stafford (2022), and Drechsler et al (2023). One key insight of that literature is that the response of deposit pricing and flows to policy rate changes may be key for understanding how monetary policy transmits to the real economy. Our paper contributes to that literature by being the first to explore how cross-selling affects the response of deposit pricing, deposit flows and lending to monetary policy. As such, our paper provides a new perspective on the determinants of bank market power and on how bank market power affects monetary policy transmission through banks: It manifests itself not only in a lower price elasticity of deposit volumes, but also in clients' stickiness to the same bank across both products and periods.

Second, we contribute to the literature on how monetary policy transmission differs when policy rates are low. For example, Basten and Mariathasan (2023) or Fuster, Schelling and Towbin (2024) showed for Switzerland, Eggertson et al (2024) for Sweden, and many papers referenced therein for the euro area, that even in times of negative policy rates banks are hesitant to set negative deposit rates, even absent legal constraints and even when loans could be refinanced more cheaply with other liabilities.[5] The literature has explored many consequences of the resulting negative deposit spreads, but has so far arguably not fully explained their rationale. For holding cash instead of deposits is also costly to clients. And we see negative deposit spreads not only when policy rates are negative, i.e. when avoiding them would require banks to saliently set negative deposit rates but also when policy rates are merely low so that banks could still earn positive deposit spreads with low but positive deposit rates but choose not to.[6]

[5] If at all, banks have set negative deposit rates only for volumes above certain thresholds and for corporate clients or high net worth individuals. While these can be expected to bring larger volumes of cross-selling business, they are even more directly characterized by larger deposit volumes, making deposit spread discounts costlier for their bank.

[6] More recently, Cao, Dubuis and Liaudinskas (2025) found banks to raise loan spreads for relationship borrowers in response to policy rate cuts in low-rate periods, consistent with attempts to make up for the lower deposit spreads our paper implies, and with exploiting clients' bank stickiness. By contrast, Berger et al (2024) find weaker monetary policy transmission to loan volumes for relationship clients, and Gelman, Goldstein and MacKinlay (2024) find weaker pass-through by universal (trading) banks, implying more limited effects of monetary policy on loan growth. In our setup, effects on loan growth are strong, consistent with the average Norwegian bank being less active in proprietary trading than the average US bank.

Third, we contribute to the broader literature in industrial organization on the value to firms of onboarding clients at lower prices for the sake of higher follow-on profits, see e.g. Klemperer (1995) for a theoretical and general motivation, Carbo-Valverde, Hannan, and Rodriguez-Fernandez (2011) for a more specific empirical application to the bank deposit market, or Basten and Juelsrud (2023) for further references. Compared to the existing literature, the present paper elucidates specifically how that trade-off changes with current policy rates.[7]

The paper closest to this one is Basten and Juelsrud (2023). But it differs in at least three ways. First in its research question: We look at the effect of cross-selling potential on the Deposit Spread Beta and Deposit Growth Beta and hence on how deposit spreads and growth respond to monetary policy changes, whereas Basten and Juelsrud (2023) focused on the cross-sectional effects of cross-selling potential on deposit spread levels, regardless of the policy rate. Second in policy implications: While Basten and Juelsrud (2023) had shown how cross-selling potential matters for optimal bank and household behavior, this paper shows how it affects the transmission of monetary policy. And third in the dataset used: While Basten and Juelsrud (2023) had used data on every single bank household relationship, this paper aggregates from that same maximum granularity up to the bank municipality level. This allows us to control for each bank's refinancing needs and at the same time investigate the effects of local deposit market concentration and largely demographics-based variation in local cross-selling potential at a level where both deposit pricing and growth have meaningful interpretations.

Fourth, we contribute to the literature on determinants of a bank's franchise value, see e.g. Drechsler, Savov and Schnabl (2021), Bolton et al (2023), Drechsler et al (2023), Luck, Plosser and Younger (2023), DeMarzo, Krishnamurty and Nagel (2024), or Narayanan, Ratnadiwakara and Strahan (2025). This literature strand is generally aware that a bank's franchise value consists of future streams of both loan and deposit spreads, less operating costs, and discusses to what extent each varies with policy rates, but to our knowledge we are the first to point out how these streams can be explicitly linked through cross-selling loans to existing depositors.

Fifth, we contribute to the emerging literature on how cross-selling of different products to the same bank clients connects asset and liability side of a bank balance sheet (Basten and Juelsrud

[7] A separate literature has emphasized the benefits of multi-period or relationship banking from reducing asymmetric information problems, e.g. Berlin and Mester (1999), Hellmann, Lindsey, and Puri (2008), Norden and Weber (2010), Ivashina and Kovner (2011), Agarwal et al. (2018), Neuhann and Saidi (2018), or Berger et al. (forthc.). As Basten and Juelsrud (2023) found a limited role for this in collateralized, standardized mortgage lending, we do not discuss it more here.

2023, Qi 2023).[8] While in the Monti-Klein model banks choose optimal deposit and loan volumes independently from each other, and in the Deposits Channel deposits matter for loans only as for refinancing, we show how deposit relationships affect lending also via cross-selling.

Below, Section 2 outlines our conceptual framework. Section 3 discusses the data and Section 4 our empirical strategy. Section 5 presents our empirical results and Section 6 concludes.

2 Conceptual Framework

In this section, we outline a conceptual framework which analyzes theoretically how future cross-selling potential affect deposit pricing today. The purpose of this section is to motivate the predictions that we later test in the data.

Consider the following model. There are two periods, "today" and "tomorrow". Banks set a deposit rate r_d, which determines the deposit spread $s_d = r - r_d$ against the policy rate r. The latter is exogenous to the bank. We consider a monopolistically competitive bank, which is facing a strictly downward sloping demand curve for deposit savings $D(s_d)$ today.

Tomorrow, part of the bank's depositors generates cross-selling profits by becoming borrowers. This is in line with Basten and Juelsrud (2023), who document that for demand-driven reasons the average Norwegian household is about 20pp more likely to cross-buy a loan from their deposit bank than an otherwise identical household would be to borrow from an otherwise identical bank absent a prior deposit relationship there. Denoting the loan volume, which can be zero, as L and the loan spread between loan and policy rate (given mostly adjustable rate loans, see Basten and Juelsrud, 2023) as l, this implies future cross-selling profits $L \times l$.[9] We assume that future loan volumes L are an increasing and linear function of the deposit volume D, as a higher deposit rate (lower spread) today attracts more depositors, some of whom will then also take out a loan tomorrow.

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[8] Relatedly, Puri and Rocholl (2008) found banks to benefit from the fact that brokerage clients tend to keep paying their account fees even when their accounts become inactive. To onboard such clients in the first place, the banks Puri and Rocholl study provide their clients with knowledge about the most attractive IPOs. So, their cross-selling may also be seen to involve a loss-leader-type strategy, even if neither leg of the strategy contains a balance sheet effective banking product.

[9] Basten and Juelsrud (2023) show also cross-selling of future deposits to current depositors, or depositor stickiness, but cross-selling of loans yields on average both greater volumes and higher spreads. Therefore, we omit here the term for profits from future deposits but note that it would not change our key analyses.

With cross-selling, deposit spreads set today influence both profits from deposits today and flow profits from cross-selling tomorrow, which are then multiplied by the discount rate $\frac{1}{1+r}$ to obtain their net present value. At the baseline we assume decision-makers to have an infinite horizon and to discount future profits at whatever is the market rate for that maturity but discuss below how predictions change when we relax that assumption. For simplification and without loss of generality we assume the bank to be risk neutral. Furthermore, we allow both loan spread *l* and loan volume *L* to potentially also vary with the current policy rate r and shall investigate below to what extent this is empirically the case.

Then it is convenient to focus on banks' choice of deposit rate r_d, which also fully determines the deposit spread as a mark-down over the policy rate r: s_d = r -r_d. The optimization problem of the bank can then be written as

$$\max_{r_d} (r - r_d) \times D(r - r_d) + \frac{1}{1+r} l_r L_r\big(D(r - r_D)\big) \qquad (1)$$

The first part of the bank's objective function is the standard monopolistic bank objective function (see e.g. Freixas and Rochet 2008), while the second part results from cross-selling. To simplify, we omit here and in what follows the expectations operator around the part following the discounting but note that these are expected rather than definite values.[10]

The net present value of cross-selling can depend on current policy rates in potentially two ways. First, as Basten and Juelsrud (2023) showed cross-selling profits in a bank household relationship to occur on average only five years after the client has been onboarded as a depositor, cross-selling profits are discounted at a rate that can be approximated with the current policy rate r. Depending on how many years in the future cross-selling profits are expected to occur, banks may in fact want to discount at a rate with maturity longer than the overnight maturity of the policy rate, where the exact maturity may vary across banks, times, clients or products and is unobservable to us. Given an on average positive correlation between overnight and longer maturity rates, in this framework we focus on the policy rate, but ***Figure 2*** shows positive Deposit Spread Betas also when relating the deposit spread to e.g. the 5- or 10-year government bond rate.

[10] An alternative way to formulate this would be to express the customer base, part of a firm's intangible capital, as a state variable in a setup where clients have search costs so that the bank, or any firm, will invest into client acquisition to the extent to which the expected net present value of future profits warrants it, as in Gourio and Rudanko (2014).

Given findings of a possible link between policy rates and loan spreads in prior work[11], we allow also loan spreads and volumes to vary with the policy rate here, and we will examine empirically below whether and if so, how they do in our setup.

In general, when setting deposit rates and thereby deposit spreads, the bank then trades off its marginal cost of a lower deposit spread against the marginal benefit of a greater deposit volume *D(s), and* against that of cross-selling in expectation a greater loan volume *L(D(s))* later. Then assuming a constant elasticity of deposit demand, $\epsilon_D \equiv -D'(r - r_d) \times \frac{r_d}{D(r-r_d)} > 0$, the optimal r_d is defined by

$$r_d = \frac{1}{\mu}\left(r + \frac{1}{(1+r)} l(r) L'(D(r - r_d))\right) \quad (2)$$

where $\frac{1}{\mu} \equiv \frac{\epsilon_d}{\epsilon_d + 1}$ is the mark-down on deposits and hence a measure of market power within the deposit market alone, while L' reflects the link between deposit and loan volume and hence cross-selling potential within the average bank household relationship. Armed with this equation, we can then derive the bank's optimal *deposit spread beta DSB* as the marginal response of the deposit spread to a change in the policy rate as follows.

Proposition 1. *(Comparative statics on DSB). The deposit spread beta DSB is given by*

$$DSB \equiv \frac{\partial s}{\partial r} = 1 - \frac{\partial r_d}{\partial r} = 1 - \frac{1}{\mu}\left(1 - \frac{1}{1+r} L'\big(D(r - r_d)\big)\left(\frac{1}{1+r} l(r) - l'(r)\right)\right) \quad (3)$$

and is

a. *increasing in deposit market power μ, i.e. decreasing in the elasticity of deposit volumes to deposit pricing.*
b. *increasing in market power from cross-selling loans $L'(D)$.*

Proof: This follows from applying the Implicit Function Theorem to Equation (2).

A crucial assumption needed for this prediction to hold is that the decision-makers who set deposit prices optimize over a sufficiently long-time horizon. This could fail if for example the design of their variable pay or plans to leave their current employer soon induced them to

[11] Examples we are aware of are Scharfstein and Sunderam (2016), Delis, Hasan, and Mylonidis (2017), and Dubuis and Hubert de Fraisse (2024).

value current deposit profits more relative to future cross-selling profits than the bank with an infinite time horizon assumed above would. Our empirical analyses will tell whether deposit pricing is indeed consistent with optimization over longer time horizons.

Furthermore, we note that from the assumptions on $D(s)$, it follows that cross-selling affects also the sensitivity of deposit growth to policy rates, i.e. the deposit growth beta. Specifically, higher cross-selling potential implies a lower deposit growth beta. Further, to the extent that deposits finance loans, a lower Deposit Growth Beta should correspond also to a more negative Loan Growth Beta. We now turn to the empirical analysis of the paper, which is centered around testing these implications. [12]

3 Data and Summary Statistics

We describe here the main data sources and the measurement of key variables, before providing and discussing some summary statistics of the variables most relevant to our analysis.

3.1 Data Sources and Preparation

Our raw dataset builds on three different sources.

