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

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Abstract

We document the consequences of money market fund risk taking during the European sovereign debt crisis. Using a novel data set of security-level holdings of prime money market funds, we show that funds with large exposures to risky Eurozone banks suffered significant outflows between June and August 2011. Due to credit market frictions, these outflows have significant spillover effects on other firms: non-European issuers that typically rely on these funds raise less financing in this period. The results are not driven by issuers' riskiness or exposure to Europe: for the same issuer, money market funds with greater exposure to Eurozone banks decrease their holdings more than other funds. We show that relationships are important in short-term credit markets so that these spillover effects cannot be seamlessly offset, even though issuers are large, highly rated firms. Our results illustrate that instabilities associated with money market funds persist despite recent changes to the regulations governing them.

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1 Introduction

In the aftermath of the financial crisis, risk taking by non-bank financial intermediaries has been heavily scrutinized. Writing before the crisis, Rajan (2006) warned that delegated investment management can create strong incentives for excessive risk taking by non-bank financial intermediaries "searching for yield". Since the crisis, the idea that risk taking at "shadow banks" may be distorted by a variety of regulatory frictions and incentive problems has gained prominence among both policymakers (Volcker, 2010; Yellen, 2011; Financial Crisis Inquiry Commission, 2011) and academics (Acharya and Richardson, 2009; Becker and Ivashina, 2012; Duffie, 2010a; Kacperczyk and Schnabl, 2012). A critical unanswered question is whether this risk taking generates adverse consequences for the broader economy.

As the long literature on the bank lending channel suggests, one reason to regulate risk taking is that distress may be transmitted across firms—problems at one group of firms can impair lender balance sheets, restricting the supply of credit to other creditworthy firms.[1] In traditional banks, the critical underlying friction is asymmetric information. Bank-dependent firms tend to be small and opaque, maintaining relationships with particular banks to mitigate information asymmetries. However, this makes it difficult for them to substitute to other sources of financing when their bank experiences difficulties. The literature has therefore long drawn a sharp distinction between the difficult-to-replace relationship-based financing provided by traditional banks and the easy-to-substitute arm's length financing provided by capital markets (Bernanke, 1983; Rajan, 1992; Petersen and Rajan, 1994). If market transactions are truly arm's length and easy to substitute, the bank lending channel may not operate in shadow banks, which are market-based sources of financing, and they may not deserve as much regulatory scrutiny as traditional banks.

We study this issue in the context of US money market funds, intermediaries in short-

[1] Theoretical work includes Bernanke and Blinder (1988), Bernanke and Gertler (1989), and Holmstrom and Tirole (1997). Recent empirical work includes Gan (2007), Khwaja and Mian (2008), Paravisini (2008), Chava and Purnanandam (2011), Iyer and Peydro (2011), and Schnabl (2012).

term credit markets that are a critical part of the shadow banking system. Using a novel data set of the security-level holdings of prime money market funds, we document that money market funds transmit distress across firms much like traditional banks do. In the context of the European sovereign debt crisis, we show that risk taking by money market funds, in the form of investments in risky 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 money market funds are only permitted to purchase securities from the highest credit-quality firms, which are usually large and highly rated.

With over $1.5 trillion in assets, prime money market funds are an important source of short-term financing for both financial and nonfinancial firms. According to the Flow of Funds, in 2010 money market funds held 37% of all open market paper, making them the single largest holder. Instabilities associated with money market funds played a central role in the financial crisis of 2008. At a smaller scale, similar instabilities surfaced in the summer of 2011 as fears about European sovereign debt problems mounted. According to the Investment Company Institute (ICI), assets managed by prime money market funds fell more than $170 billion (10%) between June and August 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 prime money market fund assets outside of the chaos surrounding the Lehman default.

Our main contribution is documenting how institutional and market 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 money market funds and cannot always seamlessly substitute between different funds as suppliers of financing. This means that money market funds can transmit distress across firms, and therefore that risk taking by money market funds can have negative spillovers effects. Specifically, risk taking may raise concerns about the creditworthiness of a subset of firms in a given fund's portfolio.

These concerns can lead the fund's investors to run, resulting in a sudden and indiscriminate loss of funding for the other creditworthy firms financed by the same fund.

Our analysis proceeds in two steps. First, we set the stage by examining the incentives for money market funds to take risk and the consequences of their risk-taking in terms of runs. Consistent with the existing literature (Christoffersen and Musto, 2002; Kacperczyk and Schnabl, 2012), we document a strong performance-flow relationship prior to June 2011, which created strong incentives for money market funds to take on risk. Facing regulatory constraints on portfolio maturity, funds took on risk by holding large positions in risky Eurozone banks—in May 2011, Eurozone bank investments accounted for more than a quarter of all prime money market fund assets.

This analysis of risk-taking incentives makes two contributions relative to the existing literature. First, our security-level holdings data allow us to construct more granular measures of risk taking than has been possible until now. Second, we analyze money fund behavior after the financial crisis, and show that incentives to take risk persist despite recent changes to the regulations governing money market funds. In particular, our results suggest that funds that took on risk prior to Lehman's default in September 2008 also took on risk by investing in Eurozone banks in the first half of 2011.[2]

This risk taking made funds vulnerable to runs between June and August 2011. Money market funds with larger exposures to Eurozone banks suffered larger investor redemptions. The magnitude of the effect is large: for institutional funds, a 10% higher exposure to Eurozone banks is associated with an annualized outflow of 22% of assets. Moreover, the effect is not driven by a general investor pullback from all risky funds. Investors treat exposure to Eurozone banks as particularly toxic: the effect of exposure to Eurozone banks remains strong when we control for fund yield as a measure of the overall riskiness of the

[2] Our results on persistence in risk taking are consistent with Fahlenbrach, Prilmeier, and Stulz (2011) who show that a commercial bank's performance during the 1998 crisis predicts its performance during the recent crisis. In contrast, Strahan and Tanyeri (2012) 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.

fund's portfolio. The effect is particularly strong for institutional funds and for funds with unsecured exposures to Eurozone banks.

After examining incentives for risk taking, we turn to the main focus of our analysis—the spillover effects of this risk taking on non-European issuers. While in the first step we document endogenous relationships between risk taking and fund flows, here identification is a critical concern, as it is in the literature on the bank lending channel. It could simply be the case that non-European firms funded by money market funds with large exposures to Eurozone banks 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, similar to Khwaja and Mian (2008) and Schnabl (2012). These specifications show that for the same issuer, money market funds 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 exposure to Europe.

We provide direct evidence demonstrating that the key friction driving these spillovers is that relationships are important in the commercial paper market. Funds with strong relationships with a particular issuer are less likely to cut their lending to the issuer during the run period. Indeed, funds not facing outflows increase their portfolio allocations to such issuers, but only as long as they have a pre-existing relationship. 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 systemic risk.

Our paper is related to both the literature on risk taking by financial institutions, including Rajan (2006), Becker and Ivashina (2012), Kacperczyk and Schnabl (2012), 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 money market fund risk taking for issuers, showing that because of credit market frictions fragility and runs in short-term funding markets can be disruptive to large, highly rated firms. Even when based on information about fund 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 real economy, our paper is also related to the growing literature on money market funds and contributes to the ongoing policy debate on the regulation of money market funds.[3] This literature has largely focused on fund risk taking before the financial crisis and the effects of government interventions during the crisis itself. Our results suggest that money market fund risk taking can have spillover effects to the broader economy, and that the instabilities associated with money market funds persist despite recent changes to the regulations governing them.

