Distortive Effects of Deposit Insurance: Administrative Evidence from Deposit and Loan Accounts [†]

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December 9, 2024

Abstract

We analyze the effects of the level of deposit insurance on the allocation of deposits across banks, and in turn, on the allocation of the supply of credit to non-financial firms. We exploit administrative datasets on the universe of retail depositors (deposit register), credit register, matched with bank-, firm- and individual-level data from Denmark; as well as deposit insurance reforms, one during the middle of the 2008 Global Financial Crisis from limited to unlimited insurance, and the other linked to a European Union reform to limit insurance coverage. For the deposit channel identification, we exploit the same individual deposit reallocation across different banks at the same time, or changes in deposits just below versus just above the insurance limits. We show that deposit insurance —via retail deposit reallocation— benefits the funding of weaker banks —with worse borrowers—, in turn keeping their elevated credit supply to worse (lower productivity and riskier) firms after the insurance reforms. Credit supply effects to worse firms are driven entirely across (not within) banks around deposit insurance reforms.

Keywords: Deposit Insurance, Deposit allocation, Deposit Rates, Credit Allocation

JEL Classification: G01, G21, G28

[†]We thank Jason Allen, Matthew Baron, Diana Bonfim, Kim Cramer, Eduardo D'avila, Giuseppe Ferrero, Chacko George, Itay Goldstein, Florian Heider, Skander Van den Heuvel, Anya Kleymenova, David E. Rappoport, Francesc Rodriguez-Tours, Anatoli Segura, Alexandros Vardoulakis, Alexander Ufier and seminar and conference participants at the Banca d'Italia, Banco de Portugal and CEPR Conference on Financial Intermediation, BCBS-BIS-CEPR Conference on bank liquidity, BIS-CEPR-SCG-SFI Conference on Financial Intermediation, Bristol Banking Workshop, ECB Banking Supervision Research Conference, EFA 2024, FED Chicago, Federal Reserve Board of Governors (Financial Stability), IMF, 17th NY Fed / NYU Stern Conference on Financial Intermediation, MoFiR, OCC Bank Research Symposium, University of Kentucky Finance conference, and Yale University (Rethinking Optimal Deposit Insurance conference). The views expressed in this manuscript are those of the authors and do not necessarily represent the views of the Danmarks Nationalbank, the Banca d'Italia, or the Eurosystem.

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1 Introduction

Bank runs have been at the center stage of financial crises throughout history (Reinhart and Rogoff 2009). In the 21st century, high-income countries (including the United States of America) have experienced bank runs by retail depositors, both during the 2008 Global Financial Crises (Shin 2009), and more recently during the 2023 collapse of Silicon Valley Bank and Signature Bank (White 2023), which was recognized as the 2nd and 3rd largest in the history of the Federal Deposit Insurance Corporation (FDIC). These events, not surprisingly, have reignited debates over deposit insurance (DI) schemes' design and implications (FDIC 2023).

This debate centers on a fundamental question: which banks benefit most from deposit insurance guarantees, and what are the resulting implications? The longstanding theoretical literature has characterized two classes of bank runs, each with distinct implications for the design of deposit insurance schemes: Diamond and Dybvig (1983) demonstrate that for solvent yet illiquid banks, runs can arise from sunspots unrelated to bank fundamentals, rendering deposit insurance an efficient solution. However, bank runs can be driven by banks' weaker fundamentals, either in conjunction with panic-driven scenarios (Goldstein and Pauzner 2005) or without panics solely driven by fundamental-based runs (Allen and Gale 2004). In this context, deposit insurance, by propping up weaker banks, could potentially distort market dynamics (Gorton 1988, Calomiris and Kahn 1991, Diamond and Rajan 2001, Rochet and Vives 2004, Dávila and Goldstein 2023). Understanding these effects is crucial to determine the optimal level of deposit insurance coverage Dávila and Goldstein (2023).

In this paper, we empirically analyze whether changes to the level of deposit insurance (DI) affect the allocation of deposits across banks, in turn, affecting the allocation of the supply of credit and risk-taking to non-financial firms. We analyze deposit reallocation due to DI changes both across and within: banks, and individuals. Our study focuses on Denmark, which provides an ideal setting for identification as we can exploit administrative matched datasets, including a deposit register covering the universe of retail depositors, and two recent reforms to the deposit insurance coverage limit. The first reform, implemented in response to the Global Financial Crisis (GFC) in October 2008, removed the existing deposit insurance

coverage limit, thereby providing unlimited insurance. The second reform, enacted in October 2010 following a European Union directive, reintroduced limited deposit insurance coverage.

We exploit administrative datasets on the universe of retail depositors (a deposit register) matched with credit register data, and additional granular information on each bank, firm, and individual. The deposit register data spans deposit accounts held by over 6 million individuals across 92 banks in Denmark from 2004 to 2015. At the *individual-bank level*, we possess annual data detailing year-end deposit volumes and interest payments over the preceding year. Notably, each deposit account is linked to a unique identifier for both the individual depositor and the corresponding bank. The deposit register is matched with the credit register, which includes term loans, credit lines, and credit cards held by approximately 100,000 non-financial firms. Finally, we obtain administrative information on banks' and firms' balance sheets and income statements, as well as tax records on individual depositors' wealth and income.

We also exploit two changes to the deposit insurance coverage limit. Prior to the GFC, the Danish government guaranteed all deposits up to a ceiling of DKK 300,000 (approximately 40,000 euros). In the aftermath of the collapse of Lehman Brothers, the Danish government chose to lift the deposit insurance limit and fully guarantee all bank deposits in October 2008. It is important to note that Danish banks financed a local credit boom, notably on real estate, with reliance on wholesale (foreign) borrowing, and hence, despite little exposure to US mortgage-back securities, Danish banks suffered from the liquidity freeze in 2008:Q3 with deteriorating local real estate. Therefore, in 2008:Q3 there was substantially liquidity stress but limited deposit insurance coverage, while in 2008:Q4 there was still the crisis but with unlimited deposit insurance coverage. In addition, in alignment with a European Union directive post-GFC aimed at standardizing deposit insurance across European member states, deposit insurance was limited to DKK 750,000 (circa 100,000 euros) in October 2010. Notably, deposit insurance applies at the depositor-bank level throughout the entire period under consideration.

We analyze the deposit and credit data at the bank-time, bank-account-time, individual-bank-time and firm-bank-time level. The analyses include a comprehensive set of granular

fixed effects, including e.g. depositor and borrower fixed effects within a period. We identify the effects of deposit insurance reforms using three sources of variation. First, we compare outcomes before and after the two deposit insurance reforms, which changed coverage from limited to unlimited in 2008 and back to limited in 2010. Second, we analyze changes in deposits in narrowly defined windows around the coverage limits, that is, around 300,000 DKK before the first reform and around 750,000 DKK after the second reform. Third, to study if banks benefit differently from deposit guarantees, we leverage their differential exposure to the adverse effects of the GFC based on their pre-GFC loan-to-deposit ratio, which serves as a proxy for bank illiquidity. This measure has been utilized by the IMF-EU-ECB rescue programs during the European banking crises post-2010 (IMF 2011), and has been utilized in analyzing credit supply to households in Denmark during the GFC (Jensen and Johannesen 2017).

We first document that exposed banks, characterized by higher credit-to-deposit ratios pre-GFC, have weaker loan portfolios prior to 2008. In particular, exposed banks lend more during the 2004-07 period to less productive firms (with lower total factor productivity) and also to real-estate and construction firms.[1] Moreover, this weaker ex-ante loan portfolio during 2004-07 results in higher ex-post loan losses during the 2008-15 period.

Consistently, exposed banks suffer funding liquidity problems at the onset of GFC with limited DI coverage; while this effect reverses with unlimited coverage. In particular, we analyze quarterly bank-level data from the Danish supervisor to document the impact of the onset of the GFC on exposed banks. We analyze the change in bank retail deposits, or deposit rate, or bank liquidity during 2008:Q3, as in this period the GFC was very active (e.g. Lehman Brothers failed), while deposit insurance was still capped at 300,000 DKK. We find robust evidence on mounting liquidity pressure at exposed banks in this period (i.e., less retail deposits, higher deposit rates, and a reduction of liquid assets). However, when we analyze 2008:Q4 in which the crisis was still unfolding but deposit insurance coverage was changed to unlimited, results reverse. Liquidity pressure from the GFC at exposed banks significantly eased as deposit

[1]Lending to lower productivity firms is over and above real estate, as all the credit results (during pre-GFC and after 2007) are robust to industry-time fixed effects, in which industry is at the 2- or 3-digit level.

insurance limit was lifted in October 2008.

