Reciprocal Lending Relationships in Shadow Banking *

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This Version: January 2018
First Draft: July 2017

Abstract

As key lenders in the shadow banking sector, prime money market funds (MMFs) provide funding for banks through various instruments, with maturities up to one year. Post-crisis regulations apply stricter liquidity rules to both MMFs and banks, likely generating contradictory effects, as MMFs are encouraged to do more overnight lending and banks to borrow longer-term. Using a novel dataset, I find that MMFs and banks seem to resolve this dilemma by developing a "bundling" strategy across multiple funding markets. In particular, MMFs substantially increase their investments in long-term debt issued by banks that have recently accommodated MMFs' overnight investment needs, and charge significantly lower rates on those long-term debt issued by accommodative banks. Such cross-market reciprocal relationships are robust after controlling for bank credit risks and traditional relationship measures, and are stronger between MMFs and foreign banks, who depend on MMFs for funding more than U.S. banks do.

Keywords: Relationship lending, money market funds, liquidity, regulation

JEL Codes: G20, G18, G40

*The views expressed herein are those of the author and do not necessarily reflect those of the Federal Reserve Board or its staff. For helpful comments, I would like to thank Jack Bao, Burcu Duygan-Bump, Seth Carpenter, Sergey Chernenko, Joshua Gallin, Marcin Kacperczyk, Elizabeth Klee, Congyu Liu, Jose A Lopez, John McGowan, Ralf Meisenzahl, Stefan Nagel, Amiyatosh Purnanandam, Shane Sherlund, Larry Wall, seminar participants at the Federal Reserve Board, Shanghai Jiao Tong University, and Shanghai Advanced Institute of Finance (SAIF), and conference participants at the 2018 Columbia/TCH Conference on Optimal Bank Liquidity Regulation, 2018 MFA, 2018 Northeastern University Finance Conference, and 2018 SFS Cavalcade. All remaining errors are mine. Contact: yi.li@frb.gov.

1 Introduction

As key funding providers in the shadow banking sector, prime money market funds (MMFs) in U.S. had about $2 trillion of assets under management as of October 2015, two-thirds of which were lending contracts with banks that are rather illiquid in the secondary market. Disruptions in funding markets between MMFs and banks, should they occur, could lead to severe deterioration in banks' liquidity conditions and pose systemic risks to broader financial markets.[1]

However, little is known about the lending relationships between MMFs and banks, especially in the post-crisis period, when new regulations apply stricter liquidity rules on both MMFs and banks. While these new regulations are designed to independently reduce the liquidity risks of MMFs and banks, a simultaneous implementation of them will generate inevitable tensions in the relationship between the lender (i.e., MMF) and the borrower (i.e., bank), as a lending contract that improves one side's liquidity condition is generally at the cost of the other side.

To understand these novel post-crisis dynamics, it is important to note that the funding markets between MMFs and banks comprise a large set of financial instruments with various maturities, ranging from overnight to about one year.[2] While these funding instruments are all "short-term" in the traditional sense, their liquidity implications vary significantly for market participants.

[1]For examples, see Covitz, Liang, and Suarez (2013) and Duygan-Bump, Parkinson, Rosengren, Suarez, and Willen (2013) for MMF runs in the asset-backed commercial paper (ABCP) market in 2007, and how the runs played a central role in transforming concerns about the credit quality of mortgage-related assets into a global financial crisis. Also see Copeland, Martin, and Walker (2014) for MMF runs in the tri-party repo market during the financial crisis. In addition, MMFs themselves are susceptible to investor runs. In September 2008, the Reserve Primary Fund "broke the buck" because of its holdings of some Lehman assets. Worried investors pulled their money out of the fund, which saw its assets decline by two thirds in one day and was forced to liquidate its portfolios. Such panic triggered a large industry-wide exodus, even though many MMFs didn't hold any Lehman securities.

[2]Examples of unsecured lending instruments between MMFs and banks include Eurodollar time deposits that mature mostly overnight, financial commercial paper (CP) that matures mostly within 30 days, and certificates of deposits (CDs) with maturities that can extend over one year. Examples of secured (or, collateralized) lending instruments include repurchase agreements (repos) that may last from 1 to 30 days (mostly overnight) and asset-backed commercial paper (ABCP).

Post-crisis regulations in general aim at limiting financial institutions' liquidity risks.[3] Specifically, post-crisis regulations on MMFs (i.e., the 2010 SEC reforms) discourage MMFs from investing in long-term unsecured debt, like certificates of deposits (CDs), and motivate funds to engage in more overnight lending. On the other hand, regulations on banks (e.g., the Basel III regulations regarding Liquidity Coverage Ratio, or LCR) promote stable long-term funding and implicitly punish overnight borrowings that can entail significant rollover risks. Combined, these new liquidity regulations on MMFs and banks generate unbalanced supply and demand in both the overnight and long-term funding markets between them.

To resolve this dilemma of having MMFs and banks leaning toward opposite ends of the maturity spectrum, both parties may have some incentives to develop a mutually beneficial relationship and trade with each other in a reciprocal manner. On the borrowing side, banks may be willing to tolerate some overnight borrowing as a "means to an end" in exchange for long-term funding from MMFs. On the lending side, MMFs may be willing to provide some long-term funding in exchange for convenient access to overnight investments. Such "bundling" arrangements, if they exist, suggest that trading decisions across multiple funding markets between MMFs and banks are made collectively. A MMF and a bank may negotiate "a suite of contracts" consisting of various funding instruments, especially on the two ends of the maturity spectrum.

Two important funding markets between MMFs and banks are of special interests in this paper: the Eurodollar time deposit market and the CD market, with time deposits on the very short-term end and CDs on the very long-term end of the maturity spectrum between MMFs and banks.[4]

Taking advantage of a novel dataset, I confirm the existence of a "bundling" strategy across funding markets between MMFs and banks, and show that their reciprocal lending

[3]For instance, the SEC adopted the MMF reforms in 2010, which require MMFs to improve their liquidity levels and shorten portfolio maturities. On the other hand, intended to strengthen the liquidity positions of banks, the liquidity coverage ratio (LCR) started to be regulated and measured in 2011, incentivizing banks to have stable funding with maturities greater than 30 days.

[4]Note that I also perform a battery of robustness tests using alternative definitions of "short-term" securities and "long-term" securities between MMFs and banks.

relationships are reflected both in funding amount and in funding costs, and are especially strong for foreign banks, who rely on MMFs for stable dollar funding more than domestic banks do. My main results are as follows.

First, I test whether a bank's recent borrowing from a MMF in the overnight market is positively associated with an increase in long-term funding contracts between the bank and the fund. Specifically, I construct a dataset consisting of MMF–bank pairs at monthly frequencies and regress the quarterly change in long-term debt (i.e. CDs with maturity over one month) on the lagged overnight debt dummy variable, which equals 1 if the bank has accommodated the MMF at least once in the time deposit market in the past quarter, and zero otherwise, while controlling for traditional measures of relationship strength and relative importance, as well as other MMF characteristics.[5]

Regression results show that there is significant bundling across CD and time deposit markets.[6] In particular, if a bank has accommodated a MMF at least once in the time deposit market over the past quarter, the outstanding amount of long-term CDs between the two increases by about $12 million.

Foreign banks rely on MMFs for long-term funding much more than domestic banks do, as foreign banks have limited access to alternative sources of dollar funding, such as retail deposits.[7] Therefore, the bundling level between MMFs and foreign banks may differ from that of MMFs and domestic banks. Consistent with this hypothesis, I find clear evidence that MMFs are more likely to engage in reciprocal lending with foreign banks than with domestic banks. Specifically, a foreign bank's accommodation in the time deposit market is associated with a $13 million increase in CD funding from the MMF, while a domestic

[5]Fund fixed effect, bank fixed effect and year-month fixed effect are all controlled.

[6]For robustness, I also use alternative dependent variables and alternative explanatory variables. For instance, the baseline model defines the dependent variable as the change in CDs with maturities over 30 days, I further restrict the definition to CDs with maturities over 60 days, as well as expanding the definition to all direct debt with maturities over 30 days. In both settings, the "bundling" results remain strong and robust. In addition, I use lagged time deposit transaction amount, rather than the dummy, as the explanatory variable and obtain consistent results.

[7]For detailed background information about foreign banks' dollar funding needs from U.S. MMFs, see Section 2.1. For papers on this subject, see Ivashina, Scharfstein, and Stein (2015); and Correa, Sapriza, and Zlate (2013).

bank's accommodation in the time deposit market is associated with only $4 million increase in CD funding from the MMF.

To focus on the lending relationships of major market participants, I construct a monthly dataset of all possible pairs between the top 50 MMFs and top 50 banks (2,500 per month) and conduct further analyses on bundling with this subsample.[8] I find that reciprocal lending between top MMFs and top banks is robust and much larger in amount than that in the baseline sample. In particular, if a top bank accommodates a top MMF at least once in the time deposit market over the past quarter, the outstanding amount of long-term CDs between the two increases by about $36 million. Again, such bundling effect is stronger for foreign banks.

MMFs usually find it more difficult to find a repository for their overnight cash on quarter-ends, when some borrowers reduce their overnight borrowing from MMFs for window dressing purposes.[9] Consequently, it is natural to hypothesize that if a bank accommodates a MMF's investment need in the overnight market at a quarter-end, the reciprocal effects in terms of increasing long-term lending should be stronger than a regular month-end (i.e. non-quarter-end) accommodation.

Such a quarter-end effect does exist. In fact, accommodative overnight borrowing at a regular month-end is associated with $32 million more long-term funding, while accommodative borrowing at a quarter-end is associated with $39 million more long-term funding. This quarter-end effect is greater in magnitude and more significant for foreign banks, who are in general more reluctant to borrow overnight debt on quarter-ends.

During the European sovereign debt crisis starting from mid-2011, MMFs sharply reduced their lending amount to European banks.[10] To evaluate the strength of reciprocal lending under market stress, I further include a crisis dummy and its interaction term with the

[8] Transactions within this 50×50 network comprise 81% of the whole funding markets between prime MMFs and banks.

[9] See Munyan (2015) for the quarter-end effect in the tri-party repo market between MMFs and banks.

[10] For papers on this event, see Chernenko and Sunderam (2014); and Ivashina, Scharfstein, and Stein (2015).

time deposit dummy as explanatory variables. Regression results show that while MMFs in general reduced their long-term funding to foreign banks during the crisis, the reciprocal lending relationship remained strong and stable.[11]

Some alternative theories other than reciprocal relationship could potentially account for my findings on bundling. For example, what if MMFs' investment decisions in all markets are based on banks' credit risk levels? In other words, what if MMFs invest in safe banks and withdraw from relatively risky banks across all markets? To rule out this alternative explanation, I use banks' credit default swap (CDS) spreads as proxies for their credit risks, and include CDS spread and its interaction with the time deposit dummy as additional explanatory variables. After controlling for banks' credit risks, the bundling result is still strong and significant, only slightly smaller in magnitude compared to the baseline model.

To address the concern that other time-varying bank characteristics (in addition to credit risks) may contribute to bundling across markets, I control for the bank×year-month two-way fixed effects.[12] The results on bundling are basically unchanged.

Another potential theory is that the bundling relationship is driven by some intrinsic characteristics of the MMF-bank pairs. For example, the MMF and the bank may share the same ultimate parent or same dealer, or have headquarters close to each other. To address this concern, I further control for the bank×fund fixed effects. The bundling results are even stronger after controlling for these two-way fixed effects.

Lastly but importantly, I explore whether MMFs offer any benefits in terms of lower long-term funding costs, as an extra reward to banks' accommodative transactions in the overnight market. Results show that recent accommodations in the time deposit market are associated with a significant reduction in the funding rates of long-term CDs, controlling for CD characteristics that may affect rates.

[11] To address the opposite concern that the results of reciprocal lending are driven by the crisis period, I also use a subsample excluding the European debt crisis period to repeat all major tests. Results from this robustness check are similar to those obtained from the full sample.

[12] Note that in the baseline model, I already control for fund fixed effects, bank fixed effects, and year-month fixed effects.

Interestingly, reciprocal funding rates on long-term CDs are only offered to accommodative foreign banks, but not to accommodative domestic banks. This finding is consistent with the results on funding amount, and suggests that the reciprocal relationship between MMFs and foreign banks is stronger than that of MMFs and domestic banks, and is not only reflected in the amount of long-term funding, but in the costs of funding as well. All results on funding costs are robust after controlling for bank credit risks and two-way fixed effects (either bank×fund or bank×year-month), and not affected by the European sovereign debt crisis.

To the best of my knowledge, this paper is the first to differentiate between long-term and short-term funding markets between MMFs and banks, and the first to document any reciprocal "bundling" of contracts across these markets. This paper unveils a novel yet robust cross-market synergy between MMFs and banks, who are both under regulation pressure and seek to develop mutually beneficial relationships.

This paper contributes to several strands of literature. First, it provides a completely new perspective on lending behaviors of MMFs in the shadow banking sector.[13] Chernenko and Sunderam (2014) document frictions in MMF lending during the European sovereign debt crisis, when large outflows from MMFs generate spillover effects on non-European borrowers. Hu, Pan, and Wang (2015) and Han and Nikolaou (2016) study MMFs' lending behaviors in the tri-party repo market. However, existing research on MMFs' lending behavior either lumps all of their lending contracts together or focuses on one specific market, while not recognizing the substantial heterogeneity of these markets in terms of relative desirability and bargaining power. The focus of my paper is to study how MMFs coordinate with banks, their most important borrowers, to deal with such heterogeneity and conduct bundling across multiple funding markets for the benefit of each other.

Second, it complements the literature on the crucial role of U.S. MMFs in funding global

[13]Most papers on MMFs focus on run-like behaviors of MMF investors and fund managers' responses during crises. For examples, see Kacperczyk and Schnabl (2013); Duygan-Bump, Parkinson, Rosengren, Suarez, and Willen (2013); McCabe (2010); Schmidt, Timmermann, and Wermers (2016); Strahan and Tanyeri (2015); and Gallagher, Schmidt, Timmermann, and Wermers (2015).

banks. Ivashina, Scharfstein, and Stein (2015) find that when U.S. MMFs sharply reduced their lending to European banks during the European sovereign crisis, European banks that were more reliant on MMFs experienced larger declines in their outstanding dollar loans. In a similar vein, Correa, Sapriza, and Zlate (2013) find that U.S. branches of European banks also reduced lending to U.S. entities. In this paper, I document that the reciprocal lending relationship between U.S. MMFs and foreign banks is significantly stronger than that between U.S. MMFs and U.S. banks, driven by foreign banks' greater reliance on U.S. MMFs for dollar funding. Notably, such a strong relationship is not weakened during the European debt crisis.

Third, this paper adds to the general literature on relationship lending. The vast majority of existing literature on relationship lending studies banks' relationship lending to firms in the loan market.[14] This paper, however, focuses on how relationships play a role on the liability side of banks' balance sheets, which is as important as the asset side (i.e. loans to firms) and proven to be vulnerable to significant rollover risks by the 2007–2008 financial crisis.[15]

Finally, my study contributes to the emerging literature on the unintended consequences of post-crisis regulations. Acharya (2012) provides an overview of the Basel III regulations on banks, including its intentions and unintended consequences. Allen, Chan, Milne, and Thomas (2012) point out the difficulty for the entire financial services industry to adapt to the new Basel rules on banks. Munyan (2015) and Allahrakha, Cetina, and Munyan (2016) document the effects of bank regulations on the tri-party repo market. My paper, however, focuses on the contradictory nature of the post-crisis regulations on banks and MMFs, and study the novel cross-market reciprocal relationships that subsequently arise.

