Spillovers of funding dry-ups*

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ABSTRACT

We uncover a new channel for spillovers of funding dry-ups. The US money market fund (MMF) reform led to an exogenous reduction in unsecured MMF funding for some banks. We use novel data to trace those banks to a corporate deposit funding platform. As they sought to replace the lost dollar funding, the funding squeeze spilled over to other banks with no MMF exposure. The latter paid more for corporate dollar deposits, and their pool of funding providers deteriorated. Their dollar lending volumes and margins declined. Our results suggest banks' competitiveness in funding markets affect their competitiveness in lending markets.

JEL Classification: G21, G28
Keywords: funding dry-ups, spillovers, money market funds, corporate deposits, dollar funding, banks

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1 Introduction

Dry-ups in funding markets often lead to financial crises, with adverse macroeconomic consequences. Understanding their dynamics is therefore important. However, isolating the effect of a funding dry-up from broader crisis effects is a challenge for empirical research, as they usually go hand-in-hand. We study the dynamics of funding dry-ups by exploiting a policy event, the US money market fund (MMF) reform, that led to a wholesale funding shortfall in only one market during an otherwise tranquil period.

We use the US MMF reform implemented in October 2016 as the policy event in a difference-in-differences framework. The reform was adopted in order to curb the run-prone nature of MMFs. In response, fund families converted prime funds into government funds, which, in effect, replaced the provision of unsecured funding to banks with buying government securities. The reform resulted in an aggregate loss of around $350 billion in unsecured dollar funding for global banks with MMF exposure.

We first provide evidence of a new channel through which funding dry-ups spill over from one funding market to others. When banks face a funding shortage in one market, they substitute into other sources of funding, intensifying competition in those markets. As a result, banks in other markets that are not directly affected by the original funding dry-up might nevertheless face a funding squeeze as they are crowded out by the directly affected banks in the latter's search for alternative funding. Banks affected by the MMF reform only through spillovers had to increase the rates they pay for wholesale corporate deposit funding by 20-30% relative to their pre-reform average.

These spillovers could be material, in that they could affect bank lending. We show that banks that ultimately suffer from a funding dry-up indirectly through spillovers grant relatively less dollar loans despite charging a lower price. These results suggest that banks' competitiveness in funding markets affect their competitiveness in lending markets.

The MMF reform constitutes close to an ideal setting to study channels of spillovers from a funding squeeze. In addition to taking place during an otherwise tranquil period for financial markets, it directly affected only banks that actively borrow from MMFs (which we call MMF banks). This allows for a clean distinction between MMF banks and banks with no direct exposure to MMFs (which we call non-MMF banks). Moreover, since it only affected the dollar wholesale funding of banks, the reform should only have an impact in dollar markets and not in other currencies. We extensively rely on funding segments in other currencies throughout the paper and conduct placebo tests to provide evidence for spillovers of funding dry-ups.

We combine three granular datasets to study spillovers in funding markets and their effect on bank lending. First, we identify banks that suffered a loss in dollar funding due to the reform by using transaction-level data from the regulatory filings of US MMFs. Second, we use a unique and granular dataset from one of the largest corporate deposit trading platforms located in Europe. In the platform, firms auction deposits and banks bid for them. The dataset contains bid-level information on deposit auctions in various currencies. Our main focus is on transactions in dollars

since the reform induced a wholesale dollar funding shortage. However, we use information on deposits in other currencies as a key robustness check which allows us to show that spillovers occur only for banks' dollar funding. Third, we use data on syndicated loans to study changes in the lending behavior of banks in our sample.

As part of our identification strategy, we compare MMF and non-MMF banks, pre- and post-reform across different currencies to rule out the possibility that a non-random matching between MMFs and banks explains our results in the corporate deposit platform. In particular, we show that while there are spillovers in dollar-denominated corporate deposits after the reform, there is no impact on pound-denominated corporate deposits between the same set of firms and banks.

The terms of funding that banks obtain from MMFs versus corporate depositors vary substantially. This is reflected in the segmentation of markets in the pre-reform period. MMF funding is on average more expensive, but it also offers longer-term and more stable funding. In our sample, some banks are active in both markets, while others only participate in the corporate deposit market.[1] We take this as evidence that banks active in both markets have a stronger preference for stable funding.[2] We also differentiate between corporate depositors and divide them into two categories: stable funding providers and others, depending on how persistently they place corporate deposit auctions. We present evidence that banks active in both markets are also the ones preferred by firms, especially by stable funding providers in the pre-reform period.

The inferences we make about the ranking of preferences by banks and firms lead naturally to hypotheses that we test using the MMF reform as an exogenous funding shock. After the implementation of the reform, MMF banks lost unsecured funding from MMFs, their preferred source of funding. We conjecture that after the MMF reform, these banks would resort to less preferred unsecured funding sources such as large corporate deposits. Since these banks are also preferred by firms, this would mean either a loss of deposits or a rise in deposit rates for non-MMF banks due to intensified competition in the corporate deposit market. Moreover, we expect that these effects are stronger for funding offered by firms that are stable funding providers.

We show that after the reform, non-MMF banks pay higher deposit rates than MMF banks in order to retain their corporate deposit funding. Moreover, we document a composition effect and explain the higher deposit spread that non-MMF banks pay after the reform. Once MMF banks lost MMF funding and intensified competition for corporate deposits, they crowded-out non-MMF banks by securing funding from firms that are most alike MMFs, i.e. stable and large deposit-providing firms. Non-MMF banks were forced to form new relationships with less stable funding providers by bidding higher prices. Importantly, we show that these effects only apply to dollar

[1] In our difference-in-differences analysis we use this to categorize banks into two groups. We refer to banks that suffered a loss of unsecured funding from MMFs as a direct result of the reform as *MMF banks*, and to the rest as *non-MMF banks*. MMF banks are large global banks active in both markets. Non-MMF banks tend to be, on average, smaller European banks active in the corporate deposit market. However, the latter group also includes global and domestic systemically important banks as per the definitions of the Financial Stability Board (FSB) or national supervisors.

[2] The reasons for the observed segmentation are not of interest in this paper, as long as we ensure that our results are not driven by a non-random matching between MMFs and banks.

deposits – there is no effect on pound deposits around the time of the MMF reform. This suggests that the effect is driven by spillovers due to the reform rather than any unobserved heterogeneity between the two groups of banks.

Finally, we focus on the implications of those spillovers in wholesale funding markets on bank lending. In the aftermath of the reform, the lending rates that non-MMF banks charge, controlling for loan characteristics, are lower relative to MMF banks. So is their lending in dollars. We use an empirical design in the spirit of Khwaja and Mian (2008) to control for loan demand and compare the *same* firm borrowing in dollars from MMF and non-MMF banks. In this way we rule out that potential confounding effects related to firms' demand for loans from non-MMF banks might be driving results. On the liability side, non-MMF banks pay more for funding, and at the same time their lending mark-ups decrease, leading to a relative decline in profit margins. Taken together, the results point to a loss of competitiveness in lending markets driven by the loss of competitiveness in funding markets and suggest that funding dry-ups might lead to concentration in the banking sector.

Related literature. Our paper mainly contributes to the literature on stress and spillovers in funding markets. We highlight a new channel of spillovers of funding dry-ups that operates through substitution between markets, intensified competition and crowding out.

Chernenko and Sunderam (2014) study the consequences of a MMF funding dry-up during the euro crisis. They compare MMFs with large and small exposures to eurozone banks and find that the former reduce their lending to firms more around the European sovereign debt crisis, due to spillovers from MMF outflows. In their analysis, MMFs and their pre-crisis exposure to European banks are the key conduit for spillovers. In contrast, in our analysis banks with exposures to MMFs and their competitive behavior around the MMF reform are the key channel of spillovers in our analysis. Our focus is essentially on comparing a group of banks that borrow unsecured funding from MMFs (MMF banks) with another group that does not (non-MMF banks).

Aldasoro, Ehlers, Eren and McCauley (2017) show evidence of substitution between different sources of wholesale dollar funding. They document that at the global consolidated level, non-US banks taken together partially replaced the lost MMF funding following the reform with repos and other sources of offshore deposit funding. Our paper zooms in on the offshore corporate deposit funding, by looking at granular data on wholesale corporate dollar funding outside of the US. We show that the aggregate picture of overall stable dollar funding masks important differences among groups of banks.[3] Aldasoro, Ehlers and Eren (2019) find that disruptions in repo markets spill over to FX swap markets, affecting pricing in those markets. In a related paper on corporate deposits, Friedmann (2017) document that during the Great Financial Crisis (GFC), banks bid more often for, and obtained more, unsecured corporate deposits. Other related studies of wholesale markets in distress include studies of markets for certificates of deposits (e.g. Pérignon, Thesmar and Vuillemey, 2018), ABCP markets (e.g. Kacperczyk and Schnabl, 2010; Covitz, Liang and Suarez,

[3] Aldasoro and Ehlers (2018) document the growing share of dollars non-US banks source outside of the US.

2013; Acharya, Afonso and Kovner, 2017), unsecured interbank markets (e.g. Afonso, Kovner and Schoar, 2011), and repo markets (e.g. Duffie, 2010; Gorton and Metrick, 2012; Krishnamurthy, Nagel and Orlov, 2014).

We also contribute to the literature on the transmission of shocks to bank lending and real outcomes, including the literature on the dollar funding and lending of global banks. Dollar funding shocks to non-US global banks act as a powerful mechanism for international spillovers (e.g. Shin, 2012; Ivashina, Scharfstein and Stein, 2015). The closest paper to ours in this literature is by Ivashina, Scharfstein and Stein (2015). They show that in response to a shock to their credit quality, euro area banks lost dollar funding to a greater extent (compared to local currency funding) due to its wholesale nature. Synthetic borrowing also gets more expensive, and the dollar lending of these banks suffers relative to their euro lending. Other related studies on direct spillovers from funding stress include, for example, the Great Depression (e.g. Bernanke, 1983), the property market collapse in Japan (e.g. Peek and Rosengren, 1997; Gan, 2007), the Russian sovereign default (e.g. Schnabl, 2012) or the GFC (e.g. Ivashina and Scharfstein, 2010; Aiyar, 2012; De Haas and Van Horen, 2012). Our findings highlight a mechanism through which a shock in one funding market leads to a reduction in lending for banks only active in other funding markets. These highlight both a direct effect of funding shocks on real outcomes and a potential mechanism for international spillovers. Moreover, the fact that lending volumes and rates both decrease in our setup highlights a channel of decreasing demand for loans by borrowers from lenders that ultimately suffer a funding shortage.

The liability structure of banks and their competitiveness in sourcing deposits are increasingly recognized as key reasons for why banks are special (e.g. Drechsler, Savov and Schnabl, 2017; Egan, Lewellen and Sunderam, 2017). While the focus of the literature has been mostly on retail deposits, wholesale funding constitutes an increasingly important part of bank liabilities, especially for the dollar banking activities of non-US banks. Two major wholesale funding providers are money market funds and non-financial corporate firms. In a paper that is a close companion to ours, Aldasoro, Ehlers and Eren (2019) study competition in the MMF sector and the implications for pricing of both repo and unsecured funding of global banks. Data unavailability has previously hindered the study of corporate deposit markets. We use a novel, granular dataset on corporate deposits to study competition for corporate deposits, the nature of market segmentation for banks between MMF and corporate deposit funding and linkages between the two markets, as well as the impact of competition in wholesale funding markets on lending markets.

Our paper is further related to the literature on price competition for deposits, which goes back to the seminal work of Stiglitz and Weiss (1981) and Diamond (1984). It also closely relates to Stahl (1988) and Yanelle (1997), who theoretically show that competitiveness on the liability and asset sides are interrelated. Our results are in line with these theories.

Finally, our paper contributes to the literature on bank-firm relationships. A large literature studies bank-firm relationships through the lens of *banks as lenders*. Elyasiani and Goldberg (2004) conduct a comprehensive literature review on relationship lending and conclude that relationships

between banks and firms increase funding availability and reduce loan rates. Our results imply that studying relationships through the lens of *banks as borrowers* might be as important, especially in terms of banks' access to stable funding providers. In a related study of banks as borrowers with a deposit auction setting similar to ours, Friedmann, Imbierowicz, Saunders and Steffen (2017) find that stronger relationships significantly increase the probability of winning a deposit auction. However, this benefit seems to come at a cost, as relationship banks bid higher on average during their observation period.

Roadmap. The rest of the paper is organized as follows: Section 2 provides some background on MMFs, the US MMF reform and the data sources. Section 3 provides a description of the two funding markets, outlines the underlying conceptual framework and the empirical design. Section 4 presents the empirical results on the impact of the MMF reform on interest rates in the corporate deposit platform. Section 5 shows the results on the changes in bank-firm relationships in the platform after the reform. Section 6 presents empirical results on changes in bank lending prices and volumes. Section 7 concludes.

2 Institutional background and data

In this section, we provide institutional background on US MMFs and their interactions with banks. We discuss the details of the 2016 US MMF reform, which forms the basis of our identification strategy. In order to motivate our focus on corporate deposits, we highlight the rising importance of non-financial corporate deposits as a wholesale funding source for banks. Finally, we describe the details of multiple, granular data sources that we rely on for our analysis of spillovers.

2.1 Money market funds and the MMF reform

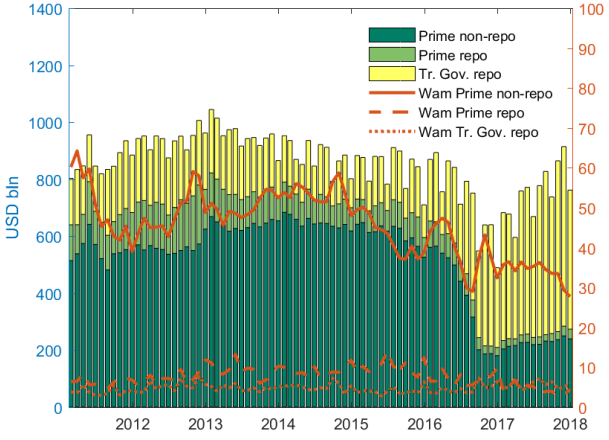
US MMFs are open-ended mutual funds that invest in money market instruments such as repos, commercial paper (CP), certificates of deposits (CD), and asset-backed commercial paper (ABCP). With around $3 trillion in assets under management, MMFs are an important source of funding for banks, as well as an attractive investment for a range of investors. Since their inception in the 1970s and up to the GFC, they were perceived as an investment as safe as bank deposits, but able to provide better returns. The ability to keep their net asset values (NAV) at $1 per share was historically an important factor underpinning this perception, since MMF investments are not insured. However, when the oldest MMF (Reserve Primary Fund) "broke the buck" in the aftermath of the Lehman Brothers collapse, this perception vanished as investors ran to redeem their shares, bringing about the collapse of the fund. This in turn led to additional investor redemptions in other funds (e.g. Schmidt, Timmermann and Wermers, 2016; Kacperczyk and Schnabl, 2013). The run-prone nature of MMFs was again highlighted during the European sovereign debt crisis (Chernenko and Sunderam, 2014).

The revealed fragility of MMFs prompted the Securities and Exchange Commission (SEC) to respond by adjusting the regulation governing MMFs, known as Rule 2a-7 of the Investment Company Act of 1940. After requirements to invest in even higher quality assets with shorter maturities adopted in 2010, an important revision of Rule 2a-7 was approved by the SEC in July 2014. The reform came into effect fully on October 14, 2016, but had earlier compliance dates for parts of the reform package starting on April 14, 2016. Due to the short-term nature of funding in this market, much of the adjustment happened closer to the date of full implementation (Figure 1).

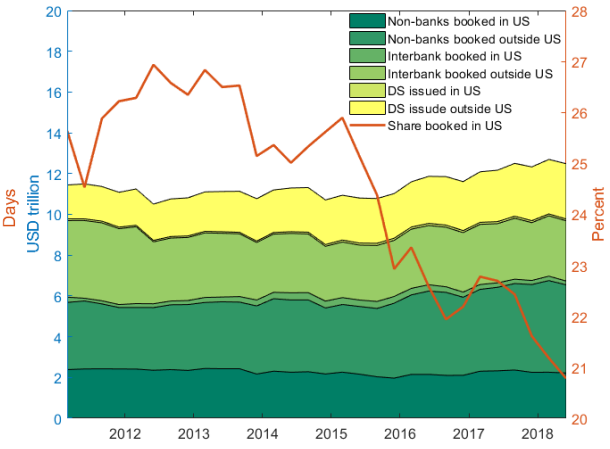
With the primary goal of addressing the risk of runs on MMFs, the reform required institutional prime funds and municipal funds to switch from a stable to a floating NAV calculation and introduced redemption gates and fees at the discretion of the fund. This led to the conversion of many prime funds to government funds. While prime funds can invest in CPs, CDs, repos and other types of bank debt, government funds are restricted to holding government securities or financing banks only through repos backed by government securities.

Figure 1
The MMF reform and the role of non-bank deposits

(a) Funding by US MMFs to foreign banks



(b) On-balance sheet USD funding of non-US banks



Notes: Panel (a) presents unconsolidated data based on the transactions of non-US banks with MMFs. Panel (b) presents worldwide consolidated on-balance sheet data based on a combination of the BIS debt securities statistics and the consolidated and locational banking statistics.
Source: Crane data (left-hand panel), BIS consolidated banking statistics (immediate counterparty basis), debt securities statistics and locational banking statistics (right-hand panel).

