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# Frictions in Shadow Banking: Evidence from the Lending Behavior of Money Market Mutual Funds*

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**Abstract**

We document frictions in money market mutual fund lending that lead to the transmission of distress across borrowers. Using novel security-level holdings data, we show that funds with exposure to Eurozone banks suffered large outflows in mid-2011. These outflows had significant spillovers: non-European issuers relying on such funds raised less short-term debt financing. Issuer characteristics do not explain the results: holding fixed the issuer, funds with higher Eurozone exposure cut lending more. Due to credit market frictions, funds with low Eurozone exposure provided substitute financing only to issuers they had pre-existing relationships with, even though issuers are large, highly-rated firms.

*JEL* G01, G18, G21, G28, G32

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# 1 Introduction

Risk taking by nonbank financial intermediaries has been heavily scrutinized in the aftermath of the financial crisis. Writing before the crisis, Rajan (2006) argued that delegated investment management can create incentives for risk taking by nonbank financial intermediaries "searching for yield." Since the crisis, policymakers and academics have focused on frictions and incentive problems that encourage risk taking at "shadow banks," nonbank financial intermediaries involved in credit intermediation.[1] A critical unanswered question is whether this risk taking can have negative spillovers to the broader economy. In this paper, we provide evidence that there are important frictions in shadow bank lending. These frictions create a channel through which risk taking can create spillovers, disrupting the ability of creditworthy firms to raise financing and invest.

Frictions in lending are central to our understanding of how traditional banks can affect the broader economy. As the large literature on bank lending channels suggests, traditional banks maintain relationships with individual firms to mitigate frictions due to asymmetric information. These frictions can impede the ability of firms to substitute to other sources of financing when their bank experiences difficulties. As a result, distress may be transmitted across firms: problems at one firm can impair bank balance sheets, restricting the supply of credit to other creditworthy firms.[2] Thus, when a bank makes a risky loan to a firm with a high probability of distress, it increases the probability that the other firms it lends to suffer a credit supply shock.

The literature has long drawn a sharp distinction between the relationship-based financing provided by traditional banks and the arm's length financing provided by capital markets. Frictions in lending have been extensively studied in the context of traditional banks, but have received less attention in capital markets, where there is generally thought to be less

[1] See, e.g., Volcker (2010), Yellen (2011), Financial Crisis Inquiry Commission (2011), Acharya and Richardson (2009), Becker and Ivashina (2013), Duffie (2010), Kacperczyk and Schnabl (2013).

[2] Theoretical work includes Bernanke and Blinder (1988), Bernanke and Gertler (1989), and Holmstrom and Tirole (1997). Recent empirical work includes Gan (2007), who studies the effects of the Japanese real estate bust, Khwaja and Mian (2008), who study the aftermath of Pakistani nuclear tests in 1998, Paravisini (2008), who studies a government lending program in Argentina, Iyer and Peydro (2011), who study a major bank failure in India, and Chava and Purnanandam (2011) and Schnabl (2012), who study how bank transmitted distress after the Russian default in 1998.

scope for asymmetric information about the large firms raising financing.[3] However, if frictions exist in shadow bank lending, which is largely market-based, risk taking by shadow banks may have consequences for the broader economy.

We study this issue in the context of US prime money market mutual funds (MMMFs),[4] intermediaries in short-term credit markets that are a critical part of the shadow banking system. Using a novel data set of the security-level holdings of MMMFs, we document important frictions in their lending. These frictions create a channel through which MMMFs can transmit distress across firms. We show that risk taking by MMMFs, in the form of lending to Eurozone banks, drove large investor redemptions in the summer of 2011, reducing the ability of non-European firms to raise short-term financing. This is particularly surprising given that MMMFs are permitted to purchase securities of only the highest rated firms.

With close to $1.7 trillion in assets,[5] prime MMMFs are an important source of short-term financing for both financial and nonfinancial firms. According to the Flow of Funds, MMMFs are the single largest holder of open market paper. Instabilities associated with MMMFs played a central role in the financial crisis of 2008. At a much smaller scale, similar instabilities surfaced in 2011 as fears about European sovereign debt problems mounted. As shown in Figure 1, assets managed by MMMFs fell more than $180 billion (11%) between June 8 and August 31, 2011 due to concerns that these funds were heavily exposed to European sovereign debt through their lending to European banks. This "slow-motion run" (Economist, 2011) represents the largest three-month decline in MMMFs assets outside of the financial crisis.

Our main contribution is documenting how frictions in short-term credit markets blur the sharp distinction between relationship-based and arm's length financing that is traditionally drawn in the literature. In particular, our evidence demonstrates that issuers maintain relationships with specific MMMFs and may not always be able to seamlessly substitute between different funds as suppliers of financing. This creates a channel through which MMMFs can

[3] See, e.g., Bernanke (1983), Rajan (1992), Petersen and Rajan (1994).

[4] We will refer to prime money market mutual funds simply as MMMFs.

[5] As of June 1, 2011.

potentially transmit distress across firms and means that risk taking by MMMFs can have negative spillover effects. Specifically, suppose a MMMF adds a risky firm to its portfolio and concerns arise about the creditworthiness of that firm. These concerns can cause the MMMF's investors to pull their money, resulting in a loss of funding for the other creditworthy firms financed by the same fund.

Our analysis traces the complete chain of events from the incentives for MMMFs to take risks to the ultimate consequences of that risk taking for issuers. We first examine the incentives for MMMFs to take risk. Consistent with the existing literature (Christoffersen, 2001; Christoffersen and Musto, 2002; Kacperczyk and Schnabl, 2013), we document a strong performance-flow relationship prior to June 2011, which created incentives for MMMFs to take on risk. Holding large positions in Eurozone banks was an attractive way to take on risk—in May 2011, Eurozone bank investments accounted for more than a quarter of all MMMF assets.

We next consider the consequences of this risk taking as fears about Eurozone banks grew. McCabe (2010), Strahan and Tanyeri (2013) and Schmidt, Timmermann, and Wermers (2013) show that during the financial crisis MMMF investor redemptions were concentrated among risky funds, suggesting that investors are informed about MMMF portfolio quality. Consistent with this idea, we find that MMMFs with greater exposures to Eurozone banks suffered larger investor redemptions between June and August 2011. Moreover, the effect does not appear to be driven by a general pullback from all risky MMMFs. Investors were particularly focused on exposures to Eurozone banks: the effect of Eurozone bank exposures is unchanged when we control for MMMF yield as a measure of the overall riskiness of the fund's portfolio.

We then turn to the main focus of our analysis—the spillover effects of these outflows on non-European issuers. We start by documenting that non-European firms funded by MMMFs with larger exposures to Eurozone banks raise less total financing from MMMFs between June and August 2011. Here, however, identification is a critical concern, as it is in the literature on the bank lending channel. It could simply be the case that these firms are riskier firms and that the June–August 2011 period was associated with a broad withdrawal of funding from all risky issuers.

We address such concerns using our unique security-level data to estimate specifications with issuer fixed effects in a single cross section of issuer-fund (i.e. borrower-lender) pairs, similar to Khwaja and Mian (2008) and Schnabl (2012). In particular, our empirical specifications effectively compare the change in lending to the same issuer of two MMMFs, one with high exposure to Eurozone banks and one with low exposure to Eurozone banks. These specifications show that for the same issuer, MMMFs with larger exposures to Eurozone banks are more likely to withdraw financing. Thus, our results cannot be explained by unobservable issuer characteristics, including riskiness or direct or indirect exposure to Europe. Issuer characteristics, or changes in characteristics over June–August 2011, should cause all MMMFs to react the same way.

We provide direct evidence that the key friction driving these spillovers is that relationships are important in the money markets. Drawing on the literature on relationship banking, we adapt a variety of measures of relationship strength to the context of MMMFs. We show that, consistent with theory (Bolton, Freixas, Gambacorta, and Mistrulli, 2013), MMMFs with strong relationships with a particular issuer are less likely to cut their lending to that issuer. Moreover, MMMFs actually try to increase their portfolio allocations to issuers whose other lenders are suffering outflows, but only if they have pre-existing relationships with these issuers. Thus, our results suggest that relationships matter in market-based financing—even for large, highly rated firms, arm's length finance is never fully arm's length. This separates our paper from recent work on the bank lending channel and illustrates how frictions in short-term debt markets can make them a source of financing disruptions.

The magnitudes of the spillovers we document are not overly large. The context for our study is an episode of moderate stress for MMMFs. Of course, the importance of frictions is typically concentrated in severe downturns. Much of the literature on frictions in banking, for instance, focuses on the Great Depression (Bernanke, 1983), the Japanese real estate bust (Peek and Rosengren, 1997; Gan, 2007), the Russian sovereign default (Schnabl, 2012), and the financial crisis (Ivashina and Scharfstein, 2010; Aiyar, 2012; Almeida, Campello, Laranjeira, and Weisbenner, 2012; De Haas and Van Horen, 2012; Chodorow-Reich, 2013). The episode we study is much less severe. Investor redemptions in the episode we study were significantly slower and much smaller in total than those following the Lehman bankruptcy.

We think of our results as documenting a channel that is likely to be more significant during times of severe market stress.

Our paper is related to both the literature on risk taking by financial institutions, including Rajan (2006), Becker and Ivashina (2013), Kacperczyk and Schnabl (2013), and the literature on bank runs and credit supply, including Bernanke (1983), Calomiris and Gorton (1991), Calomiris and Mason (2003), as well as the bank lending channel literature discussed above. Our key contribution is to study the consequences of MMMF risk taking for issuers, showing that because of credit market frictions, fragility in short-term funding markets can be disruptive to large, highly rated firms. Even when based on information about MMMF exposures to particular risky issuers, investor redemptions can still create collateral damage, reducing the ability of other creditworthy issuers to raise short-term financing. In addition to contributing to the broader literature on risk taking by financial intermediaries and its effects on the broader economy, our paper is also related to the growing literature on MMMFs.[6] This literature has largely focused on MMMF risk taking before the financial crisis, the dynamics of MMMF redemptions during the crisis, and the effects of government interventions during the crisis. Our results document frictions that create a channel through which MMMF risk taking can have spillover effects to the broader economy.

Our paper is also related to the literature on spillovers across holdings of institutional investors, including Ben-David, Franzoni, and Moussawi (2013), Boyson, Helwege, and Jindra (2013), Aragon and Strahan (2012), Coval and Stafford (2007), Greenwood and Thesmar (2011), Manconi, Massa, and Yasuda (2012), and Lou (2012), among others. Relative to this literature, our results are novel in two respects. First, we emphasize the importance of risk taking for generating the initial shock to the supply of capital. Second, we focus on outcomes related to firm financing. Specifically, we show that spillovers across MMMF holdings impair the ability of firms to raise short-term financing. In contrast, the literature on spillovers across holdings focuses primarily on temporary price impacts.

[6] Recent papers on MMMFs include Christoffersen (2001), Christoffersen and Musto (2002), Baba, McCauley, and Ramaswamy (2009), McCabe (2010), Adrian, Kimbrough, and Marchioni (2011), Duygan-Bump, Parkinson, Rosengren, Suarez, and Willen (2013), Kacperczyk and Schnabl (2013), Strahan and Tanyeri (2013), and Schmidt, Timmermann, and Wermers (2013).

# 2 Background and Hypothesis Development

We use events in the money markets in the summer of 2011 as a laboratory in which to study frictions in shadow banking. In this section, we provide relevant background information and use this information to develop hypotheses we will test in the empirics.