Deposit and loan accounts

The first data source is relationship-level data on all bank person pairs for the period 2004 – 2018. It covers the population of Norwegian individuals and banks, and contains information on outstanding deposit and loan balances, as well as interest paid and interest received over the course of the year. The data are annual and reported at the end of the year both by each natural person and by each bank for tax purposes. Roughly 85 % of the loans in Norway to natural persons are mortgages, while more than 99 % of the outstanding deposits covered by our data have a contractual maturity of less than a year. Importantly, these data include relationship level deposit and loan amounts, and *effective* rates and spreads.

[12] Greenwald, Schulhofer-Wohl, and Younger (2023) recently showed that in practice deposit betas may in turn be increasing in market rates. This could more strongly reduce banks' incentives to lend or weaken the increase in deposit spread betas and hence the reduction in deposit and resulting loan volumes in the Drechsler, Savov, and Schnabl (2017) lens, thus either strengthening or weakening monetary policy transmission. Given our focus on cross-selling incentives rather than deposit profits alone, we ignore this here although different estimates for different policy rate levels between 50bp and 500bp would be a possible extension of our conceptual framework.

Other household information

The second data source is a comprehensive account of individual-level information for all Norwegian taxpayers. At an annual frequency, we observe balance sheet and income statement information. We observe also various pieces of demographic information, including postcode of residence, age, education, and whether a household receives governmental child benefits.

Bank-level information

Third, we add bank-level information from the supervisory database ORBOF, which contains all major balance sheet and income statement variables for all banks operating in Norway.

Combining the data

All data sources described above have individual identifiers, both for individuals and for banks. Moreover, all individuals can be combined into unique households. We first aggregate information from individual-bank relationships to household-bank relationships. After having created some key statistics described below, we then aggregate deposit volumes (as sum), deposit spreads (as mean), market shares (as sum) and predicted cross-buying propensity, amount and spread (as averages) to the bank municipality year (BMY) level in line with our identification strategy described in more detail in Section 4 below.

3.2 Variable Definitions

Cross-selling indicators

Our baseline indicator of cross-selling potential in each single bank household relationship is the estimated propensity of a depositor to later borrow from the same bank. We estimate this as a function of key characteristics observable also to the bank and explain estimation procedure and results in more detail in Section 5 below. We choose estimated borrowing propensity as our baseline measure of cross-selling potential because of its straightforward interpretation. At the same time, for the ultimate net present value of a depositor´s cross-selling potential the bank might care not only about borrowing propensity but also about expected loan volume and spread. Therefore, we use the same household and relationship observables to estimate also expected loan volume and spread respectively.

Measures of deposit market concentration

Given the importance of market concentration measures in the existing literature on bank deposit pricing, we measure and analyze that as well. Like Drechsler, Savov, and Schnabl (2017), we start with the Herfindahl-Hirschmann Index HHI, i.e. the sum of squared deposit market shares in each relationship household's municipality. To give market concentration the best chance, we also exploit the full granularity of our data and compute even more granularly the market share of the bank of each relationship in the household's municipality, which in contrast to the HHI varies across banks also within each municipality.

Data aggregation from relationship to bank municipality level

While our first outcome of interest, deposit spreads, can be approximated with reasonable precision as policy rate minus the ratio of deposit interest earned in relationship and year over the average deposit volume in that relationship averaged across the current and the previous year (to avoid downward bias on rates in cases in which deposit volumes were brought in and earnt interest only toward the end of the year), deposit growth contains more right-tail outliers due to cases in which initial deposit volumes were very low. Therefore, we aggregate deposit spreads (as means) and volumes (as sums) for subsequent computations of deposit growth from the level of individual bank household relationships to that of bank municipality cells. This is in line with the fact that we consider municipalities the relevant geographic market delineation, i.e. we deem a household able to open with sufficient ease a deposit or loan relationship with any bank that already has at least one other household client in that municipality. In many cases, the presence of at least one existing client coexists with the presence of at least one branch, although in a few cases clients started their relationships in another municipality and maintained their relationship, often using online banking, when moving municipalities.

3.3 Summary Statistics

We present summary statistics in ***Table 1,*** starting in Panel A with close to 45 million observations on individual bank household relationships observed for up to 15 years, before displaying in Panel B observations at our baseline level of bank municipality combinations. Then Panels C1-C3 show the summary statistics for our loan growth regressions at the level of respectively bank by municipality, bank by NACE3 sector, and bank by NACE5 sector, before Panel D concludes with the highest aggregation to the bank level as used for descriptive connections between bank level deposit spread betas and cross-selling potential proxies.

To start with, Panels A and B both show that the setup studied was characterized by policy rate levels of between 0.5 and 5.32 percentage points (pp) and year-on-year (yoy) changes of between -3.57 and 1.64pp. In that environment, banks managed to earn deposit spreads of on average 0.46pp (relationship level) to 0.48pp (bank municipality, BM, level), while the average yoy change therein was 0.08 at both aggregation levels. Mean deposit volumes were about NOK 135,000 (about USD 13,500) at the relationship and about NOK 22 million at the bank municipality level, growing on average at -27% (with winsorization at P95) at the rather noisy relationship level and at on average -0.35% at the bank municipality level. Concluding Panels A and B, borrowing propensity averaged 18pp at the relationship and 14pp at the BM level, HHI averaged respectively 29 and 38pp, and market shares averaged respectively 21 and 1.6pp.

Panels C1-C3 show that in the samples used for loan growth analyses loan growth averaged about -4pp at the bank municipality level, depending on the computation method between -2.6 and -3.1pp at the bank NACE3 sector level, and between -5.3 and -6.5pp at the bank NACE5 sector level. The HHI at those levels averages again about 0.3, while borrowing propensity averages 0.2 in all three cases.

To conclude, Panel D shows that at the bank level Deposit Spread Betas range between -17.23 and 8.53 with a median of 0.42, predicted borrowing propensity ranges between -0.02 and 0.29 with a median of 0.15, and HHI ranges between 0.18 and 0.60 with a median of 0.26.

4 Empirical Strategy

4.1 Analyzing deposit pricing and growth

The focus of our empirical analysis of deposit pricing and growth is to explore the role of cross-selling potential, and we contrast that with the impact of more traditional measures of bank market power. A key empirical challenge is to hold fixed a bank's refinancing needs due to variations in loan demand[13]. Those are likely correlated with policy rate changes. For instance, an increase in the policy rate could be the central bank's response to high price and loan growth, or alternatively, if monetary policy transmits sufficiently fast, reduce loan demand and so

[13] Drechsler, Savov, and Schnabl (2017) speak of "lending opportunities". We refer to the same omitted variable but denote it "loan demand" or "refinancing needs" to reflect our understanding that the variation of interest results from variations in loan demand rather than from variations in banks´ loan supply.

refinancing needs. Either could in turn affect deposit pricing. To the extent that changes in loan demand are not randomly allocated across banks, they could confound our estimates.

This empirical challenge is not new and has in the literature been addressed by Drechsler, Savov, and Schnabl (2017) by comparing the deposit pricing of US bank branches within the same bank and year, exploiting that deposit prices may vary across branches while deposits raised are then pooled at the bank level to refinance lending. More recently, Begenau and Stafford (2022) have criticized this strategy for the reason that many US banks do not set branch-specific deposit prices, thus possibly limiting the external validity of the Drechsler, Savov, and Schnabl (2017) strategy to banks with branch-specific deposit pricing. As an alternative, Narayanan, Ratnadiwakara and Strahan (2025) have recently regressed bank level deposit franchise values on bank level average demographics, then predicted branch level franchise values given branch level characteristics, and then compared how branch closures and openings vary with these predicted branch level franchise values within each bank and year. We concur with them that effective deposit spreads and franchise values may vary beyond offered ones and often vary with demographics.

In particular, our strategy exploits instead three major advantages of our data and setup: First, we observe deposit prices not just by branch or bank but for every single bank household relationship, together with household observables that allow us to reliably estimate that household´s propensity to later also borrow from that bank. That allows us to compare deposit pricing at a granularity even below the branch level, while controlling for any refinancing needs through bank*year fixed effects.[14] Second, as we observe not only offered but effective deposit rates for each relationship we can exploit the finding of Basten and Juelsrud (2023) that these do indeed vary across individual households served by the same bank in the same year. This is partly because banks offer different rates on accounts with different demographic eligibility criteria and partly because different households use and switch between different deposit products available to them within the same bank. Importantly, when a Deposit Spread Beta is higher because clients are less willing to switch products rather than because the bank chooses a lower pass-through from policy to deposit rate changes within each product, it still reflects less deposit market power for the bank. Third, pooling of deposit funding at the bank level does indeed seem very plausible in our setup. To start with, we note that there are no geographical

[14] By contrast, municipality*year fixed effects would be collinear with the HHI measure, against which we horse race our cross-selling measures, as HHI does not vary within each municipality.

restrictions on internal capital markets in banks. In addition, it is useful to check how geographically diversified the average bank in our sample is. After all, a bank active in only 1 or 2 municipalities would arguably have very limited potential to redistribute deposits raised in one municipality to finance lending in another. To check this, we start by examining the number of municipalities across which the business of each of the banks in our sample is spread out. While this number does range all the way from 1 to 439, the 5th percentile is already 42, the mean 329 and the median 340 municipalities.

While the raw data at the level of individual bank household relationships, as used in Basten and Juelsrud (2023), would give us most statistical power, deposit growth rates there can be misleading in that cases of near-zero initial deposit volumes result in some very high growth rates also when the Norwegian Kroner (NOK) value of deposit growth is of limited significance for the bank's lending potential. Therefore, we aggregate observations from the bank household to the bank municipality level, using average deposit rates and spreads, and total deposit volumes before computing year-on-year growth rates. The resulting regression equation is this:

$$Y_{b,m,y} = \alpha + \beta_1 \Delta PR_y PrB_{b,m,y} + \beta_2 \Delta PR_y HHI_m + \cdots + \delta_{b,y} + \varepsilon_{b,m,y} \qquad (4)$$

where the subscript *b* indexes the bank, *m* the household´s municipality, and *y* the year. Our key outcomes of interest are deposit spread changes and deposit growth. Policy rate changes are denoted ΔPR and are computed year-on-year to match the annual frequency of our deposit and loan rate and volume data. For our baseline regressions, we estimate the borrowing propensity of each household with each bank. For variations, we proxy cross-selling potential not just with the expected borrowing propensity, but also with expected loan amount or expected loan income. We then compute the averages of these proxies across all clients by bank and municipality. In some specifications we horse race cross-selling potential with the *HHI* in municipality *m*, in alternative ones with the Market Share *MS* of bank *b* in municipality *m*. The dots in the equation indicate inclusion of the non-interacted cross-selling metrics, HHI or MS. The bank*year fixed effects $\delta_{b,y}$ control for refinancing needs pooled at the bank level. The resulting comparison across municipalities but within each bank and year accounts also for the fact that on average different banks may select into different types of municipalities, as in the observation by d'Avernas et al. (2023) that in the US larger banks are often present in more urban areas where they sell deposits at higher prices but with greater liquidity services.

4.2 Analyzing implications for loan supply

We argued above that effective deposit pricing, and consequently deposit growth, may vary across relationships or municipalities within the same bank year, whereas refinancing is then pooled at the bank level. When analyzing the effects of deposit market concentration or cross-selling potential on deposit pricing and growth, that allowed us to control for loan demand using bank*year fixed effects. But when the outcome of interest are variations in loan growth resulting from variations in loan supply, bank*year fixed effects may not work, as the outcome of interest, loan growth, varies at the same level as potential bias from loan demand.

In fact, estimates of the causal effect of the two types of deposit market power on the elasticity of loan growth to policy rate changes may be biased by at least two sources. One is reverse causality whereby the policy rate change triggers changes in loan demand, these trigger changes in effective loan growth, and these motivate banks to change their deposit pricing to raise the deposits necessary to refinance that loan growth. The other is omitted variable bias resulting from changes to assets other than loans or to liabilities other than deposits. One example for such a bias are reductions in banks' central bank reserves, e.g. when policy rate increases are accompanied by quantitative tightening: On the one hand this means ceteris paribus a reduction in total assets and liabilities and hence also one in deposits, on the other hand banks may then replace some of these reserves with loans implying higher loan growth.