[14]For a few examples, see Berger and Udell (1995); Boot and Thakor (2000); and Ivashina and Kovner (2011). For surveys of the literature on relationship lending by banks, see Boot (2000) and Elyasiani and Goldberg (2004).

[15]In the aftermath of the crisis, more research has been done on banks' wholesale funding sources, for examples, see Demirgüç-Kunt and Huizinga (2010); López-Espinosa, Moreno, Rubia, and Valderrama (2012); and Huang and Ratnovski (2011). Nevertheless, none of these papers study the relationships between banks and their wholesale funding providers. There are, however, papers that study the relationship between banks and their retail depositors. For examples, see Puri and Rocholl (2008) and Iyer and Puri (2012).

The remainder of the paper is organized as follows. Section 2 provides more background information and institutional details; Section 3 describes the data and provides summary statistics; section 4 discusses empirical results; and Section 5 concludes.

2 Background

2.1 Foreign Banks' Funding Needs from U.S. MMFs

Perhaps strikingly, a large share of dollar-denominated banking business is performed by foreign banks (see Ivashina, Scharfstein, and Stein (2015) and Shin (2012)). Unlike U.S. banks, who have FDIC-insured retail deposits as their stable source of dollar funding, foreign banks rely heavily on institutions like U.S. MMFs to finance their dollar-denominated assets. In the past decade, foreign banks have significantly increased their U.S. dollar assets and experienced growing pressure of raising adequate dollar funding.[16]

Adding to that pressure, post-crisis Basel regulations regarding LCR encourage banks to have stable funding (with maturities over 30 days) to finance their longer-term dollar assets.[17] Intended to strengthen the liquidity positions of banks, the LCR rule requires banks to self-insure against funding difficulties and incentivizes unsecured borrowings with maturities greater than 30 days. U.S. MMFs are important suppliers of such dollar funding to foreign banks. Over the November 2010–October 2015 period, over 30 percent of prime MMFs' assets were unsecured investments in foreign banks with maturities over 30 days.

Because U.S. MMFs have become important suppliers of dollar funding to foreign banks, strains in U.S. MMFs can be easily passed to much broader markets in which foreign banks

[16]For the data of foreign banks' dollar assets and liabilities, see BIS Locational banking statistics. McCauley and von Peter (2009) introduced the concept of "US dollar funding gap": the amount of US dollars invested in longer-term assets which is not supported by longer-term US dollar liabilities. This gap is the amount that banks must roll over before their investments mature.

[17]The regulations on LCR require that banks must hold a minimum amount of unencumbered, high-quality liquid assets (HQLA) to withstand net cash outflows over a 30-day "stress period," characterized by simultaneous idiosyncratic and market-wide shocks. Therefore, any bank liabilities maturing within 30 days (net of bank assets maturing within 30 days) must be accompanied by similar-amount HQLA, making those liabilities incapable of financing other assets.

actively participate. For example, the runs on US prime MMFs following the Lehman failure in September 2008 stressed both the global interbank market and the FX swap market (see Baba, McCauley, Ramaswamy et al. (2009)). Another example is the more recent European sovereign debt crisis, when U.S. MMFs sharply reduced their exposures to European banks. In addition to the stresses in financial markets, real economy was affected as well, as firms who relied more on European banks before the crisis had a more difficult time borrowing (see Ivashina, Scharfstein, and Stein (2015)).

2.2 MMFs' Investment in Eurodollar Time Deposits

Despite what the name implies, the Eurodollar market is not related to foreign exchange rates. Eurodollars are unsecured and (mostly) overnight U.S. dollar time deposits issued offshore by foreign and domestic banks. Although these dollar deposits are now transacted in all major global financial centers, they are still referred to as Eurodollars, indicating its origin. U.S. prime MMFs are the dominant lenders in the Eurodollar market.[18]

The Eurodollar market is an important overnight funding market. According to the data collected by the Federal Reserve, the Eurodollar market is around three to four times larger than the federal funds market.[19] In recent years, the average daily volume of overnight Eurodollars has been fairly stable from day to day, with the exception of quarter ends, when the volume generally shrinks.

Prime MMFs invest actively in the Eurodollar time deposits market, making up about 80 to 90% of total lending in recent years. MMFs engage in time deposit transactions for two potential reasons. The first is to improve their liquidity levels and shorten portfolio maturities, especially after the SEC adopted the MMF reforms in late 2010, which changed

[18] Other lenders include corporations, foreign central banks, etc.

[19] The federal funds market enables depository institutions with reserve balances in excess of reserve requirements to lend reserves to institutions with reserve deficiencies. Like Eurodollars, federal funds lending is unsecured and usually overnight. The key difference between the Eurodollar market and the federal funds market is that a broader set of institutions, especially prime MMFs, can invest in Eurodollar time deposits, whereas only depository institutions and GSEs can lend in the federal funds market. Also, compared to the participating banks in the federal funds market, borrowers in the Eurodollar market are larger in size.

requirements for MMFs from stipulating no minimum liquidity to mandating that a minimum percentage of their assets be highly liquid securities, so that those assets could be readily converted to cash to pay redeeming shareholders.[20] The reforms also shortened the average maturity limits for MMFs, intending to limit the exposure of funds to certain risks such as sudden interest rate movements.[21] After the SEC applied these stricter rules on MMFs' liquidity and maturity levels, in general prime MMFs have invested in more liquid assets than before.

The other reason for MMFs to participate in Eurodollar time deposit lending is intraday cash management. MMFs typically complete (or finish the negotiation of) the majority of their lending activities around noon (including overnight repos with private sectors and the Federal Reserve), while retaining a cash buffer to cover unexpected investor flows and unforeseeable investment opportunities. Since the Eurodollar market is active until late afternoon and the rates on Eurodollar time deposits are generally unchanged throughout the day, the remaining cash buffer of prime MMFs is likely to be invested in the Eurodollar market (in the form of time deposits) towards the end of the day.

Because of these reasons, in recent years prime MMFs have significantly increased their reliance on banks, either domestic or foreign, to accommodate their investment needs in the overnight Eurodollar market. Figure 1 shows that Eurodollar time deposits made up only about 3% of prime MMFs' total assets before the 2010 SEC reforms, while expanding to over 7% in the post-regulation period.

[20] Specifically, the SEC required that all prime MMFs must have at least 10 percent of assets in cash, U.S. Treasury securities, or securities that convert into cash (e.g., mature) within one day, and at least 30 percent of assets in cash, U.S. Treasury securities, short-term agency debt, or securities that convert into cash within one week.

[21] Specifically, the SEC restricted the maximum "weighted average life" maturity of a fund's portfolio from unlimited to 120 days, and reduced the maximum weighted average maturity (WAM) of a fund's portfolio from 90 days to 60 days.

3 Data and Summary Statistics

3.1 Data

The main dataset is constructed from the SEC Form N-MFP, in which the SEC requires U.S. MMFs to report their security-level portfolio holdings as of the last business day of each month, starting from November 2010. Filing the Form N-MFP was actually part of the SEC 2010 reforms on MMFs. My dataset covers the November 2010–October 2015 period.[22] I focus my study on prime MMFs, who are allowed to invest in private entities.[23] Feeder funds, who invest in other MMFs, are excluded from the dataset.

Over the five-year sample period from November 2010 to October 2015, two-thirds of prime MMF assets are investments in banks, making banks (or bank holding companies) the most important borrowers of MMFs.[24] In addition, almost all prime MMFs lend to banks to a greater or lesser degree, as the total assets of prime funds without any outstanding bank lending contracts make up only 0.2 percent of total assets of prime funds.

To focus on the relationships between nontrivial MMFs and banks, in each month I exclude from the sample MMFs whose total lending to banks is less than $1 million and banks whose total borrowing from MMFs is less than $1 million. A MMF-bank pair is considered to have zero exposure to each other in a specific month if their outstanding exposure is less than $10,000 in that month. After applying all these filters, I have 299 MMFs and 343 banks in this five-year sample.[25] As of the end of October 2015, total assets held by prime MMFs

[22]The sample period ends in October 2015 because the SEC implemented another MMF reform in October 2016, the effects of which were first seen in late 2015. In the year leading up to the reform compliance date, the MMF industry saw a dramatic shift of assets from prime MMFs to government MMFs, as the new reform applies a floating net asset value to institutional prime MMFs and standby redemption fees and "gates" to all prime MMFs. Adding to the complication, the first post-crisis rate hike occurred in December 2015, followed by several more. Note that I run all major tests with the data from November 2010 to June 2017 and obtain even stronger results.

[23]There are two other types of MMFs: government funds and tax-exempt funds. Government funds can only invest in government and agency debt, or repos backed by government or agency debt. Tax-exempt funds are also known as municipal funds, who invest in short-term municipal securities. Note that none of these two types of funds can invest in any direct debt issued by private banks.

[24]There are also borrowers whose parents are bank holding companies, but the borrowers themselves are not banks. They are not categorized as bank borrowers in this paper.

[25]I repeat all major tests with the full sample without any exclusions and my results remain robust.

are about $1.8 trillion, out of which over $1.1 trillion are lending contracts with banks.

The filings of Form N-MFP started in late 2010. To demonstrate the dramatic difference in MMF holdings between this period and the pre-regulation period, I also use the iMoneyNet database to complement my analyses.[26] Unlike the N-MFP data, which reports security-level holding information of MMFs, the iMoneyNet data provides much coarser information on fund holdings. Specifically, it includes the percentage of each asset category held by a MMF (at weekly frequency), such as treasury, repos, Eurodollar time deposits, foreign CDs, domestic CDs, etc. The data covers January 2000 to October 2015.

In addition to the MMF holding data, I also collect banks' CDS spread data from Markit and hand-match the banks names to the N-MFP data. Specifically, I use the 5-year CDS spread on senior unsecured debt as a proxy for banks' credit risks.

3.2 Summary Statistics

Table 1 reports summary statistics of MMFs and banks over the November 2010-October 2015 period. As shown in Panel A, the dataset includes 13,715 fund-month observations. On average, there are about 229 individual funds in a given month. Across all fund-months, the average fund size is about $7.6 billion and is strongly right-skewed, with the median size at about $1.3 billion. Weighted average life (WAL) of MMF portfolios averages at 63 days, consistent with their regulation requirements. On average, CDs make up about 19% of MMF month-end portfolios, while Eurodollar time deposits compose about 5%.[27] The average number of bank counterparties for a MMF is 21.

Panel B of Table 1 provides bank-level summary statistics by bank domicile. The dataset includes 1,315 domestic (U.S.) bank-month observations and 3,917 foreign bank-month observations. Compared to domestic banks, foreign banks obtain much more financing from

[26]It is worth noting that iMoneyNet reports its data at the share-class level, while Form N-MFP reports holdings at the fund level. It is a common for MMFs to create multiple share classes from the same fund and target different types of investors, such as retail and institutional investors.

[27]Note that these average numbers are calculated based on the percentage holdings of all fund-months. Generally speaking, the percentage of bank-related assets tends to be higher for larger banks.

MMFs and have more MMF counterparties. However, domestic banks are on average able to secure longer-tenor funding from MMFs. In terms of financing instruments, foreign banks rely heavily on direct debt like CDs and financial CP, while domestic banks are more likely to use repos and other instruments.

Table 2 reports security-level statistics for MMFs' holdings of outstanding CDs and time deposits. Over the November 2010–October 2015 period, CD contracts between MMFs and domestic banks have an average size of $75 million and average maturity of about 105 days, and CD contracts between MMFs and foreign banks have an average size of $92 million and average maturity of about 3 months. In general, it is cheaper for domestic banks to raise money from MMFs in the CD market. Specifically, the average yield on domestic CD contracts is about 26 basis points, while 31 basis points for foreign banks.[28] It is worth noting that time deposits are in general larger in size than CDs.

4 Empirical Results

4.1 Reciprocal Lending

Taking lessons from the 2007–2008 financial crisis, during which banks and prime MMFs were under severe pressure to maintain adequate liquidity, post-crisis regulations aim to limit their liquidity risks. However, when these independently proposed regulations are simultaneously imposed on both the lending side and the borrowing side of funding markets, they would inevitably generate contradictory effects, as the lenders (MMFs) would prefer short-term lending and the borrowers (banks) would prefer long-term borrowing. As a result, tensions emerge in both the long-term and overnight funding markets between MMFs and banks.

In the long-term funding market, the 2010 SEC reforms apply stricter rules on MMFs' liquidity levels, which discourage MMFs from financing long-term debt. Meanwhile, banks

[28]Note that over the entire sample period, the policy rate was set in the range of 0-25 basis points (i.e. with zero lower bound) by the Federal Reserve.

are highly motivated by Basel III regulations to seek longer-term funding from MMFs. This is especially so for foreign banks, who have limited access to alternative dollar funding sources like retail deposits. With decreasing supply and increasing demand of long-term funding, MMFs are likely to gain more bargaining power and become more selective when financing long-term debt.

The supply-and-demand condition flips in the ultra short-term funding market. In particular, MMFs have strong overnight investment needs to control their liquidity levels and manage daily cash buffers, while banks are reluctant to have overnight liabilities shown in their balance sheets. In fact, anecdotal evidence suggests that some banks participate in the overnight market "to keep good relationships with MMFs." From time to time, MMFs find it difficult to secure an overnight "parking lot" for their extra cash, especially on quarter-ends.

Given MMFs' inclination toward short-term lending and banks' inclination toward long-term borrowing, both parties may have incentives to develop a mutually beneficial relationship and to trade with each other in a reciprocal manner. Specifically, in this subsection I test whether a bank's accommodative borrowing from a fund in the overnight market is positively associated with an increase in long-term funding contracts between the bank and the fund. Such "bundling" across different funding markets, if it exists, represents a novel reciprocal lending relationship that is to the best of my knowledge not documented before.

Two funding markets are of special interests in this study: the CD market and the Eurodollar time deposit market. These two markets are on the two ends of the funding maturity spectrum between MMFs and banks, with CDs on the very long-term end and time deposits on the very short-term end.[29]

[29]It is worth noting that the description of "long-term" and "short-term" is in the context of the funding markets between MMFs and banks, with "the very long-term" referring to about one year, and "the very short-term" referring to overnight.

4.1.1 Reciprocal Lending: All Banks

Using the MMF holding data reported in Form N-MFP, I construct a dataset consisting of fund-bank pairs at monthly frequencies. In each month, for each pair of fund and bank whose total exposure to each other is nonzero, I compute the outstanding amount of different types of funding instruments between them, along with some traditional relationship measures, including relative dependence and number of counterparties.