## 2.1 Background

Concerns about European sovereign debt began to surface in late 2009, when Greece revealed that its debt had been substantially understated due to accounting problems.[7] Concerns quickly arose that Greece and other peripheral countries in the Eurozone, including Portugal and Ireland, might default.

These concerns, in turn, created anxiety about Eurozone banks due to their holdings of potentially risky sovereign debt as well as their indirect exposures to peripheral Eurozone economies. In May 2010, faced with growing turmoil in financial markets and funding difficulties for several Eurozone sovereigns, the European Union announced a stabilization package for Greece. Although these measures alleviated Greece's immediate funding needs, problems continued to develop. Subsequent events suggested that sovereign debt problems would not be limited to Greece. Ireland accepted a bailout package in November 2010. Portugal accepted a similar package in May 2011.

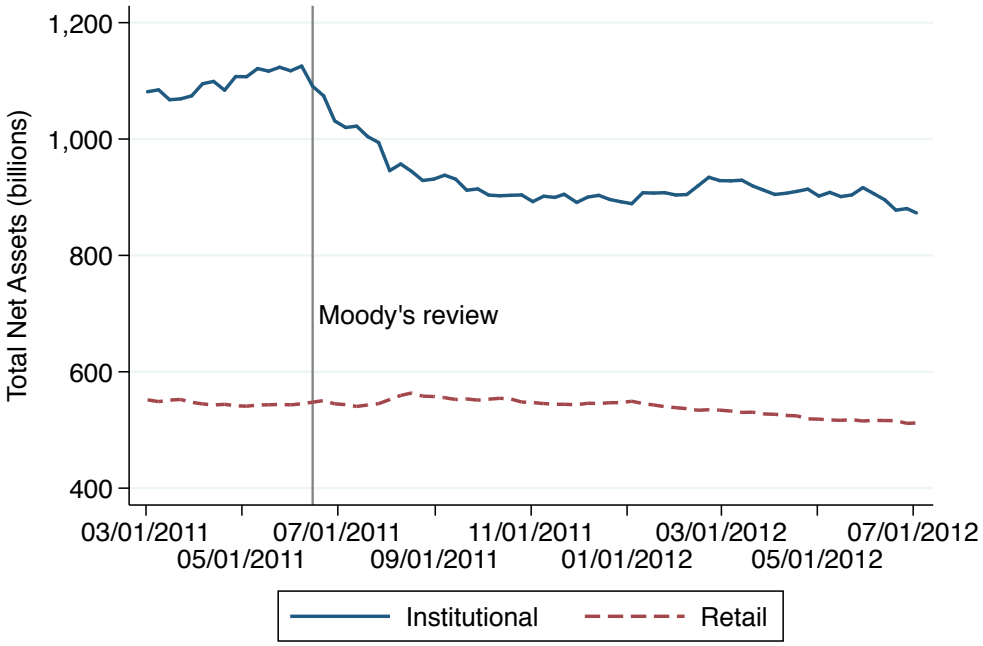
As large haircuts or outright default on Greek debt became increasingly likely, concerns about the solvency of Eurozone banks with large holdings of sovereign debt resurfaced in June 2011. On June 15, Moody's placed the large French banks BNP Paribas, Credit Agricole, and Societe Generale on review for possible downgrade citing their exposures to Greece.

Figure 1 shows that Moody's review set off large investor redemptions from prime MMMFs. Assets managed by these funds peaked at $1.67 trillion on June 8 and declined by over $180 billion (11%) to $1.49 trillion on August 31, 2011.

This was a relatively large shock. The decline in aggregate MMMF assets is the largest

[7] See Bloomberg's European Crisis Timeline for more information: http://www.bloomberg.com/news/2011-11-07/europe-timeline-maastricht-to-papandreou.

**Figure 1**
**Total Net Assets of Prime MMMFs**
Weekly data from the Investment Company Institute.




three-month decrease except for the depths of the financial crisis in the fall of 2008.[8] Of course, both the total decline in assets and the speed of redemptions were substantially less severe than during the financial crisis.

## 2.2 Hypothesis Development

With this background in mind, we now discuss the set of hypotheses we will test in the data. Throughout the paper, we separate our analysis into two symmetric periods: June–August 2011 (the post period), the period of large-scale investor redemptions from prime MMMFs, and March–May 2011 (the pre period), the three months leading up to these investor redemptions.

The first hypothesis we test is that MMMFs faced incentives to take on exposures to

[8] Based on data from the Investment Company Institute (ICI), covering the 1984–2011 period.

Eurozone banks in the pre period. As shown by Christoffersen (2001), Christoffersen and Musto (2002), and more recently by Kacperczyk and Schnabl (2013), MMMFs face strong performance-flow relationships. In normal market conditions, higher-yielding MMMFs tend to attract inflows, while lower-yielding MMMFs tend to suffer outflows.[9] Since MMMFs are compensated for assets under management, this performance-flow relationship creates incentives for risk taking (Chevalier and Ellison, 1997).

During the pre period, as concerns about European sovereign debt simmered, Eurozone banks offered higher yields on their borrowings than other issuers to attract funding. In our data, the difference in yields was on average about 20 basis points (bps) during the pre period. The mean and standard deviation of pre period yields in our data are 26 bps and 11 bps respectively, so this was a significant difference. We hypothesize that the higher yields offered by Eurozone banks allowed MMMFs with high exposure to those banks to attract inflows during the pre period.

*Hypothesis 1. MMMFs with greater exposure to Eurozone banks receive greater inflows in the pre period.*

Second, we hypothesize that this risk taking led to outflows after the Moody's review. McCabe (2010), Strahan and Tanyeri (2013) and Schmidt, Timmermann, and Wermers (2013) show that outflows from MMMFs following the Lehman bankruptcy were concentrated among MMMFs with risky portfolios, suggesting that MMMF investors are informed about fund portfolio quality. This suggests that outflows in the post period should be concentrated in MMMFs with high exposure to Eurozone banks.

Anecdotally, the same is true of outflows following the Moody's review—MMMFs with large exposures to Eurozone banks suffered the largest outflows. For example, Fidelity Prime Money Market Portfolio, which in May 2011 invested 28% of its assets in Eurozone banks, had outflows of $20 billion (30%), leading Fidelity to issue multiple statements arguing that its exposures to European banks represented "minimal credit risk."[10] Similarly, Dreyfus

[9] Schmidt, Timmermann, and Wermers (2013) document that this relationship is reversed during the financial crisis, showing that higher-yielding MMMFs suffered higher outflows following the Lehman default. We show a similar result for the post period, June–August 2011.

[10] These statements were not sufficient to stem investor redemptions. The first statement was made on June 24th, 2011; the fund nonetheless suffered $10 billion (18% of June 2011 assets) of outflows in July 2011.

Institutional Cash Advantage Fund, with 39% of its assets invested in Eurozone banks, suffered outflows of $22.4 billion, almost 50% of its assets. Our second hypothesis is that this pattern holds systematically in the data.

*Hypothesis 2. MMMFs with greater exposure to Eurozone banks suffer greater outflows in the post period.*

Our remaining hypotheses concern the main focus of our paper: the effects of these outflows on issuers. We take as the null hypothesis the idea that MMMFs provide frictionless arm's length financing. Under this null, if issuer demand for financing is fixed, all issuers should see the same decline in funding when MMMFs suffer outflows. We pose the alternative hypothesis that MMMF lending has some features of relationship-based financing. Under this alternative, the specific MMMFs from which issuers borrow matter. In particular, issuers that rely on MMMFs with high exposure to Eurozone banks will have more difficulty raising financing.

*Hypothesis 3. Issuers relying on MMMFs with greater exposure to Eurozone banks borrow less in the post period.*

Of course, direct tests of hypothesis 3 suffer from an endogeneity problem. It could simply be the case that issuers funded by MMMFs with large exposures to Eurozone banks are risky firms, and that the June–August 2011 period was associated with a broad withdrawal of funding from all risky issuers. A more stringent test, similar to Khwaja and Mian (2008) and Schnabl (2012), is to use security-level data and add issuer fixed effects. This holds fixed issuer characteristics and isolates the effects of the change in capital supply from MMMFs.

*Hypothesis 4. Holding fixed the issuer, MMMF lending declines more for MMMFs with greater exposure to Eurozone banks.*

Our last two hypotheses are more direct tests of the alternative hypothesis that MMMF lending has some features of relationship-based financing. Bolton, Freixas, Gambacorta, and Mistrulli (2013) argue that when faced with capital supply constraints, relationship-based lenders are more likely to cut lending to borrowers with whom they have weak relationships. In our context, this suggests that MMMFs with high Eurozone bank exposure will particularly cut lending to issuers with whom they have weak relationships.

*Hypothesis 5. Holding fixed the issuer, MMMFs with greater exposure to Eurozone banks*

*cut their lending more sharply to issuers with whom they have weak relationships.*

Finally, we hypothesize that relationships also play an important role in preventing issuers from raising substitute financing from MMMFs with low exposure to Eurozone banks. Relationships between issuers and specific MMMFs may be important for mitigating short-run adverse selection problems. If a money market mutual fund that typically provides financing to a particular issuer becomes constrained due to outflows, that issuer will have to seek financing from other funds. But other funds may fear that the issuer's inability to raise financing from its typical funders reflects inside information on the part of those funders. Thus, they may be unwilling to provide financing in the short run until they have done their own research. The fact that MMMFs buy informationally insensitive securities, and therefore have limited credit research capabilities (Gorton, 2009; Hanson and Sunderam, 2013), may exacerbate these problems, even though funds invest in large, highly rated issuers.

Moreover, in the context of MMMFs, there is an important institutional friction that may constrain substitution. Individual MMMFs may only purchase securities from a fixed list of issuers that their boards have preapproved. In particular, SEC Rule 2a-7, which governs MMMFs, states: "The money market mutual fund shall limit its portfolio investments to those United States Dollar-Denominated securities that the fund's board of directors determines present minimal credit risks."[11] Thus, we hypothesize that MMMFs will provide substitute financing only to issuers with which they have pre-existing relationships.

*Hypothesis 6. MMMFs provide substitute financing only to those issuers with which they have pre-existing relationships.*

[11] Despite the fact that only a relatively small number of issuers raise financing from MMMFs, there is anecdotal evidence that the approved issuer lists are both restrictive and slow to change. For instance, Reich and Tang publishes their list on their website. On their November 15, 2011 list, the oldest that we have access to, there are over 150 issuers that are in our N-MFP data but are not pre-approved by Reich and Tang. Of these, 48 are nonfinancials, including such highly rated (P-1) issuers as Honda, Cargill, Automatic Data Processing, Merck, Google, Texas Instruments, Cisco, Philip Morris International, eBay, Medtronic, Honeywell International, Target, and Campbell Soup. Reich and Tang's list is also quite stable over time. On November 15, 2011, it had 164 approved issuers. By December 27, 2012, over a year later, only 34 issuers were removed and 22 were added. Out of the removed issuers, 16 were downgraded by Moody's to second tier, and 9 are subsidiaries whose parents remain on the list.

# 3 Data

We construct a novel data set of the security-level holdings of all U.S. money market mutual funds. Since November 2010, money market mutual funds have been required to use SEC form N-MFP to report their portfolio holdings as of the last business day of each month. Funds are required to file within 5 business days after the end of the month, but the forms become publicly available only 60 days later. Our data set covers the November 2010–May 2012 period, but most of our analyses focus on the March–August 2011 period.

