Tracing Banks' Credit Allocation to their Funding Costs*

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Abstract

We quantify how banks' funding costs affect their lending behavior and the real economy. For identification, we exploit banks' heterogeneous liability structure and the existence of regulated deposits in France whose rates are set by the government. Using administrative credit-registry and regulatory bank data, we find that a one-percentage-point increase in funding costs reduces credit by 17%. To insulate their profits, banks also reach for yield and rebalance their lending towards smaller and riskier firms. These changes are not compensated for by less affected banks at the aggregate city level, which implies that firms have to adjust their investment.

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1 Introduction

How banks' funding and operating costs affect their behavior and are transmitted to the real economy is at the core of policy debates about the financial system, ranging from the effectiveness of monetary policy to the effects of micro- and macroprudential regulations.[1] By reducing banks' profits, and thereby tightening their financing constraint, higher costs stemming from higher interest or operating expenses can affect their credit supply (Gertler and Kiyotaki, 2010). However, as banks jointly optimize their assets and liabilities, identifying exogenous variation in funding costs that does not directly affect the level of banks' liabilities or the profitability of their potential investments is challenging.

In this paper, we identify variation that relates only to the cost of a funding source that is inframarginal to banks, without varying other determinants of banks' interest margin, including differences in their ability to substitute across marginal sources of funding. This enables us to isolate a specific input to banks' profit function and quantify its pass-through to the quantity and composition of banks' credit supply. To this end, we use rich administrative data over the period 2010–2015 in France, covering banks' balance-sheet information and a detailed breakdown of their funding structure, the near universe of bank loans to firms, as well as firms' balance sheets and income statements from tax returns.

For identification, we exploit the existence of regulated-deposit accounts offered to households in France. Unlike regular savings accounts, the rate on regulated deposits is neither determined by the banks themselves nor directly dependent on the monetary-policy rate. It is instead set by the government up to twice a year, and is mostly driven by political considerations rather than macroeconomic forces. These politically rooted shifts in the cost of regulated deposits are therefore plausibly exogenous to banks' investment opportunities and opportunity cost of alternative funding sources.

Since, in addition, balance-sheet exposure to regulated deposits is stable over time and varies primarily across banks due to regulatory obligations, the rate on regulated deposits

[1] For instance, the transmission of monetary policy to the real sector and its effectiveness depend in part on the pass-through to banks' funding costs (Gertler and Kiyotaki, 2010). More generally, banks' cost of capital can affect the quantity and quality of credit supply in response to both microprudential (Repullo and Suárez, 2013; Begenau, 2020) and macroprudential regulations (Jiménez, Ongena, Peydró, and Saurina, 2017).

is an inframarginal cost. A higher rate on regulated deposits cuts into banks' profits, which ultimately depletes their net worth and can, thus, influence their lending behavior. Banks that incur higher funding costs may reduce their credit supply and reallocate their credit portfolio towards higher-yielding loans so as to insulate their profits.

By comparing banks with a higher share of regulated deposits relative to otherwise-funded banks, we trace out the effects of these exogenous shifts in bank funding costs at different levels of aggregation: the bank-firm level, the firm level, and the city level. Because our measure of exposure exploits differences in the *composition* of bank liabilities, we can control for confounding effects that may be due to differences in the *level* of bank liabilities or leverage. As a result, we estimate the effect of a change in the cost of funding net of any change in total liabilities (such as fluctuations in deposits as in Drechsler, Savov, and Schnabl, 2017) that would directly affect bank lending.

Our first set of results shows how banks' credit supply responds to regulatory-driven variation in funding costs. Using granular data on loans at the bank-firm-time level allows us to implement a standard within-firm estimator (e.g., Khwaja and Mian, 2008) to control for any changes in firms' credit demand that might be correlated with changes in banks' funding costs. We find that banks contract their lending by 17% when they incur a one-percentage-point increase in their cost of funding, which implies an elasticity of -0.25. This average estimate masks important nonlinearities. We can use the large fluctuations in the cost difference between regulated deposits and other funding sources during our sample period to estimate the curvature of the elasticity between banks' credit supply and these funding costs nonparametrically. The elasticity is highly nonlinear: banks can sustain up to 21 basis points higher average funding costs before they start contracting their lending.

While we control for many time-varying elements that are potentially correlated with bank lending, we cannot, by definition, account for time-varying *unobserved* heterogeneity across banks. We address the possibility that time-varying bank-level characteristics may be correlated with changes in the relative cost of regulated deposits in several ways.

Besides exploiting the fact that the fraction of regulated deposits remaining on banks' balance sheets is set by law and varies across banks, we include a battery of additional high-dimensional fixed effects such as banks' county-by-time and banking group (BHC)-by-time fixed effects. County-by-time fixed effects ensure that we only exploit variation across banks in the *same* county, so that lending decisions cannot be affected by differences in local market power or local business cycles. The inclusion of BHC-by-time fixed effects, in turn, implies that we use variation across banks belonging to the same group, thereby netting out any differences in top-management styles and abilities, the impact of prudential regulation, or broader funding shocks such as a run on the wholesale funding market.

Furthermore, our results are similar when we use only variation in the composition of total deposits rather than liabilities. This implies that changes in lending behavior are not driven by time-varying factors correlated with banks' general dependence on deposit funding, such as their business models, but instead are directly linked to the cost of regulated deposits relative to other types of deposits.

We also explore how the elasticity of credit supply to changes in the relative cost of regulated deposits varies across banks. Higher average funding costs depress lending by more for weakly capitalized banks, and for banks with lower liquidity buffers to absorb the cost increase. This points to an amplification of the sensitivity of banks' credit supply if their probability of default is higher, consistent with the mechanism that higher average funding costs affect banks' credit supply via a change in their expected net worth (e.g., Gertler and Kiyotaki, 2010).

Our second set of results shows that a key margin of adjustment for banks is not only the net credit supply but also the change in credit composition. Banks rebalance their loan portfolios across borrowers and loan characteristics in an effort to shield their profits from funding-cost fluctuations. When the cost of regulated deposits increases, more exposed banks engage in greater risk taking and shift their portfolios toward higher-yielding loans. They do so by increasing the average maturity of their loans and their exposure to riskier firms, such as smaller firms or firms operating in industries with higher bankruptcy risk.

The magnitude of this credit reallocation is sizable. We estimate that banks reallocate up to one-third of their corporate-loan portfolio in response to higher regulated-deposit costs. This highlights the importance of accounting for changes within banks' loan portfolio instead of relying solely on the net volume of credit supply to fully characterize how funding-cost shocks affect banks' lending behavior and ultimately the real economy. Indeed, this asset-side response can, in and of itself, affect the aggregate economy if the reallocation of credit across heterogeneous firms, holding constant its total volume, matters for aggregate output (e.g., Baqaee, Farhi, and Sangani, 2021).

In our third set of results, we implement a "local lending market" approach and show that banks' loan-portfolio rebalancing also affects the allocation of corporate credit at the more aggregate city level. The implications are twofold. First, banks less reliant on regulated deposits do not step in to serve the unaddressed local loan demand, potentially because lending relationships are sticky. Second, this opens up the possibility that variation in banks' funding costs has real economic effects, e.g., on firm-level investment, at least for those firms that are adversely affected by banks' lending decisions in the face of higher funding costs.

We test the effects on firms' outcomes by aggregating our bank-level shock at the firm level using the loan exposure of firms to each of their existing lenders. In this manner, we find that firms more exposed to regulated-deposit dependent banks reduce their tangible assets and stock of total capital assets when the relative cost of regulated deposits increases.

Our unique setting provides us with a clean measure of the funding costs of regulated-deposit dependent banks to estimate how exogenous variation in the cost of funding affects both the quantity and the quality of credit. It is appealing for multiple reasons. First, our source of variation in banks' funding costs stems from the composition, rather than the level, of (deposit) liabilities. Furthermore, we show that banks' exposure to regulated deposits is virtually time-invariant and not a source of funding that they can readily replace. This enables us to estimate the elasticity of banks' credit supply with respect to the cost of a particular type of liability, without varying other determinants of banks' interest margin, including differences in their ability to substitute across marginal sources of funding.

Second, the use of credit-registry data allows us to hold constant banks' investment opportunities, so we can identify banks' credit supply. Third, we observe all banks and small and medium-sized enterprises in the economy, with sizable treatment and control groups. As a result, we can estimate how bank- and firm-level heterogeneity shape the magnitude of the funding-cost pass-through to the real economy.

Finally, while the literature typically has to rely on one-time shocks—e.g., the liquidity drought in the interbank market in 2007/8 (e.g., Iyer, Peydró, da Rocha-Lopes, and Schoar, 2013; Cingano, Manaresi, and Sette, 2016; De Jonghe, Dewachter, Mulier, Ongena, and Schepens, 2019)—we have both large and frequent variations in banks' cost of funding, enabling us to estimate nonlinear effects on credit supply to the real economy.

By providing an estimate of the elasticity of banks' credit supply with respect to their funding costs, we contribute to a large literature that identifies shocks to credit supply (e.g., Peek and Rosengren, 2000; Khwaja and Mian, 2008; Paravisini, 2008), and that examines the real economic consequences of variations in firms' financing frictions and access to bank credit (see, among many others, Becker and Ivashina, 2014; Chodorow-Reich, 2014; Huber, 2018; Carlson, Correia, and Luck, 2022; Xu, 2022).

To approximate the funding costs of banks that do not rely on regulated deposits, we use the pass-through of the monetary-policy rate to rates on all other deposits and market-based funding. This links our analysis to studies that document if and how monetary policy is transmitted to deposit rates (Hannan and Berger, 1991; Driscoll and Judson, 2013; Drechsler, Savov, and Schnabl, 2017) and, more generally, to the literature on the transmission of monetary policy through banks. Many theoretical models in this literature consider that monetary policy affects bank behavior through its effect on bank profits and ultimately net worth, which determines banks' external-finance premium due to the existence of asymmetric information that creates collateral constraints (e.g., Gertler and Kiyotaki, 2010; Martinez-Miera and Repullo, 2017). The implications of these models have been tested empirically for the quantity of bank lending (Kashyap and Stein, 2000; Kishan and Opiela, 2000; Jiménez, Ongena, Peydró, and Saurina, 2012) and for its quality in terms of risk taking (Jiménez, Ongena, Peydró, and Saurina, 2014; Ioannidou, Ongena, and Peydró, 2015; Dell'Ariccia, Laeven, and Suarez, 2017; Paligorova and Santos, 2017; Whited, Wu, and Xiao, 2021).

A growing body of work argues that if monetary policy affects the supply of deposits or the cost thereof, cross-sectional heterogeneity in banks' funding structure matters for the transmission of monetary policy. This has been shown to be the case when there is imperfect pass-through of monetary policy to deposit rates, either as a result of imperfect competition for deposits (Drechsler, Savov, and Schnabl, 2017, 2021; Balloch and Koby, 2020; Wang, Whited, Wu, and Xiao, 2022) or due to a zero lower bound on retail deposit rates (Heider, Saidi, and Schepens, 2019; Bubeck, Maddaloni, and Peydró, 2020; Eggertsson, Juelsrud, Summers, and Wold, 2023), which reduces the interest rate sensitivity of banks' liability side compared to the asset side (Gomez, Landier, Sraer, and Thesmar, 2021). However, in all of those settings, deposit rates are set by banks themselves. Our paper identifies instances of sticky deposit rates that are not due to banks' price-setting behavior, so we can use them as a plausibly exogenous source of variation in banks' funding costs to explain credit supply.

Finally, our paper is related to the literature on banks' deposit franchise that emphasizes the latter's role in value creation (e.g., Egan, Lewellen, and Sunderam, 2022) and the importance of heterogeneous depositors for financial stability (e.g., Xiao, 2020).

2 Background and Empirical Strategy

2.1 Regulated-deposit Accounts in France

As of end-2021 regulated deposits accounted for 14% of French households' total financial assets. As they are risk-free, tax-free, highly liquid, and have a very low entry threshold (minimum of €15), these accounts are the most popular savings scheme in France for medium- and low-income households subject to income tax. Most importantly, regulated deposits pay interest at a rate set by the government that banks cannot adjust.

