Tracing Banks' Credit Allocation to their Funding Costs*

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Abstract

We quantify how banks' funding costs affect their lending behavior directly, and indirectly by feeding back to their net worth. 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 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, with repercussions for firms' investment.

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1 Introduction

How banks' funding costs affect their behavior and are transmitted to the real economy is at the core of policy debates on the financial system, ranging from the effectiveness of monetary policy to the effects of micro- and macroprudential regulations of financial intermediaries.[1] While of central importance, providing a clean and reliable estimate of the elasticity between banks' funding costs and their credit supply and loan-portfolio composition remains a major challenge for at least two reasons. First, banks' marginal cost of funding is rarely observed in standard accounting data.[2] Second, banks jointly optimize their liabilities and assets, so identifying exogenous variation—and not only a one-time shock—in funding costs that does not directly affect banks' net worth, the level of their liabilities, or the profitability of their potential investments is difficult.

This paper quantifies the pass-through of banks' funding costs to the quantity and composition of bank credit supply. To do so, 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-sheet 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 provide us with a source of plausibly exogenous variation in banks' funding costs. As we observe the rate on regulated

[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 Suarez, 2013; Begenau, 2020; Carlson, Correia, and Luck, 2022) and macroprudential regulations (Jiménez, Ongena, Peydró, and Saurina, 2017).

[2] A notable exception is Cassola, Hortaçsu, and Kastl (2013), based on banks' bidding behavior in the European Central Bank's weekly refinancing operations during the 2007 crisis.

deposits, we can determine the difference in funding costs for regulated-deposit dependent banks as compared to otherwise-funded banks. We then 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.

Our measure of exposure to an exogenous shift in funding costs exploits differences in the *composition* of bank liabilities, i.e., banks' reliance on regulated deposits for their funding, as opposed to regular deposits or the interbank market. This enables us to control for confounding effects that may be due to differences in the *level* of bank liabilities and net worth. As a result, we estimate the direct effect of a change in the cost of funding, net of any change in total liabilities (e.g., change in deposits as in Drechsler, Savov, and Schnabl, 2017) or in net worth (e.g., Gertler and Kiyotaki, 2010) that would directly affect bank lending.

Our first set of results studies how banks' credit supply responds to regulatory-driven variations in funding costs. Using granular data on loan exposure at the bank-firm-time level allows us to implement a standard within-firm estimator (e.g., Khwaja and Mian, 2008) to net out 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 exploit the large fluctuations in the difference in funding costs during our sample period to estimate the curvature of the elasticity between banks' credit supply and their funding costs nonparametrically. The relationship between banks' credit supply and their funding costs is highly nonlinear: banks can sustain up to 21 basis points higher funding costs until they contract their lending.

While we control for many time-varying elements of banks' balance sheets, 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 cost of regulated-deposit funding in several ways. First, we exploit the fact that the variation across banks in their reliance on regulated deposits is driven by differences in regulatory obligations rather than their endogenous decisions on their liability structure.

Second, we include a battery of additional high-dimensional fixed effects such as banks' county-by-time and banking group (BHC)-by-time fixed effects, and find quantitatively similar results. 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.

Third, our results are invariant to comparing regulated-deposit dependent banks with banks funded by regular deposits or interbank loans. In particular, the comparison of regulated-deposit dependent banks with banks funded by other types of deposits effectively holds constant banks' business models, which can also govern their lending behavior, e.g., through the ease with which they can securitize their loans (Keys, Mukherjee, Seru, and Vig, 2010; Keys, Seru, and Vig, 2012).

Having shown that funding costs matter for the supply of credit, we then turn to exploring how this elasticity varies across banks. We find that higher funding costs depress lending by more for weakly capitalized banks, and for banks with lower liquidity buffers to absorb the increase in funding costs. This points to an amplification of the sensitivity of banks' credit supply to their funding costs as their net worth shrinks, consistent with the idea that funding costs can have a direct effect on bank credit supply as well as a feedback effect via a change in bank net worth that ultimately affects the overall cost of financial intermediation (e.g., Gertler and Kiyotaki, 2010; Di Tella and Kurlat, 2021).

Our second set of results examines whether banks rebalance their loan portfolios across borrowers and loan characteristics in an effort to shield their profits from funding-cost fluctuations. When facing higher funding costs, exposed banks engage in greater risk taking and shift their portfolios toward higher-yielding loans 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. Furthermore, banks with a larger share of non-performing loans extend their credit supply in response to higher funding costs, potentially reflecting gambling for resurrection.

Therefore, even in the best case in which banks are perfectly able to insulate their profits from fluctuations in funding costs by rebalancing their loan portfolios, this asset-side response can in and of itself affect the aggregate economy if the reallocation of capital, holding constant its total volume, matters for aggregate output (e.g., Baqaee, Farhi, and Sangani, 2021). By implementing a "local lending market" approach, we show that banks' loan-portfolio rebalancing also affects the allocation of corporate credit at the more aggregate city level.

The implications are twofold. First, less affected banks do not step in to serve the unaddressed local loan demand, potentially because lending relationships are sticky. Second, this opens up the possibility that variations in banks' funding costs have real economic effects, at least for those firms that are adversely affected by banks' lending decisions in the face of higher funding costs. To investigate this, we study how firms react to changes in the funding costs of their relationship lenders' funding costs. 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 institutional setting provides us with a clean measure of the funding costs of regulated-deposit dependent banks to estimate how exogenous variations in the cost of funding affect both the quantity and the quality of credit. We view our setting as appealing for multiple reasons. First, our source of variation in banks' funding costs stems from the composition, rather than the level, of (deposit) liabilities. This enables us to study banks' reactions to exogenous variations in their funding costs, holding constant their net worth and level of liabilities, which is all the more important given evidence that banks' access to insured deposits may drive their capital-structure choices (e.g., Jiang, Matvos, Piskorski, and Seru, 2020).