A natural concern for this way of data construction is that fund-bank pairs with zero exposure to each other will be dropped from the sample. Such omitted observations can carry meaningful information, especially if the pair has nonzero exposures to each other in previous months, in which case the current zero exposure marks an end of a relationship, temporary or permanent. To address this concern, I supplement the dataset by adding back the fund-bank pairs with zero current exposure and nonzero previous-quarter exposures. By doing so, I make sure that the dataset captures all observations that mark the end of a relationship. Only when a fund-bank pair has two consecutive quarters of zero interactions across all funding markets, the observation is dropped.[30]

To test if there is significant "bundling" across CD and time deposit markets between MMFs and banks, I run the following regressions:

$$\begin{aligned}\Delta CD_{i,j,t} = &\, Time\ Deposit\ Dummy_{i,j,t-1} + Dep\ on\ Bank_{i,j,t-1} + Dep\ on\ Fund_{i,j,t-1} \\ &+ Num\ of\ Fund\ Counterparties_{j,t-1} + Num\ of\ Bank\ Counterparties_{i,t-1} \\ &+ Fund\ Flow_{i,t} + Fund\ Characteristics_{i,t-1} + FE + \epsilon_{i,j,t}, \quad (4.1)\end{aligned}$$

where the dependent variable $\Delta CD_{i,j,t}$ measures the net change in outstanding amount of CDs (with maturity over 30 days) between fund i and bank j over a three-month period, measured in million dollars.[31] The key explanatory variable is $Time\ Deposit\ Dummy_{i,j,t-1}$,

[30] To fully address this concern, in Section 4.2 I fully interact the top 50 MMFs and top 50 banks to construct a monthly dataset of all possible pairs (2,500 per month) and conduct analyses with that dataset.

[31] MMF portfolios demonstrate nontrivial seasonality at quarter-ends, although mostly driven by overnight investments. By calculating changes over three months, I effectively avoid potential seasonality noises.

which equals 1 if fund i and bank j engage in any time deposit transactions at the most recent three month-ends, and zero otherwise. Constructed from observations of three month-ends, this dummy variable is intended to capture banks' accommodative behavior more accurately, as MMFs' needs to invest in time deposits fluctuate over time and at some month-ends they may not need an overnight repository for their cash at all. For the same reason, I focus on whether bank j has accommodated fund i at least once in the past quarter, rather than the total amount of time deposits transacted between them.[32]

For control variables, I calculate traditional relationship measures that evaluate the fund's and the bank's relative importance to each other, with $Dependence\ on\ Bank_{i,j,t}$ representing fund i's dependence on bank j and $Dependence\ on\ Fund_{i,j,t}$ representing bank j's dependence on fund i. Specifically,

$$Dependence\ on\ Bank_{i,j,t} = \frac{Exposure_{i,j,t}}{\sum_j Exposure_{i,j,t}} \times 100, \tag{4.2}$$

where $Exposure_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t, and the denominator of Equation (4.2) represents fund i's total lending amount to banks. Therefore, Equation (4.2) measures the importance of bank j, among all banks, as a trading counterparty to fund i at time t. Similarly, we define

$$Dependence\ on\ Fund_{i,j,t} = \frac{Exposure_{i,j,t}}{\sum_i Exposure_{i,j,t}} \times 100, \tag{4.3}$$

which measures the importance of fund i as a funding source to bank j at time t. In some regressions, I also use $Exposure_{i,j,t}$ as an alternative measure for traditional relationship between fund i and bank j.

Another way to measure relative importance and bargaining power of fund i and bank j is to count the numbers of their counterparties, respectively. In model (4.1), I also control for $Num\ of\ Fund\ Counterparties_{j,t-1}$, which is the number of funds who lend to bank j at time $t-1$, and $Num\ of\ Bank\ Counterparties_{i,t-1}$, which is the number of banks who

[32] When testing the robustness of my results, I use the amount of time deposits as an alternative explanatory variable.

borrow from fund i at time $t-1$.

In addition to traditional relationship measures and proxies for relative bargaining powers, I further control for fund characteristics. $Fund\ Flow_{i,t}$ represents net investor flows of fund i over the same three-month window as the dependent variable, and it controls for any change in CD amount that is explained by investor flows. Other lagged fund characteristics include fund size, fund yield, and weighted average maturity of fund portfolios.

Table 3 reports results from estimating various specifications of model (4.1). All specifications calculate standard errors by clustering at the fund level.[33] Column (1) regresses the net change in CDs on the lagged time deposit dummy, while controlling for fund flows. This simplest model specification yields a positive coefficient on the time deposit dummy, significant both statistically and economically. Investor flows also have a strong positive effect on the change in outstanding CDs, as expected.

Column (2) further controls for the lagged fund-bank exposure, which proxies the strength of existing relationship in a traditional sense between the fund and the bank. It is interesting to find that this traditional relationship measure is negatively associated with the change in CD amount. Column (3) introduces measures of relative importance of the fund and the bank to each other, which are also popular relationship measures used in existing literature. Consistent with the results in Column (2), the estimated coefficients on the two lagged "dependence" variables are both negative, and significant at the 1% level. Meanwhile, the strong positive effect remains for the lagged time deposit dummy. Given the fact that coefficient on the lagged time deposit dummy is much smaller in magnitude in Column (3) than in Column (2), I use specification (3) as a baseline for future regressions. Therefore, what I estimate in future regressions can be considered as a "lower bound" for the effects under alternative model specifications.

Column (4) further controls for bank-level and fund-level characteristics. It shows that more fund counterparties of the bank and more bank counterparties of the fund are both

[33] Clustering at the bank level, or double-clustering at the fund-bank level, does not qualitatively change the significance levels of my results.

associated with a decrease in CD amount, and funds with longer portfolio maturities tend to reduce their fundings in the CD market. Columns (5) further controls for fund fixed effect, bank fixed effect, and year-month fixed effect. Results of this augmented specification show that if a bank accommodates a MMF at least once in the time deposit market over the past quarter, the outstanding amount of long-term CDs between the two increases by about $12 million.

4.1.2 Reciprocal Lending: Foreign Vs. Domestic Banks

Foreign banks rely on U.S. MMFs for dollar funding more than domestic banks do, as foreign banks have limited access to alternative dollar funding sources, such as retail deposits. Therefore, the "bundling" effect between MMFs and foreign banks may be stronger than that between MMFs and domestic banks. To test this hypothesis, I conduct the tests separately for foreign banks and domestic banks, and report the regression results in Table 4.

Columns (1)-(3) show that for foreign banks, the estimated coefficient on the lagged time deposit dummy is strongly positive and significant at the 1% level. Specifically, a foreign bank's accommodation in the time deposit market is associated with a $13 million increase in long-term CD funding from the MMF, as shown in Column (3). Again, traditional relationship measures have a negative effect on the net change in long-term CD, suggesting that if a foreign bank and a MMF have formed a strong relationship in the traditional sense (i.e. heavy mutual dependence measured by total exposures), they are likely to reduce their CD contracts. This is possibly related to the SEC's rules regarding MMFs' portfolio diversification, which requires that a MMF's exposure to a particular private borrower cannot exceed 5% of its total assets under management.

Columns (4)-(6) show that for domestic banks, the coefficient on the lagged time deposit dummy remains positive, but loses its significance in the first two specifications. It is, however, significant in Column (6), where it shows that a domestic bank's accommodation in the time deposit market is associated with a $4 million increase in CD funding from the

MMF, which is a lot smaller in magnitude and less statistically significant compared to the estimated coefficient for foreign banks.

In sum, I find clear evidence that MMFs are more likely to engage in reciprocal lending with foreign banks. Intuitively, since foreign banks are more dependent on MMFs for long-term dollar funding through CDs, they may try harder to develop a mutual understanding with MMFs that they expect more long-term funding in return for their accommodations in the overnight market, while domestic banks may care less about such bundling arrangements. Another reason may also help explain the results. Specifically, small U.S. banks typically don't have convenient access to the Eurodollar market, as documented by Cipriani and Gouny (2015). This may generate a hurdle for small domestic banks to accommodate MMFs in the time deposit market, even if they want to develop a mutually beneficial relationship through this channel.[34]

4.1.3 Reciprocal Lending: Robustness

I perform a series of checks to illustrate the robustness of my findings. First, I use alternative dependent variables and report results in Table 5. The baseline model defines the dependent variable as the change in the outstanding amount of CDs with maturity over 30 days. In Columns (1)-(3) of Table 5, the dependent variable is redefined as the change in outstanding CDs with maturity over 60 days. Intuitively, CDs with longer maturities are more desirable to banks, while MMFs may become more cautious and selective when funding them. The regression results in Columns (1)-(3) remain similar to the baseline model.

Columns (4)-(6) of Table 5 expand the definition of long-term debt between a MMF and a bank. Specifically, the change in long-term debt is calculated from all types of direct debts with maturities over 30 days, including CDs, financial commercial paper, and other instruments. The regressions with this dependent variable load an even larger coefficient on the lagged time deposit dummy for foreign banks compared to the baseline model, as shown

[34]To address this concern, in Section 4.2 I restrict my analyses to large banks, domestic or foreign, who have similar levels of access to the time deposit market.

in Column (5), suggesting that reciprocal lending to foreign banks can be conducted through various direct debt instruments.

Next, I apply alternative explanatory variables to the baseline model and report regression results in Table 6. Columns (1)-(3) redefine the time deposit dummy by restricting it to overnight time deposits only, which make up a large bulk of the time deposit market. Regression results with this variation are similar to those of the baseline model.

Besides time deposits, the other ultra short-term funding instrument between MMFs and banks is overnight repurchase agreement (repo).[35] To explore whether there is bundling of long-term debt and overnight repos, I replace the lagged time deposit dummy with a lagged overnight repo dummy, and report regression results in Columns (4)-(6) of Table 6. Interestingly, recent overnight repo transactions do not significantly contribute to an increase in CD amount. The following facts help explain this finding. First, MMFs' demand for repos is not as strong as that for time deposits. Although repos have the same overnight maturity as time deposits, they are less useful in managing MMFs' intraday cash buffers, as repo transactions are completed around noon while the time deposit market remain active until the end of the day. Second, the regulation burden on banks from borrowing in repos is lighter than borrowing in time deposits, as repos are collateralized. Third, the Federal Reserve's Reverse Repo facility helps absorb occasional surges in MMFs' investment needs in repos.[36]

While I have discussed why the time deposit dummy, rather than the amount of time deposits, is a better proxy for banks' inclination to accommodate MMFs, Columns (7)-(9) of Table 6 report regression results using the lagged time deposit amount as the key explanatory variable. Specifically, $Time\ Deposit\ Amount_{i,j,t-1}$ is the average of time deposit transaction

[35] Unlike time deposits or CDs, which are unsecured direct debt, repos are secured debt collateralized with Treasuries, agency debt, MBS, and in less common cases, equities and corporate bonds. Repo transactions between MMFs and banks occur in the tri-party repo market with two central clearing banks, and maturities run from overnight to more than 1 month. The large majority of these repos are overnight and collateralized with Treasuries.

[36] In September 2013, the Federal Reserve started the exercise of using an overnight reverse repurchase agreement (ON RRP) facility as a supplementary policy tool to help control the federal funds rate and keep it in the target range set by the FOMC. The ON RRP offering rate serves as the soft floor of overnight rates. Through this facility, eligible MMFs can lend their extra cash to the Federal Reserve and take U.S Treasuries as collaterals.

amount between fund i and bank j at the most recent three month-ends. Consistent with the results of the baseline model, this variable attracts positive coefficients for the full sample and the foreign bank sample, significant at the 5% level. The estimated coefficients are economically significant as well. In particular, a $1 million increase in the lagged time deposit transaction is associated with $42,000 more long-term CDs for a foreign bank, as shown in Column (8). Given that the average transaction size of time deposits is more than $200 million, this result is nontrivial.

Finally, I discuss the "timing" of variables in more details. The dependent variable is the change in long-term CDs over a three-month period, and the explanatory variable of interests, time deposits dummy, is based on the most recent three month-end observations.[37] Such design of timing is meant to capture the buildup and reinforcement of reciprocal relationships over a three-month period between MMFs and banks. However, to address any potential concern of contemporaneous dependent and explanatory variables, I regress the change in CDs on a lagged time deposit dummy that is constructed from month-ends that don't overlap at all with the period of measuring the change in CDs.[38] The results of these robustness tests are basically the same as those from the original timing design.[39]

4.2 Bundling between Top Funds and Top Banks

The funding markets between MMFs and banks consist of hundreds of participants on each side. However, large participants dominate these markets. To focus on the relationship dynamics of major market participants and enable further analyses on bundling, in this subsetion I select the top 50 MMFs and the top 50 banks to construct a monthly dataset of all possible pairs (2,500 per month) within this network.

[37] In other word, if the dependent variable measures change in CDs from the end of March to the end of June, time deposit dummy equals 1 if the MMF and the bank have at least one time deposit transaction at the end of March, April, or May.

[38] Specifically, if the dependent variable measures change in CDs from the end of March to the end of June, the lagged time deposit dummy equals 1 if the MMF and the bank have at least one time deposit transaction at the end of January, February, or March.

[39] Results are available upon requests.

4.2.1 Reciprocal Lending between Top Funds and Top Banks

The top 50 MMFs are selected in the following way. First, I rank funds based on their total lending amount to banks over the sample period (i.e. November 2010–October 2015). I then require that funds persistently report their holdings without any missing month and keep the top 50 eligible funds. Such criteria make sure that all the eligible funds are important lenders to banks through the whole sample period.[40] These top 50 funds contribute 84% of total prime MMFs' lending amount to banks.

The top 50 banks are selected in a similar way. The rankings are based on their total borrowing amount from MMFs over the sample period and I require that the eligible banks borrow persistently from the MMF sector. There are 39 foreign banks and 11 U.S. domestic banks in the final top 50 list. Together their total borrowing amount accounts for 96% of borrowings by all banks from prime MMFs.

When focusing on the transactions within this 50×50 network, I find that they comprise 81% of the funding markets between prime MMFs and banks. In addition, their transactions cover about 84% of long-term CDs and 82% of time deposits. Figure 2 plots monthly coverage of the top-50 network, which is in general smooth over the sample period.

I construct a monthly dataset of all possible pairs within this top-50 network and perform tests of reciprocal lending on this dataset. Results are reported in Table 7. In summary, the reciprocal lending relationship between top MMFs and top banks is strong and robust.[41] In particular, if a top bank has accommodated a top MMF at least once in the time deposit market over the past quarter, the amount of long-term CDs between the two increases by about $36 million, as shown in Column (2). This result suggests that the bundling results in

[40] I also rank funds based on their total lending to banks over the first quarter of the sample period, and similarly rank funds based on their total lending to banks over the last quarter of the sample period. The correlations between these rankings and the overall ranking are as high as 0.9. In addition, the selected top 50 funds are among the top 70 funds based on the two alternative rankings.

[41] All tests in Table 7 are repeated with alternative dependent variables, including change in CD amount with maturity over 60 days and change in total amount of direct debt with maturity over 30 days. These robustness tests generate qualitatively similar results. I also repeat the tests using alternative explanatory variables , including the lagged overnight time deposit dummy and lagged time deposit amount, and obtain similar results. These robustness results are available upon requests.

Section 4.1 are not driven by some small outliers, and fully addresses the concern that the baseline sample doesn't include all possible pairs interacted between each and every MMF and bank.

I repeat the tests for large foreign banks and large domestic banks separately and obtain consistent results with those of the baseline sample. In particular, a large foreign bank's accommodation in the time deposit market is associated with a $38 million increase in long-term CD funding from the MMF, as shown in Column (4) of Table 7, and a large domestic bank's accommodation is associated with $17 million more long-term CDs, as shown in Column (6).

It is worth noting that large domestic banks, like foreign banks, actively engage in bundling with MMFs. Compared to small U.S. banks, large domestic banks are under stricter regulatory watch, focus less on retail deposits as their funding sources, and have much larger broker-dealer subsidiaries with greater funding needs. Therefore, large domestic banks may seek reciprocal lending from MMFs more actively than smaller banks. Moreover, large U.S. banks have convenient access to the time deposit market, and can easily accommodate MMFs' overnight investment needs in that market if they want to.