2.1.1 Livret A

The most common regulated-deposit account is called "livret A," which can be opened by any individual or non-profit organization. It was established in 1818 to pay back the debts incurred during the Napoleonic wars, and was originally distributed by three "incumbent" banks (La Banque Postale, Caisses d'Epargne et de Prévoyance, and Crédit Mutuel). The Law of Modernization of the Economy extended the right to offer livret-A accounts to all French credit institutions (including "new banks") starting January 1, 2009. In spite of the

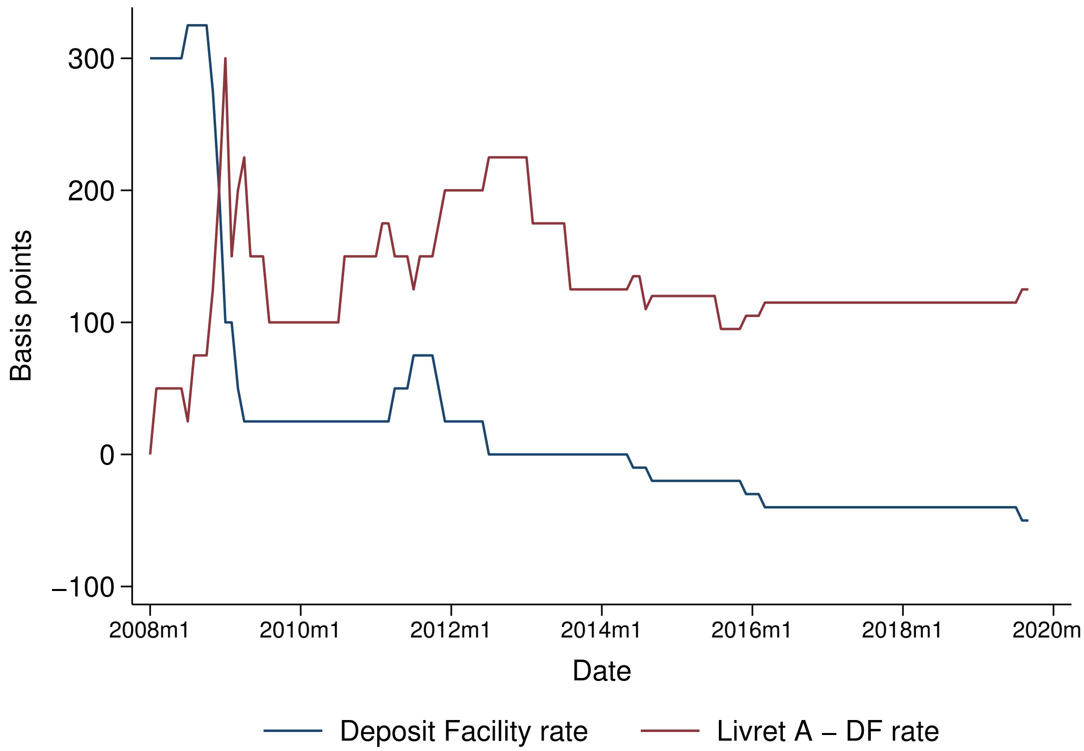

Figure 1: **Changes in Funding-cost Gap.** This figure shows the evolution of the ECB's deposit facility (DF) rate and the gap between the livret-A rate and the latter from 2008 to 2019.

rates being set by the government, French banks widely offer such accounts because French depositors have a strong preference for them and tend to max out on regulated deposits before demanding any regular savings products and other, non-savings products. That is, banks are de facto forced to offer regulated deposits to be competitive.

Given the popularity of livret-A accounts, the government had to impose a cap, often binding for middle-income households, on how much money can be saved in this form. Each depositor can only hold a single livret A, and deposits cannot exceed €22,950 for individuals (not including the capitalization of interests) or €76,500 for non-profit legal entities.[2] Regulated deposits include livret A, which represent one-third of such deposits, as well as other types of savings accounts for which the rates are pegged to the livret-A rate. The rate is the same as, or above, the livret-A rate for most of these regulated deposits (LDD, Livret Jeunes, LEP, PEL), and is equal to two-thirds of the livret-A rate for one type

[2] After the financial crisis and the European sovereign debt crisis, this product was so popular that the government increased the maximum amount by 50%, in two stages, from €15,300 to €19,125 and €22,950 in October 2012 and January 2013, respectively.

of account (CEL). As the proportion of CEL accounts is only 5%, it is safe to assume that the overall rate paid out on regulated deposits is equal to at least the livret-A rate.

The livret-A rate is set by the government. It is calculated by the French Central Bank twice a year, on January 15 and July 15, and becomes effective on February 1 and August 1, respectively.[3] The government can deviate from this revision procedure and has the discretion to decide a new rate, which has been very common in practice.[4]

Thus, unlike rates on ordinary savings accounts or interbank funding, the rate on regulated deposits does not track the monetary-policy rate and fluctuates for reasons independent of it. In Figure 1, we plot the time-series variation in the difference between the livret-A rate and the main policy rate of the European Central Bank (ECB), the deposit facility rate. From 2010 to 2014, the ECB's monetary policy is both contractionary and expansionary, whereas the difference between the livret-A and the deposit facility rate tends to increase over the same time period. The correlation between this difference and the actual monetary-policy rate during this period is -0.01.

2.1.2 Banks' Funding Costs and Credit Supply

The existence of regulated deposits in France allows us to exploit exogenous changes in banks' profits stemming from the interaction between the rates on regulated deposits and the amount of these deposits among banks' liabilities, both of which vary for reasons largely independent of banks' decisions, as we explain below.

[3] Over our sample period from 2010 to 2015, the formula for the livret-A rate corresponds to whichever is the higher of: (a) the sum of the monthly average three-month Euribor rate and the monthly average euro overnight index average (Eonia) rate divided by four, plus the French inflation rate, as measured by the percentage change over the latest available 12 months of the consumer price index, divided by two; or (b) the French inflation rate, as measured by the percentage change over the latest available 12 months of the consumer price index, plus 0.25%.

[4] For instance, on February 1, 2012, François Fillon decided to maintain the rate at 2.25%, although the inflation rate would have prompted an increase in the livret-A rate to 2.75%. On February 1, 2013, the Minister of the Economy at the time, Pierre Moscovici, lowered the livret-A rate only to 1.75% when the strict application of the formula would have implied a greater drop, to 1.5%. Similarly, on August 1, 2013, the livret-A rate was reduced to 1.25% instead of 1%. And on February 1, 2014, although the Governor of the French Central Bank recommended lowering the rate to 1%, and the formula actually implied lowering it further to 0.75%, the Minister decided to keep the livret-A rate at 1.25%.

Rates on regulated deposits. These rates cannot be adjusted by banks but, instead, vary due to political motives unrelated to bank behavior or macroeconomic fluctuations (see, for instance, Figure 1). Besides regulated deposits, banks fund themselves by issuing other deposits or through the interbank market. Compared to the livret-A rate, the rates on these alternative funding sources are significantly more aligned with the monetary-policy rate: retail deposit rates exhibit primarily upward, but not downward, stickiness, and interbank rates still track the monetary-policy rate in the euro area relatively well despite higher post-crisis liquidity and counterparty risk (e.g., Illes and Lombardi, 2013; Heider, Saidi, and Schepens, 2019). This typical strong pass-through of the monetary-policy rate allows us to use the latter to approximate the cost for the portion of bank funding that does not come from regulated deposits.

Amounts of regulated deposits. The amount of regulated deposits on a bank's balance sheet can also be considered as mostly exogenous for two reasons. First, as explained in Section 2.1.1, regulated deposits are in high demand by households but could initially only be offered by certain banks, which created a strong path dependence in market shares. Second, by law, banks retain on their balance sheet only a fraction of the regulated deposits that they collect.

A significant portion of the collected savings are rechanneled to a special fund operated by a state-owned financial institution, the Caisse des Dépôts et Consignations (CDC). Since 1945 the primary use of these funds is the financing of social housing. Only a subset of regulated deposits is rechanneled to the CDC. We refer to them as eligible deposits, of which livret A account for 85% (the remaining accounts are LDD and LEP). Banks keep 100% of all other types of regulated deposits.[5]

The share of eligible funds that have to be transferred to the CDC is set by law, and varies primarily across banks but also over time. This share used to be substantially higher

[5] There are also some limitations on how livret-A deposits can be used. Banks have the legal obligation to devote at least 80% of the deposits to SME lending, which motivates our sample selection in the credit-registry and firm-level data. In practice, this obligation has not been binding as the ratio of outstanding amounts of credit to SMEs to livret-A deposits has been fluctuating between 210% and 250% over the period 2010–2015.

Table 1: Evolution of Percentage of Eligible Regulated Deposits Transferred to the CDC

	2010	2011	2012	2013	2014	2015
Incumbent banks (prior to the reform in 2008)	80%	76%	70%	64%	62%	61%
New banks	24%	34%	40%	37%	40%	40%

Source: Regulated Savings Observatory of the Banque de France (Observatoire de l'épargne réglementée).

for the three historical (incumbent) banks, and is enforced to converge to a single rate of 60% for all banks by 2022.[6] Table 1 summarizes the evolution of the percentages of deposits rechanneled to the CDC over time. In our empirical strategy, we use the net amount of all regulated deposits, after transfers, to measure the actual amount of deposits banks have to remunerate. By using post-transfer deposit ratios, we exploit quasi-randomness among regulated-deposit dependent banks due to the government-imposed transfer rates to the CDC. We stop the sample period before 2016 because after July 2016 banks were offered the possibility to channel all their regulated deposits to the CDC.[7]

Average funding costs and implications for banks' marginal cost of lending. As explained above, banks cannot readily adjust their exposure to regulated deposits even in the medium run due to both high demand from households and strict regulation regarding the distribution of regulated deposits and how much banks retain on their balance sheet. This implies that this source of funding is inframarginal for banks, and a change in their unit cost will only affect banks' *average* cost of funding.

However, this does not imply that banks' *marginal* cost of funding remains unaltered. As average funding costs increase, this squeezes banks' net interest margin, ultimately depleting their expected net worth. In frameworks that relate banks' credit supply to changes in their expected net worth (e.g., Gertler and Kiyotaki, 2010; Bahaj and Malherbe, 2020), a change in the latter affects the current marginal cost of funding because lower expected net worth

[6] The initial target T_{bt} was 65%, and it has been revised to 60% in 2013. In exchange for collecting livret-A funds, the CDC pays banks an intermediary commission, which is proportional to the total amount of deposits collected.

[7] This has been revoked in early 2018, and the rate of 60% has been reinforced since then.

increases the likelihood of a bank's bankruptcy. As a result, through its effect on bank net worth, a change in a bank's inframarginal cost of funding can affect credit supply.

2.2 Data Description

Credit data. Our main data source is the French national Central Credit Register (CCR) administered by the Banque de France. The dataset contains monthly information on outstanding amount of credit at the firm-branch level, granted by all credit institutions to all non-financial firms based in France, provided the total exposure (i.e., the sum of all credit of any kind and credit guarantees) of a bank to a firm exceeds €25,000. Credit is broken down by initial maturity (above and below one year). Furthermore, we focus on French small and medium-sized enterprises (SMEs). From the near universe of all such firms, we drop those belonging to the financial sector and to public administrations, and only keep firms with standard legal forms (i.e., we drop unions, parishes, cooperatives, etc.).

We use data from 2010 to 2015 for our analysis. Our sample comprises 220 distinct banks, each of which has on average 651 branches (which can be located in the same city). For each firm, we aggregate credit across all of a given bank's branches in a given county to the bank-county level.[8] We aggregate the monthly dataset at the quarterly level to merge it with deposit data available at that frequency. The level of observation in our final dataset is the firm-bank-county-quarter level $fbct$, summarizing information on the lending relationship between firm f and bank b's branch(es) in county c in quarter t.

At the more aggregate bank-county-quarter level, we use the Cefit dataset from the Banque de France, which comprises information on all outstanding amounts of credit and deposits, including loans to households and self-employed individuals that are not covered by our credit-registry data.

Deposit data. Our primary source of deposit data is regulatory data (Surfi), maintained by the ACPR. The data are available at the quarterly frequency from Q3 2010 to Q4 2015

[8] We use the definition of a French "département," which partitions the country into 100 counties. As fewer than 1% of the firms in our sample are banking with multiple branches within the same bank-county cluster, the firm-bank-county level is effectively the same as the firm-bank-branch level.

for all banks operating in France. The dataset includes deposit amounts, aggregated at the bank level b, and broken down by types of deposits (regulated vs. others) and depositors (firms, households, non-profit organizations, insurance companies and pension funds, administrations).

We adjust our deposit ratios so as to take into account the net amount of eligible deposits, i.e., after rechanneling to the CDC, in the following way. Let T_{bt} be the percentage of deposits bank b has to rechannel to the CDC in year t, then: *Net eligible deposits*$_{bt}$ = *Eligible regulated deposits*$_{bt} \times (1 - T_{bt})$. T_{bt} varies based on whether banks used to distribute livret-A accounts prior to the reform of 2008 (incumbent banks) or whether they were authorized to offer livret-A accounts only after 2008 (new banks). T_{bt} is set by law so as to converge to 60% for banks in both groups by 2022.

We use the average observed percentage of funds being transferred by banks in both groups at the end of a calendar year t to define T_{bt}, i.e., we use one percentage for new banks and another one for all incumbent banks but La Banque Postale (LBP).[9] We define the regulated-deposit ratio of bank b in quarter t as:

$$\textit{Deposit ratio}_{bt} = (\textit{Non-eligible deposits}_{bt} + \textit{Net eligible deposits}_{bt}) / \textit{Total liabilities}_{bt}.$$

Firm balance-sheet data and credit ratings. Firm accounting data for SMEs come from the Fichier bancaire des entreprises (FIBEN) dataset of the Banque de France, and consist of firm balance sheets compiled from tax returns. The dataset includes all French firms with sales of €750,000 or more.[10]

We add firm credit-rating information for FIBEN firms using the credit ratings produced by the Banque de France. The latter assigns credit ratings to all French non-financial companies with at least three consecutive years of accounting data. The main use of the ratings is

[9] Given that LBP was not active in corporate lending at the beginning of the period, and could not fulfill its obligations with respect to SME lending, it was authorized to transfer all of its livret-A deposits to the CDC. We thus discard LBP from our estimations by applying a 100% transfer rate. Including it without adjusting the rate of deposits for the rechanneling scheme or including it while applying the same transfer rate as for other incumbent banks does not change the results.

[10] We drop firms with negative debt and/or negative or zero total assets. All ratios are winsorized at the 1st and 99th percentiles.