We focus on prime funds, which are permitted to invest in non-government securities. We exclude funds that are not directly available to investors, including feeder funds that invest in other funds, internal funds that manage cash for their fund families, and variable annuities.[12] To make sure that our results are not driven by funds entering or exiting the sample, we also exclude eight small funds that either start reporting after March 2011 or stop reporting before August 2011. Our results are robust to the inclusion of all of these funds.

The resulting data set covers 177 unique funds, with about $1.7 trillion in assets.[13] The average fund manages about $8,950 million, but the distribution of fund size is quite skewed, with the top 10 funds managing around $700 billion in assets during this period.

Our first step is to collapse the raw portfolio holdings data to the fund-issuer-month level.[14] Next, we classify issuers into different types: ABCP, financial, government and

[12] Funds report their category (e.g., prime, government, municipal) in item 10 of form N-MFP. We manually examine all funds that ever report their category as prime to check for reporting errors. We manually identify internal funds by looking up their profiles as well as by searching for them in the CRSP Mutual Fund database, which does not cover internal funds. Variable annuities are identified in item 9 of form N-MFP. We also exclude two funds that hold only cash during the whole sample period and seven prime muni funds, which we define as prime funds that consistently invest more than 75% of their assets in municipal securities. Some of these funds explicitly state that their investment objectives include "sustainability and social responsibility factors."

[13] After applying our screens, aggregate assets of prime MMMFs are very close to the ICI numbers: $1,655 versus $1,660 billion as of May 31, 2011. Before applying our screens, aggregate assets of prime MMMFs are larger in N-MFP data than in ICI data. As of May 31, 2011, aggregate assets of prime MMMFs reporting on form N-MFP are $1,875 billion, while they are $1,660 billion according to the ICI. Most of the difference is due to the inclusion of internal funds in N-MFP data.

[14] Form N-MFP provides us with issuer name, security CUSIP, if available, and issuer CIK if security CUSIP is not available. Because a given issuer can have multiple issuer CUSIPs and because some instruments, such as repurchase agreements and certificates of deposit, do not have CUSIPs, we have to use a number of other data sets—the CUSIP master file, FISD, S&P Ratings iQuery, the SEC's list of all CIKs matched with entity

agencies, municipal, nonfinancial, and other. The last category includes holdings of other mutual funds and supranational issuers such as the World Bank and the European Investment Bank. We restrict the sample of issuers in several ways. First, since our focus is the availability of credit for private corporate issuers, we exclude government, agency, and supranational issuers. Second, to alleviate concerns that our results are driven by issuers' direct exposure to European economic conditions, we exclude European issuers from our analysis of spillover effects. Finally, we exclude municipal issuers because they frequently use bond insurance and letters of credit, making it difficult to determine the MMMF's ultimate credit exposure for these issuers.[15] Our results are robust to the inclusion of European and municipal issuers.

It is important to note that most of our analysis is done within the N-MFP data set and thus does not cover other sources of short-term financing available to these firms, including revolving credit lines and non-MMMF holders of commercial paper. However, according to the Flow of Funds, MMMFs are the single largest holder of commercial paper with a 37% share. Therefore, it is unlikely that significant disruptions in the sector are completely offset by other investors. We discuss the potential for firms to substitute to other sources of financing in Section 6.

We use our fund-issuer-month level data to construct a measure of the exposure of fund $f$ to Eurozone banks at time $t$, which we call *Fund Euro share*,

$$\textit{Fund Euro share}_{f,t} = \frac{\sum_{i \in \textit{Eurobanks}} \textit{Outstanding}_{i,f,t}}{\sum_i \textit{Outstanding}_{i,f,t}},$$

where $\textit{Outstanding}_{i,f,t}$ is the exposure of fund $f$ to issuer $i$ at time $t$. *Fund Euro share* is simply the fraction of the fund's assets invested in Eurozone banks. In our data, this

names, and data sets of Fitch, Moody's and S&P credit ratings publicly available per Rule 17g-2—to link each security to the ultimate parent of the issuer. For example, our algorithm attributes all of the following to BNP Paribas: CDs issued by its Chicago, New York, and San Francisco branches (which have their own issuer CUSIPs), commercial paper issued by BNP Paribas Finance, and repurchase agreements entered into by BNP Paribas Securities.

[15] Furthermore, municipal issuers are generally small (the median municipal issuer borrows just $35 million from prime MMMFs), are missing from the CUSIP master file most of the time, and have the most variation across funds in the spelling of a given issuer's name.

measure is a continuous variable that ranges from 0 to 62.4%, with an average of 17.0% and a standard deviation of 11.3%.

In addition we construct a measure of issuer $i$'s indirect exposure to Eurozone banks, which we call *Issuer Euro share*,

$$\textit{Issuer Euro share}_{i,t} = \frac{\sum_f \textit{Outstanding}_{i,f,t} \times \textit{Fund Euro share}_{f,t}}{\sum_f \textit{Outstanding}_{i,f,t}}.$$

This is the value-weighted average of *Fund Euro share* across MMMFs that provide financing to issuer $i$. It measures how exposed the funds that provide financing to issuer $i$ are to Eurozone banks. In our data, this measure ranges from 0 to 46.6%, with an average of 16% and a standard deviation of 7.9%.

Table 1 reports summary statistics on the funds in our data, the unit of observation being a fund-month during the March–August 2011 period. The average fund has $8,950 million in assets, diversified across different instrument types but concentrated in financial issuers: together ABCP and financial issuers account for 68% of the average portfolio. Consistent with the regulatory constraints on maturity, average portfolio maturity is around 39 days. The gross yield earned by the funds' assets is around 24 basis points, while the net yield received by the investors after fund fees and expenses is less than 4 basis points. The mean and standard deviation of the share of fund's assets invested in Eurozone banks are 17% and 11.3%. When discussing the economic significance of the exposure to Eurozone banks we will look at the 10% difference, which roughly corresponds to a one standard deviation change.

Table 2 reports issuer and fund-issuer level summary statistics. Panel A reports statistics for the 231 issuers in our sample: 72 ABCP, 75 financial, and 84 nonfinancial. Panel B reports fund-issuer level statistics for the same set of issuers. The median issuer has $327 million outstanding, but the distribution is skewed, with mean and maximum outstandings of $2.98 billion and $57.67 billion respectively. The median issuer is held by 9 MMMFs. A number of issuers are very widely held. Out of the issuers in our sample, the most widely held is the Bank of Nova Scotia, which is held by 138 or three-quarters of funds. When studying the importance of relationships in money markets we will separately analyze the most widely

**Table 1**
**Summary Statistics: Funds**

This table reports summary statistics for prime money market mutual funds in our data. The sample of funds consists of prime money market mutual funds filing form N-MFP during the whole March–August 2011 period, excluding funds that exclusively serve the internal cash management needs of their mutual fund families, feeder funds that invest in other funds, variable annuities, and prime muni funds. The sample period is March–August 2011. Flows are scaled by lagged assets. Portfolio maturity is the weighted average portfolio maturity. Fund-level gross yield is the value reported on form N-MFP. Fund-level net yield is the weighted average of share class-level net yields. Institutional share is the share of fund's assets in institutional shares classes. Fund Euro share is the share of fund's assets invested in Eurozone banks that were part of July 2011 stress tests. Non-EU financial share is the share of fund's assets invested in financial firms outside of the European Union. The number of fund-month observations is 1,062.

| | | | Percentile | | |
|---|---|---|---|---|---|
| | Mean | SD | 25 | 50 | 75 |
| *Fund characteristics* | | | | | |
| Total Net Assets (millions) | 8,950 | 18,571 | 535 | 1,869 | 8,957 |
| Institutional share (%) | 54.8 | 45.0 | 0.0 | 68.6 | 100.0 |
| Portfolio maturity (days) | 38.7 | 11.1 | 33.0 | 41.0 | 46.0 |
| Gross yield (bps) | 23.7 | 7.5 | 18.0 | 24.0 | 29.0 |
| Net yield (bps) | 3.8 | 5.6 | 1.0 | 1.0 | 5.0 |
| Euro share (%) | 17.0 | 11.3 | 7.7 | 16.9 | 24.4 |
| Unsecured Euro share (%) | 12.6 | 9.4 | 4.8 | 11.2 | 19.0 |
| Fund flows (bps) | −43.2 | 748.7 | −369.3 | −36.5 | 266.6 |
| *Instrument shares (%)* | | | | | |
| ABCP | 11.1 | 11.9 | 0.8 | 7.5 | 18.4 |
| CD | 21.6 | 16.3 | 6.4 | 20.5 | 34.4 |
| Financial CP | 16.1 | 9.4 | 10.5 | 14.6 | 20.4 |
| Government/Agency | 12.5 | 12.3 | 3.6 | 10.2 | 18.1 |
| Government/Agency repo | 11.9 | 13.0 | 1.7 | 8.6 | 16.6 |
| Nonfinancial CP | 8.2 | 13.4 | 0.0 | 2.3 | 10.1 |
| Municipal debt | 5.9 | 9.1 | 0.0 | 1.8 | 9.2 |
| Other repo | 2.8 | 5.8 | 0.0 | 0.0 | 2.2 |
| Other | 9.8 | 11.1 | 3.4 | 7.4 | 12.4 |
| *Issuer shares (%)* | | | | | |
| ABCP | 10.5 | 11.6 | 0.0 | 7.2 | 17.5 |
| Government/Agency | 12.8 | 12.6 | 3.8 | 10.5 | 18.1 |
| Rest of EU financial | 11.4 | 7.6 | 5.8 | 10.8 | 16.1 |
| Eurozone financial | 17.9 | 11.8 | 8.2 | 17.6 | 25.1 |
| Municipal | 6.3 | 10.2 | 0.0 | 1.9 | 9.2 |
| Non-EU financial | 28.2 | 13.0 | 19.1 | 28.8 | 37.6 |
| Nonfinancial | 9.5 | 14.7 | 0.7 | 3.6 | 10.7 |
| Other | 3.3 | 8.6 | 0.0 | 1.6 | 3.9 |

held issuers, for which relationships with MMMFs are likely to be less important.

**Table 2**
**Summary Statistics: Issuers and Exposures**

This table reports summary statistics for issuers and fund-issuer exposures in our data. The sample of issuers consists of non-European issuers, excluding sovereign, agency, municipal, and supranational issuers. The sample of funds consists of prime money market mutual funds filing form N-MFP during the whole March–August 2011 period, excluding funds that exclusively serve the internal cash management needs of their mutual fund families, feeder funds that invest in other funds, variable annuities, and prime muni funds. The sample period is March–August 2011.

| | | | | Percentile | | |
|---|---|---|---|---|---|---|
| | *N* | Mean | SD | 25 | 50 | 75 |
| Panel A: Issuers | | | | | | |
| Outstanding (millions) | 1,386 | 2980.4 | 7707.8 | 34.8 | 327.3 | 1632.2 |
| Weighted average maturity (days) | 1,264 | 49.4 | 72.5 | 12.5 | 26.2 | 46.2 |
| Yield (bps) | 1,251 | 25.5 | 11.8 | 17.5 | 25.0 | 32.4 |
| Issuer Euro share (%) | 1,264 | 16.0 | 7.9 | 9.9 | 16.6 | 21.4 |
| Number of funds | 1,386 | 21.9 | 28.3 | 4.0 | 9.0 | 30.0 |
| Panel B: Fund-Issuer Exposures | | | | | | |
| Exposure (millions) | 24,905 | 150.4 | 398.0 | 10.0 | 35.0 | 126.9 |
| Portfolio share (%) | 24,905 | 1.9 | 1.9 | 0.6 | 1.3 | 2.6 |
| Weighted average maturity (days) | 24,904 | 42.1 | 55.3 | 9.0 | 25.3 | 53.6 |
| Yield (bps) | 24,283 | 24.6 | 11.6 | 17.1 | 24.2 | 30.4 |

# 4 MMMF Flows: Risk Taking and Runs

We now turn to the empirical results. As mentioned above, we separate our analysis into two symmetric periods: June–August 2011 (the post period), the period of large-scale investor redemptions from prime MMMFs, and March–May 2011 (the pre period), the three months leading up to these investor redemptions. We do this to make the results as transparent as possible and to avoid econometric issues surrounding standard errors in panel data sets with short time dimensions (Bertrand, Duflo, and Mullainathan, 2004; Donald and Lang, 2007; Angrist and Pischke, 2009; Cameron, Gelbach, and Miller, 2008).