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 virtually all banks and firms in the economy, with sizable treatment and control groups. In this manner, we can elucidate 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 of the pass-through of funding costs to credit supply.

Our paper estimates the elasticity of banks' credit supply with respect to their funding costs. As such, it contributes to a large literature that identifies shocks to bank credit supply (e.g., Peek and Rosengren, 2000; Khwaja and Mian, 2008; Paravisini, 2008), and that examines the real economic consequences of banks' credit allocation (see, among many others, Bertrand, Schoar, and Thesmar, 2007; Chodorow-Reich, 2014; Becker and Ivashina, 2014; Benmelech, Bergman, and Seru, 2021).

As we use the pass-through of the monetary-policy rate to approximate the cost of funding of banks that do not rely on regulated deposits, our analysis is linked to the rich literature on the transmission of monetary policy through banks' balance sheets. 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). These models have been tested empirically, in papers showing that the cross-section of banks' balance sheets or their net worth matters 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) or overall portfolio yields (Hanson and Stein, 2015).

We contribute to this literature by showing that in contrast to the class of models with bank net worth as the prime determinant of the transmission of monetary policy, changes in banks' funding costs can have a *direct* effect on credit supply, irrespective of their ultimate effect on bank net worth. Note that while we hold constant bank net worth by exploiting the composition, rather than the level, of liabilities, this does *not* imply that net worth does not matter. On the contrary, the fact that we find a nonlinear effect of banks' funding costs on their credit supply is consistent with an additional feedback effect stemming from depressed bank net worth as a result of higher funding costs. The existence of these direct and indirect effects implies that the cross-section of banks is important for estimating the average pass-through of a change in funding costs on the economy.

This also helps clarify our contribution relative to Drechsler, Savov, and Schnabl (2017), where banks increase the spreads they charge on deposits in concentrated markets if the monetary-policy rate increases. This, in turn, leads to a credit contraction as deposits flow out of the system.[3] By comparing the supply of credit by banks with a different composition of liabilities, holding constant their total liabilities and investment opportunities on the asset side (through the inclusion of firm-time fixed effects), we can cleanly measure the pass-through of the *price* of deposit funding and disentangle it from a change in the latter's *quantity*.

Our source of variation in banks' funding costs stems from a differential pass-through of monetary policy to regulated-deposit rates vs. rates on all other deposits and market-based funding. As such, our paper naturally relates to studies that document if and how monetary policy is transmitted to deposit rates (Hannan and Berger, 1991; Driscoll and Judson, 2013), which has been at the center of theories of monetary-policy transmission.[4]

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

[3] On the other hand, Li, Loutskina, and Strahan (2019) show that when banks raise deposits in concentrated markets, this reduces the funding risk of originating long-term illiquid loans, leading to an increase in the average maturity of newly granted loans.

[4] Seminal models such as Bernanke and Blinder (1988), Kashyap and Stein (1994), or Bernanke and Gertler (1995) consider that monetary policy affects the real economy by varying banks' cost of deposits, which has since then been contested by New Keynesian models arguing that the vast financial deregulation and innovation of the 1980s and 1990s as well as the emergence of a "market-based financial system" made this channel irrelevant (e.g., Woodford, 2010).

for deposits (Drechsler, Savov, and Schnabl, 2017; Balloch and Koby, 2020; Wang, Whited, Wu, and Xiao, 2021) 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, 2020), which reduces the interest rate sensitivity of banks' liability side compared to the asset side (Gomez, Landier, Sraer, and Thesmar, 2021). However, deposit rates are ultimately 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 their lending behavior.

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, 2021) and the importance of heterogeneous depositors for financial stability (e.g., Egan, Hortaçsu, and Matvos, 2017; Artavanis, Paravisini, Robles-Garcia, Seru, and Tsoutsoura, 2019).

2 Background and Empirical Strategy

2.1 Deposit Accounts in France

French households channel €950bn into short-term savings accounts. Three-quarters are stored in regulated-deposit accounts. 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 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 and Regulated Deposits

The most common regulated-deposit account is called "livret A," a fully liquid, guaranteed, tax-free savings instrument that 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 (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 rates being set by the government, French banks widely offer such accounts because French depositors tend to max out on regulated deposits before demanding any regular savings products and other, non-savings products.

Given the popularity of livret-A accounts, the government has imposed a cap, often binding for middle-income households, on how much money can be saved in this form. Individuals 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.[5] 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 deposits (LDD, Livret Jeunes, LEP, PEL), and is equal to two-thirds of the livret-A rate for one type of deposit 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.[6] The government can deviate from this revision procedure, and has the discretion to decide a new rate. This has been very common in practice.[7]

[5] 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.

[6] 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%.

[7] For instance, on February 1, 2012, the government under 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%.