Table 2: Summary Statistics

Panel A: Main sources of variation & bank-level variables	Mean	p5	p25	Median	p75	p95	Std. dev.	N
Deposit ratio$_{bt}$ (Q4 2010 − Q4 2015)	0.14	0.00	0.00	0.15	0.25	0.34	0.12	3,673
Total deposit ratio$_{bt}$	0.51	0.06	0.37	0.51	0.68	0.92	0.24	3,673
Assets$_{bt}$ in billion €	32.39	0.19	1.41	8.25	16.44	116.81	122.31	3,673
Equity ratio$_{bt}$	0.04	0.00	0.01	0.02	0.04	0.12	0.07	3,673
Liquidity ratio$_{bt}$	0.01	0.00	0.00	0.01	0.01	0.04	0.05	3,673
Gap$_t$ in % (Jan 2010 − Dec 2015)	1.47	0.95	1.20	1.35	1.75	2.25	0.40	72
Panel B: Firm-bank-county-quarter level								
Credit in thousand €	397.87	28.00	54.00	119.00	287.00	1166.00	3,044.31	4,134,974
Panel C: Bank-county-quarter level								
$\frac{\text{Large firms}}{\text{Total loans}}$	0.07	0.00	0.02	0.04	0.08	0.25	0.10	28,063
$\frac{\text{Small firms}}{\text{Total loans}}$	0.09	0.00	0.04	0.07	0.11	0.23	0.08	28,063
$\frac{\text{Loans to self-employed}}{\text{Total loans}}$	0.08	0.00	0.02	0.06	0.13	0.20	0.07	28,063
$\frac{\text{High-bankruptcy industries}}{\text{Total loans}}$	0.29	0.03	0.18	0.26	0.36	0.62	0.17	27,139
$\frac{\text{Risky firms}}{\text{Rated firms}}$	0.60	0.21	0.49	0.61	0.74	0.97	0.21	26,336
$\frac{\text{MLT loans}}{\text{Total loans}}$	0.87	0.68	0.86	0.90	0.92	0.96	0.12	28,063
Panel D: ZIP-code-quarter level								
Deposit ratio$_{kt}$	0.21	0.11	0.18	0.22	0.25	0.29	0.06	664,654
Total credit in thousand €	5,353.22	61.00	294.00	834.00	2,496.00	15,827.00	59,609.23	664,654
Panel E: Firm-year level								
Deposit ratio$_{ft}$	0.12	0.00	0.03	0.13	0.21	0.29	0.10	380,657
Capital assets in million €	2.74	0.10	0.38	0.84	1.94	7.78	16.07	380,657
PP&E in million €	2.36	0.07	0.27	0.63	1.55	6.72	15.69	380,657
$\frac{\text{CapEx}}{\text{Capital assets}}$	0.23	0.00	0.03	0.09	0.24	0.87	0.46	380,657
$\frac{\text{Tangible investment}}{\text{PP\&E}}$	0.14	0.00	0.02	0.05	0.14	0.51	0.28	380,657
Employment	28.53	5.00	12.00	18.00	34.00	86.00	32.91	380,657

In Panel A, *Deposit ratio*$_{bt}$ is the ratio of regulated deposits over total liabilities of bank b in quarter t; *Total deposit ratio*$_{bt}$ is the ratio of all deposits over total liabilities of bank b in quarter t; *Assets*$_{bt}$ denotes total assets of bank b in quarter t; *Equity ratio*$_{bt}$ is the ratio of equity over total assets of bank b in quarter t; *Liquidity ratio*$_{bt}$ is the ratio of cash and central-bank reserves (i.e., liquid assets) over total assets of bank b in quarter t; and *Gap*$_t$ is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate in month t. The summary statistics in Panels B, C, D, and E correspond to Tables 4, 7, 8, and 9, respectively, and the sample period is Q4 2010 to Q4 2015 (Tables 4, 7, and 8) and 2010 to 2015 (annual data, Table 9).

to determine the eligibility of bank loans to rated firms as collateral for Eurosystem funding (see Cahn, Duquerroy, and Mullins, 2019, for more details). The rating is an assessment of firms' ability to meet their financial commitments over a three-year horizon. The rating scale contains twelve ordered notches, a lower rating being synonymous with a lower probability of default and a higher rating with a higher probability of default.

Summary statistics. Table 2 presents summary statistics for all relevant samples and variables. In Panel A, we zoom in on our main sources of variation, namely bank-level variables, such as banks' regulated-deposit ratios, and the gap between the rate on regulated deposits (livret A) and the ECB's deposit facility rate. Regulated deposits account for almost one-third of total deposits and, thus, constitute an important source of retail funding. Gap_t ranges from approximately one to two percentage points, with a standard deviation of 0.4 percentage points, and we use its level at the end of each quarter in our analysis.

In Panel B, we move to the firm-bank-county-quarter level, the level of observation for all credit-registry-based regressions. On this basis, we aggregate data up to the ZIP-code-quarter level in Panel D. The aggregation at the bank-county-quarter level in Panel C is based on the Cefit dataset.[11] Finally, in Panel E, we include summary statistics for all outcome variables at the firm-year level for firms with balance-sheet data.

We also present summary statistics separately for banks with regulated-deposit ratios in the top and bottom half of the distribution in Table 3. Banks with higher regulated-deposit ratios are smaller in terms of assets, generally more dependent on deposits, and source their deposits primarily from households rather than corporations, whereas the opposite holds for banks with lower regulated-deposit ratios. In line with this, highly regulated-deposit dependent banks lend more to households and self-employed individuals, rather than firms, as compared to banks with regulated-deposit ratios in the bottom half.

As a consequence, more regulated-deposit dependent banks also have a larger fraction of medium- to long-term loans (0.90 vs. 0.63). While this is substantially driven by the greater portion of mortgage lending in those banks' loan portfolios, the fraction of medium-

[11] In Panel C, firms' average ratings, which are used to identify risky firms, are calculated from rating data merged with the credit registry.

Table 3: High- vs. Low-regulated-deposit Banks

Banks with regulated-deposit ratios in the top half	Mean	p5	p25	Median	p75	p95	Std. dev.	N
Total deposit ratio$_{bt}$	0.58	0.36	0.45	0.57	0.69	0.93	0.17	1,836
$\frac{\text{Household deposits}}{\text{Total deposits}}$	0.56	0.34	0.42	0.52	0.72	0.85	0.17	1,836
$\frac{\text{Corporate deposits}}{\text{Total deposits}}$	0.34	0.10	0.22	0.38	0.44	0.50	0.13	1,836
Total loans in billion €	10.88	0.34	5.40	8.17	12.00	26.22	14.30	1,836
Corporate loans in billion €	2.65	0.10	1.23	2.05	3.07	6.31	3.34	1,836
Mortgages in billion €	5.58	0.16	2.37	3.78	5.52	14.19	8.86	1,836
Loans to self-employed in billion €	1.03	0.02	0.34	0.75	1.37	2.28	1.42	1,836
$\frac{\text{MLT loans}}{\text{Total loan portfolio}}$	0.90	0.84	0.89	0.91	0.92	0.94	0.04	1,836
$\frac{\text{MLT corporate loans}}{\text{Corporate loan portfolio}}$	0.57	0.40	0.52	0.58	0.65	0.71	0.11	1,836
Equity ratio$_{bt}$	0.02	0.00	0.01	0.02	0.03	0.07	0.02	1,836
Assets$_{bt}$ in billion €	18.25	0.65	7.97	12.50	18.62	53.96	28.40	1,836
Banks with regulated-deposit ratios in the bottom half								
Total deposit ratio$_{bt}$	0.44	0.01	0.20	0.44	0.66	0.92	0.28	1,837
$\frac{\text{Household deposits}}{\text{Total deposits}}$	0.32	0.00	0.02	0.35	0.52	0.83	0.27	1,819
$\frac{\text{Corporate deposits}}{\text{Total deposits}}$	0.58	0.11	0.36	0.55	0.89	1.00	0.29	1,819
Total loans in billion €	7.94	0.07	0.40	1.29	4.39	29.66	24.52	1,819
Corporate loans in billion €	3.11	0.02	0.11	0.54	1.66	13.13	8.71	1,819
Mortgages in billion €	2.27	0.00	0.00	0.02	0.95	8.76	8.10	1,819
Loans to self-employed in billion €	0.39	0.00	0.00	0.00	0.08	2.25	1.33	1,819
$\frac{\text{MLT loans}}{\text{Total loan portfolio}}$	0.63	0.03	0.40	0.76	0.89	0.97	0.31	1,819
$\frac{\text{MLT corporate loans}}{\text{Corporate loan portfolio}}$	0.51	0.00	0.36	0.50	0.66	1.00	0.28	1,837
Equity ratio$_{bt}$	0.06	0.00	0.01	0.03	0.07	0.19	0.09	1,837
Assets$_{bt}$ in billion €	46.52	0.14	0.72	2.42	9.64	303.15	169.45	1,837

All variables are measured at the bank-quarter level bt. Summary statistics in the top (bottom) panel are for banks with ratios of regulated deposits over total liabilities in the top (bottom) half of the distribution. *Total deposit ratio*$_{bt}$ is the ratio of all deposits over total liabilities of bank b in quarter t. Summary statistics on banks' lending activity correspond to the respective descriptions in Table 7, with the exception of $\frac{MLT\ corporate\ loans_{bt}}{Corporate\ loan\ portfolio_{bt}}$, which is the ratio of bank b's corporate loans with a maturity of more than one year over its total corporate-loan exposure (based on the data in Table 4). *Equity ratio*$_{bt}$ and *Assets*$_{bt}$ are, respectively, the ratio of equity over total assets and total assets of bank b in quarter t.

to long-term loans among their corporate loans is also higher (0.57 vs. 0.51), with a smaller standard deviation (0.11 vs. 0.28). Due to the stickiness of rates on regulated deposits, banks with higher regulated-deposit ratios obtain a low sensitivity by design, and seem to match it on their asset side by granting long-term loans. This is consistent with the observation in Drechsler, Savov, and Schnabl (2021) that U.S. banks match their interest rate sensitivities in spite of a large maturity mismatch between their asset and liability side.

2.3 Identification

We use the following specification to estimate how banks' funding costs affect their lending:

$$\begin{aligned} \ln(Credit)_{fbct} &= \beta_1 Deposit\ ratio_{bt-1} \times Gap_t + \beta_2 Deposit\ ratio_{bt-1} \\ &\quad + \mu_{fbc} + \theta_{ft} + \psi_{ct} + \epsilon_{fbct}, \end{aligned} \tag{1}$$

where $Credit_{fbct}$ measures the euro amount of debt outstanding between firm f and bank b's branch(es) in county c in quarter t, $Deposit\ ratio_{bt-1}$ is the ratio of regulated deposits over total liabilities of bank b in quarter $t-1$, which is assigned to all branches of bank b, Gap_t is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate (in %) at the end of quarter t. μ_{fbc}, θ_{ft}, and ψ_{ct} denote firm-bank-county, firm-quarter, and bank b's county-quarter fixed effects, respectively. We cluster standard errors at the bank level, which corresponds to our level of identifying variation.

Our coefficient of interest, β_1, captures the extent to which banks that rely more on regulated deposits, rather than other types of liabilities (e.g., ordinary deposits or interbank funding), alter their lending when the gap between the rate on regulated deposits and the monetary-policy rate changes. Under the assumption that otherwise-funded banks experience perfect pass-through of the ECB's deposit facility (DF) rate to their funding costs, $Deposit\ ratio_{bt-1} \times Gap_t$ is the difference in average funding costs for banks more dependent on regulated deposits and all other banks, including those that rely exclusively on other sources of funding. In a robustness check, our estimates hold up to explicitly differentiating between interbank-funded banks and those funded only by non-regulated deposits.

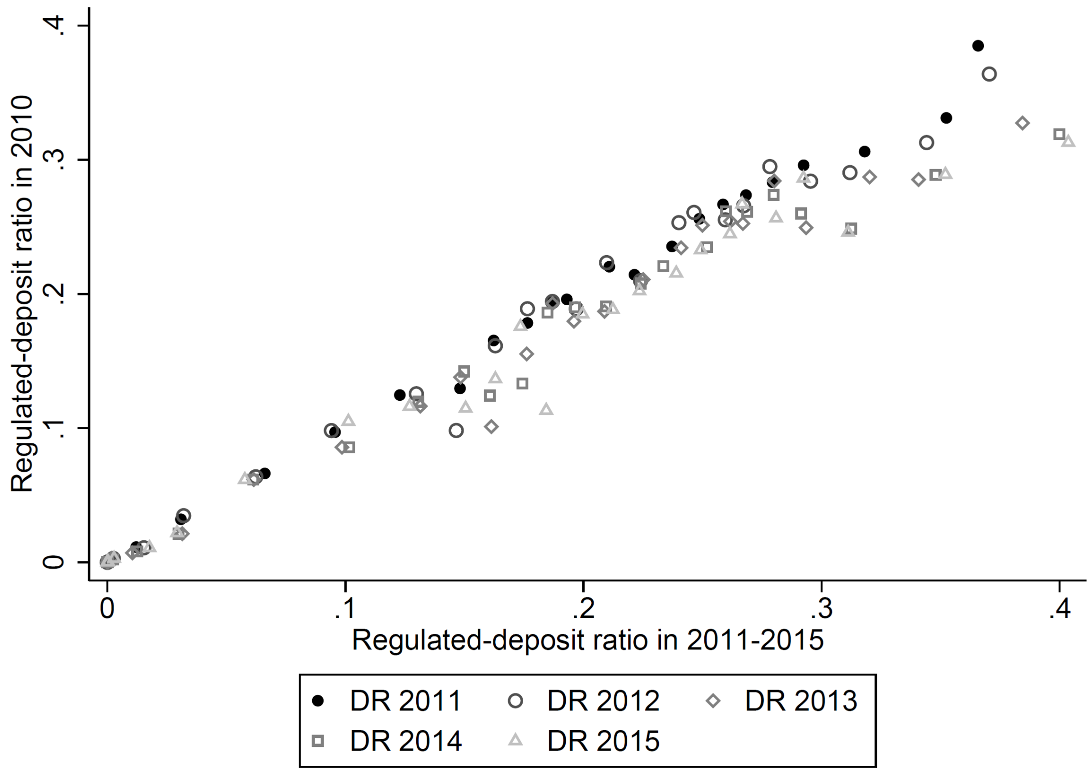

Figure 2: **Variation of Regulated-deposit Ratios within Banks over Time.** The figure shows a binscatter plot of bank-level regulated-deposit ratios, $Deposit\ ratio_{bt}$, in 2010 (y-axis) vs. $2011-2015$ (x-axis).

