Relationship Lending in Shadow Banking: Cross-Holding Relation through Money Market Funds

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Abstract

This paper explores the nature and impacts of shadow banks' relationship lending by analyzing bilateral-connected financial firms who mutually hold each other's debt through their own affiliated money market funds (MMFs). Using novel MMFs' monthly holdings data, I show that, in the context of the 2011 Eurozone crisis, non-European financial firms surprisingly increased their MMFs' stakes in bilateral-connected European financial firms, while MMFs generally reduced their exposure to European issuers. I provide evidence that this bias represents reciprocity between the bilateral-connected financial firms. In return, the European financial firms, through their affiliated MMFs, accepted more insecure than secure debt from their bilaterally-connected non-European partners during the same period. Issuer- or fund-characteristics do not explain the results. Similar tests show that cross-holding relation (CHR) affects MMFs' lending after the 2013 Dodd-Frank stress test in the same pattern. A further investigation shows that CHR also affects issuers unconnected with MMFs, because they are unable to raise money from new funds in a short time after their old lenders cut off the financing.

JEL classifications: G21, G32, G10, G14

Keywords: Shadow Banking, Financial Crisis, Relationship Lending, Money Market Funds

1. Introduction

Relationship lending provided by financial intermediaries is one of the central issues in banking, and has been extensively studied in the context of traditional banks to their borrowers (see, e.g. Bharath et al., 2007; Bolton et al., 2016; Prilmeier, 2017). However, little attention has been paid to relationship lending provided by non-bank financial intermediaries. These "shadow banks" include the U.S. prime money market mutual funds (MMFs) that, with $1.7 trillion in assets under management in 2011, provide an important source of short-term financing for both financial and nonfinancial firms. Chernenko and Sunderam (2014) show there are economically significant frictions in the MMF market. This paper studies further by identifying a cross-holding relation (CHR) between financial firms who mutually hold each other's debt through affiliated MMFs. CHR creates friction in lending and makes a significant difference in MMFs holdings.

As illustrated by Figure 1, three different roles are played by financial firms in the MMF market: funds sponsor only (such as American Century Investment and Waddell & Reed Financial), issuer of money market instruments only (such as Barclays and RBS), both issuer and funds sponsor (such as J.P. Morgan and Deutsche Bank). When two financial firms serve dual roles of issuers and funds sponsors, they are able to mutually hold each other's money market instruments through affiliated MMFs (for example, J.P.Morgan and Deutsche Bank in Figure 1). Therefore, CHR is established by this bilateral bonding. A detailed example is shown in Figure 2. Here, following the assumption in recent literature (e.g., Kacperczyk and Schnabl, 2013) that a financial firm can set its MMF's risk, I treat a financial firm as a unity bringing together its affiliated MMFs and issuers.[1].

This paper's study of CHR contains three parts. The first part shows how this relation plays

[1] A key concern of treating these financial firms and their affiliated MMFs as conglomerates is the agency problem between fund families and MMF managers, given mutual funds are normally viewed as stand-alone entities. However, recent literature (e.g., Kacperczyk and Schnabl, 2013) abstracted from the agency problem by assuming that a financial firm can set its MMF's risk. This assumption is plausible in the context of MMFs, 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 et al., 2012; Parlatore, 2016). From a financial firm's perspective, it combines affilated MMFs and issuers, which respectively serve as channels in the short-term debt market to lend money and to borrow money, and these two channels jointly determine the financial firm's position in this particular market. Other studies in different empirical settings also jointly consider financial institutions' different departments. See, for example, Ritter and Zhang (2007), Massa and Rehman (2008), Ivashina and Sun (2011).

against the independence rule in arm's length financing, and creates bias in MMFs holdings towards bilaterally-connected issuers. The second part digs deeper and finds reciprocity motivates financial firms to be committed in CHR, which provides an implicit commitment when one side is in trouble. The third part reveals a negative spillover effect on other issuers who are not involved in CHR.

Before presenting the empirical approach and test results in more detail, I emphasize the big concern about endogeneity when studying how relationship lending matters. MMFs' higher exposure to their bilaterally-connected issuers may also be the result of an endogenous decision associated with these issuers' good creditworthiness. Following Chernenko and Sunderam (2014), I apply the time window in the summer of 2011 to address this endogenous concern. Securities held by MMFs are supposed to be high-liquidity and short-term public debt. But in mid-2011, after Moody's put several European banks under downgrade review, investors suddenly lost their trust in the creditworthiness of European borrowers, and MMFs with high exposure to European borrowers suffered large outflows. This shock creates an ideal laboratory environment for my study. In this short special period, money market instruments issued by European financial firms were generally viewed as risky, and hence differences in MMFs' stakes in different European financial firms should be independent of these firms' 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 used in this paper also address this concern well, given the data allow the control for time-varying variables and fixed effects from both the issuer side and the fund side. In the last section of this paper, I also apply a similar natural experiment in the context of the 2013 Dodd-Frank stress tests. the creditworthiness of bank holding companies (BHCs) that showed very low tier 1 common ratio was negatively affected, though not as severely as European banks in the Eurozone Crisis, by the release of the stress test results in March 2013.

I investigate three distinctive questions from literature. First, I examine whether MMFs exposures to bilaterally-connected issuers and to unconnected European ones between the pre-

and the post-period are different. With a standard univariate analysis, I find that, if a European issuer is bilaterally connected with a fund, the fund's exposure to this connected partner increases by 0.35% measured in portfolio weights after the Eurozone crisis. In contrast, the fund's portfolio weight on every other unconnected European issuer drops by 0.23%. Economically, it means an average U.S. MMF financed every connected European partner $29.58 million more, but it cuts off $19.66 million in lending to every other European borrower after mid-2011. These results are robust to multivariate tests using difference-in-differences models with the control of issuer and fund characteristics.

My data for fund-issuer pairs allow me to control for variates and fixed effects at both the issuer-level and the fund-level, ensuring that MMFs' bias in connected issuers is not simply a mirror of the impacts from some observable or unobservable features on a certain issuer or a certain fund. Based on multivariate regressions that hold the issuer fixed, I find that, after Moody's review, MMFs finance less to unconnected European issuers, but lend more to their bilaterally-connected European partners. Likewise, holding fixed the MMF, I find that European issuers receive more finance support from the MMFs belonging to their bilaterally-connected financial firms. Particularly, although issuers who can build CHR with MMFs must be conglomerates owning MMFs, my main findings are robust after controlling for issuer types. Therefore, the results are unlikely to be driven by the "too big to fail" phenomenon. 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.

Moreover, in a comparison of different riskiness proxies across all fund-issuer pairs, I do not find any evidence showing 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 the issuer-fixed effect and the fund- fixed effect. Therefore, MMFs' holding bias on connected issuers is unlikely to be driven by differences in money market instruments' riskiness.

Second, I examine what motivates MMFs to tilt towards bilaterally-connected issuers, and find

reciprocity. To be specific, I analyze the reverse fund-issuer pairs of the bilateral connection. For each reverse fund-issuer pair, the fund belongs to a European financial firm, whose money market instruments are simultaneously held by the issuer's affiliated MMFs (for example, the fund-issuer pair with Deutsche Bank affiliated MMFs as the fund and JP Morgan as the issuer in Figure 2 is a reverse pair). Testing with difference-in-difference regressions, I show that the *Holding Risk* – a risk measure proposed by Kacperczyk and Schnabl (2013) which is the difference in portfolio weights of insecure and secure securities – significantly increases by 10.85-14.26 basis points in reverse pairs than in any other fund-issuer pairs during the post-period. This is a direct evidence of reciprocity between connected financial firms: a European financial firm, through its affiliated MMFs, accepts more insecure debt issued by its connected partner. I interpret it as a compensation for these partners' help in increasing their MMFs' stakes in these European financial firms. In return for this help, European partners' affiliated MMFs are willing to hold their bilaterally-connected partners' low-quality debt, which is unpopular in the MMF market.