One way to address such potential biases successfully, already proposed by Drechsler, Savov, and Schnabl (2017), is to aggregate the driver of deposit pricing and growth of interest, in their case deposit market concentration and in our case additionally cross-selling potential, from the branch or bank municipality level to the bank level, and then compare loan growth across different banks but within the same municipality and year, so as to keep as much as possible loan demand fixed.

We follow Drechsler, Savov, and Schnabl (2017) in using as outcome of interest loans to non-financial corporations (NFCs), including in our case not only loans to small and medium-sized enterprises (SMEs) but to all non-financial corporations (NFCs) to make the outcome sufficiently representative. This focus on corporate as opposed to household loans makes sense for our purposes not only in that corporate loans may be deemed more important for monetary policy transmission than household loans (most of which are mortgages in the setup studied) but also to focus on a loan segment that is entirely separate from the household loans that (albeit with several years delay after deposit onboarding) are part of the cross-selling we study.

For this analysis, we start from 178 banks that offer both household deposits and corporate loans, and are active in up to 491 municipalities, with the average municipality featuring about 37 banks with at least one client there. On this sample we estimate the following:

$$Y_{b,m,y} = \alpha + \beta_1 \Delta PR_y PrB_{\boldsymbol{b}} + \beta_2 \Delta PR_y HHI_m + \cdots + \delta_{\boldsymbol{m,y}} + \varepsilon_{b,m,y} \qquad (5)$$

where the outcome of interest, loan growth or the volume of new loans by bank * municipality * year, is regressed on interactions of the policy rate change with bank level averages of both cross-selling potential and HHI, as well as the main terms, while controlling now for municipality*year fixed effects to capture current corporate loan demand.

As a robustness check on this bank municipality level analysis, we repeat our analyses at the bank sector level, allowing us to control for loan demand by way of sector*year instead of municipality*year fixed effects. For the results displayed and discussed below, we use the first 3 digits of each firm's NACE classification[15], resulting in 400 different sectors and on average 131 banks active in each sector.[16]

5 Results

In the following, we start in ***Subsection 5.1*** by relating estimates of a time-invariant deposit spread beta for each bank to that bank's average cross-selling potential and deposit market concentration. Thereafter, ***Subsection 5.2*** starts our quest for causal identification by estimating the propensity of each single bank household deposit relationship to turn into a borrower relationship, as well as the expected loan volume and spread, thus generating our different measures of cross-selling potential. In ***Subsection 5.3*** we then present our core estimates on how Deposit Spread Beta and Deposit Growth Beta differ within each bank and year across municipalities in which, given a different mix of household types, the bank has different average cross-selling potential. ***Subsection 5.4*** then discusses analyses on the implications of different deposit pricing and growth for loan growth. Thereafter, ***Subsection 5.5*** explores whether policy rate changes are associated not only with different discounting of

[15] So we use the section, division and group, but not the class and subclass levels of https://www.ssb.no/en/klass/klassifikasjoner/6/om

[16] A variation in which we use all 5 digits of the NACE classification yields 1270 different sectors and hence fewer banks per sector and year but yields qualitatively the same regression results.

future cross-selling profits but affect also the flow profits thereof via changes in loan propensity or spreads. Next, ***Subsection 5.6*** presents a wide range of robustness checks, before ***Subsection 5.7*** concludes with evidence on the external validity of our findings beyond Norway.

5.1 Visualizing the Link between Betas and Market Power Measures

For some first descriptive analyses, we first estimate a separate Deposit Spread Beta for each bank. Their histogram in ***Figure 3*** reflects first the positive relationship for the average bank that we saw already in the system-wide ***Figure 2,*** i.e. on average banks tend to earn higher deposit spreads the higher the policy rate. At the same time however, it shows also that the bank-specific Deposit Spread Beta varies widely across the 217 banks studied, raising the question of why this is so, and whether it is correlated with other bank characteristics.

To explore this, ***Figure 4*** bin scatters these bank*municipality level Deposit Spread Betas against the estimated propensity of the average household depositor to also borrow from the same bank at some point. This is our core measure of cross-selling potential, the estimation of which we explain in more detail in the next subsection. For a first baseline estimate, the upper panel uses Deposit Spread Betas estimated across all available sample years 2004-18. As displayed also in regression format in ***Appendix Table 1***, we find each unit increase in the bank-level borrowing propensity PrB associated with a 0.25 unit increase in the Deposit Spread Beta, or more specifically an increase in the PrB by 1 SD or 0.05 units associated with a 0.05*0.25 or about 1bp higher. Following that, the bottom panel of the figure as well as columns 4-6 of ***Appendix Table 1*** show the relationship to be a bit over four times as strong for those 11 out of 15 years in which the policy rate was at or above 1.5pp, a threshold below which ***Figure 1*** showed banks to have on average negative deposit spreads.

Following this first descriptive evidence, we next want to analyze more formally in single-step regressions how the Deposit Spread Beta varies with cross-selling potential. To use the maximum amount of data and to be conservative, our baseline analyses use all years. But following the visual evidence that the relationship may have been weaker in the 4 of 15 years with very low policy rates we shall below also conduct one variation where we drop those.

5.2 Propensity of each depositor to convert into a borrower

On these grounds, we next start our quest for causal identification by displaying in ***Table 2*** the estimation of the propensity that the same household will ever be observed to also take a loan from that same bank (column 1), as well as the expected loan volume (column 2), and loan spread (column 3). Overall, we observe close to 3.7 million households and, over all years, up to 217 banks. The average household has 3.6 bank relationships, resulting in a bit over 18 million bank household relationships. As the average such relationship is observed for a bit over 5 of our 15 years, this yields about 90 million observations, thereof about 1.3 mio. relationship years for which we observe also loan spreads.

Using these, we find that initial household head age below 30 is associated with a 1.3pp higher propensity of the deposit relationship to turn also into a loan relationship within the sample years we observe, and to increase expected loan volumes by 31.4%. Parenthood makes borrowing 4.5pp less likely, but due to significantly higher loan volumes conditional on borrowing it is nonetheless associated with 44.5% higher expected loan volumes. At the same time, both youthfulness and parenthood are associated with lower loan spreads, which if considered could potentially moderate a client's attractiveness to the bank. Therefore, we shall complement our baseline measure of cross-selling potential, the mere borrowing propensity, also with alternative measures that consider also expected loan volumes and spreads.

Beyond demographics like age and parenthood, as well as household financial variables including income, wealth and deposits, we find a significant role also for relationship characteristics: Each additional bank the household is already using is associated with a 1.5pp lower propensity to borrow from the observed relationship bank, while a more concentrated market and hence fewer other banks present in that municipality, comes with a higher loan propensity.

We use as our measures of cross-selling potential these three estimated metrics. We would get estimates in the same direction but with significant downward bias when using, without any regression estimation, the fraction of households who definitely borrow already within our sample period. We prefer the estimated borrowing propensity as it allows us to better capture also borrowing that can be expected given a household´s demographics but happens only after the end of our sample.

5.3 Core analyses

Now the up to 217 banks have clients in up to 490 municipalities. As many banks operate only in a limited subset thereof, in practice that yields about 71,000 bank municipality pairs and over the up to 15 years about 360,000 observations, i.e. the average bank municipality pair exists in our sample for a bit over 5 years, reflecting that some relationships disappear again not only when an account with a bank is closed but also for example when the household composition changes.

The key finding of interest, displayed in ***Table 3,*** columns 2-4, line 1, is that when the average deposit relationship in that bank and municipality is expected to turn into a loan relationship at some point the Deposit Spread Beta is between 10 and 16pp higher, controlling for bank refinancing needs and in columns 3 and 4 also for the effects of deposit market concentration and deposit market share respectively. In line with Drechsler, Savov, and Schnabl (2017), we find an economically and statistically significant effect also for HHI, though not for the more granular metric of a bank's own market share. Controlling for potential effects of deposit market concentration does reduce the coefficient on cross-selling by about a third, reflecting that both types of market power matter.

That raises the question which type of market power, deposit market concentration or cross-selling potential, has the larger effect in the setup we study. For that it makes sense to look at the effect of a 1 standard deviation (SD) change in each, displayed for all three measures of market power in the three lines at the bottom of the table. The estimates imply that a 1SD higher borrowing propensity PrB is associated with a 0.6 to 0.9bp higher Deposit Spread Beta, similar to the 0.7bp effect found for HHI, whereas no significant effect is found for a bank's own deposit market share. Interestingly this seems similar to the effect obtained for a 1SD increase in HHI in the US setup studied by Drechsler, Savov, and Schnabl (2017), which they report to lie at 0.09*0.96pp at the branch and similarly high at the bank level.

Next, ***Table 4*** shows the results from measuring cross-selling potential not only with how likely a deposit relationship is to turn into a loan relationship, but also with the expected loan volume (columns 1-4) or with expected loan income (columns 5-8). We find the effects of a 1SD change in these measures, again reported at the bottom of the table to be very similar in columns 1-4, ranging between 0.5 and 0.8bp, but about 50% higher with a range of between 1.4 and 1.6bp in columns 5-8. While here as with the many robustness checks discussed below, our results turn out even stronger than in our baseline, which we on purpose chose to be conservative, more interesting is the very finding that banks do seem to consider also expected loan spreads, rather than simplifying by looking at expected borrowing propensity only.

Next ***Table 5*** shows the effects on deposit growth, conventionally computed as log difference. In columns 1-4 we use the raw growth rates, while in 5-8 we winsorize them at 10%. In the raw data, we find a 1SD higher borrowing propensity associated with a 3.6 to 5.1pp lower Deposit Growth Beta, whereas a 1SD higher HHI is if anything associated with a less negative Deposit Growth Beta and a 1SD higher deposit market share of the bank in question is associated with a Deposit Growth Beta that is lower but not statistically significantly so. We note that the effects of interest fall to between 1.9 and 2.9pp when we winsorize growth rates at 10%, and to levels in between when we winsorize at e.g. 1 or 5%, but sign and significance are robust to any reasonable winsorization (or trimming).

5.4 Implications for Loan Growth

We showed above that greater cross-selling potential can motivate banks to choose a higher Deposit Spread Beta and a more negative Deposit Growth Beta, thus amplifying the extent to which policy rate increases lead banks to raise deposit prices and depositors respond to those by reducing their deposit growth. At the same time, the relatively low cost and relatively lower sensitivity to interest rate or liquidity risk make deposits many banks' preferred liability and so the loss of deposits accepted with this deposit pricing may not be fully replaced with other liabilities, reducing instead banks´ loan supply.

As discussed in Section 4.2 above, the challenge when testing this is that the loan growth we observe depends on both loan supply and loan demand, loan demand may also change with monetary policy, and for the outcome loan growth we cannot just control loan demand away by way of bank*year fixed effects as the variation of interest now is at the same level. So instead, we now compare the loan growth response to monetary policy changes of banks with different bank level cross-selling potential and deposit market concentration, but within the same municipality and year, or for a variation sector and year, to control for loan demand.

Table 6 thus shows in column 1 that in a bank municipality cell where the bank has perfect cross-selling potential a 100bp policy rate hike is predicted to lower log difference computed firm loan growth by 66pp, so a 1SD change in cross-selling potential or about 0.03 lowers loan growth by 0.03*66=1.98pp for each 100bp rate hike, or by about 0.5pp for each 25bp rate hike. Compared to that, column 2 shows each 1SD change in the bank level HHI, or 0.08 units, to lower loan growth by about 0.08*14 = 1.12pp for each 100bp rate hike or by about 0.28pp for each 25bp rate hike. Overall, this suggests that both types of market power have comparable effects on the response of loan growth to monetary policy, although column 3 suggests that in the setup studied the effect of cross-selling potential is robust and in fact becomes even larger when placing both types of market power in the regression together, while that of market concentration becomes insignificant (and switches sign). These effects are qualitatively confirmed albeit slightly smaller when, in columns 4-6, we compute the outcome loan growth as symmetric growth rather than with the log difference formula. Finally, in columns 7-9 we follow Drechsler, Savov, and Schnabl (2017) in focusing exclusively on the volume of new loans, which we define as loan volumes that in this bank municipality cell are non-zero in the current year but were zero in the previous year. Here we find each 1 SD increase in cross-selling potential to lower the volume of new lending by 0.03*100*2.75 or 8.25%, an effect which in sign and size again survives the "horse race" with market concentration, although this loses its statistical significance when clustering standard errors by municipality and year.