As such, β_1 reflects the elasticity of banks' credit supply with respect to their funding costs, measured in our setting by the relative cost of regulated deposits vis-à-vis other sources of funding. This relative cost varies with the relative cost per euro of regulated deposits (Gap_t) and the share of regulated deposits over total bank liabilities ($Deposit\ ratio_{bt-1}$).

Figure 2 plots the persistence in the share of regulated deposits over different horizons (from 2010 to 2011 up to 2015). The correlation aligns very well with the 45-degree line, with deviations from it that can be explained by the exogenously imposed time variation in transfer rates to the CDC (see Table 1). This is consistent with our argument that banks cannot adjust their exposure to regulated deposits even in the medium run. Therefore, our estimated empirical elasticity of banks' credit supply is unlikely to reflect differences in their ability to substitute across marginal sources of funding.

Our regression specification with multiple high-dimensional fixed effects addresses several potential sources of endogeneity. μ_{fbc} are borrower-by-bank county (i.e., comprising all branches of a given bank in a given county) fixed effects that remove time-invariant unobserved heterogeneity across borrower-lender pairs. This accounts for potential differences in sorting motives between borrowers and lenders. This also implies that our treatment effect is estimated only for the intensive margin, within an existing borrower-lender pair, and does not depend on the creation/destruction of new bank-firm relationships.

We control for time-varying unobserved heterogeneity across firms that might affect their credit *demand* by including borrower-by-quarter fixed effects θ_{ft}. The cost of doing so is that our coefficient of interest is only identified for firms borrowing from multiple lenders, as otherwise the time-varying bank-level shock would be perfectly collinear with the firm-by-quarter fixed effects.

How well these fixed effects control for demand depends on the potential existence of loan demand that is specific to certain types of banks, which could stem from a correlation of banks' business models with their reliance on (regulated) deposits. We address this concern by showing that our results are quantitatively unchanged when we compare the credit-supply response of regulated-deposit dependent banks with that of banks funded by other types of deposits, rather than through the interbank market. Such comparison holds constant loan demand driven by endogenous matching between borrowers and lenders with specific characteristics that are related to their funding structure (deposits vs. interbank funding). As generally deposit-reliant banks pursue similar business models, differential loan demand correlated with variation in banks' business models is unlikely to drive our results.

Because borrowers are not necessarily located in the same county as the bank branches from which they obtain loans, we can also include bank county-by-quarter fixed effects ψ_{ct}.[12] This set of fixed effects controls for time-varying unobserved differences across counties where the credit-granting branches of bank b are based. Therefore, β_1 is estimated by comparing different banks (and their branches) in the same county lending to the same firm over time.[13]

After including all of the above-mentioned fixed effects, the remaining source of potential

[12] Within the subset of firms borrowing from multiple banks, 38% borrow from at least one bank located in a different county.

[13] What is more, if firms borrowing from multiple banks across different counties share the same motivation for additionally sourcing credit from a bank branch in another county, bank county-by-quarter fixed effects also capture location-specific credit demand.

Table 4: Average Effect of Funding Costs on Credit Supply

	ln(Credit) (1)	ln(Credit) (2)	ln(Credit) (3)	ln(Credit) (4)	ln(Credit) (5)	ln(Credit) (6)	ln(Credit) (7)
Deposit ratio × Gap	-0.103***	-0.168***	-0.156***	-0.170***	-0.168***	-0.169***	
	(0.029)	(0.050)	(0.055)	(0.048)	(0.051)	(0.049)	
Deposit ratio	0.151	0.140	0.262*	0.120	0.134	0.122	-0.021
	(0.096)	(0.122)	(0.153)	(0.114)	(0.095)	(0.096)	(0.116)
Total deposit ratio × Gap			0.016				
			(0.024)				
Total deposit ratio			-0.164**				
			(0.082)				
Equity ratio × Gap				0.258		0.263	
				(0.225)		(0.220)	
Equity ratio				0.042		0.025	
				(0.578)		(0.559)	
Bank size × Gap					0.001	0.001	
					(0.002)	(0.002)	
Bank size					-0.008	-0.003	
					(0.036)	(0.035)	
Deposit ratio × Gap in top tercile							-0.148***
							(0.051)
Deposit ratio × Gap in 2^{nd} tercile							-0.038
							(0.033)
Firm-bank-county FE	✓	✓	✓	✓	✓	✓	✓
Firm-quarter FE	✓	✓	✓	✓	✓	✓	✓
County-quarter FE	✓	✓	✓	✓	✓	✓	✓
BHC-quarter FE		✓	✓	✓	✓	✓	✓
N bank clusters	196	196	196	196	196	196	196
N	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974
R^2	0.94	0.94	0.94	0.94	0.94	0.94	0.94

The level of observation is credit to firm f by bank b's branch(es) in county c in quarter t. The sample period is Q4 2010 to Q4 2015. The dependent variable is the natural logarithm of the euro amount of debt outstanding between firm f and bank b's branch(es) in county c in quarter t. *Deposit ratio*$_{bt-1}$ is the ratio of regulated deposits over total liabilities of bank b in quarter $t-1$. *Total deposit ratio*$_{bt-1}$ is the ratio of all deposits over total liabilities of bank b in quarter $t-1$. *Equity ratio*$_{bt-1}$ is the ratio of equity over total assets of bank b in quarter $t-1$. *Bank size*$_{bt-1}$ is the natural logarithm of total assets of bank b in quarter $t-1$. *Gap*$_t$ is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate (in %) at the end of quarter t. *Gap in top* (2^{nd}) *tercile*$_t$ is a dummy variable for whether *Gap*$_t$ ranges in the top (middle) tercile of its distribution. Robust standard errors (clustered at the bank level) are in parentheses.

endogeneity is that time-varying bank-level shocks are correlated with our shock to banks' funding costs. While it is impossible to fully solve this problem since this is our level of identifying variation, we partially address this issue in two ways.

First, we estimate equation (1) with banking group (BHC)-by-quarter fixed effects.[14] In this manner, we only exploit differences across banks belonging to the *same* banking group and, thus, control for time-varying unobserved differences at this more aggregate level that may affect credit supply (e.g., differences in bank business models at the group level or broader wholesale funding shocks). Second, we additionally control for interactions of Gap_t with other bank-level characteristics (size and leverage).

3 Results

3.1 Average Effect on Credit Supply

In the first column of Table 4, we estimate equation (1), using as $Deposit\ ratio_{bt-1}$ the ratio of regulated deposits over total liabilities in quarter $t-1$. We find that regulated-deposit dependent banks reduce their lending when the interest they have to pay on these deposits increases. This estimate becomes even larger after the inclusion of BHC-quarter fixed effects in column 2 (our preferred specification), which suggests imperfect internal capital markets within banking groups.[15] As $Deposit\ ratio_{bt-1} \times Gap_t$ measures the difference in funding costs incurred by any bank with non-zero regulated deposits vs. banks whose cost of funding is aligned with the monetary-policy rate, our estimate in column 2 implies that banks contract their lending by 16.8% if they incur one percentage point higher funding costs.

To estimate the elasticities of different outcomes with respect to the average cost of funding, one can apply the standard formula:

$$elasticity^{Y}_{Cost_{funding}} = \Delta \ln(Y) / \left[(Cost^{new}_{funding} - Cost^{old}_{funding}) / Cost^{old}_{funding} \right].$$

[14] We have 69 banking groups in our sample.

[15] If banking groups were able to reallocate well resources across their different banks, we should find a smaller, i.e., less negative, point estimate in column 2, as the reallocation would allow banks belonging to the same group to immunize themselves against any bank-level shocks that could affect their lending.

Since the average value for Gap_t is 147 basis points, we can set $Cost^{old}_{funding}$ equal to 1.47 and we can compute $\Delta\ln(Y)$ from our reduced-form regressions. $\Delta\ln(Y)$ is estimated to be -0.168 when funding costs increase by 100 basis points, which implies an elasticity of $-0.168/(1/1.47) = -0.25$.

So far, our coefficient of interest is estimated by comparing banks more dependent on regulated deposits with all other types of banks, i.e., those funded by other types of deposits or through the interbank market. By effectively pooling together these banks, we implicitly assume that their funding costs are aligned with the monetary-policy rate.

In column 3, we relax this assumption, and split up this group of banks into deposit-funded and interbank-funded banks by using only the latter as the omitted category. For this purpose, we include as a control variable $\textit{Total deposit ratio}_{bt-1}$, the ratio of all deposits, including regulated deposits, over total liabilities of bank b in quarter $t-1$, interacted with Gap_t. The effect of $\textit{Deposit ratio}_{bt-1} \times Gap_t$ is quantitatively unchanged, while the point estimate for $\textit{Total deposit ratio}_{bt-1} \times Gap_t$ is close to zero (and statistically insignificant). This implies that our estimated effect of funding costs on bank lending is virtually invariant to choosing either type of banks as a comparison group for regulated-deposit dependent banks. Controlling for $\textit{Total deposit ratio}_{bt-1} \times Gap_t$ also allows us to hold constant any shared characteristics of banks relying more on deposits—regulated or not—that could govern credit-supply responses to fluctuations in Gap_t.

In columns 4 to 6, we address the related concern that regulated-deposit dependent banks may have other balance-sheet characteristics that affect the sensitivity of their credit supply to variation in Gap_t. As the latter can also stem from changes in the monetary-policy rate, we consider bank characteristics that govern the transmission of monetary policy to credit supply through bank net worth, namely leverage (Kishan and Opiela, 2000; Jiménez, Ongena, Peydró, and Saurina, 2012) and size (Kashyap and Stein, 1995). In columns 4 and 5, we add banks' equity ratio and size (measured by the natural logarithm of their assets), respectively, and their interactions with Gap_t, and control for both simultaneously in column 6. In all three cases, our coefficient of interest on $\textit{Deposit ratio}_{bt-1} \times Gap_t$ remains quantitatively unchanged compared to the baseline estimate in column 2.

Table 5: Average Effect of Funding Costs on Credit Supply: Difference-in-Differences

Treatment definition	ln(Credit) Dep. ratio Q3 2010 (1)	ln(Credit) Top 50% (2)	ln(Credit) Top 25% (3)	ln(Credit) Incumbent banks (4)
Treatment × High-gap period	-0.225***	-0.016*	-0.029***	-0.042***
	(0.048)	(0.008)	(0.009)	(0.009)
Firm-bank-county FE	✓	✓	✓	✓
Firm-quarter FE	✓	✓	✓	✓
County-quarter FE	✓	✓	✓	✓
BHC-quarter FE	✓	✓	✓	✓
N bank clusters	190	190	190	190
N	3,384,752	3,384,752	3,384,752	3,384,752
R^2	0.95	0.95	0.95	0.95

The level of observation is credit to firm f by bank b's branch(es) in county c in quarter t. The sample period is Q4 2011 to Q4 2015. The dependent variable is the natural logarithm of the euro amount of debt outstanding between firm f and bank b's branch(es) in county c in quarter t. $Treatment_b$ is a time-invariant characteristic at the bank level b. In column 1, it is equal to the ratio of regulated deposits over total liabilities of bank b in Q3 2010. In columns 2 and 3, it is defined as an indicator variable for whether bank b's regulated-deposit ratio in Q3 2010 is, respectively, in the top half or quartile of the bank-level distribution. In column 4, $Treatment_b$ is a dummy variable for whether bank b is one of the "incumbent banks," i.e., Caisses d'Epargne et de Prévoyance or Crédit Mutuel. $High\text{-}gap\ period_t$ is a dummy variable for the period from Q4 2011 up until (and including) Q2 2013, which is characterized by a high value of Gap_t, the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate. Robust standard errors (clustered at the bank level) are in parentheses.

In column 7, we estimate the effect of a change in the relative cost of regulated deposits nonparametrically by replacing Gap_t with two indicator variables that equal one if Gap_t belongs to the top or middle tercile of its distribution, respectively. The top tercile comprises all observations with a value of Gap_t of at least 150 basis points, and the middle tercile comprises all observations with a value of Gap_t of at least 120 (but fewer than 150) basis points. Therefore, the coefficient on $Deposit\ ratio_{bt-1}$ now captures the effect for regulated-deposit dependent banks when Gap_t is less than 120 basis points.