Third, I examine how CHR may indirectly affect other issuers who also borrow money from the same MMFs involved in the relationship with European firms. Funds only have limited capital on hand, especially after mid-2011 when many of them suffered significant net outflows. If a MMF decides to increase its stake on one issuer, it has to cut off financing to some other issuers. In a market where relationship-based lending is prevalent, the other issuers may have difficulties to borrow money from other lenders in a short period of time due to the lack of a relationship. In my sample, more than half of money market instruments are held by MMFs that are involved in CHR with European firms before mid-2011. According to a test of the spillover effect, if these MMFs cut off financing to unconnected issuers in the post-period, these issuers are prone to have trouble borrowing money from other MMFs.

In the last part of this paper, a similar natural experiment is conducted in the context the 2013 Dodd-Frank stress tests. Similar findings show that, comparing with other MMFs, MMFs that are involved in CHR with BHCs, which are revealed to have low tier 1 common ratio in the stress test, increase their exposures to these BHCs in the post period; meanwhile, *Holdings Risk* in the reverse

pairs also increase.

My study links to different strands of literature. It contributes to studies in credit supply of financial intermediaries. Relationship-based lending has long been discussed in the banking literature (e.g., Boot, 2000; Bharath et al., 2007; Bolton et al., 2016), including an increasing attention to shadow banking. "Relationship" is commonly mentioned as a general term, and the relationship mechanism is measured by proxies based on prior lending activities rather than being detected directly. This paper documents an important channel that financial institutions use to build relationship. In this mechanism, relationship lending can be directly tested, and motivations behind it can also be clearly explained. I also add to the findings of Chernenko and Sunderam (2014) who apply the same empirical setting of MMFs and the same shock of the 2011 Eurozone crisis, and find non-European issuers relying on funds exposed to Eurozone banks raised less short-term debt financing because of frictions. This paper, on the one hand, makes an extension by identifying CHR, which is one important source creating frictions in shadow banking. On the other hand, this paper's other main focus is on reciprocity behind CHR, which offers one important explanation to relationship lending in shadow banking.

This paper also relates to literature of the conflict of interests (see Mehran and Stulz (2007) for a summary), especially those concerning connections between different divisions of financial conglomerates. 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 stakes in 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. While these papers are about financial institutions' two different divisions in two markets, this paper is about them in the same market.

In addition, my paper belongs to the growing literature in recent years on MMFs' yield-reaching behavior. Kacperczyk and Schnabl (2013) initiate this line of research by documenting

that MMFs whose sponsors are more concerned with reputations take fewer risks. Chodorow-Reich (2014) links "reaching for yield" to MMFs' heterogeneity in administrative cost, and Di Maggio and Kacperczyk (2017) relate "reaching for yield" to the macro environment with zero-bound interest rate. Other recent research in MMFs studies influences of sponsor support (Parlatore (2016)) and tournament motivation of fund managers (La Spada (2014)).

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. Section 4 analyzes the impact of CHR on MMFs lending behavior. Section 5 explores the potential motivation behind CHR. Section 6 extends the discussion to spillover effects. Section 7 conducts similar tests in the context of the 2013 Dodd-Frank stress test. Section 8 concludes.

2. Background and Hypothesis Development

This section explains financial firms' bilateral connections in the MMF market, reviews the Eurozone crisis, and develops hypotheses that will be tested.

2.1 Financial Firms' Bilateral Connection in the U.S. MMFs Market

The money market is where financial instruments with high liquidity and very short maturities are traded. Money market funds offer baskets of these instruments, which are normally considered to be safe, to institutional and individual investors. Unlike other mutual funds, money market funds are allowed by the SEC's Rule 2a-7 to use the amortized cost pricing method to keep a constant $1 per share NAV. Because they provide investors a stable asset value and cash on demand, they have always been viewed as safe as cash until the 2008 crisis when money market funds experienced extraordinary stresses originated from defaults of some short-term debt in their portfolio holdings. To improve money market funds financial stability, a number of substantial reforms by the SEC were adapted in 2010 and 2014 (see, e.g. Gallagher et al., 2015b; Hanson et al., 2015).

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. money market funds into five categories: prime, treasury, government/agency, single state fund and other tax exempt fund. The abbreviation "MMFs" in this paper refers to prime money market funds because they mainly invest in non-government securities.

As shown in Figure 1, multiples roles are played by different financial firms in the MMF market: some, such as American Century Investment and Waddell & Reed Financial, only stand on the fund side and sponsor MMFs; some, such as Barclays and RBS, stand on the issuer side only and issue different money market instruments; the rest of the few, such as JP Morgan and UBS, stand on both the fund and the issuer sides: 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. 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.

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 2, 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 Eurozone Crisis in 2011

Since the 2008 crisis, MMFs experienced their most rapid period of outflows during the Eurozone crisis of 2011. This crisis's cause can be traced back to 2009, when Greece's sovereign debt were revealed to be massively understated because of accounting issues. Investors' panic was

driven by concerns of Greece's and some other European countries' high defaults chance, and soon spread out. The other concern was about solvency of Eurozone banks, who not only were exposed to Eurozone economy but also held a large amount of sovereign debt from countries in trouble. On June 13, Standard and Poor's downgraded Greek sovereign debt to CCC and, 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' exposures to Greece. Although the European Central Bank (ECB) approved financing bailout plan for Greece on July 2, on July 5, Moody's downgraded Portuguese sovereign debt to "junk" status, followed by a similar downgrade of Ireland on July 12. On July 21, the ECB approved a second rescue package for Greece, but concerns of contagion kept spread until cover much of the European continent. As a result, CDS premiums on banks in core European countries rose markedly.

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

2.3 The Dodd-Frank Banking Stress Test

In the wake of the financial crisis, the 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 was 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 tests examine how bank balance sheets would hold up under the pressure of an extremely adverse economic scenario, which includes 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 these tests is the tier 1 common ratio. The mandated minimum level by regulators is 5% and the median among tested BHCs is 7.7% in 2013. Though only Ally Financial fails the test pretty seriously, many of the rest 17 BHCs who pass the test have 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, though not as severely as European banks in the Eurozone Crisis, by the release of the stress test results in March 2013.

2.4 Hypothese Development

My hypotheses concern the cross-holding relation described in Figure 2. My interest is whether and how this bilateral bonding plays against the independence rule in arm's length financing. However, the bilateral connection and an issuer's characteristics, especially its creditworthiness, could be endogenously correlated, so it is ambiguous to simply conduct a direct test.

The time window around the Eurozone crisis in June, 2011 creates a laboratory environment for the test. Money market instruments issued in Europe, which had been considered to be safe, were suddenly under the shadow of investors' doubt. Following this fact is an intuitive question: is there any difference between a financial firm's lending to its bilaterally-connected and unconnected Eurozone issuers after this downgrade shock? Using the start of June 2011 as a breakpoint, I follow Chernenko and Sunderam (2014) to 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 grading reviews on European banks. Compared to the standard arm's length financing, in which lenders and borrowers are absolutely independent from each other, in the case when two financial firms mutually hold each other's debt, there is reciprocity existing in this relationship. The bilateral bonding motivates a MMF's sponsor to offer help to its connected European partner who found it difficult to borrow money from other MMFs after Moody's review; and also, this implicit commitment would be beneficial to the sponsor.