To further explore the robustness of these findings, ***Table 7*** computes corporate loan growth not by bank and municipality but instead by bank and industry sector. Here as well, the bank level measure of cross-selling potential has a SD of 0.03 and so each 1 SD change is predicted to lower loan growth by 0.03*27 = 0.81pp. By comparison, each 1 SD (0.09 unit) change in HHI is predicted to lower it by 0.09*1.54 or 0.14pp, although that HHI effect is not statistically significant and even switches sign in a "horse race". Results are qualitatively similar also when in ***Appendix Table 2*** we use NACE 5 instead of NACE 3 sector definitions. Overall this confirms the findings from ***Table 3*** whereby in our setup cross-selling potential matters at least as much as HHI.

Also interesting is the fact that the effect of a 1SD higher borrowing propensity on loan growth of between 0.81-1.12pp is at most half as large as those on deposit growth (1.9 – 3.6pp). Given that deposits are at the baseline the largest source of loan refinancing, this reflects that while on the one hand banks do not want to fully replace lost deposits with other funding such as interbank borrowing or bond issuance, they do replace some of it.

5.5 Flow Profits by Policy Rate Change

When introducing our conceptual framework, we discussed that changes in policy rates may change not only the discount factor on future cross-selling profits, but also the flow profits from future cross-selling by changing loan volumes or spreads or both. In ***Table 8*** we test empirically whether this is the case. To control for credit risk of every single loan, we now use not bank municipality but relationship level data. While the upper panel weights each relationship equally, the bottom one weights each relationship by the mean deposit volume of that relationship across all years in which the relationship is observed. As the weighting turns out to affect results only marginally, we focus this discussion on the unweighted results. In both panels, columns 1-3 present baseline results, columns 4-6 add bank fixed effects, while columns 7-9 control for credit risk as discussed below. We start in columns 1, 4 and 7 with about 18 million bank household year observations in which there are deposits. This falls to about 12 million when in columns 2, 5 and 8 we restrict attention to relationships that at some point but not necessarily already in the year observed include a loan, and falls to about 4.5mio when focusing on observations with a loan already now. In our baseline estimates displayed here, we use as key explanatory variable of interest the policy rate change DPR, in line with our core estimates discussed above and to be more conservative. But we note that using instead rate levels yields qualitatively similar estimates, with one exception discussed below.

That said, we start our discussion with the baseline estimates in columns 1-3 of the upper panel. To start with, we find a policy rate increase by 100bp to reduce the propensity that a deposit relationship started in that year will also turn into a loan relationship later by 1.1pp. That alone would seem to directionally reduce the flow profits, so reduce cross-selling potential and so incentivize higher rather than lower deposit spreads. But we note that that effect has the opposite sign when we use as explanatory variable the policy rate level (available on request) or when we control for credit risk (column 7). More importantly, either effect seems economically small compared to e.g. a mean of 18pp and a SD of 7pp of the borrowing propensity (cf. ***Table 1***). At the same time, while for completeness we start with the borrowing propensity, ultimately important for expected flow profits are expected volumes. There we find each 100bp policy rate increase to reduce the expected loan volume by between 2.7pp and 12.2pp, which we deem economically significant. In the same vein, we find each 100bp policy rate hike associated with a 31bp lower loan spread. That effect seems the most economically important to us and is also very evident visually in ***Figure 5***.

But we need to ask whether lower loan spreads associated with higher policy rate levels or changes mean truly lower flow profits for banks, or might reflect also less credit risk, in which case the impact of policy rates on *risk-adjusted* flow profits would be smaller than that on non-risk-adjusted ones. To test this, we generate an indicator that takes the value one whenever a relationship contains a non-zero loan volume and when yet zero loan interest is being paid. We note here that this need not imply default in the sense of failure to repay the principal, but we see it as a proxy for the loan being a non-performing loan (NPL) in the sense of due interest payments being at least 90 days delayed. As very small loan amounts could also be lent as interest-free loans, we compute also a variant in which we require the loan volume to exceed the 75th percentile and generate an indicator for whether a loan ever becomes non-performing by that metric. Finally, as we see interest not by month but only by year, the measure would seem to be somewhat noisy, so in ***Appendix Table 3*** we regress the loan spread on both indicators. The exact risk premium varies across the measures and depending on whether we do not (columns 1 and 3) or do (columns 2 and 4) use bank fixed effects, it ranges between 22 and 48bp. But across all estimates, the credit risk proxies of interest are associated with a risk premium that is statistically and economically significant, suggesting that our proxies do succeed at picking up credit risk. And yet, when in the 3 right-most columns of ***Table 8*** we control for these proxies, the estimates of interest change only little. At the same time, we note that since almost all loans of interest are adjustable rate (cf. Basten and Juelsrud, 2023), policy rate changes would not seem to change loan spreads due to changes in interest rate risk either.

What can we conclude from this? It seems robustly the case that if anything policy rate hikes are associated not only with a higher discount factor on future cross-selling flow profits but also with lower flow profits themselves. At the same time, we have to acknowledge that despite being able to control for credit risk fairly well with the hindsight (in contrast to banks at client onboarding) of which relationships will later include non-performing loans, and despite being able to rule out changes in interest rate risk as a major driver, we cannot entirely rule out that the monetary policy changes studied might also have changed some component of loans' riskiness. And if credit risk differences remain uncontrolled for, then the point estimates presented here would seem to overstate the effect of policy rates on (risk-adjusted) flow profits. We therefore choose to focus on the overall effect of cross-selling potential on the deposit spread beta but acknowledge that likely a part thereof operates through the *flow profit sub-channel* and not all of it through the *discounting sub-channel*.

5.6 Robustness checks

While we have discussed ***Appendix Table 1*** on bank level Deposit Spread Betas, ***Appendix Table 2*** on loan growth at the NACE5 sector level and ***Appendix Table 3*** on the validity of our NPL measures, and already above, here we discuss also ***AT 4-6*** with variations on our core analysis from ***Table 3*** above. ***Figure 1*** showed negative average deposit spreads for periods with policy rate levels below about 1.5pp, at least when computed against policy and hence short-term rates. And our initial exploratory analyses in ***Figure 4*** had suggested a stronger link between cross-selling potential (CSP) and the Deposit Spread Beta in "normal" periods than in periods with policy rates below 1.5pp. So, we now examine this more formally in ***Appendix Table 4***, and find a 1SD higher PrB associated with a 0.7 - 1.0bp higher Deposit Spread Beta. Compared to our baseline estimates of 0.6 – 0.9bp in ***Table 3*** this is indeed larger, but only marginally so, validating our choice to use for most of our estimations all years available.

Following that, ***Appendix Table 5*** uses instead of yoy changes in respectively policy rates and deposit spreads their levels and finds the effects of interest to grow to 1.4 - 1.5bp, a bit over 50% larger than the baseline estimates. At the same time, once we use levels instead of changes the effect of HHI becomes insignificant while that of MS even turns significantly negative. We see this as confirmation that our choice of first-differencing both right- and left-hand side time-variant variables is rather conservative, cutting the effect size of interest by at least one third.

Finally, ***Appendix Table 6*** shows the results from using weighted regressions so that each bank municipality year observation is weighted by its share in the total deposit volume of that bank in that year. The rationale for using this method is to recognize that pricing and resulting volume choices in a bank's larger local markets contribute more to the bank's total refinancing available, hence its lending, and hence the transmission of monetary policy to loan growth. A priori, it is not clear whether in the wake of policy rate hikes banks would increase deposit spreads more in their major or in their minor markets. On the one hand, they may have higher market shares and more market power in their major markets. On the other hand, for a given client elasticity raising prices there costs more deposits. That said, our results show that a 1SD higher PrB is associated with a 2.5bp higher Deposit Spread Beta without and even a 5.7bp higher Deposit Spread Beta with controls for potential effects of HHI, so estimates become between a good 2.5 and almost 6 times as large, consistent with banks indeed having and using more market power in their major markets. We find this very interesting in its own right, as well as to confirm the conservative character of our baseline estimates.

5.7 External validity

A natural question is to what extent these findings apply also to other countries. One limitation in answering this is that few if any countries outside Scandinavia provide comparably detailed data on every single bank household deposit and loan relationship. So overall, attempts to find other suitable data to test this as explicitly as possible in other major economies are still in an early stage and warrant further research.

However, for the euro area, hosting about 350 million inhabitants, we can use data based on a compulsory survey the Single Supervisory Mechanism (SSM) regularly conducts with the euro area´s 120 most significant banks, which comprise most of the market, as part of the pillar 2 profitability assessment within its Supervisory Review and Evaluation Process (SREP)[17]. The survey explicitly asks whether cross-selling considerations matter for deposit and loan pricing.[18] In ***Figure 6*** we compute interquartile ranges and medians for deposit rates and loan spreads for non-financial corporation (NFC) and household (HH) clients, in each case separately for banks that deemed cross-selling to matter vs. banks that did not.[19] The graph shows that, for both types of client, banks that report to consider cross-selling did both pay higher deposit rates, or equivalently offer lower and hence for clients more attractive deposit spreads, and charge higher loan spreads. This is consistent with loss-leader pricing also in the euro area. Related evidence suggests that also in the euro area a key reason why banks can charge higher loan spreads to existing clients is clients' hesitance to switch banks.[20] At the same time, that hesitance makes cross-selling relevant without the need for banks to explicitly bundle products, which regulators can make illegal.[21]

As we could use responses to the SREP question on cross-selling only for 2023, and as furthermore earlier years contained more limited variation in policy rates than our Norwegian

[17] https://www.bankingsupervision.europa.eu/activities/srep/html/index.en.html

[18] Specifically, banks were asked: "Is the pricing of this product affected by cross-selling considerations (deposits/funding)?"

[19] We combine the survey answers "partly" (rare) and "fully" to make the answer binary. Banks are split into two groups based on their answer to the question whether the pricing of new loans was affected by cross-selling considerations. Loan spreads are weighted averages across floating and fixed rate portfolios, using new business volumes as weights. Loan spreads are reported by banks as the average yield on the respective loan category less the respective funding costs, which should reflect the maturity. Deposit rates are computed based on net interest income flows and outstanding amounts. If a bank reported no impact of cross selling on floating (fixed rate) loans, but an impact for the other, all lending is considered impacted.

[20] For example, on p.193 of its evaluation of the Mortgage Credit Directive, the European Commission found 68% of consumers to report purchasing their mortgage from their main bank.

[21] E.g. the Dutch competition authority ACM recommended in May 2024 to "prohibit tying of checking and savings products", but they can prohibit only explicit bundling or tying, not client preferences against switching banks. Further, while both the EU's Mortgage Credit Directive and its Consumer Credit Directive include bans on explicit tying, an evaluation of the European Consumer Organization (page 14) finds still ample loopholes.

sample does, these data do unfortunately not allow to test whether in addition to cross-sectionally lower deposit spreads euro area banks with cross-selling considerations choose also higher deposit spread betas as hypothesized and confirmed with Norwegian data in this paper. But the fact that in the euro area we see both an influence of cross-selling considerations on deposit pricing in general, and a positive deposit spread beta makes it at least very plausible that we would have obtained similar findings for at least parts of the euro area. But further research on cross-selling in other economies remains valuable.

How does this square with the US setup studied by Drechsler, Savov, and Schnabl (2017)? While we lack evidence on the relevance of cross-selling specifically in the US, cross-selling may matter there as well. At the same time, we stress that we do not see it as alternative to market power. Instead, we highlight that the concept of market power is more multi-faceted than deposit market concentration alone, thus complementing the earlier findings on how optimization of deposit or cross-selling profits affects bank lending via deposit volumes.

6 Conclusion

In this paper, we have shown how the potential for banks to cross-sell mortgages to their retail depositors later strengthens the pass-through of monetary policy to deposit spreads (evidenced by a weaker pass-through to deposit rates) and therewith to deposit and loan growth. The estimates are quantitatively significant. This means that considering how banks price deposits today in reference to the expected sale, within the same relationship, of other products tomorrow, provides a novel way through which monetary policy is transmitted through banks.