We find that the effect of funding costs on credit supply is highly nonlinear. It becomes negative and significant (at the 1% level) only for values of Gap_t in the top tercile, while there is no discernible difference in credit supply between regulated-deposit dependent banks relative to all other banks when Gap_t is below 150 basis points. As the average bank holds 14% of its liabilities in regulated deposits (see Panel A of Table 2), this implies that banks can sustain up to ($0.14 \times 150 =$) 21 basis points higher average funding costs before they

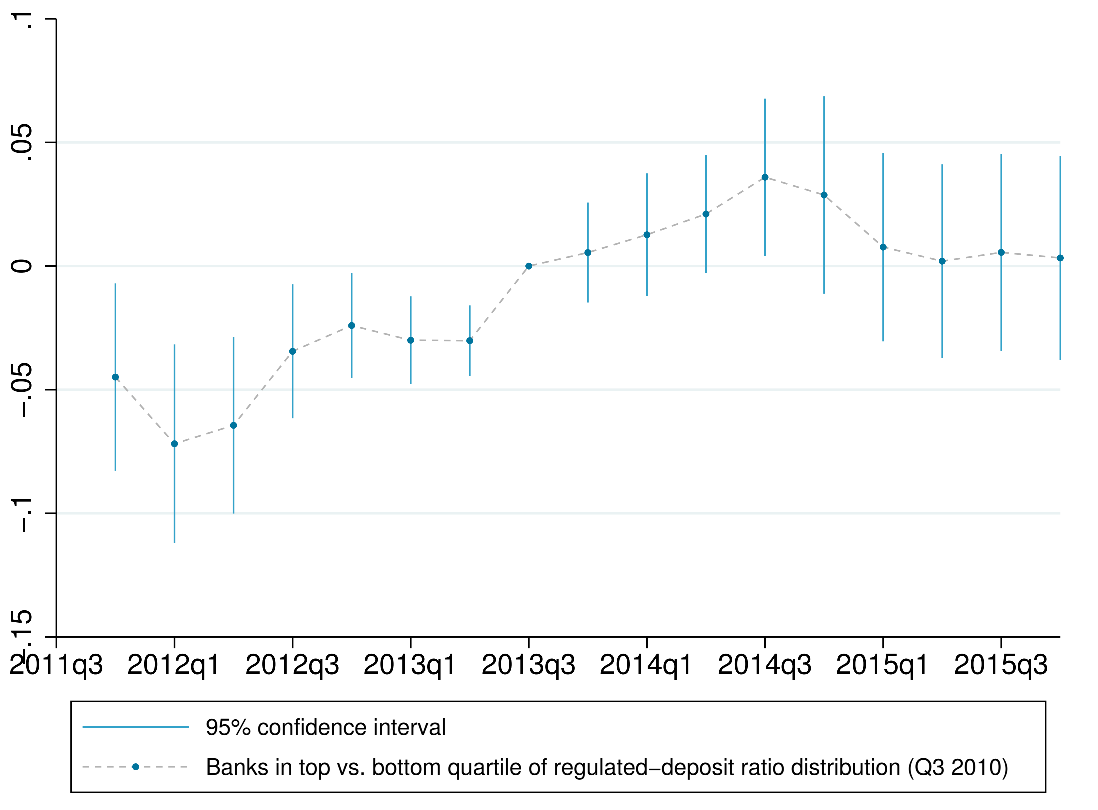

Figure 3: **Low vs. High Funding-cost Gap and Lending by Regulated-deposit Dependent Banks.** This figure plots β_k over time from estimating the following regression specification from Q4 2011 to Q4 2015 at the quarterly frequency:

$$\ln(Credit)_{fbct} = \sum_{k=1,k\neq 8}^{17} \beta_k High\ deposits_b \times D_t^k + \mu_{fbc} + \theta_{ft} + \psi_{ct} + \xi_{j(b)t} + \epsilon_{fbct},$$

where $High\ deposits_b$ equals one when bank b's regulated-deposit ratio is in the top quartile of the distribution in Q3 2010, and zero if it is in the bottom quartile, and D_t^k is an indicator variable for the k^{th} quarter-year starting in Q4 2011 ($k = 1$), with Q3 2013—the beginning of the low Gap_t period—being the omitted category ($k = 8$). In addition, $\xi_{j(b)t}$ denote banking group j (of bank b) by quarter fixed effects.

start contracting their lending.

Because the bank-level regulated-deposit ratio is stable over time (see Figure 2), we can replace our bank-level exposure measure by a pre-determined and time-invariant regulated-deposit ratio. In Tables A.1 and A.2 of the Online Appendix, we use the ratio of regulated deposits over the total liabilities of bank b in Q3 2010 and Q4 2010, respectively. Our estimates remain robust across all specifications.

Using a pre-determined time-invariant exposure variable also allows us to estimate a difference-in-differences specification with a pre- and a post-period. For this purpose, we zoom in on the sample from Q4 2011 until Q4 2015, during the first half of which (up until Q2 2013) Gap_t is high and ranges from 150 to 225 basis points. This is precisely the range that we have found to mark the nonlinear credit-supply response of regulated-deposit dependent banks (in column 7 of Table 4). Gap_t drops sharply to around 100 basis points thereafter (see Figure 1).

In column 1 of Table 5, we first use the time-invariant regulated-deposit ratio in Q3 2010 (as in Table A.1) and interact it with $\textit{High-gap period}_t$, an indicator variable for the period from Q4 2011 to Q2 2013. In line with the fact that this time period is characterized by high values of Gap_t that exceed those during the remaining sample period by over one percentage point, the difference-in-differences estimate is slightly larger than our baseline estimate in column 2 of Table 4. In columns 2 and 3 of Table 5, we replace the treatment-exposure variable by indicator variables for whether bank b's regulated-deposit ratio in Q3 2010 is, respectively, in the top half or quartile of the bank-level distribution. Compared to all remaining banks, those with a regulated-deposit ratio in the top quartile of the distribution contract their lending by 2.9% in the high-gap period as opposed to the low-gap period. Finally, in column 4, we yield an even larger estimate when using the incumbent banks that offered regulated deposits well before the 2008 reform and, as such, have significantly higher regulated-deposit ratios to start with (see Table 1).

Figure 3 plots the event-study version of Table 5, namely the estimated difference in credit supply for banks in the top vs. bottom quartile of the (time-invariant) ratio of regulated deposits over total liabilities (in Q3 2010) over time. Banks dependent on regulated deposits lend less during the high-gap period until Q2 2013. Thereafter, the funding-cost gap drops markedly and then stabilizes. The credit-supply difference between highly and weakly regulated-deposit dependent banks follows a similar pattern: it stabilizes and remains indistinguishable from zero in the period starting in Q4 2013 relative to the reference quarter Q3 2013.

Role of bank heterogeneity. In Table 6, we explore the heterogeneity across banks in their credit-supply response, by modifying the regression specification from column 2 of

Table 6: The Effect of Funding Costs on Credit Supply across Bank Characteristics

Bank characteristic	ln(Credit) Equity ratio (1)	ln(Credit) Low equity (2)	ln(Credit) Liquidity ratio (3)	ln(Credit) High liquidity (4)	ln(Credit) NPL share (5)	ln(Credit) High NPL (6)
Deposit ratio × Gap × Bank characteristic	3.566**	-0.161*	18.722***	0.164*	3.112**	0.240***
	(1.788)	(0.083)	(6.641)	(0.089)	(1.396)	(0.085)
Deposit ratio × Gap	-0.271***	-0.128**	-0.289***	-0.205***	-0.270***	-0.200***
	(0.065)	(0.059)	(0.063)	(0.058)	(0.077)	(0.053)
Deposit ratio × Bank characteristic	-6.387	0.087	-25.829*	-0.358	-11.058***	-0.546***
	(4.719)	(0.188)	(13.197)	(0.249)	(3.068)	(0.150)
Deposit ratio	0.322**	0.151	0.315*	0.248	0.486***	0.200*
	(0.149)	(0.161)	(0.190)	(0.152)	(0.174)	(0.118)
Bank characteristic × Gap	-0.228	0.010	-2.062**	-0.023	-0.339	-0.033**
	(0.242)	(0.018)	(0.894)	(0.015)	(0.244)	(0.014)
Bank characteristic					1.648***	0.077***
					(0.621)	(0.026)
Firm-bank-county FE	✓	✓	✓	✓	✓	✓
Firm-quarter FE	✓	✓	✓	✓	✓	✓
County-quarter FE	✓	✓	✓	✓	✓	✓
BHC-quarter FE	✓	✓	✓	✓	✓	✓
N bank clusters	196	196	196	196	196	196
N	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974
R^2	0.94	0.94	0.94	0.94	0.94	0.94

The level of observation is credit to firm f by bank b's branch(es) in county c in quarter t. The sample period is Q4 2010 to Q4 2015. The dependent variable is the natural logarithm of the euro amount of debt outstanding between firm f and bank b's branch(es) in county c in quarter t. *Deposit ratio*$_{bt-1}$ is the ratio of regulated deposits over total liabilities of bank b in quarter $t-1$. *Gap*$_t$ is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate (in %) at the end of quarter t. In the first four columns, *Bank characteristic*$_b$ is a time-invariant bank-level characteristic, namely bank b's continuous ratio of equity over total assets (column 1), an indicator for whether its equity-to-assets ratio is in the bottom tercile of the bank-level distribution (column 2), the continuous ratio of bank b's cash and central-bank reserves (i.e., liquid assets) over total assets (column 3), and an indicator for whether its ratio of cash and central-bank reserves over total assets is in the top tercile of the bank-level distribution (column 4), all measured at the beginning of the sample period (Q3 2010). In columns 5 and 6, *Bank characteristic*$_{bt-1}$ is based on bank b's share of non-performing loans (NPLs) out of total loans, and the respective variable in column 6 is an indicator for whether its share of NPLs out of total loans is in the top tercile of the bank-level distribution, in quarter $t-1$. Robust standard errors (clustered at the bank level) are in parentheses.

Table 4 to include interactions with different bank characteristics.

We first consider banks' capitalization, as reflected by their (time-invariant) equity-to-assets ratio at the beginning of our sample period. In column 1, higher funding costs depress bank lending less for strongly capitalized banks. In column 2, we show that there is a distinct negative effect on credit supply by low-equity banks, which we characterize as banks with equity-to-assets ratios in the bottom tercile of the distribution. These estimates lend support to the idea that banks' funding costs affect their credit supply through a change in their expected net worth, and this sensitivity becomes stronger when banks are closer to the default threshold. This can also explain the nonlinearity of banks' credit-supply response to higher funding costs (cf. column 7 in Table 4)

In column 3, we show a similar effect for low-liquidity banks, i.e., banks with a relatively low ratio of cash and central-bank reserves to total assets (measured again at the beginning of the sample period). This is consistent with the idea that banks' credit-supply response is amplified when they cannot absorb the funding-cost increase and are, thus, more likely to experience a reduction in their expected net worth. In column 4, where we use a discrete variable based on the distribution of liquidity ratios, we see that the effect is driven primarily by high-liquidity banks lending disproportionately more.

In columns 5 and 6, we consider banks' share of non-performing loans (NPLs) out of total loans in the previous quarter. For both the continuous and the discrete version of the variable, with the latter capturing banks in the top tercile of the distribution, we find that high-NPL banks' lending response is positively related to their funding costs. This suggests that banks gamble for resurrection in the face of higher funding costs.

Robustness checks. We present a battery of robustness checks in the Online Appendix. In Table A.3, our results are robust to controlling for *Deposit ratio transferred to* CDC_{bt-1}, which is the fraction T_{bt} of regulated deposits (no longer on bank b's balance sheet) transferred to the CDC over total liabilities of bank b in quarter $t-1$. In this manner, we account for intermediary commissions, which tend to be time-invariant and as such are unlikely to covary with Gap_t, received by bank b in exchange for deposits transferred to the CDC for the purpose of financing social housing (see Section 2.1.2).

In Table A.4, we show that our estimates are robust to different definitions of *Deposit* $ratio_{bt}$. Using the Banque de France's Cefit database, we can construct deposit ratios at the more granular bank-county level. The data are broken down by the same types of depositors as in the regulatory data, but cannot perfectly isolate regulated deposits. As such, we can only observe "special deposits," defined as regulated deposits plus ordinary savings.[16] In the first two columns, we re-run the same specifications as in columns 1 and 2 of Table 4, using as our exposure variable the special-deposit ratio at the bank-county-quarter level $bct - 1$. The results are qualitatively similar, but the estimates are somewhat weaker. Any differences between the estimates in the first two columns and those in Table 4 do not stem from the definition of the deposit ratio employed in the latter table, however. To verify this, we re-run the same two regressions, and modify the bank-level deposit ratio according to the definition in the first two columns. The estimated coefficients on the relevant interaction term in Table A.4 are similar to those in Table 4.