4.2.2 Quarter-End Effects

MMFs usually find it more difficult to secure an overnight repository for their cash at quarter-ends, when foreign banks and companies (especially those in Europe) tend to reduce their overnight borrowing from MMFs for window dressing purposes, a behavior documented by Munyan (2015) for the tri-party repo market. In fact, since the Federal Reserve introduced the Reverse Repo facility, through which MMFs can lend their extra cash to the Federal Reserve, the facility has seen surges in usage by MMFs at almost every quarter-ends.

Bearing this fact in mind, it is natural to hypothesize that if a bank accommodates a MMF's investment need in the overnight market at a quarter-end, the reciprocal effects in terms of increased long-term lending should be stronger than a regular month-end (i.e.,

non-quarter-end) accommodation.

To test this hypothesis, I include a lagged quarter-end time deposit (TD) dummy as an additional explanatory variable to the baseline model 4.1 and report results of the top-50 sample in Table 8. The lagged quarter-end TD dummy equals 1 if the bank borrows from the MMF in the time deposit market at the previous quarter-end, and zero otherwise. Therefore, $TD\ Dummy_{i,j,t-1} = 1$ and $QtrEnd\ TD\ Dummy_{i,j,t-1} = 1$ means that bank j has accommodated fund i at least once in the past three months, with one or all of the accommodations occurring at a quarter-end.[42]

Columns (1)-(3) of Table 8 show that such a quarter-end effect does exist. In particular, an accommodative borrowing of time deposits at a regular month-end is associated with $32 million more long-term funding of CDs, while an accommodative borrowing at a quarter-end is associated with $39 million more long-term funding of CDs. The difference is both economically and statistically significant. Such a quarter-end effect is larger in magnitude and more significant for foreign banks, who are in general more reluctant to borrow overnight debt at quarter-ends.

For Columns (4)-(6), I use the lagged dummy variable that is based on overnight time deposits and obtain an even stronger quarter-end effect. In particular, quarter-end borrowing of overnight time deposits is associated with $12 million more reciprocal lending in long-term CDs, compared to regular month-end borrowings, significant for both foreign banks and domestic banks. Columns (7)-(9) show regression results on repo-based dummy variables. There is no quarter-end effect in this setting.[43]

[42] Note that when $QtrEnd\ TD\ Dummy_{i,j,t-1} = 1$, $TD\ Dummy_{i,j,t-1}$ must equal 1 as well. Also, the lagged time deposit dummy is based on the past three months of observations, among which there must be one quarter-end observation.

[43] Although there is no quarter-end effect for repo dummies, there is significant bundling effect. Specifically, transactions of overnight repos at recent month-ends are associated with an increase in long-term funding, although the magnitude is about half the size as that of time deposits. This result suggests that large MMFs and large banks tend to develop bundling relationships across broader markets.

4.2.3 Reciprocal Lending during the European Debt Crisis

The sample period covers the European sovereign debt crisis from mid-2011 to mid-2012. To study whether the crisis affects the strength of reciprocal lending between MMFs and banks, and to address the concern that the results of reciprocal lending are actually driven by the crisis period, I conduct further tests.

In mid-2011, as investors' fears about the solvency of European sovereign debt mounted, prime MMFs experienced an investor outflows of 11% (or $180 billion in dollar amount) of their total assets from June to August. Chernenko and Sunderam (2014) document this large outflow at the wake of the sovereign debt crisis and its spillover effects through MMFs. The sense of urgency was heightened in the fall and continued in the winter. In January 2012, S&P downgraded France and eight other European countries, as well as the EU bailout fund. Worries continued in the first half of 2012. In mid-2012, due to successful fiscal consolidation and implementation of structural reforms in the countries being most at risk, financial stability in the eurozone started to improve significantly and interest rates fell.

Figure 3 plots prime MMF total assets and the average 5-year CDS spreads of banks in different regions. Following Chernenko and Sunderam (2014), I define the start of the European crisis as June 2011, when prime MMFs saw a notable decline in their assets and banks' CDS spreads shot up. I define the end of the crisis period as June 2012, when prime MMFs' total assets first started to rebound persistently and bank CDS spreads first started to decline persistently since the start of the crisis. [44] The results remain qualitatively similar if I shorten the crisis period to 9 months.

To analyze the effects of sovereign debt crisis on reciprocal lending, I include a crisis dummy and its interaction term with the time deposit dummy as additional explanatory variables. The regression results of these augmented specifications are reported in Table 9. Consistent with intuition, on average a MMF reduces its long-term funding to a foreign

[44] Chernenko and Sunderam (2014) define the crisis period as the three-month period from June 2011 to August 2011, which is suitable for their purpose of the paper, as they are interested in how frictions emerge as MMFs experience relatively large outflows within a relatively short time period.

bank by about $16 million during the crisis time, while posing no reduction on long-term funding to domestic banks, as indicated by the estimated coefficients on the crisis dummy in Column (2) and Column (3), respectively. More importantly, the estimated coefficient on the interaction term between crisis dummy and time deposit dummy is not significant, and the estimated coefficient on the lagged time deposit dummy is virtually unchanged. These results suggest that the reciprocal lending relationship remains stable during the crisis.[45] For robustness, Columns (4)-(6) repeat the tests using lagged time deposit amount as the explanatory variable. Again, the estimated coefficients on the interaction term are insignificant.

Results in Table 9 show that reciprocal lending is not weakened under stress. To address the opposite concern that the results of reciprocal lending are entirely driven by the crisis period, I exclude the crisis period (i.e., June 2011–June 2012) from the sample and repeat all tests. I obtain similar results with the subsample, ruling out the possibility that bundling is driven by the crisis.

4.2.4 Ruling out Alternative Theories

Is it possible that the positive relationship between the increase in long-term debt and recent time deposit transaction is driven by reasons other than reciprocal lending? For example, what if MMFs' investment decisions are generally based on banks' credit risks? In that case, a MMF may invest in creditworthy banks and stay away from riskier banks across all markets, including time deposit and CD markets. In other words, both time deposit transactions and changes in long-term debt are endogenously driven by banks' credit risk levels.

This story sounds reasonable in theory, but less so anecdotally. Although MMFs are very risk-averse, they generally don't worry about banks' credit risks when lending overnight in the time deposit market, especially when the market is in general calm. Since I have run

[45] In fact, during the crisis, a foreign bank who has recently borrowed in the time deposit market is likely to experience an increase of about $25 million in long-term CD funding, rather than a decrease of CD funding.

tests within the non-crisis subsample and obtain similar results as those of the full sample, this alternative story is unlikely to hold.

However, to directly address any remaining concerns, I collect CDS spread data for the top 50 banks from Markit and hand-match them with my main dataset based on bank (or bank holding company) names. Following literature, I use the 5-year CDS spread on senior unsecured debt as a proxy for banks' credit risks.

I test the effects of credit risks on bundling by including CDS spread and its interaction term with time deposit dummy to the baseline model, and report results in Table 10. In general, MMFs reduce their long-term CD funding to banks with higher credit risks. Specifically, a 10-basis-point (bp) increase in CDS spread of a non-accommodating bank is associated with about a $1.4 million decrease in long-term CD funding, as shown in Column (2). More importantly, the lagged time deposit dummy still attracts a positive coefficient, significant at the 1% level. The magnitude is a little smaller than that without controlling for bank credit risks, but is still quite large. This finding confirms that the observed bundling is not driven by bank credit risks.

I repeat the tests for foreign banks and domestic banks separately. After controlling for banks' credit risks, the estimated coefficients on time deposit dummy are strongly positive for both foreign banks and domestic banks. It is important to note that the change in long-term lending is not sensitive to domestic banks' credit risks at all, as shown in Columns (5)–(6). This result provides strong support to the anecdotal understanding that MMFs' lending decisions are in general not sensitive to banks' credit risks, unless during crisis time. Figure 3 shows that the average CDS spread of North American banks also heightened during the European sovereign debt crisis. However, since these banks are not directly involved in the crisis, MMFs seem not to care about their implied credit risks, even when making the investment decisions for long-term CDs. Therefore, it is safe to conclude that banks' credit risk levels do not simultaneously drive the investment (or divestment) decisions in both the time deposit market and the CD market.

To address the concern that other time-varying bank characteristics, like the change of managers or shifts in debt structures, may simultaneously drive transactions in both the time deposit and CD markets, I control for the bank×year-month fixed effects and report results in Columns (1)-(3) of Table 11. The estimated coefficients on the time deposit dummy are basically unchanged.

Another alternative theory is that the bundling relationship is driven by some intrinsic characteristics of the MMF-bank pairs. For example, the MMF and the bank may share the same ultimate parent, use the same dealer, have headquarters close to each other, or have connections between fund and bank managers.[46] To address these concerns, I control for the bank×fund fixed effects and report regression results in Columns (4)-(6) of Table 11. The bundling results are even stronger after controlling for the bank×fund fixed effects.

4.3 Reciprocal Lending Measured by Funding Cost

So far, my empirical analyses on reciprocal relationships have been focused on funding amount, which is of first-order importance to the funding markets between MMFs and banks, as the major concern for these markets is a freeze of funding rather than the increase in funding costs, as documented by Copeland, Martin, and Walker (2014) for the tri-party repo market during the financial crisis. However, a natural question to ask is whether MMFs offer any benefits in terms of lower funding costs in addition to more funding amount, as an extra reward for banks' accommodative transactions in the time deposit market.

I use the security-level data to explore the answer of this question. Specifically, I test whether recent accommodation in the time deposit market is associated with lower rates in long-term funding contracts (i.e., CDs), while controlling for other potential determinants of CD rates. To be a qualified observation for this CD sample, I require that the size of the CD lending contract is at least $1 million and the remaining maturity is at least 30 days.[47]

[46] I identify all the same-parent pairs within the top-50 network and find that there is virtually no time deposit transaction between same-parent MMFs and banks over the sample period.

[47] Similar and even stronger results are obtained If I don't apply such restrictions.

To mitigate the influence of possible data errors, in each month CD yields are winsorized at the top and bottom 5 percent level.[48]

The model specification is as follows:

$$\begin{aligned} CD\ Yield_{i,j,k,t} = TD\ Dummy_{i,j,t-1} + \log(CD\ Size_{i,j,k,t}) + \log(CD\ Maturity_{i,j,k,t}) \\ + Relationship\ Controls_{i,j,t-1} + Bank\ Characteristics_{j,t-1} \\ + Fund\ Characteristics_{i,t-1} + FE + \epsilon_{i,j,k,t}, \quad (4.4) \end{aligned}$$

where the dependent variable $CD\ Yield_{i,j,k,t}$ measures the yield of CD contract k (with maturity over 30 days and size over \$1 million) between fund i and bank j at time t, measured in basis points. The explanatory variable of key interests is $TD\ Dummy_{i,j,t-1}$, which equals 1 if fund i and bank j have engaged in any time deposit transactions at previous three month-ends, and zero otherwise.

I control for variables that commonly contribute to the determination of security yields, including the logarithms of the CD contract size, as well as the logarithms of CD maturity. In addition, I control for the traditional relationship measures that evaluate funds' and banks' relative importance to each other, as defined by Equation (4.2) and Equation (4.3), as well as the number of funds who lend to bank j at time $t-1$, and the number of banks who borrow from fund i at time $t-1$. Other lagged fund characteristics are also controlled, including fund size, fund weighted average maturity, and fund yield.

Regression results of CD yields are reported in Table 12. In particular, the lagged time deposit dummy attracts a negative coefficient and is significant at the 1% level, as shown in Columns (1)-(2). This estimated coefficient is economically significant as well, as it suggests that the accommodative transaction in the time deposit market is associated with about 1-basis-point reduction in the funding rate. Note that this result is obtained after controlling for fund fixed effects, bank fixed effects, and year-month fixed effects. Moreover, the policy

[48]Note that looser wisorization (i.e. at top and bottom 1 percent) does not qualitatively change the results. In fact, stronger results are obtained using the 1-percent wisorized data.

rate is in the range of 0–25 basis points over the entire sample period, and the average CD yield is about 28 basis points.[49] Consistent with intuition, larger CD size is associated with lower rates, while longer maturity is associated with higher rates.

Consistent with my findings that traditional relationship measures have negative effects on funding amount in CDs, results in Column (2) of Table 12 show that stronger mutual dependence between a MMF and a bank actually makes it more expensive for the bank to borrow from the MMF in the CD market, suggesting that MMF has more bargaining power when making long-term investment decisions. The positive loadings on numbers of counterparties provide further evidence about this.

I repeat the exercises for foreign banks and domestic banks separately and report regression results in Columns (3)-(4) and Columns (5)-(6), respectively. It is interesting to find that reciprocal funding rates for CDs are offered only to accommodative foreign banks, but not to accommodative domestic banks. This finding echoes the results on funding amount, suggesting that the reciprocal relationship between MMFs and foreign banks is stronger than that of MMFs and domestic banks, not only reflected in the amount of long-term funding, but in the costs of funding as well.

Table 13 reports how the European sovereign debt crisis affects reciprocal funding rates. Specifically, I include a crisis dummy and its interaction term with the time deposit dummy to Model (4.4).[50] Not surprisingly, it is more costly (8 basis points higher) to issue long-term CD during the crisis, as shown in Column (1). More importantly, however, is that the estimated coefficient on the interaction term is insignificant, while the lagged time deposit dummy still attracts a positive and significant coefficient, suggesting that the reciprocal relationship in terms of funding costs is not significantly weakened during the crisis.

I conduct the crisis analyses for foreign banks and domestic banks separately and report results in Columns (2)-(3) of Table 13. Results on foreign banks are generally consistent

[49] In fact, when I run the same regression with the sample from November 2010 to June 2017, which covers four interest rate hikes, the estimated coefficient on the lagged time deposit dummy is about negative 2.5 basis points, significant at the 1% level.

[50] The crisis dummy equals 1 for observations between June 2011 and June 2012, and zero otherwise.

with those of the full sample, while results on domestic banks show some interesting variations. While the estimated coefficient on the time deposit dummy remain insignificant for domestic banks, the coefficient on the interaction term is strongly negative and significant at 1%. In other words, although a domestic bank's accommodation during normal time is not associated with any rate benefit, its accommodation during crisis time is associated with about 7-bp reduction in CD funding rates.

I then focus on the CD contracts between the top 50 MMFs and the top 50 banks to conduct a variety of robustness tests.[51] Table 14 reports results on reciprocal funding costs between top MMFs and top banks. In Column (1) I repeat the baseline test using the top-50 sample, and obtain similar results as those with the full sample. Column (2) further controls for the bank×year-month fixed effect to address the concern that the result is possibly driven by some time-varying bank characteristics like credit risks, and Column (3) controls for the bank×fund fixed effects to address the concern that the result is potentially driven by some intrinsic characteristic of a fund-bank pair. The estimated coefficients on the time deposit dummy remain strongly negative and significant at the 1% level for these two augmented specifications, although slightly smaller in magnitude.[52]

To test the effect of banks' credit risks on reciprocal funding costs, Column (4) of Table 14 controls for the credit risk level of the borrowing bank, proxied by the bank's 5-year CDS spread. The estimated coefficient on the lagged CDS spread bears a positive sign, significant at the 1% level, suggesting that MMFs charge more on CDs issued by less creditworthy banks. More importantly, the time deposit dummy still attracts a strongly negative coefficient, suggesting that results on reciprocal funding costs are robust after controlling for banks' credit risks.

[51] Note that this top-50 network covers about 84% of long-term CDs between all MMFs and all banks.

