Reciprocity in Shadow Bank Lending: Evidence from the Cross-Holding Relation in Money Market Funds

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Abstract

This paper documents a reciprocal cross-holding relation (CHR) between financial conglomerates: banks mutually hold each other's money market instruments through their affiliated money market funds (MMFs). Using novel security-level holdings data, this study shows that U.S. banks increased their MMFs' portfolio weights on bilateral-connected European financial firms after Moody's downgraded review of European banks in mid-2011, a unique period in which MMFs generally reduced their exposure to European issuers to avoid further redemption. This study provides evidence that this bias represents reciprocity between the bilateral-connected financial firms. In return, during the same period, European financial firms held more risky securities issued by their bilaterally-connected non-European partners through their affiliated MMFs. Issuer- or fund-characteristics do not fully explain the results.

JEL classifications: G21, G32, G10, G14

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"You scratch my back, and I will scratch yours."

—English idiom

1. Introduction

As a key source of wholesale funding in short-term credit markets, money market mutual funds (MMFs) are important intermediaries in the shadow banking system. As of June 2015, assets under the management (AUMs) of MMFs in the United States reached $2.96 trillion.[1] Many financial conglomerates issue money market instruments at the same time that they sponsor MMFs. During 2010–2015, 163 banks issued different financial securities held by U.S. MMFs; more than twenty of these banks had affiliated MMFs. Engaged in both borrowing and lending activities in this shadow banking context, banks borrow from other MMFs, on the one hand, while their affiliated MMFs lend to other banks, on the other. This novel feature of serving dual roles enables two financial conglomerates to mutually lend to each other through their affiliated MMFs, hence, establishing a cross-holding relation (CHR).

When two financial conglomerates are bilaterally-connected in a CHR, a potential *reciprocity* naturally arises. Although MMF lending is market-based and, in theory, should be fully arm's length, this potential reciprocity may bias MMF portfolio holdings toward bilaterally-connected issuers. This paper examines the extent to which the *reciprocal* CHR affects shadow bank lending through MMFs, especially during financial crises in which some banks experience trouble in borrowing.

To understand why a CHR can have a broader influence in the MMF market, it is important to note that dual-role banks bear heavy weight on both the issuer side and the fund side; that the financial securities they issued account for more than 30% of holdings in MMFs' overall portfolios; and that their affiliated MMFs manage more than 46% of the total AUMs of all MMFs.

[1] Data source: The report "Money Market Fund Statistics" by the Division of Investment Management of the U.S. Securities and Exchange Commission in June, 2015.

Analyzing the effect of a cross-holding relation on MMFs' lending poses a significant empirical challenge with regard to endogeneity. MMFs' higher exposure to their bilaterally-connected issuers may also be endogenously associated with these issuers' good creditworthiness. Following Chernenko and Sunderam (2014), this study uses the summer of 2011 as timeframe to address this issue. Securities held by MMFs are supposed to be credit-worthy financial instruments with high liquidity; however, in mid-2011, after Moody's put several European banks under downgrade review as fears about European sovereign debt problems mounted, investors suddenly lost faith in the creditworthiness of European banks, and MMFs with high exposure to these banks suffered large outflows. This shock presents an ideal laboratory environment for my study. During this short, special period, money market instruments issued by European banks were generally viewed as risky; hence, differences in MMFs' portfolio weights of different European banks should be independent of these banks' creditworthiness. The endogeneity issue may be still of concern if issuers with different levels of creditworthiness were not equally affected by the Moody's downgrade review. The novel comprehensive MMF data allow me to mitigate this concern by controlling for time-varying variables and fixed effects on both the issuer side and the fund side.

The other concern is the agency problem between fund families and MMF managers when treating a bank and its affiliated MMFs as a unity. Although mutual funds are normally viewed as stand-alone entities, in the special context of MMFs, it is plausible to conduct a study at the firm-level, as other studies have recently done (e.g., Kacperczyk and Schnabl, 2013)), not only because MMF managers themselves are limited in terms of risk taking and asset selection, but also due to MMFs' dependence on voluntary sponsor support to maintain a stable NAV (Brady, Anadu, and Cooper, 2012; Parlatore, 2016). From a conglomerate's perspective, a financial firm combines affiliated MMFs and issuers, which respectively serve as channels in the short-term credit market to lend and borrow money, and these two channels jointly determine that financial firm's position in this particular market.[2]

[2]Other studies in different empirical settings also jointly consider financial institutions' different departments, see, for example, Ritter and Zhang (2007) of IPO underwriting and mutual fund investment, Massa and Rehman (2008) and Ivashina and Sun (2011) of corporate loan lending and mutual fund investment.

To explore the influence of a reciprocal CHR, I examine how this situation affected MMFs' lending to European banks during the European bank crisis in mid-2011. Prior to June 2011, U.S. MMFs were heavily exposed to European banks to reach for high yield. As shown in Figure 1, a particular U.S. financial conglomerate (e.g., J.P. Morgan)—whose affiliated MMFs lend to a European financial conglomerate (e.g., Deutsche Bank)—also borrows from MMFs that are sponsored by this European financial conglomerate; thus, a CHR is established between these two entities. My tests firstly show that: right after June 2011, U.S. financial conglomerates increased their MMFs' portfolio weights on European banks involved in a pre-existing CHR with them. This response is quite surprising given that MMFs had, in general, reduced their exposure to European banks since June 2011 to avoid further investor redemptions due to panic about the solvency of European banks that mounted during that special period. The second part of this paper digs deeper, finding that banks' increasing their MMFs' portfolio weights represents reciprocity behind a CHR: the bilateral connection provides an implicit guarantee when one side involved is in trouble. The third part of this article reveals that this change is also related to a negative lending spillover onto Non-European issuers, reflecting that this short-term credit market is not frictionless.[3]

My tests start by examining the change of MMFs' exposure to European banks around mid-2011. After June 2011, an average MMF increases its exposure to a bilaterally-connected European issuers by 0.35% of portfolio weight; in contrast, its portfolio weight on every other unconnected European issuer drops by 0.23% of portfolio weight. Next, to ensure that this finding is not driven by some observable or unobservable features of a certain issuer or a certain fund, I use difference-in-differences models to test the change of lending, with the control of characteristics and fixed effects at both the issuer-level and the fund-level. Multivariate regressions show that, after June 2011, holding the issuer fixed, European issuers receive more lending from the MMFs that are in a pre-existing CHR with them, but not from other MMFs; likewise, holding fixed the MMF, funds finance less to unconnected European issuers, but lend more to their bilaterally-connected

[3]In Appendix F., I conduct a similar natural experiment in the context of the 2013 Dodd-Frank stress tests. The findings show that, if MMFs are involved in CHR with the bank holding companies (BHCs) who are revealed to have low tier 1 common ratio in the stress test, they increase their portfolio weights on these BHCs after the disclosure of test results.

European partners. Although issuers who can build a CHR must be conglomerates, my main findings are robust after controlling for firm size. Therefore, the results are unlikely to be driven by the "too big to fail" phenomenon. MMFs' bias in connected European issuers is not present in placebo specifications before the 2011 European bank crisis. A broader comparison including non-European issuers proves further that the findings are not driven by some unobservable changes on all bilaterally-connected fund-issuer pairs.

Chernenko and Sunderam (2014) conducted a study of a negative relationship between fund flow and fund's *Euro Share*, and show that MMFs with greater exposure to European banks before mid-2011 suffer greater outflows in the June–August 2011 period. So it is possible that MMFs' bias toward bilaterally-connected European issuers is because these funds do NOT suffer outflows driven by their exposure to European banks. However, my test shows that MMFs involved in a CHR with European issuers suffer significant outflows driven by their increase in *Euro Share*, hence the negative flow-*Euro Share* relationship does, indeed, exist in those funds. A surprising implication of this finding is that, although bearing large outflows driven by *Euro Share* after June 2011, MMFs involved in a CHR with European issuers still bias the portfolio weights toward them.

Another possibility is that the securities issued by European banks to their bilaterally-connected MMFs are more secure, so that MMFs are willing to tilt to these issuers after June 2011. However, I do not find any evidence that securities issued by MMFs' bilaterally-connected European issuers are less risky than MMFs' other holdings after mid-2011. The results are robust after controlling for characteristics and fixed effects at both the issuer-level and the fund-level. Therefore, MMFs' holding bias on connected European issuers is also not likely to be driven by differences in money market instruments' riskiness.

At this point in the study, I test reciprocity behind a CHR, which motivates MMFs to tilt toward bilaterally-connected European issuers. To be specific, I analyze the *reverse* fund-issuer pairs in a bilateral connection—namely, the lending from the original issuer's affiliated MMF to the original fund's sponsor. For example, as shown with the blue arrow in Figure 1, the fund-

issuer pair with Deutsche Bank-affiliated MMFs as the fund and JP Morgan as the issuer is a reverse pair. Testing with difference-in-difference models, I find that the *Holdings Risk* increases significantly more in reverse pairs than in any other fund-issuer pairs during June-August 2011. A deeper look into different holdings shows that portfolio weight of risky securities in reverse pairs increases by 10.17 basis points, while the portfolio weight of safest instrument decreases by 6.53 basis points. Together, the two changes contribute to the increase of *Holdings Risk* in reverse pairs. These findings provide direct evidence of reciprocity between connected financial conglomerates: a European bank, through its affiliated MMFs, accepts more risky securities issued by its connected partner, though risky securities are unpopular in the MMF market after mid-2011. This action can be interpreted as paying compensation for these partners' help in increasing their MMFs' lending to the European bank.

Lastly, I examine how the nature of a CHR is related the spillover effect on Non-European issuers who borrow money from the MMFs involved in a CHR with European firms. Funds only have limited funding on hand, especially after mid-2011, when many of them suffered significant net outflows. If a MMF decides to increase its portfolio weight on one issuer, it has to cut off financing to some other issuers. In a market that is not frictionless—because of the problem of information asymmetry—issuers that get a lending cut may have difficulty borrowing from other MMFs in a short period of time. The increase of lending from MMFs involved in a CHR to their bilaterally-connected European issuers affects a larger base of Non-European issuers, given that more than half of money market instruments are held by these funds in the MMF market. Echoing the spillover effect in Chernenko and Sunderam (2014), I find the Non-European issuers suffer reduction in financing after mid-2011, if they borrows from these MMFs before mid-2011.

My paper adds to the recent growing body of literature on shadow bank lending in the context of MMFs. To the best of my knowledge, it is the first paper to show how financial conglomerates coordinate with each other by building a cross-holding relationship in order to realize *quid pro quo*. The reciprocal cross-holding relation is different from the reciprocal bundling strategy between MMFs and banks in Li (2017), which treats MMFs and banks as independent borrowers and

lenders, respectively, and explores how they cooperate in the face of contradictory post-crisis regulations on liquidity. In my study, reciprocity is rooted in financial conglomerates' nature of serving dual roles as borrowers and lenders in a particular market.

One strand of the MMF literature focuses on implicit guarantees inside financial institutions. Both Kacperczyk and Schnabl (2011) and Parlatore (2016) show that financial institutions that sponsor money market mutual funds act as providers of implicit guarantee to those funds, thus MMFs' risk-taking incentives are affected by whether the funds can get sponsors' support. My findings show that reciprocity can serve as a driver of implicit guarantees between financial institutions.

My work also relates to the major body of MMF studies about risky yield-reaching behavior. Different reasons motivate MMFs to take risks before the 2007-2010 financial crisis, for example, expanding risk-taking opportunities and the positive flow-yield relation (Kacperczyk and Schnabl, 2013), low administrative fees (Chodorow-Reich, 2014), the macro environment with zero-bound interest rate (Di Maggio and Kacperczyk, 2017), and tournament motivation of fund managers (La Spada, 2018).[4] My tests, though conducted in the post-crisis period, show that being involved in a pre-existing CHR with issuers of risky securities can also explain some risky holdings in MMFs' portfolios.

This paper also joins the broader literature on connections between different divisions under the umbrella of one financial conglomerate. For example, Ritter and Zhang (2007) find that investment banks allocate their underwritten hot IPOs to their affiliated funds to boost the funds' performance and thus attract more money; Massa and Rehman (2008) show that funds increase their portfolio weights on the firms that borrow from their affiliated banks in the period following the deal. Ivashina and Sun (2011) find that institutional participants in loan renegotiations subsequently trade in the stock of the same company. These papers focus on the Chinese-wall issue of the conflict of interests within one financial institution.[5] Taking a slightly different tack, my study

[4] Other papers in MMFs studies focus on MMFs behaviors during crises, see, for example, McCabe (2010), Strahan and Tanyeri (2015), and Schmidt, Timmermann, and Wermers (2016).

[5] See Mehran and Stulz (2007) for a summary of the conflict of interest.

focuses on the cooperation between two financial institutions through their different departments.

The rest of the paper proceeds as follows: Section 2 provides the background information and develops two main testing hypotheses. Section 3 describes the data. The methodology and major results are presented in Section 4. I conclude in Section 5.

2. Background and Hypotheses Development

This section explains cross-holding relation in the MMF market, reviews the European bank crisis, and develops hypotheses that will be tested.

2.1 CHR in the U.S. MMFs Market

MMFs invest in high-quality assets like short-term securities, liquid debt and monetary instruments, which are normally considered to be safe. Unlike other mutual funds, MMFs are allowed by the SEC's Rule 2a-7 to use the amortized cost pricing method to keep a constant $1 per share NAV, hence they have always been viewed as safe as cash until the 2008 crisis, when MMFs experienced extraordinary stresses originating from defaults of some short-term debt in their portfolio holdings. To improve MMFs financial stability, a number of substantial reforms by the SEC were adopted in 2010 and 2014.[6]

One important reform is that funds must report their portfolio details by filing form N-MFP every month. The SEC's N-MFP form classifies all U.S. MMFs into five categories: prime fund, treasury fund, government/agency fund, single state fund, and other tax exempt fund. The abbreviation "MMF" in this paper refers to prime money market funds because they mainly invest in non-government securities.

As shown in Figure 2, multiples roles are played by different financial firms in the MMF

[6]For more details about these reforms see Gallagher, Schmidt, Timmermann, and Wermers (2015b) and Hanson, Scharfstein, and Sunderam (2015).

market: some, such as American Century Investment and Waddell & Reed Financial, only stand on the fund side, sponsoring MMFs; some, such as Barclays and RBS, stand on the issuer side only, issuing different money market instruments; the rest, such as JP Morgan and Deutsche Bank, stand on both the fund and the issuer sides. For the third type serving dual roles, under the umbrella of one financial conglomerate, affiliated MMFs provide funding to other money market instruments issuers, meanwhile, affiliated investment banks or security companies receive funding from other MMFs. [7]

Serving the dual roles of both the fund and the issuer provides two financial firms opportunities to establish bilateral connections. For example, as shown in Figure 1, through its affiliated MMF, JP Morgan can hold short-term money market instruments issued by Deutsche Bank's banking department; meanwhile, Deutsche Bank's affiliated MMF can also hold short-term money market instruments issued by JP Morgan's banking department.

2.2 The European bank Crisis in 2011

Since the 2008 crisis, MMFs experienced their most rapid period of outflows during the European bank crisis of 2011. The very beginning of this crisis can be traced back to 2009, when Greece's sovereign debt was revealed to be massively understated because of accounting issues. Investors then kept worrying about high default chances of Greece and some other European countries, and panic soon spread. As a consequence, investors doubted European banks' solvency, because those banks were exposed to the European bank economy and held a large amount of sovereign debt from countries in trouble. On June 13, 2011, Standard and Poor's downgraded Greek sovereign debt to CCC; on June 15th, Moody's placed large French banks BNP Paribas, Credit Agricole, and Societe Generale on review for possible downgrade because of these banks' exposure to Greece; in July, Moody's downgraded Portugal and Ireland. Following that, investors' worries spread contagiously

[7] This market also involves a small group of non-financial institutions: the U.S. government, who is the issuer of Treasuries, agencies or municipals who issue agency or municipal debt, and non-financial firms, whose non-financial commercial papers, account for a very small proportion in MMFs portfolio holdings.

until covering much of the European continent. As a result, CDS premiums on banks in core European countries rose markedly.

This series of events created a disaster for European financial institutions' creditworthiness in that summer. Right after mid-2011, the concern of European financial institutions' credit quality motivated U.S. investors to redeem from MMFs with high exposure to European bank risk. From June to July, prime MMFs lost roughly $113 billion as outflows (Gallagher et al., 2015a). By the end of August 2011, the assets under their management declined by 11% (Chernenko and Sunderam, 2014). Facing large redemptions, U.S. MMFs sharply reduced their investments in European banks.