Chernenko and Sunderam (2014) show that MMFs with greater exposure to Eurozone banks suffer greater outflows after June, 2011. Thus, if following rules of fully arm's length lending, MMFs should have decreased their exposure to all European debt so that they would not intensify further investor redemptions; in other words, European issuers would have seen universal decline in MMFs' funding due to investors' continuous concern. However, under an alternative hypothesis that financial firms' cross-holding relation in the MMF market creates a channel of relationship lending, a MMF might treat Eurozone issuers bilaterally connected with its sponsors differently than other Eurozone issuers. Whether or not having this bilateral connection with a MMF matters to an Eurozone issuer whose securities are generally less likely be held by MMFs after the Eurzone crisis. As shown in Figure 3, J.P. Morgan's MMFs would treat Deutsche Bank and RBS who both issue money market instruments differently.

Hypothesis One. The changes of MMFs' exposure to bilaterally-connected and unconnected European issuers between the pre- and the post-period are different.

This hypothesis should emphasize the control of the issuer-fixed effect and the fund- fixed effect, in case of the endogenous concern, which says MMFs (issuers) bilaterally connected with issuers (MMFs) are different from other MMFs (issuers) by nature, drives the difference in lending between the pre- and post-periods. To be specific, after the Eurozone crisis: (1) the funding a given Eurozone financial firm receives from MMFs would be different depending on its bilateral connection with MMFs; (2) a given MMF's portfolio weights on European issuers would be

different depending on its bilateral connection with issuers.

Second, I study why financial firms commit to relationship lending in the MMF market. I directly investigate whether MMFs' bias towards bilaterally-connected issuers is driven by reciprocity.

Given the nature that two parties involved in the cross-holding relationship have stakes in each other, it is very likely that reciprocity is reflected in securities that are issued to each other. 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 to Deutsche Bank's MMFs could also be different from other money market instruments. This possibility gives rise to my second hypothesis:

Hypothesis Two. Comparing to other holdings in same portfolios of European financial firms' MMFs, securities issued by their bilaterally-connected financial firms are different in the post-period than in the pre-period.

Here is the implication of this hypothesis. For two connected financial firms in my empirical setting, when the one in Europe has difficulty borrowing money after mid-2011, the reason why the other one is willing to help is that the European side should provide some benefits to compensate its connected partner, which is reflected in the portfolio holdings of European financial firms' MMFs.

3. Data and Summary Statistics

I collect data from different sources. I have 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.[2] 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

[2]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) and Hu et al. (2015)

can be found in the Appendix A. This novel dataset covers the period from November 2010 to August 2013.

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 with the CRSP Mutual Fund Database. 89.34% of N-MFP class-level observations are able to be linked to CRSP,[3] which gives class-level expense ratios, types (institutional or retail), ages, etc. The study is conducted on the fund- series level so that all class-level characteristics (e.g. net yield, age, expense ratio) are finally aggregated to the fund level weighted by values of class assets.

MMFs do not follow a uniform standard to report fund names and securities' issuer names in N-MFP forms. To clear up this messy information, I search these names in Factset and Bloomberg to get funds' and issuers' formal names and headquarter locations. For MMFs, I also double check with SEC form N-SAR about their sponsors' names.

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 measured in USD and with the "Modified-Modified" restructuring clause.[4]

The final sample covers 345 financial firms. Figure 5 shows how funds and issuers are distributed among these financial firms. From the last stacked columns in all the four panels, we can see that, in total, there are 90 financial firms sponsoring funds and 299 financial firms issuing money market instruments. The two sides' overlapping are 43 financial firms serving dual roles, their names are listed in the Appendix B. The fund-side financial firms own a total of 264 unique MMFs, which together manage $1.76 trillion in assets every month during my sample period.

[3] 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.

[4] For those issuers only showing CDS rates in Euro in the Markit database, I convert the Euro CDS rates to USD ones using real-time exchange rates.

Although only less than half of financial firms on the fund side serve dual roles, they sponsor almost two thirds of MMFs, and their total AUM occupy more than 88% of all MMFs' AUM. The issuer-side financial firms issue securities with a monthly total value of $1.27 trillion. About 15% of financial firms on the issuer side are also fund sponsors; securities issued by them account for 32% 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. Only five out of them are both fund sponsors and security issuers, but securities issued by these six firms take more than 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 with the documented fact by Ivashina et al. (2015) that a large share of dollar liabilities are issued by foreign banking entities. Comparing financial firms serving dual roles in Panel B and Panel C, on the fund side, European firms have much less AUM than their non-European peers, but on the issuer side, both firms are very close in total value of issued securities.

[Insert Table 1 about here]

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 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 sponsor also issue debt in the MMF market), dual-role MMFs have larger TNA, younger fund age, ownership tilted towards institutional investors, and slightly lower expense ratios. The fund flow calculated as the difference between *Subscription* and *Redemption* shows an average dual-role fund's size decreases by 0.40% monthly while an average stand-alone fund's size increase 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 *CD* (certificate of deposit); 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.

[Insert Table 2 about here]

Table 2 reports summary statistics of securities in MMFs portfolio holdings. Panel A lists non-government securities. On average, *ABCP*, *CD*, *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, *CD* 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.

4. The Cross-Holding Relation (CHR) through MMFs

4.1 Identify CHR

Although relationship-based lending has long been discussed in the banking literature,[5] rather than being detected directly, the relationship mechanism is measured based on prior long-term lending activities. In a word, "relationship" is used as a general term instead of a specific one. Here,

[5] See, for example, Bharath et al. (2007), Bolton et al. (2016).

however, I document an important channel financial institutions use to build relationship: a cross-holding relation conducted through affiliated MMFs.

My detailed empirical analysis is conducted on the fund-issuer 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 at time t, and $\sum_i Outstanding_{f,i,t}$ is the total value of fund f's portfolio holding at time t. Therefore, *Exposure* represents a given fund f's portfolio weights to different issuers i at time t.

According to the definition of the cross-holding relation, 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".

[Insert Table 3 about here]

Table 3 gives an overview of fund-issuer pairs in my sample during the whole March-August 2011 period. Panel A compares connected pairs with unconnected pairs. 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 the cross-holding relation. This fact is understandable 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 $250.905 million per pair in

connected pairs is higher, while risk exposure proxies such as yield, net yield and days-to-maturity are lower. The facts jointly imply that the cross-holding relation 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 launched later than this paper's testing period.)

Panel B in Table 3 compares fund-issuers pairs between European and non-European issuers. Averagely, European issuers borrows more in terms of both fund weight and dollar amount, and the distributions their borrowing is more volatile. European securities' higher yields and net yields in the MMF market are in line with European banks' feature of offering higher yields on their borrowings as concerns about European sovereign debt simmered.

4.2 The Impact of CHR on MMFs' Lending Behavior

Starting from this section, I show my empirical test results. As highlighted in Section 2, I separate my analysis into two symmetric periods surrounding Moody's review of Eurozone banks: March-May 2011 (the pre-period) when MMFs still reached for high-yield securities, and June-August 2011 (the post-period) when MMFs suffered large redemptions because of investors' worries about MMFs' exposure to European borrowers.

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 Eurozone 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 an 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. The 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 Eurozone 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

My first hypothesis focuses on real effects of the cross-holding relation on MMFs' lending to European issuers. The univariate analysis above provides preliminary evidence that MMFs' lending to bilaterally-connected and unconnected European issuers changes differently after the Eurozone 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;[6] *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 size ($Log(Fund\ Size)_{f,t}$), 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. 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 5 about here]

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

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, the cross-holding relation increases a MMF's exposure to the corresponding European issuer by 0.36%–0.47% 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, the cross-holding relation 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 house-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 the cross-holding relation 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. All issuers are put into seven categories: "Conglomerate", "Bank", "Investment Company", "Insurance Company", "Government", "Agency", "Non-financial Firms". 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.