[52] I also repeat the robustness tests for foreign banks and domestic banks separately, controlling for the two-way fixed effects. Results are reported in Columns (5)-(8) of Table 14. Basically, results on reciprocal funding costs for foreign banks and domestic banks remain robust.

5 Conclusion

As major wholesale funding providers for banks, prime money market funds (MMFs) lend about two-thirds of their money to banks through various funding instruments, with maturities ranging from overnight to about one year. However, post-crisis regulations, which apply stricter liquidity rules on both MMFs and banks, are likely to generate tensions on their funding activities, as MMFs are encouraged to shorten maturities of their lending contracts and banks to lengthen the tenor of their liabilities.

In this paper, I find that MMFs and banks seem to reconcile such dilemmas by developing a "bundling" strategy across funding markets of different maturities. In particular, MMFs substantially increase their purchases of long-term debt issued by banks who have recently accommodated MMFs' overnight investment needs. Such reciprocal relationships are robust after controlling for bank credit risks and traditional relationship measures, and are not weakened during the European Sovereign debt crisis. It is also stronger between MMFs and foreign banks, who depend on U.S. MMFs for dollar funding more than domestic banks do. In addition, foreign banks that have been accommodative in the overnight market enjoy significantly lower rates on their long-term debt with MMFs.

These results reveal novel yet sophisticated relationship management in shadow banking, as investment decisions across multiple markets are made collectively in a reciprocal manner. In fact, some MMFs have indicated that relationship management is an important part of their investment decision process, and they intend to maintain mutually beneficial relationships with their counterparties (i.e. banks). Similarly, some banks have mentioned that they accommodate MMFs in the overnight market to "maintain a good relationship" with them. Therefore, my findings are consistent with this anecdotal evidence, while providing much deeper insights on the mechanism and magnitude of such "mutually beneficial relationships."

Bundling of contracts across various funding markets between MMFs and banks helps alleviate the conflicting effects of post-crisis regulations. However, as MMFs and banks

develop a mutual understanding that overnight accommodations help promote longer-term funding, they are more likely to transact with the same counterparties in both the short-term and long-term markets. Over time, it is possible that both the lending side and the borrowing side will start to consolidate and become less diversified.[53] Further research is needed to address the concern that bundling may lead to consolidation of the industry and a "too-big-to-fail" situation in the market.

[53]To ensure that MMFs diversify their portfolios, the SEC requires that a MMF's exposure to a particular private borrower cannot exceed 5% of its total assets under management. However, this requirement does not necessarily prevent any MMF or bank from growing into more important and connected market participants.

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Figure 1: **MMF Holdings of CDs and Time Deposits**

This figure plots prime MMF holdings of CDs and Eurodollar time deposits, as shares of total assets under management and over the Jan. 2000 - Nov. 2015 period. Source of data: iMoneyNet.

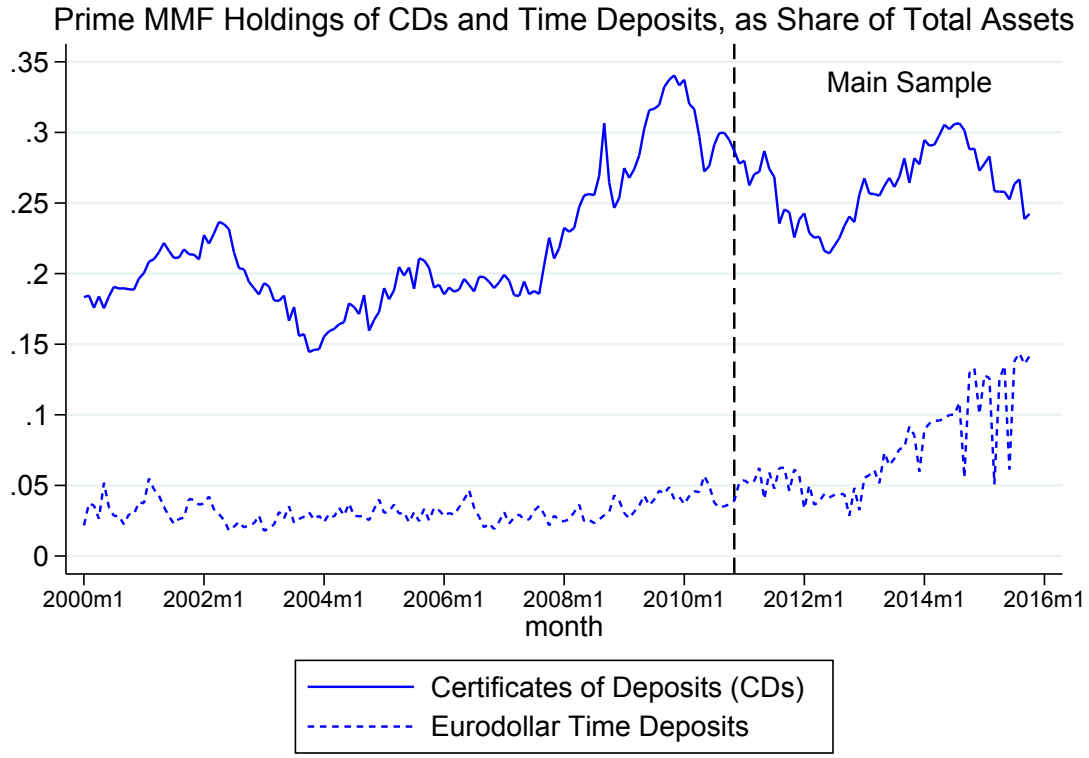

Figure 2: **Market Share of Top 50 Banks and Top 50 Funds**

This figure plots market shares of top 50 banks and top 50 prime MMFs. Top 50 MMFs are selected based on their total lending amount to banks over the Nov. 2010-Oct. 2015 sample period, and top 50 banks are selected based on their total borrowing amount from MMFs over the same sample period. I then calculate the outstanding amount of lending contracts within this 50×50 network and see how much it makes up of the entire funding markets between prime MMFs and banks.

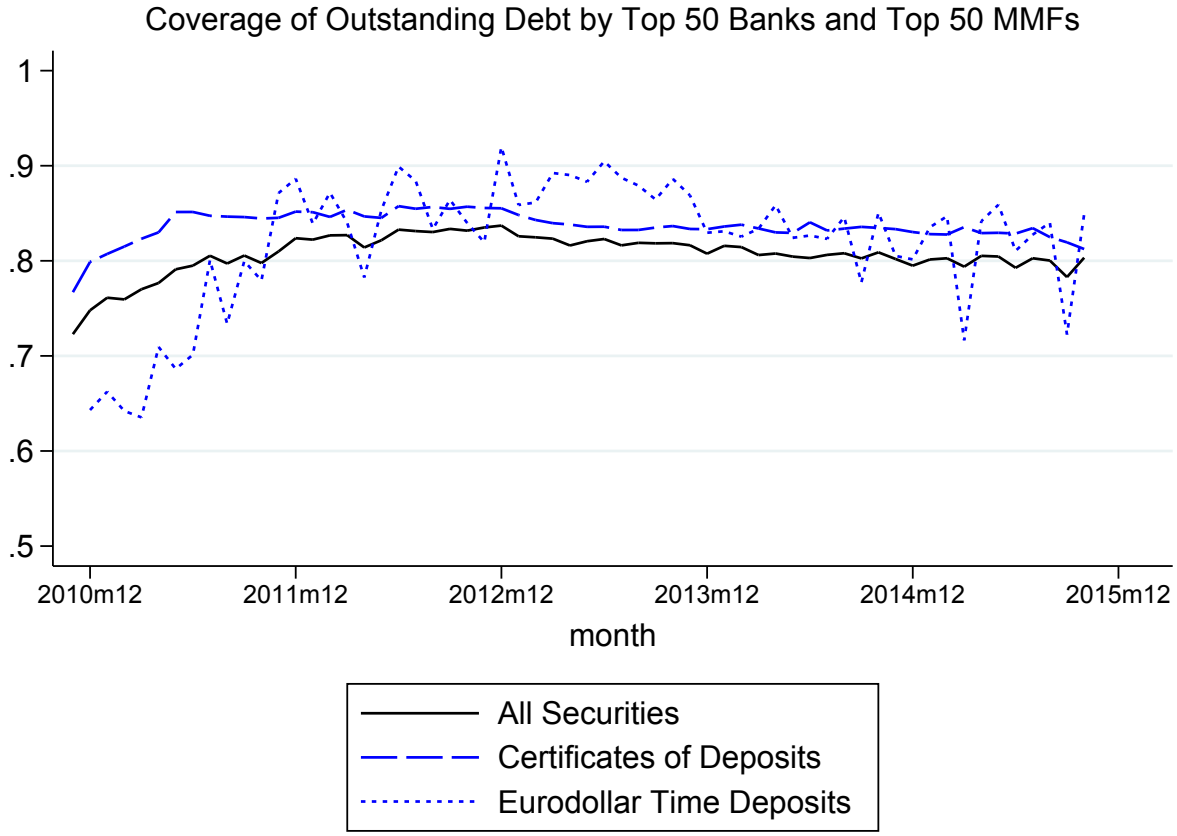

Figure 3: **European Sovereign Debt Crisis**

This figure plots prime MMF total assets (right y-axis, in trillion dollars) and average bank CDS spreads in different regions (left y-axis, in basis points) over the sample period from Nov. 2010 to Oct. 2015. Specifically, I use 5-year CDS spreads on senior unsecured debt of banks as a proxy for banks' credit risks that may concern MMFs. The shaded area represents the European sovereign debt crisis, starting from June 2011 and ending in June 2012.

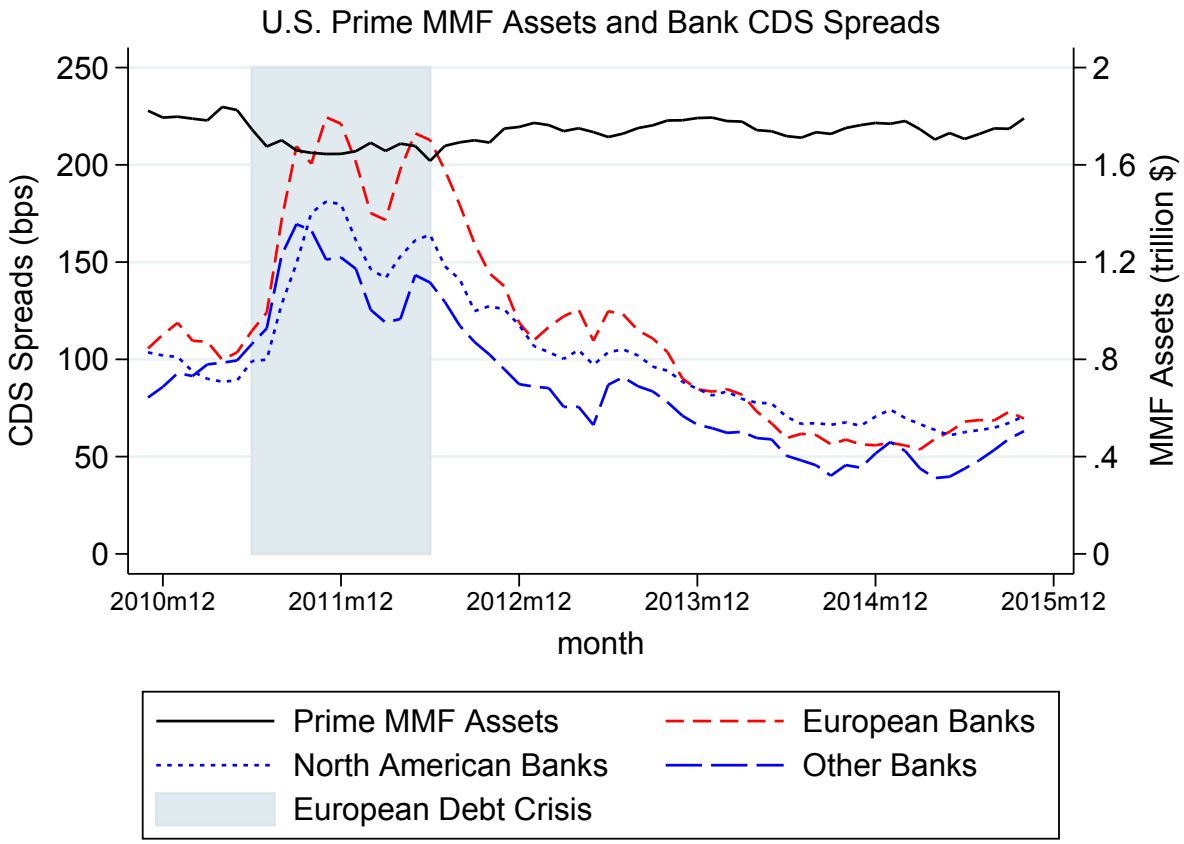

Table 1: **Summary Statistics of MMFs and Banks**

This table reports summary statistics of prime MMFs and banks over the November 2010-October 2015 period, based on monthly obervations. In each month, MMFs whose total exposure to banks is less than $1 million and banks whose total exposure to MMFs is less than $1 million are excluded. A MMF-bank pair is considered to have zero exposure in a specific month if their outstanding exposure to each other is less than $10,000 in that month. Panel A presents fund-level summary statistics. "Bank Assets" are a fund's lendings to banks as percentage of the fund's assets under management, and other percentage holdings are similarly defined. Panel B presents bank-level summary statistics by bank domicile. "Borrowing in CD" is defined as the percentage of the bank's borrowings from MMFs in the form of CDs.

Panel A: Fund-Level Summary Statistics

Varible	N	Mean	S.D.	P25	Median	P75
Assets under Management (mn $)	13,715	7,583.7	16,926.9	342.7	1,293.9	6,612.6
Weighted Average Life (WAL, days)	13,715	63.3	23.6	47.0	64.0	81.0
Fund Yield (in percent)	13,715	0.25	0.96	0.16	0.21	0.26
Quarterly Flow (mn $)	12,806	-7.3	1,453.6	-84.6	-6.5	39.0
Number of Bank Counterparties	13,715	20.5	10.9	12.0	20.0	29.0
Bank Assets (%)	13,715	53.0	24.5	35.0	55.4	72.1
Bank-Issued CDs (%)	13,715	18.5	14.5	5.7	16.1	29.9
Bank-Issued Financial CP (%)	13,715	12.4	9.0	5.8	11.2	17.4
Bank-Issued Repos (%)	13,715	14.3	14.8	2.1	11.4	20.9
Eurodollar Time Deposits (%)	13,715	5.1	5.7	0.0	0.0	8.5

Panel B: Bank-Level Summary Statistics

Varible	N	Mean	S.D.	P25	Median	P75
Domestic Banks						
Borrowing from MMFs (mn $)	1,315	7,784.5	13,609.4	11.5	326.0	8,056.4
Borrowing in CD (%)	1,315	22.7	36.7	0.0	0.0	39.6
Borrowing in CP (%)	1,315	8.4	20.1	0.0	0.0	2.7
Borrowing in Repos (%)	1,315	24.7	36.8	0.0	0.0	50.2
Borrowing in time deposits (%)	1,315	4.4	13.9	0.0	0.0	0.0
WAL of borrowing (days)	1,315	79.3	95.1	7.4	34.3	124.3
Number of MMF counterparties	1,315	37.6	46.4	3.0	11.0	60.0
Foreign Banks						
Borrowing from MMFs (mn $)	3,917	14,875.3	16,426.8	939.8	7,791.5	25,709.2
Borrowing in CD (%)	3,917	38.1	34.4	0.0	30.5	70.0
Borrowing in CP (%)	3,917	35.2	38.2	1.6	17.7	69.4
Borrowing in Repos (%)	3,917	9.5	21.1	0.0	0.0	5.2
Borrowing in time deposits (%)	3,917	8.4	16.2	0.0	0.1	10.0
WAL of borrowing (days)	3,917	61.7	52.0	25.6	50.2	80.9
Number of MMF counterparties	3,917	59.2	54.1	8.0	39.0	109.0

Table 2: **Summary Statistics of Outstanding Securities**

This table report security-level summary statistics for MMFs' outstanding CD and time deposit holdings over the November 2010-October 2015 period, based on monthly obervations and by bank domicile. In each month, MMFs whose total exposure to banks is less than $1 million and banks whose total exposure to MMFs is less than $1 million are excluded. A MMF-bank pair is considered to have zero exposure in a specific month if their outstanding exposure to each other is less than $10,000 in that month.