The remainder of this paper is organized as follows. Section 2 briefly describes the market turmoil associated with the European sovereign debt crisis. After describing the data in Section 3, we present our results on fund risk taking and investor withdrawals in Section 4. Section 5 presents our results on the spillover effects of investor withdrawals on non-European issuers. Section 6 discusses the results and their implications, and Section 7 concludes.

[3] Recent papers on money market funds include Christoffersen (2001), Christoffersen and Musto (2002), Baba, McCauley, and Ramaswamy (2009), Duygan-Bump, Parkinson, Rosengren, Suarez, and Willen (2010), McCabe (2010), Adrian, Kimbrough, and Marchioni (2011), Kacperczyk and Schnabl (2012), Strahan and Tanyeri (2012), and Wermers (2012).

2 Background

We focus on events in the money markets in the summer of 2011 driven by fears of European sovereign debt defaults.[4] These fears began to surface in late 2009, when Greece revealed that its debt had been substantially understated due to accounting problems. Concerns quickly arose that Greece and other peripheral countries in the Eurozone, including Portugal and Ireland, might default.

Concerns about sovereign debt, in turn, created anxiety about Eurozone banks because of their direct 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 and created the €440 billion European Financial Stability Facility (EFSF) for future interventions.

Although these measures alleviated Greece's immediate funding needs, they did not address the underlying unsustainability of its debt burden. Furthermore, subsequent events suggested that sovereign debt problems would not be limited to Greece. Ireland accepted an EFSF-funded 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 the Moody's review set off large investor redemptions from prime money market funds. The 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.[5]

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

[5] Figure 1 shows that the assets of institutional prime money market funds fell during the week ending on June 15. Unfortunately, our ICI data do not allow us to pinpoint the exact timing of these outflows. Peter

This was a large shock—the fall in aggregate assets is the largest three-month decline except for the depths of the financial crisis in the fall of 2008.[6] Moreover, not all funds were equally affected—those with large exposures to Eurozone banks suffered very large 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." Similarly, Dreyfus Institutional Cash Advantage Fund, with 39% of its assets invested in Eurozone banks, suffered outflows of $22.4 billion, almost 50% of its assets.

3 Data

We construct a novel data set of the security-level holdings of all US money market funds. Since November 2010, money market 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–August 2011 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 feeder funds that invest in other funds, internal funds that manage cash for their fund families and variable annuities.[7] We exclude eight small funds that either start

Crane kindly provided us daily data from Crane Data for the period of April–June 2011. According to Crane Data, half of the outflows between June 8 and June 15 occur on June 15, the day of the Moody's review.

[6] Based on ICI data covering the 1984–2011 period.

[7] 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."

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.[8] The average fund manages about $9.4 billion, 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. 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 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.

Next, we classify issuers into different types: ABCP, financials, government and 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. SEC Rule 2a-7, which governs money market funds, requires that these issuers be of the highest credit quality, which is typically interpreted to mean carrying either the highest or second-highest rating from the credit rating agencies. We further 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

[8] After applying our screens, aggregate assets of prime money market funds 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 money market funds are larger in N-MFP data than in ICI data. As of May 31, 2011, aggregate assets of prime money market funds 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.

that our results are driven by issuers' direct exposure to European economic conditions, we exclude European issuers. Finally, we exclude municipal issuers because they frequently use bond insurance and letters of credit, making it difficult to determine the money market fund's ultimate credit exposure for these issuers.[9] 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-money market fund holders of commercial paper. However, according to the Flow of Funds, with a 37% share, money market funds are the single largest holder of commercial paper. Therefore, it is unlikely that significant disruptions in the sector are completely offset by other investors. Moreover, in Section 6 we provide suggestive evidence that nonfinancial firms are not able to completely substitute to other sources of commercial paper financing.

We use our unique 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*,

$$Fund\ Euro\ share_{f,t} = \frac{\sum_{i \in Eurobanks} Outstanding_{i,f,t}}{\sum_i Outstanding_{i,f,t}}$$

where $Outstanding_{i,f,t}$ 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 measure ranges from 0 to 45.8%, with an average of 19.0% and a standard deviation of 11.2%.

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

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

[9] Furthermore, municipal issuers are generally small (the median municipal issuer borrows just $35 million from prime money market funds), 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.

This is the value-weighted average of *Fund Euro share* across money market funds 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 44.4%, with an average of 17.3% and a standard deviation of 8.4%.

Table 1 reports fund-level summary statistics. We split funds by their *Fund Euro share*. Funds with high *Fund Euro share* tend to be larger, serve more institutional investors, and make up a larger fraction of their fund family's assets.[10] High *Fund Euro share* funds exhibit both slightly higher gross yields, the yield earned by the fund's portfolio assets, and slightly higher net yields, the yield paid to investors. This makes sense since these funds hold securities issued by Eurozone banks, which offer higher yields. The difference in median gross yield of 4 basis points is small in absolute value, but is economically meaningful when compared to the median gross yield of 25 basis points. We also report the breakdown of fund portfolios by instrument and issuer type. The two types of funds have similar portfolio compositions, though of course funds with high *Fund Euro share* have a greater exposure to Eurozone financials, primarily in the form of CDs.

Table 2 reports issuer- and fund-issuer level summary statistics for the issuers in our sample. We focus on these issuers when we analyze the spillover effects of the outflows suffered by money market funds. Panel A reports statistics for the 72 ABCP, 75 financial, and 88 nonfinancial issuers in our sample. Panel B reports fund-issuer level statistics for the same issuers. The median issuer has $279 million outstanding, but the distribution is skewed, with mean and maximum outstandings of $2.9 billion and $55.1 billion respectively. There are some differences between issuers with high and low *Issuer Euro share*. In our analysis of spillovers, we will use issuer fixed effects to ensure that these differences are not driving our results. The median issuer is held by 9 money market funds. A number of issuers

[10] We measure *Adviser's MMF share* as follows. First, using our N-MFP data, we calculate the total TNA of all prime money market funds managed by an adviser. Second, using the CRSP mutual fund database, we calculate the total TNA of all mutual funds managed by the adviser. Finally, we calculate the ratio of the two numbers as of March 2011.

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 exclude the most widely held issuers, for which relationships with money market funds are likely to be less important.

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 money market funds, 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).

4 Risk-Taking and Runs

4.1 MMFs Face Strong Incentives to Take Risk in the Pre Period

We begin our analysis by studying money fund risk taking. Given that there are other papers (Christoffersen and Musto, 2002; McCabe, 2010; Kacperczyk and Schnabl, 2012; Strahan and Tanyeri, 2012) on the subject, our analysis in this section has two goals. First, our security-level holdings data allow us to construct more granular, bottom-up measures of risk taking. Here we explore the properties of these measures in normal market conditions before relating them to runs and spillover effects on issuers. Second, by studying risk taking following the financial crisis, our analysis contributes to the ongoing policy debate about money market funds. Some have argued that recent regulatory changes have made money funds more stable, so that they no longer pose systemic risks. Indeed, studying the period immediately after Lehman's default, Kacperczyk and Schnabl (2012) and Strahan and Tanyeri (2012) find that funds significantly reduced their risk taking. In contrast, our results indicate that once conditions normalized after the crisis, incentives to take risk remained: the funds

that took larger risks before Lehman also took on exposure to Eurozone banks during the spring of 2011.

We first analyze the incentives money market funds faced to take on risk in the pre period. In Table 3, we show that there is a strong performance-flow relationship in the pre period. We take a transparent approach, collapsing our monthly panel into a single fund-level cross section. 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.[11]

In column 1 we regress fund flows on *Fund Euro share* and 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%.

Column 2 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. commercial paper or CDs). Though the coefficients are 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.