4.2.3 Comparison among All Issuers

This section shows fund-issuer pairs' *Exposure* changes in the entire sample including non-European issuers. Table 6 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 6 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 *EuropeanIssuer* 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.

4.2.4 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, the cross-holding relation 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 7.

[Insert Table 7 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 Eurozone 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 the cross-holding relationship is not simply a reflection of documented relationship strength by previous researches but helpful to deepen the understanding about the relationships mechanism.

4.2.5 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.

To measure the riskiness of securities, I apply three risk measures suggested by Kacperczyk and Schnabl (2013). The first one is *Spread*, namely a security's gross yield net of one-month T-bill rate. After adjusting for time varying interest rate, this measure can largely reflect a debt's risk. The second one is *Maturity*, namely a security's days-to-maturity. Intuitively, the longer the days-to-maturity, the larger the uncertainty. For each fund-issuer pair, both *Spread* and *Maturity* are averaged weighed by each security's value in the fund's portfolio. The last one is *Holdings Risk*, calculated as the weight of an issuer's insecure securities net of its secure securities in a fund's portfolio. Secure securities include government repo, agency repo and Treasury repo, while other types of securities belong to the insure category.

[Insert Table 8 about here]

For fund-issuer pairs with European issuers, Table 8 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 Eurozone 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 corss-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 C also shows that changes in riskiness of securities issued by connected and unconnected European issuers surrounding the Eurozone crisis are the same.

5. The Reciprocity Effect

This section aims to answer why financial houses commit to relationship lending in the MMF market.

As shown above, MMFs were willing to increase stakes in bilaterally-connected European partners after the Eurozon crisis, but this willingness is not related to securities' riskiness. Therefore, it is not because their connected European issuers provided less risky money market instruments that makes MMFs tilt to these issuers in portfolio weights after mid-2011. Now a further question is: what other benefits could MMFs get from helping their bilaterally-connected European partners after the crisis?

There is reciprocity between two connected financial firms. The nature of the bilateral connection is that both parties mutually hold each other's debt, in other words, MMFs of the European financial houses also have stakes in their bilaterally-connected partners, whose MMFs, according to findings in Section 5, have increased their stake in European partners in the post-period. 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.

A fund-issuer pair (f,i) is called "Reverse Pair" if the 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. Obviously "Reverse Pair" is a bilaterally-connected pair in which MMFs are under the umbrella of European financial houses.

[Insert Table 9 about here]

I compare "Reverse Pairs" with other fund-issuer pairs[7] surrounding the Eurozone crisis. Four different variables are applied: *Exposure*, *Spread*, *Maturity* and *Holdings Risk*. The first one is defined in the specification (1) and the rest three are defined in the specification A.1. The corresponding univariate statistics and *t*-test of differences are presented in Table 9. The empirical

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

statistical reference of reverse pairs is 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. A 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 and comparing with other fund-issuer pairs, MMFs sponsored by European financial firms increase their portfolio holdings of money market instrument issued by their connected issuers (namely those whose MMFs increase stakes in bilaterally-connected European financial firms), moreover, they also accept more insecure securities than secure securities from their connected issuers. This pattern is not found in Panel B and Panel C. both reverse and unconnected pairs experience declines in securities' *Spread* and *Maturity*.

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

$$\begin{aligned} Lending_{f,i,t} = & \alpha + \beta_1 Reverse\ \ Pair_{f,i} \times Post + \beta_2 Reverse\ \ Pair_{f,i} + \beta_3 Post \\ & + \beta_4 BConnected_{f,i} + \beta_5 European\ \ Issuer_i + \beta_6 European\ \ Fund\ \ Sponsor_f \\ & + \gamma Control_{f,t} + \varepsilon_{f,i,t}, \end{aligned} \tag{3}$$

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 10 about here]

Table 10 reports the results when *Lending* is measured by *Holdings Risk*.[8] Across all columns, estimates of β_1 are positive and statistically significant at the level of 1%: *Holdings Risk* in reverse pairs increases 10.85-14.26 basis points after the Eurozone crisis. This finding is robust after

[8]The results when *Lending* is measured by the other three measures are presented in A.2.

controlling different fixed effects, especially the pair's feature of being bilaterally connected, 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, three out of five estimates of β_3 are negative and statistically significant at the level of 5%: *Holdings Risk* generally decreases 2.37-4.14 basis points in the post period.

These findings imply that, after the Eurozone crisis, although MMFs 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' MMFs' willingness to continually finance the corresponding European financial firms after mid-2011. Plus, the negative coefficient of *Post* complies with the same fact that normally the portfolio weights gap between insecure and secure securities in each fund-issuer pair decrease after mid-2011.

Results in Table 10 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' willingness, through their affiliated MMFs, to accept more insecure debt from these financial firms after the Eurozone crisis, a period when both European debt and insecure securities are unwelcome in the MMF market.

6. Spillover Effects

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

Due to the limited available capital 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, then these issuers may meet difficulties to borrow money from other lenders in a short time due to the lack of relationship (Chernenko and Sunderam (2014)).

Now I introduce a variable $SEuro\ \ Fund\ \ Share$, which is decided as :

$$SEuro\ \ Fund\ \ Share_{i,t} = \frac{\sum_f Outstanding_{f,i,t} \times SEuro\ \ Fund_f}{\sum_f Outstanding_{f,i,t}},$$

where $SEuro\ \ Fund$ is a dummy equal to one if the MMF has bilaterally-connected European issuers. $SEuro\ \ Fund\ \ Share$ reflects how heavily an issuer relies on these $SEuro\ \ Fund$s to borrow money. If $SEuro\ \ Fund\ \ Share = 0$, then this issuer is not held by any $SEuro\ \ Fund$. I put all issuers in the sample into two groups: $SEuro\ \ Fund\ \ Share = 0$, and $SEuro\ \ Fund\ \ \ Share > 0$.

[Insert Table 11 about here]

In Table 11, 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 the cross-holding relation 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 Eurpean issuers as well as riskier securities.

To further investigate how the spillover effect differs by issuers' $SEuro\ \ Fund\ \ Share$, I apply

the following test in Chernenko and Sunderam (2014):

$$\Delta Outstanding_i = \alpha + \beta Issuer\ \ Euro\ \ Share_i + \varepsilon_i, \tag{4}$$

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 12 about here]

As shown in Table 12, 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.

7. The 2013 Dodd-Frank Stress Test: A Similar Natural Experiment

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 specifications 1 and 3, using December 2012 to February 2013 as the pre-period and March-May 2013 as the post-period. Changes of *Exposure* and *Holdings Risk* are reported in Table 13 and Table 14 respectively.

[Insert Table 13 about here]

[Insert Table 14 about here]

Though the results are much weaker than those in Table 6 and Table 10, we can still observe that, comparing with other MMFs, MMFs that are involved with these low tier 1 common ratio BHCs increase their exposures to these BHCs in the post period, meanwhile, *Holdings Risk* in the reverse pairs also increase. The two tables together reflect CHR's impact on MMFs' lending after the 2013 Dodd-Frank stress test.

8. Conclusion

In the context of the U.S. money market funds, this paper study the existence and influence of relationship financing in shadow banking. In particular, I document a bilaterally-connected relation

that financial firms mutually hold each other's debt through their affiliated MMFs.

Using 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 downgrade 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 in funds' portfolio holdings is driven by the motivation of reciprocity between bilateral-connected financial firms. In return, the European financial firms, through their affiliated MMFs, accept more insecure debt from their bilaterally-connected partners. Issuer or fund characteristics do not explain the results. I further show the cross-holding relation also have spillover effects on unconnected issuers when they fail to raise money from new MMFs shortly.

My findings improve the current understanding of the nature of relationship lending between financial institutions, particularly "shadow banks" that act as intermediaries providing short-term credit but are active in capital markets that are usually thought to be financed by "arm's length".