The reform represented an important negative unsecured dollar funding supply shock to global non-US banks, which heavily relied on MMFs for their unsecured dollar funding (Figure 1, left-hand panel).[4] The aggregate funding by MMFs before and after the reform remained largely the

[4]While MMFs are for the most part a vehicle for bank funding, the MMF reform affected non-financial corporate borrowers to some degree as well. Between April and October 2016, total borrowing by non-financial corporates from prime funds declined from $43.4 billion to $17.7 billion. Even though the levels and changes are very small compared to those of banks, non-financial corporates receiving less funding from MMFs could potentially affect our results. Nevertheless, we do not believe this is the case for three reasons: First, the maturity of MMF borrowing is typically longer. Hence, borrowing from MMFs in order to invest in bank deposits is not a profitable strategy. Second, only a handful of non-financial corporates borrow from MMFs compared to a large number of corporates lending in our

same, but as a result of the fund conversion, the MMF sector increased its holdings of government securities and decreased the unsecured funding provided to banks. This resulted in a drop in unsecured money market funding to non-US banks of around $350 billion between April 2016 and October 2016. The bulk of this adjustment occurred in the last couple of months before the full implementation of the reform. Importantly, the reform is an exogenous shock which *directly* affects only the dollar funding of one group of banks in our sample (MMF banks). The dollar funding of the second group of banks in our sample is only affected *indirectly* via the spillovers generated by the reaction of the first group to the exogenous shock.

This unsecured dollar funding squeeze did not, however, lead to a dollar funding crisis as in the GFC (McGuire and von Peter, 2012). As documented in Aldasoro, Ehlers, Eren and McCauley (2017), non-US banks were able, at a consolidated worldwide level, to replace the loss of non-bank dollar deposits in the US with non-bank dollar deposits elsewhere, as well as repos (Figure 1, right-hand panel). One of these substitutes is corporate deposit funding from outside US, an increasingly important source of wholesale funding for banks globally.

2.2 Corporate Deposits

Non-financial corporate deposits account for an increasing share of funding for banks. To motivate the rising importance of non-financial corporate deposits, Figure 2 presents selected liability positions of euro area banks. We focus on euro area banks due to availability of disaggregated data that label non-financial corporate deposits as a separate balance sheet item.

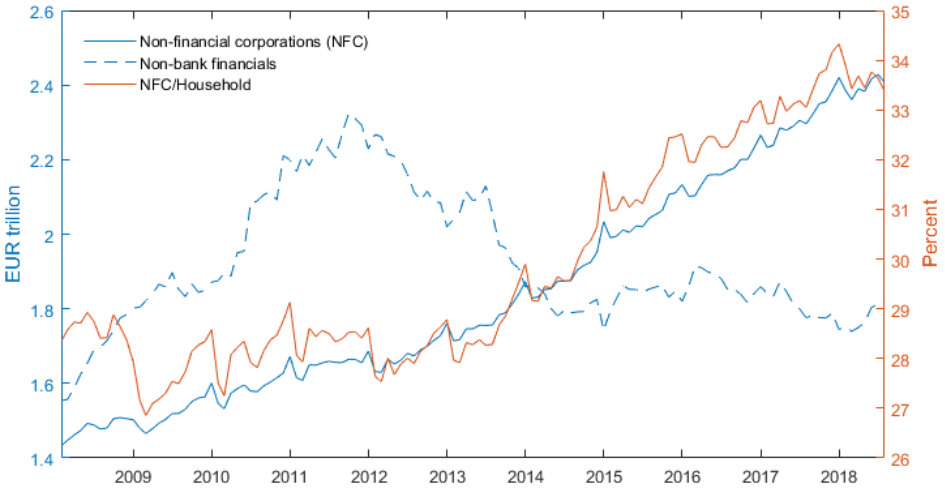
Over a period of ten years from 2008 to 2018, non-financial corporate deposits have risen substantially by close to €1 trillion to about €2.4 trillion as of July 2018. Starting in early 2013, non-financial corporate deposits have not only accelerated growth in absolute terms, but have also gained importance relative to household deposits (orange line), the largest source of funding for banks. This occurred simultaneously with an absolute decline in funding coming from non-bank financial institutions, e.g., MMFs.

2.3 Data

We draw on various data sources. First, we use a rich dataset on transaction-level MMF holdings coming from their regulatory filings to the SEC, in order to identify and quantify the initial funding shock to MMF banks. Second, we make use of a novel and granular dataset of corporate deposit transactions at auction bid level to quantify spillovers and study competition for funding among banks. Third, we obtain data on syndicated loans to analyze the impact of wholesale funding competition and spillovers on lending competition among the banks in our sample. We also use other data sources such as balance sheet information for banks and market data. We describe all data sources in detail below.

deposit platform. Third, the total volumes in our platform were roughly stable during our sample period.

Figure 2
Deposit liabilities of euro area banks



Source: ECB Statistical Data Warehouse, Balance Sheet Items, Euro area counterparties.

MMF data

We calculate banks' initial funding loss using month-end holdings of MMFs as reported in their regulatory filings to the SEC (SEC N-MFP forms), collected by Crane Data. Crane Data reports detailed information on the instruments MMFs invest in, such as transaction amounts, prices, remaining maturities and other important contract characteristics.

We restrict the sample to the unsecured funding instruments through which banks borrow from MMFs, namely CDs, CPs and ABCPs, as this is the market that was negatively affected by the reform (Aldasoro, Ehlers and Eren, 2019).[5] We link the contract-level information to the parent institution of the issuer, and aggregate funding from the three instruments at the bank-month level.

Corporate deposits data

The core of our analysis builds on a unique and comprehensive dataset of corporate deposit auctions on one of the largest electronic trading platforms by volume in Europe.

On this platform, non-financial corporate firms offer their excess liquidity in a certain currency, choosing the size and maturity. The platform is less prone to supply-side confounding factors, as funding supply is purely determined by firms' excess liquidity.[6] There are no restrictions for the deposit-providing firms on deposit amounts or maturities traded on the platform. Banks can trade with firms they have a trading agreement with and can bid in auctions by quoting an interest rate

[5] As noted above (Figure 1, right-hand panel), non-US banks were – in aggregate and on a consolidated worldwide basis – able to compensate for the unsecured funding loss. While a significant part of this came from offshore non-bank deposits, some also came from secured funding such as repos with MMFs. Considering a measure of unsecured funding lost net of funding recovered through repos with MMFs leads to the reclassification of two banks in our sample, without affecting the results we present below.

[6] Figure A.1 in Appendix A presents the distribution of notional dollar amounts and transactions in dollars for our main sample.

(provided they have been invited to provide a quote by the firm). Interest rates are quoted using an actual/360 day count convention and transactions are settled on the same day. The bidding period lasts for two minutes by default and banks can adjust their quotes anytime during this period. Banks cannot see the quotes of other banks, hence initial quotes and adjustments should not be influenced by the behavior and risk evaluation of other bidders. After the bidding period, firms choose a winning bid out of the last quotes of all bidding banks at their own discretion. In other words, there are no rules on how to select the winning bid: even a bid which is not the highest may win an auction if, say, the firm has a good relationship with the bank and aims to keep it that way.

The dataset contains all bids (including adjustments) placed by different banks during the deposit auctions. Banks participating in auctions are identified by name. This allows us to match bank information to other datasets. Deposit providing firms are anonymous, but have a unique identifier. This allows us to track firms over time.

We mainly focus on dollar deposits as the MMF reform represented a negative shock to dollar funding, but also conduct placebo tests using other currencies. In 2016, transactions denominated in dollars, euros, and pounds respectively had a daily turnover of around $1.5 billion, €2.7 billion, and £0.8 billion, and a median transaction size of about $23 million, €50 million, and £20 million. In 2016, banks directly affected by the MMF reform captured slightly more than 70% of this market, whereas non-MMF banks accounted for the rest. On average, each bank obtains $610 million in dollar funding in 15 transactions per month, which aggregates to a monthly average transaction volume of $29 billion and on average 690 transactions per month.

It is important to note that even though the platform that we study is a large one, it only constitutes a small share of the entire dollar corporate deposit market. Therefore, while our results apply to this platform, any broader conclusions rely on the assumption that it is a representative sample of the global corporate deposit market.

Lending data

We use syndicated loan data from Dealogic for the analysis of lending volumes and prices. Dealogic provides detailed data on bank syndicated loan origination in various currencies around the globe.

The dataset includes information on the borrowing companies and the syndicate banks, as well as their individual role (e.g., arranger vs. participant), the currency, and the loan tranche value. Some important loan details, however, are not available for all loans. Loan spreads paid above interbank rates (such as LIBOR) and maturities are only available for around 50% of the loans. Exact shares of the loan tranche volume per bank are included for around 25% of the loans. We extrapolate the available allocation information of loan tranche volumes to loans without such details. In particular, we use the average monthly distribution of loan shares on arranger and participant banks per currency to allocate the loan shares of loans originated in the same month and denominated in the same currency.

After the data preparation and before reducing the sample to banks active on the deposit

trading platform, we obtain about 90,000 loan observations for the period of six months before and six months after the US MMF reform, denominated in 42 currencies – around half of the observations are denominated in dollars. The average dollar-denominated loan has a value of $70 million, a spread of 250 basis points over LIBOR, and 4.5 years maturity.

Bank characteristics and market data

We include additional bank balance sheet and income statement information from S&P Global Market Intelligence (formerly SNL Financial), which is at annual frequency for most banks in the sample. Daily pricing data of five-year bank credit default swaps (CDS) on senior unsecured debt are retrieved from Markit.

3 Empirical design

In this section, we present summary data on the characteristics of the funding markets, banks, and the interactions between funding providers and banks, in particular with regards to transaction volumes, maturities, and prices. We use these data to lay out the conceptual framework and discuss the details of our empirical design.

3.1 Market segmentation, MMF and corporate deposit funding

The two markets we study are segmented. Figure 3 illustrates the nature of this segmentation. In our dataset, there are some banks that are active in both markets (*Bank A*). Other banks do not have any funding relationships with US MMFs, but borrow dollars in the corporate deposit market (*Bank B*).

Figure 3
Funding market segmentation

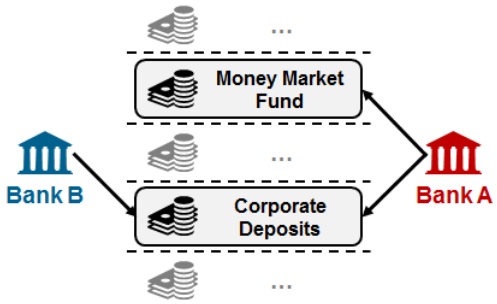


Table 1 describes key characteristics of the contracts that banks have with MMFs and corporate deposit providers. A key difference between the two markets is that funding from MMFs has two desired features for banks that are active in both markets. First, the average size of a transaction with MMFs is more than twice as large as that from corporate deposits. Second, and perhaps more importantly, the average maturity of MMF funding exceeds that of corporate deposits by a

wide margin. However, partly reflecting the longer maturities, the rates paid for MMF funding are higher than for corporate deposits.

Table 1
Key characteristics of markets from October 1, 2015 to March 31, 2016

	US MMFs	Corporate Deposits	
	Bank type A	Bank type A	Bank type B
Avg. transaction [USD mn]	105.31	50.09	42.81
Avg. maturity [days]	45.85	8.70	8.31
Avg. rate [bps]	51.44	26.21	32.68

Source: Crane Data and corporate deposit data.

Notes: Bank type A refers to banks active in both markets and bank type B to banks not active on US MMF markets, as illustrated in Figure 3. US MMF transactions consider only banks active in both markets, i.e., type A banks. In line with corporate deposits characteristics, for the MMF market only certificates of deposits are considered.

We explore the difference between the two markets to shed light on the reasons for the observed market segmentation. We regress the rate paid for unsecured MMF funding and corporate deposits on interactions between contract maturity, size, and whether the funding comes from MMFs or corporate deposits. We run the regression in Equation 1 on contract-level data:

$$\begin{aligned} Rate_{ijct} = \alpha &+ (\alpha_i + \alpha_t + \alpha_{it}) MMF_j + maturity_{ijct} + maturity_{ijct} * MMF_j \\ &+ transaction\_size_{ijct} + transaction\_size_{ijct} * MMF_j \\ &+ maturity_{ijct} * transaction\_size_{ijct} \\ &+ maturity_{ijct} * transaction\_size_{ijct} * MMF_j + \epsilon_{ijct} \end{aligned} \tag{1}$$

The dependent variable is the interest rate paid by bank i to either MMF or corporate funding provider j in contract c at time t in basis points. $maturity_{ijct}$ and $transaction\_size_{ijct}$ denote the maturity and transaction size of the contract respectively. MMF_j is a dummy variable equal to 1 if the funding provider is a MMF, and zero if the funding provider is a corporate firm. α_i, α_t, and α_{it} denote fixed effects at the bank, month, and bank-month level. The sample consists of all transactions from October 1, 2015 to March 31, 2016 of banks active in both the corporate deposit platform and US MMF markets. The time period is before the start of the implementation of the US MMF reform in order to capture market characteristics prior to the regulatory change. In order to make the comparison between the two funding markets as meaningful as possible, only certificates of deposits of US MMFs are considered for this regression.

Table 2 highlights a trade-off for banks choosing between MMF funding and corporate deposit funding. Banks pay on average more when transacting with MMFs. However, for longer maturities and/or larger transaction sizes, banks can pay marginally less for funding if their counterparties are MMFs. Since banks of type A in Figure 3 did have large total transaction volumes with MMFs, we take this as an indication that they have a preference for stable funding. At the same time,

Table 2
The determinants of the price of funding with US MMFs and corporate firms

	(1)	(2)	(3)	(4)	(5)
MMF_j	21.6329***	22.1948***	20.0099***	20.8606***	20.9239***
	(2.1065)	(2.1222)	(2.3068)	(2.2985)	(2.3149)
$maturity_{ijct}$	0.2261***	0.2116***	0.2385***	0.2298***	0.2281***
	(0.0311)	(0.0297)	(0.0294)	(0.0278)	(0.0291)
$maturity_{ijct} * MMF_j$	-0.0770**	-0.0774**	-0.0785**	-0.0852***	-0.0854***
	(0.0320)	(0.0311)	(0.0294)	(0.0276)	(0.0281)
$transaction\_size_{ijct}$	0.0045	0.0229***	0.0068	0.0237**	0.0229**
	(0.0109)	(0.0067)	(0.0129)	(0.0090)	(0.0092)
$transaction\_size_{ijct} * MMF_j$	-0.0119	-0.0298***	-0.0129	-0.0296***	-0.0287***
	(0.0116)	(0.0074)	(0.0135)	(0.0098)	(0.0101)
$maturity_{ijct} * transaction\_size_{ijct}$	0.0027***	0.0012**	0.0027***	0.0012***	0.0013***
	(0.0004)	(0.0005)	(0.0004)	(0.0004)	(0.0004)
$maturity_{ijct} * transaction\_size_{ijct} * MMF_j$	-0.0026***	-0.0011**	-0.0026***	-0.0011**	-0.0012***
	(0.0005)	(0.0005)	(0.0004)	(0.0004)	(0.0004)
N	19,846	19,846	19,846	19,846	19,845
R^2	0.3092	0.6035	0.3477	0.6387	0.6447
Month FE		✓		✓	
Bank FE			✓	✓	
Bank-month FE					✓

Notes: OLS regressions at the contract level as in Equation 1. The dependent variable is the interest rate paid by bank i to either MMF or corporate funding provider j in contract c at time t in basis points. $maturity_{ijct}$ and $transaction\_size_{ijct}$ denote the maturity and transaction size of the contract respectively. MMF_j is a dummy variable equal to 1 if the funding provider is an MMF, and zero otherwise. The sample consists of all transactions of banks active in both the corporate deposit platform and US MMF markets, from October 1, 2015 to March 31, 2016. The time period is before the start of the implementation of the US MMF reform in order to capture the market characteristic prior to the regulatory intervention. Only certificates of deposits of US MMFs are considered for the analysis. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

it could well be the case that all banks prefer MMF funding but MMFs select issuers based on *their perception* of bank quality or risk. While the reasons for the observed segmentation are not of interest here, the existence of segmentation forms a key part of our framework and subsequent analysis. Against this background, we need to ensure the effects we observe are due to a funding shock spillover and not driven by non-random matching between MMFs and banks. We do so by comparing the impact of a pure dollar funding shock on MMF and non-MMF banks pre- and post reform across different currencies.

3.2 Identification strategy and descriptive statistics

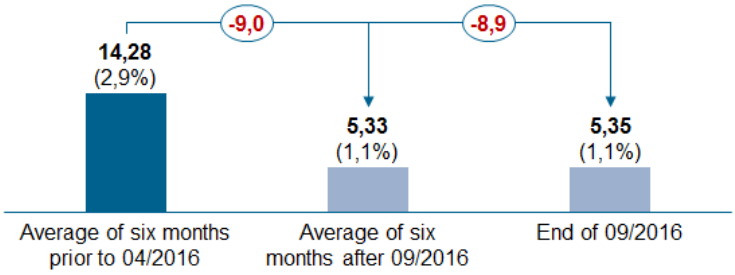
Our identification strategy relies on a difference-in-differences analysis. We match the MMF data with the corporate deposit data using bank names. The matched sample allows us to categorize banks active on the platform according to their funding loss from MMFs during the reform implementation. We categorize banks as *MMF* if they suffered a funding loss in the six months after full reform implementation in October 2016 relative to the six months up to the start of reform implementation in April 2016. The classification of MMF banks as such is conditional on these

banks having funding exposures to MMFs in the three months prior to April 2016.[7] Banks not fulfilling these conditions are classified as *non-MMF*.[8]

Figure 4 presents descriptive statistics on the unsecured funding loss of MMF banks. These banks had an average funding exposure of $14.3 billion in the six months prior to April 2016 (close to 3% of total assets). This amount dropped to $5.3 billion in the six months post reform implementation period, which implies an average funding loss of about $9 billion.[9]

Figure 4

MMF banks' US MMF funding exposure in $ billions (% of total assets)



Source: authors' calculations using Crane Data for banks active on the corporate deposit trading platform.