Column 3 adds net yield as a regressor. Net yield comes in strongly positively, and column 4 shows that it reduces the coefficient on *Fund Euro share*, suggesting that the positive effect of *Fund Euro share* in the pre period is due to the higher yields offered by

[11] 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 money market funds in April 2011. 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.

Eurozone banks. The magnitude of the coefficient on net yield is large. An increase in net yield of 10 basis points is associated with additional flows equal to 13.8% of assets on an annualized basis. This performance-flow relationship is consistent with the findings of Christoffersen and Musto (2002) and Kacperczyk and Schnabl (2012). Column 5 shows that the performance-flow relationship is convex. The reward in terms of fund flows for offering a higher net yield is increasing in the net yield of the fund. Finally, column 6 shows that institutional investors drive the performance-flow relationship. We interact net yield with a dummy indicating whether the fund is an institutional fund. The results show that the performance-flow relationship is strongly positive only for funds that primarily serve institutional investors.

Table 3 shows that funds face strong incentives to take on risk by investing in Eurozone banks. Which funds respond most strongly to these incentives? In Table 4, we examine the characteristics of funds with high *Fund Euro share*. We run cross-sectional regressions of fund f's average *Fund Euro share* in the pre period on other fund characteristics.

We first examine basic fund characteristics. Higher *Fund Euro share* is associated with larger funds that have higher gross yields.[12] Going from a *Fund Euro share* of 0 to 100% increases gross yields by 20 basis points.

We next turn to fund characteristics that have a more direct economic link to risk taking. We first ask whether institutional funds invest more in Eurozone banks, since we saw above that institutional investors are more aggressive in seeking out the funds offering high yields. Column 3 shows that institutional funds do have higher *Fund Euro share*.

We next examine the idea that funds with significant franchise or reputational value at stake take less risk. If the failure of a money market fund impairs the franchise value of the other funds managed by the same asset manager, the manager will have an incentive to rein in risk taking by the money market fund. The larger the other funds are relative to the

[12] A few funds report their gross yield as zero, which cannot be the case. We exclude these funds from the regressions that include gross yield.

adviser's prime money market funds, the stronger these incentives will be. Consistent with Kacperczyk and Schnabl (2012), column 4 shows that this is the case. *Fund Euro share* is higher when prime money market funds make up a larger fraction of the overall mutual fund assets managed by the fund's adviser.[13]

Next we turn to the effect of operating leverage on risk taking. Given the persistent low interest rate environment, many money market funds were forced to waive some of their fees in order to continue paying non-negative net yields to investors. If funds have some fixed costs, this effectively means that their operating leverage increased, which should encourage additional risk-taking. Column 5 shows that funds offering larger fee waivers (as a percentage of fund assets) have higher *Fund Euro share*s, though the effect is not statistically significant. Column 6 shows that the effect is concentrated in fund families where prime money funds make up a large fraction of the fund family's total assets. This makes sense—an asset manager with little franchise value at stake and few other sources of income will be more likely to take on risk to help cover expenses.

Column 7 explores the persistence of fund risk taking. We use the CRSP Mutual Fund database to collect flows experienced in September 2008 at the peak of the financial crisis. We use these fund flows as a simple proxy for fund risk taking at the time. McCabe (2010) and Strahan and Tanyeri (2012) show that funds with riskier portfolios suffered larger outflows following Lehman's default. Consistent with the idea that risk taking is indeed persistent, funds that took more risk before the Lehman default and consequently had larger outflows in September 2008 also have larger exposures to Eurozone banks in the spring of 2011.

Finally, column 8 shows a saturated multivariate specification. The coefficients on gross yield, operating leverage interacted with franchise value, and flows in September 2008 remain statistically significant.

[13] To account for correlation across funds managed by the same adviser, we calculate standard errors clustered by adviser.

4.2 Investors Run on Funds with Large Eurozone Exposure

We now turn to the consequences in the post period of the money market fund risk-taking documented above. In Table 5 we examine the determinants of fund flows in the post period. In column 1 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 lagged *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 2 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,[14] and there is a strong independent effect of *Fund Euro share* in the post period. This suggests that money market fund investors were not withdrawing from funds that generally invest in riskier assets, only from those with large exposures to Eurozone banks. Column 3 shows that the effect of *Fund Euro share* is also robust to controlling for gross yield instead of net yield, which is a more direct measure of the riskiness of a fund's portfolio.

In column 4, we decompose the effect of *Fund Euro share* based on whether the fund's exposure to Eurozone banks is through secured lending or unsecured lending. The results show that only unsecured exposures are associated with outflows.

It may seem somewhat surprising that money market fund investors evaluate the exposures of their funds to Eurozone banks. After all, the relative safety of these funds should weaken investor incentives to monitor risk-taking (Kacperczyk and Schnabl, 2012). However, as column 5 shows, our results are largely driven by institutional funds. Institutional

[14] By contrast, McCabe (2010) uses gross yield as a measure of portfolio risk and finds that following the collapse of Lehman Brothers, funds with higher gross yields experienced larger outflows and were more likely to be supported by their sponsors.

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 money market fund exposures to European banks at the time (e.g., "US Money Fund Exposure to European Banks Remains Significant,"Fitch Ratings 2011).

5 Collateral Damage

We now show that, while it may be individually rational, the risk-taking behaviour documented above can have significant spillover effects on other issuers and therefore on the real economy. Specifically, we find that money market funds effectively transmit distress from Eurozone banks to non-European firms by temporarily disrupting their ability to raise financing in the money markets.

Before we turn to the results, it is worth discussing why we might expect to observe such spillovers. An important institutional friction is that individual money market funds are typically constrained to purchase securities from a fixed list of issuers that their boards have pre-approved. In particular, SEC Rule 2a-7, which governs money market funds, states: "The money market 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." Thus, if a money market fund that typically provides financing to a particular issuer becomes constrained due to outflows, there may not be many other funds that can immediately step in to provide financing to that issuer. As we saw above, money market funds with large exposures to Eurozone banks suffered significant outflows in the post period. Thus, we might expect the non-European issuers financed by those funds to experience temporary difficulties raising financing. Moreover, money market funds are subject to concentration limits: no more than 5% of a fund's assets may be invested in a particular issuer. Thus, in the presence of slow-moving capital (Duffie, 2010b), funds not suffering outflows may not be

able to increase the amount of financing they provide to a pre-approved issuer.

In addition, relationships between issuers and specific money market funds—either direct or intermediated by dealers—may be important for mitigating short-run adverse selection problems, even in the absence of formal regulatory constraints. If a money market fund that typically provides financing to a particular issuer becomes constrained due to outflows, that issuer will have to seek financing from other funds, possibly offering higher yields as an enticement. However, as in Rajan (1992), 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.

5.1 Spillovers: Fund-Issuer Level Evidence

We now turn to the transmission of distress from Eurozone banks to other non-European firms generated by investor redemptions. While the previous sections documented endogenous relationships between risk taking and fund flows, here identification is a critical concern. It could simply be the case that non-European firms funded by money market funds 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.

We address such concerns using our unique security-level data to estimate specifications with issuer fixed effects, similar to Khwaja and Mian (2008) and Schnabl (2012). 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. Recall that we exclude European firms. All our results would be stronger if we included these issuers. It is important to note that this means that our estimates are likely to be a lower bound on the cross-firm spillover effects transmitted by money market funds. European firms, particularly financials, are the issuers for whom spillovers are likely to be most

important. We omit them for the sake of cleaner identification, but this comes at the cost of underestimating the magnitude of the spillovers. Our final sample consists of non-European financials, nonfinancials, and asset-backed commercial paper (ABCP) issuers.