Varible	N	Mean	S.D.	P25	Median	P75
Issued by Domestic Banks						
CD Size (mn $)	27,732	74.8	129.9	5.5	25.0	84.5
CD Yield (bps)	27,615	25.8	11.6	20.0	24.0	30.0
CD Days to Maturity	27,732	105.2	88.9	37.0	80.0	153.0
Time Deposit Size (mn $)	1,866	223.4	341.7	18.1	100.0	300.0
Time Deposit Yield (bps)	1,792	17.0	51.8	6.0	11.0	15.0
Time Deposit Maturity (days)	1,866	2.3	1.4	1.0	3.0	3.0
Issued by Foreign Banks						
CD Size (mn $)	310,345	91.8	152.7	10.0	35.0	100.0
CD Yield (bps)	309,065	31.0	13.8	23.4	28.0	35.0
CD Days to Maturity	310,322	94.3	84.3	33.0	70.0	132.0
Time Deposit Size (mn $)	21,429	231.0	393.6	25.0	89.0	250.0
Time Deposit Yield (bps)	21,115	12.3	8.4	7.0	11.0	15.2
Time Deposit Maturity (days)	21,429	2.8	1.5	1.0	3.0	4.0

Table 3: **Reciprocal Lending in Amount: All Banks**

This table reports regression results of Model (4.1). The dependent variable $\Delta\text{CD}_{i,j,t}$ measures the net change in outstanding amount of CDs (with maturity over 30 days) between fund i and bank j over a three-month period. Time Deposit $\text{Dummy}_{i,j,t-1}$ equals 1 if fund i and bank j engage in any time deposit transactions at the most recent three month-ends, and zero otherwise. Dependence on $\text{Bank}_{i,j,t} = \text{Exposure}_{i,j,t}/\sum_j \text{Exposure}_{i,j,t} \times 100$, and Dependence on $\text{Fund}_{i,j,t} = \text{Exposure}_{i,j,t}/\sum_i \text{Exposure}_{i,j,t} \times 100$, where (Fund-Bank) $\text{Exposure}_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t. Num of $\text{Funds}_{j,t-1}$ is the number of funds who lend to bank j at time $t-1$, and Num of $\text{Banks}_{i,t-1}$ is the number of banks who borrow from fund i at time $t-1$. Fund $\text{Flow}_{i,t}$ represents net investor flows of fund i over the same three-month window as the dependent variable. $\Delta\text{CD}_{i,j,t}$, Fund-Bank $\text{Exposure}_{i,j,t-1}$, Fund $\text{Flow}_{i,t}$, and Fund $\text{Size}_{i,t-1}$ are all measured in million dollars. Fund $\text{WAL}_{i,t-1}$ represents weighted average maturity of fund i's portfolio, measured in days. Fund $\text{Yield}_{i,t-1}$ is in basis points. Standard errors are clustered at the fund level with corresponding t-values in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable: $\Delta\text{CD}_{i,j,t}$ (maturity>30 days)					
	(1)	(2)	(3)	(4)	(5)
$\text{Time Deposit Dummy}_{i,j,t-1}$	7.510***	14.965***	8.291***	8.821***	11.633***
	(4.27)	(4.10)	(4.28)	(4.45)	(4.71)
$\text{Fund-Bank Exposure}_{i,j,t-1}$		-0.037***			
		(-11.09)			
$\text{Dependence on Bank}_{i,j,t-1}$			-0.813***	-0.873***	-1.156***
			(-5.25)	(-5.43)	(-5.84)
$\text{Dependence on Fund}_{i,j,t-1}$			-1.015***	-1.085***	-1.617***
			(-3.49)	(-3.39)	(-3.75)
$\text{Num of Funds}_{j,t-1}$				-0.050***	-0.148***
				(-2.85)	(-4.53)
$\text{Num of Banks}_{i,t-1}$				-0.213***	-0.109
				(-2.71)	(-0.38)
$\text{Fund Flow}_{i,t}$	0.007***	0.007***	0.007***	0.007***	0.007***
	(7.15)	(7.27)	(7.15)	(7.08)	(7.80)
$\text{Fund Size}_{i,t-1}$				0.000	0.000
				(0.52)	(0.52)
$\text{Fund WAL}_{i,t-1}$				-0.046***	-0.158***
				(-2.92)	(-4.91)
$\text{Fund Yield}_{i,t-1}$				-0.049	-0.063
				(-0.95)	(-1.18)
Constant	-1.169***	5.881***	3.691***	17.528***	24.765***
	(-2.93)	(5.41)	(4.63)	(4.86)	(4.45)
Fund FE	No	No	No	No	Yes
Bank FE	No	No	No	No	Yes
Year-Month FE	No	No	No	No	Yes
Adjusted R^2	0.006	0.020	0.008	0.009	0.013
N of obs	304100	304100	304100	304100	304100

Table 4: **Reciprocal Lending in Amount, by Bank Domicile**

This table reports regression results of Model (4.1), with Columns (1)-(3) using the subsample of foreign banks and Columns (4)-(6) using the subsample of domestic banks. The dependent variable $\Delta\text{CD}_{i,j,t}$ measures the net change in outstanding amount of CDs (with maturity over 30 days) between fund i and bank j over a three-month period. Time Deposit Dummy$_{i,j,t-1}$ equals 1 if fund i and bank j engage in any time deposit transactions at the most recent three month-ends, and zero otherwise. Dependence on Bank$_{i,j,t}$ = Exposure$_{i,j,t}/\sum_j$ Exposure$_{i,j,t} \times 100$, and Dependence on Fund$_{i,j,t}$ = Exposure$_{i,j,t}/\sum_i$ Exposure$_{i,j,t} \times 100$, where Exposure$_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t. Num of Funds$_{j,t-1}$ is the number of funds who lend to bank j at time $t-1$, and Num of Banks$_{i,t-1}$ is the number of banks who borrow from fund i at time $t-1$. Fund Flow$_{i,t}$ represents net investor flows of fund i over the same three-month window as the dependent variable. $\Delta\text{CD}_{i,j,t}$, Fund Flow$_{i,t}$, and Fund Size$_{i,t-1}$ are all measured in million dollars. Fund WAL$_{i,t-1}$ represents weighted average maturity of fund i's portfolio, measured in days. Fund Yield$_{i,t-1}$ is in basis points. Standard errors are clustered at the fund level with corresponding t-values in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable: $\Delta\text{CD}_{i,j,t}$ (maturity>30 days)						
	Foreign Banks			**Domestic Banks**		
	(1)	(2)	(3)	(4)	(5)	(6)
Time Deposit Dummy$_{i,j,t-1}$	8.545***	10.434***	12.833***	1.322	0.728	4.229**
	(4.43)	(4.66)	(4.72)	(0.78)	(0.39)	(2.51)
Dependence on Bank$_{i,j,t-1}$		-1.265***	-1.485***		-0.240***	-0.346***
		(-5.59)	(-5.80)		(-3.18)	(-3.72)
Dependence on Fund$_{i,j,t-1}$		-1.419***	-2.019***		-0.418*	-0.757**
		(-3.42)	(-3.93)		(-1.92)	(-2.14)
Num of Funds$_{j,t-1}$		-0.054***	-0.157***		-0.008	-0.092*
		(-2.82)	(-4.53)		(-0.54)	(-1.77)
Num of Banks$_{i,t-1}$		-0.223***	-0.105		-0.210	-0.154
		(-3.36)	(-0.34)		(-1.47)	(-0.79)
Fund Flow$_{i,t}$	0.008***	0.008***	0.008***	0.001**	0.001**	0.001
	(7.21)	(7.15)	(7.75)	(2.35)	(2.26)	(1.64)
Fund Size$_{i,t-1}$		0.000	0.000		0.000**	0.001
		(0.00)	(0.40)		(2.33)	(1.06)
Fund WAL$_{i,t-1}$		-0.056***	-0.169***		-0.006	-0.089***
		(-2.94)	(-4.62)		(-0.31)	(-2.70)
Fund Yield$_{i,t-1}$		-0.030	-0.084		-0.140*	0.079
		(-0.46)	(-1.30)		(-1.86)	(0.65)
Constant	-1.914***	20.415***	29.377***	2.158***	7.041**	6.395
	(-3.70)	(5.22)	(4.68)	(3.44)	(2.18)	(1.45)
Fund FE	No	No	Yes	No	No	Yes
Bank FE	No	No	Yes	No	No	Yes
Year-Month FE	No	No	Yes	No	No	Yes
Adjusted R^2	0.008	0.011	0.015	0.000	0.004	0.013
N of obs	250606	250606	250606	53494	53494	53494

Table 5: **Robustness: Reciprocal Lending in Amount**

(Alternative Dependent Variables)

This table reports regression results of variations of Model (4.1). The dependent variable for Columns (1)-(3) is the net change in outstanding amount of CDs (with maturity over 60 days) between fund i and bank j over a three-month period, and the dependent variable for Columns (4)-(6) is the net change in outstanding amount of all direct debt (including CDs, financial CP and bank notes, with maturity over 30 days) between fund i and bank j. Time Deposit Dummy$_{i,j,t-1}$ equals 1 if fund i and bank j engage in any time deposit transactions at the most recent three month-ends, and zero otherwise. Dependence on Bank$_{i,j,t}$ = Exposure$_{i,j,t}$/ $\sum_j$ Exposure$_{i,j,t}$ $\times$ 100, and Dependence on Fund$_{i,j,t}$ = Exposure$_{i,j,t}$/ $\sum_i$ Exposure$_{i,j,t}$ $\times$ 100, where Exposure$_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t. Num of Funds$_{j,t-1}$ is the number of funds who lend to bank j at time $t-1$, and Num of Banks$_{i,t-1}$ is the number of banks who borrow from fund i at time $t-1$. Fund Flow$_{i,t}$ represents net investor flows of fund i over the same three-month window as the dependent variable. ΔCD$_{i,j,t}$, Fund Flow$_{i,t}$, and Fund Size$_{i,t-1}$ are all measured in million dollars. Fund WAL$_{i,t-1}$ represents weighted average maturity of fund i's portfolio, measured in days. Fund Yield$_{i,t-1}$ is in basis points. Standard errors are clustered at the fund level with corresponding t-values in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	Dependent Variable: **ΔCD$_{i,j,t}$ (mat>60 days)**			Dependent Variable: **ΔDirect Debt$_{i,j,t}$ (mat>30 days)**		
	All	Foreign	Domestic	All	Foreign	Domestic
	(1)	(2)	(3)	(4)	(5)	(6)
Time Deposit Dummy$_{i,j,t-1}$	9.837***	10.952***	2.716**	13.456***	15.150***	2.739
	(4.94)	(4.93)	(2.48)	(4.59)	(4.67)	(1.59)
Dependence on Bank$_{i,j,t-1}$	-0.843***	-1.078***	-0.255***	-1.777***	-2.262***	-0.644***
	(-5.70)	(-5.68)	(-3.84)	(-6.63)	(-6.44)	(-4.75)
Dependence on Fund$_{i,j,t-1}$	-1.110***	-1.399***	-0.481**	-2.764***	-3.474***	-1.257***
	(-3.51)	(-3.53)	(-2.27)	(-4.99)	(-5.10)	(-2.80)
Num of Funds$_{j,t-1}$	-0.134***	-0.146***	-0.064	-0.242***	-0.252***	-0.176***
	(-4.54)	(-4.56)	(-1.62)	(-5.57)	(-5.39)	(-3.37)
Num of Banks$_{i,t-1}$	-0.011	0.032	-0.227	-0.385	-0.481	-0.049
	(-0.05)	(0.12)	(-1.64)	(-1.22)	(-1.41)	(-0.20)
Fund Flow$_{i,t}$	0.005***	0.006***	0.001	0.009***	0.010***	0.003***
	(7.98)	(7.51)	(1.22)	(11.31)	(10.71)	(3.20)
Fund Size$_{i,t-1}$	0.000	0.000	0.001	0.000	0.000	0.001**
	(0.54)	(0.35)	(1.27)	(0.39)	(0.15)	(2.01)
Fund WAL$_{i,t-1}$	-0.207***	-0.231***	-0.085***	-0.247***	-0.243***	-0.254***
	(-5.24)	(-5.00)	(-2.66)	(-5.75)	(-5.37)	(-4.02)
Fund Yield$_{i,t-1}$	-0.034	-0.043	0.041	-0.111*	-0.137*	0.130
	(-0.62)	(-0.67)	(0.43)	(-1.85)	(-1.87)	(0.75)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.009	0.011	0.011	0.020	0.023	0.017
N of obs	304100	250606	53494	304100	250606	53494

Table 6: **Robustness: Reciprocal Lending in Amount (Alternative Explanatory Variables)**

This table reports regression results of variations of Model (4.1). The dependent variable is the net change in outstanding amount of CDs (with maturity over 30 days) between fund i and bank j over a three-month period. Overnight TD Dummy$_{i,j,t-1}$ equals 1 if fund i and bank j engage in any overnight time deposit transactions at the most recent three month-ends, and zero otherwise. Overnight Repo Dummy$_{i,j,t-1}$ is similarly defined. Time Deposit Amount$_{i,j,t-1}$ is the average transaction amount of time deposits between fund i and bank j in the previous three months. Dependence on Bank$_{i,j,t} = \text{Exposure}_{i,j,t}/\sum_j \text{Exposure}_{i,j,t} \times 100$, and Dependence on Fund$_{i,j,t} = \text{Exposure}_{i,j,t}/\sum_i \text{Exposure}_{i,j,t} \times 100$, where Exposure$_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t. Num of Funds$_{j,t-1}$ is the number of funds who lend to bank j at time $t-1$, and Num of Banks$_{i,t-1}$ is the number of banks who borrow from fund i at time $t-1$. Fund characteristics include Fund Flow$_{i,t}$ (net investor flows of fund i over the same three-month window as the dependent variable), Fund Size$_{i,t-1}$, Fund WAL$_{i,t-1}$ (weighted average maturity of fund i's portfolio, measured in days), and Fund Yield$_{i,t-1}$ (in basis points). ΔCD$_{i,j,t}$, Fund Flow$_{i,t}$, and Fund Size$_{i,t-1}$ are all measured in million dollars. Standard errors are clustered at the fund level with corresponding t-values in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	ΔCD$_{i,j,t}$ (maturity>30 days)								
	All	Foreign	Domestic	All	Foreign	Domestic	All	Foreign	Domestic
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Overnight TD Dummy$_{i,j,t-1}$	10.012***	11.176***	4.073**						
	(4.43)	(4.42)	(2.41)						
Overnight Repo Dummy$_{i,j,t-1}$				1.542	2.074	-0.602			
				(0.99)	(0.90)	(-0.45)			
Time Deposit Amount$_{i,j,t-1}$							0.039**	0.042**	0.015
							(2.18)	(2.19)	(1.37)
Dependence on Bank$_{i,j,t-1}$	-1.150***	-1.478***	-0.345***	-1.151***	-1.481***	-0.332***	-1.156***	-1.484***	-0.347***
	(-5.83)	(-5.80)	(-3.69)	(-5.91)	(-5.88)	(-3.75)	(-5.87)	(-5.84)	(-3.69)
Dependence on Fund$_{i,j,t-1}$	-1.614***	-2.016***	-0.756**	-1.605***	-2.009***	-0.750**	-1.636***	-2.035***	-0.765**
	(-3.74)	(-3.92)	(-2.13)	(-3.73)	(-3.91)	(-2.13)	(-3.75)	(-3.88)	(-2.15)
Num of Funds$_{j,t-1}$	-0.148***	-0.156***	-0.092*	-0.145***	-0.152***	-0.091*	-0.149***	-0.157***	-0.091*
	(-4.53)	(-4.53)	(-1.77)	(-4.41)	(-4.42)	(-1.74)	(-4.53)	(-4.53)	(-1.76)
Num of Banks$_{i,t-1}$	-0.109	-0.104	-0.155	-0.104	-0.097	-0.164	-0.099	-0.091	-0.157
	(-0.38)	(-0.34)	(-0.81)	(-0.36)	(-0.32)	(-0.84)	(-0.34)	(-0.29)	(-0.81)
Fund Characteristics$_{i,t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.013	0.015	0.013	0.012	0.015	0.013	0.013	0.015	0.013
N of obs	304100	250606	53494	304100	250606	53494	304100	250606	53494