This new channel complements the already established Deposits Channel by emphasizing that banks' market power manifests itself not only in higher deposit market concentration or a lower price elasticity of deposit growth, but also in clients' bank stickiness across products and across periods. With this recognition, we can explain not only the pass-through of monetary policy to deposit pricing and growth, but also the negative deposit spreads observed in many currency areas in periods of low (and not just negative) policy rates. We also demonstrate an explicit link between a bank's deposit and loan franchise.

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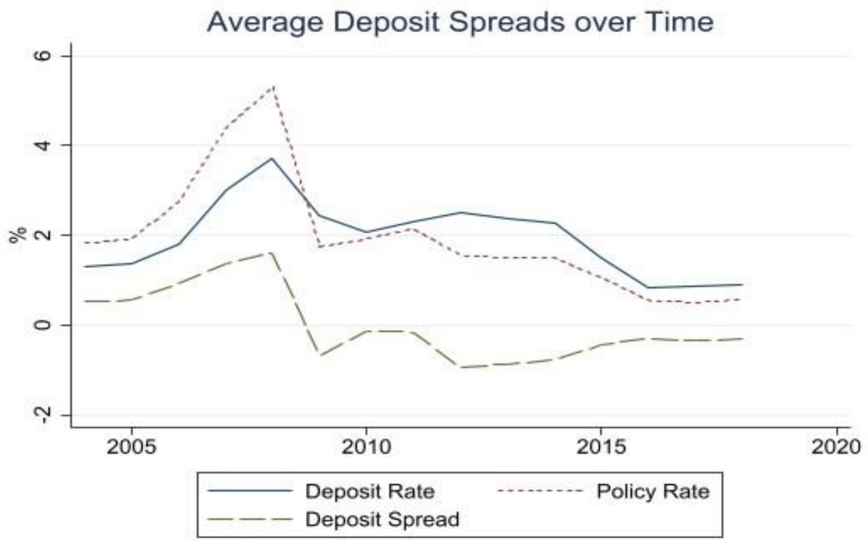
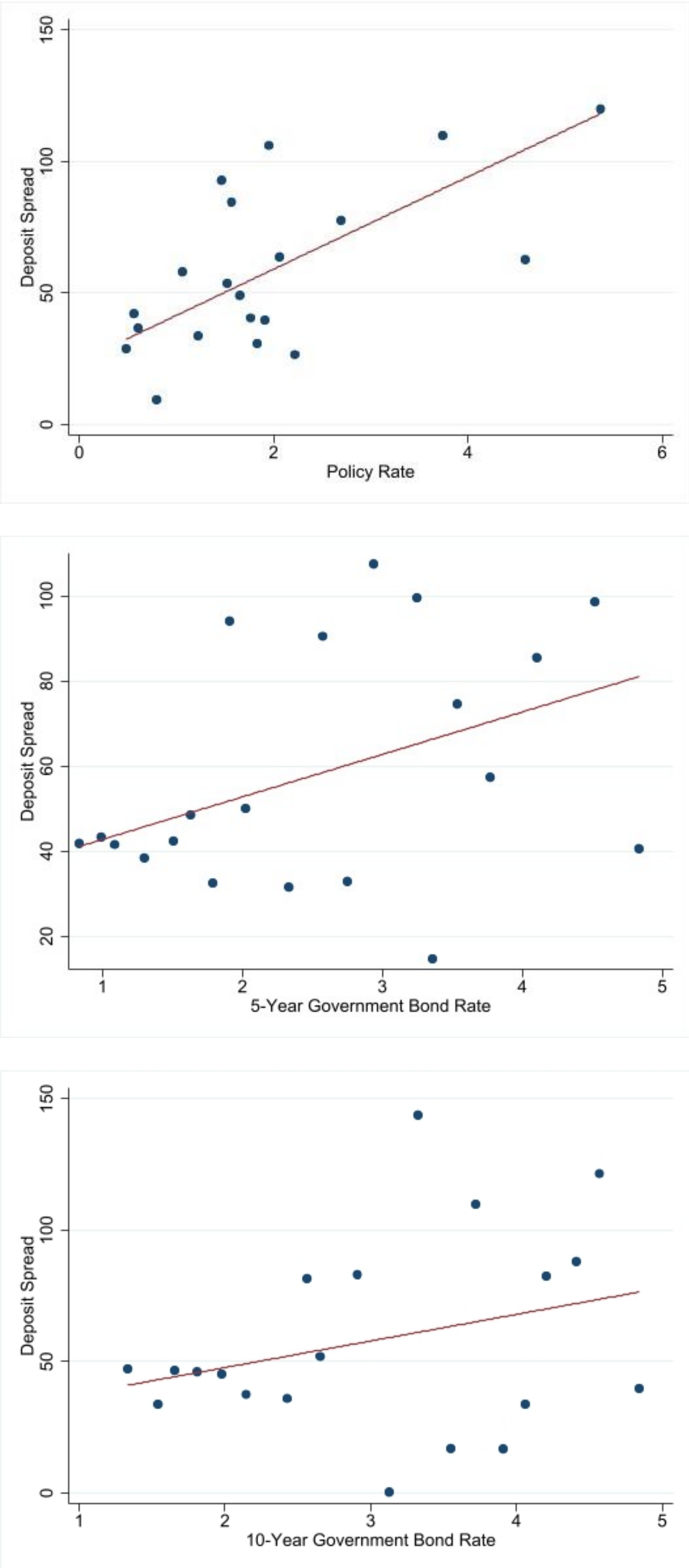
Figures

Figure 1: Average Deposit Spreads in Norway over time



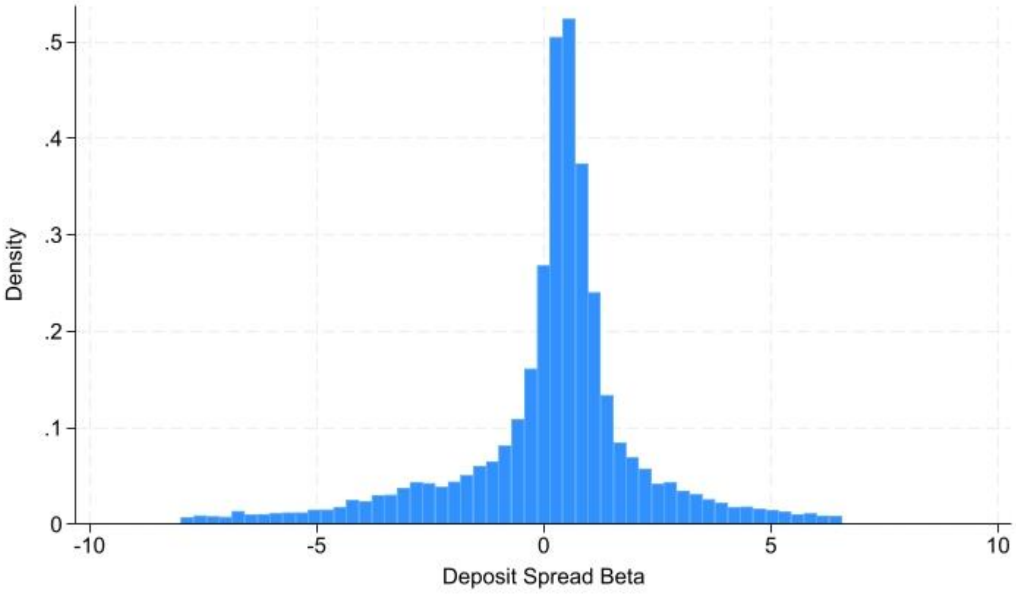
This figure plots [Norwegian policy rates](), average deposit rates taken from [Finansportalen](), and their difference by year.

Figure 2: Deposit Spread, Policy Rate, and 5- and 10-year Government Bond Rates



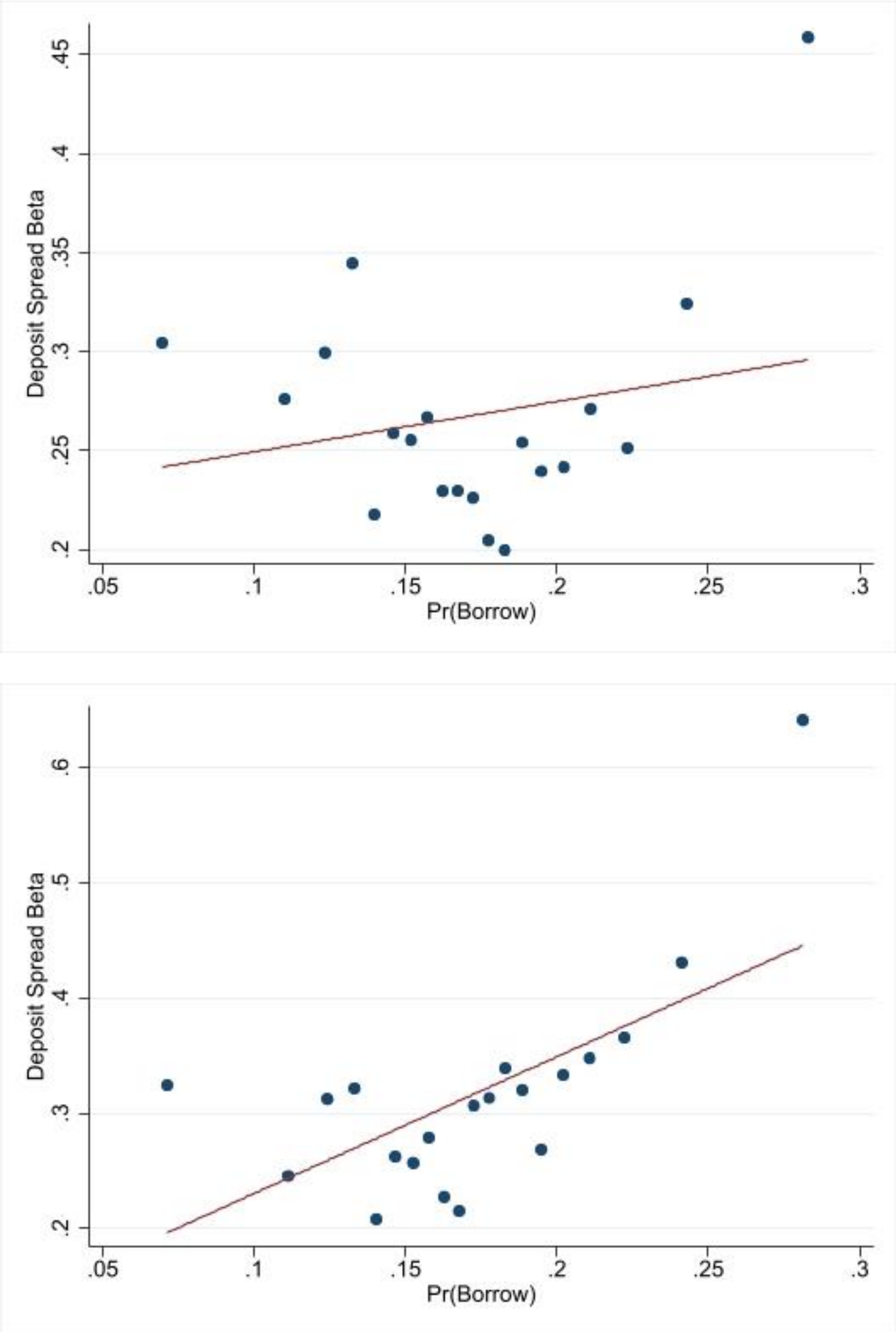
Panel A plots the spread between policy rate and effective deposit rate (deposit interest received in that year over the average deposit volume in that and the prior year) against the policy rate. Panel B plots it against the 5- and Panel C against the 10-year government bond rate.

Figure 3: Distribution of Deposit Spread Betas Across Banks



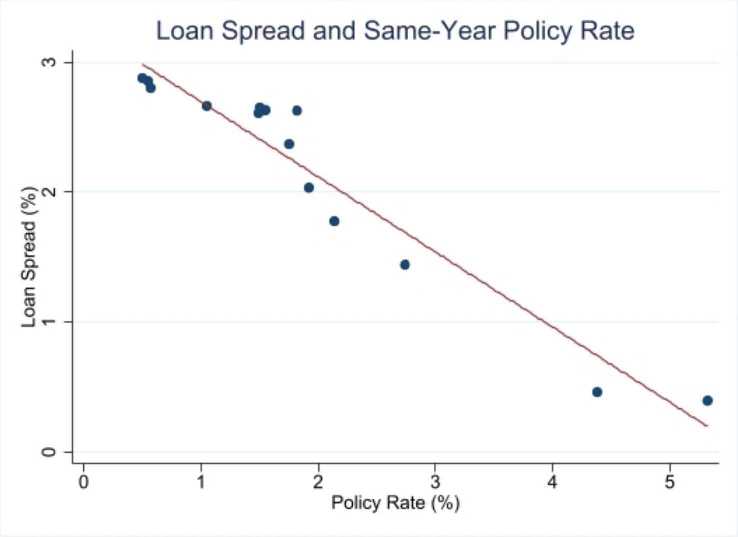
This figure plots the distribution of deposit spread betas across Norwegian banks.