Our final sample comprises a total of 55 banks and 89 deposit providing firms executing 4,319 transactions on the platform. Of these banks, 31 are identified as MMF and 24 as non-MMF banks. From the 24 banks in the latter group, 3 are in the MMF sample, but have a negligible exposure to MMFs. Our sample consists of banks from 19 different countries (see Table A.1 in Appendix A). Banks within a country are typically all either in one group or the other, with the exception of those jurisdictions where the largest banks are headquartered (such as France, Germany, Spain, Switzerland and the United Kingdom).

The main analyses are based on an observation period of three months before the first MMF reform compliance date on April 14, 2016 ("pre" period) and three months after the full implementation of the reform on October 14, 2016 ("post" period) as depicted in Figure 5.

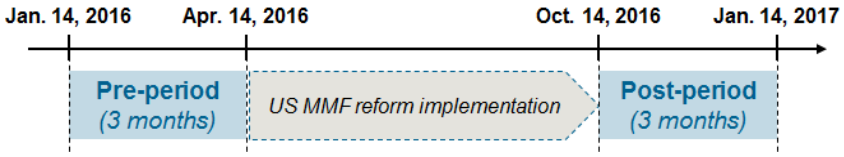
As shown in Table 3, it is striking that in the corporate deposit platform the group of banks that seems to be negatively affected by the reform are non-MMF banks, for which the US MMF

[7]The applied funding loss definition results in the same classification as using the point-in-time funding loss as of end of September 2016 – i.e., the last pre-reform implementation observation – except for two banks. This point in time consideration captures one-time outliers that do not correctly reflect the actual funding substitution need and therefore the average of six months after the reform implementation is the better comparison. Similarly, using three instead of six months before and after the reform implementation for measuring the funding loss only reclassifies one bank and looking into the development of MMF exposures again reveals that this is driven by an uninformative outlier. In our view, using the six-month window reflects better the reliance of banks on funding from MMFs, as well as the loss of funding as a consequence of the MMF reform. Finally, as noted above, considering the loss of unsecured funding net of funding gained through secured transactions such as repos with MMFs leads to the reclassification of only two banks, with no effect on our results.

[8]One could alternatively use the intention to treat rather than the actual treatment of a funding loss to classify banks. Using an intention to treat dummy would only reclassify one bank with a relevant MMF exposure prior to the reform, which does not change results.

[9]The same number is obtained when looking at the funding these banks got in September 2016.

Figure 5
Timeline of empirical setup



reform had no first order impact. These banks pay higher prices after the reform and yet lose market share in aggregate. Moreover, they bid more often, yet enter in fewer transactions.

In our subsequent analysis, we argue that the spillover channel could explain this observation. In particular, we use granular data to analyze the spillover effects of the US MMF reform into the corporate deposit market through competitive pressures and crowding out arising from increased presence of MMF banks in this market using a difference-in-differences framework.

Table 3
Summary statistics dollar-denominated auctions by bank group and period

Bank group	MMF banks		non-MMF banks		All banks	
Period	pre	post	pre	post	pre	post
No. bids	4,386	4,264	1,314	1,457	5,700	5,721
No. trans.	1,417	1,617	614	536	2,031	2,153
No. banks	29	31	20	20	49	51
No. firms	56	56	44	40	70	71
thereof new	-	*15*	-	*15*	-	*26*
Avg. notional	45.86	42.15	36.90	37.19	43.15	40.92
Avg. maturity	10.55	14.62	8.01	10.59	9.78	13.61
Avg. spread	-2.03	-0.84	3.18	9.62	-0.45	1.77
Market share	74.15	77.37	25.85	22.63	-	-

Notes: Summary statistics for corporate deposit auctions denominated in dollars. Bank groups and pre-reform/post-reform periods as specified in Section 3.2. *No. bids* is the total number of bids. *No. trans.* is the number of transactions. *No. banks* is the number of banks active in transactions. *No. firms* is the number of deposit providing firms active in transactions. *thereof new* denotes the number of firms having their very first transaction with one of the active banks in the post period. *Avg. notional* is the average notional deposit amount of transactions in $ millions. *Avg. maturity* is the average maturity of transactions in days. *Avg. spread* is the deposit spread (deposit interest rate - interbank benchmark rate of comparable maturity) in basis points. *Market share* denotes aggregate share of total notional deposit amount on the trading platform in percentages for each group.

Table 4 presents balance sheet information for both groups for the pre- and post-reform periods.[10] Banks in the two groups differ along some dimensions. MMF banks are on average larger, more leveraged, with a larger share of loans and a smaller deposit-to-assets ratio compared to non-MMF banks. While MMF banks tend to be larger, the correlation between size and reliance on MMF funding is far from perfect. In all regressions we control for bank-specific characteristics such as size, leverage and business model. Furthermore, in Appendix B we show that bank heterogeneity – e.g. in terms of size – does not explain our results. MMFs usually have risk management prac-

[10] As we only have year-end data for some banks, we approximate the pre-reform period as end-2015 and the post-reform period as end-2016.

tices that allow them to trade only with high credit quality counterparties. Accordingly, non-MMF banks have higher CDS spreads.

Similar to the patterns in corporate deposits, non-MMF banks seem to have been impacted negatively also on the asset side. The most notable changes between the pre and post reform are the relative increase in loans for MMF banks and a reduction for non-MMF banks. In particular, what stands out is a decline in the net interest income revenue share for non-MMF banks. This anticipates to some extent our key result: non-MMF banks pay more for dollar corporate deposit funding and charge less for dollar lending, i.e. their margins deteriorate.

In the second part of our analysis, we go beyond the corporate deposit platform and look at lending in different currencies. In particular, we use syndicated loan data in order to establish whether negative spillovers on the funding side affected the lending of non-MMF banks negatively following the reform, again using a difference-in-differences framework.

Table 4
Balance sheet characteristics and CDS by bank group, pre and post reform

Bank group	MMF		non-MMF	
Period (year-end)	2015	2016	2015	2016
Total assets [USD bn]	1,022	1,043	307	308
Leverage (total assets/equity)	18.0	17.9	15.1	14.6
NII revenue share [%]	55.3	56.0	55.2	47.6
Loans-to-deposits [%]	106.1	107.6	103.9	100.8
Loans-to-total assets [%]	48.8	49.4	46.7	45.7
Deposits-to-total assets [%]	47.6	48.3	49.3	50.2
5-year CDS spread [bp]	67.3	80.8	93.1	114.1

Source: S&P Global Market Intelligence and Markit; authors' calculations.

4 The MMF reform and interest rates on corporate deposits

In this section, we show that the negative funding shock due to the MMF reform spills over to other markets, to banks with no MMF exposure. Following the reform, these banks had to increase their offered deposit interest rate bids to retain funding in response to intensified competition for unsecured dollar funding.

We proceed as follows. We first present evidence that there were no significant differences between the deposit spreads paid by MMF and non-MMF banks prior to the implementation of the reform, while the divergence took place following the reform. We then show this formally in a difference-in-differences framework. Finally, we compare the interest rates in dollar- versus pound-denominated deposits paid by the two groups of banks and find that the results only apply to dollar-denominated funding. This suggests the results are driven by the reform and are not the result of non-random matching between MMFs and banks.

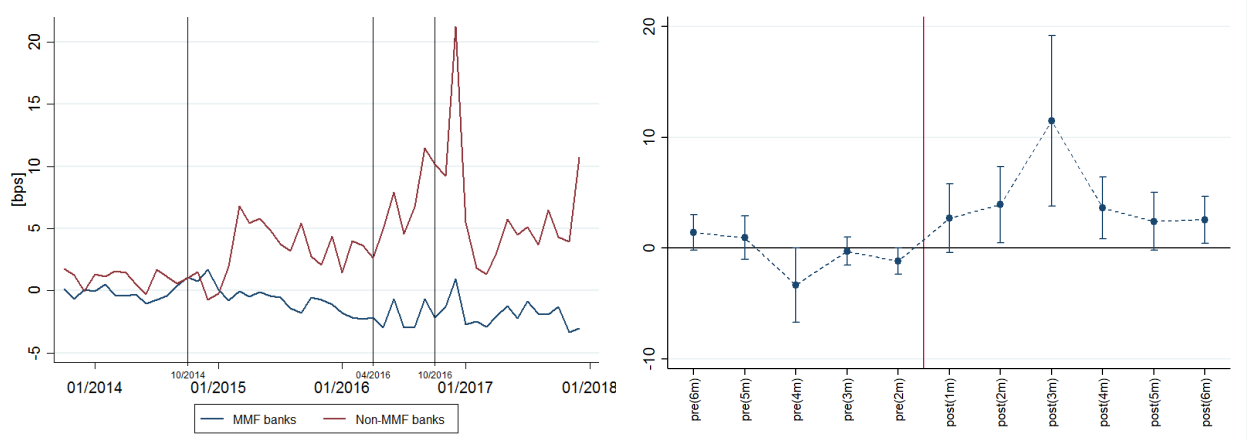
4.1 Trends in deposit spreads of MMF and non-MMF banks

The cost of wholesale corporate dollar deposits for MMF and non-MMF banks started to diverge around the MMF reform. The left panel of Figure 6 plots the average monthly deposit spread for each group for dollar-denominated deposits.[11] These trends were roughly similar between the two groups of banks prior to the first implementation date in April 2016.[12]

The parallel trends assumption is evaluated more formally in the right panel of Figure 6, where we plot the estimated coefficients and confidence bands of a regression of deposit spreads on an interaction between a dummy indicator for non-MMF banks and a dummy indicator for the six months pre and post reform.[13] Hence, these coefficients capture the difference between the prices paid by the two groups of banks in the respective months. In the run-up to the reform, these coefficients are statistically not significantly different from zero, whereas they move to positive territory post reform.

Figure 6

Monthly average deposit spread and parallel trend test visualization



Left panel: The deposit spread is defined as the deposit interest rate minus the USD LIBOR rate of comparable maturity, in basis points. Monthly average deposit spread per bank group, i.e. treated and non-treated banks.
Right panel: Point estimates for the coefficients of $pre/post \cdot nonMMF$ interactions from Table B.2, column (5) and the 90% confidence bands. The vertical red line denotes the MMF reform date.

4.2 Identifying spillovers: deposit spreads before and after the MMF reform

To assess the economic and statistical significance of the divergence in deposit spreads paid by MMF and non-MMF banks, and to identify spillovers more formally, we run the following regression

[11] Throughout our analysis, we define the deposit spread as the interest rate of deposit transactions minus the interbank benchmark rate, i.e., USD LIBOR rates for dollar-denominated transactions of comparable maturities, in basis points. In this way we take into account effects on deposit rates *net* of monetary policy. This is particularly relevant when considering multiple currencies, as we can control for differences in monetary policy across countries.

[12] The initial divergence of deposit spreads at the beginning of 2015 could also be driven by the adoption of the law in October 2014. We show in Appendix B that this difference is not statistically significant.

[13] The estimation equation includes bank and auction controls, as well as bank fixed effects and firm-month fixed effects. The table for this regression can be found in Appendix B.

based on transaction-level data, i.e., using information on all winning bids in the corporate deposit auctions:

$$\begin{aligned} Spread_{ijat} = \alpha_{jt} + (\alpha_i +)\beta_1 \cdot nonMMF_i + \beta_2 \cdot nonMMF_i \cdot post_t + \beta_3 \cdot YearEnd_t \\ + \beta_4 \cdot YearEnd_t \cdot nonMMF_i + \gamma \cdot \boldsymbol{X}_a + \delta \cdot \boldsymbol{Y}_{i(t-1year)} + \kappa \cdot CDS_{it-1} + \epsilon_{ijat} \end{aligned} \tag{2}$$

$Spread_{ijat}$ describes the deposit spread (net of LIBOR in the same currency and of comparable maturity) paid by bank i to firm j in auction a at time t. $nonMMF_i$ denotes a dummy variable that equals 1 if bank i is not directly affected by the money market fund reform (i.e., non-MMF bank) and 0 otherwise. $post_t$ is a dummy variable equal to 1 if the transaction occurs in the post reform period and 0 otherwise. $\boldsymbol{X}_a$ is a vector of transaction-specific control variables (maturity and the logarithm of notional amounts). $\boldsymbol{Y}_{i(t-1year)}$ is a vector of bank balance sheet control variables lagged by one year, and contains bank size (measured by the logarithm of total assets), bank leverage (defined as total assets over total equity), and the share of net interest income of total revenues as a business model indicator. CDS_{it-1} is the one-day lag of the logarithm of the 5-year CDS spread of bank i. As the variation in the regression setting is at the transaction-level, we are able to exploit within-bank variation and include bank fixed effects α_i that absorb bank-specific time-invariant characteristics. α_{jt} are $firm \times time$ fixed effects that absorb time-varying firm-specific characteristics and all common, time-specific variation, thereby controlling for any supply effects. Short term funding markets display temporary spikes around reporting dates, notably quarter-end and year-end. We control for potential confounding pricing effects by including a year-end dummy in order to absorb variation unrelated to spillovers.[14] The main coefficient of interest is β_2, capturing the difference-in-differences effect $nonMMF_i \cdot post_t$.

Results of the regression on deposit spreads, varying control variables and fixed effects, are presented in Table 5. In line with Figure 6, we find no significant difference in the deposit spread that MMF banks pay compared to non-MMF banks prior to the reform conditional on the included controls. However, we observe a strong premium paid by non-MMF banks after the reform: These banks have to pay between 6 and 9 basis points more to obtain dollar deposits compared to MMF banks, which is not only statistically significant, but also economically large. Non-MMF banks have to increase their deposit rates by 20-30% (relative to their pre-reform average) to retain their corporate deposit funding levels.[15] The results are robust to varying the period lengths and moving pre- and post-reform periods away from April and October, respectively, for reasonably large distances. Furthermore, they are also confirmed by period placebo tests.[16]

Results could be driven by selection effects in bank-firm pairs. This would occur if some firms

[14] Given the window used for analysis, a year-end dummy and a quarter-end dummy coincide.

[15] The difference-in-differences coefficient only reflects a change of non-MMF relative to MMF banks. However, Figure 6 indicates that deposit rates of MMF banks are fairly stable over time, so that the positive diff-in-diff coefficient of non-MMF banks can be interpreted as a deposit rate mark-up from pre- to post-period. Mark-up levels refer to rates in Table 1.

[16] See Online Appendix C.1 and Online Appendix C.2 for details.

Table 5
Non-MMF banks pay more for dollar deposits after the MMF reform

	(1)	(2)	(3)	(4)	(5)	(6)
$nonMMF_i$	2.3866		3.1729		3.1200	
	(1.9544)		(2.4494)		(2.4110)	
$nonMMF_i * post_t$	6.5272**	9.0780***	7.8583**	8.9239***	7.3676**	8.5695***
	(2.7123)	(2.5851)	(3.2925)	(3.0183)	(3.3312)	(3.0197)
$YearEnd_t$	61.6920	63.3683	62.3323	63.2261	-2.2706	-1.8601
	(64.9287)	(65.3202)	(65.0324)	(65.5317)	(5.0746)	(4.1533)
$YearEnd_t * nonMMF_i$	121.4400	118.4636	213.6991***	203.5935***	278.1908***	268.3042***
	(94.6347)	(92.4191)	(73.8187)	(72.3840)	(35.7706)	(31.6742)
$Notional_a$			0.5531	0.5465*	0.5601	0.4629
			(0.3681)	(0.3063)	(0.4017)	(0.3536)
$Maturity_a$			0.1072***	0.0883***	0.1046***	0.0863**
			(0.0349)	(0.0323)	(0.0366)	(0.0333)
$Size_{i(t-1year)}$	-1.2512	10.2497	-1.0781	4.1495	-1.1146	4.6394
	(0.9440)	(11.5589)	(0.6965)	(13.0049)	(0.7483)	(13.4696)
$Leverage_{i(t-1year)}$			0.4201***	-0.3332	0.3758**	-0.4343
			(0.1541)	(0.5388)	(0.1667)	(0.6233)
$NII_{i(t-1year)}$			-0.0729	-0.4179	-0.0777	-0.3959
			(0.0489)	(0.2695)	(0.0543)	(0.2778)
$CDS_{i(t-1)}$			-2.4249	-3.4505**	-2.2485	-3.8088**
			(1.8923)	(1.6891)	(1.9625)	(1.8486)
N	3,873	3,872	3,627	3,626	2,972	2,971
R^2	0.4653	0.5272	0.5308	0.5769	0.6576	0.7515
Firm-month FE	✓	✓	✓	✓	✓	✓
Bank FE		✓		✓		✓

Notes: OLS regressions for Equation 2. The dependent variable is the deposit spread $Spread_{ijat}$ defined as the deposit interest rate minus USD LIBOR rate of comparable maturity (in basis points), payed by bank i to firm j in auction a at time t. $nonMMF_i$ is a dummy variable equal to 1 if a bank is not directly affected by the MMF reform and $post_t$ a dummy variable equal to 1 in the post MMF reform period. $Notional_a$ stands for the logarithm of the notional deposit amount, $Maturity_a$ for the remaining time (in days) until the funding matures, $Size_{i(t-1year)}$ stands for the logarithm of bank total assets, $Leverage_{i(t-1year)}$ for total assets over equity, and $NII_{i(t-1year)}$ for the share of net interest income of bank's total revenue lagged by one year and $CDS_{i(t-1)}$ for the one-day lag in the logarithm of the bank's 5-year CDS spread. In columns (5) and (6), we use only a reduced sample of firms that interact at least once with banks from either group of MMF banks and non-MMF banks. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

that demand a higher spread trade only with non-MMF banks and these banks are not able to trade with low spread-demanding firms. In order to rule out this selection concern, we re-run the regressions on a reduced sample, where we only consider firms that interact at least once with a bank from either group of banks during the observation period. The results are shown in column (5) and (6) of Table 5 and document that selection is not driving our findings. The point estimate as well as the standard error of the interaction variable in the reduced sample model are virtually unchanged.