2.3 Hypothese Development

This paper's interest is whether and how CHR biases lending of MMFs. However, it is ambiguous to simply conduct a direct test, because CHR could be endogenously correlated with issuers' characteristics, especially their creditworthiness. The time window around the European bank crisis in June, 2011 creates a laboratory environment: money market instruments issued by European banks, though had always been considered to be safe, suddenly raised fear among investors. An intuitive question following this fact is: is there any difference in portfolio weights between MMFs' bilaterally-connected and -unconnected European issuers after the European bank crisis?

I focus on the March-August 2011 period and separate the entire sample into two symmetric parts: March-May and June-August 2011, which respectively represent the pre- and post-periods of Moody's put downgraded reviews on European banks.[8] Chernenko and Sunderam (2014) show that MMFs with greater exposure to European banks suffer greater outflows after June, 2011. Thus, if the lending of MMFs is fully market-based, MMFs should have decreased their exposure to all European issuers so that they would not intensify further investor redemptions; in other words,

[8]The choose and separation of the same sample period follows Chernenko and Sunderam (2014).

all European issuers would have seen decline in MMFs' funding. However, the pre-existing CHR brings potential reciprocity, which will be reflected in the lending from a bank's affiliated MMFs to the bank's bilaterally-connected European partners. As shown in Figure 3, J.P. Morgan's MMFs would treat two European issuers—Deutsche Bank which is bilaterally-connected with J.P.Morgan and RBS which is not—differently.

Hypothesis One. In the post-period, MMFs increase their portfolio weights of the European banks which are in pre-existing CHR with the funds' sponsors.

This hypothesis should emphasize the control of the issuer-fixed effect and the fund- fixed effect, in case that MMFs (issuers) involved in CHR are different from other MMFs (issuers) by nature, and it is these differences that drive the difference in lending between the pre- and post-periods. To be specific, after the European bank crisis: (1) the funding a given European bank receives from MMFs would be different, depending on whether the bank is in CHR with a fund's sponsor; (2) a given MMF's portfolio weights on European banks would be different, depending on whether the fund's sponsor is in CHR with a bank.

Next, I directly investigate whether MMFs' bias towards bilaterally-connected issuers is driven by reciprocity. For each fund-issuer pair in CHR, there is always a reverse fund-issuer pair in which the fund is affiliated with the original issuer and the issuer is the original fund's sponsor. Given the nature that two parties involved in CHR have stakes in each other, the securities in the reverse pair can be the reflection of reciprocity. As shown in Figure 4, when J.P. Morgan's MMFs tilt their portfolio weight to Deutsche Bank, money market instruments issued by J.P. Morgan and hold by Deutsche Bank's MMFs could also be different from money market instruments in other fund-issuer pairs. Here comes the second hypothesis, which discusses the motivation of the fund side if Hypothesis One is true.

Hypothesis Two. In the post-period, securities held in reverse fund-issuer pairs are different from securities in other fund-issuer pairs.

Hypothesis Two, if true, implies that the European side of a CHR should provide some benefits

as a return to its connected partner, and this compensation is reflected in the portfolio holdings of the European bank's affiliated MMFs.

3. Data and Summary Statistics

I collect data from different sources. This paper has a novel dataset based on the SEC form N-MFP, which all U.S. money market funds are required to report each month since November 2010.[9] N-MFP forms provide information on three levels: 1) fund-level data on gross yields, TNAs, maturities, advisors, etc.; 2) class-level data on Nasdaq tickers, net yields, shareholder flow activities (gross subscription and gross redemption) etc.; 3) holdings-level data on each security's issuer, yield, maturity date, value, maturity, type etc. The detailed classification of different types of securities can be found in the Appendix B. N-MFP forms classify MMFs into five categories: "prime", "treasury", "government/agency", "single state fund" and "other tax exempt fund". My focus is prime MMFs because they are major MMFs investing in non-government securities. In addition, I filtered out 35 feeder funds that make almost all of their investments through master funds.

More fund information is complemented by the CRSP Mutual Fund Database. 89.34% of N-MFP class-level observations are able to be linked to CRSP,[10] which gives class-level expense ratios, types (institutional or retail), ages, etc. The study is conducted on the fund- series level so all class-level characteristics (e.g. net yield, age, expense ratio) are finally aggregated to the fund level weighted by values of class assets. Names of funds and security issuers are not reported uniformly in N-MFP forms. I use Factset and Bloomberg to get funds' and issuers' formal names as well as headquarter locations. Issuers that are sovereign, agency, municipal, or non-financial firms are removed from the data. For each fund, I also obtain their sponsor names from the SEC

[9] SEC requires funds to file N-MFP within five business day after each month ends, but forms would not be publicly available until 60 days after. The same data are used by Chernenko and Sunderam (2014), Hu, Pan, and Wang (2015), and Li (2017).

[10] I match N-MFP data with CRSP Mutual Fund Database by Nasdaq tickers first; then I manually match the rest whose Nasdaq tickers are wrong or missing in N-MFP by checking class names and fund advisor names.

form N-SAR. Lastly, I collect European issuers' CDS information from the Markit CDS pricing database as a control measure of European borrowers' credit risk. Throughout this paper I use five-year CDS rates that are measured in USD and are with the "Modified-Modified" restructuring clause.[11]

The resulting dataset covers the November 2010-August 2013 period, but most of our analyses focus on the March-August 2011 period, during which there are 216 financial firms. Figure 5 gives a snapshot. In total, there are 77 financial firms sponsoring funds and 163 financial firms issuing money market instruments. The two sides' overlapping are 24 financial firms serving dual roles, 19 Non-European and 5 European, their names are listed in the Appendix C. The fund-side financial firms own a total of 264 unique MMFs, which together manage monthly average assets of $1.76 trillion during the sample period. Although one third of financial firms on the fund side serve dual roles, they sponsor 40% of MMFs, and their total AUM occupy almost half of all MMFs' AUM. The issuer-side financial firms issue securities with a monthly total value of $1.23 trillion. About 15% of financial firms on the issuer side are also fund-sponsors; securities issued by them account for 31% in value of all issued securities in the MMF market. These facts indicate that, no matter on the fund side or on the issuer side, only big financial firms are capable to act dual roles. This feature is even more pronounced for European firms. Securities issued by the five dual-role firms take around one fourth of all European issuers' security value. Comparing Panel A with Panel C, on the issuer side, European financial firms are fewer than non-European financial firms in numbers, but they accounts for more than 60% in the value of issued securities. This summary conforms to the documented fact by Ivashina, Scharfstein, and Stein (2015) that a large share of dollar liabilities are issued by foreign banking entities.

[Insert Table 1 about here]

Panel A of Table 1 reports summary statistics of month-fund observations during the whole sample period. The average fund has $7051.88 million in net asset (TNA) and is 18.62 years

[11] For CDS rates only shown in Euro in the Markit database, I convert them to USD ones using real-time exchange rates.

old; 33.24% of its shares are for institutional investors and its portfolio maturity is 38.40 days. Comparing stand-alone MMFs (lender only) and dual-role MMFs (whose sponsors also issue money market instruments in the MMF market), dual-role MMFs have larger TNA, younger fund age, more tilted ownership towards institutional investors, and slightly lower expense ratios. The fund flow calculated as the difference between *Subscription* and *Redemption* shows that the size of an average dual-role fund decreases by 0.40% monthly while the one of an average stand-alone fund increases by 0.16%; this difference can be related to the former's higher exposure to European debt (41.13%), which might be a main trigger of investors' redemption. Moreover, dual-role funds invest 14.40% of their assets on their connected partners. Standard deviations of annualized *Gross Yield* and *Net Yield* shows MMFs are heterogeneous in reaching for yield, and dual-role funds are more prone to reach for yield than their stand-alone peers. In term of portfolio holdings, the average fund invests 25.53% in *ABCP* (asset backed commercial paper) and *Financial CP* (financial commercial paper), 17.95% in *Bank Obligation*; portfolio holdings of dual-role funds and stand-alone funds are quite similar in these three categories. However, dual-role funds hold far fewer secure debt issued by government or agencies but more insecure debt such as other repurchase agreements. The detailed information of different types of securities in MMFs portfolio holdings is reported in Table A.1 of the Appendix B.

Panel B reports summary statistics of month-issuer observations during the whole sample period. The average issuer issues $8.63 billion market instruments, with an average yield of 30.48 bps and an average maturity of 38.88 days, takes an average MMF portfolio weight of 2.39% from around 40 MMFs. Comparing issuers-only and dual-role issuers (who have affiliated MMFs), dual-role issuers issue more money market instruments to larger numbers of MMFs, account for higher weight in MMF portfolios, and provide a lower average yield with a shorter maturity. In term of security types, the average issuer mainly issues *ABCP*, *Bank Obligation*, and *Financial CP*. Comparing issuers-only and dual-role issuers, *ABCP* and *Government/Agency Repo* occupy larger weight in dual-role issuers' security pool, while issuers-only weigh much more on *Bank Obligation*.

My detailed empirical analysis is conducted on the fund-issuer pair level, namely one fund-issuer pair in every month is one observation in the sample. Lending is measured by the exposure of fund f to issuer i at month t:

$$Exposure_{f,i,t} = \frac{Outstanding_{f,i,t}}{\sum_i Outstanding_{f,i,t}},$$

where $Outstanding_{f,i,t}$ is the total value of money market instruments that are issued by issuer i and held by fund f in month t, and $\sum_i Outstanding_{f,i,t}$ is the total value of fund f's portfolio holding in month t. Therefore, *Exposure* represents a given fund f's portfolio weights to different issuers i in month t. When t is one of the three months in the post-period, I use the average $\sum_i Outstanding_{f,i}$ of the pre-period as the denominator, so that *Exposure* is not passively affected by the change in the total value of fund f's portfolio after June, 2011.

To measure the riskiness of each fund-issuer pair, I apply three risk measures suggested by Kacperczyk and Schnabl (2013). The first one is *Spread*, namely an asset's gross yield net of one-month T-bill rate. After adjusting for time varying interest rate, this measure largely reflects asset risk. The second one is *Maturity*, namely an asset's days-to-maturity. Intuitively, the longer the days-to-maturity, the larger the uncertainty in an asset. Each issuer may have multiple issued securities in one fund's portfolio, so for each fund-issuer pair, both *Spread* and *Maturity* are firstly measured on the fund-security level, and then are averaged to the fund-issuer level by weighing assets value. The last one is *Holdings Risk*, calculated as the weight of an issuer's bank obligations net of the weight of its safest securities in the same portfolio. The safest securities include government repo, agency repo and Treasury repo. All variable definitions appear in Appendix A.

[Insert Table 2 about here]

Table 2 reports summary statistics of pair-month observations during the whole sample period. The median fund-issuer pair has $44.99 million outstanding, but the distribution is skewed, with

mean outstanding of $2.16 billion. The median pair's MMF portfolio weight is 2.1%, with an average spread of 20.40 bps and an average maturity of 36.26 days. The distribution of *Holdings Risk* is also skewed with mean of 25.61 bps and median of 0.00 bps.[12] In panel B, I list the summary statistics of pairs whose issuers are from Europe. The above five characteristics of these pairs are quite similar to the ones of the entire pair sample.

4. Methodology and Empirical Results

In this section I describe the tests employed to estimate the hypothesized bias in MMFs' portfolio weights towards bilaterally-connected issuers (Hypothesis One), and the hypothesized difference of securities in reverse pairs (Hypothesis Two). I also add a discussion about how MMFs' tilt to connected European issuers is associated with negative lending spillovers to other issuers who also borrow money from these funds.

4.1 Construction of CHR Measures

According to the definition of CHR, a pair (f,i) has a dummy *BConneced* equal to one if both $Exposure_{f,i,t}$ and $Exposure_{i,f,t}$ are larger than zero when t is one of the three months in the pre-period. It means that, before mid-2011,when fund f holds securities issued by issuer i, if i also has an affiliated MMF that simultaneously holds securities issued by f's sponsor, then this fund-issuer pair is called "bilaterally connected".

A fund-issuer pair (f,i) is called "reverse pair" if the fund f is sponsored by a European financial firm and, simultaneously, this European firm's money market instruments are also owned by the issuer i's affiliated MMFs (for example, in Figure 1, the fund-issuer pair with Deutsche Bank affiliated MMFs as the fund and JP Morgan as the issuer is a reverse pair). Obviously "reverse pair" is a bilaterally-connected pair in which MMFs are under the umbrella of European

[12] Securities in pairs with zero *Holdings Risk* are neither bank obligations nor safe assets like repos.

financial houses.

[Insert Table 3 about here]

Table 3 gives an overview of connected and unconnected fund-issuer pairs in the sample during the whole March-August 2011 period. The observed number of bilaterally connected pairs is far smaller than that of unconnected ones: only above 6% of fund-issuer pairs (1947 month-pairs) are reflections of CHR. This fact is reasonable given that the numbers in Figure 5 already show not every entity in this market has the capacity to both sponsor MMFs and issue money market instruments. Generally speaking, a fund weighs 3.07% of its portfolio holdings on every bilaterally-connected issuer, more than the weight on unconnected ones; as a comparison, the lending value of $204.91 million per pair in connected pairs is higher than $160.70 million in unconnected ones, while risk exposure proxies such as yield, net yield and days-to-maturity are lower. The facts jointly imply that CHR is associated with lending at a larger dollar amount and lower risk exposure. It is worth noting that a fund's portfolio weight on a connected issuer can reach as high as 10.27%, which is far larger than the five percent issuer diversification limit required by the SEC since the 2014 MMF reform (which is launched later than this paper's testing period.)

4.2 Tests of Hypothesis One

4.2.1 Univariate Analysis

I start my empirical analysis by testing the first hypothesis. I investigate how MMFs' lending to bilaterally-connected and unconnected European issuers changes around the European bank crisis.

[Insert Table 4 about here]

Panel A in Table 4 presents the univariate statistics and *t*-test of differences in MMFs' European exposure between the post- and pre-periods. Given the relative small number of pairs involved in CHR, I use a bootstrap method to generate the empirical distribution of connected pairs'

Exposure difference under the null hypothesis. Specifically, for each pair in the connected sample, I randomly select with replacement a pair who has a European issuer. This process continues until each pair in our original connected sample is represented by a pair with European issuer in this pseudo-connected sample. Then I estimate the mean of *Exposure* difference in the pseudo-connected sample. This yields one observation of differences in MMFs' European exposure between the post- and pre-periods. This entire process is repeated until I have 1,000 pseudo-connected samples, and thus 1,000 mean *Exposure* difference observations. These 1,000 mean *Exposure* difference observations are used to approximate the empirical distribution of mean *Exposure* difference for connected pairs.

On average, if a European issuer is bilaterally connected with a fund, after the European bank crisis, the fund's exposure to this connected partner increases by 0.35% measured in portfolio weight; in contrast, a fund's portfolio weight on every unconnected European issuer drops by 0.23%. The corresponding economic implication is surprising: after Moody's review on European banks in June 2011, an average U.S. MMF financed every connected partner in Europe $29.58 million more while cut off $19.66 million in lending to every other European borrower. Both differences are statistically significant at 5% at least. The other noteworthy fact is, in both the pre- and post-periods, the average exposure of connected pairs almost doubles that of unconnected ones.

For comparison, I show results of the same univariate test for non-European issuers in Panel B of Table 4. The empirical statistical reference of connected pairs is also generated by the similar bootstrap method in Panel A. Generally speaking, exposure in fund-issuer pair here is less than that in Panel A, which is in line with the fact that European securities take a large share in the dollar dominated MMF market. After the crisis, funds add weights on both connected and unconnected issuer, although the difference of exposure in connected pairs is statistically insignificant and much smaller than the difference in unconnected ones. This change is consistent with documented facts that MMFs turned to non-European borrowers after the crisis in Europe broke out.