Broadly speaking, as non-bank financial intermediaries who also have the similar banking function, financial institutions like MMFs may create panics spreading around the broader economy. My results shed lights on how even a very large number of borrowers who don't have relationship with MMFs can be deeply affected by MMFs' relationship lending to connected borrowers.

Appendix A. 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)", "certificate of deposit (CD)", "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 cfinance", the other four types of firms only issue non-financial commercial paper in my sample.

Secondly, I name issuers of securities in the last four investment categories after the corresponding investment's category name. Measured in the value weight, across the entire holdings sample 4.2% are "Treasuries", 10.2% are "government or agency debt", 18.8% are "municipal or agency debt" and 7.6% are "other".

Appendix B. Financial Firms Serving Dual-Roles in the MMFs Market

The following lists the 38 Non-European financial entities who both sponsor dollar-dominated MMFs and issue money market fund instruments.

American Beacon Advisors, Inc.	Mitsubishi UFJ Financial Group, Inc.
Bank of America Corp.	Morgan Stanley
Bank of Montreal	Nationwide Mutual Insurance Company
BlackRock, Inc.	New York Life Insurance Co.
Brown Brothers Harriman & Co.	Northern Trust Corp.
Federated Investors, Inc.	PNC Financial Services Group, Inc.
Fidelity Investments	Pacific Mutual Holding Company
Fifth Third Bancorp	Prudential Financial, Inc.
Franklin Resources Inc.	Putnam Investments
General Electric	Royal Bank of Canada
Guggenheim Partners, LLC	State Street Corporation
Huntington Bancshares, Inc.	The Bank of New York Mellon Corp.
Invesco	The Charles Schwab Corporation
JP Morgan Chase & Co.	The Goldman Sachs Group, Inc.
M&T Bank Corp.	The Toronto-Dominion Bank
Macquarie Group Limited	U.S. Bancorp
MassMutual Financial Group	UMB Financial Corporation
Meeder Investment Management, Inc.	Vanguard Group, Inc.
MetLife, Inc.	Wells Fargo & Company

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

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

Appendix C. 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.1 about here]

Results of this difference-in-difference model are presented in Table A.1. 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 Eurozone crisis are the same. In other words, although the corss-holding relationship make a difference in lending, there is no differences in securities' riskiness.

However, Table A.1 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 Eurozone crisis.

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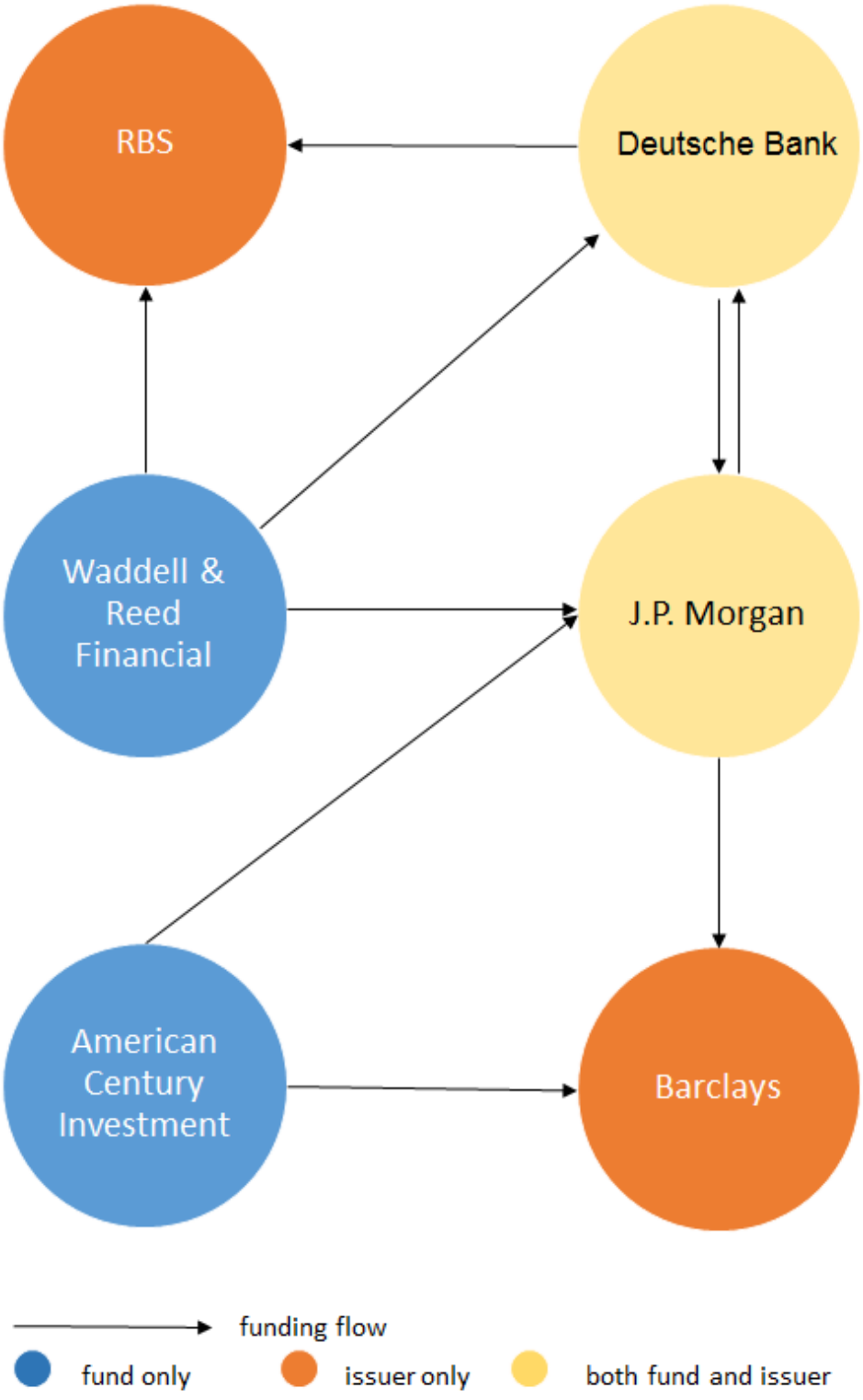