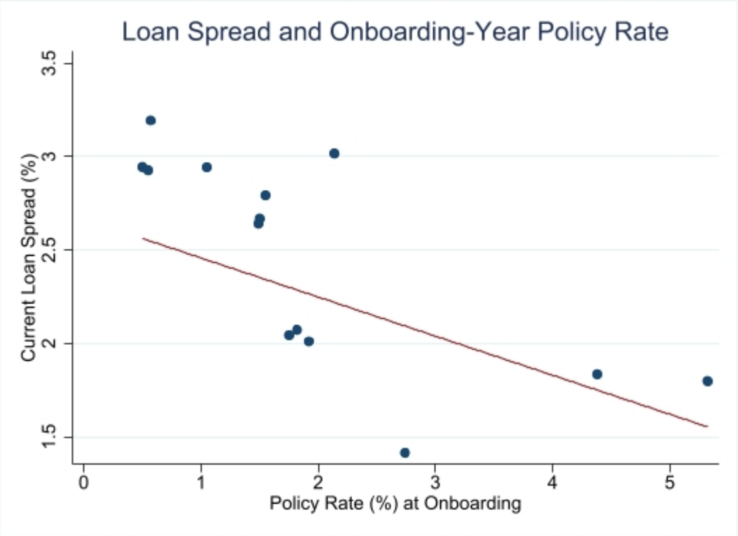
Figure 4: Bank Level Deposit Spread Betas plotted against Borrowing Propensity



Panel A uses all sample years available, i.e. 2004-18. Panel B focuses on years 2004-15 in which policy rates were above 1.5pp.

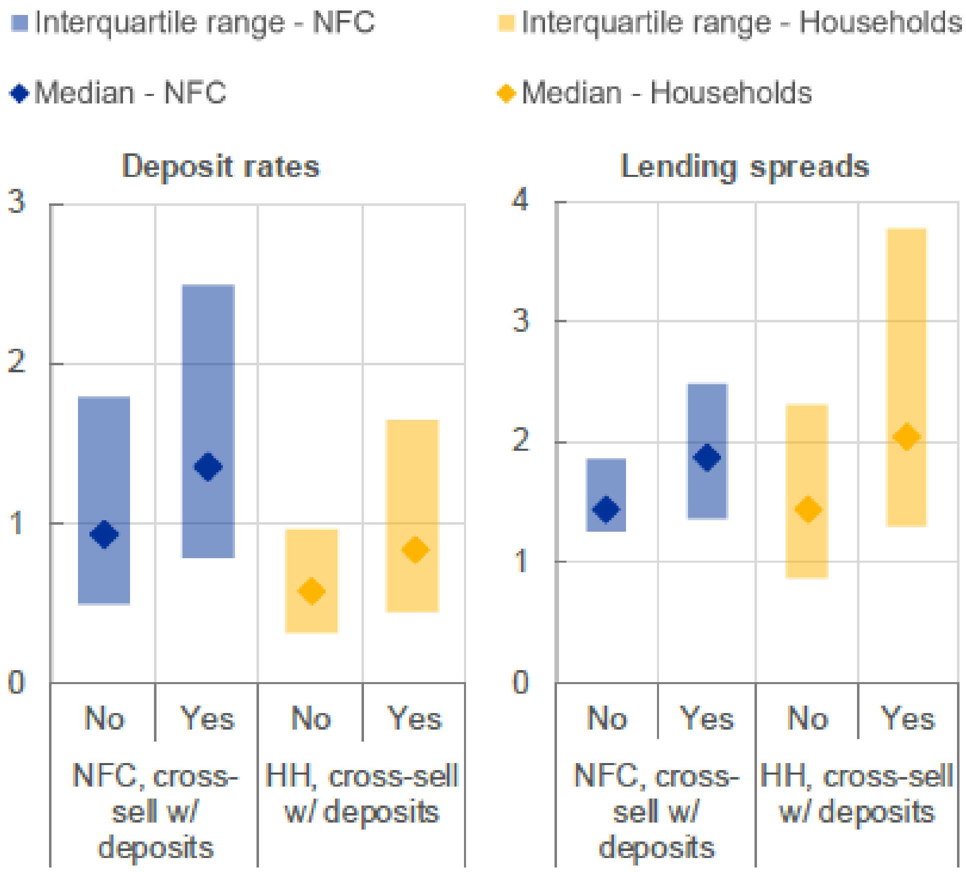
Figure 5: Loan Spread by Same-Year and by Onboarding-Year Policy Rate





Panel A plots loan spreads against policy rates in the same year, Panel B plots them instead against policy rates in the year in which that client was first observed to interact with that bank. Loan spreads are computed as loan rates minus policy rates. Loan rates in turn are computed as loan interest paid scaled by the loan amount, and the loan amount is averaged between the current and the preceding year to better account for the fact that some loans may have been initiated only toward the end of the calendar year at the end of which they are reported.

Figure 6: Cross-Selling and Deposit Pricing in the euro area



The left panel shows deposit rates paid to clients, the right one shows lending spreads charged. In each panel, the first 2 dots and bars capture bank relationships to Non-Financial Corporations (NFCs), the other two capture relationships to households (HHs). In each case, “Yes” refers to banks who in a survey administered by the euro area’s single supervisory mechanism SSM say that cross-selling matters for their pricing, whereas “No” refers to banks that say it does not. In all cases the dot shows the median, while the bar shows the interquartile range. For further details, see Section 5.7.

Tables

Table 1: Summary statistics

A. Rel. Level	Obs.	Mean	SD	Min	P50	Max
Policy Rate (PR)	43,654,911	1.931	1.378	0.500	1.550	5.320
Policy Rate Change (DPR)	43,654,911	-0.129	1.160	-3.570	-0.010	1.640
Deposit Spread (DS)	43,654,911	0.457	1.278	-2.435	0.442	2.856
DS Change (DDS)	43,654,911	-0.077	1.097	-5.292	0.000	5.292
Deposit Volume	43,654,911	135,410	302,281	0	20,194	2,001,353
Deposit Growth (log-diff)	30,154,294	-27.200	65.126	-100.000	-30.002	172.853
Pr (borrow) = PrB	43,654,911	0.180	0.072	-1.108	0.174	0.426
Pr (mean debt) in NOK	43,654,912	1,079,847	507,389	-1,351,384	1,113,093	15,100,000
Pr(ln mean debt)	43,654,913	13.222	0.773	9.844	13.304	33.573
Pr(LoanSpread LS)	43,654,914	4.989	1.991	-29.534	4.838	18.670
Pr(LS Overnight)	43,654,915	2.339	1.138	-12.005	2.163	10.001
Herfindahl Hirschmann Index HHI	43,654,911	0.291	0.121	0.114	0.264	0.864
Deposit Market Share MS	39,551,680	0.212	0.287	0.000	0.052	0.998

B. BM Level	Obs.	Mean	SD	Min	P50	Max
Policy Rate (PR)	363,204	1.885	1.281	0.500	1.550	5.320
Policy Rate Change (DPR)	363,204	-0.100	1.080	-3.570	-0.010	1.640
Deposit Spread (DS)	363,204	0.480	0.926	-2.860	0.452	2.856
DS Change (DDS)	363,204	-0.082	0.695	-5.567	-0.022	5.532
Deposit Vol. (1000 NOK)	363,204	22,000	544,000	0	32	125,000,000
Deposit Growth (log-diff)	360,300	-0.353	72.155	-91.643	0.475	86.382
Pr(borrow) = PrB	573,503	0.14	0.07	-1.29	0.15	0.38
Pr(Mean Debt), NOK mio	573,503	1.13	0.44	-1.11	1.13	15.07
Pr(Ln Mean Debt)	573,503	12.70	1.46	5.21	12.70	58.43
Pr(LoanSpread)	573,503	4.87	1.68	-28.42	4.71	17.72
HHI	363,204	0.381	0.132	0.114	0.361	0.864
Deposit Market Share MS	353,350	0.016	0.085	0.000	0.000	0.998
Number of Clients	363,204	192	2,049	1	7	277,994

Continuation of Table 1

C1. Loan growth at Bank Municipality Level						
	Obs.	Mean	SD	Min	P50	Max
Loan Growth (LD)	91,293	-3.90	93.92	-407.92	-3.67	389.38
Loan Growth (Sym)	91,293	-3.89	64.36	-193.37	-3.67	192.11
Ln (New Loan Volume)	23,439	12.98	3.79	-0.69	13.41	25.00
Bank-Level Pr(borrow)	130,652	0.19	0.03	0.04	0.20	0.27
Bank-Level HHI	130,652	0.31	0.08	0.16	0.29	0.70
C2. Loan growth at Bank Sector (NACE3) level						
Loan Growth (LD)	125,923	-3.06	91.75	-414.90	-3.08	368.25
Loan Growth (Sym)	125,923	-2.63	63.49	-193.84	-3.08	190.21
Ln (New Loan Volume)	26,622	12.69	3.59	-0.69	13.15	25.05
Bank-Level Pr(borrow)	196,035	0.20	0.03	0.04	0.20	0.27
Bank-Level HHI	196,035	0.33	0.09	0.16	0.30	0.70
C3. Loan growth at Bank Sector (NACE5) level						
Loan Growth (LD)	188,366	-6.54	97.31	-457.54	-4.60	381.74
Loan Growth (Sym)	188,366	-5.25	65.26	-195.94	-4.60	191.42
Ln (New Loan Volume)	46,327	12.41	3.58	-0.69	12.93	25.05
Bank-Level Pr(borrow)	346,292	0.20	0.03	0.04	0.20	0.27
Bank-Level HHI	346,292	0.32	0.09	0.16	0.30	0.70

D. Bank Level	Obs.	Mean	SD	Min	P50	Max
Deposit Spread Beta DSB	91	-0.17	2.81	-17.23	0.42	8.53
Pr(borrow)	196	0.15	0.05	-0.02	0.15	0.29
HHI	196	0.26	0.05	0.18	0.25	0.60

Panel A shows summary statistics for our core analyses at the level of individual bank household relationships, Panel B at our baseline level of bank municipality (BM) cells. Panels C1-C3 show summary statistics for our loan growth analyses at respectively bank by municipality, bank by NACE3 sector, and bank by NACE5 sector. Panel D shows summary statistics for our visual analysis at the bank level. DS is the deposit spread between policy rate and average deposit rate at the respective level, Pr(borrow) is the estimated propensity for a depositor to also borrow from the same bank at some point. The following lines show predicted loan amount, predicted log loan amount, and predicted loan spread respectively. HHI is the Herfindahl-Hirschmann Index, i.e. the sum of squared market shares in the respective municipal deposit market, Mshare is that bank's deposit market share in that household's municipal deposit market. In Panels C1ff, LD stands for log-difference, while Sym stands for symmetric growth where the year-on-year difference is divided by the average of initial and final level.