For each money market fund f and each 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. Finally, recall that the friction we have in mind is that asymmetric information makes fund-issuer relationships important. Thus we would not expect to find significant spillovers for issuers borrowing from a large number of funds. Yet these widely held issuers constitute a significant fraction of our fund-issuer level data set. Therefore, to focus on issuers that are more likely to be affected, we exclude the ten most widely held issuers during the pre period.[15]

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

$$\Delta\overline{Outstanding}_{i,f} = \alpha_i + \beta \times Fund\ Euro\ share_f + \varepsilon_{i,f}$$

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 within issuer. The regressions 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. We cluster our standard errors by fund because the independent variable is constant within fund (see Kloek, 1981; Moulton, 1990).

[15] Appendix Table AII reports the results for the ten most widely held issuers.

Table 6 shows the results. In the first column, the coefficient on *Fund Euro share* is negative and statistically significant. The magnitudes here are economically significant. A money market fund with a 10% larger exposure to Eurozone banks reduces its exposure to a given issuer 8.7% 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 2, 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.

In column 3, 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 5, investors largely withdrew from funds that had unsecured exposure to Eurozone banks. Consistent with outflows being driven by riskier exposures, column 3 shows that only unsecured exposure to Eurozone banks creates spillovers on non-European issuers.

Columns 4–6 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%. The regression coefficient in column 4 is positive and significant. A fund with a 10% higher *Fund Euro share* is 4% more likely to completely exit its position in a given issuer. Given a baseline exit rate of 19.4%, this represents a 21% increase. Overall, the results are broadly similar to those in columns 1–3.[16]

For brevity, we do not report the results of value-weighted regressions here. However, Appendix Table AIII shows that we get similar results when we value-weight the regression

[16] Indeed, most of the effect in columns 1–3 is driven by exit. When we restrict our analysis of $\Delta \overline{Outstanding}_{i,f}$ to fund-issuer pairs that are not exited in the post period, the coefficient on *Fund Euro share* is negative but not significant.

using fund-issuer exposure during the pre period. This is not simply a matter of the smallest issuers getting shut out of the market, though we are excluding the very largest issuers.

5.2 Documenting the Mechanism: Relationships

In this section, we provide evidence that the key friction driving our results is the importance of relationships between funds and issuers. We construct two measures of the strength of the relationship between an issuer and a money market fund. The measures are similar in spirit, but come from different data sources. Both measures assess the extent to which a fund has previously lent to a given borrower. Our "in-sample" measure counts how often a fund lends to a given borrower over the period November 2010–May 2011 in our data from SEC form N-MFP. 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 this 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.[17]

Because the in-sample measure is based on panel data, we can define relationship strength within issuer. Specifically, for each issuer we label a fund as having a strong relationship with the issuer if it lends to the issuer more frequently than the median fund lending to that issuer. By contrast, the out-of-sample measure is based on a single cross section of data. Therefore, we simply label a fund as having a strong relationship with the issuer if it lends to that issuer at all during the first half of 2010. Of course, as before our regression specifications will include issuer fixed effects so that the results are driven by variation within issuer. The in- and out-of-sample measures classify 62% and 48% of fund-issuer pairs as having a strong relationship.

These measures are intuitive, potentially capturing the importance of relationships in short-term credit markets. A fund that lends to a given issuer more frequently is likely to

[17] 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.

have better information on the issuer and perhaps even personal connections to the issuer's management. Indeed, as Panel A in Table 7 shows, our measures of relationship strength are associated with differences in lending terms in the pre period. As one would expect, funds that have a strong relationship with an issuer lend for somewhat longer maturities.[18] This is intuitive. A fund that has a stronger relationship with an issuer and potentially better information about that issuer will be less concerned about shocks to the issuer's creditworthiness in the short-term and will therefore be willing to extend credit for longer maturities. Controlling for deciles of maturity, which we do not report for the sake of brevity, strong relationships are also associated with 1–2 basis points higher yields. This suggests that issuers may be willing to pay higher yields to cultivate stronger relationships with particular funds.

In Panel B of Table 7, we turn to the effect of relationship strength on the spillovers we documented in Table 6. We split the effect of *Fund Euro share* by the strength of the fund's relationship with the issuer. The table shows that high *Fund Euro share* funds cut funding more sharply from issuers with whom they have a weak relationship, though the difference is not statistically significant. This is true using both measures of relationship strength, and we find stronger results when we value weight the regressions in Appendix Table AIV. It is important to note that these results are not mechanically driven by the fact that strong relationships are associated with longer maturity loans. We measure post period lending over three months, which ensures that virtually all loans must be rolled over.

[18] One might be concerned about the possibility of a mechanical association between maturity and our "in-sample" measure of relationship strength. If a fund lends for say six months then we will observe it lending in multiple months, and our "in-sample" measure will tend to classify the fund-issuer pair as having a strong relationship. However, this is quite unusual in our data: fewer than 11% of fund-issuer observations have remaining maturity more than six months. Moreover, our "out-of-sample" measure is immune to this mechanical bias.

5.3 Documenting the Mechanism: Substitution Across Funds

Finally, we examine the extent to which substitute financing from funds not facing significant redemptions in the post period is available to issuers. To do so, we now focus on fund-level variation, rather than focusing on the issuer-level variation we analyzed in the last two subsections. Specifically, we examine the share of each issuer in a fund's portfolio. We regress the change in portfolio share on *Issuer Euro share*, the average exposure to Eurozone banks of the money market funds that finance the issuer in the pre period, while controlling for fund fixed effects.[19] Now all identification is coming within fund. The regressions ask whether funds treat issuers with higher *Issuer Euro share* differently than they treat other issuers, holding fixed the fund.

The results show that unconstrained funds with low *Fund Euro share* try to fill the gap left when constrained funds with high *Fund Euro share* withdraw financing. Specifically, funds with low *Fund Euro share* increase the share of high *Issuer Euro share* issuers in their portfolios, but only for issuers with which they have strong relationships.

The first three columns of Table 8 focus on unconstrained funds with low (below median) *Fund Euro share*. These funds did not face heavy investor redemptions in the post period and therefore were able to provide some substitute financing for issuers with high *Issuer Euro share*. Using our in-sample measure of relationship strength, column 1 shows that these funds increased their lending to high *Issuer Euro share* issuers they have strong relationships with. The coefficient on *Issuer Euro share* interacted with strong relationship is significant at 5.4%. There is no effect for high *Issuer Euro share* issuers they have weak relationships with. Recall that these specifications include fund-level fixed effects. Within a given fund, lending in the post period is tilted towards issuers with high *Issuer Euro share* relative to other issuers, but only for issuers that have a strong relationship with the fund.

[19] Note that the change in portfolio share is defined for all fund-issuer pairs, while $\Delta \overline{Outstanding}_{i,f}$ is only defined for fund-issuer pairs where there was positive lending in the pre period. Thus, these specifications allow us to examine fund decisions to start lending in the post period. The number of observations also goes up significantly relative to our previous results.

Column 2 shows that we obtain similar results when we use our out-of-sample measure of relationship strength. Finally, in column 3 we combine the two relationship measures, labelling a fund-issuer pair as a strong relationship if either the in-sample measure or the out-of-sample measure say it is. This is likely our best proxy for the approved issuer list friction discussed above. Since the lists change slowly, if an issuer has ever received financing from a fund, it is likely to remain on that fund's approved issuer list. The results with this measure are similar in magnitude to the others, and statistically significant at 1.7%.

Note that these results 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 unconstrained funds find them attractive and increase exposure to them.