Bank heterogeneity, in particular regarding size, could also be driving results. Banks face varying degrees of financial frictions that determine their access to wholesale funding and ability to substitute. We thus control for bank size, leverage and net interest income in all regressions. Table B.3 in Appendix B presents additional analyses showing that bank heterogeneity in terms of

size is not driving our results.[17]

4.3 Placebo test: Dollar- versus pound-denominated deposit spreads

There are two key factors in our identification strategy. First, the US MMF reform only affected one single dollar wholesale funding market. Second, the richness of our dataset in providing us corporate deposit auctions in multiple currencies between the same set of firms and banks.

We compare our dollar results with currencies that are not impacted by the US MMF reform. We find that the results only hold for dollar auctions, providing strong support for our hypothesis of spillovers. Using this multi-currency aspect of our dataset helps us to rule out the alternative hypotheses that non-MMF banks had higher funding costs during our sample period for reasons unrelated to the US MMF reform or the possibility that non-random matching between banks and MMFs was driving results.

The platform provides us with a similarly diversified dataset in terms of participating MMF and non-MMF banks as well as sufficiently many transactions for euro- and pound-denominated auctions. We focus on pound-denominated auctions as euro money market products are strongly influenced by negative deposit facility rates and quantitative easing programs by the ECB during our sample period.[18]

We add pound-denominated deposit auctions to the sample and interact our main variables of interest in Equation 2 with a dollar dummy variable to measure the differential effect of the US MMF reform on dollar- versus pound-denominated transactions. If the effect that we identify in Table 5 originated from the US MMF reform, pound-denominated auctions would not be affected and we should observe a significantly different effect between dollar-denominated and pound-denominated transactions in the aftermath of the MMF reform. We estimate the following difference-in-differences-in-differences equation:

$$\begin{aligned} Spread_{ijact} = {} & \alpha_c + \alpha_{jt} + (\alpha_i + \alpha_{ct}+)\beta_1 \cdot nonMMF_i + \beta_2 \cdot nonMMF_i \cdot USD_a \\ & + \beta_3 \cdot nonMMF_i \cdot post_t + \beta_4 \cdot nonMMF_i \cdot post_t \cdot USD_a \\ & + \beta_5 \cdot YearEnd_t + \beta_6 \cdot YearEnd_t \cdot USD_a + \beta_7 \cdot YearEnd_t \cdot nonMMF_i \\ & + \beta_8 \cdot YearEnd_t \cdot nonMMF_i \cdot USD_a + \gamma \cdot \boldsymbol{X}_a + \delta \cdot \boldsymbol{Y}_{i(t-1year)} + \kappa \cdot CDS_{it-1} + \epsilon_{ijact} \end{aligned} \tag{3}$$

The dependent and control variables remain the same as in Equation 2.[19] The $nonMMF_i$ dummy variable is additionally interacted with a dummy variable USD_a, which is equal to 1 for

[17] Heterogeneity in terms of other bank characteristics such as leverage and net interest income also does not explain our findings. Results are available upon request.

[18] The Brexit referendum in June 2016 has a strong impact on pound money market products, which does not leave our platform unaffected either. However, those effects follow directly on the date of the referendum and were washed out already before the full implementation date of the US MMF reform and the beginning of the post-reform period on October 14, 2016.

[19] In particular, the deposit spreads in dollars (pounds) are net of dollar (pound) LIBOR of comparable maturities.

transactions denominated in dollars and 0 for transactions in pounds.

Table 6

The effect on corporate deposit spreads for non-MMF banks is dollar-specific

	(1)	(2)	(3)	(4)
$nonMMF_i$	-2.2175	-1.4400	-0.7786	
	(1.6785)	(1.6905)	(1.6341)	
$nonMMF_i * USD_a$	7.3848***	5.6012**	4.1778*	4.8048**
	(2.0224)	(2.1020)	(2.3161)	(1.8616)
$nonMMF_i * post_t$	-1.7459	-1.6108	-3.1624	-3.9736
	(3.3469)	(3.1545)	(3.4453)	(2.9130)
$nonMMF_i * post_t * USD_a$	8.9070**	9.1459**	11.7752**	12.8498***
	(4.1384)	(4.0119)	(4.3987)	(3.8127)
N	6,776	6,776	6,776	6,774
R^2	0.5686	0.5712	0.5729	0.6016
Year-end, bank and auction controls	✓	✓	✓	✓
Firm-month FE	✓	✓	✓	✓
Bank FE				✓
Currency FE		✓		
Currency-month FE			✓	✓

Notes: OLS regressions for Equation 3. The dependent variable is the deposit spread $Spread_{ijact}$ defined as the deposit interest rate minus the LIBOR rate of comparable maturity (in basis points), paid by bank i to firm j in auction a denominated in currency c (i.e. dollar or pound) at time t. $nonMMF_i$ is a dummy variable equal to 1 if a bank is a non-MMF bank, $post_t$ a dummy variable equal to 1 in the post MMF reform period and USD_a a dummy variable that equals 1 for dollar-denominated transactions. Auction controls include the logarithm of the notional deposit amount and the remaining time (in days) until the funding matures; bank controls include the lagged logarithm of bank total assets, the lagged leverage (total assets over equity), the lagged share of net interest income of bank's total revenue, and the lagged logarithm of CDS spreads (daily). Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

Table 6 presents the results. We start with a specification similar to column (3) in Table 5. We then add currency fixed effects (α_c) and $currency \times time$ (α_{ct}) fixed effects to control for time-constant and time-varying characteristics of currencies, respectively. We do not observe any significant trend in the difference between the funding costs for MMF and non-MMF banks in pound-denominated transactions. However, non-MMF banks pay a statistically significant and economically large premium after the US MMF reform implementation for dollar transactions compared to pound transactions. The premium of about 8 to over 12 bps is even higher than the premium in the within-currency analysis of dollar transactions only. This finding underscores the notion that the results in Table 5 reflect the causal effect of intensified competition for wholesale dollar funding arising from the US MMF reform.[20]

[20]We control for differences in monetary policy by having deposit rates net of the respective currency LIBOR interbank rates, as well as by controlling for *currency* and $currency \times time$ fixed effects. In addition, in untabulated results, we also exclude US and UK banks from the regression and find that our results continue to hold.

5 Stable funding providers and bank-firm relationships

In this section, we explore the role played by bank-firm relationships for the spillovers found above. Guided by the results in Section 3 that MMF funding is a more stable source of funding than corporate deposits, we show that MMF banks crowd out non-MMF banks in receiving funding from stable funding providers. We show that the higher rates paid by non-MMF banks are driven by several firm-specific factors determining their quality as funding providers as well as bank-firm relationships.

5.1 Heterogeneity of funding providers

We exploit the heterogeneity of firms as funding providers in our dataset in order to study the compositional shifts in the corporate deposit platform following the reform. Even though we do not observe the names of firms, we use their identification codes in the dataset to categorize firms and also study bank-firm relationships.

Guided by the revealed preference of MMF banks for the stability of MMF funding (i.e., longer maturities and larger transaction sizes), we categorize firms along two dimensions: (i) stability of funding provision and (ii) lot sizes offered. For the first dimension, we introduce an indicator measuring the stability of firms' funding provision on the platform, i.e., whether a firm is consistently providing funding on the platform, at a level commensurate with past levels. We define the indicator as the ratio of monthly aggregate notional deposit amount provided by a firm over the average monthly notional deposit amount of the prior six months in which the firm was active on the platform.[21] Firms are then categorized as "stable funding providers" if their average indicator score during the observation period is larger than or equal to 1, or above the median of all firms. For the second dimension, we divide firms into big and small lot size providers. A firm is classified as big lot size provider if its average transaction size is above the median of all firms' average transaction volumes.[22]

We also build measures of relationships. To evaluate whether MMF banks manage to acquire funds from new firms (the extensive margin) or whether they win more often auctions with firms they already have a relationship with (the intensive margin), we introduce a measure of *new relationship* as a dummy variable that is equal to 1 if the first transaction (determined considering all currencies traded on the platform) between bank i and firm j takes place after April 2016.

Just as banks, firms can also have different preferences in terms of the counterparties they choose to deposit with. On the one hand, as lenders they might simply prefer the highest bidders.[23] At the same time, firms are also borrowers and might prefer to establish or keep relationships with a bank even though it is not the highest bidder. Having beneficial loan conditions or preferred access

[21] The denominator calculation excludes months without activity in order to compare the current month to an average active month.

[22] Firms' average transaction sizes are calculated using all currencies on the platform. To ensure comparability across currencies, transactions were first translated to the same currency using daily exchange rates.

[23] See Friedmann, Imbierowicz, Saunders and Steffen (2017) who show that the highest quote is most often selected by deposit providers.

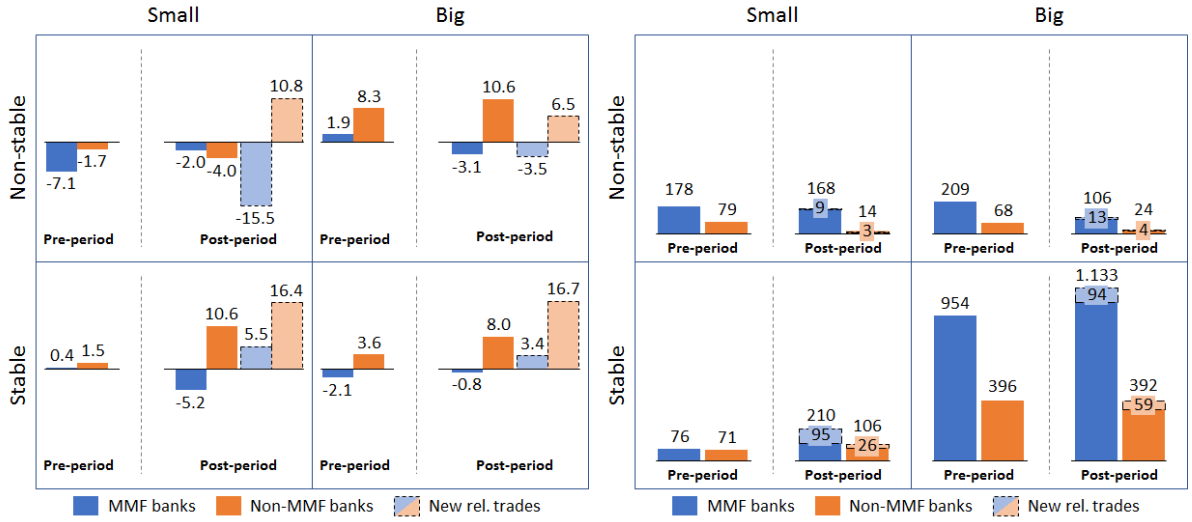
to international trade finance services might be more important for firms than maximizing deposit conditions on a stand-alone basis. As MMF banks are on average larger and have better access to international markets, it is reasonable that – all else equal – they might be preferred by deposit providing firms as counterparties.

Figure 7 shows the average deposit spread per transaction and the number of executed transactions by firm type and bank group, and provides descriptive evidence for this hypothesis. Already before the reform, funding providers seem to have had a preference for MMF banks. MMF banks paid less, on average, to obtain funding from big and stable funding providers. Non-MMF banks could only get favorable terms with smaller and less stable funding providers.

Following the reform, the costs for non-MMF banks rose across the board, and significantly more for stable funding providers, with only a few small and non-stable funding providers offering slightly better conditions. Moreover, MMF banks substituted non-stable funding providers by stable ones through new relationships. Non-treated banks could only maintain the overall level of transactions with stable funding providers by offering significantly higher prices.

Figure 7

Average deposit spread [bps] (left) and number of transactions (right) by firm type



Notes: Only transactions with the respective firm type according to transaction size (small vs. big) and stability of funding provision (stable vs. non-stable) considered in each quadrant. The post-reform period averages distinguish further between trades out of existing and new (i.e. first trade after April 2016) firm-bank relationships.

5.2 Bidding success

In this section, we test the hypothesis that non-MMF banks were crowded out of stable funding providers by MMF banks in the corporate deposit platform following the reform. We study the probability of winning a deposit auction by bank type in a difference-in-differences framework as before. The goal is to assess the role played by bank-firm relationships, firms' stability of funding provision and firms' deposit volumes, beyond the graphical evidence provided in Figure 7. In particular, we estimate the following equation at the *auction quote* level for dollar auctions only:

$$
\begin{aligned}
WinningBid_{ijabt} = \alpha_{jt} + (\alpha_i + \alpha_{abt}+)\beta_1 \cdot nonMMF_i + \beta_2 \cdot nonMMF_i \cdot post_t \\
+ \beta_3 \cdot nonMMF_i \cdot post_t \cdot newReln_{ij} + \beta_4 \cdot nonMMF_i \cdot stable_j(big_j) \\
+ \beta_5 \cdot nonMMF_i \cdot stable_j(big_j) \cdot post_t \\
+ \beta_6 \cdot nonMMF_i \cdot stable_j(big_j) \cdot post_t \cdot newReln_{ij} \\
+ \beta_7 \cdot highestQuote_{ab} + \gamma \cdot \boldsymbol{X}_a + \delta \cdot \boldsymbol{Y}_{i(t-1year)} + \kappa \cdot CDS_{it-1} + \epsilon_{ijabt}
\end{aligned} \tag{4}
$$

where $WinningBid_{ijabt}$ is a dummy variable that equals 1 if bank i wins the deposit offered by firm j in auction a with bid quote rank b at time t. Equal quotes are allocated to the same bid quote rank resulting in equally many bid quote ranks as distinct quotes in an auction. We again use the $nonMMF_i$ dummy variable to flag banks not directly affected by the US MMF reform, i.e., non-MMF banks. $newReln_{ij}$ is a dummy variable for new relationships which is equal to 1 if the first transaction (determined considering all currencies traded on the platform) between a bank i and firm j took place after April 2016. Transactions from new relationships can by definition only take place in the post-reform period, so that the variable can be interpreted as if it was interacted with the post-reform period dummy. $stable_j$ is equal to 1 if firm j offering the deposit is a stable funding provider according to the aforementioned definition. big_j is equal to 1 if the average transaction size of firm j is larger or equal to the median of average transaction sizes of all other firms. $highestQuote_{ab}$ is a dummy variable equal to 1 if bid quote rank b is the highest quote rank in auction a.

We present results in Table 7. In line with Friedmann, Imbierowicz, Saunders and Steffen (2017), we find that the highest quote is consistently an important driver of the likelihood of winning a deposit auction, across both bank groups and periods. Moreover, we find that non-MMF banks have a lower probability of obtaining funding from firms they used to rely on.[24] However, they manage to win on average more auctions from new relationship firms in the post-reform period, as column (1) and column (2) document. This higher probability of winning new relationships for non-MMF banks, however, is driven by non-stable funding providers (columns (3) and (4)). In addition, there is evidence that these banks win less often auctions with large funding providers in the post-reform period for both old and new relationship firms (columns (5) and (6)).

Overall, Table 7 documents a composition effect and explains the higher deposit spread that non-MMF banks pay after the reform. Once MMF banks lost MMF funding and intensified competition for corporate deposits, they crowded-out non-MMF banks by securing funding from firms that are most alike MMFs, i.e., stable and large deposit providing firms. In order to keep their funding volume, non-MMF banks had to form new relationships with less stable funding providers and smaller firms, and had to pay a premium for both building up new relations and keeping in place existing ones.[25]

[24] The negative and significant coefficient of $nonMMF_i * post_t$ is also present if we compare two offers with identical quotes within an auction, i.e. using bid-quote rank fixed effects.