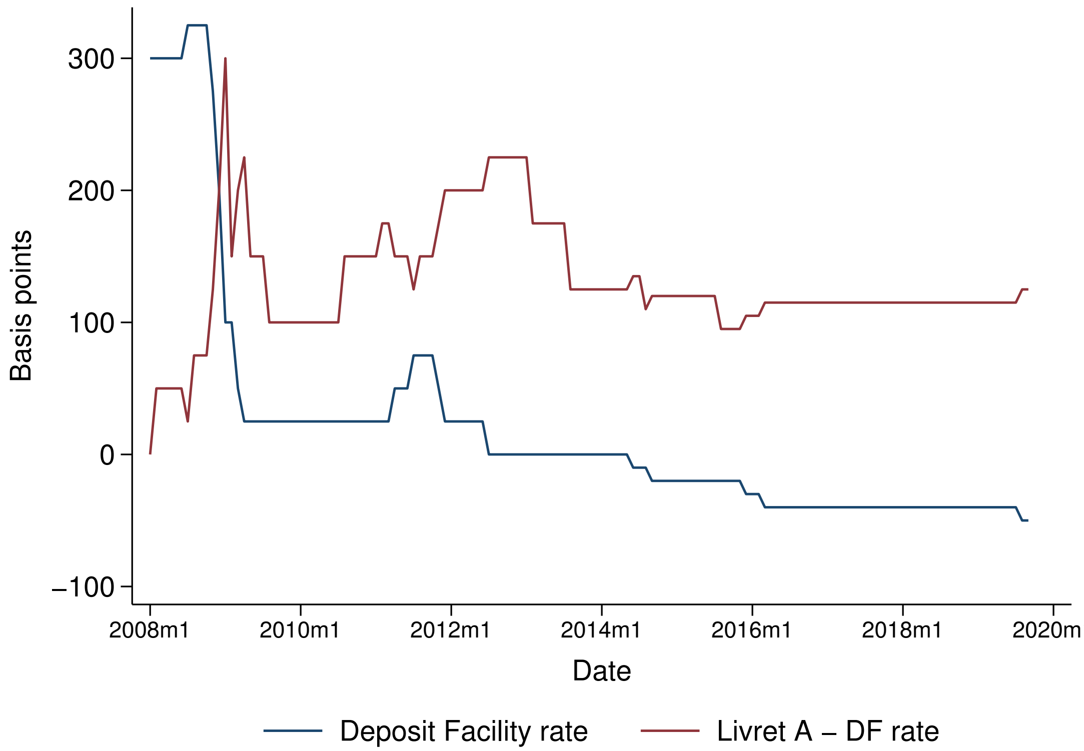


Figure 1: **Changes in Funding-cost Gap.** This figure shows the evolution of the ECB's deposit facility (DF) rate and the gap between the livret-A rate and the latter from 2008 to 2019.

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 European Central Bank's main policy rate, 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 said difference and the actual monetary policy during this period is -0.01.

2.1.2 Implications for Banks' Funding Costs

As changes in the rate on regulated deposits are best thought of as politically determined, they constitute plausibly exogenous shocks to the cost of funding for banks that rely on them. To measure variation in banks' funding costs, we decompose banks' liabilities into regulated deposits and all other sources of funding, such as regular deposits (from both households and non-financial corporations) or interbank funding. The difference in funding costs for a bank dependent on regulated deposits relative to otherwise-funded banks is a function of the rate, which varies due to political motives unrelated to bank behavior and macroeconomic fluctuations, multiplied by the amount of regulated deposits in the bank's liabilities.

The amount of regulated deposits can be considered as mostly exogenous as well. Banks do not bear the full cost of paying interest on regulated deposits as they only keep a fraction of those on their balance sheets. Indeed, 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). The primary use of these funds is the financing of social housing (since 1945). 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.[8]

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: Observatoire de l'épargne réglementée.

The share of eligible funds that have to be transferred to the CDC is set by law, and varies across banks and over time. This share used to be substantially higher initially for the three historical (incumbent) banks, and is enforced to converge to a single rate of 60% for all banks by 2022.[9] 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

[8] 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. 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.

[9] 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.

remunerate. We stop the sample period before 2016 as after July 2016, banks were offered the possibility to channel all their regulated deposits to the CDC.[10]

This regulation provides us with plausibly exogenous variation in banks' de-facto reliance on regulated deposits. This implies that banks can adjust neither the price nor the quantity of regulated deposits on their balance sheets. 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 (Hannan and Berger, 1991), 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).

As France is part of the euro area, monetary-policy rates are set by the European Central Bank (ECB), an independent central bank which attempts to stabilize prices across multiple countries facing different macroeconomic situations. As such, movements in the ECB's main policy rate are arguably more exogenous to the French macroeconomic condition.[11] The typically strong pass-through of the monetary-policy rate to regular deposit and interbank rates allows us to approximate the costs for the portion of banks' funding that does not come from regulated deposits.

Rates on regulated-deposit accounts cannot be adjusted by banks. Therefore, the gap between the livret-A rate and the monetary-policy rate determines whether regulated deposits are a cheap or an expensive source of funding, and pins down the precise marginal cost for this specific source of funding. When the monetary-policy rate is lower than the livret-A rate, banks have to pay more for regulated deposits than what they can recoup on their asset side. Therefore, banks that rely on regulated deposits incur higher cost of funding than do banks whose cost of funding is more aligned with the monetary-policy rate, e.g., interbank-funded banks.

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

[11] The fact that rates on regulated deposits and monetary-policy rates are not set by the same institution therefore alleviates the classic concern of reverse causality between macroeconomically driven outcomes in the credit market and changes in monetary policy (see, for instance, Maddaloni and Peydró, 2011).

2.2 Data Description

The sample we use results from merging the French national Central Credit Register (CCR) with two banking databases on deposits, the Surfi database from the French prudential authority (ACPR) and the Cefit database from Banque de France (BdF). From the near universe of all French 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.).

Credit register. Our main data source is the French national Central Credit Register 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).