4.2.2 Multivariate Analysis

A. The Difference-in-Differences Test

My first hypothesis focuses on real effects of CHR on MMFs' lending to European issuers. The univariate analysis above provides preliminary evidence that MMFs' lending to bilaterally-connected and unconnected European issuers changes in different directions after the European bank crisis. However, this phenomenon may be driven by issuers' or funds' other characteristics. To control for these factors, in the following section, I use multivariate regressions to test the change in each fund-issuer pair's *Exposure*. The results are reported in Table 5. My analysis is based on the following multivariate regression model:

$$\begin{aligned} Exposure_{f,i,t} =& \alpha + \beta_1 BConnected_{f,i} \times Post + \beta_2 BConnected_{f,i} \\ &+ \beta_3 Post + \lambda_1 Control_{f,t} + \lambda_2 Control_{i,t} + \varepsilon_{f,i,t}, \end{aligned} \tag{1}$$

where *Exposure* is fund-issuer pairs' exposure winsorizd at the 5th and 95th percentiles;[13] *BConnected* is a dummy equal to one for all bilaterally connected fund-issuer pairs in the pre-period; *Post* equals one when the month t is in the post-period; $Control_{f,t}$ and $Control_{i,t}$ form a group of control variables on the issuer side and the fund side respectively, including the natural logarithm of fund TNA ($Fund\ Size_{f,t}$), fund net yield ($Net\ Yield_{f,t}$), fund expense ratios ($Expense\ Ratio_{f,t}$) and fund-level institutional share proportions ($Institutional\ Share_{f,t}$), fund flows ($Fund\ Flow_{f,t-1}$) and issuer's five-year CDS rates ($CDS\ Rate_{i,t}$). The month-fixed effect accounts for any time differences that may drive risk differences across fund-issuer pairs. Similarly, unobserved time-invariant differences among issuers, funds, fund-sponsors or issuer type are controlled by the issuer-, the fund-, the sponsor-fixed or the issuer-type-fixed effect. All issuers are put into seven categories: "Conglomerate", "Bank", "Investment Company", "Insurance Company", "Government", "Agency", "Non-financial Firms". I consider error terms to be within funds and within issuers, therefore standard errors are two-way clustered at the fund level and the issuer level.

[13] The results are similar without winsorization and with it at different levels (1st and 99th, 10th and 90th).

[Insert Table 5 about here]

From Column 1 to Column 5, consistent with the univariate analysis, I find a strong positive relationship between the bilateral connection and fund-issuer pairs' exposure in the post-period: after mid-2011, CHR increases a MMF's exposure to the corresponding European issuer by 0.36%–0.45% of its portfolio holdings, which means the lending amount in per connected fund-issuer pair is inflated by $34.76–$42.95 million. The results are statistically and economically significant: in the post-period, CHR corresponds to a 18.9%–23.35% increase in *Exposure* relative to the cross-sectional standard deviation of *Exposure* to European issuers.

An identification concern is that bilaterally connected issuers are less risky, and so that they became more popular in the post-period when MMFs were prone to escape from risky issuers. I address this problem by adding European issuers' five-year CDS rates across all columns as a control variable of issuers' default risk. Results show that MMFs' *Exposure* to European issuers is less for issuers with higher CDS rate. Plus, it is also less for funds with larger size, higher expense ratio and lower institutional share.

Moreover, the issuer-fixed effect is included in Column 2 to Column 4, where *BConnected* and *Post* lose their statistical significance, indicating the positive (negative) relationship between the bilateral connection (the post-period) and *Exposure* mirrors some persistent nature from issuers. However, the positive coefficient of $BConnected \times Post$ remains statistically significant, therefore, MMFs' tilt of portfolio weight to bilaterally-connected European issuers is very unlikely to be associated with these issuers' creditworthiness. As predicted by Hypothesis One, in the post-period, holding fixed the issuer, MMFs finance less to unconnected European issuers but lend more to their bilateral connected European partners.

A similar identification concern also exists on the fund side. Although funds' key characteristics have been controlled, my results might be also driven by unobserved time-invariant differences among funds or fund-sponsors. These fund-level or sponsor-level characteristics may be associated with funds' building-up of bilateral connections. I address this problem by including the fund-fixed

effect in Column 1 and Column 3 to Column 5, as well as the sponsor-fixed effect in the last two columns. These specifications do not change the quality of previous results but support Hypothesis One which also predicts that, in the post-period, holding fixed the MMF, European issuers receive more finance support from the MMFs belonging to their bilaterally-connected financial firms.

Undoubtedly, issuers who have the capacity of building CHR with MMFs are prone to be conglomerates with different departments running under their umbrellas. Complying with the "too big to fail" intuition, one explanation of MMFs' higher exposure on bilaterally-connected issuers after the crisis is these issuers are secured because they are conglomerate. Although this feature of being conglomerate has been controlled by the issuer-fixed effect, to further distinguish it from the bilateral connection, I control the issuer-type-fixed effect in Column 4. I also add a dummy *Conglomerate* in Columns 5. My main findings are robust. Although the bilateral connection of this paper's focus is proven to be different from the conglomerate effect, Column 5 indicates that being a conglomerate also helps issuers to gain funding from MMFs in the post-period.

B. Placebo Tests

To ensure the difference-in-differences (DD) test above is not biased, I conduct placebo tests in this section to analyze the DD test's sensitivity. The idea is to redo the same test using data prior the post-period, although due to the limitation of the N-MFP data's time span, I can only track back to November 2010, when MMFs are required to disclose their portfolio holdings in detail to SEC for the first time.

Using the data from November 2010 to May 2011, I conduct two placebo tests following the specification 1. Both placebo tests, as the true one, are six-month long and include all fund-European issuer pairs. The first(last) three months in each placebo sample are called the pre-(post-) period. The goal is to investigate whether we observe similar changes in MMF portfolio holdings surrounding placebo cutoffs as we do around the mid-2011 cutoff. These placebo tests provide evidence on the extent to which MMF portfolio weights of bilaterally-connected and -unconnected pairs are different before the 2011 European bank crisis.

[Insert Table 6 about here]

Both Panel A and B in Table 6 indicate that there are no significant differences in MMF portfolio weight between bilaterally-connected and -unconnected pairs which have European issuers in the two placebo tests. The difference-in-differences in the two six-month placebo samples are both insignificant. Thus, it does not appear that our results are mechanically driven by a trend happened before the 2011 European bank crisis.

C. Comparison among All Issuers

This section includes non-European issuers to show how fund-issuer pairs' *Exposure* changes in the entire sample between the pre- and post-periods. Table 7 presents results of the following multivariate regression model:

$$\begin{aligned} Exposure_{f,i,t} =& \alpha + \beta_1 BConnected_{f,i} \times Post \times European\ \ Issuer_i \\ &+ \beta_2 BConnected_{f,i} \times Post + \beta_3 BConnected_{f,i} \times European\ \ Issuer_i \\ &+ \beta_4 Post \times European\ \ Issuer_i + \beta_5 BConnected_{f,i} + \beta_6 Post \\ &+ \beta_7 European\ \ Issuer_i + \gamma Control_{f,t} + \varepsilon_{f,i,t}, \end{aligned} \tag{2}$$

where *Exposure*, *BConnected* and $Control_{f,t}$ are the same as these defined in the specification 1; *European Issuer* is a dummy equal to one if the issuer *i* is from Europe. The month fixed effect accounts for any time differences that may drive risk differences across fund-issuer pairs. Similarly, unobserved time-invariant differences among issuers, funds or fund-sponsors are controlled by the issuer-, the fund- or the sponsor-fixed effect, and standard errors are two-way clustered at the fund level and the issuer level.

[Insert Table 7 about here]

From Column 1 to Column 4, I find that, in the post-period, a MMF's portfolio weight on European issuer decreases by 0.13%-0.22%; however, the bilateral connection increase a fund's portfolio weight on an connected European issuer by 0.46%-0.54%. In comparison, the coefficients

of the interaction terms between *BConneced* and *Post*, and the one between *BConneced* and *European Issuer* are both close to zero. Hence, the bias in MMFs' portfolio weight is neither universal across all issuers in the post-period nor common for all European issuers during the entire sample period.

4.2.3 MMF Flows

MMFs' bias towards bilaterally-connected European issuers in the post-period is puzzling in the context that, as documented by Chernenko and Sunderam (2014). Before digging the motivation behind CHR, it's necessary to test whether the outflow consequences in the post-period of MMFs' European exposure documented by Chernenko and Sunderam (2014) still hold among MMFs involved in CHR with European issuers. In other words, if the biased MMFs are not exposed to the outflow consequence, then it's not surprising that they increase stakes on bilaterally-connected European issuers.

To show how flows of different MMFs respond to funds' risk-taking activities in the two periods, I apply the following multivariate regression model:

$$Fund\ \ Flow_{f,t} = \alpha + \beta_1 Euro\ \ Share_{f,t} + \gamma Control_{f,t} + \varepsilon_{f,t}, \tag{3}$$

where $Fund\ Flow$s are funds' net flows scaled by one-month lagged fund assets, the ratios are winsorized at the 5th and 95th percentiles. *Euro Share* is the share of a fund's assets invested in European financial firms. $Control$ includes the monthly $Fund\ Size$, *Institutional Share*, and *Net Yield*. The month fixed effect accounts for any time differences that may drive flow differences across MMFs.

[Insert Table 8 about here]

Table 8 presents results. The tests are conducted in the pre- and post-periods separately. Panel A covers all MMFs, and Panel B and Panel C are subsamples of MMFs involved and not

involved in CHR with European financial firms. As shown in Column 3 and 4 of Panel A, when we regress fund flows on *Euro Share* in the post-period, the effect of *Euro Share* is significantly negative. The same two columns in Panel B show similar results: for MMFs involved in CHR with European issuers, a one-standard-deviation increase in *Euro Share* is associated with annualized fund flows of -8.23% of assets. Given their mean annualized fund flows in the post-period were -18.30%, the effect of *Euro Share* is not negligible. As a comparison, results in Column 3 and 4 of Panel C are insignificant, though still negative. In a word, the negative *Flow-Euro Share* relation documented by Chernenko and Sunderam (2014) is concentrated in MMFs that are bilaterally-connected with European issuers. Combining this with the findings of portfolio weight bias in the previous sections, it is surprising that, even though investors evaluate the exposures of their MMFs to European banks, these MMFs still increase their portfolio weight on bilaterally-connected European issuers while bearing large outflows driven by *Euro Share* in the post-period.

Another interesting finding in Table 8 is that net yield plays different roles in the two periods. In the pre-period, funds show a strong performance-flow relationship: higher-yielding funds attract more fund flows, and this relationship is prone to MMFs not involved in CHR with European issuers. In the post-period, however, net yield fails to drive flows.

4.2.4 Securities Comparison

A further look of relationship lending is to check if it is associated with differences in riskiness of securities issued by connected and unconnected issuers.

[Insert Table 9 about here]

For fund-issuer pairs with European issuers, Table 9 presents the univariate statistics and *t*-test of differences in securities' riskiness between the post- and pre-periods. The empirical statistical reference of connected pairs is generated by the similar bootstrap method in Section 4.2.1. In Panel A and Panel B, both connected- and unconnected-pairs behave in the same pattern: surrounding

the European bank crisis, the change of *Spread* is close to zero, while *Maturity* is reduced by 9-10 days. A slightly different pattern appears in Panel C: *Holdings Risk* does not change for connected pairs but increases by 3.42 base points for unconnected pairs. In a word, although the cross-holding relationship make a difference in lending, there is no differences in securities' riskiness. A further multivariate analysis using the difference-in-difference model in Appendix E. also confirms this finding.

4.3 Tests of Hypothesis Two

As shown above, MMFs increased exposures to bilaterally-connected European partners after the European bank crisis, but this bias is not related to securities' riskiness. In other words, it is not because their connected European issuers provided less risky money market instruments that makes MMFs tilt to these issuers after mid-2011. Then here comes the question: what other benefits could MMFs get from helping their bilaterally-connected European partners after the crisis?

There is reciprocity between two financial firms involved in CHR with each other. The nature of the bilateral connection is that both parties mutually hold each other's debt, therefore, MMFs of the European financial firms also have stakes in their bilaterally-connected partners. To test the reciprocity effect, I turned my eyes to the reverse lending, which is portfolio holdings of MMFs who are sponsored by European financial firms.

4.3.1 Univariate Analysis

I compare "reverse pairs" with other fund-issuer pairs surrounding the European bank crisis.[14]

[Insert Table 10 about here]

Four different variables are tested. The corresponding univariate statistics and *t*-test of differences are presented in Table 10. The empirical statistical reference of reverse pairs is

[14]Bilateral connected pairs with European issuers are excluded.

generated by the similar bootstrap method in Section 4.2.1. In Panel A, funds' exposure in reverse pairs increases by 0.13% while that in other pairs does not change. Stronger evidence is show in Panel D: *Holdings Risk* increases by 5.74 base points for reverse pairs but decreases by 2.79 base points for other pairs. These findings suggest that, in the post-period, comparing with other fund-issuer pairs, MMFs sponsored by European financial firms increase their portfolio holdings of money market instruments issued by their connected issuers, moreover, these MMFs also accept more risky securities than safest securities from their connected issuers. Panel B and Panel C do not show the similar pattern: both reverse and other pairs experience declines in securities' *Spread* and *Maturity*.

4.3.2 Multivariate Analysis

A more detailed comparison is made by estimating the following regression model:

$$\begin{aligned} Lending_{f,i,t} = &\alpha + \beta_1 Reverse\ \ Pair_{f,i} \times Post + \beta_2 Reverse\ \ Pair_{f,i} + \beta_3 Post \\ &+ \beta_4 BConnected_{f,i} + \beta_5 European\ \ Issuer_i + \beta_6 European\ \ Fund\ \ Sponsor_f \\ &+ \gamma Control_{f,t} + \varepsilon_{f,i,t}, \end{aligned} \tag{4}$$

where *Lending* is measured by *Exposure*, *Spread*, *Maturity* and *Holdings Risk* respectively. *European Issuer* is a dummy equal to one if the issuer is an European firm. *European Fund Sponsor* is a dummy equal to one if the fund's sponsor is an European firm. Other independent variables are the same as these defined in specifications 1 and 2. I consider error terms to be within funds and within issuers, therefore standard errors are two-way clustered at the fund level and the issuer level.

[Insert Table 11 about here]

Table 11 reports the results when *Lending* is measured by *Holdings Risk*.[15] Across all columns,

[15]The results when *Lending* is measured by the other three measures are presented in A.4.

estimates of β_1 are positive and statistically significant at the level of 1%: *Holdings Risk* in reverse pairs increases 13.84-15.46 basis points after the European bank crisis. This finding is robust after controlling different fixed effects, especially the pair's feature of being bilaterally connected (*BCoonected*), the issuer's feature of being a European firm (Column 4), and the fund-sponsor's feature of being a European firm (Column 5). As a comparison, estimates of β_3 are negative and statistically significant at the level of 10%: *Holdings Risk* generally decreases 3.17-5.57 basis points in the post-period.

These findings imply that, after the European bank crisis, although MMFs usually hold LESS insecure securities than secure ones, European financial firms that owns MMFs accept MORE insecure securities than secure ones from their bilaterally-connected partners. According to Chernenko and Sunderam (2014), insecure money market instruments were popular in the pre-period because their high yields were what yield-reaching MMFs were chasing, but this popularity soon went to the opposite side in the post-period when MMFs turned to less risky assets to avoid further redemption. Clearly, getting a MMF to accept insecure securities is hard in the post-period. I interpret the surprising change in *Reverse Pair*s' *Holding Risk* as European firms' compensation for, as shown in Section 4, these bilaterally-connected partners' continual financing the corresponding European financial firms after mid-2011.

Holdings Risk is calculated as the weight of an issuer's bank obligations net of the weight of its safest securities in the same portfolio. To give a deeper look into *Holdings Risk*, in Table 12, I test the changes in the two components separately.

[Insert Table 12 about here]

Column 1 to 5 show that portfolio weight of bank obligations in reverse pairs increases 7.35-10.17 basis points after the European bank crisis. Column 6 to 10 show that portfolio weight of safest instrument in reverse pairs decreases 5.23-6.53 basis points after the European bank crisis. The two changes together contribute to the increase of *Holdings Risk* in reverse pairs.

Results above find evidence in favor of Hypothesis Two about reciprocity. To be specific, the

fact that financial firms tilt in their MMFs' portfolios to bilaterally-connected European issuers is associated with the corresponding European financial firms' acceptance of—through their affiliated MMFs—more risky bank obligation and less safest instruments like repos from these financial firms after the European bank crisis, a period when both European debt and risky securities are unwelcome while safe repos are popular in the MMF market.

4.4 Spillover Effects

Analyses in previous two sections are all about direct impacts of CHR. Given the small ratio that bilaterally-connected pairs take (5%) in the full sample of fund-issuer pairs, people may question how deeply and widely CHR affects the overall MMF market. In this section, I start a discussion about how MMFs' tilt to connected European issuers is related to the influence on other issuers who also borrow money from these funds.

Due to the limited available funding on MMFs' hand, especially in the post-period when a lot of MMFs suffered big net outflows, if a MMF decides to increase its stake in one issuer, it has to cut off financing to some other issuers due to financial constraints, then these issuers may meet difficulties to borrow money from other lenders in a short time due to frictions in lending.