Figure 1: An illustration of different financial firms in the MMF market

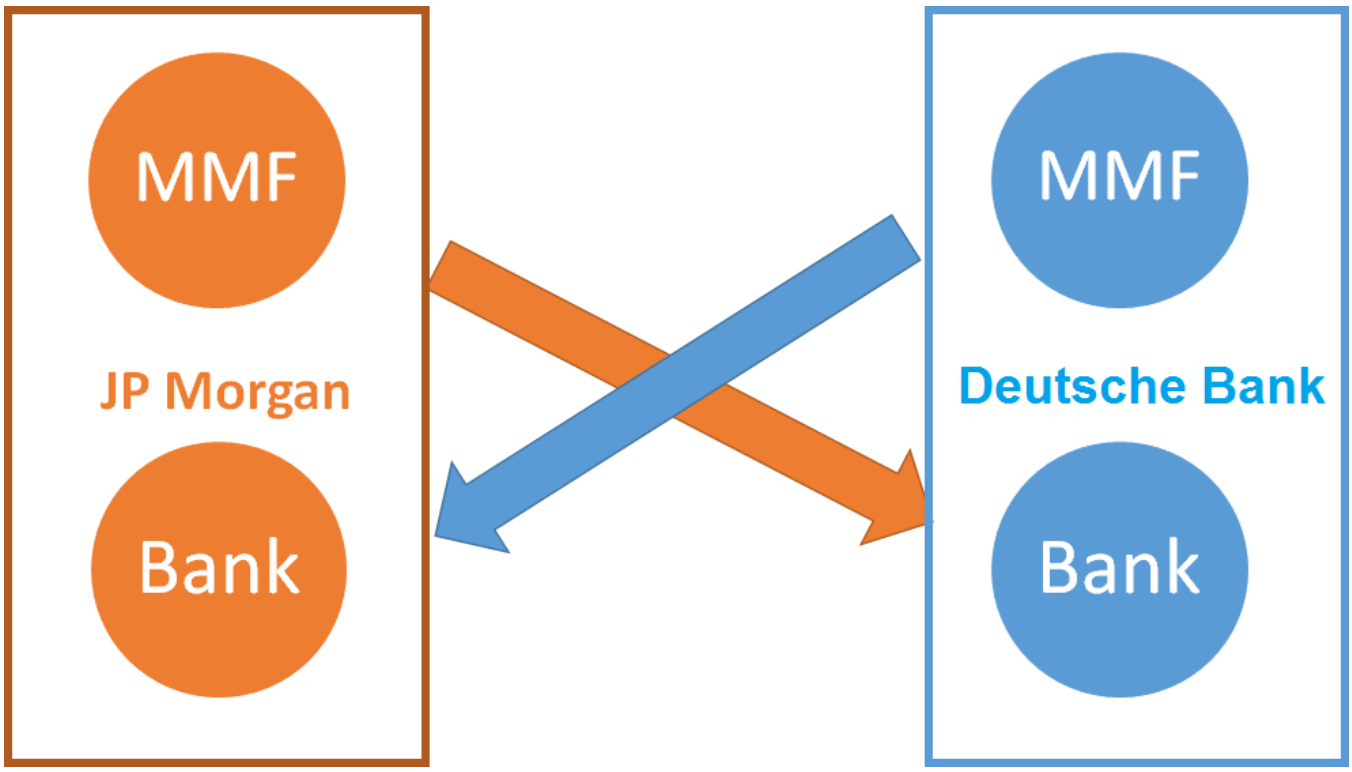


Figure 2: An example of the bilateral connection of two financial firms in the MMF market