We begin our analysis by studying MMMF incentives for risk taking and the potential for that risk taking to lead to rapid investor redemptions. Our first hypothesis is that the higher yields offered by Eurozone banks allowed MMMFs with greater exposure to those banks to attract more inflows during the period. Our second hypothesis concerns the consequences in the post period of the MMMF risk taking documented above.

We examine both of these hypotheses by analyzing fund flows in Table 3. We collapse our monthly panel into a single fund-level cross section. In the first five columns, the dependent

variable is fund flows in the pre period. We scale cumulative fund flows over March–May 2011 by total net assets as of February 2011. To ensure that our results are not driven by outliers, fund flows are winsorized at the 5th and 95th percentiles.[16]

In column 1 we regress fund flows on net yield and fund size. Consistent with the prior literature (Christoffersen, 2001; Christoffersen and Musto, 2002; Kacperczyk and Schnabl, 2013), we find a strong performance-flow relationship: higher-yielding funds attract more fund flows. The magnitude of the effect in our sample period is large. An increase in net yield of 10 basis points is associated with additional fund flows equal to 13.8% of assets on an annualized basis.[17]

In column 2, we regress fund flows on *Fund Euro share* and fund size. The coefficient on *Fund Euro share* during the pre period is positive and statistically significant at 10%, showing that investors reward funds with higher *Fund Euro share* because their Eurozone bank exposures allow them to offer higher yields. The economic magnitudes are meaningful. A one standard deviation increase in *Fund Euro share* is associated with additional flows of 5.2% of assets on an annualized basis. For comparison, annualized mean fund flows in the pre period were −2.8%.

If the positive effect of *Fund Euro share* on fund flows is due to Eurozone banks offering higher yields, then controlling for net yield should reduce the coefficient on *Fund Euro share*. Column 3 shows that this is indeed the case.

Column 4 uses our unique security-level data to examine finer grain measures of risk taking. We divide the effect of *Fund Euro share* according to whether the exposure is secured (i.e. repurchase agreements) or unsecured (i.e. CP or CDs). Though the coefficients are

[16] For example, three Morgan Stanley funds experience the largest inflows in our sample, with each fund more than doubling in size. These apparent inflows are due to a one-time sweep of the cash balances of Morgan Stanley Smith Barney clients into Morgan Stanley MMMFs in April 2011. Since this decision was made by Morgan Stanley with investors having relatively little say in the matter, these fund flows are unlikely to be informative about the general performance-flow relationship. Rather than make subjective judgements about such outliers, we winsorize fund flows at the 5th and 95th percentiles. We get similar results when we winsorize at the 1st and 99th percentiles.

[17] For reference, Kacperczyk and Schnabl (2013) estimate that in the pre-crisis period a 10 basis point increase in yield is associated with a 7% increase in fund assets on an annualized basis. Thus, the performance-flow relationship was nearly twice as strong per basis point during March–May 2011 as it was during August 2007–August 2008. This is consistent with the conjecture of Rajan (2006), who suggested that risk taking incentives in financial intermediaries may increase as nominal yields fall.

**Table 3**
**Fund Flows during the Pre and Post Periods**

In columns 1–5, the dependent variable is cumulative net flows during the March–May 2011 period scaled by February 2011 net assets. In columns 6–10, the dependent variable is cumulative net flows during the June–August 2011 period scaled by May 2011 net assets. Fund flows are annualized and winsorized at the 5th and 95th percentiles. Explanatory variables are measured as of the beginning of the relevant period, i.e., as of February 2011 in columns 1–5 and as of May 2011 in columns 6–10. Fund flows and Euro share are expressed in percentage form. Fund Euro share is the share of the fund's portfolio invested in Eurozone banks. Unsecured Euro share is the fraction of the fund's portfolio invested in unsecured Eurozone bank claims. Repo Euro share is the fraction of repurchase agreements with Eurozone banks in the fund's portfolio. Fund size is the log of fund TNA. Institutional funds are funds with more than 99% of fund assets in institutional share classes. Robust standard errors are reported. *, **, and *** indicate statistical significance at 10%, 5%, and 1%.

| | March–May 2011 | | | | | June–August 2011 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Size | 2.88* | 3.09* | 2.02 | 3.00* | 2.60 | −8.13*** | −6.65*** | −6.50*** | −5.88*** | −6.08*** |
| | (1.67) | (1.58) | (1.71) | (1.61) | (1.64) | (2.07) | (2.06) | (2.14) | (2.04) | (2.16) |
| Net yield (bps) | 1.38*** | | 1.27** | | −0.82 | −0.40 | | −0.19 | | −2.50* |
| | (0.52) | | (0.53) | | (0.69) | (0.98) | | (0.96) | | (1.47) |
| Fund Euro share | | 0.52* | 0.42 | | 0.51 | | −0.88*** | −0.87*** | | −0.15 |
| | | (0.27) | (0.28) | | (0.31) | | (0.31) | (0.32) | | (0.38) |
| Unsecured Euro share | | | | 0.56* | | | | | −1.29*** | |
| | | | | (0.30) | | | | | (0.38) | |
| Repo Euro share | | | | 0.46 | | | | | −0.03 | |
| | | | | (0.50) | | | | | (0.54) | |
| Institutional fund | | | | | 9.96 | | | | | 37.01** |
| | | | | | (11.77) | | | | | (17.51) |
| Fund Euro share | | | | | −0.53 | | | | | −2.08*** |
| × Institutional | | | | | (0.61) | | | | | (0.65) |
| Net yield | | | | | 2.62*** | | | | | 3.01* |
| × Institutional | | | | | (0.93) | | | | | (1.81) |
| Constant | −32.05*** | −36.56*** | −33.17*** | −36.15*** | −36.32*** | 57.98*** | 61.79*** | 61.22*** | 57.49*** | 50.34*** |
| | (11.40) | (11.13) | (11.49) | (11.53) | (11.14) | (15.84) | (15.16) | (15.40) | (15.00) | (15.19) |
| $N$ | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 | 177 |
| Adjusted $R^2$ | 0.082 | 0.057 | 0.094 | 0.052 | 0.135 | 0.093 | 0.124 | 0.120 | 0.135 | 0.160 |

similar, only unsecured exposure to Eurozone banks has a statistically significant association with fund flows. This is consistent with the idea that funds are rewarded for taking on unsecured exposures, which are riskier and increase fund yields more. Finally, columns 5 shows that the performance-flow relationship is strongly positive for funds that primarily serve institutional investors.

We now turn to our second hypothesis, which concerns the consequences in the post period of the MMMF risk taking documented above. Columns 6–10 of Table 3 examine the determinants of fund flows in the post period.

In column 7 we regress fund flows on *Fund Euro share*. In contrast to the pre period, where *Fund Euro share* had a positive effect on flows, in the post period the effect of *Fund Euro share* is significantly negative and much larger in magnitude. A one standard deviation increase in *Fund Euro share* is associated with annualized fund flows of $-9.9\%$ of assets. Mean annualized fund flows in the post period were $-5.7\%$, so the effect of *Fund Euro share* is large.

Column 8 shows that our results are robust to controlling for net yield. In contrast to our results for the pre period, net yield does not drive out the effect of *Fund Euro share* in the post period. Funds with higher net yields do not experience larger outflows in the post period, and there is a strong independent effect of *Fund Euro share* in the post period. Though it is not definitive evidence, this suggests that investors were not withdrawing from funds that generally invest in riskier assets, only from those with large exposures to Eurozone banks.

In column 9, we decompose the effect of *Fund Euro share* based on whether the fund's exposure to Eurozone banks is in the form of secured or unsecured lending. Investors are likely to be more concerned about unsecured exposures to Eurozone banks because they are riskier than about secured exposures, which are collateralized. Our results show that this is indeed the case—only unsecured Eurozone bank exposures are associated with outflows.[18]

It may seem somewhat surprising that investors evaluate the exposures of their MMMFs

[18] Similarly, we find that fund flows are more sensitive to exposures to banks in Greece, Ireland, Italy, Spain, and Portugal, which not surprisingly were in significantly weaker financial condition, than to banks in other Eurozone countries.

to Eurozone banks. After all, the relative safety of these funds should weaken investor incentives to monitor risk taking (Kacperczyk and Schnabl, 2013). However, as column 10 shows, our results are largely driven by institutional funds. Schmidt, Timmermann, and Wermers (2013) find a similar result studying outflows from MMMFs during the financial crisis. Institutional investors are more likely to have the incentives and capabilities necessary to closely monitor fund risk taking. For instance, they likely subscribe to reports by brokerage houses, money market data providers such as iMoneyNet and Crane Data, and the credit rating agencies, which were reporting on MMMFs' exposures to European banks at the time.[19][20]

# 5 Collateral Damage

What are the consequences of the large fund outflows documented above for non-European issuers? One view is that MMMFs provide frictionless arm's length financing. Under this view, if issuer demand for financing is fixed, all non-European issuers should experience the same decline in funding when MMMFs suffer outflows. An alternative hypothesis is that MMMF lending has some features of relationship-based financing. Under this alternative view, it matters which specific MMMFs an issuer happens to borrow from. Specifically, hypothesis 3 above posited that issuers borrowing from MMMFs with greater exposure to

[19] Fitch Ratings, for example, has been producing monthly reports discussing changes in the exposure of MMMFs to Eurozone banks.

[20] One may also wonder why MMMFs could not stem these outflows by reducing their exposures to Eurozone banks. One answer is that secondary markets for large CDs and commercial paper are not very liquid (Covitz and Downing, 2007), so MMMFs trying to sell their Eurozone bank exposures would potentially have to do so at significant discounts. A second answer is that risk taking by funds is persistent. In unreported results available upon request, we find that the cross-sectional rank of funds by yield, a measure of risk, is highly persistent over time. We also find that outflows around Lehman's bankruptcy, a proxy for risk taking before the crisis, are strongly correlated with risk taking in the pre period both in the form of exposure to Eurozone banks and in the form of lending through repo backed by highly distressed structured finance collateral. (See, for example, Fitch Ratings (2012) on the risks of MMMFs lending against highly distressed structured finance collateral.) Our results on persistence in risk taking are consistent with Fahlenbrach, Prilmeier, and Stulz (2012), who show that a commercial bank's performance during the 1998 crisis predicts its performance during the recent crisis, though their evidence shows persistence over a longer period than ours. In contrast, Strahan and Tanyeri (2013) find that money funds that took on more risk leading up to Lehman's default did not invest in riskier assets in the fall of 2008 after they were guaranteed by the government. This may be because funds feared the negative stigma associated with actually using government guarantee.