Now I introduce a variable $SEuro\ \ Fund\ \ Share$. If an issuer is not held by any fund that has bilaterally-connected European issuers in the pre-period, then $SEuro\ \ Fund\ \ Share_i = 0$ otherwise $SEuro\ \ Fund\ \ Share_i = 1$. I then put all issuers in the sample into two groups based on $SEuro\ \ Fund\ \ Share$.

[Insert Table 13 about here]

In Table 13, we can see that 165 financial firms borrow money from $SEuro\ \ Fund$s before mid-2011, namely more than half of issuers can be indirectly affected by CHR in the post-period. On average, issuers in this group are big borrowers in terms of their debt outstanding in the MMF market, indicating influences on them may represent big impacts on the entire issuer side. Plus,

this group has more European issuers as well as high-yield securities.

Then I apply the following test in Chernenko and Sunderam (2014):

$$\Delta Outstanding_i = \alpha + \beta Issuer\ \ Euro\ \ Share_i + \varepsilon_i, \tag{5}$$

where $\Delta Outstanding$ is the percentage change in the issuer's average $Outstanding$ between the pre- and post-period; $Issuer\ \ Euro\ \ Share$ measured an issuer's indirect exposure to European financial firms, calculated as :

$$Issuer\ \ Euro\ \ Share_{i,t} = \frac{\sum_f Outstanding_{f,i,t} \times Fund\ \ Euro\ \ Share_{f,t}}{\sum_f Outstanding_{f,i,t}},$$

given $Fund\ \ Euro\ \ Share$ is a fund's total exposure to European issuers. In the regression, I use each issuer's average $Issuer\ \ Euro\ \ Share$ in the pre-period. To release the identification concern that issuers' $Issuer\ \ Euro\ \ Share$ and $SEuro\ \ Fund\ \ Share$ are associated with their creditworthiness, I also control for each issuer's $Yield$ and $European\ Issuer$ dummy.

[Insert Table 14 about here]

As shown in Table 14, the negative effect of being financed by MMFs that have large European issuer exposure on other issuers, as documented in Chernenko and Sunderam (2014), is only found in issuers who borrow money from $SEuro\ \ Fund$s. The inclusion of $Yield$ and $European\ Issuer$ does not change this impact, suggesting the results are not driven by MMFs general aversion to risk in the post-period. However, I do not find significant similar results for issuers not relying on $SEuro\ \ Fund$s. Plus, the distributions of $Issuer\ \ Euro\ \ Share$ in the two groups are very similar. These findings indicate the two groups of issuers are very different in whether or not they are easily affected by their indirect exposure to European issuers. Those financial firms borrowing money from MMFs who are bilaterally connected with European issuers are prone to have trouble in borrowing money from other MMFs in the post-period if their old lenders cut off the financing.

5. Conclusion

In the context of the U.S. money market funds, this paper studies the existence and influence of a reciprocal cross-holding relation between financial conglomerates. Applying the market turmoil in European banks in mid 2011 as an exogenous event, I show that non-European financial firms increase their MMFs' stakes in bilateral-connected European financial firms after Moody's review of some European banks in mid-2011 while MMFs generally reduced their exposure to European borrowers at the same time. I provide evidence that this change is motivated by reciprocity. I further show CHR also creates negative spillovers on Non-European issuers.

My findings improve the current understanding of lending behaviors of "shadow banks". Especially how financial conglomerate coordinates with each other to realize *quid pro quo* in shadow bank lending.

References

Brady, S. A., Anadu, K. E., Cooper, N. R., 2012. The stability of prime money market mutual funds: Sponsor support from 2007 to 2011. Federal Reserve Bank of Boston, Risk and Policy Analysis Working Papers 12-3.

Chernenko, S., Sunderam, A., 2014. Frictions in shadow banking: Evidence from the lending behavior of money market funds. Review of Financial Studies 27, 1717–1750.

Chodorow-Reich, G., 2014. Effects of unconventional monetary policy on financial institutions. NBER Working Paper 20230.

Di Maggio, M., Kacperczyk, M., 2017. The unintended consequences of the zero lower bound policy. Journal of Financial Economics 123, 59–80.

Gallagher, E., Schmidt, L., Timmermann, A., Wermers, R., 2015a. By force of flow: Investor behavior and money market fund risk allocations during the eurozone crisis. Working paper.

Gallagher, E., Schmidt, L., Timmermann, A., Wermers, R., 2015b. The stability of money market mutual funds: the effect of the 2010 amendments to rule 2a-7. Working paper.

Hanson, S. G., Scharfstein, D. S., Sunderam, A., 2015. An evaluation of money market fund reform proposals. IMF Economic Review 63, 984–1023.

Hu, G. X., Pan, J., Wang, J., 2015. Tri-party repo pricing. NBER Working Paper 21502.

Ivashina, V., Scharfstein, D. S., Stein, J. C., 2015. Dollar funding and the lending behavior of global banks. The Quarterly Journal of Economics 130, 1241–1281.

Ivashina, V., Sun, Z., 2011. Institutional stock trading on loan market information. Journal of Financial Economics 100, 284–303.

Kacperczyk, M., Schnabl, P., 2011. Implicit guarantees and risk taking: evidence from money market funds. NBER Working paper .

Kacperczyk, M., Schnabl, P., 2013. How safe are money market funds. The Quarterly Journal of Economics 128, 1073–1122.

La Spada, G., 2018. Competition, reach for yield, and money market funds. Journal of Financial Economics 129, 87–110.

Li, Y., 2017. Reciprocal lending relationships in shadow banking. Working paper .

Massa, M., Rehman, Z., 2008. Information flows within financial conglomerates: Evidence from the banks–mutual funds relation. Journal of Financial Economics 89, 288–306.

McCabe, P., 2010. The cross section of money market fund risks and financial crises. federal reserve board finance and economics discussion series. Working paper .

Mehran, H., Stulz, R. M., 2007. The economics of conflicts of interest in financial institutions. Journal of Financial Economics 85, 267–296.

Parlatore, C., 2016. Fragility in money market funds: Sponsor support and regulation. Journal of Financial Economics 121, 595–623.

Ritter, J. R., Zhang, D., 2007. Affiliated mutual funds and the allocation of initial public offerings. Journal of Financial Economics 86, 337–368.

Schmidt, L., Timmermann, A., Wermers, R., 2016. Runs on money market mutual funds. American Economic Review 106, 2625–57.

Strahan, P. E., Tanyeri, B., 2015. Once burned, twice shy: Money market fund responses to a systemic liquidity shock. Journal of Financial and Quantitative Analysis 50, 119–144.

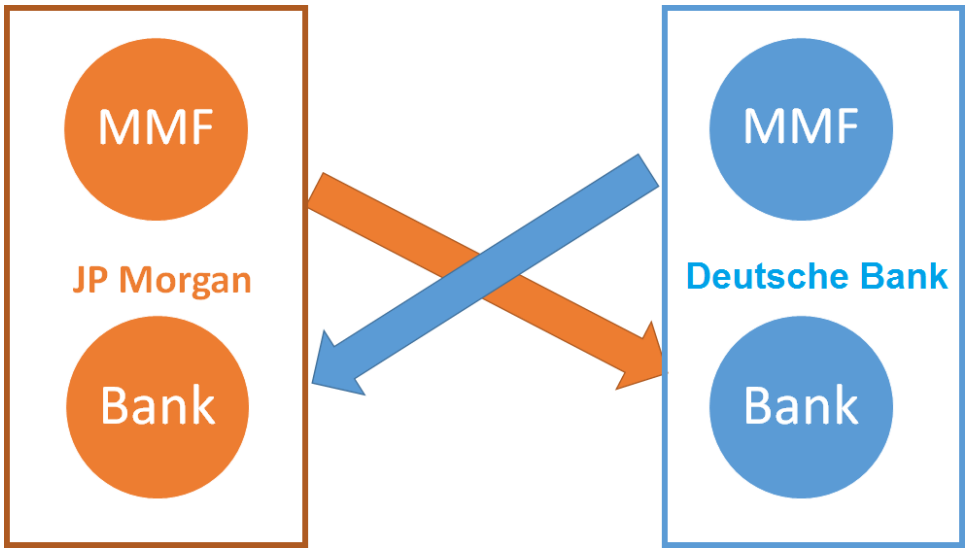


Figure 1: An example of cross holding relation (CHR) of two financial firms in the MMF market