[25] The results are again robust against varying the period lengths and moving pre- and post-reform periods away

Table 7
Bank-firm relationships after the reform

	(1)	(2)	(3)	(4)	(5)	(6)
$nonMMF_i$	0.0751**		0.0556		-0.1652*	
	(0.0371)		(0.0687)		(0.0873)	
$nonMMF_i * post_t$	-0.1128**	-0.1217**	-0.2259	-0.2099	0.1177	0.1365
	(0.0459)	(0.0476)	(0.1587)	(0.1515)	(0.0873)	(0.0918)
$nonMMF_i * post_t * newReln_{ij}$	0.1828***	0.2191***	0.6934***	0.6592**	0.2696***	0.2089***
	(0.0274)	(0.0426)	(0.2484)	(0.2497)	(0.0356)	(0.0295)
$nonMMF_i * stable_j$			0.0277	0.0343		
			(0.0595)	(0.0644)		
$nonMMF_i * stable_j * post_t$			0.1128	0.0851		
			(0.1624)	(0.1612)		
$nonMMF_i * stable_j * post_t * newReln_{ij}$			-0.5440**	-0.4783*		
			(0.2444)	(0.2486)		
$nonMMF_i * big_j$					0.2683***	0.2680**
					(0.0920)	(0.1039)
$nonMMF_i * big_j * post_t$					-0.2562***	-0.2926***
					(0.0916)	(0.0928)
$nonMMF_i * big_j * post_t * newReln_{ij}$					-0.0892*	0.0015
					(0.0449)	(0.0520)
$highestQuote_{ab}$	0.7724***	0.7605***	0.7715***	0.7598***	0.7704***	0.7602***
	(0.0256)	(0.0275)	(0.0255)	(0.0275)	(0.0255)	(0.0276)
N	5,661	5,658	5,661	5,658	5,661	5,658
R^2	0.6808	0.6877	0.6818	0.6885	0.6826	0.6894
Bank and auction controls	✓	✓	✓	✓	✓	✓
Bank FE		✓		✓		✓
Firm-month FE	✓	✓	✓	✓	✓	✓

Notes: OLS regressions for Equation 4. The dependent variable is $WinningBid_{ijabt}$ defined as a dummy variable that equals 1 if bank i wins the deposit offered by firm j in auction a (only dollar auctions) with bid b at time t. $nonMMF_i$ is a dummy variable equal to 1 if a bank is a non-MMF bank and $post_t$ a dummy variable equal to 1 in the post-reform period. $newReln_{ij}$ is a dummy variable equal to 1 if the first transaction (determined considering all currencies traded on the platform) between a bank i and firm j takes place after April 2016. $highestQuote_{ab}$ is a dummy equal to 1 if bid b was the highest in auction a. $stable_j$ is equal to 1 if firm j offering the deposit is a stable funding provider. big_j is equal to 1 if the average transaction size of firm j is larger or equal to the median of average transaction sizes of all other firms. Auction controls include the logarithm of the notional deposit amount and the remaining time (in days) until the funding matures; bank controls include the lagged variables logarithm of bank total assets, leverage (total assets over equity), share of net interest income of bank's total revenue, and the lagged logarithm of CDS spreads (daily). Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

5.3 Placebo test: Dollar versus pound transactions

We again rule out that non-MMF banks had a general decrease in their bidding success that is not related to the MMF reform. As before, we do this by comparing the results of dollar auctions with pound-denominated auctions as a suitable control currency. Our main variables of interest in Equation 4 are again additionally interacted with a dollar dummy variable to measure the differential effect of the US MMF reform on dollar- versus pound-denominated transactions. If the effect that we identify in Table 7 originates from the US MMF reform, we should observe a significantly different effect between dollar-denominated and pound-denominated transactions. We

from April and October, respectively, for reasonably large distances, and are confirmed by period placebo tests. See Online Appendix C.1 and Online Appendix C.2 for details.

estimate the following auction quote level difference-in-differences-in-differences equation:

$$
\begin{aligned}
WinningBid_{ijabct} = {} & \alpha_{ct} + \alpha_{jt} + (\alpha_i +)\beta_1 \cdot nonMMF_i + \beta_2 \cdot nonMMF_i \cdot post_t \\
& + \beta_3 \cdot nonMMF_i \cdot USD_a + \beta_4 \cdot nonMMF_i \cdot post_t \cdot USD_a \\
& + \beta_5 \cdot newReln_{ij} + \beta_6 \cdot newReln_{ij} \cdot nonMMF_i \\
& + \beta_7 \cdot newReln_{ij} \cdot USD_a + \beta_8 \cdot newReln_{ij} \cdot nonMMF_i \cdot USD_a \\
& + \beta_9 \cdot stable_j(big_j) + \beta_{10} \cdot stable_j(big_j) \cdot nonMMF_i \\
& + \beta_{11} \cdot stable_j(big_j) \cdot USD_a + \beta_{12} \cdot stable_j(big_j) \cdot nonMMF_i \cdot USD_a \\
& + \beta_{13} \cdot highestQuote_{ab} + \gamma \cdot \boldsymbol{X}_a + \delta \cdot \boldsymbol{Y}_{i(t-1year)} + \kappa \cdot CDS_{it-1} + \epsilon_{ijabt}
\end{aligned}
\tag{5}
$$

The dependent and control variables remain the same as in Equation 4. USD_a is again a dummy variable that discriminates dollar transactions from pound transactions. The results are shown in Table 8 and document that non-MMF banks had a higher (lower) probability of winning auctions with new relationships (stable and big funding providers) only for dollar-denominated auctions. This result points to a crowding-out of non-MMF banks from dollar deposit funding only after the MMF reform.

Table 8

Bank-firm relationships and the probability of winning USD versus GBP deposit auctions

	(1)	(2)	(3)	(4)	(5)	(6)
$nonMMF_i * post_t$	-0.0233	-0.0194	-0.0128	0.0115	-0.2357*	-0.2270*
	(0.0386)	(0.0409)	(0.1167)	(0.1261)	(0.1279)	(0.1272)
$nonMMF_i * post_t * USD_a$	-0.0637	-0.0659	-0.1931	-0.1566	0.3524**	0.3781**
	(0.0502)	(0.0508)	(0.1705)	(0.1630)	(0.1717)	(0.1729)
$nonMMF_i * post_t * newReln_{ij}$	-0.1106	-0.0703	-0.1665	-0.1309	-0.1169	-0.0865
	(0.0788)	(0.0642)	(0.1429)	(0.1506)	(0.0771)	(0.0613)
$nonMMF_i * post_t * newReln_{ij} * USD_a$	0.2763***	0.2671***	0.8446***	0.7780***	0.3635***	0.2713***
	(0.0768)	(0.0635)	(0.2318)	(0.2465)	(0.0856)	(0.0619)
$nonMMF_i * stable_j * post_t$			-0.0085	-0.0349		
			(0.1287)	(0.1391)		
$nonMMF_i * stable_j * post_t * USD_a$			0.1310	0.0882		
			(0.1675)	(0.1628)		
$nonMMF_i * stable_j * post_t * newReln_{ij}$			0.0738	0.0682		
			(0.1497)	(0.1753)		
$nonMMF_i * stable_j * post_t * newReln_{ij} * USD_a$			-0.6169**	-0.5513**		
			(0.2437)	(0.2674)		
$nonMMF_i * big_j * post_t$					0.2310*	0.2250
					(0.1375)	(0.1370)
$nonMMF_i * big_j * post_t * USD_a$					-0.4534**	-0.4857***
					(0.1796)	(0.1757)
$nonMMF_i * big_j * post_t * newReln_{ij} * USD_a$					-0.0842**	0.2713***
					(0.0389)	(0.0619)
Highest quote	0.7716***	0.7651***	0.7712***	0.7648***	0.7710***	0.0071
	(0.0204)	(0.0212)	(0.0204)	(0.0212)	(0.0204)	(0.0441)
N	10,095	10,092	10,095	10,092	10,095	10,092
R^2	0.6711	0.6781	0.6717	0.6788	0.6722	0.6791
Bank and auction controls	✓	✓	✓	✓	✓	✓
Bank FE		✓		✓		✓
Currency-month FE	✓	✓	✓	✓	✓	✓
Firm-month FE	✓	✓	✓	✓	✓	✓

Notes: OLS regressions for Equation 4. The dependent variable is $WinningBid_{ijabt}$ defined as a dummy variable that equals 1 if bank i wins the deposit offered by firm j in auction a with bid b at time t. $nonMMF_i$ is a dummy variable equal to 1, if a bank is a non-MMF bank and $post_t$ a dummy variable equal to 1 in the post-reform period and USD_a a dummy variable that equals 1 for dollar-denominated transactions. $newReln_{ij}$ is a dummy variable equal to 1 if the first transaction (determined considering all currencies traded on the platform) between a bank i and firm j takes place after April 2016. $stable_j$ is equal to one if firm j offering the deposit is a stable funding provider according to the aforementioned definition. big_j is equal to 1 if the average transactions size of firm j is larger or equal to the median of average transaction sizes of all other firms. $highestQuote_{ab}$ is a dummy variable equal to 1 if bid b contains the highest quote in auction a. Auction controls include the logarithm of the notional deposit amount and the remaining time (in days) until the funding matures; bank controls include the lagged variables logarithm of bank total assets, leverage (total assets over equity), share of net interest income of bank's total revenue, and the lagged logarithm of CDS spreads (daily). Interaction terms not including $post_t$ are not included in the table for presentational purposes. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

6 Bank lending: prices and volumes

A natural question that arises from our results so far is whether, and if so how, bank lending is affected. Assuming the outcomes in the corporate deposit platform are representative of rising costs for non-MMF banks, we ask the following questions: Do banks pass on the rising costs to borrowers? Do banks increase risk-taking to keep their profit margins? Do banks cut their lending in dollars relative to other currencies as the sourcing of dollars becomes more expensive? Or did

they lose competitiveness in lending markets through lower demand for their loans as a consequence of losing competitiveness in funding markets?

We show that non-MMF banks reduced lending rates relative to MMF banks – in particular for dollar loans – yet reduced the relative share of dollar loans in their portfolio. These results suggest that intensified competition in funding markets led to a decrease in profitability by affecting interest margins.

We use loan-level data from the syndicated loan market to study the differences between MMF and non-MMF banks in terms of dollar loan pricing and volumes for the period of 3 and 6 months around the MMF reform. We match the funding dataset to syndicated loan data from Dealogic, ending up with 43 non-US banks, 27 and 16 of which are MMF and non-MMF banks, respectively. We consider loans denominated in major currencies.[26] In the 12 months around the US MMF reform, banks in our sample originated almost 12,000 loans, split into about 32,000 loan shares (i.e., bank individual shares of a syndicated loan).

6.1 Loan pricing

We study loan pricing at the loan level. Zooming in on dollar loans, we look at the loan rate charged by bank i to firm j in loan contract l at time t:

$$\begin{aligned} LoanMargin_{ijlt} = \alpha_{jt} + (\alpha_i+)\beta_1 \cdot nonMMF_i + \beta_2 \cdot post_t + \beta_3 \cdot nonMMF_i \cdot post_t \\ + \gamma \cdot \boldsymbol{X}_l + \delta \cdot \boldsymbol{Y}_{i(t-1year)} + \kappa \cdot CDS_{it-1} + \epsilon_{ijlt} \end{aligned} \tag{6}$$

where $LoanMargin_{ijlt}$ describes the loan spread charged above LIBOR in loan l by bank i to firm j originated on day t. The vector $\boldsymbol{X}_l$ contains loan control variables, namely the logarithm of the face value of the loan and the loan maturity at origination (in years). $Borrower \times time$ fixed effects (α_{jt}) are included in all regressions to control for loan demand by firms. Other variables (including fixed effects and bank controls) follow the naming convention in the previous section.

Table 9 presents the results. In column (1), we estimate the baseline version of Equation 6, which includes *borrower* $\times$ *time* fixed effects as well as bank-specific controls. Column (2) adds bank CDS spreads to the group of bank-specific controls. Column (3) controls in addition for bank fixed effects. As loan origination via a syndicate is usually negotiated over a longer period, a three month window might be too narrow to capture the post-reform effects on bank lending. We therefore re-run the regressions using a 6 month window in columns (4)-(6). In all specifications, we observe a negative estimate for β_3, indicating a lower spread for dollar loans of non-MMF banks post-reform. In the aftermath of the MMF reform, non-MMF banks cut their dollar loan margins on average by close to 2 basis points relative to MMF banks.

Next, we compare the pricing of dollar loans versus loans in other currencies. In Equation 7 we

[26] The currencies considered are: AUD, CAD, CHF, DKK, EUR, GBP, HKD, JPY, SEK and USD. Six months before and after the US MMF reform implementation, these currencies account for over 95% of originated loans by our sample banks. These currencies encompass all home currencies of the banks in our sample, plus the USD. Non-USD loans were converted into USD using daily currency exchange rates.

Table 9
Non-MMF banks charge less for their dollar loans post MMF reform

	(1)	(2)	(3)	(4)	(5)	(6)
Period length	3 months	3 months	3 months	6 months	6 months	6 months
$nonMMF_i$	0.3911	0.8615		0.6181*	1.0237***	
	(0.3687)	(0.5377)		(0.3102)	(0.3576)	
$nonMMF_i * post_t$	-1.7310*	-1.3738	-1.4828	-1.7383**	-1.4162*	-1.5280*
	(0.9565)	(1.1313)	(1.0448)	(0.6901)	(0.7781)	(0.8537)
$LoanSize_l$	3.0357	3.0497	3.0417	-1.4702	-1.4723	-1.4722
	(2.2158)	(2.2289)	(2.2317)	(1.7325)	(1.7398)	(1.7389)
$Maturity_l$	5.4271***	5.4264***	5.4270***	8.1086***	8.1044***	8.1019***
	(1.1108)	(1.1120)	(1.1130)	(1.8374)	(1.8390)	(1.8382)
N	4,191	4,178	4,176	8,318	8,295	8,295
R^2	0.9004	0.9001	0.9001	0.9139	0.9135	0.9136
Bank controls	✓	✓	✓	✓	✓	✓
Borrower-month FE	✓	✓	✓	✓	✓	✓
Bank FE			✓			✓

Notes: OLS regressions for Equation 6. All regressions are for dollar loans. The dependent variable $LoanMargin_{ilt}$ is defined as the loan spread charged above LIBOR for loan l by bank i originated on day t. $nonMMF_i$ is a dummy variable equal to 1 if the bank is not directly affected by the MMF reform and $post_t$ a dummy variable equal to 1 in the post MMF reform period. $LoanSize_l$ stands for the logarithm of the face value of the loan, $Maturity_l$ for the remaining time (in years) until the loan matures at the time of origination. Bank controls include the lagged logarithm of bank total assets, leverage (total assets over equity) and the share of net interest income of bank's total revenue. In columns (2), (3), (5) and (6), we additionally include the logarithm of the bank 5 year CDS spread. The length of the period considered for estimation before and after US MMF reform implementation is denoted below the column numbering. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

expand on the specification in Equation 6 by including loans in all the 10 currencies in our sample, and include a dummy to capture those loans that are made in dollars:

$$\begin{aligned} LoanMargin_{ijlct} = \alpha_{ct} + \alpha_{jt} + (\alpha_i +)\beta_1 \cdot nonMMF_i + \beta_2 \cdot nonMMF_i \cdot USD_l \\ + \beta_3 \cdot nonMMF_i \cdot post_t + \beta_4 \cdot nonMMF_i \cdot post_t \cdot USD_l + \\ + \gamma \cdot \boldsymbol{X}_l + \delta \cdot \boldsymbol{Y}_{i(t-1year)} + \kappa \cdot CDS_{it-1} + \epsilon_{ilct} \end{aligned} \tag{7}$$

$LoanMargin_{ijlct}$ describes the loan spread charged above LIBOR for loan l by bank i to firm j originated on day t in currency c. USD_l is a dummy variable equal to 1 if loan l is denominated in dollars. The vector $\boldsymbol{X}_l$ contains the same loan control variables as Equation 6 (loan size and maturity at origination). All regressions control for $currency \times month$ fixed effects (α_{ct}, absorbing all time-varying currency-specific factors), $borrower \times month$ fixed effects (α_{jt}, controlling for loan demand) and bank-specific controls. Columns (2) and (4) control in addition for bank fixed effects, thereby absorbing all time-invariant bank-specific characteristics.

The triple interaction term is negative, statistically significant regardless of the specification and economically relevant. Post reform, non-MMF banks cut their loan margins for dollar loans on average by around 7 basis points relative to MMF banks. There is no such effect for loans in other currencies; in fact the effect for non-dollar loans is positive, though around half the size of

Table 10
Dollar loan margins after the MMF reform (Dollar vs. other currencies)

	(1)	(2)	(3)	(4)
Period length	3 months	3 months	6 month	6 months
$nonMMF_i$	-2.8778		-2.3076*	
	(1.8125)		(1.2748)	
$nonMMF_i * USD_l$	4.7000*	4.7295*	4.2012**	4.0529**
	(2.4519)	(2.6466)	(1.8693)	(1.8557)
$nonMMF_i * post_t$	3.6489*	3.5360*	3.9766*	3.8116
	(1.8911)	(2.0136)	(2.2632)	(2.4337)
$nonMMF_i * post_t * USD_l$	-6.2661**	-6.3105**	-6.6602**	-6.5940**
	(2.6986)	(2.8603)	(2.7484)	(2.7677)
N	5,772	5,771	11,512	11,512
R^2	0.9147	0.9146	0.9243	0.9243
Bank and loan controls	✓	✓	✓	✓
Currency-month FE	✓	✓	✓	✓
Borrower-month FE	✓	✓	✓	✓
Bank FE		✓		✓

Notes: OLS regressions for Equation 7. The dependent variable $LoanMargin_{ilct}$ is defined as the loan spread charged above interbank rate (e.g., LIBOR) for loan l by bank i originated in currency c on day t. $nonMMF_i$ is a dummy variable equal to 1 if the bank is not directly affected by the MMF reform and $post_t$ a dummy variable equal to 1 in the post-reform period. USD_l is a dummy variable equal to 1 if the loan is denominated in USD. Loan controls include the logarithm of the face value of the loan and its maturity (remaining time in years until the loan matures, at the time of origination). Bank controls include the lagged logarithm of bank total assets, leverage (total assets over equity), the share of net interest income of bank's total revenue and the logarithm of bank CDS spreads. The length of the period considered for estimation before and after US MMF reform implementation is denoted below the column numbering. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

the effect for dollar loans and not as strong in terms of statistical significance. This suggests that non-MMF banks could partly compensate for the profitability reduction in dollar loans by shifting their focus to other currencies, e.g., their home country currency.

6.2 Loan volumes

We next study volumes at the loan level. Potentially confounding events, such as the Brexit referendum, could in principle affect the demand for loans unevenly for MMF and non-MMF banks. To rule out the concern that such events may be driving results, we control for loan demand in a Khwaja and Mian (2008) setup and compare USD loan volumes within firms and across banks.[27] We run the following regression:

[27] We reduce the sample to bank-borrower pairs that have at least one USD loan in the pre- and post-period and include both USD and non-USD transactions of those pairs for estimation. This still leaves us with a sufficiently large sample of 999 loans originated by 32 banks (11 of which are non-MMF banks) to 56 firms.

$$
\begin{aligned}
log(volume_{ijlct}) = \alpha_{ct} + (\alpha_i + \alpha_j + \alpha_{jt})\beta_1 \cdot nonMMF_i + \beta_2 \cdot nonMMF_i \cdot USD_c \\
+ \beta_3 \cdot nonMMF_i \cdot post_t + \beta_4 \cdot nonMMF_i \cdot post_t \cdot USD_c \\
+ \gamma \cdot mat_l + \delta \cdot \mathbf{Y}_{i(t-1year)} + \kappa \cdot CDS_{it-1} + \epsilon_{ict}
\end{aligned} \tag{8}
$$

where $log(volume_{ijlct})$ denotes the logarithm of the loan volume from bank i to firm j in loan l in currency c in period t and mat_l denotes the maturity of loan l; the remaining elements in equation 8 follow the notation in equation 7. In a refinement of this specification, we aggregate all loans and collapse the data to a cross section of changes in the loan volume from bank i to firm j in currency c before and after the reform, and run the following regression[28]

$$
\Delta Loan_{ijc} = \alpha_c + \alpha_i + \alpha_j + \beta_1 \cdot nonMMF_i \cdot USD_c + \gamma \cdot mat_l + \epsilon_{ijc} \tag{9}
$$

Table 11 presents the results of these regressions. Controlling for loan characteristics, time-invariant firm characteristics, time-varying currency characteristics (column (1)) and time-invariant bank characteristics (column (2)), non-MMF banks originate smaller dollar loans following the MMF reform. The magnitude and significance of the results are virtually unchanged if we control further for borrower demand by means of *borrower* × *month* fixed effects (column (3)) and for time-varying bank characteristics (column (4)). Furthermore, collapsing the time dimension into a cross-section of changes in loan volume by bank-firm pairs *within* a currency confirms that these smaller loans aggregate to an overall lower loan origination by non-MMF banks in terms of volume. Non-MMF banks reduce their dollar loans more post reform, for the *same* firm (i.e., for a *given* loan demand).[29]

Summing up, we find that non-MMF banks were ultimately crowded out from dollar business. They pay more for obtaining dollar funding from a worse pool of funding providers. This impacts their competitiveness in dollar lending. They grant fewer dollar loans with smaller lot sizes and at a rate discount. Our lending results also corroborate that the corporate deposit platform is representative of how the US MMF reform affected dollar funding markets at large.