Eurozone banks experienced larger contractions in their aggregate borrowing from MMMFs.

Table 4 presents evidence in support of this hypothesis. The dependent variable is the percentage change in average outstanding amount for each issuer in our N-MFP data between the pre (March–May 2011) and post (June–August 2011) periods. The independent variable is *Issuer Euro share*. Thus, we estimate the following regression

$$\Delta Outstanding_i = \alpha + \beta \times Issuer\ Euro\ share_i + \varepsilon_i.$$

We omit European firms from the analysis. In some specifications we include fixed effects for each issuer type (e.g., ABCP, financial, and nonfinancial) to ensure that our results are not driven by a general decline in financing for a particular issuer type.

**Table 4**
**Issuer-Level Effects**

The dependent variable is $\Delta Outstanding_i$, the percentage change in the issuer's average outstanding amount between the pre and post periods. The sample consists of non-European ABCP, financial, and nonfinancial issuers. The dependent variable is winsorized at the 5th and 95th percentiles. Robust standard errors are reported.*, **, and *** indicate statistical significance at 10%, 5%, and 1%.

| | (1) | (2) | (3) |
|---|---|---|---|
| Issuer Euro share$_i$ (%) | $-1.611^{***}$ | $-1.473^{**}$ | $-1.407^{**}$ |
| | (0.585) | (0.619) | (0.642) |
| Yield$_i$ (%) | | | $-0.157$ |
| | | | (0.473) |
| Constant | $0.344^{***}$ | $0.319^{**}$ | $0.348^{**}$ |
| | (0.128) | (0.129) | (0.163) |
| Issuer type FE | − | + | + |
| $N$ | 231 | 231 | 231 |
| Adjusted $R^2$ | 0.037 | 0.030 | 0.027 |

Column 1 of Table 4 shows that being financed by MMMFs that have large Eurozone bank exposures has a strong negative effect on non-European issuers. Issuers with a 10% higher *Issuer Euro share* (i.e., financed by MMMFs with 10% higher exposure to Eurozone banks in the pre period) grow their financing 16% less in the post period. In column 2, we add issuer type fixed effects and get similar results. In column 3, we control for the average yield offered by the issuer in the pre period as a measure of issuer riskiness. While not definitive, this suggests that our results are not solely driven by a general aversion to risk

among money market mutual fund managers.

## 5.1 Identifying Spillovers: Fund-Issuer Level Evidence

The analysis in Table 4 is subject to an obvious endogeneity problem. It could simply be the case that non-European firms funded by MMMFs with large exposures to Eurozone banks are risky firms, and that the June–August 2011 period was associated with a broad withdrawal of funding from all risky issuers, i.e. "a flight to quality."[21]

We address such concerns by testing hypothesis 4 using our unique security-level data to estimate specifications with issuer fixed effects. This ensures that our results cannot be explained by unobservable issuer characteristics, including riskiness or direct exposure to Europe. We again take a transparent approach, collapsing our monthly panel into a single cross section where the unit of observation is a fund-issuer pair. That is, each fund-issuer pair appears only once in the dataset.

For each fund $f$ and issuer $i$, we calculate the fund's average holdings of the issuer's securities in the pre (March–May 2010) and post (June–August 2010) periods. We then calculate the percentage change in this fund-issuer exposure measure between the pre and post periods, winsorizing at the 5th and 95th percentiles.

We regress the percentage change in fund-issuer exposure on *Fund Euro share* while controlling for issuer fixed effects:

$$\Delta Outstanding_{i,f} = \alpha_i + \beta \times Fund\ Euro\ share_f + \varepsilon_{i,f}.$$

We also control for the issuer's share in the fund's portfolio to account for portfolio concentration limits. Specifically, if an issuer already makes up a large fraction of a fund's portfolio, the fund will not be able to increase its lending to that issuer, no matter how attractive the opportunity is.

In these regressions all our identification is coming from within-issuer variation. The re-

[21] Note, however, that the results in Table 3 suggest investors were not withdrawing from all funds that generally invest in riskier assets, only from those with large exposures to Eurozone banks. Also, in Table 4, it is not the case that riskier issuers, as proxied for by pre period yield, experience larger declines in outstandings during the post period.

gressions ask whether funds with higher exposure to Eurozone banks behave differently than those with lower exposure, holding fixed the issuer. Thus, the results cannot be explained by unobservable issuer characteristics, including riskiness, or changes in those characteristics between the pre period and the post period. Issuer characteristics (or changes in characteristics over the post period) should cause MMMFs with high or low exposures to Eurozone banks to react the same way. We cluster our standard errors by fund because the independent variable is constant within fund (see Kloek, 1981; Moulton, 1990).

Table 5 presents the results. We split our sample of issuers into the top ten most widely held issuers and other issuers. We expect lending to the most widely held issuers to be fairly close to the frictionless ideal. Lending to the other issuers, on the other hand, is more likely to be subject to asymmetric information, making frictions and relationships important.

In the first column, we regress the change in outstanding on *Fund Euro share* for the sample of the most widely held issuers. The coefficient on *Fund Euro share* is close to zero and is not statistically significant. In the second column, we estimate the same regressions for the less widely held issuers. For these issuers, *Fund Euro share* has a significant negative effect on the change in outstanding. A money market mutual fund with a 10% larger exposure to Eurozone banks reduces its exposure to a given issuer 8.6% more.

One concern with these specifications might be that even within a particular issuer, some funds make riskier, higher-yielding loans to that issuer. This could be the case if, for instance, these funds lend for longer terms or against poorer collateral. To address this concern, in column 3, we control for the yield that fund $f$ earns on its investment in issuer $i$. The fact that the coefficient on *Fund Euro share* is essentially unchanged helps ensure that our results are not driven by the tendency of funds with high *Fund Euro share* to take riskier positions in the same issuer. Column 4 presents a more stringent version of this test, interacting yield with *Fund Euro share*. The interaction term is close to zero and not statistically significant. Its inclusion only slightly reduces the magnitude of the coefficient on *Fund Euro share* itself, but it does reduce the statistical significance. Overall, this suggests that holdings of higher-yielding debt held by MMMFs with high Eurozone bank exposures are not driving our results. However, we cannot make definitive statistical statements once the interaction term is included.

**Table 5**
**Identifying Spillovers to Non-European Issuers**

This table reports the results of the regressions of the change in fund $f$'s exposure to issuer $i$ between the pre and post periods. In Panel A, the dependent variable is $\Delta Outstanding_{i,f}$, the percentage change in the average exposure of fund $f$ to issuer $i$ between the pre and post periods. The change in exposure is winsorized at the 5th and 95th percentiles. In Panel B, the dependent variable, $Exit_{i,f}$, is equal to 100 if $\Delta Outstanding_{i,f}$ is equal to $-100\%$, and is equal to 0 otherwise; the coefficients can be interpreted as capturing the change, in percentage points, in the probability of exit. Issuer fixed effects are included in all specifications. Portfolio share is the share of issuer $i$ in the portfolio of fund $f$. Standard errors are adjusted for clustering by fund. *, **, and *** indicate statistical significance at 10%, 5%, and 1%.

| | Top 10 | Other Issuers | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Panel A: $\Delta Outstanding_{i,f}$ (%) | | | | | |
| Portfolio share$_{i,f}$ (%) | −13.59*** | −14.42*** | −14.40*** | −14.40*** | −14.56*** |
| | (1.83) | (1.44) | (1.45) | (1.45) | (1.45) |
| Fund Euro share$_f$ (%) | −0.09 | −0.86*** | −0.87*** | −0.74 | |
| | (0.26) | (0.28) | (0.28) | (0.62) | |
| Yield$_{i,f}$ (bps) | | | 0.08 | 0.17 | |
| | | | (0.26) | (0.46) | |
| Fund Euro share$_f$ × Yield$_{i,f}$ | | | | −0.01 | |
| | | | | (0.02) | |
| Unsecured Euro share$_f$ (%) | | | | | −1.11*** |
| | | | | | (0.31) |
| Repo Euro share$_f$ (%) | | | | | −0.18 |
| | | | | | (0.49) |
| Constant | 50.98*** | 36.17*** | 34.23*** | 32.25** | 36.97*** |
| | (6.86) | (5.65) | (9.14) | (13.25) | (5.64) |
| $N$ | 1133 | 3837 | 3837 | 3837 | 3837 |
| Adjusted $R^2$ | 0.103 | 0.116 | 0.115 | 0.115 | 0.117 |
| Panel B: $Exit_{i,f}$ (%) | | | | | |
| Portfolio share$_{i,f}$ (%) | −2.07*** | −3.39*** | −3.56*** | −3.57*** | −3.35*** |
| | (0.43) | (0.53) | (0.53) | (0.53) | (0.53) |
| Fund Euro share$_f$ (%) | 0.19 | 0.38*** | 0.39*** | 0.55** | |
| | (0.12) | (0.12) | (0.12) | (0.25) | |
| Yield$_{i,f}$ (bps) | | | −0.48*** | −0.37** | |
| | | | (0.07) | (0.14) | |
| Fund Euro share$_f$ × Yield$_{i,f}$ | | | | −0.01 | |
| | | | | (0.01) | |
| Unsecured Euro share$_f$ (%) | | | | | 0.47*** |
| | | | | | (0.12) |
| Repo Euro share$_f$ (%) | | | | | 0.14 |
| | | | | | (0.25) |
| Constant | 6.94** | 16.81*** | 28.75*** | 26.25*** | 16.53*** |
| | (2.71) | (2.63) | (3.54) | (4.97) | (2.60) |
| $N$ | 1133 | 3837 | 3837 | 3837 | 3837 |
| Adjusted $R^2$ | 0.040 | 0.156 | 0.166 | 0.166 | 0.156 |

In column 5, we split the effect of *Fund Euro share* based on whether the fund's exposure to Eurozone banks is secured or unsecured. As we saw in Table 3, outflows were concentrated in funds with high unsecured exposures to Eurozone banks. Consistent with outflows being driven by riskier exposures, column 5 shows that only unsecured exposure to Eurozone banks creates spillovers on non-European issuers.

In Panel B, we use a different dependent variable. We simply look at whether fund-issuer level exposures that are nonzero in the pre period are completely closed out in the post period. This is equivalent to the change in the exposure variable used in Panel A being equal to −100%. When looking at the most widely held issuers in column 1, we once again find no effect of *Fund Euro share*. For the less widely held issuers in column 2, the effect is positive and statistically significant. A fund with a 10% higher *Fund Euro share* is 3.8% more likely to completely exit its position in a given issuer. Given a baseline exit rate of 19.4%, this represents a 20% increase. Overall, the results for exit in Panel B are broadly similar to those for the change in outstanding in Panel A.[22]

Given these results, it is natural to ask how long the spillover effects persist in the data. We address this question in Table 6, where we extend our sample of forms N-MFP through March 2012. The dependent variable in each column is the percentage change in fund-issuer outstanding between the three-month pre period (March–May 2011) and the three-month post period specified in the column heading. For instance, the first column reports our baseline result from Table 5, while the second column looks at the change in lending between March–May and September–November 2011.

The negative effect of *Fund Euro share* on the change in fund-issuer exposure persists after August 2011 but declines gradually over time. For the June–August 2011 period, the coefficient on *Fund Euro share* is −0.86. During the September–November 2011 period, the coefficient declines in magnitude to −0.64, which is around three-quarters of the original effect, and is statistically significant at the 10% level. By March–May 2012, the coefficient declines to −0.06 and is no longer statistically significant.