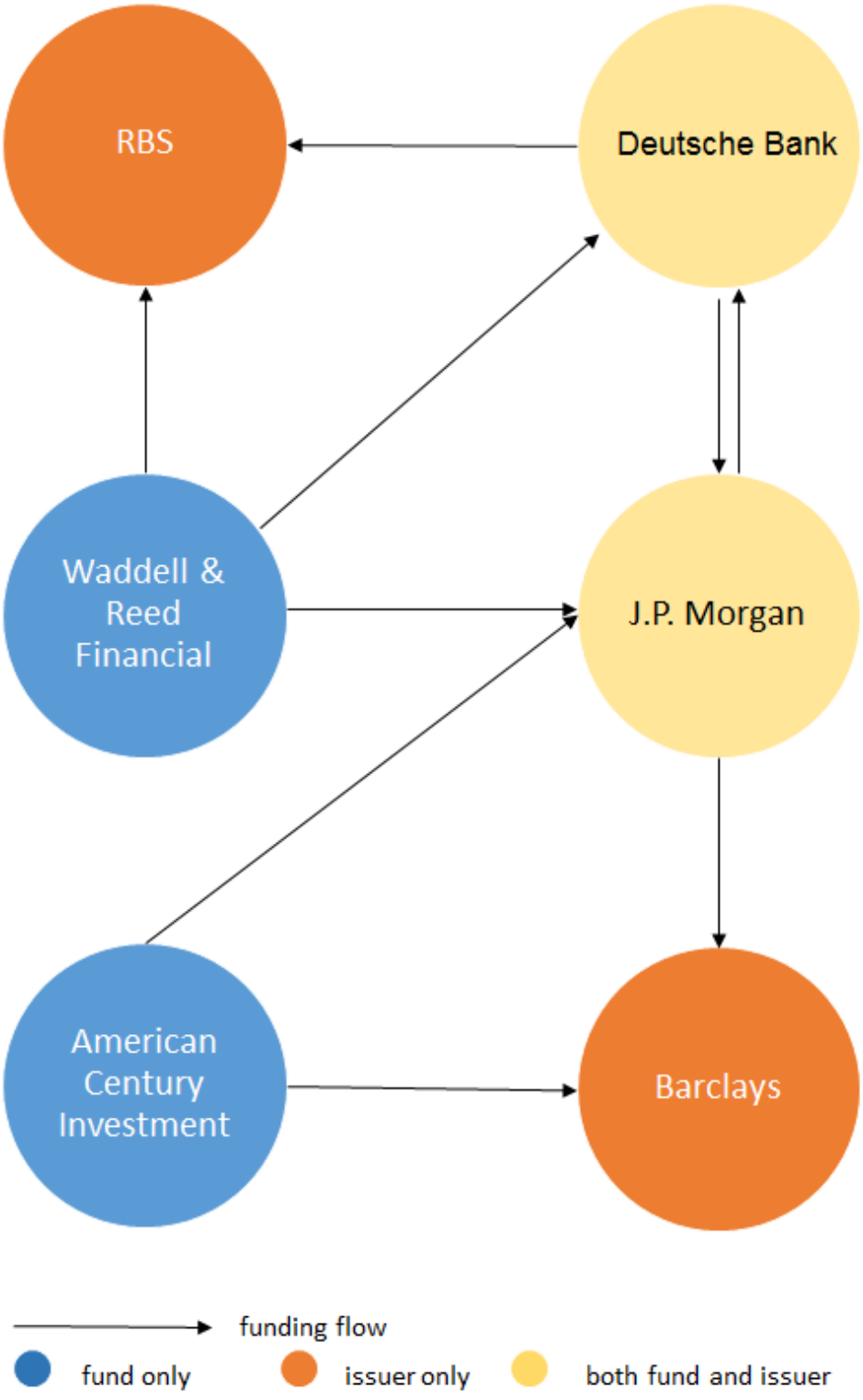


Figure 2: An illustration of different financial firms in the MMF market

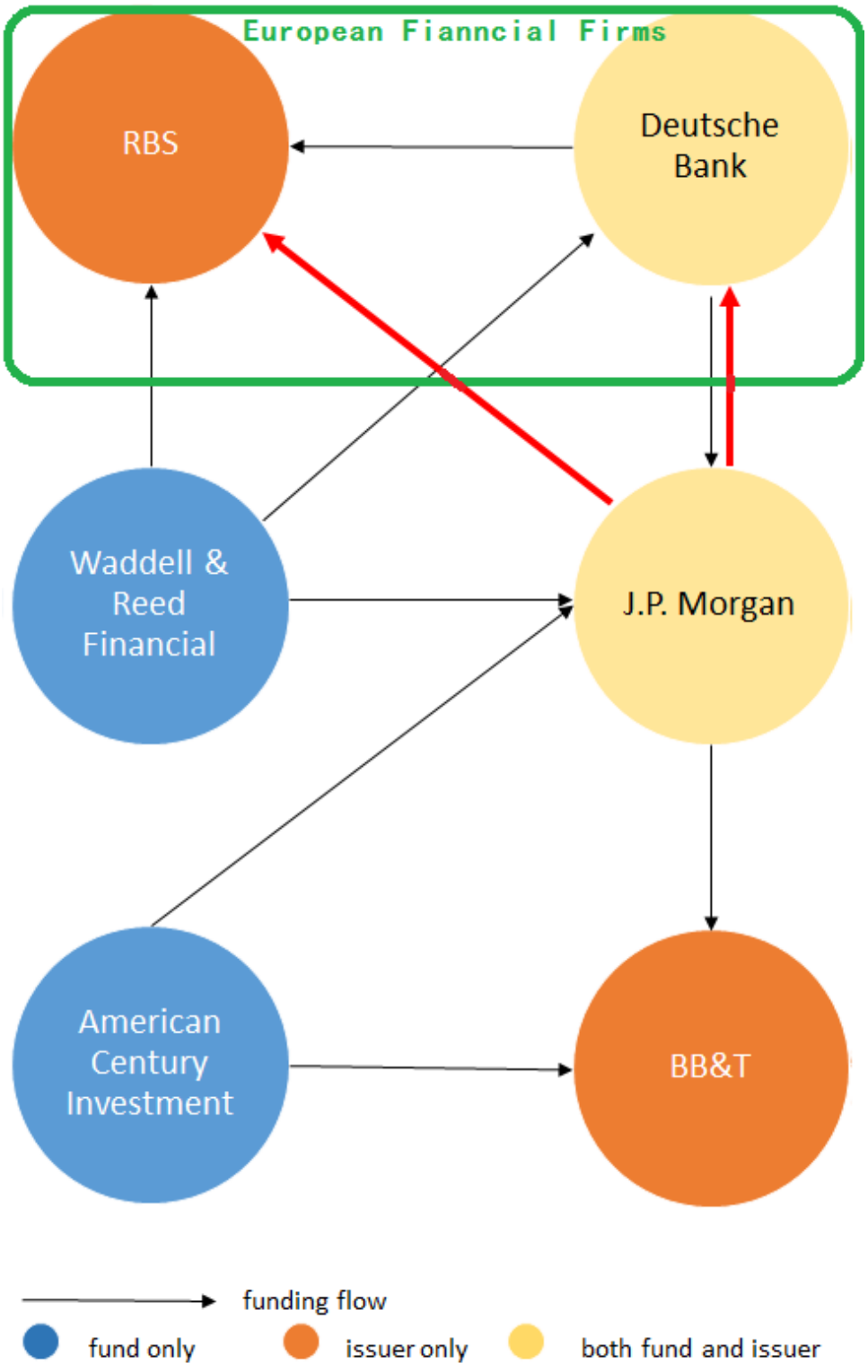


Figure 3: An illustration of Hypothesis One

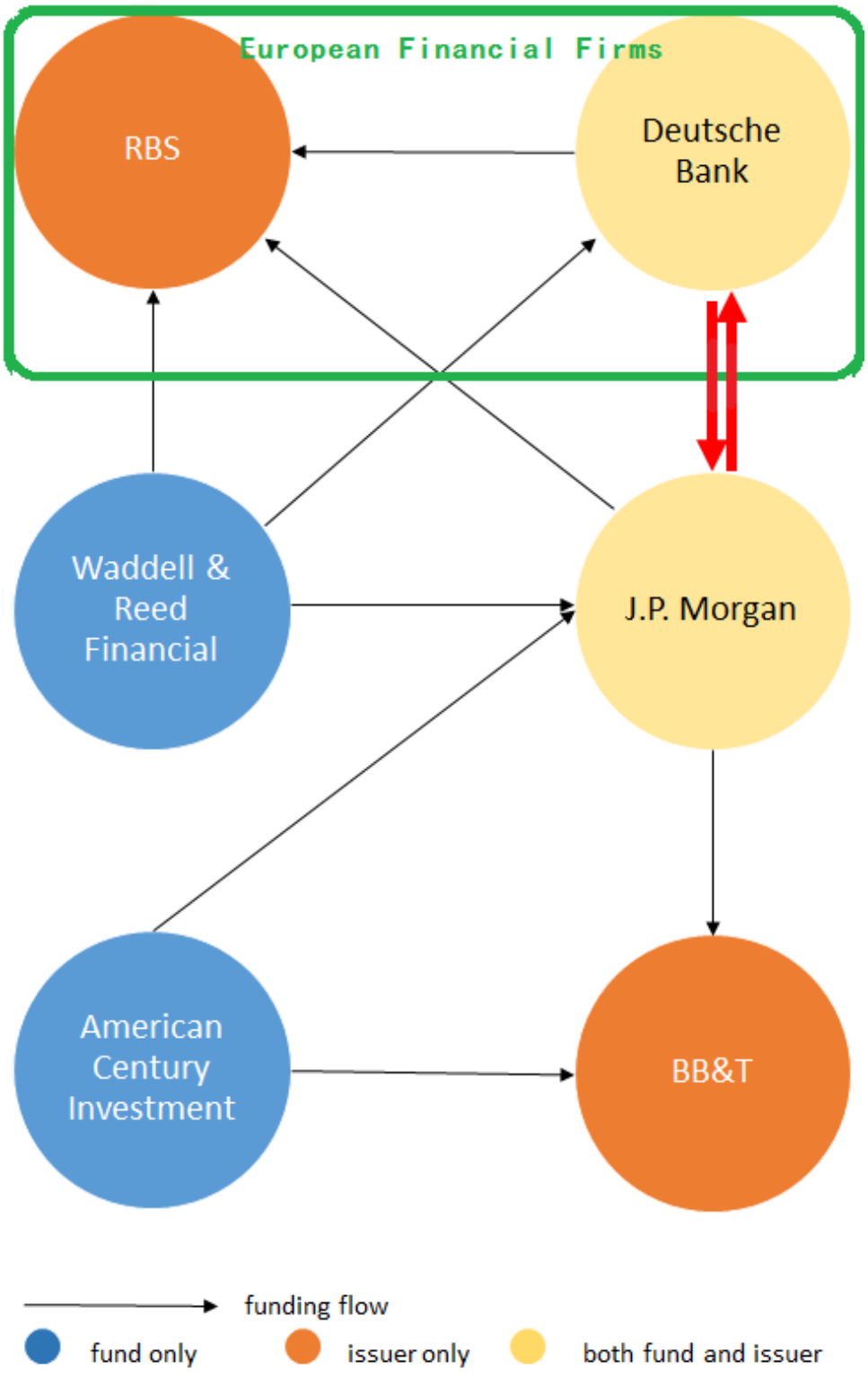
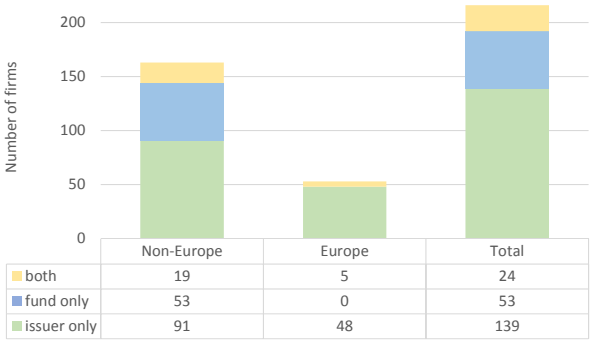
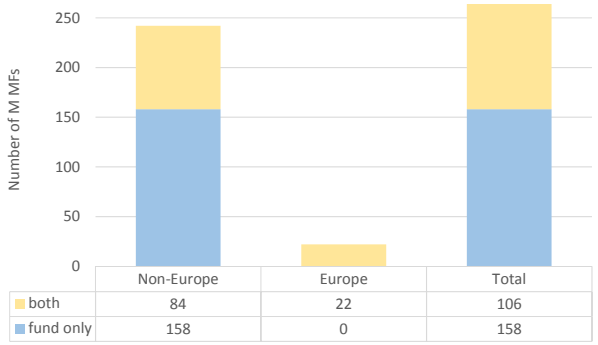


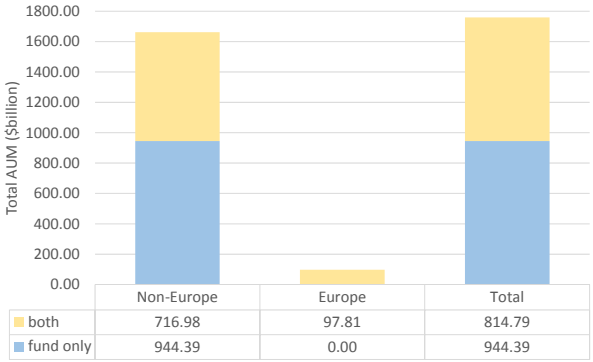
Figure 4: An illustration of Hypothesis Two



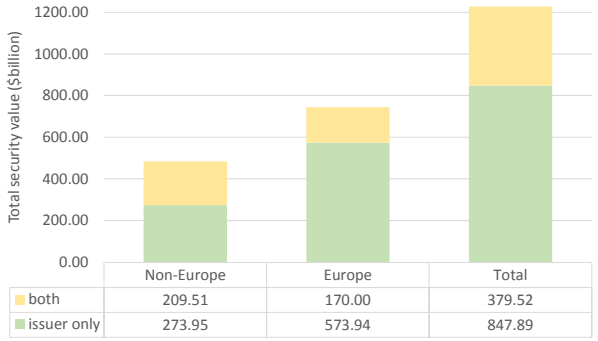
(a) Number of financial firms



(b) Number of MMFs



(c) Total assets under management of MMFs ($ billions, monthly average)



(d) Securities' total value ($ billions, monthly average)

Figure 5: Financial firms in the MMF market during the whole March-August 2011 period

Panel A reports summary statistics of prime money market funds in the sample during the whole March-August 2011 period. *Total Net Asset*, *Portfolio Maturity* are as reported in N-MFP. *Age*, *Institutional Shares* and *Expense Ratio* are value-weighted averages of class-level characteristics from CRSP. *Fund Flow* is the difference between *Subscription* and *Redemption*, which are value-weighted averages of the same class-level items from N-MFP. *Gross Yield* is the annualized fund-level 7-day gross yield from N-MFP. *Net Yield* is the value-weighted average of annualized class-level 7-day net yield from N-MFP. *Conncted Share* is the share of fund's assets invested in bilaterally-connected partners. *Euro Share* is the share of fund's assets invested in European banks. Standard deviations are presented in the parentheses. Panel B reports summary statistics of issuers that are financial firms in the sample during the whole March-August 2011 period. For an issuer, $Outstanding$ is the total value of its issued money market instruments, *Portfolio Weight*,*Yield*, *Net Yield* and *Maturity* are value-weighted averages of these instruments' MMF portfolio weight, yield, net yield and maturity, respectively. Standard deviations are presented in the parentheses.

Table 1: Summary Statistics: Funds and Issuers

	Mean	SD	Mean	SD	Mean	SD
Panel A: Funds						
	All		Stand-Alone Funds		Dual-Role Funds	
			Fund Characteristics			
Total Net Assets ($billions)	7.05	16.23	2.26	5.14	9.63	19.29
Institutional Share(%)	33.24	43.23	22.91	37.28	39.14	45.26
Age(years)	18.62	8.36	19.81	8.29	17.94	8.32
Portfolio Maturity(days)	38.40	11.08	38.34	11.51	38.43	10.85
Expense Ratio(bps)	28.35	9.40	30.01	11.95	27.56	7.76
Gross Yield(bps)	22.76	7.50	20.74	7.52	23.87	7.25
Net Yield(bps)	3.43	7.83	2.59	5.34	3.88	8.85
Fund Flow(bps)	-20.82	2237.97	15.78	946.20	-40.50	2687.24
Connected Share (%)	7.22	10.29	0.00	0.00	14.40	10.38
Euro Share (%)	36.38	16.57	27.02	17.07	41.13	14.11
			Instrument Shares(%)			
ABCP	10.41	11.86	9.67	13.11	10.81	11.10
Bank Obligation	17.95	16.22	10.79	13.21	21.84	16.38
Financial CP	15.12	10.78	15.05	12.32	15.16	9.84
Government/Agency	23.53	18.91	32.01	24.25	18.94	13.14
Non-financial CP	8.50	14.21	13.85	16.19	5.59	12.06
Government/Agency Repo	8.50	11.51	6.43	11.96	9.63	11.11
Treasury Repo	3.13	7.26	2.12	5.33	5.59	12.06
Other Repo	2.14	5.03	0.63	4.03	9.63	11.11
Other	7.98	8.09	6.28	7.92	8.89	8.04
Panel B: Issuers						
	All		Issuers Only		Dual-Role Issuers	
			Issuers Characteristics			
Outstanding ($billions)	8.63	15.17	7.18	14.10	15.81	18.02
Exposure (%)	2.39	2.3	2.22	2.52	3.22	1.61
Weighted Average Yield (bps)	30.48	20.42	32.7	21.69	20.13	6.28
Weighted Average Net Yield (bps)	26.1	20.07	28.3	21.32	15.88	6.08
Weighted Average Maturity (days)	48.5	42.97	50.44	44.79	39.11	31.22
Number of Funds	40.01	53.34	32.88	49.78	75.14	56.48
			Issuers Shares (%)			
ABCP	10.46	26.22	8.55	25.11	19.69	29.45
Bank Obligation	39.16	42.23	43.62	43.49	17.51	26.51
Financial CP	26.62	36.35	27.47	37.23	22.51	31.49
Non-financial CP	11.2	27.69	12.42	29.76	5.25	12.23
Government/Agency Repo	3.71	12.94	1.61	9.21	13.88	21.1
Treasury Repo	0.01	0.08	0.01	0.08	0.03	0.06
Other Repo	2.25	8.22	0.87	4.04	8.96	16.23

Table 2: Summary Statistics: Fund-Issuer Pairs

	N	Mean	SD	Percentile		
				25	50	75
Panel A: All						
Outstanding ($1M)	34129	215.78	514.47	10.00	44.99	190.09
Exposure (%)	34129	2.73	2.71	1.05	2.10	3.64
Spread (bp)	29398	21.04	12.30	13.80	20.40	27
Maturity (days)	33918	54.27	58.85	11.62	36.26	75
Holdings Risk (bp)	34129	25.61	55.30	0.00	0.00	93.14
Panel B: European Issuers						
Outstanding ($1M)	17385	256.75	570.57	12.30	53.99	230.00
Exposure (%)	17385	2.97	2.75	1.21	2.35	3.93
Spread (bp)	14924	23.05	12.39	16.00	22.20	29.2
Maturity (days)	17317	50.66	52.03	12.94	36.10	70.41
Holdings Risk (bp)	17385	27.78	54.06	0.00	0.00	89.68

This table reports summary statistics of fund-issuer pairs in the sample during the whole March-August 2011 period. For each fund(f)-issuer(i) pair, *Exposure* is the value weight of an issuer's securities in a fund's portfolio holdings, *Outstanding* is the total value of money market instruments that are issued by issuer i and held by fund f in month t, *Spread* is a security's gross yield net of one-month T-bill rate. *Maturity* is a security's days-to-maturity. For each fund-issuer pair, both *Spread* and *Maturity* are value-weighed average. *Holdings Risk* is the weight of an issuer's bank obligations net of the weight of its safest securities in the same portfolio. The safest securities include government repo, agency repo and Treasury repo.

Table 3: Connected versus Unconnected Fund-Issuer Pairs

					Percentile				
		N	Mean	SD	Min	25	50	75	Max
CON	Exposure (%)	1947	3.07	2.74	0.25	0.98	2.21	4.25	10.27
	Outstanding ($1M)	1947	204.91	300.31	1.94	16.50	72.01	250.06	1129.00
	Yield (bps)	1674	19.99	8.67	5.00	13.58	19.97	26.23	35.44
	Net Yield (bps)	1674	15.07	8.46	0.00	9.00	15.00	21.14	30.82
	Maturity (days)	1947	34.77	38.14	1.00	3.53	20.64	52.75	133.00
UCON	Exposure (%)	32182	2.49	1.75	0.30	1.06	2.10	3.61	6.66
	Outstanding ($1M)	32182	160.70	253.76	0.79	10.00	43.00	185.71	956.86
	Yield (bps)	27724	25.98	10.63	6.86	18.90	26.00	32.42	47.81
	Net Yield (bps)	27724	21.03	10.33	2.64	14.00	20.88	27.30	42.60
	Maturity (days)	31971	52.38	49.95	1.00	12.06	37.41	76.00	178.58

This table reports distributions of key variables across different fund-issuer pairs in the sample during the whole March-August 2011 period. Variable definitions appear in Appendix A. A fund-issuer pair (f,i) is called "connected" if the issuer i has an affiliated MMF that simultaneously holds securities issued by the financial firm who owns fund f in the pre-period.

Table 4: Changes of MMF's Exposure between the Pre- and Post-Periods

	Pair	Post		Pre			
	Number	Mean(%)	SD(%)	Mean(%)	SD(%)	Diff(%)	SD(%)
Panel A: European Issuers							
Connected	148	4.013***	3.906	3.660***	3.465	0.352**	1.564
Unconnected	3714	2.174***	1.802	2.408***	1.717	-0.234***	1.408
Panel B: Non-European Issuers							
Connected	278	2.112***	1.928	2.021***	2.032	0.091	1.350
Unconnected	3583	1.990***	1.600	1.811***	1.547	0.179***	1.214

This table reports changes of *Exposure* in fund-issuer pairs surrounding Moody's review. For each fund-issuer pair, *Exposure* is the value weight of an issuer's securities in a fund's portfolio holdings, calculated as: $Exposure_{f,i,t} = \frac{Outstanding_{f,i,t}}{\sum_i Outstanding_{f,i,t}}$, where $Outstanding_{f,i,t}$ is the total value of money market instruments that are issued by issuer i and held by fund f in month t, and $\sum_i Outstanding_{f,i,t}$ is the total value of fund f's portfolio holding in month t. "Pre" is the period from March to May in 2011, "Post" is the period from June to August in 2011. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively, and connected pairs' statistical significance is based on bootstrapped p-values.

Table 5: Changes in MMFs' Exposure to European Borrowers between the Pre- and Post-Periods

	(1)	(2)	(3)	(4)	(5)
BConnected × Post	0.379***	0.446***	0.403***	0.403***	0.361**
	(0.134)	(0.134)	(0.132)	(0.133)	(0.140)
BConnected	1.121*	0.063	0.215	0.215	0.923**
	(0.585)	(0.283)	(0.279)	(0.280)	(0.387)
Post	-0.320**	-0.056	-0.034	-0.112*	-0.296*
	(0.157)	(0.083)	(0.077)	(0.061)	(0.166)
Conglomerate × Post					0.591**
					(0.288)
Conglomerate					0.075
					(0.096)
Fund Size	-0.175	-0.176***	-0.203	-0.203	-0.178
	(0.210)	(0.043)	(0.227)	(0.227)	(0.212)
Net Yield (bps)	-0.016	0.012	-0.013	-0.013	-0.015
	(0.010)	(0.017)	(0.011)	(0.012)	(0.009)
Age(years)	-0.027	0.004	-0.033	-0.033	-0.031
	(0.032)	(0.007)	(0.033)	(0.033)	(0.032)
Expense Ratio(bps)	-0.017*	-0.003	-0.019*	-0.019*	-0.016
	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)
Institutional Share(%)	3.806**	0.202	3.931***	3.931***	3.883**
	(1.441)	(0.156)	(1.407)	(1.411)	(1.482)
Fund Flow(bps)	-0.002	-0.001	-0.001	-0.001	-0.002
	(0.003)	(0.006)	(0.004)	(0.004)	(0.003)
CDS Rate(%)	0.252***	-0.027	-0.060	-0.060	0.210***
	(0.091)	(0.062)	(0.056)	(0.056)	(0.071)
Month-Fixed Effects	Y	Y	Y	Y	Y
Fund-Fixed Effects	Y	N	Y	Y	Y
Issuer-Fixed Effect	N	Y	Y	Y	N
Sponsor-Fixed Effects	N	N	N	Y	Y
Issuer-Type-Fixed Effects	N	N	N	Y	N
Observations	10835	10835	10835	10835	10835
Adjusted R^2	0.268	0.276	0.421	0.421	0.289

The sample is fund-issuer pairs with European issuers for the whole March-August 2011 period. The dependent variable is fund-issuer pairs' exposure winsorized at the 5th and 95th percentiles. Variable definitions appear in Appendix A. All regressions are at the monthly level. Reported in the parentheses are two-way clustered standard errors at the fund- and the issuer- level. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively.