We use data from January 2010 to December 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), whereas the median bank has only 267 branches. For each firm, we aggregate credit across all of a given bank's branches in a given county to the bank-county level.[12] 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.

Deposit data. Deposit data come from two different sources that provide complementary information at different levels of aggregation. The most important source of deposit data is regulatory data (Surfi), maintained by the French prudential authority (ACPR). The data are available at the quarterly level for all banks operating in France. The dataset includes

[12] 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.

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: $\textit{Net eligible deposits}_{bt} = \textit{Eligible regulated deposits}_{bt} \times (1 - T_{bt})$. T_{bt} varies over time and across banks, based on whether banks used to be distributing livret-A accounts prior to the reform of 2008 (incumbent banks) or whether they were authorized to offer livret-A accounts after 2008 only (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 one.[13] Finally, we define the regulated-deposit ratio of bank b in quarter t as follows:
$\textit{Deposit ratio}_{bt} = (\textit{Non-eligible deposits}_{bt} + \textit{Net eligible deposits}_{bt}) / \textit{Total liabilities}_{bt}$. The data are available from Q4 2010 to Q4 2015.

Firm balance-sheet data and credit ratings. Firm accounting data come from the 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.[14]

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 subsequent years of accounting data. The main use of the ratings is

[13] The exception is La Banque Postale (LBP). 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.

[14] We drop firms with negative debt and/or negative or zero total assets. All ratios are winsorized at the 1^{st} and 99^{th} 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, 6, 7, and 8, respectively, and the sample period is Q4 2010 to Q4 2015 (Tables 4, 6, and 7) and 2010 to 2015 (annual data, Table 8).

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. We present summary statistics for all relevant samples and variables in Table 2. In Panel A, we zoom in on our main sources of variation, namely bank-level variables, such as banks' regulated-deposit ratios, as well as 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,[15] which comprises information on all outstanding amounts of credit and deposits, including loans to households and self-employed individuals that are not covered by the credit registry. 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 exact 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.

[15] 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 6, 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.

As a consequence, 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 regulated-deposit dependent banks' loan portfolios, the fraction of medium- 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, the respective banks 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 the level of our identifying variation.

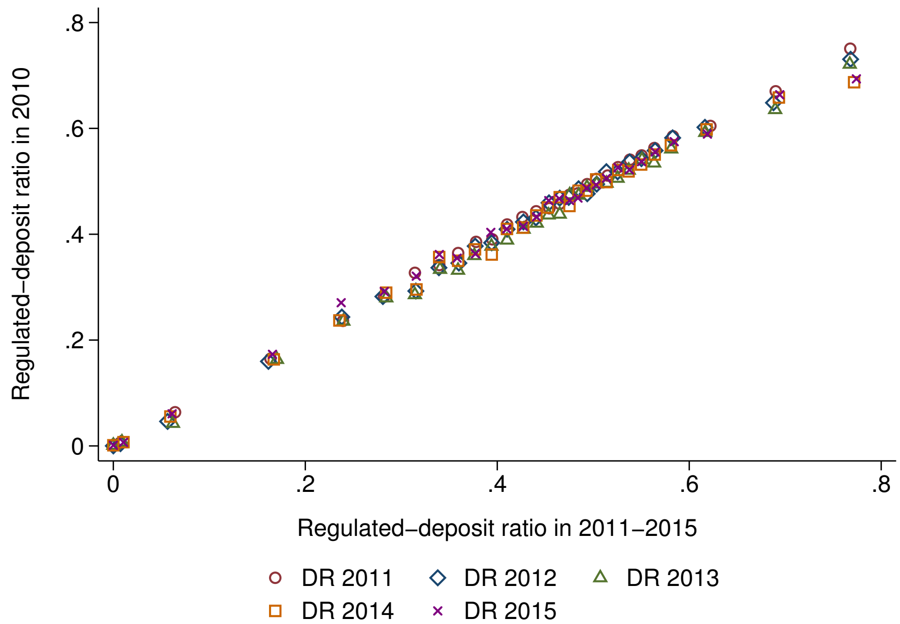
Our coefficient of interest is β_1 which captures the extent to which banks that rely more on regulated deposits, rather than other types of liabilities such as standard deposits and interbank funding, alter their lending when the gap between the rate on regulated deposits and the monetary-policy rate changes. The interaction term can be interpreted as the difference in funding costs for banks more dependent on regulated deposits and banks less dependent on them, including banks that rely exclusively on other sources of funding. Under the assumption that otherwise-funded banks experience perfect pass-through of the ECB's deposit facility (DF) rate to their funding costs, $\textit{Deposit ratio}_{bt-1} \times \textit{Gap}_t$ captures the difference in funding costs incurred by banks that rely on regulated deposits vs. otherwise-funded banks. In a robustness check, we show that our estimates hold up to explicitly differentiating between interbank-funded banks and those funded only by non-regulated deposits, even though the pass-through of the monetary-policy rate to interbank rates is typically thought to be stronger.