A challenge in identifying the causal impact of deposit insurance reforms on the allocation of deposits is the potential sorting of depositors across banks. Banks with different exposure could have different types of depositors, who may differ in their withdrawal behavior as well as the degree of uninsured deposits.[2] We deal with this challenge by studying deposits at the individual-bank level and exploiting within-individual variation in deposit withdrawals in 2008. In particular, we keep all individuals with deposits in at least two banks in December 2007, and analyze withdrawals from the same individual to differently exposed banks in 2008 while controlling for individual fixed effects. We find that a depositor withdraws more from more exposed banks in 2008, and even more so if her deposits were above the deposit insurance limit. Reassuringly, we find similar effects when analyzing all depositors, i.e., those with only one bank in 2007, and omitting the individual fixed effects.

Moreover, to specifically identify the effects stemming from the change in deposit insurance coverage, we zoom in on deposit amounts around the 300,000 DKK insurance limit and collapse the data at the bank-account level. In particular, we analyze deposits between the ranges of 150,000-450,000 DKK, 200,000-400,000 DKK, and 250,000-350,000 DKK (in the latter case, the changes are around plus/minus just 7,000 USD). As during the GFC there were different policy measures, it is important to zoom in to casually identify the effects due to the deposit insurance and not due to other policy changes. Note also that during more than ten months of 2008, the deposit insurance limit was 2008. We indeed find that exposed banks lose deposits from just above versus just below the deposit insurance limit. Not surprisingly, effects are quantitatively stronger in 2008 than 2009 and 2010 –consistent with the individual-bank level analysis in which in 2009 (versus 2008), depositors do not cut deposits above 300 from more exposed banks. Moreover, effects are completely insignificant before the GFC.

Moreover, when we analyze the post-2010 reform, we find that exposed banks gain deposits below the insurance limit. When we zoom in around the 750,000 DKK insurance limit (for

[2]As bank credit and deposit side are not independent (see e.g., Kashyap et al. 2002, Gatev and Strahan 2006, Ippolito et al. 2016), banks with different exposure to the GFC could have different deposit fragility, including the type of depositors (households).

the 600,000-900,000 DKK, 650,000-850,000 DKK, and 700,000-800,000 DKK), we find significant results as well. Importantly, exposed banks gain insured deposits by increasing the deposit rates. In fact, exposed banks raise deposit rates to keep and attract deposits when there was limited deposit insurance, in both 2008 and post-2010 reform.

Finally, we analyze the credit supply effects associated with the deposit insurance reforms. To do so, we exploit the credit register and study credit outcomes at the firm-bank level. To isolate credit supply effects, we control for credit demand with a granular set of fixed effects. The resulting empirical strategy compares lending by differently exposed banks to the same borrower in the same year (Khwaja and Mian 2008). As the majority of firms in Denmark do not have multiple lending relationships at the same time, we also implement an alternative identification strategy that includes firms with a single borrower. Here, we compare lending by differently exposed banks to firms within the same industry and location, and of comparable size, within a given year (Degryse et al. 2019).

As mentioned above, exposed banks enter into the GFC with worse ex-ante loan portfolios. We find that exposed banks' credit supply to weaker firms, i.e. those with low productivity or in the real-estate industry, remains elevated throughout the GFC and after the two deposit insurance reforms.[3] Therefore, as these banks benefit more from deposit funding due to the deposit insurance reforms, the credit supply allocation to weaker firms (with low TFP or in real estate) continues after the DI reforms. Not only do we use borrower fixed effects for the lending volume to control for credit demand, but if anything loan rates are lower for more exposed banks to the same firm if those firms have lower productivity (or are in the real estate sector).

Therefore, deposit insurance—via retail deposit reallocation— benefits the funding of weaker banks —with worse borrowers—, in turn keeping the elevated credit supply to worse firms after the insurance reforms (i.e., deposits flow to weaker banks and from the weaker banks to weaker firms). Interestingly, when there is unlimited deposit insurance in 2009 during the

[3]In one year after the GFC, the result on credit supply to real estate becomes zero and is clearly lower than the rest of the years. This does not happen to credit supply to low-productivity firms.

GFC, more exposed banks do not relatively increase more risk-taking in credit supply towards low-productivity firms or firms in real estate (but keep similar risk-taking) as compared to 2008 or before the crisis or after 2010 when there is limited deposit insurance coverage. In sum, our results do not support that unlimited (versus limited) deposit insurance brings differentially higher risk-taking by more exposed banks, but our results suggest that deposit insurance brings distortive effects by allowing exposed banks (with weaker ex-ante fundamentals) to obtain more retail deposits and hence can continue their elevated credit supply to weaker firms (proxying a capital misallocation across firms due to effects between banks, not within banks, around changing the level of deposit insurance).[4]

2 Data, deposit insurance and empirical strategy

In this section we discuss the datasets used in our analysis and present descriptive statistics. We then detail the institutional background of the deposit insurance reforms and introduce our empirical strategy.

2.1 Datasets

Our analysis is based on several administrative matched datasets. To document the effects of deposit insurance on deposit reallocation, we utilize unique data on the universe of retail deposit accounts in Danish banks at the person-bank level in each period (a deposit register). We supplement this data with supervisory information on bank balance sheets to identify banks that were relatively more exposed to the global financial crisis. Our analysis of bank lending relies on the credit register containing the universe of non-mortgage loans to non-financial firms from banks in Denmark, which we enhance with information about the firms.[5] Throughout our analyses, we focus on the period from 2004 to 2015. This subsection provides a brief overview of the data and the sample restrictions we impose.

[4]We note that we perform a positive analysis of one channel, without any normative (welfare) analysis.

[5]The data can be matched to administrative person-level wealth and income level and components.

Deposit register. We obtain information about the universe of bank deposit accounts from the Danish tax authorities. At the end of each year financial institutions in Denmark are mandated to report the year-end balances of each deposit account to the tax authority. These reports are compulsory and serve as a reliable means for tax enforcement, resulting in a high level of data quality.[6] Our dataset spans the deposit accounts of 6.5 million individuals, and for each individual at every Danish bank we observe both the consolidated end-of-year account balance and the total interest payment over the preceding year. Each deposit account is tagged with a unique identifier that links it to both an individual and a bank.

We first aggregate this account-level data up to the individual-bank-level by summing up deposit volumes and interest payments across all accounts by the same individual at the same bank in a given year.[7] We do so because deposit insurance applies at the individual-bank level and not the individual-bank-account-level. For each observation at the individual-bank-year level, we impute the effective deposit rate as the total interest payment in year t divided by the average deposit balances in year t. We approximate the deposit balance in year t by averaging the balance and the end of year t and the balance at the end of year $t-1$. The data on deposit holdings at the individual-bank level forms the basis for our individual-level analysis of deposit withdrawal behavior across banks. Subsequently, we study changes in deposits at the bank-account range level, which allows us to examine variations across different account sizes.

Credit register. Our dataset on corporate loans mirrors the retail deposit data outlined above. This dataset encompasses all non-mortgage lending accounts between non-financial firms and banks in Denmark. The data includes regular term loans, flexible credit facilities such as revolving loans or overdraft accounts, credit card debt, and commercial paper.[8] Similarly to the deposit data, for each lending agreement we have access to the identity of the

[6]The data also includes information on the contractual interest rates. However, this information is not pivotal for tax purposes and thus not consistently reported.

[7]We do not have information on the type of account (i.e., we cannot observe whether a deposit account is a checking or a savings account, for instance).

[8]In Denmark, mortgages are handled by specialized mortgage institutions, which operate under distinct regulations. Consequently, we have excluded these institutions from our analysis.

borrower, account number, outstanding credit balance, and total interest payments made over the year. We only analyze loans to non-financial firms given our interest on credit allocation to firms that are relatively more exposed to the GFC. We aggregate the account-level data up to the bank-firm-year level by summing the credit balances and interest payments across multiple accounts a firm may have at the same bank. To arrive at our baseline sample, we restrict the sample in a number of ways. First, we consider all active firms from 2004 to 2015, excluding those with equity below 1,000 USD to ensure financial substance. Additionally, we exclude cooperatives, NGOs, and other non-profit entities, primarily to omit housing cooperatives from our analysis. We drop loans granted by municipalities. We also drop all loans that are in some form of arrears or debt forgiveness. Lastly, we drop loans by mortgage banks, governmental institutions and the Danish central bank. Our final loan-level data includes 101,000 unique firms borrowing from 92 banks.