Table 6: Changes in MMFs' Exposure to European Borrowers: Placebo Tests

	(1)	(2)	(3)	(4)	(5)
Panel A: November 2010-April 2011					
BConnected × Post	-0.138	-0.073	-0.070	-0.070	-0.133
	(0.156)	(0.126)	(0.115)	(0.115)	(0.150)
Bconnected	0.584	-0.417	-0.278**	-0.277**	0.382
	(0.586)	(0.264)	(0.136)	(0.135)	(0.378)
Post	-0.081	0.152	0.034	0.137	-0.066
	(0.076)	(0.098)	(0.022)	(0.090)	(0.077)
Conglomerate × Post					0.826**
					(0.362)
Conglomerate					-0.075
					(0.071)
Observations	9772	9773	9772	9772	9772
R^2	0.239	0.272	0.429	0.429	0.272
Panel B: December 2010-May 2011					
BConnected × Post	-0.097	-0.002	-0.011	-0.013	-0.058
	(0.155)	(0.109)	(0.094)	(0.090)	(0.104)
Bconnected	0.622	-0.425	-0.268	-0.266	0.410
	(0.644)	(0.302)	(0.177)	(0.176)	(0.424)
Post	0.075	0.135	0.068	0.068	0.123
	(0.100)	(0.100)	(0.097)	(0.096)	(0.117)
Conglomerate × Post					0.875**
					(0.396)
Conglomerate					-0.221**
					(0.110)
Observations	11818	11819	11818	11818	11818
R^2	0.232	0.274	0.426	0.426	0.264
Controls	Y	Y	Y	Y	Y
Month-Fixed Effects	Y	Y	Y	Y	Y
Fund-Fixed Effects	Y	N	Y	Y	Y
Issuer-Fixed Effects	N	Y	Y	Y	N
Sponsor-Fixed Effects	N	N	N	Y	Y
Issuer-Type-Fixed Effects	N	N	N	Y	N

The sample is fund-issuer pairs with European issuers for periods before Moody's review in 2011, November 2010-April 2011 for Panel A, December 2010-May 2011 for Panel B. The dependent variable is fund-issuer pairs' exposure winsorized at the 5th and 95th percentiles. *Post* equals one when t represents a month in the post-period, which is defined as the first three months of the corresponding placebo sample. Other variables are the same with the ones in Table 5. All regressions are at the monthly level. Reported in the parentheses are two-way clustered standard errors at the fund- and the issuer- level. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively.

Table 7: Changes in Exposure to All Borrowers between the Pre- and Post-Periods

	(1)	(2)	(3)	(4)
BConnected × Post × European Issuer	0.458*	0.510**	0.542**	0.542**
	(0.245)	(0.231)	(0.241)	(0.241)
BConnected × Post	-0.143	-0.101	-0.158	-0.158
	(0.186)	(0.176)	(0.186)	(0.187)
BConnected× European Issuer	0.673	0.119	0.321	0.321
	(0.560)	(0.481)	(0.388)	(0.389)
Post × European Issuer	-0.130**	-0.209***	-0.220***	-0.220***
	(0.057)	(0.051)	(0.052)	(0.052)
BConnected	0.368	-0.022	-0.025	-0.025
	(0.249)	(0.392)	(0.289)	(0.289)
Post	0.082*	0.165***	0.146***	0.146***
	(0.045)	(0.049)	(0.045)	(0.045)
European Issuer	0.436***			
	(0.156)			
Fund Size	-0.163	-0.213***	-0.115	-0.115
	(0.149)	(0.034)	(0.132)	(0.132)
Net Yield (bps)	-0.017**	0.008	-0.009	-0.009
	(0.007)	(0.013)	(0.006)	(0.006)
Age (years)	0.011	0.005	-0.009	-0.009
	(0.027)	(0.006)	(0.024)	(0.024)
Expense Ratio(bps)	-0.002	-0.008	-0.003	-0.003
	(0.007)	(0.007)	(0.008)	(0.008)
Institutional Share(%)	1.564	0.060	1.325	1.325
	(0.974)	(0.130)	(0.956)	(0.957)
Fund Flow (%)	-0.000	0.002	0.000	0.000
	(0.002)	(0.004)	(0.002)	(0.002)
Month-Fixed Effects	Y	Y	Y	Y
Fund-Fixed Effects	Y	N	Y	Y
Issuer-Fixed Effect	N	Y	Y	Y
Sponsor-Fixed Effects	N	N	N	Y
Issuer-Type-Fixed Effects	N	N	N	Y
Observations	23018	23018	23018	23018
Adjusted R^2	0.246	0.282	0.405	0.405

The sample is all fund-issuer pairs for the whole March-August 2011 period. The dependent variable is fund-issuer pairs' exposure winsorized at the 5th and 95th percentiles. *European Issuer* is a dummy equal to one for issuers who are from Europe. Variable definitions appear in Appendix A. Reported in the parentheses are two-way clustered standard errors at the fund- and the issuer- level. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively.

Table 8: Fund Flows during the Pre- and Post-periods

	March-May 2011		June-August 2011	
	(1)	(2)	(3)	(4)
Panel A: All Funds				
Fund Euro Share	1.220	0.946	-3.099***	-2.269*
	(1.155)	(1.191)	(1.178)	(1.226)
Fund Size	0.367***	0.117	-0.303***	-0.142
	(0.090)	(0.103)	(0.114)	(0.130)
Net Yield (bps)		0.080*		-0.027
		(0.043)		(0.089)
Institutional Share		1.098**		-2.185***
		(0.494)		(0.594)
Constant	-8.582***	-4.154**	7.805***	5.328**
	(1.822)	(2.080)	(2.331)	(2.595)
Month-Fixed Effects	Y	Y	Y	Y
Observations	678	591	680	589
Adjusted R^2	0.031	0.046	0.048	0.081
Panel B: Funds Involved in CHR with European Issuers				
Fund Euro Share	1.420	3.654	-4.287*	-4.899**
	(3.011)	(3.504)	(2.381)	(2.386)
Fund Size	0.371**	0.254	-0.689***	-0.689**
	(0.153)	(0.258)	(0.191)	(0.271)
Net Yield (bps)		0.096		-0.037
		(0.179)		(0.284)
Institutional Share		-0.279		-2.442**
		(1.377)		(1.165)
Constant	-7.224**	-6.002	15.763***	17.034***
	(3.446)	(5.597)	(4.258)	(5.633)
Month-Fixed Effects	Y	Y	Y	Y
Observations	171	134	173	135
Adjusted R^2	0.040	0.051	0.106	0.193
Panel C: Funds not Involved in CHR with European Issuers				
Fund Euro Share	0.376	-0.653	-2.148	-1.973
	(1.293)	(1.353)	(1.584)	(1.684)
Fund Size	0.349***	0.077	-0.149	0.049
	(0.107)	(0.115)	(0.143)	(0.156)
Net Yield (bps)		0.088**		-0.021
		(0.044)		(0.092)
Institutional Share		1.513***		-1.916***
		(0.558)		(0.726)
Constant	-7.960***	-2.864	2.614	-0.495
	(2.117)	(2.264)	(2.886)	(3.099)
Month-Fixed Effects	Y	Y	Y	Y
Observations	507	457	507	454
Adjusted R^2	0.025	0.051	0.041	0.065

The dependent variable is the monthly net flow ratio (*Fund Flow*), the pre-period in columns 1-2, the post-period in columns 3-4. *Fund Flow*s are winsorized at the 5th and 95th percentiles. Variable definitions appear in Appendix A. All regressions are at the monthly level. Reported in the parentheses are robust standard errors. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively.

Table 9: Changes of Securities' Riskiness between the Pre- and Post-Periods

	Pair	Post		Pre			
	Number	Mean	SD	Mean	SD	Diff	SD
Panel A: Spread (bps)							
Connected	148	17.670***	13.318	17.675***	12.028	-0.005	6.730
Unconnected	3714	22.628***	11.479	22.694***	11.742	-0.066	6.568
Panel B: Maturity (days)							
Connected	148	24.854***	25.096	34.552***	28.920	-9.698***	29.875
Unconnected	3714	42.452***	45.234	53.037***	50.218	-10.585***	36.182
Panel C: Holding Risk (bps)							
Connected	148	-7.808	61.080	-7.034	63.261	-0.774	32.837
Unconnected	3714	24.813***	54.062	28.237***	52.328	3.424*	27.725

This table reports changes of securities' riskiness in fund-issuer pairs surrounding Moody's review. The sample is fund-issuer pairs with European issuers for the whole March-August 2011 period. Variable definitions appear in Appendix A. "Pre" is the period from March to May in 2011, "Post" is the period from June to August in 2011. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively, and connected pairs' statistical significance is based on bootstrapped *p*-values.

Table 10: The Comparison between Reverse Pairs and Other Fund-Issuer Pairs

	Pair	Post		Pre			
	Number	Mean	SD	Mean	SD	Diff	SD
Panel A: Exposure (%)							
Reverse Pairs	500	1.577***	1.803	1.445***	1.860	0.132*	1.533
Other Pairs	6474	2.124***	2.382	2.110***	2.429	-0.014	2.194
Panel B: Spread (bps)							
Reverse Pairs	500	15.221***	7.943	16.000***	8.880	-0.779*	4.853
Other Pairs	6474	18.655***	12.068	19.581***	12.284	-0.926*	6.125
Panel C: Maturity (days)							
Reverse Pairs	500	43.642***	53.506	51.364***	64.691	-7.722***	37.835
Other Pairs	6474	43.208***	48.348	50.396***	54.084	-7.188***	38.509
Panel D: Holding Risk (bps)							
Reverse Pairs	500	25.109	61.080	19.372	63.261	5.737***	30.797
Other Pairs	6474	19.756***	54.062	22.544***	52.328	-2.788**	24.094

This table compares securities in reverse fund-issuer pairs and those in other fund-issuer pairs (excluding bilateral connected pairs with European issuers) surrounding Moody's review. A fund-issuer pairs is called a reverse pair if, in the pre-period, the fund is sponsored by an European financial firm, and money market instruments issued by this firm are also held by the issuer's affiliated MMFs. Variable definitions appear in Appendix A. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively, and reverse pairs' statistical significance is based on bootstrapped *p*-values.

Table 11: Reciprocity: Changes in *Holdings Risk*

	(1)	(2)	(3)	(4)	(5)
Reverse Pair × Post	13.837***	13.901***	13.798***	15.464***	13.878***
	(4.011)	(1.923)	(3.231)	(3.998)	(2.251)
Reverse Pair	-25.939***	-0.438	-5.134	-24.778***	2.785
	(7.188)	(8.771)	(8.883)	(6.521)	(8.916)
Post	-5.013**	-3.170*	-2.556*	-5.566*	-3.188*
	(2.511)	(1.834)	(1.405)	(2.810)	(1.834)
BConnected	-24.992*	-4.512	3.542	-23.582**	-3.690
	(12.777)	(4.155)	(4.331)	(11.613)	(4.225)
European Issuer				-2.571	
				(8.642)	
European Fund Sponsor					-4.366
					(3.539)
Fund Size	1.844**	3.491***	1.656**	1.747**	3.421***
	(0.858)	(0.882)	(0.719)	(0.836)	(0.896)
Net Yield (bps)	-0.530	-0.266	-0.333	-0.514	-0.260
	(0.496)	(0.336)	(0.339)	(0.495)	(0.342)
Age (years)	-0.387***	-0.181	-0.269**	-0.379***	-0.186
	(0.130)	(0.153)	(0.119)	(0.132)	(0.151)
Expense Ratio(bps)	0.087	0.282	0.138	0.092	0.261
	(0.171)	(0.241)	(0.161)	(0.183)	(0.235)
Institutional Share(%)	-1.915	5.105	-0.567	-1.736	4.111
	(3.811)	(4.287)	(3.487)	(3.737)	(4.134)
Fund Flow (%)	0.086	0.142	0.032	0.089	0.148
	(0.069)	(0.128)	(0.063)	(0.072)	(0.127)
Month-Fixed Effects	Y	Y	Y	Y	Y
Fund-Fixed Effects	Y	N	Y	Y	N
Issuer-Fixed Effect	N	Y	Y	N	Y
Sponsor-Fixed Effects	N	N	N	Y	N
Issuer-Type-Fixed Effects	N	N	N	Y	Y
Observations	21843	21831	21831	21843	21831
Adjusted R^2	0.140	0.428	0.490	0.161	0.428

The sample is fund-issuer pairs (excluding bilateral connected pairs with European issuers) for the whole March-August 2011 period. The dependent variable is the portfolio weight difference between risky and risk-less assets holdings (*Holdings Risk*) per fund-issuer pair. Variable definitions appear in Appendix A. All regressions are at the monthly level. Reported in the parentheses are two-way clustered standard errors at the fund- and the issuer- level. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively.

Table 12: Reciprocity: the Decomposition of Changes in *Holdings Risk*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Bank Obligation					*Repo*				
Reverse Pair × Post	7.638**	7.380**	7.476***	10.171***	7.348**	-6.199***	-6.521***	-6.322***	-5.293**	-6.530***
	(3.457)	(3.237)	(2.709)	(3.305)	(3.184)	(2.242)	(1.227)	(1.305)	(2.345)	(1.254)
Reverse Pair	-18.491**	0.998	-0.508	-17.307**	5.447	7.447**	1.435	4.627	7.472***	2.663
	(8.266)	(6.371)	(6.310)	(7.823)	(6.702)	(3.730)	(4.299)	(5.014)	(2.737)	(4.008)
Post	-2.638	-1.331	-1.600	-2.809	-1.356	2.375	1.840*	0.956	2.757*	1.833*
	(1.620)	(1.357)	(0.987)	(1.813)	(1.350)	(1.483)	(0.992)	(0.677)	(1.422)	(1.005)
BConnected	-11.461	-1.370	4.832	-10.839	-0.234	13.531*	3.142	1.291	12.743*	3.455
	(9.094)	(3.923)	(4.759)	(8.524)	(3.364)	(7.891)	(3.801)	(3.252)	(7.545)	(3.709)
European Issuer				-2.101					0.469	
				(6.471)					(3.709)	
European Fund Sponsor					-6.029*					-1.663**
					(3.225)					(0.755)
Fund Size	2.321***	3.537***	2.088***	2.254***	3.441***	0.477	0.046	0.432	0.506	0.020
	(0.751)	(0.722)	(0.674)	(0.703)	(0.733)	(0.491)	(0.372)	(0.348)	(0.450)	(0.384)
Net Yield (bps)	-0.256	-0.026	-0.143	-0.259	-0.017	0.274	0.241	0.190	0.255	0.243
	(0.247)	(0.210)	(0.177)	(0.256)	(0.211)	(0.281)	(0.193)	(0.198)	(0.269)	(0.216)
Age (years)	-0.302**	-0.138	-0.240**	-0.301**	-0.145	0.085	0.043	0.030	0.078	0.041
	(0.128)	(0.139)	(0.117)	(0.129)	(0.136)	(0.095)	(0.064)	(0.068)	(0.089)	(0.068)
Expense Ratio(bps)	0.161	0.221	0.172	0.161	0.192	0.074	-0.061	0.033	0.069	-0.069
	(0.156)	(0.176)	(0.144)	(0.161)	(0.170)	(0.079)	(0.104)	(0.058)	(0.074)	(0.108)
Institutional Share(%)	-0.641	3.254	0.051	-0.513	1.881	1.274	-1.851	0.618	1.223	-2.230
	(3.747)	(3.442)	(3.384)	(3.573)	(3.139)	(1.258)	(1.629)	(0.978)	(1.074)	(1.598)
Fund Flow (%)	0.042	0.102	0.015	0.046	0.110	-0.044	-0.040	-0.017	-0.043	-0.038
	(0.059)	(0.108)	(0.050)	(0.053)	(0.110)	(0.032)	(0.038)	(0.031)	(0.034)	(0.051)
Observations	21843	21831	21831	21843	21831	21843	21831	21831	21843	21831
Adjusted R^2	0.151	0.421	0.488	0.189	0.423	0.102	0.387	0.441	0.138	0.387

The sample is fund-issuer pairs (excluding bilateral connected pairs with European issuers) for the whole March-August 2011 period. The dependent variable is the portfolio weight in *Bank Obligation* per fund-issuer pair. Variable definitions appear in Appendix A. All regressions are at the monthly level. Reported in the parentheses are two-way clustered standard errors at the fund- and the issuer- level. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively.