[22] Indeed, most of the effect in Panel A is driven by exit. When we restrict our analysis of $\Delta Outstanding_{i,f}$ to fund-issuer pairs that are not exited in the post period, the coefficient on *Fund Euro share* is negative but not statistically significant.

**Table 6**
**Persistence of Spillover Effects**

The dependent variable is the percentage change in the exposure of fund $f$ to issuer $i$ between the pre period (March–May 2011) and alternative post periods. For example, in column (1) the post period is June–August 2011. Changes in exposure are winsorized at the 5th and 95th percentiles. Issuer fixed effects are included in all specifications. The 10 most commonly held issuers during the pre period are excluded. Portfolio share is the share of issuer $i$ in the portfolio of fund $f$. Standard errors are adjusted for clustering by fund. *, **, and *** indicate statistical significance at 10%, 5%, and 1%.

| | Change from pre period to 3 months ending | | | |
|---|---|---|---|---|
| | August 2011 | November 2011 | February 2012 | May 2012 |
| | (1) | (2) | (3) | (4) |
| Portfolio share$_{i,f}$ (%) | $-14.42^{***}$ | $-17.35^{***}$ | $-20.11^{***}$ | $-19.06^{***}$ |
| | (1.44) | (1.78) | (2.08) | (1.96) |
| Fund Euro share$_f$ (%) | $-0.86^{***}$ | $-0.64^{*}$ | $-0.13$ | $-0.06$ |
| | (0.28) | (0.34) | (0.38) | (0.36) |
| Constant | $36.17^{***}$ | $31.08^{***}$ | $21.86^{***}$ | 10.34 |
| | (5.65) | (7.60) | (8.22) | (7.40) |
| $N$ | 3837 | 3837 | 3837 | 3837 |
| Adjusted $R^2$ | 0.116 | 0.154 | 0.182 | 0.191 |

The timing of these effects is broadly consistent with the timing of outflows from prime MMMFs, and with our evidence on frictions in MMMF lending, which we discuss in the next section. According to data from the Investment Company Institute, prime MMMFs experienced outflows of $172 billion between June 1 and August 31. They suffered another $54 billion in outflows during September–November 2011 before fund assets stabilized. At the same time, prime MMMFs' exposure to the Eurozone also bottomed out in December 2011.[23] Overall, the slow reversal of the effect we document is quite consistent with the idea that there are important frictions in MMMF lending.

## 5.2 Documenting A Mechanism: Relationships

In this section, we provide more direct evidence for the alternative hypothesis that MMMF lending has some features of relationship-based financing. We test our fifth hypothesis, that MMMFs with high Eurozone bank exposure will particularly cut lending to

[23] See for example reports by Fitch Ratings: US Money Fund Exposure and European Banks: Seeking a New Equilibrium from February 23, 2012 and US Money Fund Exposure and European Banks: A Partial Disengagement from March 22, 2012.

issuers with whom they have weak relationships.

Following the literature on relationship-based banking, we construct five different measures of the strength of the relationship between an issuer and a MMMF.[24] The first two measures are based on the frequency of prior lending and are similar in spirit to the measures used by Bharath, Dahiya, Saunders, and Srinivasan (2007) in the bank lending literature. Our "in-sample" measure counts how often a fund lends to a given borrower before the post period in our form N-MFP data (November 2010–May 2011). For each issuer, we look at the distribution of this lending frequency across all funds lending to that issuer. We consider a fund to have a strong relationship with an issuer if the fund lends more frequently than the median fund. While seven months may not seem like a lot of data, it is nontrivial in this context. Since the median maturity of a fund-issuer exposure is about 25 days, we are actually observing about 8 independent lending decisions for the typical fund-issuer pair. This would be comparable to having on the order of 8–24 years of data in the context of commercial banks.[25]

For our "out-of-sample" measure, we go further back in time to the first half of 2010. Because form N-MFP was not available at that time, we use the last quarterly (N-Q), semi-annual (N-CSRS), or annual (N-CSR) report filed by each fund during the first six months of 2010.[26] We label a MMMF-issuer relationship as strong if the MMMF lends to the issuer at all in this data.

Our third measure is based on maturity. Following the logic of Berglöf and von Thadden (1994), Hart and Moore (1994), Bolton and Scharfstein (1996), and Benmelech (2009), a lender with better information about a borrower has less use for the early liquidation option than a less informed lender. Thus, our third relationship measure classifies fund-issuer pairs as having a strong relationship if the maturity of the issuer's borrowing from the fund is longer than the median borrowing maturity for that issuer.

[24] We thank an anonymous referee for suggesting this.

[25] We are assuming that a typical loan is renewed once every 1–3 years.

[26] In contrast to form N-MFP, which is filed by each individual fund, multiple funds can file on a single form N-Q, N-CSRS, or N-CSR. Therefore, we make sure to use only that portion of each filing that covers the particular fund in question.

**Table 7**
**Relationships in Money Markets**

This table reports the results of the regressions of the change in the exposure of fund $f$ to issuer $i$ on fund Euro share interacted with fund-issuer relationship strength using different measures of relationship strength. In Panel A, the dependent variable is $\Delta Outstanding_{i,f}$, the percentage change in the average exposure of fund $f$ to issuer $i$ between the pre and post periods. The change in exposure is winsorized at the 5th and 95th percentiles. In Panel B, the dependent variable, $Exit_{i,f}$, is equal to 100 if $\Delta Outstanding_{i,f}$ is equal to $-100\%$, and is equal to 0 otherwise; the coefficients can be interpreted as capturing the change, in percentage points, in the probability of exit. In-sample relationship stength is based on the frequency with which fund $f$ lends to issuer $i$ during the November 2010–May 2011 period. Out-of-sample relationship strength is equal to 1 whenever fund $f$ holds issuer $i$ during the first sixth months of 2010. Maturity relationship strength is equal to 1 whenever the maturity of fund $f$'s exposure to issuer $i$ is greater than or equal to its median value for issuer $i$. The two quantity-based measures of relationship strength look at the share of issuer $i$ in fund $f$'s portfolio. The issuer based measure is equal to 1 whenever *Portfolio share*$_{i,f}$ is greater than or equal to its median value for issuer $i$. The fund based measure is equal to 1 whenever *Portfolio share*$_{i,f}$ is greater than or equal to its median value for fund $f$. Issuer fixed effects are included in all specifications. The 10 most commonly held issuers during the pre period are excluded. Standard errors are adjusted for clustering by fund. *, **, and *** indicate statistical significance at 10%, 5%, and 1%.

| | Length/Frequency | | Maturity | Quantity | |
|---|---|---|---|---|---|
| | In Sample | Out of Sample | | Issuer Based | Fund Based |
| | (1) | (2) | (3) | (4) | (5) |
| Panel A: $\Delta Outstanding_{i,f}$ | | | | | |
| Portfolio share$_{i,f}$ (%) | $-14.01^{***}$ | $-14.37^{***}$ | $-15.03^{***}$ | $-7.78^{***}$ | $-9.19^{***}$ |
| | (1.43) | (1.44) | (1.50) | (1.26) | (1.18) |
| Strong relationship$_{i,f}$ | $-7.27$ | $-4.99$ | $21.91^{***}$ | $-45.10^{***}$ | $-46.35^{***}$ |
| | (8.70) | (7.85) | (7.51) | (8.86) | (8.21) |
| Fund Euro share$_{i,f}$ | $-0.83^{***}$ | $-0.74^{**}$ | $-0.69^{**}$ | $-0.74^{***}$ | $-0.52^{**}$ |
| × Strong relationship$_{i,f}$ | (0.28) | (0.32) | (0.30) | (0.25) | (0.23) |
| Fund Euro share$_{i,f}$ | $-0.97^{**}$ | $-0.96^{***}$ | $-0.96^{***}$ | $-1.54^{***}$ | $-1.20^{***}$ |
| × Weak relationship$_{i,f}$ | (0.41) | (0.35) | (0.36) | (0.44) | (0.44) |
| $N$ | 3837 | 3837 | 3837 | 3837 | 3837 |
| Adjusted $R^2$ | 0.116 | 0.115 | 0.134 | 0.133 | 0.136 |
| Panel B: $Exit_{i,f}$ | | | | | |
| Portfolio share$_{i,f}$ (%) | $-1.80^{***}$ | $-3.18^{***}$ | $-3.01^{***}$ | $-1.57^{***}$ | $-0.96^{**}$ |
| | (0.44) | (0.52) | (0.52) | (0.44) | (0.48) |
| Strong relationship$_{i,f}$ | $-16.76^{***}$ | $-6.18^{*}$ | $-15.06^{***}$ | $-5.56$ | $-11.46^{***}$ |
| | (3.29) | (3.23) | (3.04) | (3.59) | (3.32) |
| Fund Euro share$_{i,f}$ | $0.21^{*}$ | $0.23^{*}$ | $0.32^{**}$ | $0.27^{*}$ | $0.28^{**}$ |
| × Strong relationship$_{i,f}$ | (0.11) | (0.12) | (0.14) | (0.14) | (0.11) |
| Fund Euro share$_{i,f}$ | $0.41^{**}$ | $0.45^{***}$ | $0.40^{***}$ | $0.42^{***}$ | $0.53^{***}$ |
| × Weak relationship$_{i,f}$ | (0.16) | (0.16) | (0.15) | (0.16) | (0.17) |
| $N$ | 3837 | 3837 | 3837 | 3837 | 3837 |
| Adjusted $R^2$ | 0.214 | 0.169 | 0.200 | 0.163 | 0.184 |

The last two measures are based on the quantity of lending. We again start with the idea that relationship lenders are likely to have higher precision information about borrowers. Standard portfolio theory would then suggest that such lenders would allocate larger shares of their portfolio to borrowers with whom they have strong relationships, all else equal. Thus, we look at the share of each borrower in a particular fund's portfolio. Our "issuer-based" measure then classifies a fund-issuer pair as having a strong relationship if the portfolio share is above the median for that issuer. Our "fund-based" measure classifies a fund-issuer pair as having a strong relationship if the portfolio share is above the median for the fund.

Our measures of relationship strength in money markets are not perfect, but they need to be. So long as they are positively correlated with the existence of a strong relationship, we just have measurement error in our relationship measures. Since we are misclassifying some weak relationships as strong and some strong relationships as weak, we are biasing ourselves against finding any differences in lending between strong and weak relationships.

The results are in Table 7. The dependent variable is the change in outstanding in Panel A and exit in Panel B. In Panel A, *Fund Euro share* always has a negative effect on the change in outstanding, but the magnitude is always stronger for weak relationships. For example, in columns 4 and 5 that use our quantity-based measures of relationship strength, the effect of *Fund Euro share* on the change in outstanding is about twice as strong for weak relationships as it is for strong relationships.[27] While a 10% increase in *Fund Euro share* is associated with a 5.2–7.4% decline in the fund's lending to issuers it has strong relationships with, it is associated with a 12–15.4% decline in lending to issuers it has weak relationships with, an economically meaningful difference. Given that there is likely measurement error in our classification of strong and weak relationships, the true difference is likely to be even larger.

In Panel B, we use *Exit* as the dependent variable and get broadly similar results. Funds with large exposure to the Eurozone banks are more likely to stop lending to their weak than to their strong relationships. The economic magnitudes are again meaningful. For example, in columns 4 and 5, a 10% increase in *Fund Euro share* has a 55–90% stronger effect on weak

[27] The negative coefficient on strong relationship in columns 4–5 captures mean reversion in portfolio share that is not picked up by the linear effect of lagged portfolio share.

relationships than on strong relationships.