Person-level data. In addition to financial records, our study integrates a comprehensive set of demographic data obtained from tax records, covering all Danish taxpayers. This dataset provides a detailed breakdown of individual balance sheets including sources of income and wealth data. It also encompasses demographic attributes such as age, educational background, and geographic location. These annual data points are collected at the end of each year, offering a granular view of each individual's socio-economic factors.

Lender and borrower characteristics. We enhance our corporate loan data with detailed information on both borrowers and lenders from databases compiled by Statistics Denmark and the financial supervisory authority. For details on corporate borrowers, we access the Danish firm register ("FIRM"), which includes data on firms' legal status, founding year, location, number of employees, and financial statements such as balance sheets and income statements. Bank-specific information, encompassing balance sheets, income statements, and key regulatory metrics like capital adequacy ratios, is sourced from the financial supervisory authority.

In summary, our deposit dataset covers 6.5 million individual accounts across 92 banks from 2004 to 2015. The credit dataset includes 101,000 unique firms borrowing from these banks during the same period.

Identify exposed banks. The global financial crisis highlighted significant vulnerabilities in the banking sector, particularly concerning funding stability. We exploit differential bank exposure to the GFC based on the loan-to-deposit ratio pre-GFC, as this measure proxies for bank illiquidity. For example, this measure has been targeted by the IMF-EU-ECB rescued programs during banking crises post-2010 (see e.g., IMF 2011), and it has been used in the context of Denmark to analyze credit supply to households during the GFC (see Jensen and Johannesen 2017). Banks with a higher proportion of loans relative to deposits on their balance sheets were considered more exposed to financial turbulence during the GFC. This ratio serves as a proxy for the extent to which banks depended on less stable wholesale market funding—a critical vulnerability during the crisis, particularly as the turmoil originally triggered by losses on US mortgage-backed securities spread through short-term funding markets (Shin 2009, Brunnermeier 2009). For our analysis, we define the *Exposed* variable for each bank as the ratio of loan-to-deposit in December 2007.

2.2 Descriptive statistics

Table 1 presents the descriptive statistics for the main variables used in the analysis measured as of December 2007.

Banks. In Panel A of Table 1 we report bank characteristics. The average bank in our sample has a size (measured in terms of total asset) of approximately 56.72 billion DKK, indicating a significant degree of variation in bank size—from small local institutions to large, systemically important banks. The loan-to-deposit ratio, a critical metric of a bank's liquidity and risk exposure during the global financial crisis, averages at 1.20 (120%), with a standard deviation of 0.43 (43%). Notable, the ratio varies widely across banks: while the 10% percentile of the distribution has a ratio equal to 0.65 (65%), the 90% percentile of the distribution is equal to 1.78 (178%). This reflects the rich heterogeneity in funding structures across banks prior to the onset of the GFC. The average Tier 1 capital ratio is 13.46% while average loan losses from 2008 to 2010 relative to total assets is 5%, echoing the broader financial distress experienced during the period.

Firms. In Panel B of Table 1, we provide an overview of the firms in our sample, measured by their balance sheet characteristics at the end of 2007. The average firm's total assets are recorded at 54.19 million DKK, with a noteworthy spread in firm size reflected by a standard deviation of 1,112 million DKK. The total factor productivity (TFP) averages 8.71, with a considerable spread across firms, as evidenced by a standard deviation of 11.76, indicating differing levels of operational efficiency. This spread is further highlighted by the percentile range, with the 10th percentile at 3.79 compared to the 90th percentile at 25.60, demonstrating substantial variability in productivity among the firms. The leverage ratio has a mean value of 67%, indicating a reliance on debt financing to a large extent within the capital structure of these firms. The return on assets, averaging 8%, points to the overall profitability of firms in our sample during the covered period.

Table 1: Descriptive statistics

	Mean	SD	Min	p10	p50	p90	Max
Panel A. Banks							
Total assets (1bn kr)	56.72	338.37	0.19	0.62	4.48	33.83	3169.77
Loan-to-deposit ratio	1.20	0.43	0.41	0.65	1.17	1.78	2.19
T1 capital ratio	13.46	8.87	3.60	7.60	11.60	19.10	72.80
Loan losses 2008-2010/TA	0.05	0.04	0.01	0.01	0.04	0.11	0.20
Panel B. Firms							
Total assets (1M kr)	54.19	1121.82	0.75	1.27	5.07	46.47	1.7e+05
TFP	8.71	11.76	-0.09	0.76	3.79	25.60	45.00
Leverage ratio	0.67	0.19	0.12	0.41	0.69	0.90	0.98
Return on assets	0.08	0.16	-0.66	-0.07	0.08	0.27	0.34

Notes: This table provides descriptive statistics measured in December 2007. Panel A and Panel B report the characteristics of banks and firms, respectively.

2.3 Deposit insurance reforms in Denmark

Leading up to the global financial crisis of 2008, the Danish economy experienced robust growth, prompting a significant expansion in domestic banks' lending activities, particularly to real estate firms. This period was also characterized by a thriving housing market. This

expansion in credit significantly outstripped the growth in deposits, prompting Danish banks to depend more on wholesale market funding. This led to a sharp rise in leverage ratios and a decline in liquidity ratios. Despite these developments, the banks remained profitable, and none failed during the pre-crisis boom (Rangvid et al. 2013).

While the Danish banking sector had minimal direct exposure to the U.S. mortgage-backed securities central to the global financial crisis, it still felt the impact of the 2007-2008 credit crunch (Shin 2009, IMF 2011, Jensen and Johannesen 2017). The situation worsened with Lehman Brothers' collapse in September 2008, causing a freeze in international credit markets and triggering a funding crisis for many Danish banks. From 2008 to 2010, about 30 small to medium-sized Danish banks failed to meet regulatory capital requirements or went out of business.

In response to the escalating crisis, the Danish government implemented a series of measures in October 2008 known as the "Bank Rescue Package I". First and foremost, it temporarily guaranteed all deposits in banks in Denmark, thereby lifting the previous deposit insurance limit of DKK 300,000 to an unlimited deposit insurance coverage (*Reform 1*). The effective lift of the deposit insurance limit was initially set to expire in September 2010. In addition, the Danish central bank launched temporary credit facilities to improve liquidity in the banking sector. While these facilities enhanced confidence in the banking sector, banks made virtually no use of them (Dam and Risbjerg 2009).[9]

In the aftermath of the GFC, the European Commission proposed to harmonize the deposit insurance schemes across European Union members because of growing concerns about cross-country flight of deposits. Effective from 1 October 2010, Denmark aligned with the new EU rules by setting the deposit insurance limit at DKK 750,000 (*Reform 2*). This threshold, determined and standardized by the European Union (around 100,000 euros), was external to the Danish banking system and left a considerable portion of bank deposits in Denmark uninsured (Iyer et al. 2019). Media coverage at the time highlighted strategies for depositors to safeguard

[9]For further details on the Danish policy response to the GFC, including the creation of the Financial Stability Company ("Finansiel Stabilitet") to oversee the activities of struggling banks, see Abildgren and Thomsen (2011) and Rangvid et al. (2013).

their savings, such as distributing deposits across several banks (Rangvid et al. 2013).[10]

2.4 Empirical strategy

We analyze the deposit and credit data at the bank-time, bank-account-time, individual-bank-time and firm-bank-time level, with differential granular level of fixed effects. We identify the effects of deposit insurance reforms using three sources of variation. First, we compare outcomes before and after the two deposit insurance reforms, which changed coverage from limited to unlimited in 2008 and back to limited in 2010. Second, we analyze changes in deposits in narrowly defined windows around the coverage limits, that is around 300,000 DKK before the first reform and around 750,000 DKK after the second reform. Third, to study if banks benefit differently from deposit guarantees, we leverage their differential exposure to the adverse effects of the GFC based on their pre-GFC loan-to-deposit ratio, which serves as a proxy for bank illiquidity. Combining these sources of variation with granular fixed effects allows us for example to exploit within-individual variation in deposit withdrawals across differently exposed banks around the deposit insurance reforms. We provide more specific details on our empirical approaches in the following section.