[28] Note that we control here for differences in the the average loan maturity with mat_l. Bank fixed effects in this specification control for changes in all bank-specific characteristics, including but not limited to their riskiness and balance sheet characteristics.

[29] As one explanation of the decrease in dollar loan volume by non-MMF banks, we observe that non-MMF banks are less often lead arrangers in dollar loans post reform (relative to non-dollar loans). Results are available upon request.

Table 11
Loan volume after the reform - USD versus other currencies

Dependent variable:	(1)	(2)	(3)	(4)	(5)
	$log(volume_{ijlct})$				$\Delta log(volume_{ijc})$
$nonMMF_i$	-0.6317				
	(0.3780)				
$nonMMF_i * USD_l$	0.6315*	0.5350*	0.5543*	0.4397	
	(0.3455)	(0.2967)	(0.2848)	(0.2702)	
$nonMMF_i * post_t$	0.8277**	0.8510**	0.8888**	0.6911*	
	(0.3720)	(0.3891)	(0.4053)	(0.3496)	
$nonMMF_i * USD_l * post_t$	-0.9488**	-0.9553**	-0.9538**	-0.8170**	-0.9086**
	(0.3874)	(0.3964)	(0.3720)	(0.3598)	(0.3850)
N	999	998	994	983	289
R^2	0.7300	0.7500	0.8299	0.8292	0.7362
Loan controls	✓	✓	✓	✓	✓
Bank controls				✓	
Borrower FE	✓	✓			✓
Borrower-month FE			✓	✓	
Bank FE		✓	✓	✓	✓
Currency-month FE	✓	✓	✓	✓	✓

Notes: OLS regressions for Equation 8 (on loan level including loan controls with a different left-hand side variable) and Equation 9. The dependent variable $log(volume_{ijlct})$ in columns (1) to (4) is defined as the logarithm of the notional amount of loan l by bank i for borrower j originated in currency c on day t. The dependent variable $\Delta log(volume_{ijc})$ in columns (5) is the difference of the average log loan amount from pre- to post-period by the bank-borrower pair (i, j) in currency c. $nonMMF_i$ is a dummy variable equal to 1 if the bank is not directly affected by the MMF reform and $post_t$ a dummy variable equal to 1 in the post-reform period. USD_l is a dummy variable equal to 1 if the loan is denominated in USD. Loan controls include the maturity (remaining time in years until the loan matures, at the time of origination) of loan l in columns (1) to (4) and the difference of the average loan maturity from pre- to post-period of bank-borrower pair (i, j) in column (5). Bank controls include the lagged logarithm of bank total assets, leverage (total assets over equity), the share of net interest income of bank's total revenue, and the lagged logarithm of CDS spreads (daily). The length of the period considered for estimation before and after US MMF reform implementation is six months. The coefficient of $nonMMF*Dollar$ in column (5) has been displayed next to the equivalent coefficients from the loan level analysis in columns (1) - (4) for ease of comparison. Currency FE are, by design, not interacted with a monthly time dimension in column (5). All columns only considers bank-borrower pairs having a USD loan in both the pre- and post-period. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

7 Conclusion

We contribute to the literature on funding market dry-ups by identifying a new channel of spillovers in which a funding dry-up in one market propagates to other markets through crowding out and intensified competition. Moreover, we show that these spillovers are material, in that they affect bank lending margins and volumes. We also contribute to the literature on bank competition in funding markets by showing that banks' competitiveness in funding markets affects their competitiveness in lending markets.

We exploit a policy reform that led to a wholesale funding dry-up in one market during an otherwise tranquil period for financial markets. This allows us to study the dynamics of funding dry-ups without the confounding factors usually present during a crisis. When the US MMF reform reduced the availability of unsecured funding for some banks, they tapped into alternative sources of unsecured funding such as deposits from large corporates. As a result, banks with no MMF

exposure had to pay higher deposit rates relative to MMF banks to retain funding, and were crowded out from stable funding providers. They lent less and at lower prices relative to MMF banks.

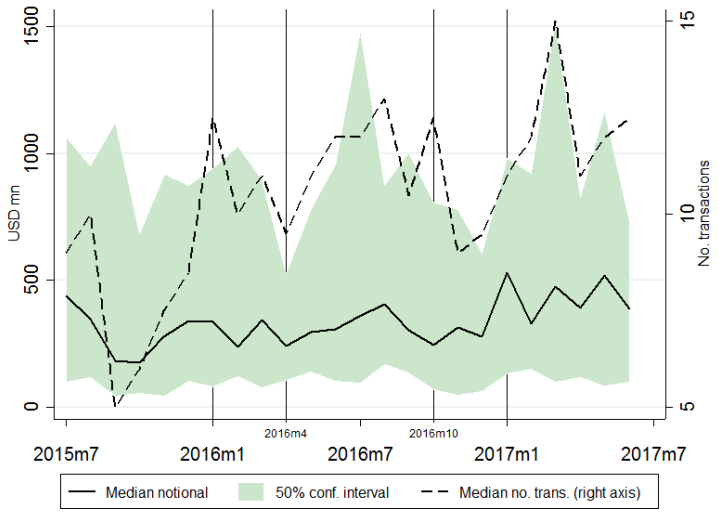
Our results have three major implications for financial stability and policy. First, they highlight that different types of liabilities – such as MMF-provided wholesale funding and corporate deposits – are substitutable to some degree. It is hence important to understand the nature of this substitutability to gauge the reaction of banks in the event of a funding dry-up in one market. Second, in an integrated but segmented financial system, shocks to one market could spill over to other markets and affect other financial institutions. As a result, these spillovers could propagate and amplify the impact of original shocks. It is therefore important for policy makers to understand the linkages between different markets and the participants in each market. Finally, these spillovers show that policy reforms can reach beyond their intended impact area. Hence, policy makers should take the possibility of spillovers into account when assessing the potential unintended consequences of their policies.

Finally, our paper provides new insights into corporate deposit markets, using a unique and granular dataset. Despite their increasing importance and potential to lead to financial instability, data unavailability has previously hindered the study of these markets. However, while our dataset provides rich information, it only covers a relatively small segment of the market for corporate deposits. Future research using other segments would be useful to understand these markets and how they might affect financial stability.

Appendix

Appendix A Additional summary statistics

Figure A.1
Monthly notional deposit amount and number of transactions per bank



Notes: The solid line depicts the median and the green area describes the first and third quartile of monthly notional deposit amounts executed by bank. The dashed line denotes the median number of transactions executed by bank to realize the monthly volumes.

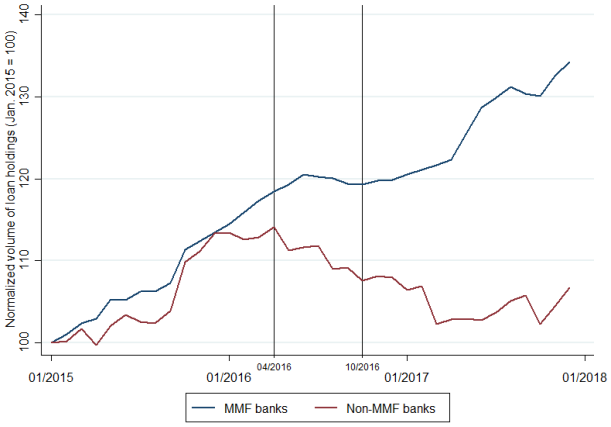
Table A.1
Share of transactions by country of headquarters and bank group (%), pre and post reform

<1 Bank group	MMF banks		Non-MMF banks	
Period	Pre	Post	Pre	Post
Australia	9	7	-	-
Austria	-	-	-	2
Belgium	-	-	9	5
Canada	4	5	-	-
Denmark	1	1	-	-
France	26	25	-	-
Germany	<1	2	57	63
Hong Kong	<1	<1	-	-
Italy	-	-	14	8
Japan	17	18	-	-
Netherlands	17	19	-	-
Spain	1	<1	2	3
Sweden	2	3	-	-
Switzerland	<1	<1	15	16
United Kingdom	18	11	2	3
United States	5	9	-	-

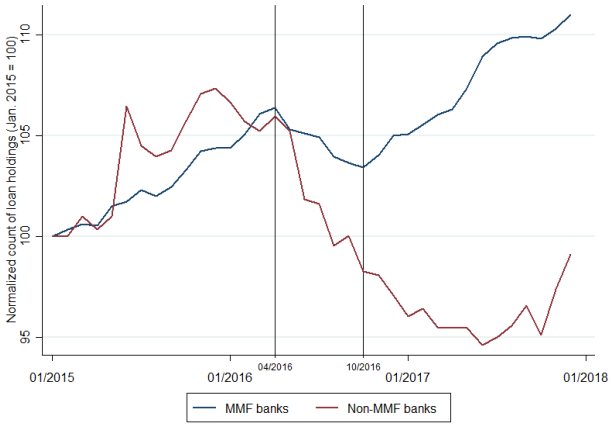
Source:Corporate deposit data, authors' calculations.

Figure A.2
Development of syndicated loan holdings – Dollar-denominated loans

(a) Volume of loan holdings



(b) Count of loan holdings



Notes: Volume and count of syndicated loan holdings are normalized to the beginning of 2015 (=100). US banks excluded.
Source: Dealogic, authors' calculation.

Appendix B Robustness tests

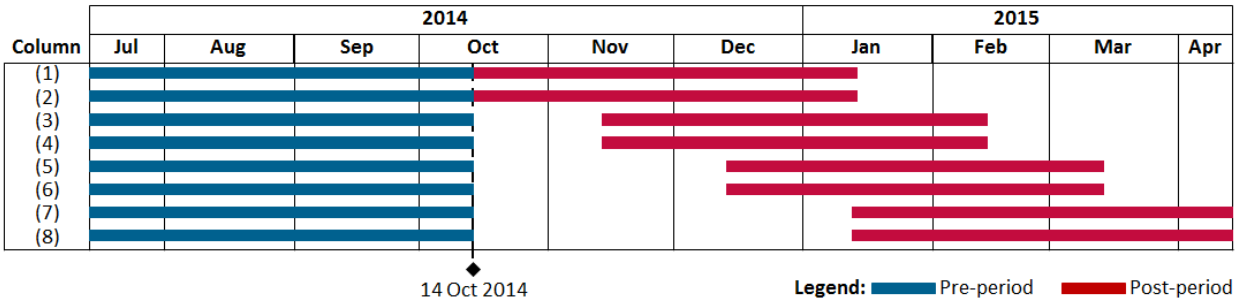
B.1 Anticipation effects

The SEC adopted several amendments to the Rule 2a-7 that governs MMFs in US under the Investment Company Act of 1940 on July 23, 2014. The effective date of the amendments was set to October 14, 2014. Given the short-term nature of the market which the reform targets, large anticipation effects should not occur long before the first compliance date on April 14, 2016. However, Figure 6 hints at an anticipation shortly after the law came into effect. To formally test this anticipation for our treatment and control groups, we run the regression in Equation 2 for different period definitions as specified in Figure B.1. The pre-reform period is defined as the three months before the effective date of the law. We test four different definitions of the post-reform period accounting for potentially delayed effects of the law.

Table B.1 presents the results of testing for a potential effect after the adoption of the law in October 2014. For the post-reform period definitions that include the year-end of 2014, there is either no statistically significant or a small negative effect (columns (1)-(6)). The post-reform period starting mid of January 2015 indicates a small early anticipation effect, which, however, loses statistical significance after controlling for time-invariant bank-specific characteristics. Consequently, we conclude that there is no empirical evidence for an early anticipation effect and that periods around the compliance dates (i.e., the implementation of the reform) capture the reform's effect of interest.

Figure B.1

Anticipation of reform implementation after October 2014 - Period definitions for regressions



Notes: Definition of pre- and post-reform periods around the effective date of the US MMF reform on October 14, 2014, corresponding to the regressions in Table B.1. All periods have a length of three months starting on the 13$^{\text{th}}$ and ending on the 14$^{\text{th}}$ of a month.

B.2 Parallel trends

The validity of results further requires the parallel assumption to be fulfilled prior to the first compliance date on April 14, 2016. The right panel of Figure 6 in the main text already presented a visual summary of the results obtained from estimating the following equation:

$$\begin{aligned} Spread_{ijat} = \alpha_{jt} + (\alpha_i +)\beta_1 \cdot nonMMF_i \\ + \beta_2 \cdot nonMMF_i \cdot pre(6m)_t + \cdots + \beta_6 \cdot nonMMF_i \cdot pre(2m)_t \\ + \beta_7 \cdot nonMMF_i \cdot post(1m)_t + \cdots + \beta_1 2 \cdot nonMMF_i \cdot post(6m)_t \\ + \beta_1 3 \cdot YearEnd_t + \beta_1 4 \cdot YearEnd_t \cdot nonMMF_i + \gamma \cdot \boldsymbol{X}_a + \delta \cdot \boldsymbol{Y}_{i(t-1)} + \epsilon_{ijat} \end{aligned} \tag{10}$$

The post-reform variable is split into monthly indicators starting six months prior to April 14, 2016 until six months after October 14, 2016. The month directly before the first compliance date is left out as reference point for the analysis. The parallel trend is confirmed if all pre-reform period interactions do not exhibit a significant divergence from zero – and especially no positive one – while the post-reform period interactions diverge from zero, in our case in the positive direction. Results in Table B.2 confirm the parallel trend assumption with no or slightly negative divergence from zero before the first compliance date.

B.3 Bank heterogeneity

In all regressions we control for bank-specific characteristics, including size, leverage, and a proxy for business model. However, concerns may remain that bank heterogeneity may be driving our key result on corporate deposit spreads. The main source of heterogeneity that could be driving results relates to bank size. As shown in Table 4, MMF banks are significantly larger than non-MMF banks. In order to rule out the concern that our results could be driven by size, we run the following regression:

Table B.1
Corporate deposit spreads - Anticipation of reform implementation after October 2014

	(1)	(2)	(3)	(4)
Period length:	3months			
Pre-period from:	14/07/2014			
to:	13/10/2014			
Post-period from:	14/10/2014	14/11/2014	14/12/2014	14/01/2015
to:	13/01/2015	13/02/2015	13/03/2015	13/04/2015
$nonMMF_i * post_t$	-0.7637**	-1.2803	0.2759	1.4269
	(0.3728)	(0.8226)	(1.0215)	(1.0618)
$YearEnd$	-1.0325	-1.0044	0.9774	
	(2.8903)	(2.8382)	(0.9628)	
$YearEnd * nonMMF_i$	0.0467	-0.0242	-2.5638*	
	(2.7830)	(2.8878)	(1.2678)	
$Notional_a$	-0.3061	-0.3519	-0.0249	-0.1117
	(0.3957)	(0.4328)	(0.1235)	(0.0823)
$Maturity_a$	-0.0151	-0.0124	0.0230*	0.0296**
	(0.0278)	(0.0322)	(0.0116)	(0.0127)
$Size_{i(t-1year)}$	-10.3824	-4.6349	-0.4894	-0.9873
	(10.0189)	(6.2030)	(4.6474)	(5.4341)
$Leverage_{i(t-1)}$	0.2104	-0.0578	-0.1319	-0.2127
	(0.7089)	(0.2949)	(0.1348)	(0.1423)
$NII_{i(t-1)}$	10.6185	4.7893*	3.4188	2.2926
	(6.5236)	(2.7493)	(2.6848)	(3.1216)
$log(CDS5y)_{i(t-1)}$	0.6879	-0.5092	-1.1760	-0.9230
	(1.6379)	(1.3475)	(1.2023)	(1.5027)
N	3513	3418	3283	3198
R^2	0.2674	0.2609	0.9451	0.9272
Firm-month FE	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓

Notes: OLS regressions for Equation 2. The dependent variable is the deposit spread $Spread_{ijat}$ defined as the deposit interest rate minus USD LIBOR rate of comparable maturity (in basis points), payed by bank i to firm j in auction a at time t. $nonMMF_i$ is a dummy variable equal to 1 if a bank is not directly affected by the reform and $post_t$ a dummy variable equal to 1 in the post MMF reform period. $Notional_a$ stands for the logarithm of the notional deposit amount, $Maturity_a$ for the remaining time (in days) until the funding matures, $Size_{i(t-1year)}$ stands for the logarithm of bank total assets, $Leverage_{i(t-1year)}$ for total assets over equity, and $NII_{i(t-1year)}$ for the share of net interest income of bank's total revenue lagged by one year and $CDS_{i(t-1)}$ for the one-day lag in the logarithm of the bank's 5-year CDS spread. Each column uses a distinct sample according to the pre-reform and post-reform period specifications in the table header. See Figure B.1 for a visual representation of the periods setup. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

$$\begin{aligned} Spread_{ijat} = \alpha_{jt} + (\alpha_i +)\beta_1 \cdot nonMMF_i + \beta_2 \cdot BIG_i + \beta_3 \cdot nonMMF_i \cdot post_t \\ + \beta_4 \cdot BIG_i \cdot post_t + \beta_5 YearEnd_t + \beta_6 YearEnd_t \cdot nonMMF_i \\ + \gamma \cdot \boldsymbol{X}_a + \delta \cdot \boldsymbol{Y}_{i(t-1)} + \epsilon_{ijat} \end{aligned} \tag{11}$$

where BIG_i is equal to 1 if bank size for bank i is above the median. All other variables are as in previous regressions.