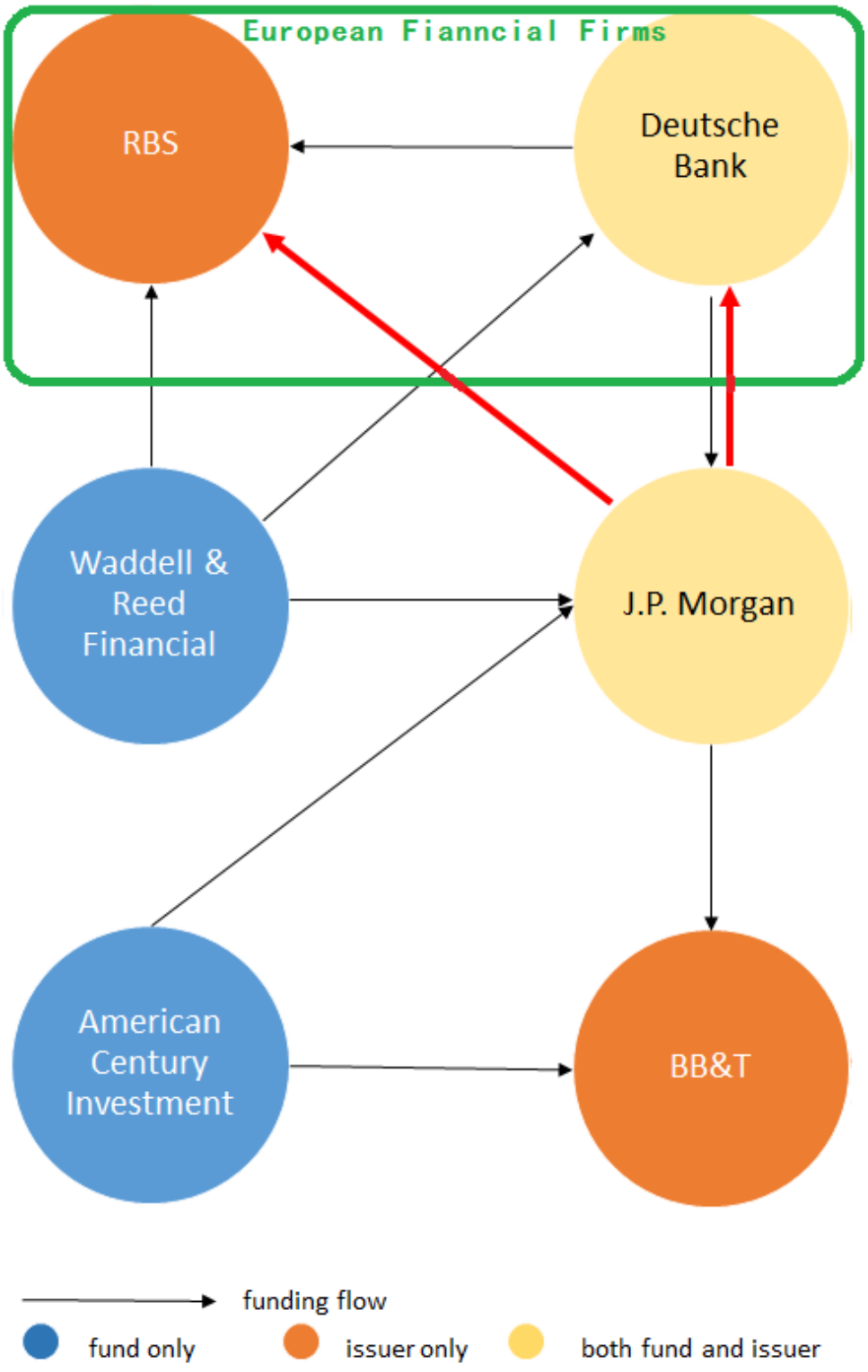


Figure 3: An illustration of Hypothesis One

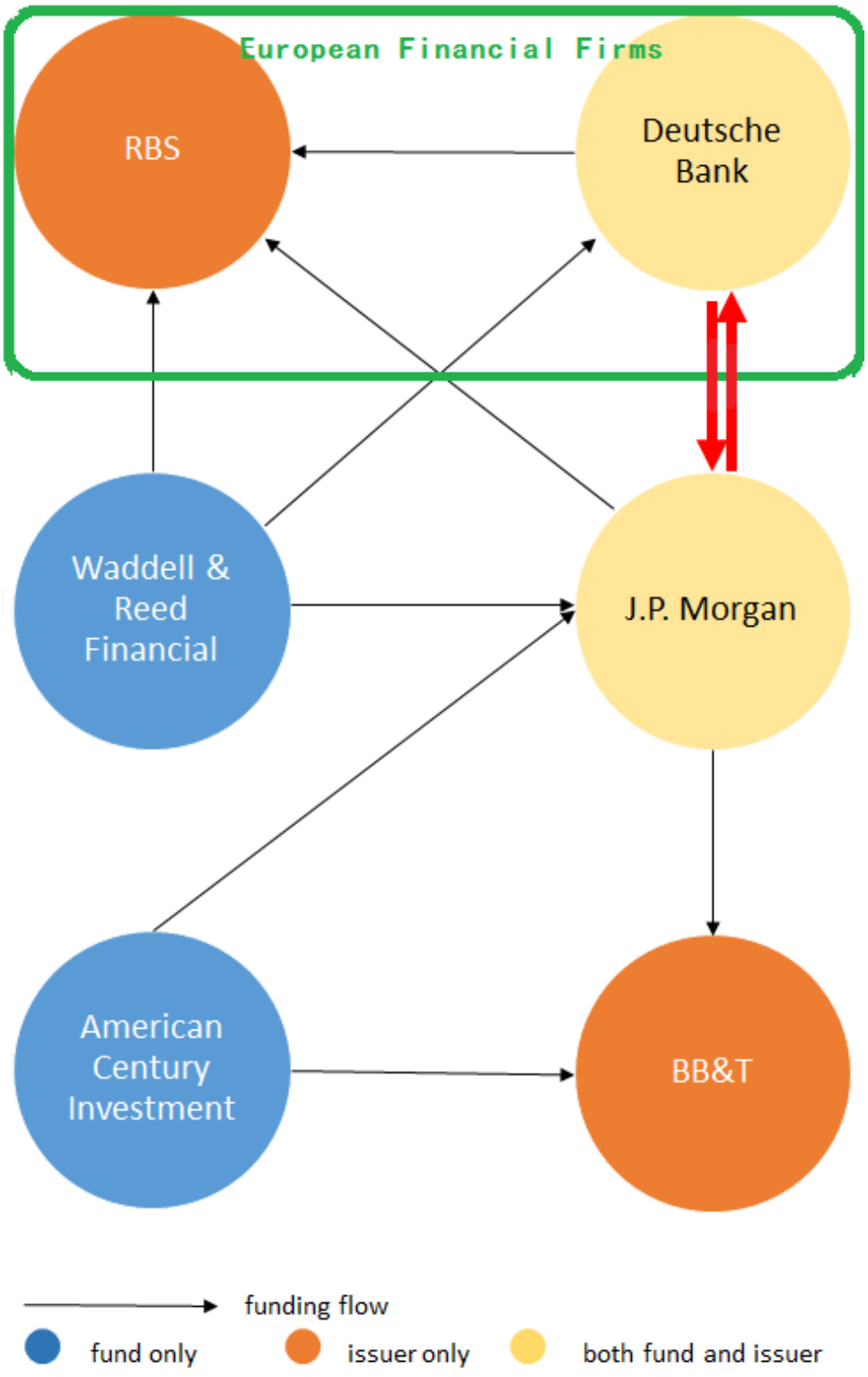
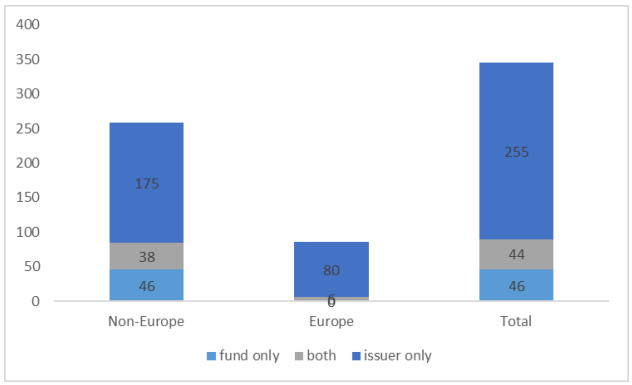
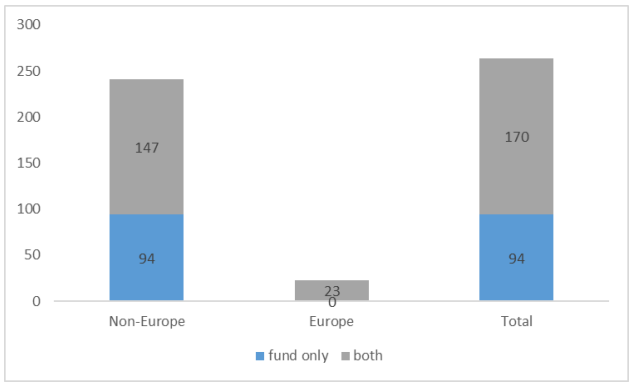


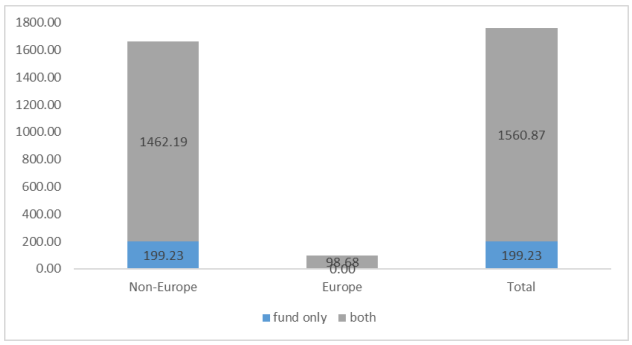
Figure 4: An illustration of Hypothesis Two



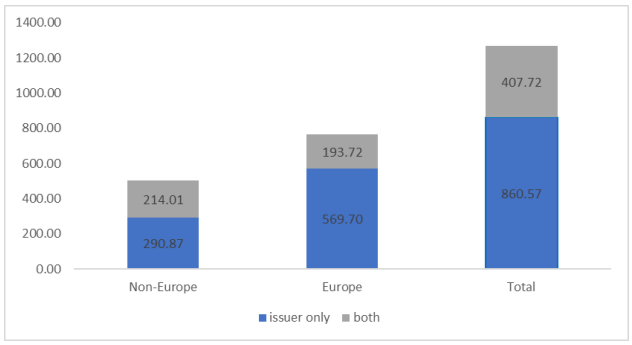
(a) Number of financial firms



(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

Table 1: Summary Statistics: Funds

	All		Stand-Alone Funds		Dual-Role Funds	
	Mean	SD	Mean	SD	Mean	SD
Panel A: Fund Characteristics						
Total Net Assets ($millions)	7051.88	16237.34	2259.04	5139.31	9629.60	19295.47
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
Panel B: Instrument Shares(%)						
ABCP	10.41	11.86	9.67	13.11	10.81	11.10
CD	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

This table reports summary statistics of all prime money market funds in my sample during the whole March-August 2011 period. The first column is for all MMFs in my sample, the second and third columns are respectively for stand-along MMFs and MMFs whose sponsors serving dual roles. *Total Net Asset*, *Portfolio Maturity* are as reported in N-MFP. *Age*, *Institutional Shares* and *Expense Ratio* are weighted averages of class-level characteristics from CRSP. *Fund Flow* is the difference between *Subscription* and *Redemption*, which are 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 weighted average of annualized class-level 7-day net yield from N-MFP. *Connceted Share* is the share of fund?s assets invested in bilaterally-connected partners. *Euro Share* is the share of fund?s assets invested in Eurozone banks. Standard deviations of the given characteristics are presented in the parentheses.

Table 2: 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
CD	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 3: Fund-Issuer Pairs Overview

					Percentile				
		N	Mean	SD	Min	25	50	75	Max
Panel A: Connected versus Unconnected pairs									
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
Panel B: European Versus Non-European Issuers									
EU	Exposure (%)	17385	2.76	1.91	0.40	1.21	2.35	3.93	7.51
	Outstanding ($1M)	17385	201.75	315.03	1.00	12.30	53.99	230.00	1185.71
	Yield (bps)	14924	27.87	10.92	8.53	20.16	27.56	34.66	50.10
	Net Yield (bps)	14924	22.83	10.68	4.00	16.00	22.20	29.20	45.00
	Maturity (days)	17317	47.87	42.86	1.00	12.94	36.10	70.41	154.00
NEU	Exposure (%)	16744	2.28	1.66	0.22	0.93	1.90	3.30	6.24
	Outstanding ($1M)	16744	125.73	194.10	0.50	8.50	35.00	149.95	722.51
	Yield (bps)	14474	23.29	9.78	5.00	16.33	23.91	29.86	42.31
	Net Yield (bps)	14474	18.46	9.47	1.00	12.00	18.72	24.60	37.55
	Maturity (days)	16601	55.05	55.75	1.00	10.00	36.57	80.00	194.13

This table reports distributions of key variables across different fund-issuer pairs in my sample during the whole March-August 2011 period. 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. For each 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 at time t, and $\sum_i Outstanding_{f,i,t}$ is the total value of fund f's portfolio holding at time t. *Yield* is the weighted-average yield paid by an issuer. *Net Yield* is *Yield* net of one-month T-bill rate. *Maturity* is the weighted-average days to maturity of an issuer's securities.