Finally, we revisit the timing of our treatment-exposure variable, *Deposit* $ratio_{bt-1}$. We use lagged regulated-deposit ratios to safeguard that our identifying variation does not stem from changes in the amount of regulated deposits but, rather, in the difference between the livret-A rate and the monetary-policy rate. We validate this by lagging *Deposit* $ratio_{bt-2}$ by another quarter and re-running all regressions from Table 4. The results in Table A.5 are virtually unaltered, implying that changes in the quantity of regulated deposits cannot explain our findings. We provide additional evidence that a change in the quantity of regulated deposits in reaction to a change in their price is unlikely to affect our results by showing that (post-transfer) regulated deposits are barely sensitive to variation in the difference between the livret-A and the deposit facility rate. As can be seen in Figure B.1, the growth rate of banks' regulated deposits comoves weakly with the contemporaneous Gap_t.[17]

[16] In addition, bank liabilities are not fully observable in this more granular dataset. Thus, we use total deposits plus commercial paper as a proxy for total liabilities. We adjust deposit amounts for the percentage of deposits transferred to the CDC by using the same percentages as for the regulatory data. Let S_{bt} be the share of eligible deposits of bank b in quarter t, then: *Deposit ratio*$_{bct} = (S_{bt} \times (1 - T_{bt}) \times \textit{Special deposits}_{bct} + (1 - S_{bt}) \times \textit{Special deposits}_{bct})/\textit{Total liabilities}_{bct}$. The data are available from Q1 2010 to Q4 2015.

[17] This is even more so the case if one takes into account that the government increased the maximum amount of regulated deposits per person by 25% in Q4 2012 and another 20% in Q1 2013.

Table 7: Reallocation of Credit: Bank-county-level Data

	Large firms / Corporate loans	Large firms / Total loans	Small firms / Total loans	Loans to self-employed / Total loans	High-bankruptcy industries / Total loans	Risky firms / Rated firms	MLT loans / Total loans
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Deposit ratio × Gap	-0.122***	-0.034**	0.064***	0.026***	0.146**	0.133**	0.039*
	(0.045)	(0.016)	(0.023)	(0.007)	(0.063)	(0.060)	(0.023)
Deposit ratio	0.425***	0.109**	-0.176***	-0.058**	-0.041	-0.310*	-0.046
	(0.154)	(0.046)	(0.062)	(0.023)	(0.187)	(0.170)	(0.061)
Bank-county FE	✓	✓	✓	✓	✓	✓	✓
County-quarter FE	✓	✓	✓	✓	✓	✓	✓
BHC-quarter FE	✓	✓	✓	✓	✓	✓	✓
N county clusters	148	148	148	148	146	138	148
N	28,063	28,063	28,063	28,063	27,139	26,336	28,063
R^2	0.69	0.71	0.74	0.96	0.78	0.71	0.88

The level of observation is all credit granted by bank b's branch(es) in county c in quarter t. The sample period is Q4 2010 to Q4 2015. The dependent variable in column 1 is the ratio of loans to large firms (with sales in excess of €1m) over corporate loans of bank b's branch(es) in county c in quarter t. The dependent variable in column 2 is the ratio of loans to large firms over total loans of bank b's branch(es) in county c in quarter t. The dependent variable in column 3 is the ratio of loans to small firms (with sales up to €1m) over total loans of bank b's branch(es) in county c in quarter t. The dependent variable in column 4 is the ratio of loans to self-employed individuals over total loans of bank b's branch(es) in county c in quarter t. The dependent variable in column 5 is the ratio of loans to firms in (three-digit) industries with above-median occurrences of bankruptcies over total loans of bank b's branch(es) in county c in quarter t. The dependent variable in column 6 is the ratio of loans to firms with a credit rating above 4 on the Banque de France's credit-rating scale (higher rating = closer to default) over all loans to rated firms (with balance-sheet data) granted by bank b's branch(es) in county c in quarter t. The dependent variable in column 7 is the ratio of medium- to long-term loans over total loans of bank b's branch(es) in county c in quarter t. *Deposit ratio*$_{bt-1}$ is the ratio of regulated deposits over total liabilities of bank b in quarter $t-1$. *Gap*$_t$ is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate (in %) at the end of quarter t. Robust standard errors (clustered at the bank level) are in parentheses.

3.2 Reallocation of Credit

Bank loan-portfolio analysis. The change in credit supply we identify so far could mask an even larger credit reallocation if banks rebalance their portfolios towards higher-yielding loans so as to shield their profits (and ultimately net worth) from an increase in their funding costs. To test this hypothesis, we complement the credit registry with a bank-county-level dataset (Cefit) that provides more detailed information on the recipients of credit, and additionally has credit information for non-corporate debtors, especially self-employed individuals (which are not covered in the credit registry).

In Table 7, the level of observation is a bank-county-quarter bct, summarizing information on all branches of a given bank b in county c and quarter-year t. In columns 1 to 5, we estimate the adjustment of banks' loan portfolios across borrower types, and use as dependent variables the ratios of loans accruing to different borrower types over bank b's total loan portfolio. In column 1, we find that following an increase in funding costs, affected banks reduce their loan exposure to large firms (with sales >€1m) in the credit registry. In column 2, this effect survives when we compare banks' loan exposure to large firms to their total loan portfolios (comprising not only corporate lending, as captured by the credit registry, but loans to all kinds of borrowers). Affected banks compensate by reallocating loans to small firms (with sales ≤€1m) for the most part (column 3) and to self-employed individuals (column 4).[18]

To the extent that small firms make for potentially riskier borrowers than large firms, affected banks increasing their loan-portfolio exposure to smaller borrowers suggests that they take on more risk in search of higher yields when they face higher funding costs. We provide further evidence of banks' risk taking in two ways. First, in column 5, we show that banks incurring higher average funding costs increase their exposure to firms with a higher risk of bankruptcy. For this purpose, we compute the ex-post bankruptcy probability at the industry level,[19] and use as our dependent variable the ratio of loans to firms in industries

[18] Note that this does not necessarily imply an increase in credit supply to small firms and self-employed individuals; instead, their relative importance in affected banks' loan portfolio increases.

[19] Based on additional data from the Banque de France (CCR) on bankruptcies and payment delinquencies, we use for each (three-digit) industry the total number of such events and scale it by the number of firms (available in these data) in the respective industry.

with above-median occurrences of bankruptcies over total loans.

Second, we exploit the credit ratings assigned by the Banque de France. To compute the proportion of loans accruing to risky firms, we label a firm as "risky" if it receives a rating worse than 4, which used to be the minimum rating required for a firm's loans to be eligible as collateral for the ECB (Cahn, Duquerroy, and Mullins, 2019). One drawback of this measure is that the Banque de France provides credit ratings only for firms with balance-sheet information.[20] Column 6 reports the result, and shows that regulated-deposit dependent banks increase their loan exposure to risky firms when their funding costs increase.

Our final test to study if banks reach for yield is to explore whether higher funding costs also induce banks to extend loans with a longer maturity. To this end, we compute the fraction of medium- to long-term loans in banks' loan portfolios and use it as dependent variable in column 7. The positive and significant coefficient on the interaction term $\textit{Deposit ratio}_{bt-1} \times \textit{Gap}_t$ confirms that when their funding costs increase, affected banks increase the average maturity of their loan portfolios.

To quantify the extent of credit reallocation, we can focus on corporate borrowers, the universe of which can be divided into large (safe) vs. small (risky) firms, representing, respectively, 43.75% and 56.25% of banks' average corporate-loan portfolios (see summary statistics in the first two rows of Panel C of Table 2). Column 1 of Table 7 implies that in response to a one-percentage-point increase in funding costs, these average portfolio allocations change to 31.55% and 68.45%. Using the estimated drop in net credit supply to firms of 10.3% up to 16.8% in response to the same funding-cost shock (from columns 1 and 2 of Table 4), we can compare the underlying reduction in credit supply to large firms and the subsequent increase therein to small firms.

To explain the decrease in its portfolio share to 31.55%, credit to large firms must have dropped by $(1 - 31.55\%/(43.75\%/(1 - 10.3\%)) =)$ 35.3% up to $(1 - 31.55\%/(43.75\%/(1 - 16.8\%)) =)$ 40.0%. This implies that credit to small firms has increased by 9.2% (in the former scenario) or 1.2% (in the latter scenario). After multiplying these percent changes with the respective average portfolio shares, we back out that $((1.2\% \times 56.25\%)/(40.0\% \times$

[20] As such, we need to limit the denominator of the dependent variable to firms with sales of €750,000 or more.

43.75%) =) 4% up to ((9.2% × 56.25%)/(35.3% × 43.75%) =) 33% of the drop in credit supply to large firms is reallocated to small firms.

Looking beyond banks' corporate-loan portfolio, our remaining estimates in Table 7 suggest even more credit reallocation across different borrowers, e.g., self-employed individuals. These significant reallocative effects, which can only be measured using granular credit-registry data, imply that analyses that focus on net credit supply alone likely underestimate the true effect of bank-level shocks on the real economy. In the extreme case, banks might be able to rebalance their loan portfolio enough to fully insulate their profits and, thus, ultimately their net worth. As a result, their net credit supply might not change at all, but the rebalancing can still have substantial real effects because in the presence of heterogeneous firms, credit reallocation affects aggregate productivity even when holding constant the overall amount of credit in the economy (e.g., Baqaee, Farhi, and Sangani, 2021; Bau and Matray, 2023).

City-level analysis. To assess whether affected banks' yield-seeking behavior is also reflected in the allocation of credit at a more aggregate level, we adopt a "local lending market" approach where we aggregate all our variables at the city (ZIP code) level. To do so, we compute a weighted average of bank dependence on regulated deposits to provide us with a city-level credit shock, and treat all cities as small independent economies facing an "aggregate shock." This type of geographical approach is designed to capture "semi-aggregate" effects (e.g., Greenstone, Max, and Nguyen, 2020).[21]

To construct the city-wide shock, we use a shift-share approach by considering the funding structure of all banks lending to firms in a given ZIP code. Namely, for each bank b lending to firms f in ZIP code k,[22] we weight the bank-level deposit ratio by the respective bank b's lagged share of all loans in ZIP code k:

$$Deposit\ ratio_{kt} = \sum_{f \in k} \frac{Credit_{fbt-1}}{\sum_{f \in k} Credit_{fbt-1}} Deposit\ ratio_{bt}, \tag{2}$$

[21] These are "semi aggregate" because while they measure the change in credit at the city level, by construction these are still reduced-form elasticities estimated relative to the control group that is assumed to be unaffected.

[22] There are around 33,000 distinct cities in France, each belonging to only one county.

Table 8: Aggregate Credit Effects of Shocks to Banks' Funding Costs

	ln(Total credit)	Large firms / Total credit	High-bankruptcy ind. / Total credit	MLT credit / Total credit	ln(Total credit)	Large firms / Total credit	High-bankruptcy ind. / Total credit	MLT credit / Total credit
Sample	All	All	All	All	> 5 firms	> 5 firms	> 5 firms	> 5 firms
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Deposit ratio × Gap	-0.143***	-0.080***	0.062***	0.064***	-0.362***	-0.126***	0.124***	0.045***
	(0.055)	(0.014)	(0.020)	(0.017)	(0.059)	(0.025)	(0.025)	(0.016)
Deposit ratio	0.027	-0.012	-0.260***	0.173***	-0.906***	-0.125**	-0.213***	-0.002
	(0.109)	(0.027)	(0.040)	(0.033)	(0.140)	(0.053)	(0.054)	(0.031)
ZIP-code FE	✓	✓	✓	✓	✓	✓	✓	✓
County-quarter FE	✓	✓	✓	✓	✓	✓	✓	✓
N ZIP-code clusters	33,046	33,046	33,035	33,046	19,142	19,142	19,140	19,142
N	664,654	664,654	663,190	664,654	353,722	353,722	353,655	353,722
R^2	0.96	0.87	0.80	0.68	0.97	0.87	0.80	0.76

The level of observation is the ZIP-code-quarter level kt. The sample period is Q4 2010 to Q4 2015. In the last four columns, the sample is limited to ZIP codes with more than five firms (with records in the credit registry). The dependent variable in columns 1 and 5 is the natural logarithm of the total euro amount of debt outstanding of all firms in ZIP code k in quarter t. The dependent variable in columns 2 and 6 is the ratio of all loans accruing to large firms (with sales in excess of €1m) over the total euro amount of debt outstanding of all firms in ZIP code k in quarter t. The dependent variable in columns 3 and 7 is the ratio of all loans accruing to firms in (three-digit) industries with above-median occurrences of bankruptcies over the total euro amount of debt outstanding of all firms in ZIP code k in quarter t. The dependent variable in columns 4 and 8 is the ratio of all medium- to long-term loans over the total euro amount of debt outstanding of all firms in ZIP code k in quarter t. *Deposit* $ratio_{kt-1}$ is the loan-exposure-weighted average *Deposit* $ratio_{bt-1}$ of the lenders to all firms in ZIP code k in quarter $t-1$ (see (2)), where *Deposit* $ratio_{bt-1}$ is the ratio of regulated deposits over total liabilities of bank b in quarter $t-1$. Gap_t is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate (in %) at the end of quarter t. Robust standard errors (clustered at the ZIP-code level) are in parentheses.

where $Credit_{fbt-1}$ measures the euro amount of debt outstanding between firm f and (all branches of) bank b in quarter $t-1$, and $Deposit\ ratio_{bt}$ is the ratio of regulated deposits over total liabilities of bank b in quarter t.

We then estimate the following specification at the ZIP-code-quarter level kt:

$$y_{kt} = \beta_1 Deposit\ ratio_{kt-1} \times Gap_t + \beta_2 Deposit\ ratio_{kt-1} + \psi_{ct} + \delta_k + \epsilon_{kt}, \tag{3}$$

where y_{kt} is a variable based on the cross-section of loans granted to firms in ZIP code k in quarter t, and ψ_{ct} and δ_k denote county-quarter and ZIP-code fixed effects, respectively. Standard errors are clustered at the ZIP-code level.