Table 2: Expected borrowing propensity, amount and spread of each deposit relationship

	(1) I(borrow)	(2) Ln(MeanDebt)	(3) Loan Spread
I(Parent)	-0.045***	0.445***	-1.091***
	(0.000)	(0.001)	(0.029)
I(Retired)	0.022***	-2.025***	0.842***
	(0.000)	(0.002)	(0.020)
I(age<30)	0.013***	0.314***	-0.386***
	(0.000)	(0.001)	(0.010)
Ln(Inc)	0.001***	0.032***	-0.389***
	(0.000)	(0.000)	(0.004)
Ln(Wealth)	0.004***	-0.033***	-0.044***
	(0.000)	(0.000)	(0.001)
Ln(Deposits)	0.126***	0.825***	-1.115***
	(0.000)	(0.001)	(0.019)
No. of banks of HH	-0.015***	0.459***	-0.333***
	(0.000)	(0.001)	(0.005)
HHI (Deposit)	0.118***	-1.780***	-1.597***
	(0.001)	(0.009)	(0.073)
Constant	-0.076***	7.482***	16.614***
	(0.001)	(0.010)	(0.130)
Observations	89,832,506	89,832,506	1,324,360
R2	0.060	0.197	0.059

The outcomes of interest in columns 1-3 are respectively an indicator of whether the deposit relationship observed with the current characteristics will ever turn into a (deposit and) loan relationship, the log loan amount (set to NOK 0.01 if no loan is taken), and the spread between loan rate and government bond rate for the same estimated maturity. Results for spreads over the overnight rate are qualitatively similar. Explanatory variables include indicators for parenthood, retirement and age below 30, the logs of income, wealth and deposits, the number of banks the household already has a relationship with, and the Herfindahl Hirschmann Index for the municipal deposit market in which the household is based. Standard errors clustered by bank*year in parentheses. * p<0.1, ** p < 0.05, *** p<0.01.

Table 3: Borrowing Propensity and the Deposit Spread Beta (DSB)

	(1)	(2)	(3)	(4)
	DDS	DDS	DDS	DDS
PrB * DPR	0.110	0.147***	0.101***	0.156***
	(0.089)	(0.031)	(0.033)	(0.031)
PrB	-0.108	-0.275***	-0.290***	-0.288***
	(0.083)	(0.025)	(0.027)	(0.026)
DPR	0.112***			
	(0.020)			
HHI * DPR			0.056***	
			(0.011)	
HHI			0.022**	
			(0.009)	
MS * DPR				-0.005
				(0.011)
MS				0.035***
				(0.007)
Constant	-0.052***	-0.037***	-0.041***	-0.035***
	(0.017)	(0.004)	(0.004)	(0.004)
Observations	363,212	363,204	363,204	353,350
R2	0.041	0.265	0.265	0.264
BYFE	N	Y	Y	Y
Effect of 1SD of PrB	0.006	0.009***	0.006***	0.009***
Effect of 1SD of HHI			0.007***	
Effect of 1SD of MS				-0.000

The outcome DDS is the year-on-year (yoy) difference in deposit spreads. DPR is the yoy change in the policy rate, PrB is each deposit relationship's propensity to turn also into a borrowing relationship in any of the years observed, HHI is the Herfindahl-Hirschmann Index (sum of squared market shares) of that relationship's bank in the municipal deposit market of that relationship's household, and MS is the market share of that relationship's bank in the municipal deposit market of that relationship's household. BYFE indicates whether (Y) or not (N) the regression includes bank*year fixed effects. The 3 bottom lines indicate how the effect of a 1pp policy rate change on the deposit spread change vary with a 1 standard deviation (SD) change in borrowing propensity, HHI and market share respectively. Standard errors clustered by bank*year in parentheses. * p<0.1, ** p < 0.05, *** p<0.01.

Table 4: Volume- and Spread-Adjusted Cross-Selling Potential and the Deposit Spread Beta (DSB)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	DDS	DDS	DDS	DDS	DDS	DDS	DDS	DDS
CSP * DPR	0.007	0.010***	0.007***	0.010***	0.000	0.003***	0.002***	0.003***
	(0.006)	(0.002)	(0.002)	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)
CSP	-0.014**	-0.025***	-0.025***	-0.026***	0.001	-0.002***	-0.002***	-0.002***
	(0.006)	(0.002)	(0.002)	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)
DPR	0.115***				0.129***			
	(0.018)				(0.017)			
HHI * DPR			0.060***				0.060***	
			(0.010)				(0.010)	
HHI			0.014				-0.007	
			(0.009)				(0.009)	
MS * DPR				0.002				0.003
				(0.011)				(0.011)
MS				0.030***				0.010
				(0.007)				(0.007)
Constant	-0.041***	-0.032***	-0.035***	-0.030***	-0.074***	-0.063***	-0.060***	-0.062***
	(0.016)	(0.004)	(0.005)	(0.004)	(0.013)	(0.003)	(0.004)	(0.003)
Observations	363,212	363,204	363,204	353,350	363,212	363,204	363,204	353,350
R2	0.041	0.265	0.265	0.264	0.041	0.264	0.265	0.263
CS measure	PrB*Ln(V)	PrB*Ln(V)	PrB*Ln(V)	PrB*Ln(V)	PrB*Ln(V)*LS	PrB*Ln(V)*LS	PrB*Ln(V)*LS	PrB*Ln(V)*LS
BYFE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Effect of 1SD of PrB	0.005	0.007***	0.005***	0.008***	0.000	0.015***	0.014***	0.016***
Effect of 1SD of HHI			0.008***				0.008***	
Effect of 1SD of MS				0.000				0.000

The outcome DDS in all columns is the year-on-year (yoy) difference in the deposit spread. The explanatory variables of interest are the yoy difference in the policy rate DPR and its interactions with cross-selling potential CSP. In columns 1-4 this is the estimated borrowing propensity used in Table 3 times the log estimated borrowing volume, whereas in columns 5-8 it is the same product additionally multiplied by the estimated loan spread, where all three estimates are based on the estimations displayed in Table 2. Additionally, we include interactions of the DPR with the Herfindahl-Hirschmann Index HHI in the deposit market of that household´s municipality, as well as with the deposit market share of that bank in that municipality. Column 1 starts only with the regressors displayed, column 2 adds bank*year fixed effects BYFE, column 3 adds also the HHI and its interaction with DPR, while column 4 adds also the market share and its interaction. Standard errors clustered by bank*year in parentheses. * p<0.1, ** p < 0.05, *** p<0.01.

Table 5: Cross-Selling Potential and the Deposit Growth Beta (DGB)

	LD DG with no winsorization				LD DG with 10% winsorization			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	DG	DG	DG	DG	DG	DG	DG	DG
PrB * DPR	-76.551***	-82.742***	-112.405***	-78.507***	-39.077***	-43.561***	-62.749***	-41.002***
	(21.957)	(23.612)	(29.772)	(21.276)	(13.204)	(14.627)	(18.505)	(13.112)
PrB	1190.318***	1279.290***	1465.205***	1177.890***	769.345***	828.214***	950.338***	760.441***
	(23.606)	(25.884)	(30.942)	(23.829)	(14.626)	(16.127)	(19.233)	(14.843)
DPR	13.286***				6.713***			
	(4.058)				(2.409)			
HHI * DPR			19.155***				12.328***	
			(5.280)				(3.490)	
HHI			-182.895***				-120.150***	
			(5.882)				(3.821)	
MS * DPR				-4.465				-2.788
				(8.613)				(5.686)
MS				269.376***				181.532***
				(12.581)				(7.720)
Constant	-199.557***	-216.392***	-178.921***	-203.508***	-125.956***	-136.896***	-112.283***	-128.338***
	(4.197)	(4.469)	(4.404)	(4.120)	(2.583)	(2.776)	(2.789)	(2.552)
Observations	282,625	282,620	282,620	275,077	282,625	282,620	282,620	275,077
R2	0.028	0.039	0.044	0.044	0.025	0.036	0.041	0.041
BYFE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Effect of 1SD of PrB	-3.494***	-3.777***	-5.131***	-3.603***	-1.784***	-1.989***	-2.864***	-1.882***
Effect of 1SD of HHI			2.535***				1.632***	
Effect of 1SD of MS				-0.418				-0.261

The outcome Deposit Growth DG is computed as the year-on-year log difference. All other variables as in preceding tables. Standard errors clustered by bank*year in parentheses. * p<0.1, ** p < 0.05, *** p<0.01.

Table 6: Corporate Loan Growth at the Bank Municipality Level

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	LG (LD)	LG (LD)	LG (LD)	LG (Sym)	LG (Sym)	LG (Sym)	Ln(new loans)	Ln(new loans)	Ln(new loans)
PrB*DPR	-66.444***		-74.271***	-47.516***		-53.557***	-2.750**		-2.110
	(16.026)		(24.471)	(10.798)		(16.408)	(1.257)		(1.533)
PrB	89.499***		131.142***	78.924***		112.861***	8.120***		10.651***
	(18.832)		(23.587)	(12.676)		(16.066)	(2.042)		(2.821)
HHI*DPR		-13.590***	4.107		-9.614***	3.190		-0.529	-0.381
		(4.508)	(7.074)		(3.081)	(4.802)		(0.385)	(0.496)
HHI		4.761	-21.510***		5.105	-17.522***		1.127*	-1.316
		(5.399)	(6.719)		(3.707)	(4.689)		(0.679)	(0.953)
Constant	-18.955***	-1.858	-20.299***	-16.558***	-1.956*	-17.654***	11.021***	12.557***	10.952***
	(3.586)	(1.670)	(3.629)	(2.410)	(1.146)	(2.440)	(0.390)	(0.197)	(0.389)
Observations	57,403	57,403	57,403	57,403	57,403	57,403	11,360	11,360	11,360
R2	0.117	0.117	0.117	0.115	0.113	0.115	0.341	0.339	0.342
Muni Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Effect of 1SD of PrB	-1.687***		-1.885***	-1.206***		-1.359***	-0.073**		-0.056
Effect of 1 SD of HHI		-1.064***	0.321		-0.753***	0.250		-0.043	-0.031

Observation level is bank by municipality by year. Columns 1-3 use as outcome loan growth to non-financial corporations (NFCs) computed as log difference, 4-6 use symmetric loan growth (year-on-year difference in loan volumes, scaled by the average loan volume in the past and current year), 7-9 use the log of loan volumes when loan volumes in that bank municipality combination are positive now but were zero the previous year. Explanatory variables as before. All columns include fixed effects (FE) for each muni(cipality), each year, and each combination thereof. Standard errors clustered by bank*year in parentheses. * p<0.1, ** p < 0.05, *** p<0.01.

Table 7: Corporate Loan Growth at the Bank Sector Level at NACE3 granularity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	LG (LD)	LG (LD)	LG (LD)	LG (Sym)	LG (Sym)	LG (Sym)	Ln(new loans)	Ln(new loans)	Ln(new loans)
PrB*DPR	-27.235**		-61.491***	-17.716**		-44.134***	1.037		-4.107***
	(11.661)		(20.010)	(7.449)		(13.140)	(0.762)		(1.123)
PrB	52.002***		127.175***	37.793***		99.053***	8.235***		7.679***
	(13.064)		(21.462)	(8.647)		(14.237)	(1.494)		(2.234)
HHI*DPR		-1.540	11.536**		-0.479	8.920***		1.133***	1.833***
		(2.615)	(4.494)		(1.747)	(3.101)		(0.203)	(0.311)
HHI		-0.282	-25.803***		-1.138	-21.011***		2.143***	0.468
		(3.012)	(4.999)		(2.063)	(3.423)		(0.423)	(0.633)
Constant	-12.305***	-1.169	-19.225***	-8.857***	-0.470	-14.490***	11.304***	12.445***	10.737***
	(2.648)	(1.011)	(3.158)	(1.749)	(0.690)	(2.076)	(0.239)	(0.102)	(0.269)
Observations	103,216	103,216	103,216	103,216	103,216	103,216	18,500	18,500	18,500
R2	0.061	0.061	0.062	0.064	0.063	0.064	0.342	0.342	0.344
Nace3 Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Effect of 1SD of PrB	-0.657**		-1.484***	-0.427**		-1.065***	0.027		-0.105***
Effect of 1SD of HHI		-0.142	1.067**		-0.044	0.825***		0.104***	0.168***

Observation level bank by sector by year, where sectors are defined by the first 3 digits of the NACE code (using all columns yields similar results but more cells with a low number of banks). Columns 1-3 use as outcomes loan growth to non-financial corporations (NFCs) computed as log difference, 4-6 use symmetric loan growth (year-on-year difference in loan volumes, scaled by the average loan volume in the past and current year), 7-9 use the log of loan volumes when loan volumes in that bank sector combination are positive now but were zero the previous year. Explanatory variables as before. All columns include fixed effects (FE) for each sector, each year, and each combination thereof. Standard errors clustered by bank*year in parentheses. * p<0.1, ** p < 0.05, *** p<0.01.