Columns 4–6 shows that there is no effect for funds with high *Fund Euro share*. These funds were faced heavy redemptions and had to reduce their positions across the board. As we will see when we present issuer-level results in Table 9, the funds with low *Fund Euro share* were not able to completely offset this withdrawal of financing. This makes sense since larger funds tend to have higher *Fund Euro share*.

6 Discussion

6.1 Issuer-Level Evidence

Our results show that money market funds transmitted funding difficulties from Eurozone banks to other issuers in the summer of 2011. Funds that were heavily exposed to Eurozone banks cut back on their lending to non-European issuers, particularly those with whom they had weak relationships. While up until now we have focused on our fund-issuer level data to address identification concerns, we next turn to the issuer-level data to understand the size of the spillovers experienced at the firm level. We will not be able to use issuer fixed effects, so identification is more of an issue here than in the fund-issuer level results above.

However, we will still try to control for issuer riskiness with the issuer's pre-period yield.[20]

Table 9 presents the issuer-level results. In columns 1-3, the dependent variable is the percentage change in average outstanding amount for each issuer 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

$$\Delta\overline{Outstanding_i} = \alpha + \beta \times Issuer\ Euro\ share_i + \varepsilon_i$$

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.

Column 1 shows that being financed by money market funds that have large Eurozone bank exposures has a strong effect on non-European issuers. Issuers with a 10% higher *Issuer Euro share* (i.e., financed by money market funds with 10% higher exposure to Eurozone banks in the pre period) grow their financing 20% less in the post period. The coefficients here are somewhat larger than those we found in the position-level data. The reason for this is that the position-level data only capture changes in lending by funds that were already lending to a particular issuer. By contrast, the issuer-level data also capture decisions by funds that have not previously lent to an issuer to start doing so. The larger coefficients in the issuer-level data reflect the fact that funds are somewhat less likely to start lending to a new issuer in the post period when that issuer had a high *Issuer Euro share* in the pre 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 the issuer's riskiness. This helps to show that our results are not solely driven by a general

[20] Moreover, in untabulated results with our fund-issuer level data, we find that our estimated coefficients on *Fund Euro share* are similar whether or not we include issuer fixed effects. This suggests that unobserved issuer characteristics are not an important driver of lending in the post period.

aversion to risk among money market fund managers.

Of course, these firms are large and highly rated. In the absence of broader disruptions to the financial system, such firms should be able to substitute to other sources of financing. In the remaining columns of Table 9, we provide suggestive evidence that even these large and highly rated firms are not able to completely and instantaneously substitute. We match as many of the nonfinancial firms as possible from our N-MFP data to Capital IQ. From Capital IQ we obtain quarterly balance sheet information on commercial paper outstanding and cash holdings.[21] We focus on nonfinancial firms because financials raise many types of short-term financing (e.g., repurchase agreements, deposits), which we cannot adequately capture in Capital IQ and which are inconsistently reported across regulatory filings for different types of financial institutions (e.g., banks, insurance companies) and across different jurisdictions. To account for the relative importance of money market funds as a source of short-term financing for a given issuer, we scale *Issuer Euro share* by the fraction of the issuer's outstanding CP held by money market funds.

Since we can only match a subset of the firms in our sample and the data are only available quarterly rather than monthly (if at all), the power of our tests is limited. However as columns 4-9 of Table 9 shows, for this small subsample, there is suggestive evidence that total CP outstanding and cash holdings decline with *Issuer Euro share*. This suggests that firms with higher *Issuer Euro share* are unable to fully substitute to non-money market fund sources of financing and use cash to pay off their commercial paper as it matures.

6.2 Implications for Financial Stability

It is important to keep in mind that the initial shock here, while significant, was relatively slow-moving. Redemptions from prime money market funds totalled $170 billion, but took 3 months to accumulate. In contrast, prime money market funds suffered $200 billion in

[21] Because not all firms consistently report the amount of outstanding CP, we have some missing observations in our regressions of the percentage change in outstanding CP.

outflows in the *week* following the Lehman Brothers bankruptcy in September 2008. The spillovers we document here would likely be much more severe if the initial shock was of that magnitude. Yet, even in the case of the significant, but by no means catastrophic, shock that we study here, there is a detectable effect on firm capital structure.

The spillovers we document here likely operate in a similar manner but at a much larger scale in periods of significant financial stress. Therefore, it is worth emphasizing the financial stability implications of our results. We show that in the pre period, money market funds had strong incentives to take on risk. In particular, column 3 of Table 3 shows that a fund offering a 10 basis point higher yield attracted annualized inflows amounting to 13.8% of assets. It is important to consider the interest rate environment. The median net yield in the pre period is 1 basis point, the average is 4 basis points, and the standard deviation is 7 basis points, so 10 basis points is a large change in yield. Nonetheless, the strength of the relationship shows how intensely money market fund investors desire yield. Since Eurozone banks were offering yields 10–20 basis points higher than other financial firms, money market funds interested in maximizing assets under management would be enticed to take on exposures to those banks. This does not appear to be moral hazard on the part of fund managers. Our results suggest that investors monitor the holdings of their money market funds, and are therefore aware of their risk taking.

Of course, our results do not speak to the ex ante efficiency of this risk taking. The extension of credit to Eurozone banks may have been optimal ex ante. Our results simply demonstrate that this risk taking stimulated by investors' desire to pick up a few basis points eventually led to investor redemptions that adversely affected other firms. In particular, they suggest that runs are not an effective disciplining device in the context of money market funds, in contrast to the logic of Diamond and Rajan (2001). In their model, the threat of a run prevents the lender from holding up depositors. Our results document investors incentivizing lenders to take on risks and running when those risks turn out poorly, thereby creating financing problems for other issuers.

The transmission mechanism documented here is created by two key features of money market funds. First, the funds issue short-term liabilities with fixed values (i.e., the funds offer stable NAV shares). This gives fund investors incentives to run, redeeming their liabilities when they perceive a risk that the fund may suffer losses. Second, money market funds invest in assets that are relatively short-term (but of longer maturity than their liabilities). This means that issuers can have difficulty rolling their financing or raising new financing when money market funds are constrained.[22]

Both of these features have recently come under scrutiny as academics and policymakers have tried to understand the role of money market funds in financial crises. The SEC recently 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. There have been proposals to eliminate the stable NAV of money market funds and require them to quote the market value of their assets like other mutual funds. The Squam Lake Group (2011), a group of prominent financial economists, calls for money market funds to have capital buffers to insulate their investors from moderate fluctuations in asset values. Ricks (2011a,b) calls for regulations similar to those governing commercial banks for any issuer of short-term "money-like" claims. Gorton and Metrick (2010) call for insurance of money market funds to guarantee their

[22] These two features also distinguish our results from the empirical literature on financial contagion, including Bae, Karolyi, and Stulz (2003) and Cella, Ellul, and Giannetti (2010). This literature typically studies equity prices, which impact issuers less directly since equity is permanent capital.

investors payment and eliminate incentives to run. Finally, McCabe, Cipriani, Holscher, and Martin (2012) argue that delaying and potentially subordinating redemption of a relatively small fraction of investor's recent balances, called *minimum balance at risk*, could create a disincentive to run.

7 Conclusion

We use the market turmoil involving Eurozone banks in the summer of 2011 to explore the instabilities associated with money market funds, a critical part of the shadow banking system. We document that money market funds transmitted distress from Eurozone banks to non-European issuers due to credit market frictions that prevent seemless substitution across sources of financing. Money market funds 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 money market funds. As a result, these issuers raised less overall financing from the money markets in the short run.