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 ($\textit{Gap}_t$) and the share of regulated deposits out of total bank liabilities ($\textit{Deposit ratio}_{bt-1}$). We ensure that β_1 is identified purely by the change in the price of regulated deposits, by controlling separately for $\textit{Deposit ratio}_{bt-1}$ in the regression. This implies that we can identify how banks adjust their lending in reaction to changes in the *price* of funding, holding constant any changes stemming from *quantities*.[16]

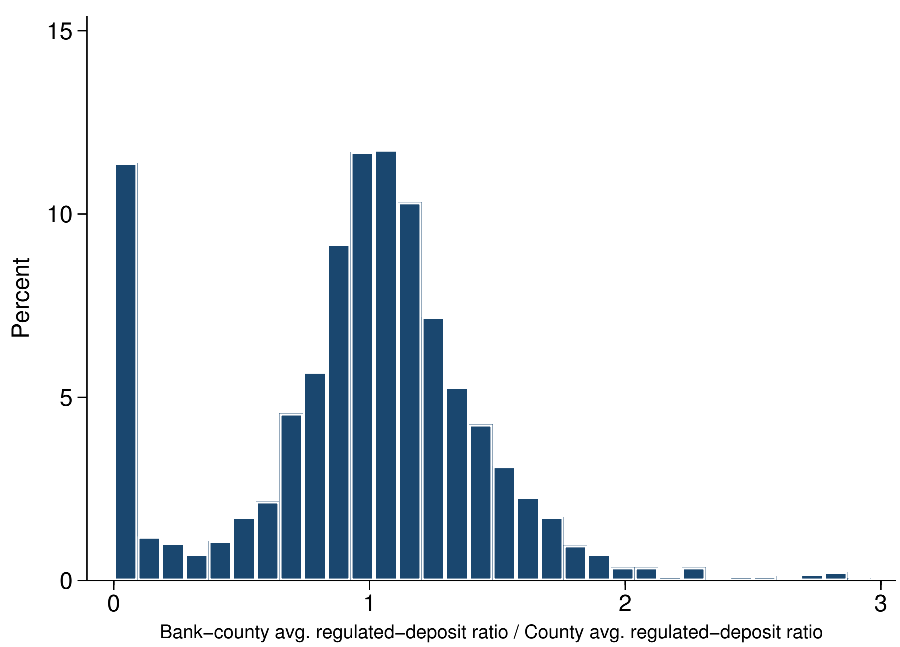
Figure 2 provides visual evidence for the sources of variation that we exploit. In the top panel, we plot the persistence in the share of regulated deposits over different horizons (from 2010 to 2011 up to 2015). The correlation almost perfectly aligns with the 45-degree line, consistent with our argument that banks cannot adjust their exposure to regulated deposits even in the medium run. In the bottom panel, we show that there is rich variation across bank branches within counties, which explains why we can control for time-varying unobserved local differences across counties.

We address several issues of endogeneity that could arise when estimating equation (1). The granularity of our data allows us to saturate the specification with multiple sets of fixed effects. μ_{fbc} are borrower-by-bank county (i.e., comprising all branches of a given bank in a given county) fixed effects, and remove time-invariant unobserved heterogeneity across

[16] This would be the case if, for instance, banks more dependent on regulated deposits experienced large inflows and outflows of deposits in general, as in Drechsler, Savov, and Schnabl (2017).



(a) Variation of Regulated-deposit Ratios within Banks over Time



(b) Variation of Regulated-deposit Ratios across Bank Branches within Counties

Figure 2: The top panel is a binscatter plot of the average regulated-deposit ratio, $Deposit\ ratio_{bt}$, for bank b's branch(es) in county c in 2010 (y-axis) vs. $2011 - 2015$ (x-axis). The bottom panel is a relative-frequency histogram of the ratio of the average regulated-deposit ratio (over the entire sample period) for bank b's branch(es) in county c to the average regulated-deposit ratio (over the entire sample period) for all banks in county c.

borrower-lender pairs. In particular, this allows us to account 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 capture the creation or destruction of a new bank-firm relationship.

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 (Table 3). We address this concern in multiple ways. First, we use post-transfer deposit ratios and, thus, exploit quasi-randomness among regulated-deposit dependent banks due to the government-imposed transfer rates to the CDC. Second, we can 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. As generally deposit-reliant banks pursue similar business models, such comparison holds relatively constant loan demand driven by endogenous matching between borrowers and lenders with specific characteristics.

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}.[17] This set of fixed effects controls for time-varying unobserved differences in the county from where a given bank sources its deposits, such as differences in local market power, which may affect the ability of bank branches to lend (e.g., Drechsler, Savov, and Schnabl, 2017). Thus, our coefficient of interest is estimated by comparing two branches in the same county and the same quarter, and it does not exploit any between-county variation.

After including all of the above-mentioned fixed effects, β_1 is estimated by comparing different banks (and their branches) in the same county lending to the same firm over time.

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

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.

In addition, we also estimate equation (1) with banking group (BHC)-by-quarter fixed effects. 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[18] that may affect credit supply (e.g., differences in bank business models at the group level or broader wholesale funding shocks).

3 Results

3.1 Average Effect on Credit Supply

In the first column of Table 4, we estimate equation (1), using as $\textit{Deposit ratio}_{bt-1}$ the ratio of regulated deposits over total liabilities in quarter $t-1$. We find that regulated-deposit dependent banks reduce their lending when they incur higher funding costs. This estimate becomes even larger after the inclusion of BHC-quarter fixed effects in column 2, which is our preferred specification, suggesting imperfect internal capital markets within banking groups.[19] As $\textit{Deposit ratio}_{bt-1} \times \textit{Gap}_t$ captures 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 cost of funding, we can apply the standard formula:

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

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 the cost of funding increases by 100 basis points, which implies an elasticity of $-0.168/(1/1.47) = -0.25$.

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

[19] If banking groups were able to reallocate well deposits across their different banks, we should find a smaller, rather than larger, point estimate, as the reallocation would allow banks belonging to the same group to immunize themselves against any effects arising from deposits they collected in their own county.