Table 13: Characteristics of Issuers in Different Issuer Groups

	SEuro Fund Share=0	*SEuro Fund Share*=1
Outstanding ($millions)	106.728	7917.022
Yield	0.016	0.023
European Issuer	21	65
Conglomerate	15	29
Number	130	165

This table reports characteristics of issuers in different *SEuro Fund Share* groups, where *SEuro Fund Share* is decided as: $SEuro\ \ Fund\ \ Share_{f,i,t} = \frac{\sum_f Outstanding_{f,i,t} \times SEuro\ \ Fund_f}{\sum_f Outstanding_{f,i,t}}$. *Outstanding* is the value of each issuer's total shares across all MMFs. *Yield* is the value-weighed average yield of each issuer's securities. *European Issuer* is a dummy equal to one if the issuer comes from Europe. *Conglomerate* is a dummy equal to one if the issuer's financial house is a conglomerate that also owns MMFs. *Number* is the number of financial houses in each group.

Table 14: Spillover Effects on Different Issuer Groups

	SEuro Fund Share=0			*SEuro Fund Share*=1		
	(1)	(2)	(3)	(4)	(5)	(6)
Issuer Euro Share	-0.102	-0.118	-0.117	-1.129***	-0.821**	-0.804**
	(-0.367)	(-0.411)	(-0.404)	(-4.986)	(-3.254)	(-3.169)
European Issuer		0.035	0.036		-0.186*	-0.187*
		(0.246)	(0.250)		(-2.597)	(-2.605)
Yield			1.230			0.654
			(0.657)			(0.639)
Observations	130	130	130	165	165	165
Adjusted R^2	0.001	0.002	0.006	0.134	0.170	0.172

This table reports spillover effects on different *SEuro Fund Share* groups, where *SEuro Fund Share* is decided as: $SEuro\ \ Fund\ \ Share_{f,i,t} = \frac{\sum_f Outstanding_{f,i,t} \times SEuro\ \ Fund_f}{\sum_f Outstanding_{f,i,t}}$. The dependent variable is $\Delta Outstanding$, the percentage change in the issuer's average *Outstanding* between the pre-and post-period. *Issuer Euro Share* is calculated as: $Issuer\ \ Euro\ \ Share_{i,t} = \frac{\sum_f Outstanding_{f,i,t} \times Fund\ \ Euro\ \ Share_{f,t}}{\sum_f Outstanding_{f,i,t}}$, given *Fund Euro Share* is a fund's total exposure to European issuers. *European Issuer* is a dummy equal to one if the issuer comes from Europe.*Yield* is the value-weighed average yield of each issuer's securities. Robust standard errors are applied. T-statistics are reported in the parentheses. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively.

Appendix

A. Variable Definitions

$BConnected_{f,i}$	A dummy equal to one for a fund-issuer pair, of which fund f holds securities issued by issuer i and i also has an affiliated MMF that simultaneously holds securities issued by f's sponsor in the pre-period.
$CDS\ Rate_{i,t}$	Issuer's five-year CDS rates that are measured in USD and are with the "Modified-Modified" restructuring clause from the Markit CDS pricing database.
$Conglomerate_i$	A dummy equal to one for issuers who are conglomerate.
$Connceted\ Share_{f,t}$	The share of fund's assets invested in bilaterally-connected partners.
$Expense\ Ratio_{f,t}$	The fund-level expense ratio, which is the value-weighted average of the class-level expense ratios from CRSP.
$Exposure_{f,i,t}$	The fund f's portfolio weight of money market instruments issued by issuer i in month t, $Exposure_{f,i,t} = \frac{Outstanding_{f,i,t}}{\sum_i Outstanding_{f,i,t}}$.
$European\ \ Issuer_i$	A dummy equal to one if the issuer i is from Europe.
$European\ \ Fund\ \ Sponsor$	A dummy equal to one if the fund's sponsor is an European firm.
$Euro\ Share_{f,t}$	The share of a fund's assets invested in European financial firms.
$Fund\ Flow_{f,t}$	Net subscriptions scaled by lagged fund assets. Net subscription is the sum of class-level difference between subscription and redemption from N-MFP. The ratios are winsorized at the 5th and 95th percentiles.
$Fund\ Size_{f,t}$	The natural logarithm of fund TNA.
$Gross\ Yield_{f,t}$	The annualized fund-level 7-day gross yield reported on form N-MFP.
$Holdings\ Risk_{f,i,t}$	The fund f's portfolio weight on the issuer i's bank obligations net of the weight of its safest securities in the same portfolio. The safest securities include government repo, agency repo and Treasury repo.
$Institutional\ Share_{f,t}$	The fund-level institutional share proportion, which is the value-weighted average of the class-level institutional shares from CRSP.
$Maturity_{f,i,t}$	Maturity is firstly measured at the security level as a security's days-to-maturity. $Maturity_{f,i,t}$ is the value-weighed average maturity of securities issued by issuer i and held by fund f in month t.
$Net\ Yield_{f,t}$	The value-weighted average of annualized class-level 7-day net yield from N-MFP.
$Outstanding_{f,i,t}$	The total value of money market instruments that are issued by issuer i and held by fund f in month t.
$Reverse\ Pair_{f,i}$	A dummy equal to one for a fund-issuer pair, of which fund f is sponsored by a European financial firm and, simultaneously, this firm's money market instruments are also owned by the issuer i's affiliated MMFs.
$Spread_{f,i,t}$	Spread is firstly measured at the security level as a security's gross yield net of one-month T-bill rate. $Spread_{f,i,t}$ is the value-weighed average spread of securities issued by issuer i and held by fund f in month t.
$SEuro\ \ Fund_f$	A dummy equal to one if a MMF has bilaterally-connected European issuers.
$SEuro\ \ Fund\ \ Share_{i,t}$	$SEuro\ \ Fund\ \ Share_{i,t} = \frac{\sum_f Outstanding_{f,i,t} \times SEuro\ \ Fund_f}{\sum_f Outstanding_{f,i,t}}$, it reflects how heavily an issuer relies on these $SEuro\ \ Fund$s to borrow money.

B. Investment and Issuer Categories

Based on investment categories reported in N-MFP, I classify portfolio holdings into 12 investment categories: "asset backed commercial paper (ABCP)", "bank obligation", "financial commercial paper", "non-financial commercial paper", "government or agency repo", "Treasury repo", "other repo", "investment company", "Treasury", "government or agency debt", "municipal or agency debt", and "other".

As for issuers categories: firstly, I search in Factset and Bloomberg formal names and business categories for issuers of securities in the first eight investment categories, 99.5% of which find matched records. This group of issuers is classified into five types: "finance", "consumer", "health", "high tech", and "manufacturing". Except for "finance", the other four types of firms only issue non-financial commercial paper in the sample. Secondly, I name issuers of securities in the last four investment categories after the corresponding investment's category name.

[Insert Table A.1 about here]

Table A.1 reports summary statistics of securities in MMFs portfolio holdings. Panel A lists non-government securities. On average, *ABCP*, *Bank Obligation*, *Financial CP* and *Other Repo* pay higher yields with larger maturities than *Government/Agency Repo*, *Treasury Repo* and *Nonfinancial CP* do. Of special note is *Other Repo*, which is a special type of repo collateralized by equities, corporate bonds or even financial derivatives, and therefore not considered as secure as normal repos which are backed by very safe assets such as Treasuries or government debt. In terms of issuing sources, there are more European issuers than U.S. issuers for repos, *Bank Obligation* and *Financial CP*, and vice versa for *ABCP* and *Non-financial CP*. Panel B shows that government or agency securities have lower yields but longer maturities than those in Panel A.

C. Financial Firms Serving Dual-Roles in the MMFs Market

The following lists the 19 Non-European financial entities who both sponsor dollar-dominated MMFs and issue money market fund instruments.

Bank of America Corp.	New York Life Insurance Co.
Bank of Montreal	PNC Financial Services Group, Inc.
BlackRock, Inc.	Prudential Financial, Inc.
General Electric	Royal Bank of Canada
Guggenheim Partners, LLC	State Street Corporation
Invesco	The Bank of New York Mellon Corp.
JPMorgan Chase & Co.	The Goldman Sachs Group, Inc.
MetLife, Inc.	The Toronto-Dominion Bank
Mitsubishi UFJ Financial Group, Inc.	Wells Fargo & Company
Morgan Stanley	

The following lists the five European financial entities who both sponsor dollar-dominated MMFs and issue money market fund instruments.

AXA SA	UBS AG
Deutsche Bank AG	ING Bank NV
HSBC Holdings Plc	

D. Bilateral Connection and Past Relationship

"Relationship" in the banking literature usually refers to the one in a long time period. The relationship strength is measured by proxies based on prior lending activities rather than being detected directly. As a comparison, CHR documented in this paper implies an important channel that financial institutions use to build relationship. To show that my above findings cannot simply be captured by indirect relationship measures in existing literature, I run a multivariate regression model which is similar to the specification 1 but includes *Past Relation*, which is measured by the following four measures at the fund-issuer pair level used in Chernenko and Sunderam (2014):

- *Frequency*: a dummy equal to one if a fund lends more frequently to an issuer than the median fund does;
- *Maturity*: a dummy equal to one if a fund-issuer pair's maturity is longer than the issuer's median borrowing maturity;
- *Quantity* (*Issuer Based*): a dummy equal to one for the fund-issuer pair (f,i) if its portfolio share is above that issuer's median portfolio share;
- *Quantity* (*Fund Based*): a dummy equal to one for the fund-issuer pair (f,i) if its portfolio share is above that fund's median portfolio share.

These four measures are built based on prior lending activities in the MMF market from November 2010 to February 2011. The tests include month-fixed effects, issuer-fixed effect, fund-fixed effects, sponsor-fixed effects, and issuer-type fixed effects. Standard errors are clustered at both the issuer- and the fund- levels. Regression results are reported in Table A.2.

[Insert Table A.2 about here]

As shown in column (1), (3), (5) and (7), a strong *Past Relation* is associated with 0.26%-1.39% increase in MMF's exposure to an European issuer, but the coefficients of the interaction term *Past Relation* $\times$ *Post* are statistically and economically insignificant except for column (7), which means that MMFs' lending difference around the European bank crisis is not conditional on indirect relationship measures in existing literature. Moreover, in column (2), (4), (6) and (8), the coefficients of *BConnected* $\times$ *Post* remain positive and statistically significant after the control of *Past Relation*, therefore confirms that similar results in Table 5 are not simply dominated by indirect relationship measures in existing literature. These findings suggest that CHR is not simply a reflection of documented relationship strength by previous researches but helpful to deepen the understanding about the relationships mechanism.

E. Multivariate Analysis of Securities Comparison

The following multivariate regression model tests changes of riskiness in depth.

$$\begin{aligned} Risk_{f,i,t} =& \alpha + \beta_1 BConnected_{f,i} \times Post + \beta_2 BConnected_{f,i} + \beta_3 Post \\ &+ \lambda_1 Control_{f,t} + \lambda_2 Control_{i,t} + \varepsilon_{f,i,t}, \end{aligned} \tag{A.1}$$

where *Risk* is measured by $Spread$, $Maturity$ and $Holdings\ Risk$ at the fund-issuer-month level; independent variables are the same as these defined in the specification 1. I consider error terms to be within funds and within issuers, therefore standard errors are two-way clustered at the fund level and the issuer level.

[Insert Table A.3 about here]

Results of this difference-in-difference model are presented in Table A.3. Except for Columns (2), all estimates of β_1 are close to zero, denoting that changes in riskiness of securities issued by connected and unconnected European issuers surrounding the European bank crisis are the same. In other words, although the cross-holding relationship makes a difference in lending, there is no difference in securities' riskiness.

However, Table A.3 conveys information about fund-issuer pairs' other features that affect *Risk*: (1) the bilateral connection is associated with lower *Risk*; (2) the post-period is associated with lower *Risk*. These two findings indicate that, securities in the connected fund-issuer pairs are less risky across the entire sample period, and MMFs hold less risky securities after the European bank crisis.

F. The Dodd-Frank Banking Stress Test

In the wake of the financial crisis, the U.S. Congress enacted the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act). The act requires the Federal Reserve to conduct an annual stress test of large bank holding companies (BHCs) to evaluate whether they have sufficient capital to absorb losses resulting from adverse economic conditions. The Federal Reserve adopted rules implementing these requirements since October 2012. The results of the first Dodd-Frank banking stress test were released in March 2013 with 18 BHCs under the supervisory stress test. The 18 BHCs are: Ally Financial, American Express, Bank of America, the Bank of New York Mellon, BB&T, Capital One Financial, Citigroup, Fifth Third Bancorp, the Goldman Sachs Group, JPMorgan, KeyCorp, Morgan Stanley, the PNC Financial Services Group, Regions Financial Corporation, State Street Corporation, SunTrust Banks, U.S. Bancorp, and Wells Fargo.

The 2013 test examined how bank balance sheets would hold up under the pressure of an extremely adverse economic scenario, which included a severe recession in the U.S. combined with a housing market drop, rising unemployment, a global financial shock, and marked slowdowns in major foreign financial markets.

Of particular focus in the Dodd-Frank test is the tier 1 common ratio. The mandated minimum level by regulators was 5% and the median among tested BHCs was 7.7% in 2013. Though only Ally Financial failed the test seriously, many of the rest 17 BHCs who passed the test had their tier 1 common ratios quite close to 5% and much lower than 7.7%, including Bank of America, the Goldman Sachs Group, JPMorgan, Morgan Stanley, and Wells Fargo. These BHCs' creditworthiness was affected by the release of the stress test results in March 2013, though not as severely as European banks in the European bank Crisis.

Among the 18 BHCs tested by the first Dodd-Frank Stress Test in 2013, six BHCs have their tier 1 common ratios quite close to the mandated minimum level 5% and much lower than the median 7.7%. This six BHCs are Ally Financial, Bank of America, the Goldman Sachs Group, JPMorgan, Morgan Stanley, and Wells Fargo. Except for the first one, the rest five are all involved in CHR in the MMF market. Though the release of the stress test results in March 2013 is less impactful than the series of events happened on European banks in mid-2011, the creditworthiness of these BHCs that showed low capital ratios was also affected. In this section, I conduct the tests that are similar to specification 1, using December 2012 to February 2013 as the pre-period and March-May 2013 as the post-period. Changes of *Exposure* are reported in Table A.5.

[Insert Table A.5 about here]

From Column 1 to Column 5, though weaker in statistical significance (10%) than those in Table 7, I find a positive relationship between the bilateral connection and fund-issuer pairs' exposure in the post-period: after the 2013 Dodd-Frank Stress Test, a MMF's exposure to their bilaterally-connected issuers which are disclosed with low tier 1 common ratios increases by 0.51%-0.60% of its portfolio holdings. The tests reflect CHR influences MMFs' lending after the 2013 Dodd-Frank stress test, in a similar though weaker pattern that it influences MMFs surrounding the 2011 European bank crisis.

[Insert Table A.6 about here]

Tests of *Holdings Risk* in the reverse pairs are shown in Table A.6. The results are much weaker given the stress test results do not create a shock as big as the one by Moody's downgrading review in 2011, plus, financial firms involved in this event are all very large BHC, which are much robust and less volatile.