We make several contributions. First, we empirically identify the transmission of distress through non-bank financial intermediaries. 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 commercial paper market. 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 fund risk taking has consequences for issuers and therefore the real economy. We show that creditworthy issuers may encounter financing difficulties because of risk taking by the funds from which they raise financing. Our results illustrate how risk taking at shadow banks may have spillover effects to the broader economy because of frictions in short-term credit markets.

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Table 1
Summary Statistics: Funds

This table reports summary statistics for prime money market funds in our data. The sample of funds consists of prime money market funds filing form N-MFP during the March–August 2011 period, excluding a) funds that exclusively serve the internal cash management needs of their mutual fund family and b) variable annuities.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 the European Union.

	Low Euro Share ($N = 534$)			High Euro Share ($N = 528$)		
	Mean	Median	SD	Mean	Median	SD
Fund characteristics						
Total Net Assets	4615	1214	12774	13335	4974	22159
Institutional share	46.43	47.08	43.70	63.25	97.96	44.75
Adviser's MMF share	20.35	12.82	21.31	33.98	33.93	20.27
Fee waivers (bps)	30.41	29.91	24.87	27.95	13.58	45.27
Fund flows	−0.06	−0.12	7.02	−0.81	−0.74	7.92
Gross yield (bps)	22.11	22.00	7.17	25.43	26.00	7.44
Net yield (bps)	3.13	1.00	6.02	4.39	1.18	5.12
Portfolio maturity (days)	39.08	40.00	8.79	38.29	42.00	13.11
Euro share	8.86	8.16	6.42	25.30	24.31	8.82
Unsecured Euro share	6.58	5.81	5.58	18.63	18.72	8.56
Instrument shares						
ABCP	13.49	11.92	13.31	8.78	5.81	9.69
CD	13.68	12.19	12.15	29.56	32.14	16.02
Financial CP	16.05	14.87	9.50	16.14	14.50	9.32
Government/Agency	14.73	10.59	14.38	10.30	9.83	9.32
Government/Agency repo	9.21	6.01	10.75	14.63	10.04	14.49
Municipal debt	8.82	3.97	11.03	2.91	0.00	4.98
Nonfinancial CP	13.30	8.02	15.20	3.09	0.83	8.59
Other repo	1.31	0.00	4.68	4.35	0.00	6.47
Other	9.42	5.94	13.76	10.25	8.35	7.63
Issuer shares						
ABCP	12.39	11.19	13.08	8.62	5.71	9.57
Eurozone financial	9.41	8.76	6.80	26.43	25.06	9.35
Rest of EU financial	8.69	7.73	6.91	14.18	12.89	7.32
Non-EU financial	24.73	25.14	13.11	31.80	33.22	11.81
Government/Agency	15.30	11.45	14.68	10.30	9.83	9.31
Municipal	9.86	4.30	12.49	2.71	0.18	5.01
Nonfinancial	14.65	8.68	16.87	4.31	1.79	9.80
Other	4.98	2.24	11.74	1.65	1.05	2.12

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 funds filing form N-MFP during the March–August 2011 period, excluding a) funds that exclusively serve the internal cash management needs of their mutual fund family and b) variable annuities. The sample period is March–August 2011. In Panel A, issuers are split by average issuer Euro share during the pre period. In Panel B, fund-issuer exposures are split by fund Euro share.

Panel A: Issuers						
	Low Euro Share ($N = 738$)			High Euro Share ($N = 732$)		
	Mean	Median	SD	Mean	Median	SD
Outstanding (millions)	846.50	79.75	2248.02	4795.22	710.14	10027.99
Number of funds	14.06	6.00	18.45	27.96	11.00	33.52
Issuer Euro share (%)	9.79	9.71	5.54	21.55	21.08	5.49
Weighted average maturity (days)	54.86	26.64	77.87	47.49	25.73	71.53
Yield (bps)	21.76	19.52	12.67	28.91	28.17	9.78
Panel B: Fund-Issuer Exposures						
	Low Euro Share ($N = 20,725$)			High Euro Share ($N = 20,684$)		
	Mean	Median	SD	Mean	Median	SD
Exposure (millions)	58.20	5.00	224.64	122.72	7.58	385.94
Portfolio share (%)	1.22	0.54	1.77	1.01	0.30	1.69
Weighted average maturity (days)	63.55	34.32	76.88	69.30	37.00	84.29
Yield (bps)	22.96	22.01	11.87	26.18	26.00	11.15

Table 3
Fund Flows during the Pre Period (March–May 2011)

The dependent variable is cumulative net flows during the March–May 2011 period scaled by February 2011 net assets. Fund flows are annualized and winsorized at the 5th and 95th percentiles. The sample consists of prime money market funds filing form N-MFP during the March–August 2011 period, excluding a) funds that exclusively serve the internal cash management needs of their mutual fund family and b) variable annuities. Explanatory variables are measured as of February 2011. 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%.

	(1)	(2)	(3)	(4)	(5)	(6)
Size	3.091*	3.003*	2.878*	2.020	2.557	2.523
	(1.577)	(1.606)	(1.667)	(1.712)	(1.738)	(1.618)
Fund Euro share	0.517*			0.423	0.407	0.360
	(0.273)			(0.277)	(0.280)	(0.280)
Unsecured Euro share		0.556*				
		(0.296)				
Repo Euro share		0.463				
		(0.504)				
Net yield (bps)			1.380***	1.265**		−0.757
			(0.519)	(0.526)		(0.686)
Net yield is $[1, 10)$ bps					6.148	
					(6.857)	
Net yield is $[10, 15)$ bps					−0.841	
					(13.532)	
Net yield is $[15, 20)$ bps					26.795*	
					(15.808)	
Net yield is $[20, 26]$ bps					39.224***	
					(12.537)	
Institutional fund						0.222
						(8.632)
Euro share × Institutional fund						2.429***
						(0.866)
Constant	−36.555***	−36.150***	−32.047***	−33.172***	−37.289***	−33.267***
	(11.130)	(11.526)	(11.396)	(11.492)	(11.836)	(11.108)
N	177	177	177	177	177	177
Adjusted R^2	0.057	0.052	0.082	0.094	0.101	0.134

Table 4
Variation in Fund Exposure to Eurozone Banks

The dependent variable is *Fund Euro share*$_{f,pre}$, the share of the fund's portfolio invested in Eurozone banks, averaged over the pre period, March–May 2011. The sample consists of prime money market funds filing form N-MFP during the March–August 2011 period, excluding a) funds that exclusively serve the internal cash management needs of their mutual fund family and b) variable annuities. Except for fund flows in September 2008, all explanatory variables are averages during the March–May 2011 period. September 2008 fund flows are from the CRSP mutual fund database. Fund size is the log of fund TNA. Adviser's MMF share is the fraction of prime money market funds in the fund adviser's total assets under management. Fee waivers is the ratio of waived fees to fund TNA. Institutional funds are funds with more than 99% of fund assets in institutional share classes. Gross yield is the 7-day gross yield reported by the fund. In columns 4, 6, and 8, standard errors are adjusted for clustering by adviser. In all other columns, robust standard errors are reported. *, **, and *** indicate statistical significance at 10%, 5%, and 1%.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Size	1.249***	2.098***	1.778***	1.537***	2.336***	1.657***	1.460***	0.704
	(0.479)	(0.439)	(0.406)	(0.464)	(0.457)	(0.496)	(0.498)	(0.536)
Gross yield	0.387***							0.349**
	(0.136)							(0.155)
Portfolio maturity		−0.140						−0.155
		(0.095)						(0.151)
Institutional fund			4.741***					2.687
			(1.548)					(1.768)
Adviser's MMF share				0.157***		0.066		0.059
				(0.047)		(0.053)		(0.062)
Fee waivers					3.801	−7.844**		−6.655*
					(2.621)	(3.713)		(3.975)
Adviser's MMF share						0.295***		0.258***
× Fee waivers						(0.089)		(0.091)
Fund flows							−0.150***	−0.140***
in September 2008							(0.050)	(0.048)
Constant	−1.522	8.153*	3.180	2.588	−0.407	4.086	6.238	6.461
	(4.160)	(4.667)	(3.230)	(3.244)	(4.078)	(3.974)	(3.781)	(8.980)
N	166	177	177	177	177	177	164	154
Adjusted R^2	0.136	0.124	0.154	0.207	0.120	0.238	0.183	0.329

Table 5
Fund Flows during the Post Period (June–August 2011)

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. The sample consists of prime money market funds filing form N-MFP during the March–August 2011 period, excluding a) funds that exclusively serve the internal cash management needs of their mutual fund family and b) variable annuities. Explanatory variables are measured as of May 2011. 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%.