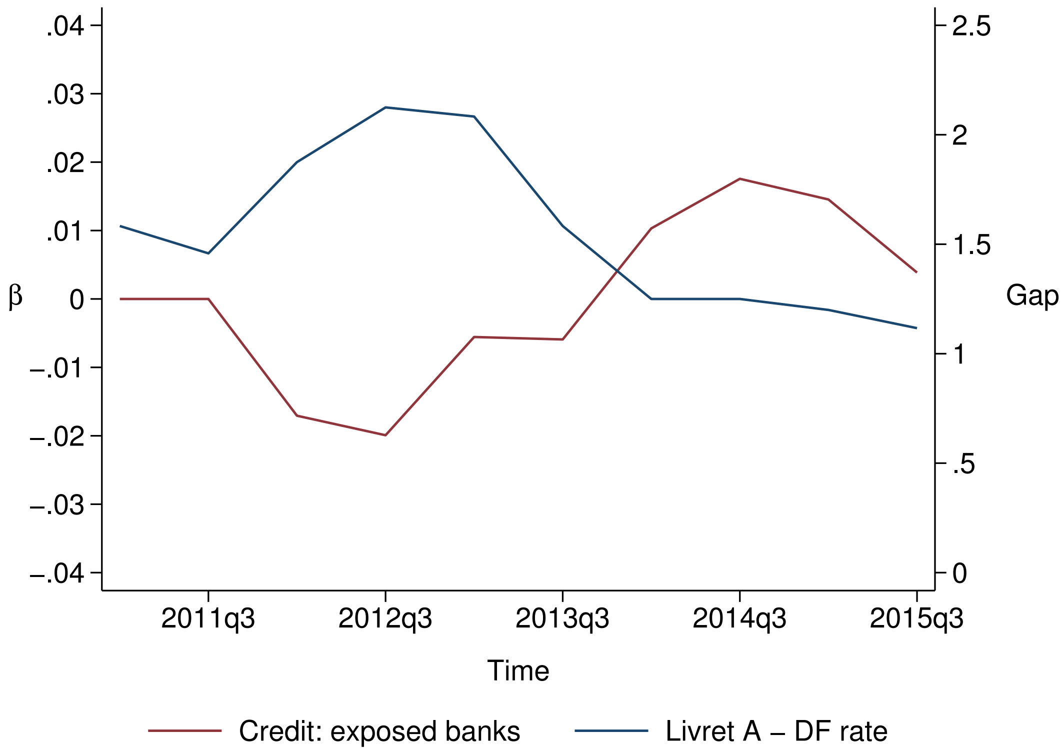


Figure 3: **Funding-cost Gap and Lending by Regulated-deposit Dependent Banks.** This figure plots Gap_t against β from estimating the following regression specification from Q1 2011 to Q3 2015 at the semi-annual frequency:

$$\ln(Credit)_{fbct} = \sum_{k=1}^{9} \beta_k High\ deposits_{bt-1} \times D_t^k + \gamma High\ deposits_{bt-1} + \mu_{fbc} + \theta_{ft} + \psi_{ct} + \epsilon_{fbct},$$

where $High\ deposits_{bt-1}$ equals one when bank b's regulated-deposit ratio is in the top third of the distribution at $t-1$, and zero if it is in the bottom third, and D_t^k is an indicator variable for the k^{th} half-year after Q1 2011 ($k=0$), the omitted category.

In Figure 3, we present graphical evidence of the same finding, and plot the difference between the livret-A and the deposit facility rate, Gap_t, alongside the estimated difference in credit supply for banks in the top vs. bottom tercile of the ratio of regulated deposits over total liabilities (lagged by one quarter). The negative relationship between the differential credit growth and Gap_t suggests that, in line with our conjecture, higher funding costs for regulated-deposit dependent banks induce them to lend less.

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 groups of banks, we implicitly assume that their funding costs are aligned with the monetary-policy rate. In column 3, we split up this group of banks into deposit-funded and interbank-funded banks by defining only the latter as the omitted category. For this purpose, we include as a control variable *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 *Deposit ratio*$_{bt-1}$ $\times$ *Gap*$_t$ is quantitatively unchanged, while the point estimate for *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. What is more, by controlling for *Total deposit ratio*$_{bt-1}$ $\times$ *Gap*$_t$, we also 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 funding costs. Banks' net worth plays a prominent role for the transmission of monetary policy to their funding costs, so we borrow two proxies from the literature (e.g., Kashyap and Stein, 2000; Jiménez, Ongena, Peydró, and Saurina, 2012) to control for it. In columns 4 and 5, we add banks' equity ratio and size, respectively, and their interactions with *Gap*$_t$, and control for both simultaneously in column 6. In all three cases, our coefficient of interest on *Deposit ratio*$_{bt-1}$ $\times$ *Gap*$_t$ remains quantitatively unchanged compared to our baseline estimate in column 2. Hence, banks' funding costs have a direct effect on credit supply even when holding constant their net worth.

In column 7, we estimate the effect of a change in funding costs 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 funding costs until they contract their lending.

To put this estimate in perspective, using data on bids for short-term loans granted by the ECB during the 2007 crisis, Cassola, Hortaçsu, and Kastl (2013) estimate that for over one-third of the (small sample of) bidding banks, funding costs increased by at least 20 and up to more than 60 basis points, with significant repercussions for these banks' profitability by the end of the same year. Therefore, our elasticity helps to understand why during such crises the typical funding-cost shock experienced by banks is associated with episodes of credit contraction.

We present a battery of robustness checks in the Online Appendix. In Table A.1, our results are robust to controlling for $\textit{Deposit ratio transferred to CDC}_{bt-1}$, 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.2, we show that our estimates are robust to different definitions of $\textit{Deposit ratio}_{bt}$. 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.[20] 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 level. 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.2 are similar to those in Table 4.