While a higher level of aggregation allows us to estimate whether firms are able to substitute credit across differentially affected local lenders, it prevents us—by construction—from controlling for time-varying unobserved heterogeneity at the firm level. In order to ensure that cities are still as comparable as possible, we control for county-by-time fixed effects in order to at least compare only cities within the same county, without using any variation across counties. Such a strategy removes time-varying unobserved heterogeneity across counties, such as differences in credit demand, in business cycles and dynamism, or in industrial composition that may influence our estimates.

Table 8 reports the results for both the net supply of credit and its composition at the city level.[23] In column 1, we estimate equation (3) and use the natural logarithm of total (corporate) credit as dependent variable. We find a large negative coefficient, significant at the 1% level, implying that non-affected banks cannot perfectly compensate for the change in credit supply from affected banks.

$Deposit\ ratio_{kt-1} \times Gap_t$ captures the difference in the city-level weighted average funding costs of regulated-deposit dependent banks in relationships with firms in the respective cities vs. cities that are home to firms only in relationships with otherwise-funded banks. As such, our estimate in column 1 implies that cities see their credit drop by 14.3% if they face funding costs that are one percentage point higher, which is economically significant and almost as

[23] As for this exercise we require data on loan recipients' cities, all dependent variables are based on corporate-lending data from the credit registry.

large as the corresponding effect at the micro level (cf. column 2 of Table 4). This suggests that borrowers have limited ability to switch banks so as to smooth over credit-supply shocks, consistent with the existence of sticky lending relationships.[24]

In column 2 of Table 8, we use as dependent variable the fraction of loans to large vs. all firms. Consistent with affected banks' loan-portfolio rebalancing (in Table 7), we find again a large negative and highly significant effect. At the city level, credit contraction following adverse shocks to banks' funding costs affects primarily large rather than small firms.

In columns 3 and 4, we consider two additional dimensions of cross-sectional heterogeneity implied by Table 7, the respective dependent variables of which we can compute at the aggregate city level based on the credit-registry data. In column 3, we show that affected banks' risk taking in terms of lending to firms in risky industries (cf. column 5 of Table 7) also holds at the more aggregate level. Relatively safe firms—in industries with below-median occurrences of bankruptcies—cannot readily substitute their relative loss of credit access with other sources of bank credit. Similarly, in column 4, we find that affected banks' extension of longer-term loans (cf. column 7 of Table 7) is also reflected in our more aggregate estimates. All of these estimates are robust to, and at times become even larger after, removing ZIP codes with at most five firms (with records in the credit registry) in the last four columns of Table 8.

3.3 Firm-level Real Effects

Our city-level results show that a reduction in the supply of credit by regulated-deposit dependent banks during periods in which they have to pay higher interest on these deposits is not compensated for by an increase in the supply of credit by otherwise-funded banks. At the firm level, this imperfect ability to substitute credit across banks is further exacerbated by the fact that the small and medium-sized firms in our sample cannot compensate for a change in bank credit (at least in the short run) with other types of financing, as 99% of

[24] There are multiple reasons that can affect switching costs: the existence of a "stigma" when switching (e.g., Darmouni, 2020) or the lack of geographic diversification across banks (e.g., Célérier and Matray, 2019). For a discussion on the importance of comparing firm-level and more aggregate estimates, see, for instance, Chodorow-Reich (2014) and Greenstone, Max, and Nguyen (2020).

them do not have any capital-market financing. As a result, variation in banks' funding costs should have real effects.

First, we show that our effects on bank lending in Table 4 are present in the subsample of firms with balance-sheet data available, which roughly corresponds to the group of large firms (with sales in excess of €1m) in the credit registry. In Table A.6, we re-run the same specifications as in Table 4 on this sample, and find that all credit-based results continue to hold and are even stronger than in the overall sample.

To test for the real effects of banks' credit-supply response to variation in their average funding costs, we estimate regressions at the firm-year level. We use a shift-share approach similar to equation (2). To compute firm-level exposure to credit-supply shocks, measured by the variable $\textit{Deposit ratio}_{ft}$, we use for each lender to firm f their bank-level deposit ratio, and weight the latter by the lagged share of all loans granted to firm f by bank b's branch(es) in county c.

We then estimate the following regression specification at the firm-year level ft:

$$y_{ft} = \beta_1 \textit{Deposit ratio}_{ft-1} \times \textit{Gap}_t + \beta_2 \textit{Deposit ratio}_{ft-1} + \psi_{ci(f)t} + \delta_f + \epsilon_{ft}, \tag{4}$$

where y_{ft} is an outcome of firm f in year t, and $\psi_{ci(f)t}$ and δ_f denote firm f's county-industry-year and firm fixed effects, respectively. Standard errors are clustered at the firm level.

In Table 9, we estimate equation (4) and use multiple firm-level outcomes. We find that more exposed firms see a drop in their total capital (column 1), mostly driven by a drop in physical capital (property, plant, and equipment, column 2). In terms of economic magnitude, $\textit{Deposit ratio}_{ft-1} \times \textit{Gap}_t$ captures the difference in the weighted average funding costs of regulated-deposit dependent banks that a firm is in a relationship with, as opposed to firms that are only in relationships with otherwise-funded banks. Therefore, our estimate in column 1 implies that firms see a drop in their stock of total capital by 3.6% if their relationship banks incur funding costs that are one percentage point higher.

In columns 3 and 4, we show that the relative reduction in total and physical capital

Table 9: Firm-level Real Effects of Shocks to Banks' Funding Costs

	ln(Total capital)	ln(PP&E)	$\frac{\text{CapEx}}{\text{Total capital}}$	$\frac{\text{Tangible investment}}{\text{PP\&E}}$	ln(Employment)
	(1)	(2)	(3)	(4)	(5)
Deposit ratio × Gap	-0.036**	-0.054***	-0.064***	-0.040***	-0.014
	(0.016)	(0.017)	(0.025)	(0.015)	(0.011)
Deposit ratio	0.165***	0.206***	0.055	0.040	0.028
	(0.032)	(0.033)	(0.044)	(0.027)	(0.022)
Firm FE	✓	✓	✓	✓	✓
County-ind.-yr. FE	✓	✓	✓	✓	✓
N firm clusters	84,015	84,015	84,015	84,015	84,015
N	380,657	380,657	380,657	380,657	380,657
R^2	0.97	0.97	0.43	0.42	0.97

The level of observation is the firm-year level ft. Furthermore, the sample is limited to rated firms (with available balance-sheet data). The sample period is 2010 to 2015. All dependent variables are measured at the firm-year level ft. $CapEx_{ft}$ is computed as the sum of firm f's tangible and intangible investment in year t. $Deposit\ ratio_{ft-1}$ is the loan-exposure-weighted average $Deposit\ ratio_{bt-1}$ of all bank branches lending to firm f in quarter $t-1$, where $Deposit\ ratio_{bt-1}$ is the ratio of regulated deposits over total liabilities of bank b in quarter $t-1$. Gap_t is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate (in %) at the end of quarter t. Industry fixed effects are defined at the three-digit level. Robust standard errors (clustered at the firm level) are in parentheses.

in columns 1 and 2 is due to the fact that more exposed firms actively reduce their investment efforts, as measured by capital expenditure over total capital (column 3) and tangible investment over physical capital (column 4). Finally, we also estimate a negative, albeit insignificant, effect on employment in column 5.

4 Conclusion

Our analysis builds on the existence of regulated deposits offered by all banks in France whose rates are set by the government and not by the banks themselves. Using these politically rooted shifts in the cost of regulated deposits, we estimate an elasticity of credit supply with respect to funding costs of -0.25. Banks' credit-supply response is highly nonlinear: they can withstand up to 21 basis points higher average funding costs before they start contracting their lending. Consistent with the idea that changes in banks' funding costs affect their credit supply through changes in their probability of default that depress their expected net worth, the credit-supply response is stronger for weakly capitalized banks and banks with lower liquidity buffers.

In reaction to an increase in their funding costs, banks do not only adjust their net credit supply but also the composition thereof: to insulate their profits, banks reach for yield by rebalancing their loan portfolio towards smaller and riskier firms, and longer-term loans. This implies that even holding constant the quantity of loans supplied in the aggregate, funding-cost shocks can affect aggregate output if borrowers and projects exhibit different productivity. Understanding better how the joint distribution of banks' and borrowers' heterogeneity shapes the transmission of bank-level shocks to aggregate output is a fruitful avenue for future research.

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ONLINE APPENDIX

A Supplementary Tables

Table A.1: Average Effect of Funding Costs on Credit Supply: Time-invariant Deposit Ratio I

	ln(Credit) (1)	ln(Credit) (2)	ln(Credit) (3)	ln(Credit) (4)	ln(Credit) (5)	ln(Credit) (6)	ln(Credit) (7)
Deposit ratio × Gap	-0.100***	-0.199***	-0.209***	-0.194***	-0.200***	-0.195***	
	(0.030)	(0.051)	(0.057)	(0.050)	(0.052)	(0.051)	
Total deposit ratio × Gap			0.010				
			(0.020)				
Equity ratio × Gap				0.118		0.117	
				(0.200)		(0.202)	
Equity ratio				0.134		0.184	
				(0.550)		(0.526)	
Bank size × Gap					-0.000	-0.000	
					(0.002)	(0.002)	
Bank size					0.002	0.007	
					(0.035)	(0.035)	
Deposit ratio × Gap in top tercile							-0.188***
							(0.063)
Deposit ratio × Gap in 2^{nd} tercile							-0.068
							(0.045)
Firm-bank-county FE	✓	✓	✓	✓	✓	✓	✓
Firm-quarter FE	✓	✓	✓	✓	✓	✓	✓
County-quarter FE	✓	✓	✓	✓	✓	✓	✓
BHC-quarter FE		✓	✓	✓	✓	✓	✓
N bank clusters	196	196	196	196	196	196	196
N	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974
R^2	0.94	0.94	0.94	0.94	0.94	0.94	0.94

The level of observation is credit to firm f by bank b's branch(es) in county c in quarter t. The sample period is Q4 2010 to Q4 2015. The dependent variable is the natural logarithm of the euro amount of debt outstanding between firm f and bank b's branch(es) in county c in quarter t. $Deposit\ ratio_b$ is the (time-invariant) ratio of regulated deposits over total liabilities of bank b in Q3 2010. $Total\ deposit\ ratio_{bt-1}$ is the ratio of all deposits over total liabilities of bank b in quarter $t-1$. $Equity\ ratio_{bt-1}$ is the ratio of equity over total assets of bank b in quarter $t-1$. $Bank\ size_{bt-1}$ is the natural logarithm of total assets of bank b in quarter $t-1$. Gap_t is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate (in %) at the end of quarter t. $Gap\ in\ top\ (2^{nd})\ tercile_t$ is a dummy variable for whether Gap_t ranges in the top (middle) tercile of its distribution. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.2: Average Effect of Funding Costs on Credit Supply: Time-invariant Deposit Ratio II

	ln(Credit)	ln(Credit)	ln(Credit)	ln(Credit)	ln(Credit)	ln(Credit)	ln(Credit)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Deposit ratio × Gap	-0.101***	-0.186***	-0.192***	-0.183***	-0.185***	-0.181***	
	(0.031)	(0.051)	(0.058)	(0.049)	(0.051)	(0.050)	
Total deposit ratio × Gap			0.007				
			(0.021)				
Equity ratio × Gap				0.204		0.206	
				(0.214)		(0.213)	
Equity ratio				-0.017		0.026	
				(0.563)		(0.540)	
Bank size × Gap					0.000	0.000	
					(0.002)	(0.002)	
Bank size					0.001	0.005	
					(0.035)	(0.035)	
Deposit ratio × Gap in top tercile							-0.175***
							(0.061)
Deposit ratio × Gap in 2^{nd} tercile							-0.062
							(0.043)
Firm-bank-county FE	✓	✓	✓	✓	✓	✓	✓
Firm-quarter FE	✓	✓	✓	✓	✓	✓	✓
County-quarter FE	✓	✓	✓	✓	✓	✓	✓
BHC-quarter FE		✓	✓	✓	✓	✓	✓
N bank clusters	196	196	196	196	196	196	196
N	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974
R^2	0.94	0.94	0.94	0.94	0.94	0.94	0.94