	(1)	(2)	(3)	(4)	(5)
Size	−6.648***	−6.496***	−6.642***	−5.877***	−6.738***
	(2.064)	(2.137)	(2.314)	(2.044)	(2.022)
Euro share	−0.880***	−0.871***	−0.861***		−0.251
	(0.306)	(0.316)	(0.310)		(0.364)
Net yield		−0.194			
		(0.959)			
Gross yield			0.154		
			(0.594)		
Unsecured Euro share				−1.289***	
				(0.385)	
Repo Euro share				−0.031	
				(0.538)	
Institutional fund					43.733**
					(17.048)
Euro share					−1.923***
× Institutional fund					(0.640)
Constant	61.792***	61.222***	57.919***	57.493***	50.572***
	(15.155)	(15.401)	(16.505)	(15.000)	(15.132)
N	177	177	166	177	177
Adjusted R^2	0.124	0.120	0.110	0.135	0.154

Table 6
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 models 1–3, the dependent variable is $\Delta\overline{Outstanding}_{i,f}$, the relative 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 modells 4–6, the dependent variable, $Exit_{i,f}$, is equal to 1 if $\Delta\overline{Outstanding}_{i,f}$ is equal to -100%, and is equal to 0 otherwise. 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 funds filing form N-MFP during the March–August 2011 period, excluding a) funds that exclusively serve the internal cash management needs of their mutual fund family and b) variable annuities. Issuer fixed effects are included in all specifications. The 10 most commonly held issuers during the pre period are excluded. Pre period is March–May 2011. Post period is June–August 2011. 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%.

	$\Delta\overline{Outstanding}_{i,f}$			$Exit_{i,f}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Portfolio share$_{i,f}$	-14.424^{***}	-14.397^{***}	-14.557^{***}	-0.034^{***}	-0.036^{***}	-0.033^{***}
	(1.441)	(1.451)	(1.450)	(0.005)	(0.005)	(0.005)
Fund Euro share$_f$	-0.865^{***}	-0.866^{***}		0.004^{***}	0.004^{***}	
	(0.279)	(0.279)		(0.001)	(0.001)	
Yield$_{i,f}$		0.077			-0.005^{***}	
		(0.263)			(0.001)	
Unsecured Euro share$_f$			-1.115^{***}			0.005^{***}
			(0.313)			(0.001)
Repo Euro share$_f$			-0.184			0.001
			(0.494)			(0.002)
Constant	36.169^{***}	34.233^{***}	36.968^{***}	0.168^{***}	0.287^{***}	0.165^{***}
	(5.651)	(9.139)	(5.643)	(0.026)	(0.035)	(0.026)
Issuer FE	+	+	+	+	+	+
N	3,837	3,837	3,837	3,837	3,837	3,837
Adjusted R^2	0.116	0.115	0.117	0.156	0.166	0.156

Table 7
Relationships in Money Markets

Panel A reports the results of regressions of maturity and yield during the period on the existence of a strong fund-issuer relationship. $Maturity_{i,f}$ and $Yield_{i,f}$ are the average values during the pre period of the exposure of fund f to issuer i. Yield regressions in models 3–4 control for deciles of maturity. Panel B reports the results of regressions of changes in the exposure of fund f to issuer i on fund Euro share interacted with fund-issuer relationship strength. $\Delta\overline{Outstanding}_{i,f}$ is the relative change in the average exposure of fund f to issuer i between the pre and post periods. $Exit_{i,f}$ is a binary variable equal to 1 if $\Delta\overline{Outstanding}_{i,f}$ is equal to -100%, and equal to 0 otherwise. 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 funds filing form N-MFP during the March–August 2011 period, excluding a) funds that exclusively serve the internal cash management needs of their mutual fund family and b) variable annuities. Issuer fixed effects are included in all specifications. The 10 most commonly held issuers during the pre period are excluded. Pre period is March–May 2011. Post period is June–August 2011. Robust standard errors are reported. *, **, and *** indicate statistical significance at 10%, 5%, and 1%.

	(1)	(2)	(3)	(4)
Panel A: Maturity and Yield during the Pre Period				
	$Maturity_{i,f}$		$Yield_{i,f}$	
	In-Sample	Out-of-Sample	In-Sample	Out-of-Sample
Strong relationship$_{i,f}$	8.569***	4.839***	1.635***	1.040***
	(1.372)	(1.506)	(0.309)	(0.304)
Constant	39.204***	42.307***	12.942***	13.178***
	(1.112)	(0.945)	(0.556)	(0.559)
Issuer FE	+	+	+	+
N	3,837	3,837	3,837	3,837
Adjusted R^2	0.550	0.546	0.621	0.618
Panel B: Changes in Exposure during the Post Period				
	$\Delta\overline{Outstanding}_{i,f}$		$Exit_{i,f}$	
	In-Sample	Out-of-Sample	In-Sample	Out-of-Sample
Portfolio share$_{i,f}$	−14.011***	−14.367***	−0.018***	−0.032***
	(1.289)	(1.287)	(0.004)	(0.004)
Strong relationship$_{i,f}$	−7.267	−4.989	−0.168***	−0.062**
	(8.017)	(7.134)	(0.030)	(0.028)
Fund Euro share$_f$	−0.832***	−0.737***	0.002**	0.002**
× Strong relationship$_{i,f}$	(0.207)	(0.259)	(0.001)	(0.001)
Fund Euro share$_f$	−0.966***	−0.964***	0.004***	0.004***
× Weak relationship$_{i,f}$	(0.343)	(0.264)	(0.001)	(0.001)
Constant	40.564***	38.313***	0.271***	0.201***
	(7.491)	(5.993)	(0.027)	(0.021)
Issuer FE	+	+	+	+
N	3,837	3,837	3,837	3,837
Adjusted R^2	0.116	0.115	0.214	0.169

Table 8
Substitution Across Funds

This table reports the results of the regressions of the change in the share of fund f's portfolio invested in issuer i between the pre and post periods on issuer Euro share interacted with fund-issuer relationship strength, split by fund Euro share. 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 funds filing form N-MFP during the March–August 2011 period, excluding a) funds that exclusively serve the internal cash management needs of their mutual fund family and b) variable annuities. Fund fixed effects are included in all specifications. Models 3 and 6 use the maximum of in- and out-of-sample relationship measures. The 10 most commonly held issuers during the pre period are excluded. Pre period is March–May 2011. Post period is June–August 2011. Standard errors are adjusted for clustering by issuer. *, **, and *** indicate statistical significance at 10%, 5%, and 1%.