Finally, we revisit the timing of our treatment-exposure variable, $\textit{Deposit ratio}_{bt-1}$. 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 $\textit{Deposit ratio}_{bt-2}$ by another quarter and re-running all regressions from Table 4. The results in Table A.3 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. If anything, the somewhat positive comovement should work against us finding a negative credit-supply response.

In Table 5, we explore heterogeneity in the effect of funding costs on credit supply across banks. For this purpose, we modify the regression specification from column 2 of Table 4 to include interactions with different bank characteristics.

[20] 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: $\textit{Deposit ratio}_{bct} = (S_{bt} \times (1 - T_{bt}) \times \textit{Special deposits}_{bct} + (1 - S_{bt}) \times \textit{Special deposits}_{bct})/\textit{Total liabilities}_{bct}$. The data are available from Q1 2010 to Q4 2015.

Table 5: 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.

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. This evidence is consistent with the idea that sufficiently high funding costs can adversely affect banks' overall intermediation costs,[21] by depressing their net worth (analogously to Di Tella and Kurlat, 2021). This generates a feedback effect that can explain the above-mentioned nonlinearity of banks' credit-supply response (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 subsequently experience a reduction in their 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—if not nonlinearly—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. In what follows, we investigate whether affected banks' loan-portfolio rebalancing reflects such risk taking.

3.2 Reallocation of Credit

To test whether affected banks rebalance their portfolios towards higher-yielding loans so as to preserve their profits, we complement the credit registry with a bank-county-level dataset

[21] Banks' intermediation costs have been shown to be substantial and stable over time (Philippon, 2015; Buchak, Matvos, Piskorski, and Seru, 2018).

(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 6, the level of observation is a bank-county-quarter bct, summarizing information on all branches of a given bank b in county c. In columns 1 to 5, we estimate the adjustment of banks' loan portfolio 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).[22]

The decomposition of the loan-portfolio reallocation across borrower types suggests a form of bank risk taking in search of higher yields. When facing higher funding costs, affected banks increase their loan-portfolio exposure to smaller and potentially riskier borrowers, and reduce their exposure to larger firms. We provide further evidence of banks' risk taking in two ways. First, in column 5, we show that banks facing higher 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,[23] and use as our dependent variable the ratio of loans to firms in industries 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

[22] 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.

[23] 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.

Table 6: 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. $\textit{Deposit ratio}_{bt-1}$ is the ratio of regulated deposits over total liabilities of bank b in quarter $t-1$. $\textit{Gap}_t$ 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.

of this measure is that the Banque de France provides credit ratings only for firms with balance-sheet information.[24] Column 6 reports the result, and shows that regulated-deposit dependent banks increase their loan exposure to risky firms when their funding costs increase. The increase in risky lending by far surpasses all other estimates of loan-portfolio rebalancing in Table 6.

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. For this purpose, 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 $Deposit\ ratio_{bt-1} \times Gap_t$ confirms that when their funding costs increase, affected banks increase the average maturity of their loan portfolios.

To assess whether affected banks' risk taking, or yield-seeking behavior, is also reflected in the allocation of credit at a more aggregate level, we adopt a "local lending market" approach, aggregate all our variables at the city (ZIP code) level by computing a weighted average of bank dependence on regulated deposits, providing 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).

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,[25] we weight the bank-level deposit ratio by the respective bank b's lagged share of all loans in ZIP code k:

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

where $Credit_{fbt-1}$ measures the euro amount of debt outstanding between firm f and (all

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

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

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:

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

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.

As for this exercise we require data on loan recipients' cities, all dependent variables are based on corporate-lending data from the credit registry. In column 1 of Table 7, 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 large as the corresponding effect at the micro level (cf. column 2 of Table 4). This suggests

Table 7: Aggregate Credit Effects of Funding-cost Shocks

	ln(Total credit)	$\frac{\text{Large firms}}{\text{Total credit}}$	$\frac{\text{High-bankruptcy ind.}}{\text{Total credit}}$	$\frac{\text{MLT credit}}{\text{Total credit}}$	ln(Total credit)	$\frac{\text{Large firms}}{\text{Total credit}}$	$\frac{\text{High-bankruptcy ind.}}{\text{Total credit}}$	$\frac{\text{MLT credit}}{\text{Total credit}}$
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.

that borrowers have limited ability to switch banks so as to smooth over credit-supply shocks, consistent with the existence of sticky lending relationships (e.g., Darmouni, 2020).

In column 2 of Table 7, we use as dependent variable the fraction of loans to large vs. all firms. Consistent with an important reallocation in the loan portfolios of affected banks (Table 6), we find again a large negative and highly significant effect. Therefore, at the city level, credit contraction following adverse shocks to banks' funding costs affects primarily large rather than small firms, significantly shifting the ratio of loans accruing to these two groups in favor of small firms.

In columns 3 and 4, we consider two additional dimensions of cross-sectional heterogeneity implied by Table 6, 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 6) 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 6) 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 7.

3.3 Firm-level Real Effects

Our city-level results suggest that a reduction in the supply of credit by regulated-deposit dependent banks during periods in which they incur higher funding costs 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[26] is further exacerbated by the fact that

[26] 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 debate on the importance for the banking literature to compare firm-level and more aggregate estimates, see, for instance, the discussion between Greenstone, Max, and Nguyen (2020) and Chodorow-Reich (2014).

the 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 them do not have any capital-market financing. As a result, variations in banks' funding costs are likely to have real effects.