If strong relationships are associated with longer maturity lending, one could be concerned that these results are mechanical. Specifically, it could be the case that funds that have long-maturity positions in particular issuers simply cannot cut their exposure to those issuers because their positions have not yet matured. If we label these fund-issuer pairs as having strong relationships, our results may reflect the mechanical inability of funds to decrease their exposure to certain issuers, rather than a desire to continue lending to issuers they have strong relationships with. Our results are unlikely to be mechanical for two reasons. First, lending maturities that are long enough to generate a mechanical relationship are quite unusual in our data: less than 10% of fund-issuer observations have remaining maturity of more than three months. Second, in unreported results we verify that our relationship results are robust to excluding fund-issuer pairs where the average maturity of borrowing is over 60 days.

Overall, the results in Table 7 provide strong support for the hypothesis that MMMF lending has some features of relationship-based financing. Consistent with theory (Bolton, Freixas, Gambacorta, and Mistrulli, 2013), when faced with capital supply constraints, relationship-based lenders are more likely to cut lending to borrowers with whom they have weak relationships.

## 5.3 Documenting A Mechanism: Substitution Across Funds

Our final hypothesis is that relationships also play an important role in preventing issuers from raising substitute financing from MMMFs that have low exposure to Eurozone banks and that as a result do not experience large outflows during the post period. Relationships may be important in impeding substitution both because of traditional asymmetric information concerns and because SEC rules prevent funds from purchasing securities of issuers that have not been pre-approved by their board of directors. Our hypothesis is then that MMMFs will provide substitute financing only to those issuers with which they have pre-existing relationships.

To examine this hypothesis, we now focus on fund-level variation, rather than focusing on the issuer-level variation that we analyzed in the last two subsections. Specifically, we

examine the share of each issuer in a fund's portfolio. To do so, we form a balanced cross section of all fund-issuer pairs. This significantly increases the number of observations relative to our previous specifications, which condition on positive fund-issuer exposure during the pre period. The balanced cross section allows us to examine fund decision to start lending in the post period. Because the 90th percentile of the pre period portfolio share in this data is zero (recall that the median issuer borrows from 9 funds, the other 168 funds have no exposure to the issuer), most of the variation in our five relationship measures is now driven by whether the fund lends at all prior to June 2011. Therefore we say that a fund has an existing relationship with an issuer if it lends to that issuer at least once in either our N-MFP data covering the November 2010–May 2011 period or our N-Q data.

Using this balanced cross-section of all fund-issuer pairs, we regress the change in portfolio share on *Issuer Euro share*, the average exposure to Eurozone banks of the MMMFs that finance the issuer in the pre period.

$$\begin{aligned}\Delta \textit{Portfolio share}_{i,f} &= \alpha_f + \beta_1 \cdot \textit{Portfolio share}_{i,f,pre} + \beta_2 \cdot \textit{Existing relationship}_{i,f} \\ &+ \beta_3 \cdot \textit{Issuer Euro share}_i \times \textit{Existing relationship}_{i,f} \\ &+ \beta_4 \cdot \textit{Issuer Euro share}_i \times \textit{No existing relationship}_{i,f} + \varepsilon_{i,f}\end{aligned}$$

We control for fund fixed effects, so all identification is coming within fund. The regressions ask whether the same fund treats issuers with higher *Issuer Euro share* differently than other issuers. Hypothesis 6 above suggests that MMMFs should attempt to provide such issuers with substitute financing, but only if they have pre-existing relationships with the issuer.

The results are in Table 8. The regressions in columns 1–3 show that MMMFs with low *Fund Euro share* tilt their portfolios towards issuers with high *Issuer Euro share*. But, because of the importance of relationships in these markets, these funds provide substitute financing only to issuers with which the funds have an existing relationship, i.e., issuers the funds lent to at least once in the past. The dependent variable, the change in portfolio share, is expressed in basis points. Therefore, the interpretation of the coefficient on $\textit{Issuer Euro share}_i \times \textit{Existing relationship}_{i,f}$ in column 2 is that, for an unconstrained fund, the portfolio shares of issuers with a 10% higher *Issuer Euro share* and an existing relation-

ship with the fund increases by 12.3 basis points.[28]

**Table 8**
**Substitution Across Funds**

The dependent variable is the change in the share of fund $f$'s portfolio invested in issuer $i$ between the pre and post periods, expressed in basis points. The sample is a cross section of all possible fund-issuer pairs. Fund fixed effects are included in all specifications. Fund $f$ and issuer $i$ are considered to have an *Existing relationship* if fund $f$ lends to issuer $i$ at any point between January 2010 and May 2011. The 10 most commonly held issuers during the pre period are excluded. Standard errors are adjusted for clustering by issuer. *, **, and *** indicate statistical significance at 10%, 5%, and 1%.

| | All | Fund Euro Share | |
|---|---|---|---|
| | Funds | Low | High |
| | (1) | (2) | (3) |
| Portfolio share$_{i,f}$ (bps) | −0.20*** | −0.12* | −0.29*** |
| | (0.02) | (0.06) | (0.06) |
| Existing relationship$_{i,f}$ | 3.37 | −14.45 | 7.90 |
| | (6.90) | (12.71) | (9.80) |
| Issuer Euro share$_i$× Existing relationship$_{i,f}$ (%) | 0.52 | 1.23** | 0.44 |
| | (0.40) | (0.51) | (0.58) |
| Issuer Euro share$_i$× No existing relationship$_{i,f}$ (%) | −0.02 | −0.07** | 0.05* |
| | (0.03) | (0.03) | (0.03) |
| Constant | 2.22*** | 3.52*** | 0.64* |
| | (0.50) | (0.77) | (0.38) |
| $N$ | 40710 | 20470 | 20240 |
| Adjusted $R^2$ | 0.082 | 0.031 | 0.166 |

Overall these results support the hypothesis that relationships play an important role in preventing issuers from raising substitute financing from MMMFs with low exposure to Eurozone banks. These results also further cut against the idea that issuers with high *Issuer Euro share* are riskier borrowers. If they were, all funds should withdraw from these issuers. But here we find that some MMMFs find them attractive and increase exposure to them.

# 6 Discussion

Our results illustrate how institutional and market frictions can create a channel through which MMMFs can transmit distress across firms and countries. As fears about European

[28] Since we are looking at the subset of all issuer types, namely non-European financials and nonfinancials and ABCP, the positive constant term indicates that on average funds are shifting their portfolios towards these issuers.

sovereign debt mounted during the summer of 2011, institutional investors withdrew from MMMFs with large exposures to Eurozone banks. As shown in Table 5, funds faced with large redemptions cut back on their lending both to Eurozone banks and to non-European issuers. As shown in Table 8, other funds attempted to increase their lending to the affected non-European issuers, but did so only to issuers with which they had prior relationships. Table 4 suggests that on average issuers with high *Issuer Euro share* in the pre period were able to raise less financing from MMMFs in the post period. Recall, however, that the evidence in Table 4 is at the issuer level, and could therefore be partially driven by a broad withdrawal of MMMF financing from risky borrowers, in addition to the transmission of distress suggested by the spillovers we identify using our position-level analysis in Tables 5 and 8.

Thus far we have studied financing provided by MMMFs. What about other sources of financing? If firms are able to seamlessly substitute to other sources of financing, then the mechanism we document, and by extension risk taking by MMMFs, might not have any significant adverse effects on firms' ability to raise financing and invest. For instance, as noted by Gatev and Strahan (2006), nonfinancial firms typically have standby lines of credit with banks to support their CP programs.[29] Firms draw down these lines of credit to pay off maturing CP in the event of a disruption in the CP market. Gatev and Strahan (2006) argue that banks are uniquely positioned to provide such insurance because they typically receive deposit inflows during market disruptions and thus effectively have hedged funding.

Our evidence cannot definitively speak to substitution to other sources of short-term financing. The issuers in our N-MFP data span a wide range of countries, firm types (e.g., nonfinancials, finance companies, banks, insurance companies), and regulatory jurisdictions, making it difficult for us to measure monthly changes in total short-term financing at the firm level. Nonetheless, we attempt to study substitution for a subset nonfinancials where we can collect data on outstanding CP, cash holdings, long-term debt issuance, and capital expenditures from Capital IQ.[30]

[29] Similar arguments apply to ABCP programs, which almost always have liquidity backstops from their sponsors (Acharya, Schnabl, and Suarez, 2013).

[30] Reporting of outstanding CP is voluntary, so not all nonfinancial issuers consistently report it.

**Table 9**
**Long-Term Bond Issuance, Changes in Cash and Capital Expenditures**

The sample consists of nonfinancial issuers for which we have information on all dependent variables in all quarters. Long-term debt issuance is the value of long-term debt issued minus the value of long-term debt repaid, all scaled by contemporaneous assets. *Change in cash* is the change in the cash-to-assets ratio relative to the first quarter of 2011. *Change in CP* is the change in the CP-to-assets ratio relative to the first quarter of 2011. *Change in CapEx* is the change in capital expenditures-to-assets ratio relative to the first quarter of 2011. Robust standard errors are reported. *, **, and *** indicate statistical significance at 10%, 5%, and 1%.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Long-Term Debt Issuance | | | Change in Cash | | |
| | Q2 | Q3 | Q4 | Q2 | Q3 | Q4 |
| Issuer Euro share$_i$ | 0.14** | 0.13* | 0.07 | 0.03 | −0.07 | −0.08 |
| | (0.07) | (0.07) | (0.10) | (0.08) | (0.10) | (0.09) |
| Constant | −0.50 | −0.51 | −0.03 | 0.05 | −0.11 | 0.51 |
| | (0.42) | (0.42) | (0.64) | (0.54) | (0.68) | (0.66) |
| $N$ | 42 | 42 | 42 | 42 | 42 | 42 |
| $R^2$ | 0.039 | 0.035 | 0.004 | 0.001 | 0.004 | 0.005 |
| | Change in CP | | | Change in CapEx | | |
| | Q2 | Q3 | Q4 | Q2 | Q3 | Q4 |
| Issuer Euro share$_i$ | −0.10** | −0.14* | −0.04 | −0.06 | −0.01 | 0.00 |
| | (0.05) | (0.07) | (0.09) | (0.04) | (0.02) | (0.02) |
| Constant | 0.02 | 0.60 | −0.27 | 0.51* | 0.22** | 0.30*** |
| | (0.29) | (0.38) | (0.53) | (0.26) | (0.09) | (0.10) |
| $N$ | 42 | 42 | 42 | 42 | 42 | 42 |
| $R^2$ | 0.034 | 0.039 | 0.002 | 0.022 | 0.008 | 0.000 |

We estimate issuer-level regressions where the dependent variable is the change in the variable of interest between the first quarter of 2011 and quarters 2–4.[31] The explanatory variable is *Issuer Euro share* multiplied by the share of issuer's CP that is held by money market mutual funds as of 2011Q1. This measure of issuer's exposure to the European sovereign debt crisis accounts for the importance of MMMFs as providers of short-term debt capital to nonfinancial firms in our sample, and it effectively assumes that other holders of CP are either not exposed to the Eurozone banks or do not suffer similar capital supply shocks.