Table 8: How components of cross-selling flow profits vary with the policy rate

A. Flow Profits by DPR

	Baseline			With Bank Fixed Effects			Controlling for later NPL status		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	I(later loan)	Mean Ln Loan Vol	Loan Spread	I(later loan)	Mean Ln Loan Vol	Loan Spread	I(later loan)	Mean Ln Loan Vol	Loan Spread
DPR	-0.011***	-0.027***	-0.313***	-0.038***	-0.122***	-0.310***	0.002***	-0.041***	-0.309***
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)	(0.000)	(0.001)	(0.001)
I(later NPL)							0.501***	-0.455***	0.179***
							(0.000)	(0.002)	(0.008)
Constant	0.639***	11.473***	1.980***	0.622***	11.412***	1.983***	0.501***	11.670***	1.965***
	(0.000)	(0.001)	(0.002)	(0.000)	(0.001)	(0.002)	(0.000)	(0.001)	(0.002)
Observations	18,814,062	12,152,225	4,629,819	18,814,060	12,152,223	4,629,817	18,814,062	12,152,225	4,629,819
R2	0.001	0.000	0.010	0.232	0.278	0.053	0.227	0.005	0.010

B. Flow Profits by DPR, Regressions Weighted by Mean Deposit Volume

	Baseline			With Bank Fixed Effects			Controlling for possible later NPL status		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	I(later loan)	Mean Ln Loan Vol	Loan Spread	I(later loan)	Mean Ln Loan Vol	Loan Spread	I(later loan)	Mean Ln Loan Vol	Loan Spread
DPR	-0.032***	-0.218***	-0.215***	-0.049***	-0.166***	-0.245***	-0.016***	-0.216***	-0.215***
	(0.000)	(0.003)	(0.005)	(0.000)	(0.002)	(0.006)	(0.000)	(0.003)	(0.005)
I(later NPL)							0.708***	0.277***	0.002
							(0.000)	(0.007)	(0.024)
Constant	0.475***	11.454***	2.264***	0.466***	11.489***	2.242***	0.281***	11.295***	2.264***
	(0.000)	(0.004)	(0.009)	(0.000)	(0.003)	(0.009)	(0.000)	(0.006)	(0.009)
Observations	12,881,872	6,770,261	2,682,831	12,881,870	6,770,259	2,682,826	12,881,872	6,770,261	2,682,831
R2	0.006	0.008	0.004	0.131	0.205	0.033	0.416	0.010	0.004

Outcomes are (1) the propensity of that deposit relationship to ever turn into a loan relationship, (2) the log of the mean (across all years observed) logged loan volume in that relationship, which can be zero, and (3) the loan spread in case of a loan. DPR is the year-on-year change in the policy rate, I(later NPL) is a dummy for whether that relationship does ever contain strictly positive debt and yet pays zero interest in that same year, a proxy for the loan becoming a non-performing loan (NPL). Standard errors clustered by bank*year in parentheses. * p<0.1, ** p < 0.05, *** p<0.01.

Appendix

Appendix Tables

Appendix Table 1: Bank level Deposit Spread Betas (DSBs) by borrowing propensity

	(1)	(2)	(3)	(4)	(5)	(6)
	DSB	DSB	DSB	DSB	DSB	DSB
PrB	0.007		0.254**	1.037***		1.188***
	(0.099)		(0.128)	(0.176)		(0.224)
HHI		0.184***	0.185***		-0.069	-0.062
		(0.070)	(0.070)		(0.122)	(0.122)
Constant	0.257***	0.206***	0.162***	0.139***	0.339***	0.132**
	(0.018)	(0.024)	(0.033)	(0.032)	(0.042)	(0.058)
Obs.	366,627	222,460	222,460	344,397	209,428	209,428
R2	0.000	0.000	0.000	0.000	0.000	0.000
Years	2004-18	2004-18	2004-18	2004-14	2004-14	2004-14

Deposit Spread Betas (DSB) obtained by regressing year-on-year changes in deposit spreads on borrowing propensity and on HHI in each bank household relationship to obtain a separate DSB for each bank. These are then related to bank-level means across all a bank's relationships of borrowing propensity (PrB) and Herfindahl-Hirschmann Index (HHI). Columns 1-3 use data from all 15 available years, columns 4-6 focus on the 11 years in which policy rate levels were at least 1.5pp. Standard errors clustered by bank*year in parentheses. * p<0.1, ** p < 0.05, *** p<0.01.

Appendix Table 2: Corporate Loan Growth at the Bank Sector Level at NACE 5 granularity

	(1) LG (LD)	(2) LG (LD)	(3) LG (LD)	(4) LG (Sym)	(5) LG (Sym)	(6) LG (Sym)	(7) Ln(new loans)	(8) Ln(new loans)	(9) Ln(new loans)
PrB*DPR	-25.205**		-47.973***	-19.201***		-35.292***	1.669***		-2.312***
	(10.670)		(17.801)	(6.911)		(11.646)	(0.575)		(0.871)
PrB	52.982***		111.381***	35.726***		85.143***	10.251***		11.568***
	(11.346)		(17.911)	(7.440)		(11.717)	(1.165)		(1.739)
HHI*DPR		-2.170	8.085*		-1.769	5.782**		1.079***	1.424***
		(2.473)	(4.137)		(1.636)	(2.769)		(0.157)	(0.244)
HHI		1.453	-21.021***		-0.571	-17.748***		2.194***	-0.323
		(2.720)	(4.325)		(1.831)	(2.898)		(0.338)	(0.507)
Constant	-15.684***	-5.045***	-20.775***	-10.815***	-3.102***	-15.112***	10.785***	12.141***	10.226***
	(2.294)	(0.895)	(2.659)	(1.502)	(0.601)	(1.730)	(0.184)	(0.080)	(0.207)
Observations	155,637	155,637	155,637	155,637	155,637	155,637	31,713	31,713	31,713
R2	0.087	0.086	0.087	0.086	0.086	0.086	0.364	0.363	0.366
Nace3 Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Nace3 FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Effect of 1SD of PrB	-0.591**		-1.125***	-0.450***		-0.827***	0.041***		-0.057***
Effect of 1SD of HHI		-0.190	0.706*		-0.155	0.505**		0.094***	0.125***

Observation level bank sector year, where sectors are defined by the first 3 digits of the NACE code (using all columns yields similar results but more cells with a low number of banks). Columns 1-3 use as outcomes loan growth to non-financial corporations (NFCs) computed as log difference, 4-6 use symmetric loan growth (year-on-year difference in loan volumes, scaled by the average loan volume in the past and current year), 7-9 use the log of loan volumes when loan volumes in that bank sector combination are positive now but were zero the previous year. Explanatory variables as before. All columns include fixed effects (FE) for each sector, each year, and each combination thereof. Standard errors clustered by bank*year in parentheses. * p<0.1, ** p < 0.05, *** p<0.01.

Appendix Table 3: Loan pricing implications of a loan becoming a non-performing loan later

	(1)	(2)	(3)	(4)
	LS	LS	LS	LS
I(later NPL)	0.478***		0.246***	
	(0.022)		(0.022)	
I(later NPL) v2		0.350***		0.224***
		(0.026)		(0.026)
Constant	2.120***	2.151***	2.149***	2.162***
	(0.008)	(0.008)	(0.008)	(0.008)
Observations	259,819	259,819	259,818	259,818
R2	0.002	0.001	0.050	0.049

The dependent variable is the loan spread LS between the loan rate and the policy rate, based on the observations that almost all loans of interest are adjustable rate (Basten and Juelsrud, 2023). The explanatory variable of interest is an indicator *I(later NPL)* for whether in that relationship we ever observe that the loan becomes a non-performing loan in the sense that despite a strictly positive loan volume yet no interest is being paid in that same calendar year. Standard errors clustered by bank*year in parentheses. * p<0.1, ** p < 0.05, *** p<0.01.

Appendix Table 4: Years 2004-14 with policy rates >= 1.5pp

	(1) DDS	(2) DDS	(3) DDS	(4) DDS
PrB * DPR	0.107	0.174***	0.127***	0.182***
	(0.091)	(0.031)	(0.033)	(0.032)
PrB	-0.150	-0.361***	-0.373***	-0.372***
	(0.103)	(0.032)	(0.033)	(0.033)
DPR	0.110***			
	(0.021)			
DPR*HHI			0.056***	
			(0.011)	
HHI			0.018	
			(0.011)	
DPR*MS				-0.002
				(0.011)
MS				0.021**
				(0.009)
Constant	-0.051**	-0.021***	-0.025***	-0.020***
	(0.023)	(0.005)	(0.006)	(0.005)
Observations	256,415	256,409	256,409	248,811
R2	0.045	0.286	0.286	0.285
BYFE	N	Y	Y	Y
Effect of 1SD of PrB	0.006	0.010***	0.007***	0.010***
Effect of 1SD of HHI			0.008***	
Effect of 1SD of MS				0.000

The outcome DDS is the year-on-year (yoy) difference in deposit spreads. DPR is the yoy change in the policy rate, PrB is each deposit relationship's propensity to turn also into a borrowing relationship in any of the years observed, HHI is the Herfindahl-Hirschmann Index (sum of squared market shares) of that relationship's bank in the municipal deposit market of that relationship's household, and MS is the market share of that relationship's bank in the municipal deposit market of that relationship's household. BYFE indicates whether (Y) or not (N) the regression includes bank*year fixed effects. The 3 bottom lines indicate how the effect of a 1pp policy rate change on the deposit spread change vary with a 1 standard deviation (SD) change in borrowing propensity, HHI and market share respectively. Standard errors clustered by bank*year in parentheses. * p<0.1, ** p < 0.05, *** p<0.01.

Appendix Table 5: Policy rate levels instead of changes

	(1)	(2)	(3)	(4)
	DS	DS	DS	DS
PrB * DPR	0.112	0.222***	0.244***	0.231***
	(0.188)	(0.067)	(0.074)	(0.069)
PrB	3.245***	0.116	0.023	0.102
	(0.407)	(0.149)	(0.164)	(0.154)
PR	0.409***			
	(0.047)			
HHI*PR			-0.035	
			(0.031)	
HHI			0.141**	
			(0.062)	
MS*PR				-0.116***
				(0.022)
MS				0.134***
				(0.038)
Constant	-1.246***	0.013	-0.007	0.001
	(0.089)	(0.013)	(0.014)	(0.013)
Observations	450,642	450,623	450,623	438,973
R2	0.055	0.162	0.162	0.161
BYFE	N	Y	Y	Y
Effect of 1SD of PrB	0.007	0.014***	0.015***	0.014***
Effect of 1SD of HHI			-0.005	
Effect of 1SD of MS				-0.009***

The outcome DS is now the deposit spread level. PR is policy rate level, PrB is each deposit relationship's propensity to turn also into a borrowing relationship in any of the years observed, HHI is the Herfindahl-Hirschmann Index (sum of squared market shares) of that relationship's bank in the municipal deposit market of that relationship's household, and MS is the market share of that relationship's bank in the municipal deposit market of that relationship's household. BYFE indicates whether (Y) or not (N) the regression includes bank*year fixed effects. The 3 bottom lines indicate how the effect of a 1pp policy rate difference on the deposit spread vary with a 1 standard deviation (SD) change in borrowing propensity, HHI and market share respectively. Standard errors clustered by bank*year in parentheses. * p<0.1, ** p < 0.05, *** p<0.01.

Appendix Table 6: Deposit volume weighted regressions

	(1)	(2)	(3)	(4)
	DDS	DDS	DDS	DDS
DPR*PrB	0.200	0.547***	1.256*	0.431***
	(0.407)	(0.198)	(0.676)	(0.104)
PrB	-0.309	0.166	0.266	0.140
	(0.327)	(0.165)	(0.498)	(0.136)
DPR	0.083			
	(0.090)			
DPR*HHI			-0.160	
			(0.115)	
HHI			-0.024	
			(0.082)	
DPR*Mshare				0.020
				(0.017)
Mshare				0.006
				(0.010)
Constant	0.008	-0.090***	-0.084	-0.087***
	(0.061)	(0.030)	(0.066)	(0.027)
Observations	310,303	310,295	310,295	301,845
R2	0.161	0.868	0.869	0.864
BYFE	N	Y	Y	Y
Effect of 1SD of PrB	0.009	0.025***	0.057*	0.020***
Effect of 1SD of HHI			-0.021	
Effect of 1SD of MS				0.002

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