First, we verify that our effects on bank lending in Table 4 also pertain to 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.4, 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 estimate the real effects of banks' credit-supply response to variations in their funding costs, we estimate regressions at the firm-year level for the subsample of said firms with balance-sheet data in France. We use a shift-share approach similar to equation (2). To compute firm-level exposure to credit-supply shocks, $\textit{Deposit ratio}_{ft}$, 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:

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

where y_{ft} is an outcome of firm f in year t, and ψ_{cit} 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 8, we estimate equation (4) and use multiple firm-level outcomes. We find that more exposed firms see a drop in their capital assets, both in general (column 1) and more specifically in terms of their property, plant, and equipment (column 2). In terms of economic significance, $\textit{Deposit ratio}_{ft-1} \times \textit{Gap}_t$ 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.

Table 8: Firm-level Real Effects of Funding-cost Shocks

	ln(Capital assets)	ln(PP&E)	$\frac{\text{CapEx}}{\text{Capital assets}}$	$\frac{\text{Tangible investment}}{\text{PP\&E}}$	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 column 3, we see that more exposed firms become smaller in terms of their stock of total capital assets because they also invest less, as reflected by a drop in their capital expenditure out of total capital assets. Similarly, we can infer from column 4 that affected firms' property, plant, and equipment decreases because they invest less in tangible assets. Finally, we also estimate a negative, albeit insignificant, effect on employment in column 5.

4 Conclusion

Using regulatory-driven shifters in banks' marginal cost of funding, we estimate an elasticity of credit supply with respect to funding costs of -0.25. Banks' credit-supply response is highly nonlinear, and stronger for weakly capitalized banks and banks with lower liquidity buffers, pointing to the fact that changes in funding costs affect bank credit supply both directly, but also indirectly via a feedback effect on bank net worth. Such feedback effect implies that the heterogeneity of bank characteristics and the distribution of shocks across banks are key parameters for models that study how banks' cost shocks are transmitted to the real economy.

Our work also highlights that studying changes in the quantity of credit supply may not be sufficient to fully appreciate how shocks to banks' funding costs can affect aggregate output. To insulate their profits, banks reach for yield, leading them to rebalance their loan portfolio towards smaller and riskier firms, and longer-term loans in reaction to an increase in their funding costs. 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 constitutes a fruitful avenue for future research.

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ONLINE APPENDIX

A Supplementary Tables

Table A.1: Effect of Funding Cost 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.2: Effect of Funding Cost 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.3: Effect of Funding Cost 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.4: Effect of Funding Cost 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

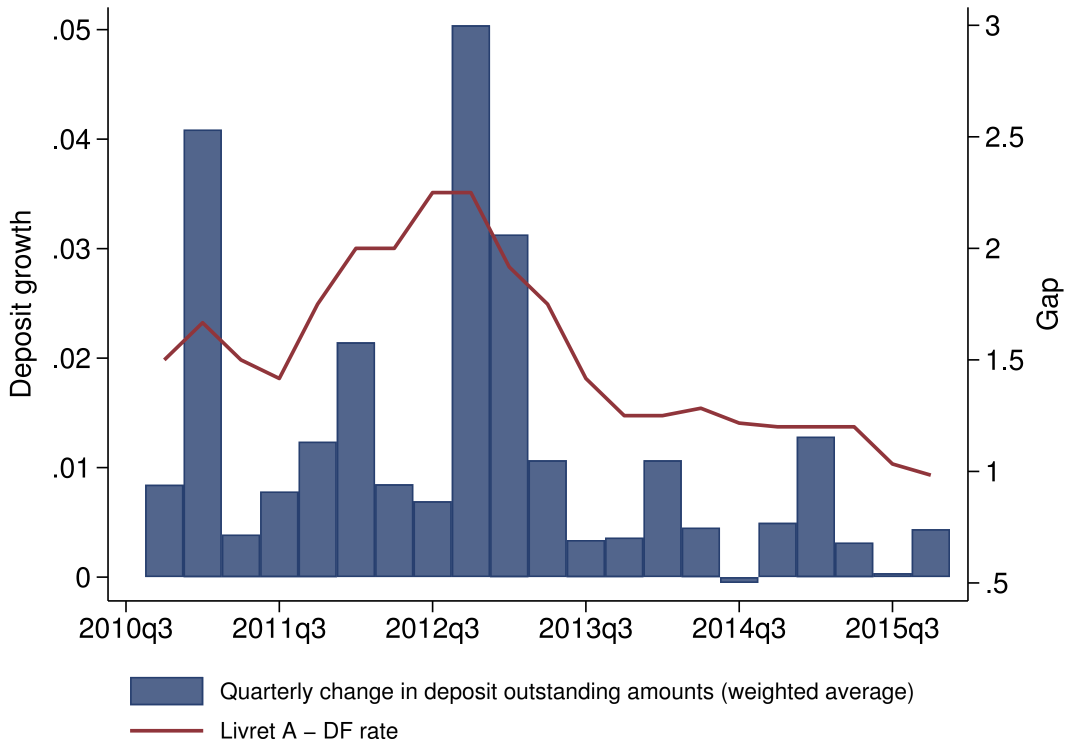

Figure B.1: **Sensitivity of Regulated Deposits to Funding-cost Gap.** This figure shows the quarterly growth rate in the weighted average of post-transfer regulated deposits at the bank level (accounting for entry and exit), $\frac{Deposits_{bdt} - Deposits_{bdt-1}}{0.5(Deposits_{bdt} + Deposits_{bdt-1})}$,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