The level of observation is credit to firm f by bank b's branch(es) in county c in quarter t. The sample period is Q4 2010 to Q4 2015. The dependent variable is the natural logarithm of the euro amount of debt outstanding between firm f and bank b's branch(es) in county c in quarter t. $Deposit\ ratio_b$ is the (time-invariant) ratio of regulated deposits over total liabilities of bank b in Q4 2010. $Total\ deposit\ ratio_{bt-1}$ is the ratio of all deposits over total liabilities of bank b in quarter $t-1$. $Equity\ ratio_{bt-1}$ is the ratio of equity over total assets of bank b in quarter $t-1$. $Bank\ size_{bt-1}$ is the natural logarithm of total assets of bank b in quarter $t-1$. Gap_t is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate (in %) at the end of quarter t. $Gap\ in\ top\ (2^{nd})\ tercile_t$ is a dummy variable for whether Gap_t ranges in the top (middle) tercile of its distribution. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.3: Average Effect of Funding Costs on Lending by Deposit-funded Banks: Control for Income from CDC Transfer

	ln(Credit) (1)	ln(Credit) (2)	ln(Credit) (3)	ln(Credit) (4)	ln(Credit) (5)	ln(Credit) (6)	ln(Credit) (7)
Deposit ratio × Gap	-0.085***	-0.138***	-0.123**	-0.140***	-0.137***	-0.138***	
	(0.030)	(0.049)	(0.055)	(0.047)	(0.050)	(0.048)	
Deposit ratio	0.325***	0.280**	0.375**	0.257*	0.274**	0.261**	0.149
	(0.114)	(0.140)	(0.159)	(0.136)	(0.122)	(0.125)	(0.141)
Deposit ratio transferred to CDC	-0.370***	-0.289***	-0.228*	-0.291***	-0.298***	-0.299***	-0.303***
	(0.103)	(0.110)	(0.116)	(0.110)	(0.110)	(0.110)	(0.109)
Total deposit ratio × Gap			0.008				
			(0.022)				
Total deposit ratio			-0.157*				
			(0.089)				
Equity ratio × Gap				0.237		0.244	
				(0.222)		(0.214)	
Equity ratio				0.147		0.112	
				(0.566)		(0.541)	
Bank size × Gap					0.002	0.002	
					(0.002)	(0.002)	
Bank size					-0.012	-0.006	
					(0.036)	(0.036)	
Deposit ratio × Gap in top tercile							-0.116**
							(0.050)
Deposit ratio × Gap in 2^{nd} tercile							-0.023
							(0.032)
Firm-bank-county FE	✓	✓	✓	✓	✓	✓	✓
Firm-quarter FE	✓	✓	✓	✓	✓	✓	✓
County-quarter FE	✓	✓	✓	✓	✓	✓	✓
BHC-quarter FE		✓	✓	✓	✓	✓	✓
N bank clusters	196	196	196	196	196	196	196
N	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974	4,134,974
R^2	0.94	0.94	0.94	0.94	0.94	0.94	0.94

The level of observation is credit to firm f by bank b's branch(es) in county c in quarter t. The sample period is Q4 2010 to Q4 2015. The dependent variable is the natural logarithm of the euro amount of debt outstanding between firm f and bank b's branch(es) in county c in quarter t. *Deposit ratio*$_{bt-1}$ is the ratio of regulated deposits over total liabilities of bank b in quarter $t-1$. *Deposit ratio transferred to CDC*$_{bt-1}$ is the fraction of regulated deposits (no longer on bank b's balance sheet) transferred to the CDC over total liabilities of bank b in quarter $t-1$. *Total deposit ratio*$_{bt-1}$ is the ratio of all deposits over total liabilities of bank b in quarter $t-1$. *Equity ratio*$_{bt-1}$ is the ratio of equity over total assets of bank b in quarter $t-1$. *Bank size*$_{bt-1}$ is the natural logarithm of total assets of bank b in quarter $t-1$. *Gap*$_t$ is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate (in %) at the end of quarter t. *Gap in top* (2^{nd}) *tercile*$_t$ is a dummy variable for whether *Gap*$_t$ ranges in the top (middle) tercile of its distribution. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.4: Average Effect of Funding Costs on Lending by Deposit-funded Banks: Robustness

	ln(Credit)	ln(Credit)	ln(Credit)	ln(Credit)
Deposits	Regulated deposits + ordinary savings (branch level)		Regulated deposits + ordinary savings (bank level)	
	(1)	(2)	(3)	(4)
Deposit ratio × Gap	-0.038**	-0.054**	-0.085***	-0.133***
	(0.018)	(0.021)	(0.025)	(0.038)
Deposit ratio	0.059	0.086*	0.133*	0.135
	(0.045)	(0.046)	(0.074)	(0.084)
Firm-bank-county FE	✓	✓	✓	✓
Firm-quarter FE	✓	✓	✓	✓
County-quarter FE	✓	✓	✓	✓
BHC-quarter FE		✓		✓
N bank clusters	204	204	196	196
N	5,267,366	5,267,366	4,134,974	4,134,974
R^2	0.94	0.94	0.94	0.94

The level of observation is credit to firm f by bank b's branch(es) in county c in quarter t. The sample period is Q1 2010 to Q4 2015 in the first two columns, and Q4 2010 to Q4 2015 in the last two columns. The dependent variable is the natural logarithm of the euro amount of debt outstanding between firm f and bank b's branch(es) in county c in quarter t. In the first two columns, $Deposit\ ratio_{bct-1}$ is the ratio of regulated deposits plus ordinary savings accounts all over total deposits and commercial paper of bank b's branch(es) in county c in quarter $t-1$. In the last two columns, $Deposit\ ratio_{bt-1}$ is the ratio of regulated deposits plus ordinary savings accounts all over total liabilities of bank b in quarter $t-1$. Gap_t is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate (in %) at the end of quarter t. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.5: Average Effect of Funding Costs on Lending by Deposit-funded Banks: Robustness to Timing

	ln(Credit) (1)	ln(Credit) (2)	ln(Credit) (3)	ln(Credit) (4)	ln(Credit) (5)	ln(Credit) (6)	ln(Credit) (7)
Deposit ratio$_{t-2}$ × Gap	-0.108***	-0.169***	-0.141**	-0.168***	-0.168***	-0.166***	
	(0.029)	(0.050)	(0.057)	(0.047)	(0.049)	(0.047)	
Deposit ratio$_{t-2}$	0.190**	0.194*	0.340**	0.181*	0.198**	0.192**	0.054
	(0.090)	(0.114)	(0.145)	(0.105)	(0.096)	(0.094)	(0.106)
Total deposit ratio$_{t-2}$ × Gap			0.019				
			(0.023)				
Total deposit ratio$_{t-2}$			-0.193**				
			(0.079)				
Equity ratio × Gap				0.253		0.259	
				(0.226)		(0.222)	
Equity ratio				0.254		0.329	
				(0.640)		(0.574)	
Bank size × Gap					0.001	0.001	
					(0.002)	(0.002)	
Bank size					-0.002	0.008	
					(0.034)	(0.032)	
Deposit ratio$_{t-2}$ × Gap in top tercile							-0.133***
							(0.048)
Deposit ratio$_{t-2}$ × Gap in 2^{nd} tercile							-0.048
							(0.033)
Firm-bank-county FE	✓	✓	✓	✓	✓	✓	✓
Firm-quarter FE	✓	✓	✓	✓	✓	✓	✓
County-quarter FE	✓	✓	✓	✓	✓	✓	✓
BHC-quarter FE		✓	✓	✓	✓	✓	✓
N bank clusters	196	196	196	196	196	196	196
N	3,962,890	3,962,886	3,962,886	3,962,886	3,962,886	3,962,886	3,962,886
R^2	0.94	0.94	0.94	0.94	0.94	0.94	0.94

The level of observation is credit to firm f by bank b's branch(es) in county c in quarter t. The sample period is Q1 2011 to Q4 2015. The dependent variable is the natural logarithm of the euro amount of debt outstanding between firm f and bank b's branch(es) in county c in quarter t. *Deposit ratio*$_{bt-2}$ is the ratio of regulated deposits over total liabilities of bank b in quarter $t-2$. *Total deposit ratio*$_{bt-2}$ is the ratio of all deposits over total liabilities of bank b in quarter $t-2$. *Equity ratio*$_{bt-1}$ is the ratio of equity over total assets of bank b in quarter $t-1$. *Bank size*$_{bt-1}$ is the natural logarithm of total assets of bank b in quarter $t-1$. *Gap*$_t$ is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate (in %) at the end of quarter t. *Gap in top (2^{nd}) tercile*$_t$ is a dummy variable for whether *Gap*$_t$ ranges in the top (middle) tercile of its distribution. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.6: Average Effect of Funding Costs on Lending by Deposit-funded Banks: Firms with Balance-sheet Data

	ln(Credit) (1)	ln(Credit) (2)	ln(Credit) (3)	ln(Credit) (4)	ln(Credit) (5)	ln(Credit) (6)	ln(Credit) (7)
Deposit ratio × Gap	-0.116***	-0.228***	-0.205***	-0.223***	-0.226***	-0.219***	
	(0.037)	(0.069)	(0.078)	(0.067)	(0.070)	(0.067)	
Deposit ratio	0.207	0.249	0.341	0.207	0.209	0.181	0.090
	(0.153)	(0.188)	(0.223)	(0.172)	(0.156)	(0.152)	(0.186)
Total deposit ratio × Gap			-0.003				
			(0.034)				
Total deposit ratio			-0.135				
			(0.115)				
Equity ratio × Gap				0.366		0.412	
				(0.337)		(0.317)	
Equity ratio				-0.046		-0.237	
				(0.721)		(0.670)	
Bank size × Gap					0.003	0.004	
					(0.003)	(0.003)	
Bank size					-0.028	-0.024	
					(0.053)	(0.052)	
Deposit ratio × Gap in top tercile							-0.187***
							(0.073)
Deposit ratio × Gap in 2^{nd} tercile							-0.084
							(0.054)
Firm-bank-county FE	✓	✓	✓	✓	✓	✓	✓
Firm-quarter FE	✓	✓	✓	✓	✓	✓	✓
County-quarter FE	✓	✓	✓	✓	✓	✓	✓
BHC-quarter FE		✓	✓	✓	✓	✓	✓
N bank clusters	158	158	158	158	158	158	158
N	1,625,830	1,625,830	1,625,830	1,625,830	1,625,830	1,625,830	1,625,830
R^2	0.92	0.92	0.92	0.92	0.92	0.92	0.92

The level of observation is credit to firm f by bank b's branch(es) in county c in quarter t. Furthermore, the sample is limited to firms with available balance-sheet data. The sample period is Q4 2010 to Q4 2015. The dependent variable is the natural logarithm of the euro amount of debt outstanding between firm f and bank b's branch(es) in county c in quarter t. *Deposit ratio*$_{bt-1}$ is the ratio of regulated deposits over total liabilities of bank b in quarter $t-1$. *Total deposit ratio*$_{bt-1}$ is the ratio of all deposits over total liabilities of bank b in quarter $t-1$. *Equity ratio*$_{bt-1}$ is the ratio of equity over total assets of bank b in quarter $t-1$. *Bank size*$_{bt-1}$ is the natural logarithm of total assets of bank b in quarter $t-1$. *Gap*$_t$ is the difference between the rate on regulated deposits (livret A) and the ECB's deposit facility rate (in %) at the end of quarter t. *Gap in top* (2^{nd}) *tercile*$_t$ is a dummy variable for whether *Gap*$_t$ ranges in the top (middle) tercile of its distribution. Robust standard errors (clustered at the bank level) are in parentheses.

B Supplementary Figures

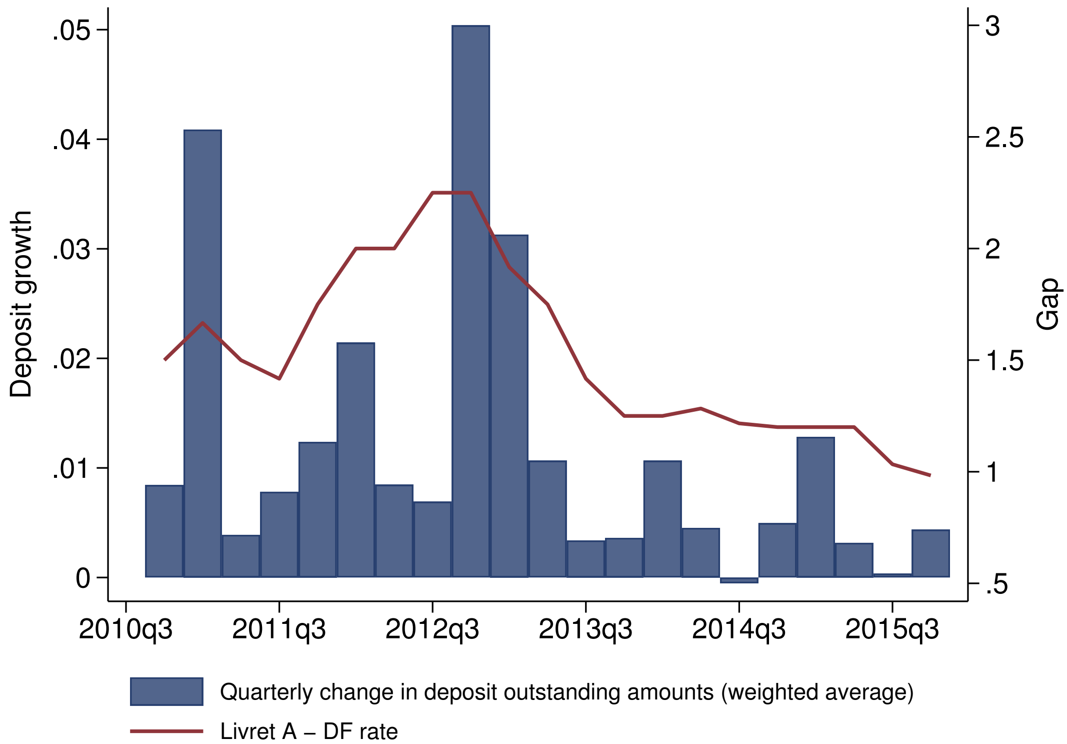

Figure B.1: **Sensitivity of Regulated Deposits to Funding-cost Gap.** This figure shows the quarterly growth rate in the weighted average of post-transfer regulated deposits at the bank level (accounting for entry and exit), $\frac{Deposits_{bdt}-Deposits_{bdt-1}}{0.5(Deposits_{bdt}+Deposits_{bdt-1})}$, alongside the evolution of the gap between the livret-A rate and the ECB's deposit facility rate from Q4 2010 to Q4 2015.