3 Results

3.1 The 2008 Global Financial Crisis and Shift from Limited to Unlimited DI Coverage: Bank-level Outcomes

In this subsection, we document that exposed banks, i.e. banks with higher loan-to-deposit ratio pre-GFC, have weaker loan portfolios prior to 2008. Utilizing the credit register matched with both the firm register and supervisory data, we compute total factor productivity (TFP) at the firm level. We then aggregate TFP at the bank level by weighting for loan volumes. We

[10] In Denmark, as in the U.S., deposit insurance coverage is determined separately for accounts held by the same individual at different banks, meaning the deposit insurance limit is applicable on a per-depositor, per-bank basis. This structure enables depositors to effectively increase their coverage by distributing their accounts across several banks.

then aggregate TFP at the bank level, weighting it by loan volumes. Additionally, we assess each bank's dependence on firms in the real estate and construction sectors by weighting each loan granted to these firms according to its relative volume at the bank level.

We estimate the following panel regressions estimated over the period 2004-2007:

$$y_{b,t} = \alpha_t + \beta_t \text{Exposed}_b + \gamma X_{b,t} + \epsilon_{b,t} \tag{1}$$

where $y_{b,t}$ represents the magnitude of the dependence at the bank level from either TFP or the real-estate firms, α_t are year fixed effects, and $X_{b,t}$ are bank controls that include banks' total assets and tier-1 capital ratio measured in 2007.

Results from the panel regressions (1) are presented in Table 2. Our results indicate that a standard deviation increase in exposure is associated with a decrease in TFP of 0.6 units, which is roughly 15% of the median firm TFP. At the same time, a standard deviation increase in exposure is associated with an increase in the share of loans to real estate firms of 5 to 7 percentage points.

Table 2: Exposed banks lend to less productive and riskier firms prior to the GFC

Outcome:	Period: 2004-2007					
	TFP			**Real-estate firm**		
	(1)	(2)	(3)	(4)	(5)	(6)
Exposed	-0.64**	-0.57***	-0.59***	0.05***	0.07***	0.07***
	(0.27)	(0.22)	(0.22)	(0.02)	(0.02)	(0.01)
Observations	330	330	330	330	330	330
R2	0.02	0.03	0.04	0.06	0.11	0.15
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls		Yes	Yes		Yes	Yes
Control: Top-6 bank			Yes			Yes

Notes: The table presents the results from estimating the panel regression (1) over 2004-2007 at the bank-level. Bank controls include banks' total assets and tier-1 capital ratio measured in 2007. We also include a control for the top-6 banks, which are the six banks with largest total assets in 2007. We report robust standard errors in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

We next estimate the effect of exposure on loan losses over the 2008-15 period. The speci-

fication that we use is similar to Equation (1) but as a dependent variable we use bank-level loan losses scaled by total assets. Table 3 shows that exposed banks feature higher ex-post loan losses during the 2008-2015 period. These results are confirmed by Figure 1, which plots the coefficient on exposed banks year-by-year. Therefore, exposed banks have weaker loan portfolio pre-GFC, resulting in higher ex-post loan defaults.

Table 3: Exposed banks feature more elevated loan losses after 2008

Outcome: Loan losses/TA	Period: 2004-2015			Period: 2008-2015		
	(1)	(2)	(3)	(4)	(5)	(6)
Exposed	0.003***	0.004***	0.003***	0.004***	0.006***	0.005***
	(0.0004)	(0.0004)	(0.0004)	(0.0006)	(0.0006)	(0.0006)
Observations	888	888	888	544	544	544
R2	0.42	0.45	0.46	0.23	0.30	0.33
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls		Yes	Yes		Yes	Yes
Control: Top-6 bank			Yes			Yes

Notes: The table presents the results from estimating a panel regression at the bank-level where the dependent variable is loan losses scaled by total assets. Bank controls include banks' total assets and tier-1 capital ratio measured in 2007. A dummy for the top-6 banks is also included. Standard errors are reported in parentheses and clustered at the bank level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

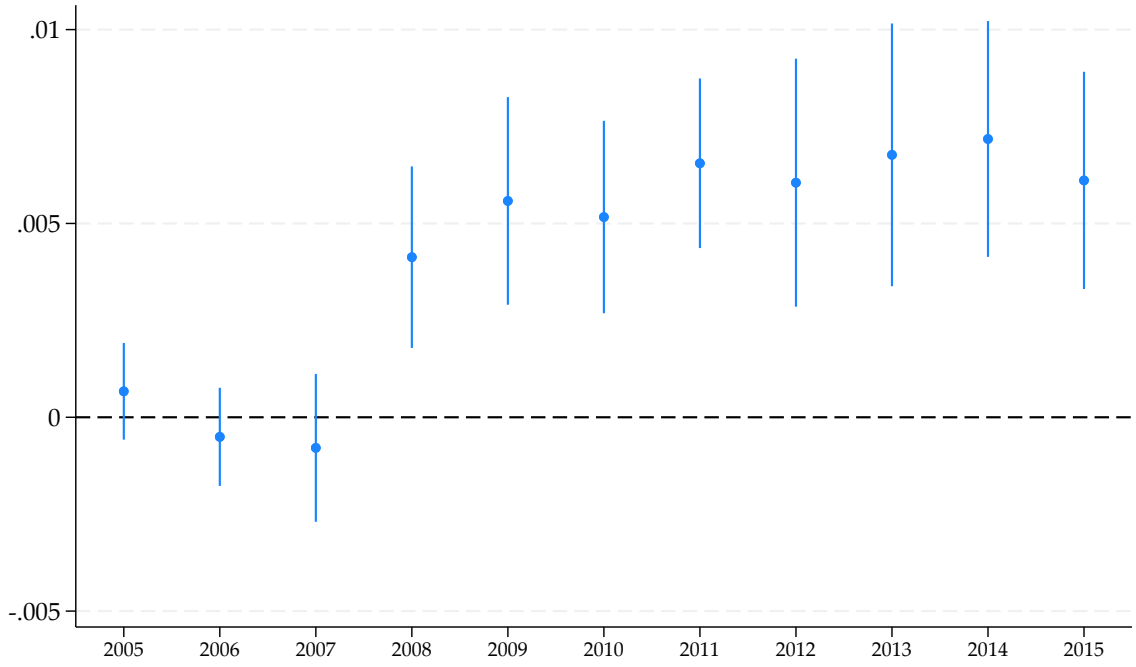
Making use of the quarterly bank-level data from the Danish supervisor, we next investigate exposed banks' funding liquidity at the GFC onset in 2008. Denmark introduced unlimited deposit insurance coverage in October 2008, therefore we should appreciate the effects of the unlimited deposit insurance on the liquidity of exposed banks in the last quarter of the year. This allows us to study whether exposed banks suffer funding liquidity problems at the GFC onset with limited deposit insurance coverage (2008:Q3) and what happens afterwards with the introduction of unlimited coverage (2008:Q4).

We therefore estimate the following specification:

$$\Delta y_b = \alpha + \beta \text{Exposed}_b + \gamma X_b + \epsilon_b \,, \tag{2}$$

where Δy_b are the quarterly change of either log total deposits, deposit rate, or log total liquidity, Exposed_b is our exposure measure of bank b, and X_b are bank-level controls such as total assets and tier-1 capital ratio measured in 2007.

Figure 1: Exposed banks display higher loan losses



Notes: The figure shows the estimates and 95% confidence intervals from a bank-level panel regression of loan losses scaled by total assets on our exposure measure.

Table 4 reports the results from estimating Equation (2) from 2008:Q2 to 2008:Q3, where deposit insurance was still capped at 300K DKK. A standard deviation increase in exposure decreases deposits by roughly 1 percentage point (and with higher deposit rates) and decreases total bank liquidity by roughly 3 percentage points. This tells us that during the GFC with limited deposit insurance, there was mounting liquidity pressure at exposed banks.

The picture reverses completely when we estimate Equation 2 from 2008:Q3 to 2008:Q4, that is over the period in which unlimited deposit insurance was introduced in Denmark. Table 5 shows that a standard deviation increase in exposure raises deposits by roughly 2 percentage points, and increases total bank liquidity by roughly 4 percentage points, while deposit rates decrease.