As the results in Table B.3 show, we observe no significant effect of bank size post-reform.[30]

[30]Results are robust to defining BIG_i in alternative ways. Similar results obtain using the other measures of bank

Table B.2
Regression on deposit spread - Parallel trend test

	(1)	(2)	(3)	(4)
$nonMMF_i$	2.7587*			
	(1.4982)			
$pre(6m)_t$ * $nonMMF_i$	-2.4666**	0.4769	1.4013	1.3575
	(1.0155)	(0.9588)	(0.9540)	(0.8711)
$pre(5m)_t$ * $nonMMF_i$	-1.2195	-0.0717	0.9168	0.4142
	(1.2309)	(1.0884)	(1.1724)	(1.0574)
$pre(4m)_t$ * $nonMMF_i$	-2.8340*	-3.0692**	-3.3365	-2.2333
	(1.5881)	(1.5101)	(2.0013)	(1.6991)
$pre(3m)_t$ * $nonMMF_i$	-0.2797	-0.9915	-0.2986	-0.5553
	(0.9254)	(0.7846)	(0.7550)	(0.7485)
$pre(2m)_t$ * $nonMMF_i$	-0.5147	-1.4276**	-1.1885	-0.9978
	(0.8896)	(0.6416)	(0.7084)	(0.6436)
$pre(1m)_t$ * $nonMMF_i$		*omitted*		
$post(1m)_t$ * $nonMMF_i$	2.1673	2.5028	2.6904	2.9831*
	(2.8666)	(1.6491)	(1.8347)	(1.5938)
$post(2m)_t$ * $nonMMF_i$	2.9927	3.9230**	3.9131*	4.4032**
	(1.9817)	(1.7882)	(2.0506)	(1.8112)
$post(3m)_t$ * $nonMMF_i$	11.6033**	10.8567**	11.4802**	11.4752**
	(4.4278)	(4.4782)	(4.5906)	(4.9386)
$post(4m)_t$ * $nonMMF_i$	1.1789	3.3362**	3.6241**	2.5900
	(1.5467)	(1.6267)	(1.6497)	(1.6326)
$post(5m)_t$ * $nonMMF_i$	-0.7206	1.4983	2.4033	2.3357
	(1.5687)	(1.3345)	(1.5514)	(1.5083)
$post(6m)_t$ * $nonMMF_i$	-0.8760	1.2303	2.5465**	2.6350*
	(1.2297)	(1.1345)	(1.2516)	(1.3276)
N	8185	8181	7687	6461
R^2	0.4525	0.5191	0.5697	0.7048
Year-end controls	✓	✓	✓	✓
Bank and auction controls			✓	✓
Firm-month FE	✓	✓	✓	✓
Bank FE		✓	✓	✓

Notes: The dependent variable is the deposit spread $Spread_{ijat}$ defined as the deposit interest rate minus USD LIBOR rate of comparable maturity (in basis points), payed by bank i to firm j in auction a at time t. $nonMMF_i$ is a dummy variable equal to 1 if the bank is not directly affected by the MMF reform and $post_t$ a dummy variable equal to 1 in the post MMF reform period. Auction controls include $Notional_a$ (logarithm of the notional deposit amount) and $Maturity_a$ (remaining time – in days – until the funding matures). Bank controls include $Size_{i(t-1year)}$ (logarithm of bank total assets), $Leverage_{i(t-1year)}$ (total assets over equity), $NII_{i(t-1year)}$ (share of net interest income of bank's total revenue), and $CDS_{i(t-1)}$ (logarithm of the bank's 5-year CDS spread). The regression also controls for year end effects by an $YearEnd$ dummy (not shown for presentation purposes). The different pre- and post-reform period dummy variables describe one month each. The number in parentheses counts the months starting in April 13 or October 2016, respectively. Thus pre(2m) describes the period form February 14, 2016 to March 13, 2016. The first month directly before the implementation period (i.e., pre(1m)) has been omitted as reference point. In column (4), we use only a reduced sample of firms that interact at least once with banks from either group of MMF banks and non-MMF banks. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

heterogeneity we already control for in the main body of the paper (e.g. net interest income, leverage).

Our key result that non-MMF banks pay more than MMF banks for dollar corporate deposits post reform remains unchanged.

Table B.3
Bank size cannot explain the results

	(1)	(2)	(3)	(4)	(5)	(6)
$nonMMF_i * post_t$	5.8080*	7.3192**	7.3849**	9.4914***	6.6380*	9.1126***
	(3.3085)	(3.0362)	(3.6377)	(3.4877)	(3.7699)	(3.3487)
$BIG_i * post_t$	-0.6073	-1.4767	0.2501	0.6919	0.1129	0.6649
	(1.7600)	(2.0732)	(2.1873)	(2.3762)	(2.4312)	(2.2888)
N	3654	3654	3626	3626	2971	2971
R^2	0.5195	0.5712	0.5320	0.5770	0.6617	0.7515
Year-end	✓	✓	✓	✓	✓	✓
Bank and auction controls			✓	✓	✓	✓
Firm-month FE	✓	✓	✓	✓	✓	✓
Bank FE		✓		✓		✓

Notes: OLS regressions for Equation 11. The dependent variable is the deposit spread $Spread_{ijat}$ defined as the deposit interest rate minus USD LIBOR rate of comparable maturity (in basis points), payed by bank i to firm j in auction a at time t. $nonMMF_i$ is a dummy variable equal to 1 if a bank is a non-MMF bank and $post_t$ a dummy variable equal to 1 in the post MMF reform period. The bank indicator BIG is equal to 1 for banks with an above median value for log(total assets) and is defined over the entire sample of banks. Auction controls include $Notional_a$ (logarithm of the notional deposit amount) and $Maturity_a$ (remaining time – in days – until the funding matures). Bank controls include $Size_{i(t-1year)}$ (logarithm of bank total assets), $Leverage_{i(t-1year)}$ (total assets over equity), $NII_{i(t-1year)}$ (share of net interest income of bank's total revenue), and $CDS_{i(t-1)}$ (logarithm of the bank's 5-year CDS spread). The regression also controls for year end effects by an $YearEnd$ dummy (not shown for presentation purposes). In columns (5) and (6), we use only a reduced sample of firms that interact at least once with banks from either group of MMF banks and non-MMF banks. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

Appendix C Additional robustness tests

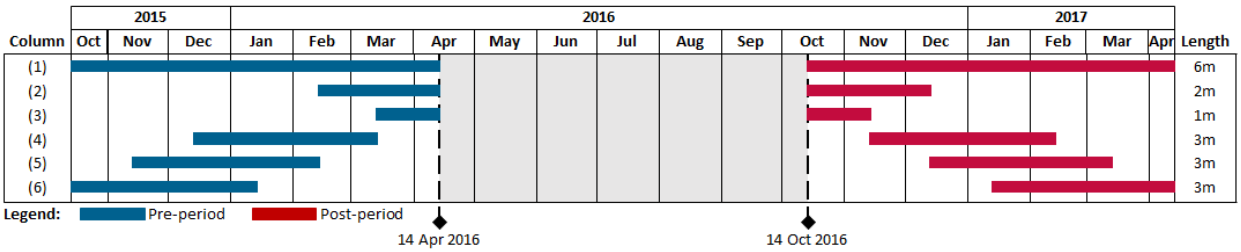
In this appendix, we provide the tables for the robustness checks discussed in the main text and the appendix of the paper. Below we list all robustness checks and the corresponding figures/tables:

Figure/Table	Desciption
Figure C.1	Corporate deposit spreads - Variation of pre- and post-reform periods - Period definitions
Table C.1	Corporate deposit spreads - Variation of pre- and post-reform periods
Figure C.2	Regression on winning bid - Variation of pre-reform and post-reform periods - Period definitions (I/III)
Figure C.3	Regression on winning bid - Variation of pre-reform and post-reform periods - Period definitions (II/III)
Figure C.4	Regression on winning bid - Variation of pre-reform and post-reform periods - Period definitions (III/III)
Table C.2	Regression on winning bid - Variation of pre-reform and post-reform periods (I/III)
Table C.3	Regression on winning bid - Variation of pre-reform and post-reform periods (II/III)
Table C.4	Regression on winning bid - Variation of pre-reform and post-reform periods (III/III)
Figure C.5	Corporate deposit spread - Placebo tests - Period definitions
Table C.5	Corporate deposit spread - Placebo tests
Figure C.6	Winning bid - Placebo tests pre-reform period - Period definitions
Table C.6	Winning bid - Placebo tests pre-reform period
Figure C.7	Winning bid - Placebo tests post-reform period - Period definitions
Table C.7	Winning bid - Placebo tests post-reform period

C.1 Alternative pre- and post-reform periods

Figure C.1

Corporate deposit spreads - Variation of pre- and post-reform periods - Period definitions



Notes: Definition of pre- and post-reform periods around the implementation of the US MMF reform corresponding to the regressions in Table C.1. Period lengths as indicated in the right-hand side column starting on the 13$^{\text{th}}$ and ending on the 14$^{\text{th}}$ of a month.

Table C.1

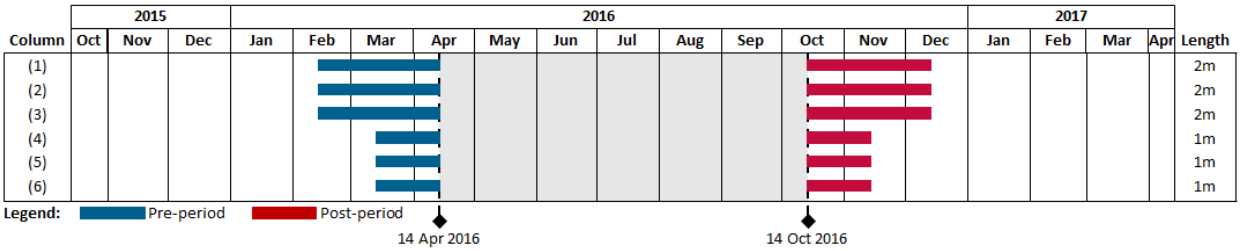
Corporate deposit spreads - Variation of pre- and post-reform periods

	(1)	(2)	(3)	(4)	(5)	(6)
Period length:	6 months	2 months	1 month	3months	3 months	3 months
Pre-period from:	14/10/2015	14/02/2016	14/03/2016	14/12/2015	14/11/2015	14/10/2015
to:	13/04/2016	13/04/2016	13/04/2016	13/03/2016	13/02/2016	13/01/2016
Post-period from:	14/10/2016	14/10/2016	14/10/2016	14/11/2016	14/12/2016	14/01/2017
to:	13/04/2017	13/12/2016	13/11/2016	13/01/2017	13/02/2017	13/04/2017
$nonMMF_i * post_t$	4.6619***	4.1076**	3.6747**	9.1805***	4.8112**	0.9093
	(1.7260)	(1.9620)	(1.7698)	(3.3084)	(2.2811)	(1.2931)
N	7687	2375	1137	3779	3742	4031
R^2	0.5675	0.7525	0.7949	0.5446	0.5386	0.6899
Year-end, bank, and auction controls	✓	✓	✓	✓	✓	✓
Firm-month FE	✓	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓	✓

Notes: OLS regressions for Equation 2. The dependent variable is the deposit spread $Spread_{ijat}$ defined as the deposit interest rate minus USD LIBOR rate of comparable maturity (in basis points), payed by bank i to firm j in auction a at time t. $nonMMF_i$ is a dummy variable equal to 1 if a bank is a non-MMF bank and $post_t$ a dummy variable equal to 1 in the post MMF reform period. Auction controls include $Notional_a$ (logarithm of the notional deposit amount) and $Maturity_a$ (remaining time in days until the funding matures). Bank controls include $Size_{i(t-1year)}$ (logarithm of bank total assets), $Leverage_{i(t-1year)}$ (total assets over equity), $NII_{i(t-1year)}$ (share of net interest income of bank's total revenue), and $CDS_{i(t-1)}$ (logarithm of the bank's 5-year CDS spread). Each column uses a distinct sample according to the pre-reform and post-reform period specifications in the table header. See Figure C.1 for a visual representation of the periods setup. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

Figure C.2

Regression on winning bid - Variation of pre-reform and post-reform periods - Period definitions (I/III)



Notes: Definition of pre- and post-reform periods around the effective date of the US MMF reform on October 14, 2014, corresponding to the regressions in Table C.2. Period lengths as indicated in the right-hand side column starting on the 13th and ending on the 14th of a month.

Table C.2

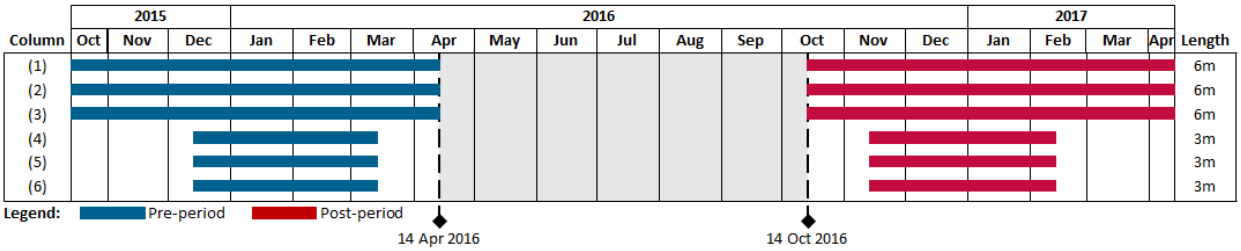
Regression on winning bid - Variation of pre-reform and post-reform periods (I/III)

	(1)	(2)	(3)	(4)	(5)	(6)
Period length:	2 months	2 months	2 months	1 month	1 month	1 month
Pre-period from:		14/02/2016			14/03/2016	
to:		13/04/2016			13/04/2016	
Post-period from:		14/10/2016			14/10/2016	
to:		13/12/2016			13/11/2016	
$nonMMF_i * post_t$	-0.1579***	-0.6796**	0.0400	-0.1637***	-0.8113**	-0.0286
	(0.0541)	(0.2590)	(0.0694)	(0.0471)	(0.3882)	(0.0601)
$nonMMF_i * post_t * newReln_{ij}$	0.2876***	1.0227***	0.2256***	0.3957***	0.8329*	0.3858***
	(0.0553)	(0.2963)	(0.0477)	(0.0475)	(0.4306)	(0.0445)
$nonMMF_i * stable_j * post_t$		0.5472*			0.6993*	
		(0.2798)			(0.4065)	
$nonMMF_i * stable_j * post_t * newReln_{ij}$		-0.7823**			-0.4480	
		(0.3007)			(0.4353)	
$nonMMF_i * big_j * post_t$			-0.2211**			-0.1558**
			(0.0921)			(0.0742)
$nonMMF_i * big_j * post_t * newReln_{ij}$			0.0630			(.)
			(0.0675)			(.)
N	3737	3737	3737	1896	1896	1896
R^2	0.6881	0.6900	0.6888	0.6787	0.6807	0.6798
Bank and auction controls	✓	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓	✓
Firm-month FE	✓	✓	✓	✓	✓	✓

Notes: OLS regressions for Equation 4. The dependent variable is $WinningBid_{ijabt}$ defined as a dummy variable that equals 1 if bank i wins the deposit offered by firm j in auction a with bid b at time t. $nonMMF_i$ is a dummy variable equal to 1 if a bank is a non-MMF bank and $post_t$ a dummy variable equal to 1 in the post-reform period. $newReln_{ij}$ is a dummy variable equal to 1 if the first transaction (determined considering all currencies) between a bank i and firm j takes place after April 2016. $stable_j$ is equal to one if firm j offering the deposit is a stable funding provider according to the aforementioned definition. big_j is equal to 1 if the average transactions size of firm j is larger or equal to the median of average transaction sizes of all other firms. Auction controls include the highest quote in an auction, the logarithm of the notional deposit amount and the remaining time (in days) until the funding matures; bank controls include $Size_{i(t-1year)}$ (logarithm of bank total assets), $Leverage_{i(t-1year)}$ (total assets over equity), $NII_{i(t-1year)}$ (share of net interest income of bank's total revenue), and $CDS_{i(t-1)}$ (logarithm of the bank's 5-year CDS spread). Each column uses a distinct sample according to the pre-reform and post-reform period specifications in the table header. See Figure C.2 for a visual representation of the periods setup. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

Figure C.3

Regression on winning bid - Variation of pre-reform and post-reform periods - Period definitions (II/III)



Notes: Definition of pre- and post-reform periods around the effective date of the US MMF reform on October 14, 2014, corresponding to the regressions in Table C.3. Period lengths as indicated in the right-hand side column starting on 13th and ending on the 14th of a month.