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 downgrade 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 at time t, and $\sum_i Outstanding_{f,i,t}$ is the total value of fund f's portfolio holding at time 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)
Log(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
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. *BConnected* is a dummy equal to one for all bilaterally connected fund-issuer pairs in the pre-period; *Post* equals one when t represents a month in the post-period; *Conglomerate* is a dummy equal to one for issuers who are conglomerate; Other control variables include the natural logarithm of fund size ($Log(Fund\ Size)_{f,t}$), 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 ($CDS\ Rate_{i,t}$). 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 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)			
Log(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
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. Other variables follow the same definition 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: Bilateral Connection and Past Relation

	Frequency		Maturity		Quantity (Issuer Based)		Quantity (Fund Based)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BConnected × Post		0.407***		0.408***		0.416***		0.470***
		(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× Post	-0.137	-0.142	0.087	0.089	0.034	0.026	-0.293***	-0.309***
	-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
Log(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 Ratio(bps)	-0.020*	-0.020*	-0.020*	-0.020*	-0.018*	-0.018*	-0.021*	-0.021*
	(0.011)	(0.011)	(0.011)	(0.011)	(0.010)	(0.010)	(0.011)	(0.011)
Institutional Share(%)	4.234***	4.213***	3.926***	3.899***	4.121***	4.103***	3.651**	3.616**
	(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
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 variables follow the same definition in Table 5. 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 8: 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 downgrade review. The sample is fund-issuer pairs with European issuers for the whole March-August 2011 period. *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 averaged weighed by each security's value in the fund's portfolio. *Holdings Risk* is the weight of an issuer's insecure securities net of its secure securities in a fund's portfolio. Secure securities include government repo, agency repo and Treasury repo, while other types of securities belong to the insure category. "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 9: 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 downgrade 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. *Exposure* follows the same definition in Table 4, *Spread*, *Maturity* and *Holding Risk* follow the same definitions in Table 8. "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 reverse pairs' statistical significance is based on bootstrapped *p*-values.

Table 10: Reciprocity: Changes in *Holdings Risk*

	(1)	(2)	(3)	(4)	(5)
Reverse Pair × Post	14.258***	11.320***	10.852***	11.796***	11.316***
	(4.418)	(3.842)	(3.685)	(3.984)	(3.846)
Reverse Pair	-11.452	-0.672	-5.295	-4.247	-5.576
	(11.082)	(3.734)	(5.200)	(7.775)	(5.079)
Post	-4.139**	-2.379**	-1.384	-0.346	-2.367**
	(1.799)	(1.103)	(1.181)	(1.030)	(1.101)
BConnected	-27.462**	-4.443	-4.483	-25.909**	-5.305
	(13.085)	(5.421)	(5.465)	(12.900)	(5.028)
European Issuer				5.375	
				(7.058)	
European Fund Sponsor					5.369
					(4.525)
Log(Fund Size)	2.873	-2.601***	-0.484	2.487	-2.553***
	(4.306)	(0.683)	(3.755)	(4.101)	(0.684)
Net Yield (bps)	0.296	-0.518*	0.056	0.205	-0.521*
	(0.296)	(0.276)	(0.259)	(0.284)	(0.267)
Age (years)	0.081	0.090	0.529	0.130	0.093
	(0.730)	(0.135)	(0.717)	(0.730)	(0.135)
Expense Ratio(bps)	0.027	-0.176	0.012	0.035	-0.163
	(0.276)	(0.152)	(0.219)	(0.266)	(0.151)
Institutional Share(%)	25.141	2.681	21.836	26.900	3.391
	(25.697)	(2.875)	(22.990)	(24.357)	(2.873)
Fund Flow (%)	0.014	0.013	0.012	0.032	0.008
	(0.061)	(0.087)	(0.053)	(0.060)	(0.087)
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	25345	25325	25325	25345	25325
R^2	0.099	0.449	0.502	0.174	0.450

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. *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 variables follow the same definitions in Table 9 and 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 11: 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 12: 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
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.

Table 13: 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 × FDBHC				0.209*
				(0.111)
FDBHC				-0.164
				(0.283)
Log(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
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 14: The 2013 Dodd-Frank Test: Changes in *Holdings Risk*

	(1)	(2)	(3)
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)
Log(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
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. Other variables follow the same definitions in Table 9 and Table 10. 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.1: 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)
Log(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
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 variables follow the same definitions in Table 6. 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.2: Reciprocity: Changes in *Exposure*, *Spread*, and *Maturity*

	Exposure			Spread			Maturity		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Reverse Pair × Post	0.014	0.018	0.019	0.258	-0.847	-0.701	-3.028	0.797	0.010
	(0.090)	(0.083)	(0.083)	(0.655)	(0.602)	(0.547)	(5.193)	(6.184)	(5.924)
Reverse Pair	-0.484	-0.460**	-0.052	-5.556***	-0.730	-0.851	6.821	-0.730	-3.954
	(0.299)	(0.194)	(0.250)	(1.818)	(0.925)	(1.232)	(11.076)	(6.577)	(8.055)
Post	-0.007	-0.015	0.019	-0.436	1.323**	-2.483***	-8.412***	-3.939	-3.496***
	(0.056)	(0.036)	(0.032)	(0.393)	(0.545)	(0.214)	(2.819)	(2.447)	(1.318)
BConnected	0.163	-0.145	-0.082	-5.674***	-1.006	-0.769	-17.746**	-3.344	-0.279
	(0.169)	(0.245)	(0.176)	(1.410)	(1.148)	(1.113)	(7.530)	(3.339)	(3.403)
Log(Fund Size)	-0.245**	-0.197***	-0.180*	-3.474***	0.566**	-3.434***	-13.292*	1.895**	-11.340
	(0.122)	(0.031)	(0.099)	(0.893)	(0.219)	(0.682)	(7.733)	(0.770)	(8.243)
Net Yield (bps)	-0.012*	0.006	-0.004	0.031	0.331**	0.050	0.305	0.388	0.365
	(0.006)	(0.011)	(0.006)	(0.066)	(0.147)	(0.057)	(0.254)	(0.359)	(0.249)
Age (years)	0.004	0.005	-0.015	-0.070	0.026	-0.092	-0.302	0.011	-0.788
	(0.027)	(0.005)	(0.024)	(0.235)	(0.041)	(0.187)	(1.219)	(0.132)	(1.391)
Expense Ratio(bps)	-0.001	-0.006	-0.003	0.047	0.319***	0.060	-0.105	0.602**	-0.208
	(0.007)	(0.006)	(0.006)	(0.057)	(0.063)	(0.044)	(0.351)	(0.239)	(0.322)
Institutional Share(%)	1.514	0.129	1.322	6.833	1.409	6.306	25.654	0.817	42.845
	(0.998)	(0.122)	(0.963)	(8.553)	(1.212)	(8.285)	(29.922)	(2.412)	(34.018)
Fund Flow (%)	-0.001	0.001	0.000	-0.009	-0.059**	-0.002	0.096	0.075	0.116
	(0.002)	(0.004)	(0.002)	(0.016)	(0.023)	(0.015)	(0.069)	(0.109)	(0.073)
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
Controls	N	N	Y	N	N	Y	N	N	Y
Observations	25345	25325	25325	21789	21770	21770	25282	25262	25262
R^2	0.225	0.277	0.399	0.322	0.431	0.533	0.098	0.299	0.356

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 11. 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.