Having investigated the liquidity stress of exposed banks during 2008 which was subse-

Table 4: Liquidity stress from 2008:Q2 to 2008:Q3

	(1)	(2)	(3)	(4)
Panel A. Total deposits				
Exposed	-0.012***	-0.012***	-0.011***	-0.011***
	(0.0029)	(0.0037)	(0.0036)	(0.0042)
Observations	77	77	77	77
R2	0.06	0.06	0.07	0.09
Panel B. Deposit rate				
Exposed	0.003**	0.004**	0.004**	0.004**
	(0.0015)	(0.0015)	(0.0016)	(0.0014)
Observations	69	69	69	69
R2	0.45	0.47	0.48	0.51
Panel C. Total liquidity				
Exposed	-0.031***	-0.025**	-0.027***	-0.027***
	(0.0092)	(0.0104)	(0.0094)	(0.0099)
Observations	89	89	89	89
R2	0.04	0.05	0.05	0.06
Control: Log(size)		Yes	Yes	Yes
Control: Capital ratio			Yes	Yes
Control: Top-6 bank				Yes

Notes: The table presents the results from estimating a cross-sectional regression of changes in bank-level outcomes. Bank controls include banks' total assets and tier-1 capital ratio measured in 2007. We also include a dummy variable equal to one for the Top-6 banks in 2007, that is the six banks with largest total assets. Robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

quently eased with the introduction of unlimited deposit insurance, we next investigate the behaviour of insured and uninsured deposits around the DI reforms of 2008 and 2010.

3.2 Deposit insurance reforms: Insured vs. uninsured deposits

In this subsection, we want to exploit the difference between insurance and uninsured depositors, analyzing the data either at: (i) the person-bank level within the same period (and

Table 5: Liquidity pressure eased from 2008:Q3 to 2008:Q4 with the introduction of unlimited deposit insurance coverage

	(1)	(2)	(3)	(4)
Panel A. Total deposits				
Exposed	0.023***	0.024***	0.022***	0.022***
	(0.0070)	(0.0073)	(0.0069)	(0.0071)
Observations	85	85	85	85
R2	0.12	0.13	0.15	0.15
Panel B. Deposit rate				
Exposed	-0.008**	-0.009**	-0.009**	-0.009**
	(0.0035)	(0.0034)	(0.0036)	(0.0035)
Observations	72	72	72	72
R2	0.33	0.36	0.37	0.37
Panel C. Total liquidity				
Exposed	0.041**	0.044**	0.037*	0.037**
	(0.0203)	(0.0219)	(0.0195)	(0.0187)
Observations	87	87	87	87
R2	0.05	0.05	0.11	0.12
Control: Log(size)		Yes	Yes	Yes
Control: Capital ratio			Yes	Yes
Control: Top-6 bank				Yes

Notes: The table presents the results from estimating a cross-sectional regression of changes in bank-level outcomes. Bank controls include banks' total assets and tier-1 capital ratio measured in 2007. We also include a dummy variable equal to one for the Top-6 banks in 2007, that is the six banks with largest total assets. Robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

checking whether there are more deposit withdrawals from more exposed, especially if above the insurance limit), or (ii) at the bank-account level just above versus just below the deposit insurance limit.

Reallocation of deposits: Individual-bank-time level analysis

To identify differences in depositors' withdrawal across banks with varying exposure to the GFC, we exploit within-individual variation in deposit withdrawals. Our starting point is the sample of all individuals who have deposits in at least two different banks at the end of 2007. Based on this sample, we estimate the individual-level response of depositors to the first deposit insurance reform using the following individual-bank-time level analysis:

$$\begin{aligned}\Delta \log(\text{deposits})_{hb2008} = \alpha_h + \alpha_b + \beta_1 \text{Exposed}_b \times \text{Above 300K}_{h,2007} \\ + \beta_2 \text{Exposed}_b + \beta_3 \text{Above 300K}_{h,2007} + \gamma X_b + \epsilon_{hb2008} \ . \end{aligned} \tag{3}$$

The dependent variable in equation (3), $\Delta \log(\text{Deposits})_{hb2008}$, denotes the change in the natural logarithm of deposits for individual h at bank b from 2007 to 2008. Exposed_b represents the bank's b standardized loan-to-deposit ratio at the end of 2007 (pre-crisis). $\text{Above 300K}_{h,2007}$ is an indicator equal to one if the individual's deposits at the end of 2007 were above the deposit insurance limit of DKK 300,000. X_b are bank-level controls such as total assets and tier-1 capital ratio measured in 2007. The model includes individual fixed effects β_h to focus on within-individual variation in deposit changes. The model also includes bank fixed effects α_b, to control for unobserved, time-invariant bank characteristics, and the error term ϵ_{hb2008}. The coefficient of the interaction term ($\text{Exposed}_b \times \text{Above 300K}_{h,2007}$) measures the withdrawal effect of individuals with deposits above the 300,000 DKK threshold at exposed banks in 2007. The coefficient is identified by exploiting within-individual variation in withdrawals across banks with varying levels of exposure.

Table 6 presents the regression results of various specifications of equation (3) in columns (1)-(5). Column (1) shows that individuals withdraw more deposits from banks with higher pre-crisis loan-to-deposit ratios. In Columns (2) and (3), we sequentially add the indicator *Above 300K* and the interaction term (*Exposed X Above 300K*) along with bank controls. Column (3) captures the compounded effect of being an individual at an exposed bank with deposits above the 300,000 DKK threshold. The negative and significant coefficients on the exposed

variable and the interaction term demonstrate that deposit withdrawals from exposed banks are even larger among individuals with deposits above the insurance limit. Importantly, the economic significance of this finding is notable: a standard deviation increase in exposure results in uninsured individuals decreasing their deposits by 6.6 percentage points (1.5 pp + 5.1 pp). We subsequently add bank-fixed effects in column (4) to show that our results are not driven by any unobserved, time-invariant bank characteristics.

We document the impact of the first deposit insurance reform, which lifted the previous DKK 300,000 limit and guaranteed all deposits, in column (5). In this column we estimate the model in (3) using the change in (log) deposits from 2008 to 2009 as the outcome variable. This provides a way to assess how changes in policy influenced depositor behavior, particularly for depositors with deposits above the old 300K insurance threshold. Interestingly, the coefficient for the interaction term *Exposed X Above 300K* is positive and highly significant. This suggests that previously uninsured depositors increased their deposits at more exposed banks once the unlimited deposit insurance scheme was in place. This shift indicates that the deposit insurance reform reduced liquidity pressure on more exposed banks.

Finally, we estimate all of the previously described models when we instead utilize the universe of all depositors, instead of restricting attention to individuals who have deposits in at least two banks in 2007. We present the results from this larger population in columns (6)-(10) of Table 6. We drop the individual-fixed effect from the specification in equation (3). As a consequence, our coefficients in these specifications are not identified from within-individual variation in deposit withdrawals, but rather from differences in withdrawals across individuals. While the identification of the effects is less clean, our sample size increases substantially from approximately 1.8 million to 5.5 million observations. Reassuringly, all estimated coefficients are qualitatively similar, and remain highly significant. However, the magnitude of the estimated coefficients is somewhat smaller compared to the results in columns (1)-(5).

Table 6: Insured vs uninsured depositors

Outcome: Δ Deposits	Individuals with 2+ banks in 2007					All individuals				
	Year: 2008				Year: 2009	Year: 2008				Year: 2009
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Exposed	-0.005***	-0.018***	-0.015***			-0.006***	-0.009***	-0.007***		
	(0.001)	(0.002)	(0.002)			(0.001)	(0.001)	(0.001)		
Above 300K		-0.514***	-0.498***	-0.502***	-0.279***		-0.439***	-0.430***	-0.431***	-0.337***
		(0.004)	(0.004)	(0.004)	(0.004)		(0.001)	(0.002)	(0.002)	(0.001)
Exposed X Above 300K			-0.051***	-0.051***	0.019***			-0.025***	-0.023***	0.019***
			(0.006)	(0.006)	(0.005)			(0.002)	(0.002)	(0.002)
Observations	1,776,698	1,776,698	1,776,698	1,776,698	1,622,053	5,521,087	5,521,087	5,521,087	5,521,087	5,588,505
R2	0.46	0.47	0.47	0.47	0.46	0.00	0.01	0.01	0.01	0.01
Individual FE	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
Bank FE				Yes	Yes				Yes	Yes
Bank controls		Yes	Yes				Yes	Yes		

Notes: The table reports coefficients and standard errors (in parenthesis) from the difference-in-differences specification of Equation (3). Each column corresponds to a different specification. Columns (1-5) report results with individual fixed effects, as noted in the lower part of the table. We report standard errors clustered at the individual-level in parenthesis. We include the following bank controls: *Bank size*, *Tier* 1*ratio*, both measured in 2007. *p <.1; **p <.05; ***p <.01.

Reallocation of deposits: bank-account-time level analysis

To identify specifically the effects stemming from the change in the deposit insurance coverage, we zoom in around the 300 thousand insurance limit and collapse the data at the bank-account level. In particular, we analyze deposits between 150-450 thousand, 200-400 thousand, and 250-350 thousand (in this latter case, the changes are around plus/minus (approximately) just 7 thousand dollars). As during the GFC there were different policy measures, it is important to zoom in to casually identify the effects due to the deposit insurance and not due to other policies.