Table C.3

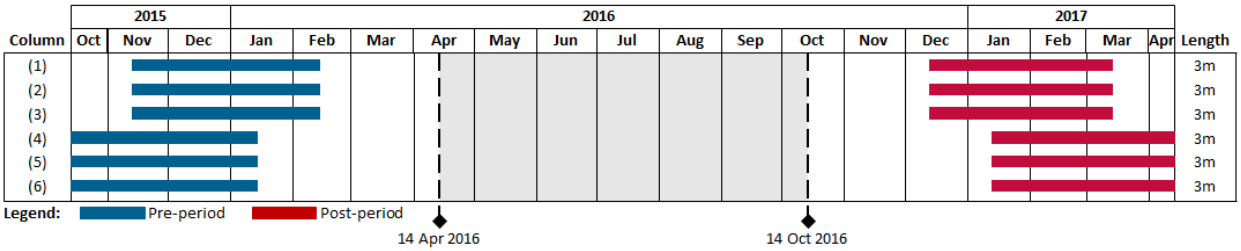
Regression on winning bid - Variation of pre-reform and post-reform periods (II/III)

	(1)	(2)	(3)	(4)	(5)	(6)
Period length:	6 months	6 months	6 months	3 months	3 months	3 months
Pre-period from:		14/10/2015			14/12/2015	
to:		13/04/2016			13/03/2016	
Post-period from:		14/10/2016			14/11/2016	
to:		13/04/2017			13/01/2017	
$nonMMF_i * post_t$	-0.0915**	-0.0660	0.0042	-0.0891**	0.0546	0.1736**
	(0.0399)	(0.0815)	(0.0674)	(0.0362)	(0.0898)	(0.0827)
$nonMMF_i * post_t * newReln_{ij}$	0.0921	0.3503***	-0.1218	0.0668	0.3731***	0.1069
	(0.0791)	(0.0934)	(0.2255)	(0.0451)	(0.1104)	(0.1374)
$nonMMF_i * stable_j * post_t$		-0.0230			-0.1627*	
		(0.0847)			(0.0904)	
$nonMMF_i * stable_j * post_t * newReln_{ij}$		-0.2886**			-0.3911***	
		(0.1109)			(0.1121)	
$nonMMF_i * big_j * post_t$			-0.1090			-0.2973***
			(0.0775)			(0.0826)
$nonMMF_i * big_j * post_t * newReln_{ij}$			0.2467			-0.0549
			(0.2155)			(0.1288)
N	12338	12338	12338	5801	5801	5801
R^2	0.6359	0.6363	0.6379	0.6466	0.6486	0.6482
Bank and auction controls	✓	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓	✓
Firm-month FE	✓	✓	✓	✓	✓	✓

Notes: OLS regressions for Equation 4. The dependent variable is $WinningBid_{ijabt}$ defined as a dummy variable that equals 1 if bank i wins the deposit offered by firm j in auction a with bid b at time t. $nonMMF_i$ is a dummy variable equal to 1 if a bank is a non-MMF bank and $post_t$ a dummy variable equal to 1 in the post-reform period. $newReln_{ij}$ is a dummy variable equal to 1 if the first transaction (determined considering all currencies) between a bank i and firm j takes place after April 2016. $stable_j$ is equal to one if firm j offering the deposit is a stable funding provider according to the aforementioned definition. big_j is equal to 1 if the average transactions size of firm j is larger or equal to the median of average transaction sizes of all other firms. Auction controls include the highest quote in an auction, the logarithm of the notional deposit amount and the remaining time (in days) until the funding matures; bank controls include $Size_{i(t-1year)}$ (logarithm of bank total assets), $Leverage_{i(t-1year)}$ (total assets over equity), $NII_{i(t-1year)}$ (share of net interest income of bank's total revenue), and $CDS_{i(t-1)}$ (logarithm of the bank's 5-year CDS spread). Each column uses a distinct sample according to the pre-reform and post-reform period specifications in the table header. See Figure C.3 for a visual representation of the periods setup. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

Figure C.4

Regression on winning bid - Variation of pre-reform and post-reform periods - Period definitions (III/III)



Notes: Definition of pre- and post-reform periods around the effective date of the US MMF reform on October 14, 2014, corresponding to the regressions in Table C.4. Period lengths as indicated in the right-hand side column starting on the 13th and ending on the 14th of a month.

Table C.4

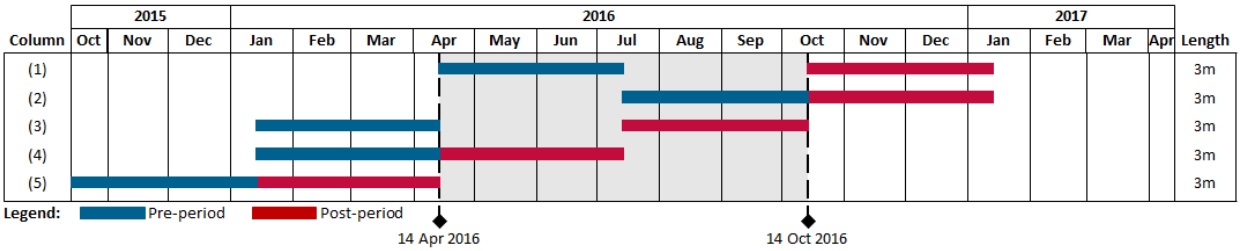
Regression on winning bid - Variation of pre-reform and post-reform periods (III/III)

	(1)	(2)	(3)	(4)	(5)	(6)
Period length:	3 months	3 months	3 months	3 months	3 months	3 months
Pre-period from:		14/11/2015			14/10/2015	
to:		13/02/2016			13/01/2016	
Post-period from:		14/12/2016			14/01/2017	
to:		13/02/2017			13/04/2017	
$nonMMF_i * post_t$	-0.0329	0.0015	0.1273	-0.0613	-0.0683	-0.0657
	(0.0315)	(0.0679)	(0.0838)	(0.0602)	(0.1035)	(0.1028)
$nonMMF_i * post_t * newReln_{ij}$	-0.0041	0.2223**	0.0624	-0.0252	0.2162*	-0.0138
	(0.0831)	(0.1040)	(0.1656)	(0.1107)	(0.1242)	(0.2156)
$nonMMF_i * stable_j * post_t$		-0.0308			0.0255	
		(0.0709)			(0.1106)	
$nonMMF_i * stable_j * post_t * newReln_{ij}$		-0.2713**			-0.2708*	
		(0.1301)			(0.1523)	
$nonMMF_i * big_j * post_t$			-0.1733*			0.0052
			(0.0914)			(0.1197)
$nonMMF_i * big_j * post_t * newReln_{ij}$			-0.1003			-0.0097
			(0.1520)			(0.1964)
N	6011	6011	6011	6676	6676	6676
R^2	0.6328	0.6332	0.6345	0.6070	0.6076	0.6084
Bank and auction controls	✓	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓	✓
Firm-month FE	✓	✓	✓	✓	✓	✓

Notes: OLS regressions for Equation 4. The dependent variable is $WinningBid_{ijabt}$ defined as a dummy variable that equals 1 if bank i wins the deposit offered by firm j in auction a with bid b at time t. $nonMMF_i$ is a dummy variable equal to 1 if a bank is a non-MMF bank and $post_t$ a dummy variable equal to 1 in the post-reform period. $newReln_{ij}$ is a dummy variable equal to 1 if the first transaction (determined considering all currencies) between a bank i and firm j takes place after April 2016. $stable_j$ is equal to one if firm j offering the deposit is a stable funding provider according to the aforementioned definition. big_j is equal to 1 if the average transactions size of firm j is larger or equal to the median of average transaction sizes of all other firms. Auction controls include the highest quote in an auction, the logarithm of the notional deposit amount and the remaining time (in days) until the funding matures; bank controls include $Size_{i(t-1year)}$ (logarithm of bank total assets), $Leverage_{i(t-1year)}$ (total assets over equity), $NII_{i(t-1year)}$ (share of net interest income of bank's total revenue), and $CDS_{i(t-1)}$ (logarithm of the bank's 5-year CDS spread). Each column uses a distinct sample according to the pre-reform and post-reform period specifications in the table header. See Figure C.4 for a visual representation of the periods setup. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

C.2 Placebo tests

Figure C.5
Corporate deposit spread - Placebo tests - Period definitions



Notes: Definition of pre- and post-reform periods around the effective date of the US MMF reform on October 14, 2014, corresponding to the regressions in Table C.5. Period lengths as indicated in the right-hand side column starting on 13th and ending on the 14th of a month.

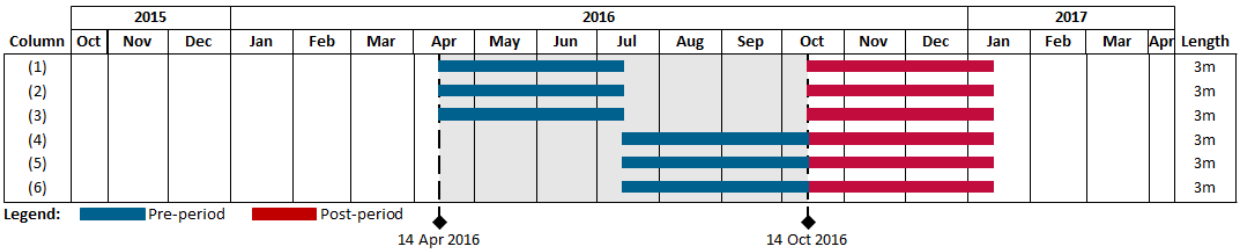
Table C.5
Corporate deposit spread - Placebo tests

	(1)	(2)	(3)	(4)	(5)
Period length:	3months	3months	3months	3months	3months
Pre-period from:	14/04/2016	14/07/2016	14/01/2016	14/01/2016	14/10/2015
to:	13/07/2016	13/10/2016	13/04/2016	13/04/2016	13/01/2016
Post-period from:	14/10/2016	14/10/2016	14/04/2016	14/07/2016	14/01/2016
to:	13/01/2017	13/01/2017	13/07/2016	13/10/2016	13/04/2016
$nonMMF_i * post_t$	7.1700***	5.2454***	0.1596	2.1758	1.3755
	(2.6023)	(1.5000)	(0.6566)	(1.4022)	(0.9999)
N	3811	4126	3707	3995	3642
R^2	0.5835	0.5880	0.7780	0.7320	0.7461
Year-end, bank, and auction controls	✓	✓	✓	✓	✓
Firm-month FE	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓

Notes: OLS regressions for Equation 2. The dependent variable is the deposit spread $Spread_{ijt}$ defined as deposit interest rate minus USD LIBOR rate of comparable maturity in basis points. $nonMMF_i$ is a dummy variable equal to 1 if a bank is a non-MMF bank and $post_t$ a dummy variable equal to 1 in the post-reform period. Auction controls include $Notional_a$ (logarithm of the notional deposit amount) and $Maturity_a$ (remaining time in days until the funding matures). Bank controls include $Size_{i(t-1year)}$ (logarithm of bank total assets), $Leverage_{i(t-1year)}$ (total assets over equity), $NII_{i(t-1year)}$ (share of net interest income of bank's total revenue), and $CDS_{i(t-1)}$ (logarithm of the bank's 5-year CDS spread). Each column uses a distinct sample according to the pre-reform and post-reform period specifications in the table header. Each column uses a distinct sample according to the pre-reform and post-reform period specifications in the table header. See Figure C.5 for a visual representation of the periods setup. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

Figure C.6

Winning bid - Placebo tests pre-reform period - Period definitions



Notes: Definition of pre- and post-reform periods around the effective date of the US MMF reform on October 14, 2014, corresponding to the regressions in Table C.6. Period lengths as indicated in the right-hand side column starting on 13th and ending on the 14th of a month.

Table C.6

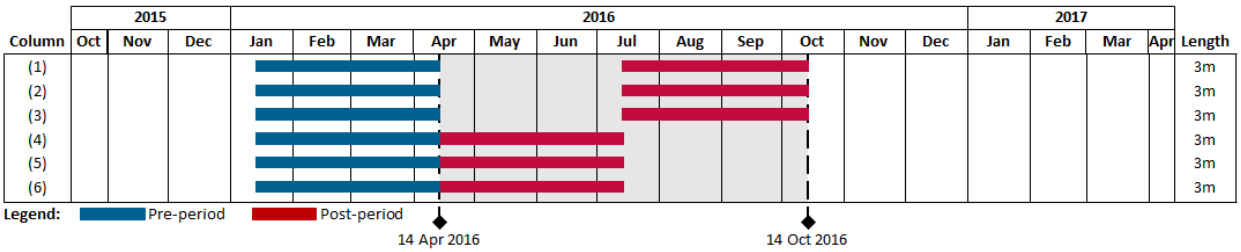
Winning bid - Placebo tests pre-reform period

	(1)	(2)	(3)	(4)	(5)	(6)
Period length:	3 months	3 months	3 months	3 months	3 months	3 months
Pre-period from:		14/04/2016			14/07/2016	
to:		13/07/2016			13/10/2016	
Post-period from:			14/10/2016			
to:			13/01/2017			
$nonMMF_i * post_t$	-0.1122**	-0.2682*	0.0226	-0.0614*	-0.1859	0.0378
	(0.0441)	(0.1406)	(0.0458)	(0.0311)	(0.1373)	(0.0498)
$nonMMF_i * post_t * newReln_{ij}$	0.1811***	0.5957**	0.1914***	0.2161***	0.6317**	0.2029***
	(0.0424)	(0.2305)	(0.0285)	(0.0411)	(0.2429)	(0.0254)
$nonMMF_i * stable_j * post_t$		0.1768			0.1366	
		(0.1422)			(0.1351)	
$nonMMF_i * stable_j * post_t * newReln_{ij}$		-0.4505*			-0.4481*	
		(0.2266)			(0.2433)	
$nonMMF_i * big_j * post_t$			-0.1581**			-0.1118*
			(0.0598)			(0.0639)
$nonMMF_i * big_j * post_t * newReln_{ij}$			-0.0078			0.0178
			(0.0542)			(0.0520)
N	5576	5576	5576	5896	5896	5896
R^2	0.6726	0.6734	0.6730	0.6476	0.6483	0.6478
Bank and auction controls	✓	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓	✓
Firm-month FE	✓	✓	✓	✓	✓	✓

Notes: OLS regressions for Equation 4. The dependent variable is $WinningBid_{ijabt}$ defined as a dummy variable that equals 1 if bank i wins the deposit offered by firm j in auction a with bid b at time t. $nonMMF_i$ is a dummy variable equal to 1, if a bank is a non-MMF bank and $post_t$ a dummy variable equal to 1 in the post-reform period. $newReln_{ij}$ is a dummy variable equal to 1 if the first transaction (determined considering all currencies) between a bank i and firm j takes place after April 2016. $stable_j$ is equal to one if firm j offering the deposit is a stable funding provider according to the aforementioned definition. big_j is equal to 1 if the average transactions size of firm j is larger or equal to the median of average transaction sizes of all other firms. Auction controls include the highest quote in an auction, the logarithm of the notional deposit amount and the remaining time (in days) until the funding matures; bank controls include $Size_{i(t-1year)}$ (logarithm of bank total assets), $Leverage_{i(t-1year)}$ (total assets over equity), $NII_{i(t-1year)}$ (share of net interest income of bank's total revenue), and $CDS_{i(t-1)}$ (logarithm of the bank's 5-year CDS spread). Each column uses a distinct sample according to the pre-reform and post-reform period specifications in the table header. See Figure C.6 for a visual representation of the periods setup. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

Figure C.7

Winning bid - Placebo tests post-reform period - Period definitions



Notes: Definition of pre- and post-reform periods around the effective date of the US MMF reform on October 14, 2014, corresponding to the regressions in Table C.7. Period lengths as indicated in the right-hand side column starting on the 13th and ending on the 14th of a month.

Table C.7

Winning bid - Placebo tests post-reform period

	(1)	(2)	(3)	(4)	(5)	(6)
Period length:	3 months	3 months	3 months	3 months	3 months	3 months
Pre-period from:			14/01/2016			
to:			13/04/2016			
Post-period from:		14/04/2016			14/07/2016	
to:		13/07/2016			13/10/2016	
$nonMMF_i * post_t$	-0.0114	0.0705	0.1291*	-0.0485**	0.0184	0.0825
	(0.0194)	(0.0474)	(0.0715)	(0.0198)	(0.0470)	(0.1105)
$nonMMF_i * post_t * newReln_{ij}$	0.0597**	1.1618***	1.1662***	0.0409*	-1.8109***	0.0244
	(0.0249)	(0.1820)	(0.1798)	(0.0208)	(0.0533)	(0.0208)
$nonMMF_i * stable_j * post_t$		-0.1045*			-0.0866	
		(0.0538)			(0.0589)	
$nonMMF_i * stable_j * post_t * newReln_{ij}$		-1.1330***			1.8710***	
		(0.1720)			(0.0688)	
$nonMMF_i * big_j * post_t$			-0.1487**			-0.1484
			(0.0695)			(0.1188)
$nonMMF_i * big_j * post_t * newReln_{ij}$			-1.1656***			(.)
			(0.1680)			(.)
N	5931	5931	5931	6251	6251	6251
R^2	0.6989	0.7001	0.7012	0.6738	0.6754	0.6750
Bank and auction controls	✓	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓	✓
Firm-month FE	✓	✓	✓	✓	✓	✓

Notes: OLS regressions for Equation 4. The dependent variable is $WinningBid_{ijabt}$ defined as a dummy variable that equals 1 if bank i wins the deposit offered by firm j in auction a with bid b at time t. $nonMMF_i$ is a dummy variable equal to 1 if a bank is a non-MMF bank and $post_t$ a dummy variable equal to 1 in the post-reform period. $newReln_{ij}$ is a dummy variable equal to 1 if the first transaction (determined considering all currencies) between a bank i and firm j takes place after April 2016. $stable_j$ is equal to one if firm j offering the deposit is a stable funding provider according to the aforementioned definition. big_j is equal to 1 if the average transactions size of firm j is larger or equal to the median of average transaction sizes of all other firms. Auction controls include the highest quote in an auction, the logarithm of the notional deposit amount and the remaining time (in days) until the funding matures; bank controls include $Size_{i(t-1year)}$ (logarithm of bank total assets), $Leverage_{i(t-1year)}$ (total assets over equity), $NII_{i(t-1year)}$ (share of net interest income of bank's total revenue), and $CDS_{i(t-1)}$ (logarithm of the bank's 5-year CDS spread). Each column uses a distinct sample according to the pre-reform and post-reform period specifications in the table header. See Figure C.7 for a visual representation of the periods setup. Standard errors are clustered at the bank level and given in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels.

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