The results are in Table 9. In columns 1–3 in the top panel, the dependent variable is the change in net long-term debt issuance (scaled by contemporaneous assets). Formally,

[31] As with the evidence in Table 4, our analysis here is at the issuer level, and could therefore be partially driven by a broad withdrawal of MMMF financing from risky borrowers, in addition to the transmission of distress suggested by the spillovers we identify in Tables 5 and 8.

the dependent variable is

$$\frac{Net\ LTD\ issuance_{i,Q2}}{Assets_{i,Q2}} - \frac{Net\ LTD\ issuance_{i,Q1}}{Assets_{i,Q1}}$$

The coefficient on *Issuer Euro share* is positive in quarters 2 and 3. The economic magnitude is as follows. The standard deviation of scaled *Issuer Euro share* is around 5%, so a two standard deviation change in *Issuer Euro share* is associated with 50-140 bps greater net long-term debt issuance (as a percentage of assets).

When the dependent variable is the change in the cash-to-assets ratio, the point estimates are generally negative, but given small sample size the coefficient is not statistically significant. For the change in the ratio of outstanding CP to assets, total outstanding CP (not just the amount held by money market mutual funds) declines with *Issuer Euro share* in quarters 2 and 3. Finally, we examine whether the negative spillovers we document have real effects on investment. When we examine changes in investment, the coefficient on *Issuer Euro share* is close to zero and not statistically significant.

Overall, our issuer-level evidence for nonfinancial firms suggests that the disruption in MMMF funding we study pushed firms away from their preferred capital structures. Issuers substituted to long-term debt and drew down their existing cash balances. Although during the summer of 2011 we find little evidence of effects on investment,[32] the transmission channel that we document could potentially have larger real effects given a larger shock.

More broadly, there are several reasons to think that firms will not be able to seamlessly substitute to other sources of short-term financing. First, the frictions we document for MMMFs are likely to apply to other major holders of CP as well. According to the Flow of Funds, the largest holders of CP are US MMMFs (33%), the rest of the world, which consists primarily of foreign MMMFs (20%), mutual funds (14%), and state and local governments (7%). These are all highly regulated entities with strict investment guidelines, and together they hold almost three quarters of outstanding CP. Thus, both formal and informal relationships are important for other major CP investors, making it unlikely that they can seamlessly provide substitute financing for firms.

[32] We may also simply lack the power to detect real effects in our small sample of nonfinancial firms.

Second, substitute short-term financing from banks is also unlikely to be seamless. Withdrawals from prime MMMFs by institutional investors are unlikely to be deposited in banks—a key reason these investors use MMMFs is to diversify their credit exposure away from (and across) banks.[33] Instead, when they withdraw funds from prime MMMFs, institutional investors tend to deposit them in government MMMFs, which invest in Treasuries and Agencies (Schmidt, Timmermann, and Wermers, 2013).[34] During the financial crisis, the Federal Reserve set up the Commercial Paper Funding Facility and the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility precisely because banks could not backstop the CP market themselves (Duygan-Bump, Parkinson, Rosengren, Suarez, and Willen, 2013). Thus, for episodes like the one we study, the Gatev and Strahan (2006) hedge mechanism may not be effective. Of course, this is not to say that non-financial firms will not draw on their lines of credit when there are disruptions in the CP market. It does suggest, however, that such disruptions are unlikely to wash out in the aggregate. Instead, by drawing on their lines of credit, nonfinancials are likely to transfer their problems to the banking sector, which may itself be facing financing problems due to the market disruption.

It is worth noting that the context for our study is an episode of moderate stress for MMMFs. The importance of frictions typically is concentrated in severe downturns. Investor redemptions in the episode we study were significantly slower and much smaller in total than those following the Lehman bankruptcy. Thus, we think of our spillover results as documenting a channel that could be more significant during times of severe market stress. In particular, we think the ultimate effects on issuers of a disruption in MMMF funding could be more significant given a larger initial shock than the one we study.

[33] See for example the unofficial transcript of the SEC roundtable on MMMFs and systemic risk http://www.sec.gov/spotlight/mmf-risk/mmf-risk-transcript-051011.htm. Indeed, during the episode we study, both US domiciled banks and US branches of foreign banks saw withdrawals of large time deposits, one of the main instruments purchased by MMMFs and institutional investors.

[34] Based on data from the Investment Company Institute, over the 2008–2012 period the correlation between weekly flows into institutional prime and institutional government MMMFs was $-0.34$. Substitution between prime and government MMMFs is particularly strong during crisis times. For example, the correlation between prime and government flows was $-0.89$ during the second half of 2008.

# 7 Conclusion

We use the market turmoil involving Eurozone banks in the summer of 2011 to explore the instabilities associated with MMMFs, a critical part of the shadow banking system. We document that MMMFs create a channel through which distress at Eurozone banks hindered the ability of non-European issuers to raise financing due to credit market frictions. MMMFs with large exposures to Eurozone banks suffered significant outflows between June and August 2011. Due to institutional and market frictions, non-European issuers that historically raised financing from these funds were unable to immediately and completely substitute to other MMMFs. As a result, in the short run these issuers raised less overall financing from MMMFs.

We make several contributions. First, we empirically identify a channel through which nonbank financial intermediaries can transmit distress. Our results demonstrate that problems at some firms raising financing from an intermediary can be detrimental to other firms raising financing from the same intermediary. Second, we show that fund-issuer relationships are important in the money markets. Since these issuers are large, highly rated firms, this suggests that relationships always play a central role in finance—arm's length financing is never completely arm's length. Third, we demonstrate that money market mutual fund risk taking has consequences for issuers and therefore could affect the broader economy. We show that creditworthy issuers may encounter financing difficulties because of risk taking by the funds from which they raise financing. Our results document a channel through which risk taking at shadow banks may have spillover effects to the broader economy because of frictions in short-term credit markets.

MMMFs have recently come under scrutiny as academics and policymakers have tried to understand their role in financial crises. In 2010, the SEC enacted changes to Rule 2a-7, which governs money market funds, requiring funds to invest in higher quality assets of shorter maturities and maintain larger buffers of "liquid assets." However, the events documented in this paper took place after these changes were enacted. There are three reasons these changes may not have fully eliminated the type of spillovers we document. First, incentives for investors to run remain. Second, the required liquidity buffers are fixed over

time so funds may not be able to simply draw them down to meet redemptions in periods of turmoil. Third, the tighter restrictions on asset maturity mean that issuers must return to the money markets more often, increasing their vulnerability to short-term disruptions.

There have also been calls for stronger reforms. The SEC has recently proposed to eliminate the stable NAV of MMMFs and require them to quote the market value of their assets like other mutual funds. This could potentially reduce investor incentives to run, but would not affect the funds' ex-ante incentives to take risk, which is what prompts the large withdrawals studied in this paper. The Squam Lake Group (2011), a group of financial economists, call for money market funds to have capital buffers to insulate their investors from moderate fluctuations in asset values and to reduce the ex-ante incentives to take excessive risks.[35]

[35] Other similar proposals include Ricks (2011a,b), who calls for regulations similar to those governing commercial banks for any issuer of short-term "money-like" claims; Gorton and Metrick (2010), who call for insurance of money market funds to guarantee their investors payment and eliminate incentives to run; and McCabe, Cipriani, Holscher, and Martin (2012), who call for a small fraction of each investor's recent balances to be set aside to cover any losses if a fund has to be liquidated.

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# Appendix

**Table AI**
**Variable Definitions**

| | |
|---|---|
| *Fund Euro share*$_{f,t}$ | The share of fund $f$'s portfolio invested in Eurozone banks in month $t$. In cross-sectional regressions, we calculate the average value during the pre period, *Fund Euro share*$_f$. |
| *Fund flows*$_{f,t}$ | Net subscriptions scaled by lagged assets, $\frac{Flows_{f,t}}{TNA_{f,t-1}}$. In cross-sectional regressions, we calculate cumulative fund flows during the pre (post) period, scaled by February (May) 2011 assets. Fund flows are annualized and winsorized at the 5th and 95th percentiles. |
| *Gross yield*$_{f,t}$ | The fund's 7-day gross yield reported on form N-MFP. Some funds incorrectly report their gross yield as zero, which cannot be the case. We exclude these observations from the regressions that include gross yield. |
| *Institutional fund*$_f$ | Binary variable equal to 1 for funds with *Institutional share* greater than 99%. |
| *Institutional share*$_{f,t}$ | The share of fund's assets in institutional share classes. A share class is considered to be institutional if a) its minimum initial investment is equal to or greater than \$1 million or is equal to \$1, or b) the name of the share class includes "institutional." |
| *Issuer Euro share*$_{i,t}$ | The value-weighted average of *Fund Euro shares*, calculated over all funds holding issuer $i$ at time $t$, with the fraction of issuer $i$ held by fund $f$ as the weight. *Issuer Euro share*$_{i,f,t} = \sum_f \frac{Outstanding_{i,f,t}}{\sum_f Outstanding_{i,f,t}} \times$ *Fund Euro share*$_{f,t}$. In cross-sectional regressions, we calculate the average value during the pre period, *Issuer Euro share*$_i$. |
| *Net yield*$_{f,t}$ | The value-weighted average of the 7-day net yields on the fund's share classes. |
| $\Delta Outstanding_i$ | Percentage change in the average outstanding of issuer $i$ between the pre and post periods. Winsorized at the 5th and 95th percentiles. |
| $\Delta Outstanding_{i,f}$ | Percentage change in the average exposure of fund $f$ to issuer $i$ between the pre and post periods. Winsorized at the 5th and 95th percentiles. |
| *Portfolio maturity*$_{f,t}$ | The fund's dollar-weighted average portfolio maturity. |

**Table AI**—*Continued*

| | |
|---|---|
| *Relationship strength (in-sample)*$_{i,f}$ | The number of months between November 2010 and May 2011 in which fund $f$ has a position in issuer $i$, divided by the number of months in which issuer $i$ is held by any prime money market fund. A fund is considered to have a strong relationship with an issuer if it lends more consistently (frequently) than the median fund lending to that issuer. |
| *Relationship strength (out-of-sample)*$_{i,f}$ | Binary variable equal to 1 whenever fund $f$ holds issuer $i$ during the first sixth months of 2010. Fund holdings are from the last N-Q or N-CSR(S) filing made during this perod. |
| *Relationship strength (maturity)*$_{i,f}$ | A fund-issuer pair is considered to have a strong relationship if the maturity of the issuer's borrowing from the fund is longer than the median for that issuer. |
| *Relationship strength (issuer-based quantity)*$_{i,f}$ | A fund-issuer pair is considered to have a strong relationship if the portfolio share is above the median for that issuer. |
| *Relationship strength (fund-based quantity)*$_{i,f}$ | A fund-issuer pair is considered to have a strong relationship if the portfolio share is above the median for that fund. |
| *Repo Euro share*$_{f,t}$ | The fraction of repurchase agreements with Eurozone banks in the fund's portfolio. |
| *Size*$_{f,t}$ | The log of fund's TNA. |
| *Unsecured Euro share*$_{f,t}$ | The difference between *Fund Euro share*$_{f,t}$ and *Repo Euro share*$_{f,t}$. Measures the fraction of unsecured claims on Eurozone banks in the fund's portfolio. |
| *Yield*$_{i,t}$ | The weighted-average yield paid by issuer $i$ at time $t$. We extract the yield on each security from the title of the issue, reported in item 27 of form N-MFP. When the issue title does not include its yield, we calculate it based on the principal (item 40), amortized cost (item 41), and time to maturity (item 35). |