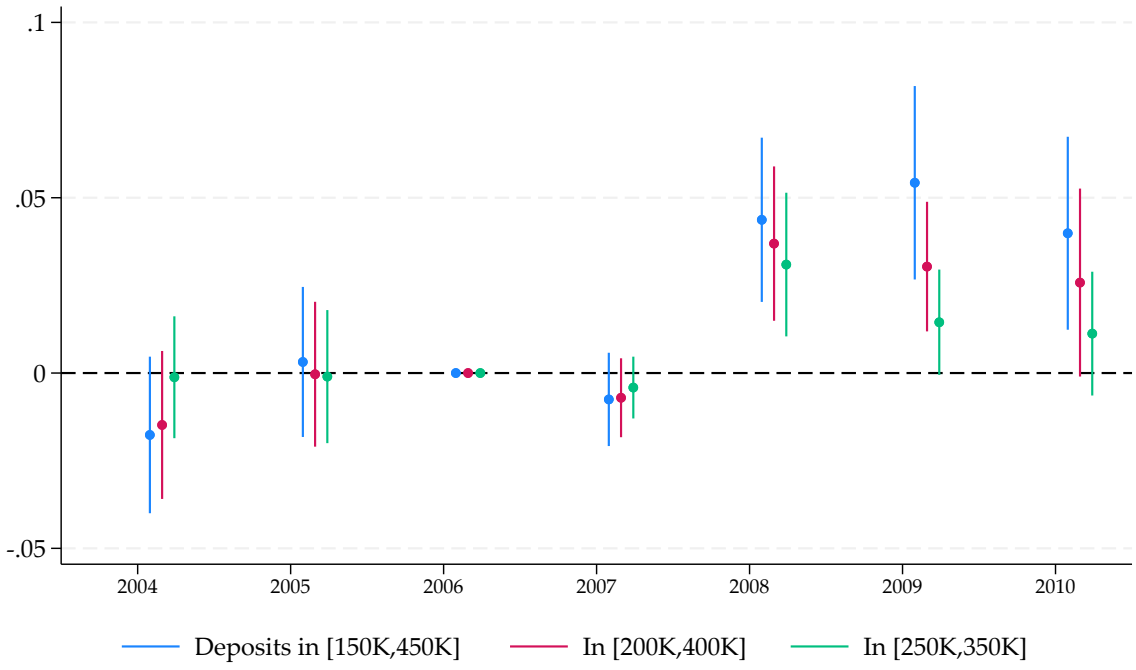
We estimate the following regression model:

$$\begin{aligned} \log(\text{deposits})_{btk} = \alpha_{bk} + \alpha_{bt} + \beta_t \alpha_t \times \text{Exposed}_b \times \text{Below 300K}_{bk} \\ + \beta_2 \alpha_t \times \text{Below 300K}_{bk} + \epsilon_{btk} \end{aligned} \tag{4}$$

The dependent variable, $\log(\text{deposits})_{btk}$, is the logarithm of deposit amounts in bank b, in year t, across deposit range k. We follow Iyer et al. (2019) and slice up each account in a number of deposit ranges around the insurance coverage: DKK 150,000 - 450,000, 200,000 - 400,000 and 250,000-350,000. *Below* 300*K* is an indicator variable equal to one for deposit range bins below the DKK 300K threshold. This specification allows us to analyze if deposit volumes *just above* and *just below* the insurance threshold change differentially around the insurance

reform coverage. Our key coefficient of interest is β_t, which indicates whether the decrease in deposits at exposed banks around the reform years is primarily driven by deposits above the insurance limit.

Figure 2: Effect on deposits at exposed banks: Reform 1



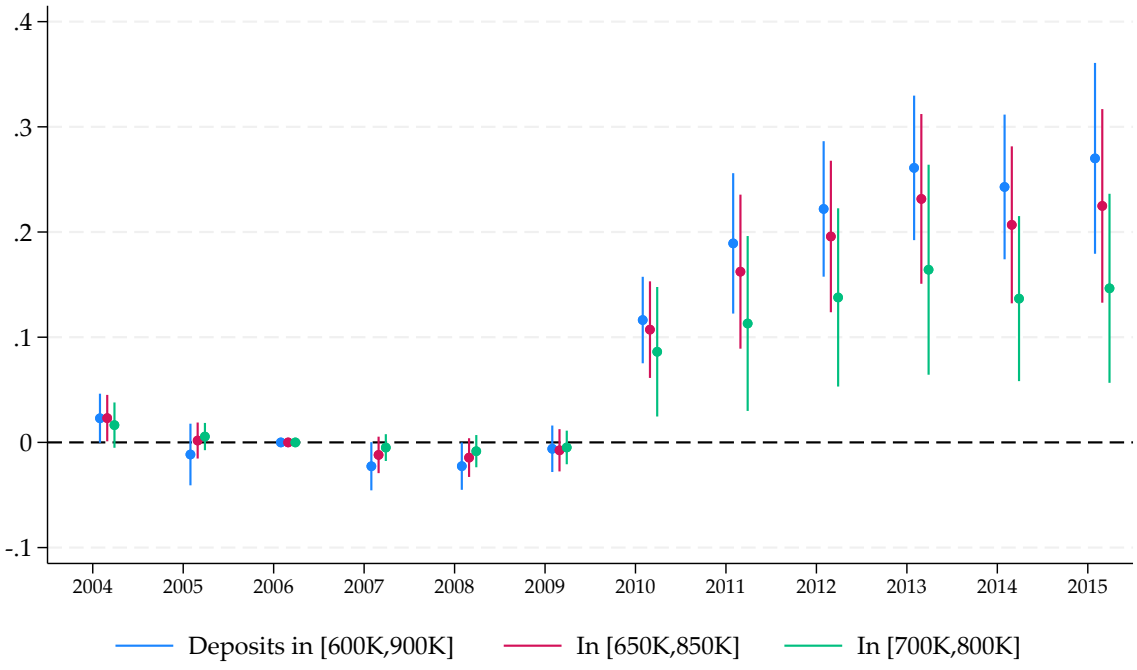
Notes: This figure depicts the triple interaction coefficients and 95% confidence intervals over time. We estimate our baseline specification in equation (4) with bank-range, and bank-time fixed effects. Each line in the figure represents a different range of deposit amounts: from 150K to 450K, 200K to 400K, and narrowly around the insurance limit from 250K to 350K.

Figure 2 shows the dynamic specification for deposits at exposed banks that fall below the 300K. We observe three distinct series, each representing a different range of deposit amounts: from 150K to 450K, 200K to 400K, and even narrowly around the insurance limit from 250K to 350K (just plus/minus 7K dollars approximately). The results in Figure 2 show a clear pattern: In 2008, exposed banks lose deposits from *just above* versus *just below* the deposit insurance limit. Moreover, effects becomes weaker in 2009 and 2010 as compared to 2008, especially in the closer threshold to the deposit insurance limit.

Prior to 2008, the coefficients suggest that exposed banks did not experience a change of

deposits from accounts around the 300K threshold. Notably, the significant uptick in the coefficients for 2008 precedes the actual implementation of the deposit insurance reform in October and thus largely captures the depositor behavior in response to the Global Financial Crisis, given the data's annual granularity. Following the enactment of the reform (towards the end of 2008), the coefficient for 2009 decreases, suggesting that the deposit levels at exposed banks in the prior year were not sustained. This decline reflects the new unlimited deposit insurance coverage taking effect, consistent with alleviating depositor concerns and reducing the urgency to keep deposits below the previous insurance cap (see also Table 6, the double interaction between $exposed \times below\ 300K$ for the year 2009 compared to 2008, with different sign).

Figure 3: Effect on deposits at exposed banks: Reform 2



Notes: This figure depicts the triple interaction coefficients and 95% confidence intervals over time. We estimate our baseline specification in equation (4) with bank-range, and bank-time fixed effects. Each line in the figure represents a different range of deposit amounts: from 150K to 450K, 200K to 400K, and narrowly around the insurance limit from 250K to 350K.

2010 reform from unlimited to limited insurance coverage

After analyzing the effects of the 2008 deposit insurance reform, we next progress to the 2010 reform, which saw the insurance limit recalibrated to DKK 750K. Unlike the previous shift to unlimited coverage, this reform introduced a new ceiling on insured deposits as Denmark aligned with the new EU deposit insurance rules by setting the deposit insurance limit at DKK 750,000 (approximately 100,000 euros).