Table A.1: Summary Statistics: Securities

Security Type	Yield(bps)		Maturity(days)		U.S.(%)		Europe(%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Panel A: Non-Government Securities								
ABCP	25.46	3.31	43.74	7.49	52.52	6.04	40.06	8.22
Bank Obligation	27.52	3.67	62.7	18.67	31.02	6.19	40.12	12.87
Financial CP	26.91	4.49	57.1	5.64	22.7	1.34	43.87	6.28
Government/Agency Repo	15.12	5.20	3.82	1.73	43.25	3.81	53.77	5.69
Treasury Repo	10.17	5.36	8.81	38.94	36.76	8.41	61.91	7.84
Other Repo	38.19	3.76	18.87	13.70	43.76	2.36	50.72	4.20
Non-financial CP	17.84	2.57	49.72	5.25	60.71	4.61	32.78	3.19
Panel B: Government or Agency Securities								
Government/Agency	15.45	2.02	117.36	74.10				
Treasury	16.53	2.06	120.58	10.95				
Municipal/Agency Debt	18.21	5.40	176.67	811.87				

This table reports summary statistics of non-government securities in panel A and that of government/agency securities in panel B. The sample period is the whole March-August 2011 period. *Yield* and *Maturity* are value-weighted average of corresponding security-level characteristics. *U.S. (%)* and *Europe (%)* represents the dollar ratio of one type of security issued in the U.S. and Europe respectively. Standard deviations of the given characteristics are presented in the parentheses.

Table A.2: Bilateral Connection and Past Relation

	Frequency		Maturity		Quantity (Issuer Based)		Quantity (Fund Based)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BConnected		0.407***		0.408***		0.416***		0.470***
× Post		(0.146)		(0.126)		(0.125)		(0.175)
BConnected		0.216		0.207		0.194		0.164
		(0.220)		(0.295)		(0.310)		(0.179)
Post	0.112	0.094	-0.009	-0.030	0.033	0.016	0.147	0.129
	(0.096)	(0.090)	(0.099)	(0.094)	(0.084)	(0.080)	(0.095)	(0.088)
Past Relation	-0.137	-0.142	0.087	0.089	0.034	0.026	-0.293***	-0.309***
× Post	(-0.093)	(-0.094)	(-0.064)	(-0.063)	(-0.079)	(-0.078)	(-0.082)	(-0.083)
Past Relation	1.083***	1.085***	0.271***	0.269***	0.940***	0.943***	1.385***	1.391***
	(-0.097)	(-0.097)	(-0.087)	(-0.088)	(-0.115)	(-0.116)	(-0.098)	(-0.099)
Fund Size	-0.164	-0.173	-0.138	-0.146	-0.178	-0.189	-0.143	-0.153
	(0.240)	(0.232)	(0.239)	(0.230)	(0.248)	(0.239)	(0.248)	(0.239)
Net Yield (bps)	-0.015	-0.014	-0.013	-0.012	-0.011	-0.010	-0.014*	-0.013
	(0.009)	(0.010)	(0.011)	(0.012)	(0.009)	(0.010)	(0.008)	(0.009)
Age (years)	-0.031	-0.029	-0.032	-0.030	-0.032	-0.030	-0.027	-0.025
	(0.033)	(0.033)	(0.031)	(0.031)	(0.033)	(0.032)	(0.037)	(0.036)
Expense	-0.020*	-0.020*	-0.020*	-0.020*	-0.018*	-0.018*	-0.021*	-0.021*
Ratio(bps)	(0.011)	(0.011)	(0.011)	(0.011)	(0.010)	(0.010)	(0.011)	(0.011)
Institutional	4.234***	4.213***	3.926***	3.899***	4.121***	4.103***	3.651**	3.616**
Share(%)	(1.425)	(1.402)	(1.419)	(1.398)	(1.459)	(1.432)	(1.551)	(1.526)
Fund Flow (%)	-0.002	-0.001	-0.002	-0.002	-0.002	-0.001	-0.002	-0.001
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)
CDS Rate (%)	-0.065	-0.058	-0.063	-0.056	-0.068	-0.061	-0.039	-0.030
	(0.056)	(0.056)	(0.056)	(0.056)	(0.058)	(0.057)	(0.056)	(0.056)
Observations	10833	10833	10833	10833	10833	10833	10833	10833
Adjusted R^2	0.463	0.464	0.422	0.424	0.440	0.442	0.494	0.495

The sample is fund-issuer pairs with European issuers for the whole March-August 2011 period. The dependent variable is fund-issuer pairs' exposure winsorized at the 5th and 95th percentiles. $Past\ Relation_{f,i}$ is measured in the October 2010-February 2011 period using different measures: *Frequency* is a dummy equal to one if a fund lends more frequently to an issuer than the median fund does; *Maturity* is a dummy equal to one if a fund-issuer pair's maturity is longer than the issuer's median borrowing maturity; *Quantity* (*Issuer Based*) is a dummy equal to one if a fund-issuer pair's portfolio share is above that issuer's median portfolio share; *Quantity* (*Fund Based*) is a dummy equal to one if a fund-issuer pair's portfolio share is above that fund's median portfolio share. Other variable definitions appear in Appendix A. All regressions are at the monthly level, include month-fixed effects, issuer-fixed effect, fund-fixed effects, sponsor-fixed effects, and issuer-type fixed effects. Reported in the parentheses are two-way clustered standard errors at the fund- and the issuer- level. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively.

Table A.3: Changes in Securites' Risk among Different Fund-Issuer Pairs between the Pre- and Post-Periods

	Spread			Maturity			Holding Risk		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
BConnected × Post	0.018	-1.250*	-1.175	-1.052	-0.127	0.879	7.892	5.294	5.949
	(0.779)	(0.658)	(0.803)	(7.192)	(7.029)	(6.974)	(5.632)	(5.359)	(5.298)
BConnected	-5.413***	-0.431	0.097	-18.411**	-7.550*	-0.498	-48.791***	-22.500***	-20.731***
	(1.709)	(0.928)	(1.639)	(8.353)	(4.061)	(6.107)	(14.506)	(5.494)	(7.236)
Post	0.549	-1.496***	0.518	-5.538	-12.966**	-5.371***	-1.858	-2.818	1.306
	(1.156)	(0.478)	(0.599)	(4.136)	(5.764)	(1.312)	(4.301)	(2.420)	(2.815)
Fund Size	-3.494***	0.596**	-4.022***	-22.242***	1.676*	-20.605**	-4.315	-3.582***	-6.500
	(1.047)	(0.290)	(0.817)	(8.250)	(0.990)	(8.248)	(6.107)	(1.105)	(6.188)
Net Yield (bps)	0.066	0.441**	0.072	-0.104	0.444	-0.017	0.499	-0.488	0.483*
	(0.088)	(0.199)	(0.103)	(0.380)	(0.475)	(0.356)	(0.315)	(0.495)	(0.281)
Age (years)	-0.283	-0.015	-0.274	-1.619	0.079	-1.271	-0.066	0.218	-0.019
	(0.248)	(0.051)	(0.259)	(1.377)	(0.151)	(1.285)	(0.848)	(0.204)	(0.916)
Expense Ratio(bps)	0.086	0.392***	0.086	0.178	0.479*	-0.007	0.000	-0.193	0.069
	(0.079)	(0.098)	(0.068)	(0.356)	(0.279)	(0.347)	(0.414)	(0.267)	(0.343)
Institutional Share(%)	3.072	0.689	5.329	26.705	-0.200	16.951	9.401	3.813	5.878
	(10.204)	(1.683)	(10.635)	(36.666)	(3.040)	(42.034)	(37.309)	(4.654)	(38.807)
Fund Flow(bps)	-0.004	-0.090**	-0.009	0.054	-0.124	0.074	0.024	-0.028	-0.006
	(0.025)	(0.040)	(0.025)	(0.078)	(0.145)	(0.072)	(0.095)	(0.132)	(0.099)
CDS Rate(%)	1.571***	-0.541	-0.785	-8.233***	-5.061**	-5.871**	-3.819	-3.686**	-3.554**
	(0.582)	(0.556)	(0.483)	(3.052)	(2.209)	(2.248)	(2.480)	(1.640)	(1.693)
Month-Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fund-Fixed Effects	Y	N	Y	Y	N	Y	Y	N	Y
Issuer-Fixed Effect	N	Y	Y	N	Y	Y	N	Y	Y
Sponsor-Fixed Effects	N	N	Y	N	N	Y	N	N	Y
Observations	9065	9063	9063	10812	10811	10810	10835	10834	10833
Adjusted R^2	0.304	0.285	0.454	0.161	0.238	0.332	0.190	0.330	0.444

The sample is fund-issuer pairs with European issuers for the whole March-August 2011 period. As defined in Table 8, the dependent variables are *Spread* in columns (1) to (3), *Maturity* in columns (4) to (6), and *Holdings Risk* in columns (7) to (9). Other variable definitions appear in Appendix A. All regressions are at the monthly level. In the parentheses are two-way clustered standard errors at the fund- and the issuer- level. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively.

Table A.4: Reciprocity: Changes in *Exposure*, *Spread*, and *Maturity*

	(1)	(2)	(3)						
	Exposure			Spread			Maturity		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Reverse Pair × Post	-0.127	-0.129	-0.165	-0.977*	-0.386	-1.320*	2.956	3.355	1.942
	(0.183)	(0.131)	(0.125)	(0.583)	(0.636)	(0.721)	(3.414)	(3.631)	(4.237)
Reverse Pair	0.489	0.424	0.568	-1.285	-2.021	-0.931	0.450	-10.402***	4.498
	(0.317)	(0.405)	(0.381)	(1.772)	(1.550)	(1.951)	(8.698)	(3.477)	(8.725)
Post	0.001	0.050	0.063	-2.259***	-0.221	-1.693***	-9.324***	-9.578***	-4.246
	(0.026)	(0.050)	(0.068)	(0.317)	(0.589)	(0.506)	(1.943)	(2.870)	(2.625)
BConnected	-0.232	0.082	-0.242	-0.435	-4.047***	-0.710	-3.521	-18.778***	-6.190**
	(0.238)	(0.288)	(0.334)	(1.519)	(1.255)	(1.459)	(4.484)	(5.680)	(2.366)
European Issuer		0.476***			3.257***			-14.513*	
		(0.162)			(1.149)			(7.979)	
European Fund Sponsor			-0.477***			-0.107			2.434
			(0.134)			(0.820)			(3.574)
Fund Size	-0.090**	-0.102**	-0.197***	0.173	0.195	0.594**	1.422**	1.256	2.174**
	(0.041)	(0.043)	(0.039)	(0.131)	(0.172)	(0.269)	(0.646)	(0.791)	(0.931)
Net Yield (bps)	-0.011*	-0.009	0.007	-0.055	-0.088	0.347**	-0.338	-0.385	0.412
	(0.006)	(0.006)	(0.011)	(0.119)	(0.131)	(0.170)	(0.408)	(0.449)	(0.405)
Age (years)	0.003	0.005*	0.005	-0.048	-0.052	0.029	-0.205*	-0.239**	0.013
	(0.003)	(0.003)	(0.006)	(0.033)	(0.035)	(0.049)	(0.107)	(0.112)	(0.153)
Expense Ratio(bps)	-0.008**	-0.008*	-0.006	0.040	0.033	0.345***	0.065	0.078	0.699**
	(0.004)	(0.004)	(0.008)	(0.051)	(0.049)	(0.058)	(0.193)	(0.242)	(0.295)
Institutional Share(%)	0.023	0.036	0.132	0.279	0.407	1.673	-1.657	-1.534	2.166
	(0.069)	(0.072)	(0.125)	(0.549)	(0.550)	(1.154)	(2.702)	(2.727)	(2.465)
Fund Flow (%)	-0.000	-0.002	0.001	-0.027	-0.028	-0.065***	0.034	0.025	0.025
	(0.002)	(0.002)	(0.006)	(0.021)	(0.022)	(0.024)	(0.070)	(0.083)	(0.141)
Month-Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Issuer-Fixed Effect	Y	N	Y	Y	N	Y	Y	N	Y
Sponsor-Fixed Effects	Y	Y	N	Y	Y	N	Y	Y	N
Issuer-Type-Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	21831	21843	21831	18742	18754	18742	21803	21815	21803
Adjusted R^2	0.356	0.230	0.255	0.470	0.304	0.363	0.332	0.116	0.282

The sample is fund-issuer pairs (excluding bilateral connected pairs with European issuers) for the whole March-August 2011 period. Following the same definition in Table 10, the dependent variables are *Exposure* in columns (1) to (3), *Spread* in columns (4) to (6), and *Maturity* in columns (7) to (9). Other variables follow the same definition in Table 10. All regressions are at the monthly level. Reported in the parentheses are two-way clustered standard errors at the fund- and the issuer- level. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively.

Table A.5: The 2013 Dodd-Frank Test: Changes in Exposure

	(1)	(2)	(3)	(4)
BConnected × Post × LBHC	0.600*	0.508	0.516*	0.534*
	(0.332)	(0.311)	(0.311)	(0.311)
BConnected × Post	-0.325**	-0.332**	-0.389***	-0.407***
	(0.140)	(0.149)	(0.146)	(0.146)
BConnected× LBHC	-0.725	-0.790*	-0.636	-0.648
	(0.473)	(0.464)	(0.447)	(0.444)
Post × LBHC	-0.248	-0.299*	-0.255	-0.453**
	(0.164)	(0.164)	(0.163)	(0.189)
BConnected	0.215	0.812***	0.548*	0.562*
	(0.321)	(0.294)	(0.298)	(0.296)
Post	-0.154***	0.020	-0.078	-0.091
	(0.047)	(0.067)	(0.063)	(0.064)
LBHC	0.419*	0.747***	0.315	0.469
	(0.232)	(0.243)	(0.243)	(0.333)
Post × DFBHC				0.209*
				(0.111)
DFBHC				-0.164
				(0.283)
Fund Size	-0.277***	-1.046***	-1.010***	-1.009***
	(0.039)	(0.331)	(0.315)	(0.314)
Net Yield (bps)	0.000	-0.020	-0.019	-0.019
	(0.020)	(0.025)	(0.023)	(0.023)
Age (years)	-0.001	-0.111	-0.127	-0.126
	(0.009)	(0.174)	(0.169)	(0.169)
Expense Ratio(bps)	-0.002	-0.018	-0.017	-0.016
	(0.009)	(0.018)	(0.017)	(0.017)
Institutional Share(%)	0.474***	0.100	-0.186	-0.196
	(0.153)	(2.190)	(2.097)	(2.093)
Fund Flow (%)	-0.001	0.003	0.003	0.003
	(0.005)	(0.002)	(0.002)	(0.002)
Month-Fixed Effects	Y	Y	Y	Y
Fund-Fixed Effects	N	Y	Y	Y
Issuer-Type-Fixed Effects	Y	N	Y	Y
Observations	17243	17277	17242	17242
Adjusted R^2	0.087	0.157	0.201	0.201

The sample is all fund-issuer pairs for the whole December 2012 to May 2013 period. The dependent variable is fund-issuer pairs' exposure winsorized at the 5th and 95th percentiles. *LBHC* is a dummy equal to one for the six BHCs who performed bad in the Dodd-Frank test, $DFBHC$ is a dummy equal to one for the 18 BHCs who were tested in the Dodd-Frank test. Other variables follow the same definition in Table 5. All regressions are at the monthly level. Reported in the parentheses are clustered standard errors at the fund-level. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively.

Table A.6: The 2013 Dodd-Frank Test: Changes in *Holdings Risk*

Reverse Pair × Post	1.676	7.565	2.921
	(4.869)	(6.178)	(4.348)
Reverse Pair	1.076	-17.481	-2.548
	(8.910)	(10.657)	(7.446)
Post	0.541	2.340**	2.666***
	(0.587)	(1.028)	(0.893)
BConnected	-25.597***	-10.844*	-18.350***
	(6.097)	(6.089)	(5.863)
Fund Size	-1.563*	-1.519**	-1.579**
	(0.819)	(0.661)	(0.731)
Net Yield (bps)	-0.389	-0.354	-0.355
	(0.371)	(0.463)	(0.336)
Age (years)	-0.022	-0.264	-0.008
	(0.214)	(0.185)	(0.196)
Expense Ratio(bps)	-0.077	0.055	-0.057
	(0.173)	(0.165)	(0.162)
Institutional Share(%)	-0.668	-1.017	-0.540
	(3.514)	(3.548)	(3.173)
Fund Flow (%)	0.059	-0.064	0.059
	(0.069)	(0.096)	(0.067)
Month-Fixed Effects	Y	Y	Y
Fund-Fixed Effects	Y	N	Y
Issuer-Type-Fixed Effects	N	Y	Y
Observations	18461	18427	18426
Adjusted R^2	0.087	0.113	0.176

The sample is fund-issuer pairs (excluding bilateral connected pairs with European issuers) for the whole December 2012 to May 2013 period. The dependent variable is the portfolio weight difference between risky and risk-less assets holdings (*Holdings Risk*) per fund-issuer pair. Variable definitions appear in Appendix A. All regressions are at the monthly level. Reported in the parentheses are clustered standard errors at the fund-level. ***, **,* indicate statistical significance at 1%, 5% and 10% respectively.