Table 7: **Reciprocal Relationships between Top Lenders and Borrowers**

I use the top 50 MMFs (based on their total lending amount to banks over the sample period) and top 50 banks (based on their total borrowing amount from MMFs) to construct a monthly dataset of all possible pairs (2,500 per month) within the network and perform tests on reciprocal lending, and report regression results in this table by bank domiciles. The dependent variable $\Delta\text{CD}_{i,j,t}$ measures the net change in outstanding amount of CDs (with maturity over 30 days) between fund i and bank j over a three-month period. Time Deposit Dummy$_{i,j,t-1}$ equals 1 if fund i and bank j engage in any time deposit transactions at the most recent three month-ends, and zero otherwise. Dependence on Bank$_{i,j,t} = \text{Exposure}_{i,j,t}/\sum_j \text{Exposure}_{i,j,t} \times 100$, and Dependence on Fund$_{i,j,t} = \text{Exposure}_{i,j,t}/\sum_i \text{Exposure}_{i,j,t} \times 100$, where Exposure$_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t. Num of Funds$_{j,t-1}$ is the number of funds who lend to bank j at time $t-1$, and Num of Banks$_{i,t-1}$ is the number of banks who borrow from fund i at time $t-1$. Fund Flow$_{i,t}$ represents net investor flows of fund i over the same three-month window as the dependent variable. $\Delta\text{CD}_{i,j,t}$, Fund Flow$_{i,t}$, and Fund Size$_{i,t-1}$ are all measured in million dollars. Fund WAL$_{i,t-1}$ represents weighted average maturity of fund i's portfolio, measured in days. Fund Yield$_{i,t-1}$ is in basis points. Standard errors are clustered at the fund level with corresponding t-values in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable: $\Delta\text{CD}_{i,j,t}$ (maturity>30 days)						
	All Banks		**Foreign Banks**		**Domestic Banks**	
	(1)	(2)	(3)	(4)	(5)	(6)
Time Deposit Dummy$_{i,j,t-1}$	29.104***	35.504***	32.782***	37.840***	11.056**	17.413***
	(6.02)	(5.81)	(6.09)	(5.72)	(2.63)	(4.06)
Dependence on Bank$_{i,j,t-1}$	-6.490***	-6.902***	-7.518***	-7.862***	-2.054***	-2.439***
	(-4.93)	(-4.93)	(-5.15)	(-4.98)	(-2.85)	(-2.91)
Dependence on Fund$_{i,j,t-1}$	-2.513***	-2.465***	-3.621***	-3.623***	-0.731*	-0.842*
	(-3.40)	(-3.36)	(-4.44)	(-4.35)	(-1.69)	(-1.96)
Num of Funds$_{j,t-1}$	0.258**	-0.537***	0.262**	-0.500**	0.256***	-0.394
	(2.35)	(-2.98)	(2.12)	(-2.61)	(3.10)	(-1.61)
Num of Banks$_{i,t-1}$	-0.034	-0.154	0.107	0.012	-0.199	-0.495
	(-0.23)	(-0.23)	(0.81)	(0.02)	(-0.82)	(-1.28)
Fund Flow$_{i,t}$	0.005***	0.005***	0.007***	0.006***	0.001*	0.001*
	(5.59)	(5.93)	(5.37)	(5.49)	(1.97)	(1.84)
Fund Size$_{i,t-1}$	0.000	0.000	0.000**	0.000	0.000**	0.000
	(1.37)	(0.62)	(2.13)	(0.51)	(2.18)	(1.30)
Fund WAL$_{i,t-1}$	-0.094**	-0.260***	-0.156***	-0.291***	0.021	-0.186***
	(-2.12)	(-3.90)	(-2.91)	(-3.41)	(0.50)	(-3.42)
Fund Yield$_{i,t-1}$	-3.124	-21.333	-2.585	-27.004	-5.873	6.435
	(-0.43)	(-0.95)	(-0.26)	(-0.95)	(-0.97)	(0.42)
Constant	13.472**	44.217***	15.694***	55.579***	2.075	26.272*
	(2.61)	(3.28)	(2.91)	(3.48)	(0.41)	(1.88)
Fund FE	No	Yes	No	Yes	No	Yes
Bank FE	No	Yes	No	Yes	No	Yes
Year-Month FE	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.014	0.019	0.018	0.024	0.004	0.014
N of obs	142500	142500	111150	111150	31350	31350

Table 8: **Quarter-End Effects**

This table reports quarter-end effects of reciprocal lending, using a monthly dataset of all possible pairs between top 50 MMFs and top 50 banks. The dependent variable is the net change in outstanding amount of CDs (with maturity over 30 days) between fund i and bank j over a 3-month period, measured in million dollars. TD Dummy$_{i,j,t-1}$ equals 1 if fund i and bank j engage in any time deposit transactions at the most recent three month-ends, and zero otherwise. ON (overnight) TD Dummy$_{i,j,t-1}$ and ON Repo Dummy$_{i,j,t-1}$ are similarly defined. Qtr-end TD Dummy$_{i,j,t-1}$ equals 1 if MMF i and bank j have a time deposit transaction at the previous quarter-end, and zero otherwise. "Fund-Bank Relationships" control for Dependence on Bank$_{i,j,t}$ = Exposure$_{i,j,t}/\sum_j$ Exposure$_{i,j,t} \times 100$, and Dependence on Fund$_{i,j,t}$ = Exposure$_{i,j,t}/\sum_i$ Exposure$_{i,j,t} \times 100$, where Exposure$_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t, as well as the number of funds who lend to bank j at time $t-1$, and the number of banks who borrow from fund i at time $t-1$. Fund characteristics include Fund Flow$_{i,t}$ (net investor flows of fund i over the same 3-month window as the dependent variable), Fund Size$_{i,t-1}$, Fund WAL$_{i,t-1}$ (weighted average maturity of fund i's portfolio, measured in days), and Fund Yield$_{i,t-1}$ (in basis points). Standard errors are clustered at the fund level with corresponding t-values in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	ΔCD$_{i,j,t}$ (maturity>30 days)								
	All	Foreign	Domestic	All	Foreign	Domestic	All	Foreign	Domestic
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
TD Dummy$_{i,j,t-1}$	31.599***	33.652***	13.414**						
	(5.11)	(5.10)	(2.49)						
Qtr-end TD Dummy$_{i,j,t-1}$	7.194*	7.823*	6.584						
	(1.77)	(1.76)	(1.07)						
ON TD Dummy$_{i,j,t-1}$				26.647***	28.390***	9.560*			
				(5.04)	(4.84)	(1.69)			
Qtr-end ON TD Dummy$_{i,j,t-1}$				12.270*	12.483*	13.288*			
				(1.86)	(1.73)	(1.71)			
ON Repo Dummy$_{i,j,t-1}$							18.760***	19.962***	8.989**
							(4.21)	(3.21)	(2.39)
Qtr-end ON Repo Dummy$_{i,j,t-1}$							1.186	1.126	-0.378
							(0.29)	(0.18)	(-0.11)
Fund-Bank Relationships	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.019	0.023	0.014	0.018	0.022	0.014	0.019	0.023	0.014
N of obs	142500	111150	31350	142500	111150	31350	142500	111150	31350

Table 9: **Reciprocal Lending during the European Debt Crisis**

This table analyzes the effects of European sovereign debt crisis on reciprocal lending, using a monthly dataset of all possible pairs between top 50 MMFs and top 50 banks. The dependent variable is the net change in outstanding amount of CDs (with maturity over 30 days) between fund i and bank j over a 3-month period. Crisis_t equals 1 for observations between June 2011 and June 2012, and zero otherwise. TD $\text{Dummy}_{i,j,t-1}$ equals 1 if fund i and bank j engage in any time deposit transactions at the most recent three month-ends, and zero otherwise. TD $\text{Amount}_{i,j,t-1}$ is the average transaction amount of time deposits between fund i and bank j in the previous quarter. Dependence on $\text{Bank}_{i,j,t} = \text{Exposure}_{i,j,t} / \sum_j \text{Exposure}_{i,j,t} \times 100$, and Dependence on $\text{Fund}_{i,j,t} = \text{Exposure}_{i,j,t} / \sum_i \text{Exposure}_{i,j,t} \times 100$, where $\text{Exposure}_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t. Num of $\text{Funds}_{j,t-1}$ is the number of funds who lend to bank j at time $t-1$, and Num of $\text{Banks}_{i,t-1}$ is the number of banks who borrow from fund i at time $t-1$. Fund characteristics include Fund $\text{Flow}_{i,t}$ (net investor flows of fund i over the same 3-month window as the dependent variable), Fund $\text{Size}_{i,t-1}$, Fund $\text{WAL}_{i,t-1}$ (weighted average maturity of fund i's portfolio, measured in days), and Fund $\text{Yield}_{i,t-1}$ (in basis points). $\Delta\text{CD}_{i,j,t}$, Fund $\text{Flow}_{i,t}$, and Fund $\text{Size}_{i,t-1}$ are all measured in million dollars. Standard errors are clustered at the fund level with corresponding t-values in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable: $\Delta\text{CD}_{i,j,t}$ (maturity>30 days)						
	All	Foreign	Domestic	All	Foreign	Domestic
	(1)	(2)	(3)	(4)	(5)	(6)
TD $\text{Dummy}_{i,j,t-1}$	34.609***	35.638***	20.079***			
	(5.89)	(5.64)	(3.59)			
TD $\text{Dummy}_{i,j,t-1} \times \text{Crisis}_t$	1.012	5.704	-5.234			
	(0.17)	(0.85)	(-1.64)			
TD $\text{Amount}_{i,j,t-1}$				0.059***	0.062***	0.039**
				(3.94)	(3.79)	(2.46)
TD $\text{Amount}_{i,j,t-1} \times \text{Crisis}_t$				0.024	0.033	0.001
				(0.28)	(0.36)	(0.07)
Crisis_t	-12.936***	-16.290***	-0.266	-12.861***	-16.029***	-0.541
	(-4.34)	(-4.15)	(-0.27)	(-4.09)	(-3.93)	(-0.54)
Dependence on $\text{Bank}_{i,j,t-1}$	-6.861***	-7.777***	-2.480***	-6.636***	-7.508***	-2.490***
	(-4.96)	(-5.00)	(-2.95)	(-4.92)	(-5.01)	(-2.89)
Dependence on $\text{Fund}_{i,j,t-1}$	-2.460***	-3.627***	-0.840*	-2.519***	-3.716***	-0.843**
	(-3.35)	(-4.35)	(-1.97)	(-3.39)	(-4.37)	(-2.01)
Num of $\text{Funds}_{j,t-1}$	-0.578***	-0.566***	-0.425*	-0.537***	-0.521***	-0.417
	(-3.10)	(-2.87)	(-1.70)	(-2.93)	(-2.70)	(-1.67)
Num of $\text{Banks}_{i,t-1}$	-0.433	-0.438	-0.191	-0.385	-0.370	-0.201
	(-0.74)	(-0.65)	(-0.65)	(-0.66)	(-0.55)	(-0.69)
Fund Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	No	No	No	No	No	No
Adjusted R^2	0.017	0.021	0.008	0.016	0.020	0.008
N of obs	142500	111150	31350	142500	111150	31350

Table 10: **Alternative Story: Driven by Bank Credit Risks?**

This table reports test results that address the concern that bundling results are driven by bank credit risks, using a monthly dataset of all possible pairs between top 50 MMFs and top 50 banks. The dependent variable is the net change in outstanding amount of CDs (with maturity over 30 days) between fund i and bank j over a 3-month period. CDS Spread$_{j,t-1}$ is the 5-year CDS spread of bank j at time $t-1$. Time Deposit Dummy$_{i,j,t-1}$ (also shortened for TD$_{i,j,t-1}$) equals 1 if fund i and bank j engage in any time deposit transactions at the most recent three month-ends, and zero otherwise. Dependence on Bank$_{i,j,t}$ = Exposure$_{i,j,t}/\sum_j$ Exposure$_{i,j,t} \times 100$, and Dependence on Fund$_{i,j,t}$ = Exposure$_{i,j,t}/\sum_i$ Exposure$_{i,j,t} \times 100$, where Exposure$_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t. Num of Funds$_{j,t-1}$ is the number of funds who lend to bank j at time $t-1$, and Num of Banks$_{i,t-1}$ is the number of banks who borrow from fund i at time $t-1$. Other fund characteristics include Fund Flow$_{i,t}$ (net investor flows of fund i over the same 3-month window as the dependent variable), Fund Size$_{i,t-1}$, Fund WAL$_{i,t-1}$ (weighted average maturity of fund i's portfolio, measured in days), and Fund Yield$_{i,t-1}$ (in basis points). ΔCD$_{i,j,t}$, Fund Flow$_{i,t}$, and Fund Size$_{i,t-1}$ are all measured in million dollars. Standard errors are clustered at the fund level with corresponding t-values in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable: ΔCD$_{i,j,t}$ (maturity>30 days)						
	All Banks		**Foreign Banks**		**Domestic Banks**	
	(1)	(2)	(3)	(4)	(5)	(6)
Time Deposit Dummy$_{i,j,t-1}$	22.399***	28.967***	18.975**	23.872***	21.064***	29.326***
	(3.44)	(4.27)	(2.46)	(3.07)	(3.31)	(4.01)
TD$_{i,j,t-1}\times$ CDS Spread$_{j,t-1}$	0.083	0.085	0.162*	0.161**	-0.081**	-0.099***
	(1.29)	(1.44)	(1.93)	(2.07)	(-2.59)	(-2.79)
CDS Spread$_{j,t-1}$	-0.086***	-0.138***	-0.142***	-0.248***	-0.007	-0.002
	(-4.72)	(-3.98)	(-4.58)	(-4.06)	(-0.98)	(-0.20)
Dependence on Bank$_{i,j,t-1}$	-6.202***	-6.623***	-6.912***	-7.310***	-1.994***	-2.349***
	(-4.81)	(-4.87)	(-4.91)	(-4.79)	(-2.81)	(-2.87)
Dependence on Fund$_{i,j,t-1}$	-2.685***	-2.663***	-4.351***	-4.384***	-0.698*	-0.798**
	(-3.10)	(-3.03)	(-4.13)	(-3.99)	(-1.72)	(-2.01)
Num of Funds$_{j,t-1}$	0.184*	-0.502***	0.072	-0.489**	0.262***	-0.507*
	(1.71)	(-2.89)	(0.58)	(-2.52)	(3.17)	(-1.68)
Num of Banks$_{i,t-1}$	-0.101	-0.149	0.030	-0.001	-0.207	-0.323
	(-0.64)	(-0.22)	(0.21)	(-0.00)	(-0.89)	(-0.99)
Fund Flow$_{i,t}$	0.006***	0.005***	0.007***	0.006***	0.000*	0.001
	(5.27)	(5.46)	(5.07)	(5.09)	(1.72)	(1.60)
Fund Size$_{i,t-1}$	0.000	0.000	0.000**	0.000	0.000**	0.000
	(1.37)	(0.44)	(2.50)	(0.41)	(2.25)	(1.21)
Fund WAL$_{i,t-1}$	-0.130**	-0.305***	-0.219***	-0.357***	0.024	-0.175***
	(-2.37)	(-3.86)	(-3.15)	(-3.51)	(0.52)	(-3.20)
Fund Yield$_{i,t-1}$	3.485	-24.390	7.457	-31.471	-2.832	7.498
	(0.37)	(-0.99)	(0.53)	(-0.99)	(-0.49)	(0.50)
Constant	27.468***	66.574***	40.047***	94.236***	2.098	29.409*
	(4.27)	(4.42)	(5.14)	(4.91)	(0.47)	(1.92)
Fund FE	No	Yes	No	Yes	No	Yes
Bank FE	No	Yes	No	Yes	No	Yes
Year-Month FE	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.014	0.021	0.019	0.026	0.004	0.014
N of obs	128000	128000	97550	97550	30450	30450