Similar to the previous analysis, we explore how exposed banks fare in light of this reform—do they witness an inflow or outflow of deposits as the new limit took effect? To do so, we assess whether accounts holding deposits *just below* the new DKK 750K threshold behave differently than those with deposits *just above* this limit. Utilizing our difference-in-differences approach, we now focus on whether deposit growth at exposed banks *above* and *below* the new DKK 750K insurance threshold experience significant changes. By narrowing our observation window to account for ranges that closely interact with the latest insurance limit, we aim to capture that the effects are driven by the deposit insurance reform and not by other shocks or changes.

We adapt Equation (4) to assess reform 2 by replacing the variable $Below; 300K$ with $Below; 750K$ to align with the new insurance threshold. Figure 3 illustrates the regression results for the period surrounding the 2010 reform. Each line in the figure corresponds to different deposit amount ranges: from 600K to 900K, 650K to 850K, and narrowly around the insurance limit from 700K to 800K. The estimates indicate a significant reallocation of insured deposits towards exposed banks after the reform was implemented (post-2010).

Following the analysis in Figure 3, Table 7 translates these specifications into a regression format by replacing the yearly indicators with the after-2010 reform dummy. Column (1) is an ordinary least squares specification, and we sequentially add fixed effects to fully account for potential confounding factors. The most granular specification is in column (5) and includes bank-range, bank-time and range-time fixed effects. Table 7 consistently shows that exposed banks experience an increase in deposits just below the new insurance limit following the 2010

Table 7: Reduction of deposit insurance limit to DKK 750K

	(1)	(2)	(3)	(4)	(5)
After reform	0.25***	0.11**	0.16***		
	(0.04)	(0.04)	(0.04)		
Exposed bank	-0.07				
	(0.11)				
After reform x Exposed bank	0.10	-0.02	0.03		
	(0.07)	(0.08)	(0.08)		
Below 750K	0.91***	0.91***			
	(0.07)	(0.06)			
After reform x Below 750K	0.54***	0.54***	0.48***	0.49***	
	(0.05)	(0.05)	(0.05)	(0.02)	
Below 750K x Exposed bank	-0.15	-0.15*			
	(0.12)	(0.09)			
After x Below x Exposed bank	0.32***	0.32***	0.25***	0.26***	0.26***
	(0.08)	(0.09)	(0.09)	(0.03)	(0.03)
Observations	17,485	17,485	17,485	17,485	17,485
R2	0.50	0.65	0.90	0.99	0.99
Bank FEs		Yes	Yes		
Bank-range FEs			Yes	Yes	Yes
Bank-time FE				Yes	Yes
Range-time FE					Yes

Notes: The table reports coefficients and standard errors (in parenthesis). Each column corresponds to a different specification. Standard errors are reported in parentheses and clustered at the bank-account range level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

reform.

3.3 Evidence on Deposit Rates

We have shown that, especially in 2008, exposed banks lose deposits from just above versus just below the 300K deposit insurance limit. By the same token, exposed banks gain deposits below the 750K insurance limit post 2010. In this section we investigate whether exposed banks are able to retain and attract deposits by increasing the deposit rates.

As we showed in Table 4 that exposed banks increase deposit rates in the GFC before the insurance limit was removed, we now study the behaviour of exposed banks following the 2010 deposit insurance reform and similarly to our specifications in Section 3, we follow Iyer et al. (2019) and estimate the following panel regression at the bank-range-time level:

$$\text{Rate}_{btk} = \alpha_b + \alpha_{bk} + \beta_1 \text{After reform}_t \times \text{Exposed}_b + \gamma_1 \text{After reform}_t \times X_b + \epsilon_{btk} \tag{5}$$

where Rate_{btk} is the average interest rate at bank b on deposits in range k. α_b and α_{bk} denote bank- and bank-range fixed effects, respectively. After reform_t is a dummy equal to one in the years from 2010 onwards. Exposed_b is our measure of banks' exposure to the GFC, the standardized loan-to-deposit ratio in 2007. X_b is a vector of bank controls including total assets (log) and the tier-1 capital ratio, both measured in 2007.

Results from specification (5) are presented in Table 8. The results suggest that a bank with average exposure to the GFC increased deposit rates significantly after the 2010 reform. For banks with above-average exposure, the increase in deposit rates is significantly larger. Noteably, the magnitude of the point estimates barely changes as we sequentially add more granular fixed effects across columns (1)-(3) in Table 8. This evidence suggests that exposed banks raised deposit rates, relative to less exposed banks, to keep and attract deposits after the 2010 reform.

We then investigate the evolution of deposit rates year-by-year estimating the following

Table 8: Deposit rates after VS before the 2010 reform

	(1)	(2)	(3)
After reform	0.65***	0.52***	0.52***
	(0.02)	(0.02)	(0.02)
Exposed bank	-0.19***		
	(0.05)		
After reform x Exposed bank	0.34***	0.22***	0.21***
	(0.04)	(0.04)	(0.04)
Observations	17,485	17,485	17,485
R2	0.44	0.58	0.90
Bank controls interacted	Yes	Yes	Yes
Bank FEs		Yes	Yes
Bank-range FEs			Yes

Notes: The table presents the results from estimating panel regression (5) over 2004-2015. Standard errors are reported in parentheses and clustered at the bank-account range level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

specification at the bank-range-time level:

$$\text{Rate}_{btk} = \alpha_t + \alpha_{b,k} + \beta_t \alpha_t \times \text{Exposed}_b + \gamma_1 \alpha_t \times X_b + \epsilon_{btk} \tag{6}$$

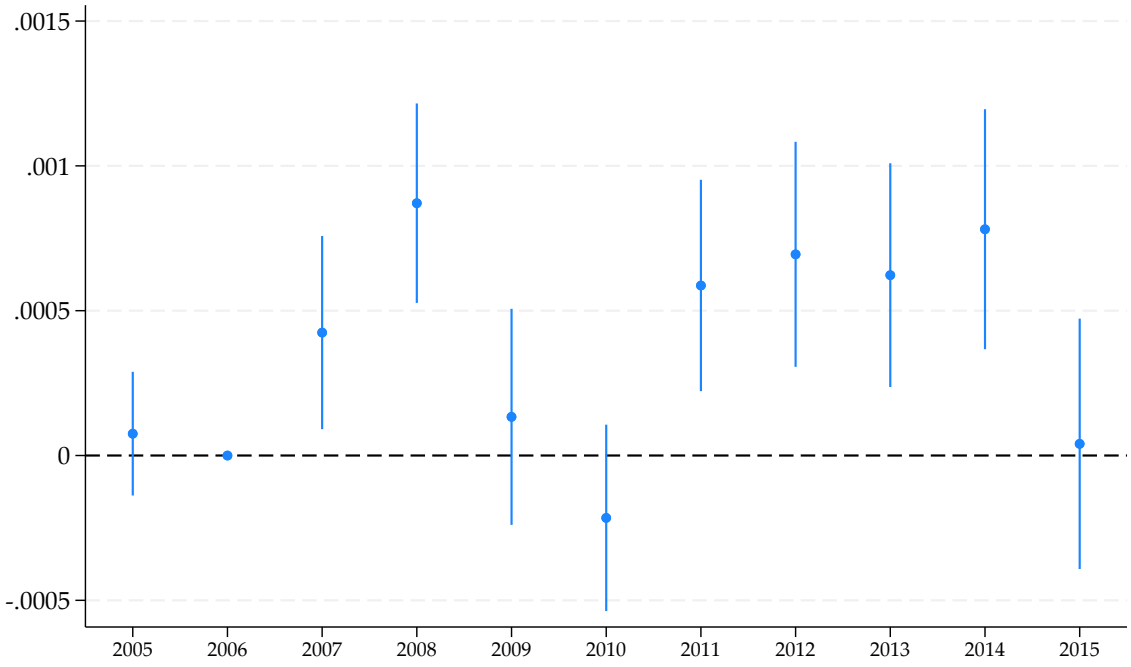
where, differently from the previous specification, the After dummy is replaced by a time dummy α_t. Figure 4 shows that exposed banks raise deposit rates to keep and attract deposits when there is limited deposit insurance in both 2008 and post-2010 reform.[11] We have shown that exposed banks gain insured deposits by increasing the deposit rates. We next turn to bank lending after the deposit insurance reforms.

3.4 Bank lending after the deposit insurance reforms

In this subsection we analyze the credit supply effects associated to the deposit insurance reforms. We have shown that exposed banks enter into the GFC with worse ex-ante loan portfolios. We now want to investigate whether this behaviour changes during the GFC and after the two deposit insurance reforms. To do so, we follow the large literature on the credit channel

[11] There is no significant difference in deposit rates within the same bank in the same period for deposits above vs below the insurance limit (not reported).

Figure 4: Relative deposit rates charged by exposed banks over time



Notes: The figure shows the estimates and the 95% confidence intervals over time from the bank-range-year panel regression (5) where the dependent variable is deposit rates.

and analyze the data at the firm-bank-level and control for fixed effects related to the borrower employing the following panel specification:

$$\text{Log(credit)}_{bft} = \alpha_{ft} + \alpha_b + \beta_1 \text{Exposed}_b \times \text{X}_{ft-1} + \beta_2 \text{X}_{ft-1} + \epsilon_{bft} \tag{7}$$

where the dependent variable is log credit granted by bank b to firm f, Exposed_b is our exposed measure at the bank level, and X_{ft-1} is a different dummy for two different specifications which is equal to one if either i) firm-level TFP is below median or ii) the firm is in the real estate and construction sector. Results are robust to different definitions of the dummies (e.g., tercile or quartile) or the continuous variable (not reported). We saturate our specification with firm-time fixed effects (α_{ft}) to compare lending by different exposed banks to the same borrower in the same year (Khwaja and Mian 2008). Additionally, we estimate an alternative

specification in which we replace the firm-time fixed effects with the industry-location-size-time fixed effects (α_{ilst}) to consider all firms in the analysis, including those with one bank in a period (Degryse et al. 2019).

Table 9 presents the results from estimating Equation (7) over three different time periods: 2008-2013, 2010-2013, and 2004-2013. Our results suggest that exposed banks' elevated credit supply to weaker firms continue during the GFC and after the two deposit insurance reforms. Over 2004-2013, for example, a standard deviation increase in exposure raises deposits to low TFP firms by 10% and to real-estate firms (relative to the firms in other sectors) by the same amount. These magnitudes are roughly confirmed over the different periods we estimate our empirical specification.[12]

Table 9: Loan-level evidence

Outcome: log credit	Period: 2008-2013		Period: 2010-2013		Period: 2004-2013	
	(1)	(2)	(3)	(4)	(5)	(6)
Exposed X Low TFP	0.11**	0.07***	0.10	0.09***	0.10***	0.07***
	(0.04)	(0.02)	(0.06)	(0.03)	(0.03)	(0.01)
Observations	38,547	170,975	23,106	110,275	74,475	286,975
R2	0.58	0.17	0.58	0.17	0.58	0.18
Bank controls	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y
Firm-Year FE	Y		Y		Y	
ILST FE		Y		Y		Y

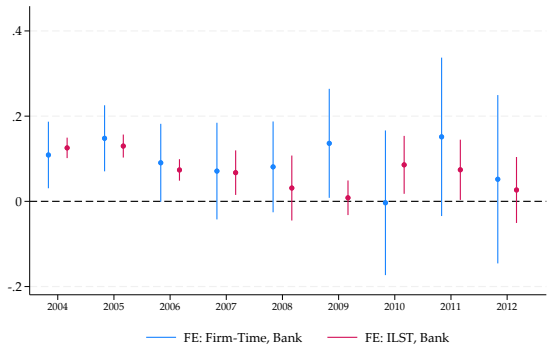
Notes: The table presents the results from estimating the panel specification (7) over three different time periods: 2008-2013, 2010-2013, and 2004-2013. Standard errors are reported in parentheses and clustered at the firm and bank level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

We extend our credit supply results by estimating Equation (7) year by year. Figure 5 confirms that the credit allocation to weaker firms continues after the reforms, specifically this is true both for lower TFP firms and firms in the real estate and construction sector (though in this latter case, results become insignificant in 2011/12).

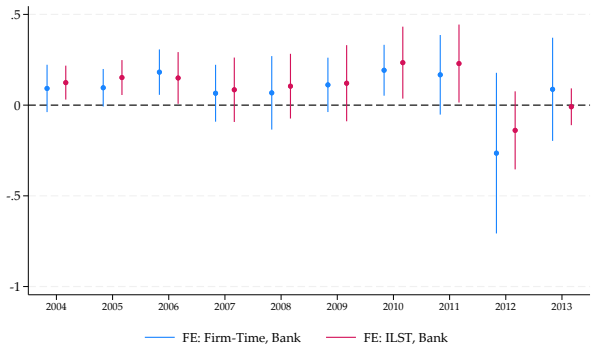
[12]Note that for real estate, the significance is lost with double cluster of standard errors over the post-2008 but the estimated coefficients are identical to the whole period (last columns), it is just that the standard errors are larger.

Figure 5: Exposed banks' credit supply to lower TFP and real estate firms does not improve in GFC and after DI reforms

(a) Lower TFP firms



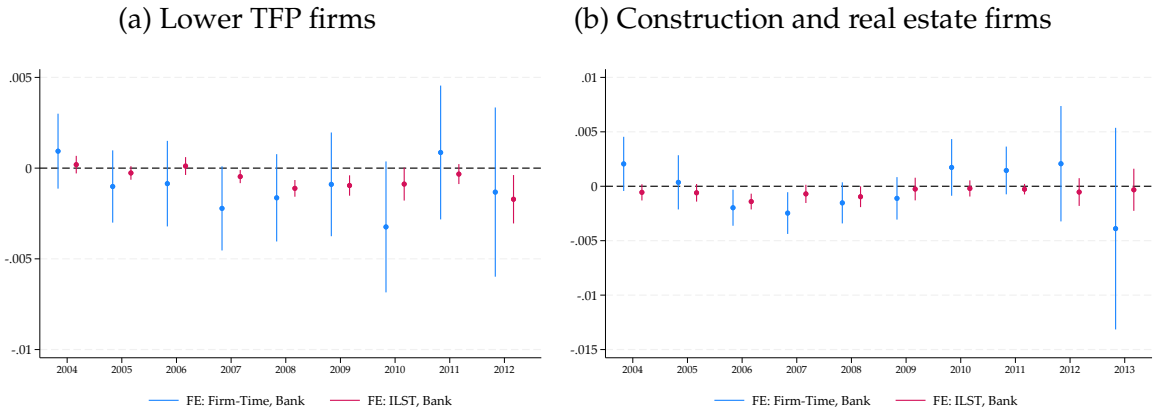
(b) Construction and real estate firms



Notes: The figure shows the estimates from a bank-firm-year panel regression where the dependent variable is log credit.

We analyze loan rate charged by bank b to firm f. Figure 6 shows that exposed banks don't raise loan rates to lower TFP firms or firms in the real estate and construction sector; if anything, exposed banks somewhat decrease loan rates to weaker firms. Interestingly, when there is full deposit insurance in 2009 during the GFC, more exposed banks do not further increase risk-taking in credit supply as compared to before the crisis or after 2010 when there is limited deposit insurance coverage. We therefore conclude that as exposed banks benefit more from funding due to the deposit insurance reforms, the credit allocation to weaker firms (with lower TFP or in real estate) continues after the reforms.

Figure 6: Exposed banks do not raise loan rates to lower TFP firms or firms in the real estate and construction sector during the GFC and after deposit insurance reforms



Notes: The figure shows the estimates from a bank-firm-year panel regression where the dependent variable is deposit rates.

4 Conclusions

We show that – via deposit reallocation – deposit insurance benefits the funding of weaker banks —with worse borrowers— and these keep credit supply to worse firms after the insurance reforms. We exploit administrative, matched data on the universe of retail depositors (deposit register), credit register, and bank-, firm and individual-level data from Denmark; as well as deposit insurance (DI) reforms, one linked to the 2008 Global Financial Crisis (GFC) from limited to full DI, and the other linked to a European Union reform to limit DI.

Exposed banks (higher credit to deposits pre-GFC) lend pre-GFC to less productive and to real-estate firms, resulting in higher ex-post loan losses. Consistently, exposed banks suffer funding liquidity problems at the GFC onset with limited DI coverage; while this reverses with unlimited coverage. At the individual-bank level data with depositor fixed effects, a depositor withdraws more from exposed banks, notably above the DI limit. Exposed banks lose deposits from just above vs below the limit. Moreover, the change from unlimited to limited DI coverage post-2010 triggers reallocation of (insured) deposits to exposed banks. Exposed banks raise deposit rates to attract deposits when limited DI in both 2008 and post-

2010 reform. Finally, using borrower fixed effects and credit volume and rates, exposed banks' riskier credit supply does not improve after the deposit insurance reforms.

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