Table 11: **Reciprocal Lending: Two-Way Fixed Effects**

This table reports regression results of reciprocal lending, further controlling for two-way fixed effects and using a monthly dataset of all possible pairs between top 50 MMFs and top 50 banks. Columns (1)-(3) control for bank×month fixed effects, and Columns (4)-(6) control for bank×fund fixed effects. The dependent variable is the net change in outstanding amount of CDs (with maturity over 30 days) between fund i and bank j over a 3-month period. Time Deposit Dummy$_{i,j,t-1}$ equals 1 if fund i and bank j engage in any time deposit transactions at the most recent three month-ends, and zero otherwise. Dependence on Bank$_{i,j,t}$ = Exposure$_{i,j,t}/\sum_j$ Exposure$_{i,j,t} \times 100$, and Dependence on Fund$_{i,j,t}$ = Exposure$_{i,j,t}/\sum_i$ Exposure$_{i,j,t} \times 100$, where Exposure$_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t. Num of Funds$_{j,t-1}$ is the number of funds who lend to bank j at time $t-1$, and Num of Banks$_{i,t-1}$ is the number of banks who borrow from fund i at time $t-1$. Other fund characteristics include Fund Flow$_{i,t}$ (net investor flows of fund i over the same 3-month window as the dependent variable), Fund Size$_{i,t-1}$, Fund WAL$_{i,t-1}$ (weighted average maturity of fund i's portfolio, measured in days), and Fund Yield$_{i,t-1}$ (in basis points). ΔCD$_{i,j,t}$, Fund Flow$_{i,t}$, and Fund Size$_{i,t-1}$ are all measured in million dollars. Standard errors are clustered at the fund level with corresponding t-values in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	Bank×Month FE			**Bank×Fund FE**		
	All	Foreign	Domestic	All	Foreign	Domestic
	(1)	(2)	(3)	(4)	(5)	(6)
Time Deposit Dummy$_{i,j,t-1}$	30.964***	32.399***	16.839***	43.743***	47.778***	18.287***
	(6.36)	(6.20)	(4.08)	(5.58)	(5.70)	(3.58)
Dependence on Bank$_{i,j,t-1}$	-6.791***	-7.709***	-2.579***	-10.716***	-11.750***	-3.765**
	(-5.08)	(-5.13)	(-3.05)	(-4.51)	(-4.60)	(-2.46)
Dependence on Fund$_{i,j,t-1}$	-2.459***	-3.627***	-0.818*	-4.248***	-6.412***	-1.424*
	(-3.31)	(-4.37)	(-1.92)	(-3.40)	(-4.00)	(-1.83)
Num of Funds$_{j,t-1}$	3.666	3.792	-2.579	-0.185	-0.136	-0.285
	(1.48)	(1.52)	(-1.18)	(-0.87)	(-0.56)	(-1.33)
Num of Banks$_{i,t-1}$	-0.146	0.023	-0.499	-0.059	0.184	-0.485
	(-0.21)	(0.03)	(-1.27)	(-0.09)	(0.25)	(-1.26)
Fund Flow$_{i,t}$	0.005***	0.006***	0.001*	0.005***	0.006***	0.001*
	(5.88)	(5.44)	(1.82)	(5.86)	(5.42)	(1.81)
Fund Size$_{i,t-1}$	0.000	0.000	0.000	0.000	0.000	0.000
	(0.63)	(0.52)	(1.28)	(0.84)	(0.84)	(1.32)
Fund WAL$_{i,t-1}$	-0.261***	-0.291***	-0.186***	-0.258***	-0.296***	-0.178***
	(-3.87)	(-3.39)	(-3.39)	(-3.82)	(-3.41)	(-3.34)
Fund Yield$_{i,t-1}$	-21.969	-27.786	6.453	-20.491	-23.453	4.529
	(-0.98)	(-0.97)	(0.41)	(-0.91)	(-0.84)	(0.29)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank×Year-Month FE	Yes	Yes	Yes	No	No	No
Bank×Fund FE	No	No	No	Yes	Yes	Yes
Adjusted R^2	0.069	0.072	0.060	0.031	0.036	0.024
N of obs	142500	111150	31350	142500	111150	31350

Table 12: **Funding Costs of Reciprocal Lending**

This table reports results on funding costs of reciprocal lending. The dependent variable is the yield of CD contract k between fund i and bank j at time t, with CD k's size larger than \$1 million and maturity more than 30 days. Time Deposit Dummy$_{i,j,t-1}$ equals 1 if fund i and bank j engage in any time deposit transactions at the most recent three month-ends, and zero otherwise. CD Size$_{i,j,k,t}$ is in million dollars and CD Maturity$_{i,j,k,t}$ is in days. Dependence on Bank$_{i,j,t}$ = Exposure$_{i,j,t}$/ $\sum_j$ Exposure$_{i,j,t}$ $\times$ 100, and Dependence on Fund$_{i,j,t}$ = Exposure$_{i,j,t}$/ $\sum_i$ Exposure$_{i,j,t}$ $\times$ 100, where Exposure$_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t. Num of Funds$_{j,t-1}$ is the number of funds who lend to bank j at time $t-1$, and Num of Banks$_{i,t-1}$ is the number of banks who borrow from fund i at time $t-1$. Other fund characteristics controls include Fund Size$_{i,t-1}$ (in million dollars), Fund WAL$_{i,t-1}$ (weighted average maturity of fund i's portfolio, measured in days), and Fund Yield$_{i,t-1}$ (in basis points). Standard errors are clustered at the fund level with corresponding t-values in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable: CD Yield$_{i,j,k,t}$						
	All Banks		**Foreign Banks**		**Domestic Banks**	
	(1)	(2)	(3)	(4)	(5)	(6)
Time Deposit Dummy$_{i,j,t-1}$	-0.816***	-0.878***	-0.798***	-0.864***	0.629	0.723
	(-8.19)	(-9.02)	(-8.00)	(-8.71)	(1.33)	(1.55)
log(CD Size$_{i,j,k,t}$)	-0.418***	-0.444***	-0.425***	-0.445***	-0.660***	-0.634***
	(-8.32)	(-9.13)	(-8.16)	(-8.74)	(-5.00)	(-4.59)
log(CD Maturity$_{i,j,k,t}$)	3.506***	3.382***	3.451***	3.305***	3.288***	3.248***
	(41.21)	(45.15)	(40.20)	(43.79)	(31.90)	(33.72)
Dependence on Bank$_{i,j,t-1}$		0.124***		0.122***		0.081*
		(6.64)		(6.09)		(1.97)
Dependence on Fund$_{i,j,t-1}$		0.040***		0.043***		-0.003
		(2.63)		(2.63)		(-0.13)
Num of Funds$_{j,t-1}$		0.016***		0.017***		-0.011
		(4.06)		(4.00)		(-0.83)
Num of Banks$_{i,t-1}$		0.049***		0.048***		0.142***
		(2.91)		(2.79)		(3.81)
Fund Size$_{i,t-1}$		0.000		0.000		0.000**
		(0.53)		(0.11)		(2.17)
Fund WAL$_{i,t-1}$		0.034***		0.030***		0.005
		(5.07)		(4.86)		(0.52)
Fund Yield$_{i,t-1}$		-0.014		-0.020		29.376***
		(-0.37)		(-0.50)		(4.89)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.590	0.595	0.593	0.600	0.558	0.573
N of obs	229549	218346	210757	199714	18792	18632

Table 13: **Funding Costs during European Debt Crisis**

This table analyzes funding costs of reciprocal lending during the European sovereign debt crisis. The dependent variable is the yield of CD contract k between fund i and bank j at time t, with CD k's size larger than \$1 million and maturity more than 30 days. Time Deposit Dummy$_{i,j,t-1}$ equals 1 if fund i and bank j engage in any time deposit transactions at the most recent three month-ends, and zero otherwise. Crisis$_t$ equals 1 for observations between June 2011 and June 2012, and zero otherwise. CD Size$_{i,j,k,t}$ is in million dollars and CD Maturity$_{i,j,k,t}$ is in days. Dependence on Bank$_{i,j,t}$ = Exposure$_{i,j,t}/\sum_j$ Exposure$_{i,j,t} \times 100$, and Dependence on Fund$_{i,j,t}$ = Exposure$_{i,j,t}/\sum_i$ Exposure$_{i,j,t} \times 100$, where Exposure$_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t. Num of Funds$_{j,t-1}$ is the number of funds who lend to bank j at time $t-1$, and Num of Banks$_{i,t-1}$ is the number of banks who borrow from fund i at time $t-1$. Fund characteristics controls include Fund Size$_{i,t-1}$ (in million dollars), Fund WAL$_{i,t-1}$ (weighted average maturity of fund i's portfolio, measured in days), and Fund Yield$_{i,t-1}$ (in basis points). Standard errors are clustered at the fund level with corresponding t-values in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable: CD Yield$_{i,j,k,t}$			
	All	Foreign	Domestic
	(1)	(2)	(3)
Time Deposit Dummy$_{i,j,t-1}$	-1.286***	-1.323***	1.249
	(-7.27)	(-7.50)	(1.27)
Time Deposit Dummy$_{i,j,t-1}\times$ Crisis$_t$	0.806	0.904	-7.833***
	(1.24)	(1.59)	(-3.27)
Crisis$_t$	7.781***	7.876***	2.248**
	(18.55)	(17.51)	(2.46)
log(CD Size$_{i,j,k,t}$)	-0.242***	-0.200**	-0.819***
	(-2.61)	(-2.02)	(-5.79)
log(CD Maturity$_{i,j,k,t}$)	3.042***	3.004***	2.865***
	(37.52)	(34.31)	(24.26)
Dependence on Bank$_{i,j,t-1}$	0.136***	0.125***	0.203***
	(6.91)	(6.11)	(5.36)
Dependence on Fund$_{i,j,t-1}$	0.048***	0.051***	-0.002
	(4.02)	(3.37)	(-0.07)
Num of Funds$_{j,t-1}$	-0.003	-0.003	-0.007
	(-0.64)	(-0.53)	(-0.58)
Num of Banks$_{i,t-1}$	-0.222***	-0.250***	0.224***
	(-4.70)	(-5.16)	(4.20)
Fund Characteristic Controls	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Year-Month FE	No	No	No
Adjusted R^2	0.327	0.326	0.355
N of obs	218346	199714	18632

Table 14: **Funding Costs between Top Banks and Top Funds**

This table reports results on funding costs of reciprocal lending between top 50 MMFs and top 50 banks. The dependent variable is the yield of CD contract k between fund i and bank j at time t, with CD k's size larger than \$1 million and maturity more than 30 days. Time Deposit Dummy$_{i,j,t-1}$ (also shortened fro TD Dummy$_{i,j,t-1}$) equals 1 if fund i and bank j engage in any time deposit transactions at the most recent three month-ends, and zero otherwise. CDS Spread$_{j,t-1}$ is the 5-year CDS spread of bank j at time $t-1$. CD Size$_{i,j,k,t}$ is in million dollars and CD Maturity$_{i,j,k,t}$ is in days. "Fund-Bank Relationships" control for Dependence on Bank$_{i,j,t}$ = Exposure$_{i,j,t}/\sum_j$ Exposure$_{i,j,t} \times 100$, and Dependence on Fund$_{i,j,t}$ = Exposure$_{i,j,t}/\sum_i$ Exposure$_{i,j,t} \times 100$, where Exposure$_{i,j,t}$ represents the total amount of outstanding contracts between fund i and bank j at time t, as well as the number of funds who lend to bank j at time $t-1$, and the number of banks who borrow from fund i at time $t-1$. Fund characteristics controls include Fund Size$_{i,t-1}$ (in million dollars), Fund WAL$_{i,t-1}$ (weighted average maturity of fund i's portfolio, measured in days), and Fund Yield$_{i,t-1}$ (in basis points). Standard errors are clustered at the fund level with corresponding t-values in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable: CD Yield$_{i,j,k,t}$								
	All Banks				**Foreign Banks**		**Domestic Banks**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Time Deposit Dummy$_{i,j,t-1}$	-0.992***	-0.699***	-0.739***	-1.222***	-0.742***	-0.639***	0.700	-0.887
	(-7.98)	(-4.66)	(-8.32)	(-5.33)	(-4.89)	(-7.36)	(1.50)	(-1.48)
TD Dummy$_{i,j,t-1}$×CDS Spread$_{j,t-1}$				0.003				
				(0.96)				
CDS Spread$_{j,t-1}$				0.024***				
				(6.12)				
log(CD Size$_{i,j,k,t}$)	-0.473***	-0.427***	-0.215***	-0.505***	-0.435***	-0.200***	-0.316***	-0.472***
	(-7.76)	(-5.89)	(-3.55)	(-8.07)	(-5.59)	(-2.94)	(-3.98)	(-3.76)
log(CD Maturity$_{i,j,k,t}$)	3.510***	3.375***	2.873***	3.487***	3.390***	2.819***	2.896***	2.807***
	(35.53)	(35.97)	(26.91)	(36.23)	(32.95)	(26.93)	(20.37)	(19.01)
Fund-Bank Relationships	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund Charateristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank×Year-Month FE	No	Yes	No	No	Yes	No	Yes	No
Bank×Fund FE	No	No	Yes	No	No	Yes	No	Yes
Adjusted R^2	0.596	0.681	0.658	0.592	0.673	0.664	0.790	0.638
N of obs	107623	107623	107623	96836	99043	99043	8580	8580