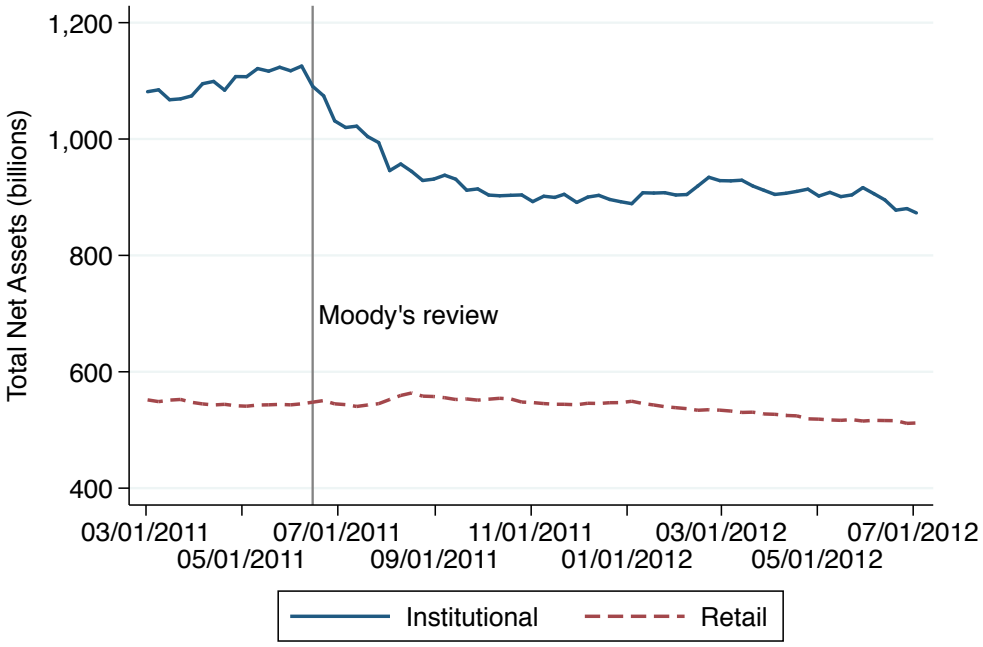
	Low Euro Share Funds			High Euro Share Funds		
	In-sample	Out-of-sample	Max	In-sample	Out-of-sample	Max
	(1)	(2)	(3)	(4)	(5)	(6)
Portfolio share$_{i,f}$	−0.070*	−0.088**	−0.087**	−0.091***	−0.104***	−0.100***
	(0.042)	(0.034)	(0.038)	(0.022)	(0.022)	(0.023)
Strong relationship$_{i,f}$	−0.176	−0.018	−0.100	0.060	0.040	0.062
	(0.128)	(0.082)	(0.085)	(0.105)	(0.064)	(0.061)
Issuer Euro share$_i$	0.010*	0.007*	0.009**	−0.002	0.002	−0.001
× Strong relationship$_{i,f}$	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)	(0.003)
Issuer Euro share$_i$	−0.000	−0.000	−0.001*	0.000	0.000	0.000
× Weak relationship$_{i,f}$	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.030***	0.023***	0.028***	0.007**	0.007**	0.006**
	(0.007)	(0.007)	(0.006)	(0.004)	(0.003)	(0.003)
Fund FE	+	+	+	+	+	+
N	20,470	20,470	20,470	20,240	20,240	20,240
Adjusted R^2	0.028	0.034	0.032	0.056	0.065	0.059

Table 9
Issuer Level Effects

In models 1–3, the dependent variable is $\Delta\overline{Outstanding_i}$, the percentage change in the issuer's average outstanding amount between the pre and post periods. In models 4–6, the dependent variable is $\Delta Outstanding\ CP_i$, the percentage change in the issuer's overall outstanding CP. In models 7–9, the dependent variable is $\Delta Cash\ Holdings_i$, the percentage change in the issuer's cash holdings. The sample consists of non-European ABCP, financial, and nonfinancial issuers in models 1–3 and of non-European nonfinancial issuers in models 4–9. In models 4–9, *Issuer Euro share* is the March 2011 value of *Issuer Euro share*$_i$ multiplied by money market funds' share of the issuer's outstanding CP, calculated as the ratio of $Outstanding_{i,t}$ to issuer's outstanding CP from Capital IQ. Dependent variables are winsorized at the 5th and 95th percentiles. Outstanding CP and cash holdings are from Capital IQ. Robust standard errors are reported.*, **, and *** indicate statistical significance at 10%, 5%, and 1%.

	$\Delta Outstanding_i$			$\Delta Outstanding\ CP_i$			$\Delta Cash\ Holdings_i$		
				$Q_2 - Q_1$	$Q_3 - Q_2$	$Q_3 - Q_1$	$Q_2 - Q_1$	$Q_3 - Q_2$	$Q_3 - Q_1$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Issuer Euro share$_i$	−2.520***	−2.165***	−2.024***	−1.364	−7.345**	−8.239***	0.040	−1.206*	−1.305*
	(0.659)	(0.664)	(0.704)	(4.438)	(3.188)	(2.975)	(0.589)	(0.622)	(0.739)
Yield$_i$			−37.432						
			(54.353)						
Constant	53.905***	47.730***	55.183***	16.449	28.126	28.477**	10.875**	9.067*	16.741**
	(14.132)	(13.599)	(17.477)	(12.295)	(17.207)	(13.934)	(5.214)	(5.239)	(7.314)
Issuer type FE	−	+	+	−	−	−	−	−	−
N	235	235	235	51	51	51	67	67	67
Adjusted R^2	0.081	0.081	0.080	−0.019	0.012	0.037	−0.015	0.004	−0.003

Figure 1
Total Net Assets of Prime Money Market Funds
Weekly data from the Investment Company Institute.



Appendix

Table AI
Variable Definitions

Adviser's MMF share$_f$	The fraction of prime money market funds in the fund adviser's total assets under management. *Adviser's prime money market fund assets* are the sum of TNA of all prime money market funds managed by the adviser. *Adviser's total assets under management* are the sum of TNA of all mutual funds in CRSP that are managed by the adviser. We manually match adviser names in N-MFP filings and CRSP. *Adviser's MMF share* is calculated as of March 2011.
Δ*Cash Holdings*$_{i,s\to t}$	Percentage change in cash and short-term investments between quarters s and t. Defined for nonfinancial issuers using Capital IQ data, and winsorized at the 5th and 95th percentiles.
$\Delta CP_{i,s\to t}$	Percentage change in outstanding Commercial Paper (CP) between quarters s and t. Defined for nonfinancial issuers using Capital IQ data, and winsorized at the 5th and 95th percentiles.
Fee waivers$_f$	The ratio of expense reimbursements to fund's TNA. Expense reimbursements are from item 72Y on the fund's N-SAR filing for 2010 fiscal year.
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*$_{f,pre} = T_{pre}^{-1} \sum_{t\in pre}$ *Fund Euro share*$_{f,t}$.
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%.

Table AI—*Continued*

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 is 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*$_{i,pre} = T_{pre}^{-1} \sum_{t \in pre}$ *Issuer Euro share*$_{i,t}$.
Net yield$_{f,t}$	The value-weighted average of the 7-day net yields on the fund's share classes.
$\Delta\overline{Outstanding_i}$	Percentage change in the average outstanding of issuer i between the pre and post periods. $\Delta\overline{Outstanding_i} = \frac{T_{post}^{-1} \sum_{t \in post} Outstanding_{i,t}}{T_{pre}^{-1} \sum_{t \in pre} Outstanding_{i,t}} - 1$. Winsorized at the 5th and 95th percentiles.
$\Delta\overline{Outstanding_{i,f}}$	Percentage change in the average exposure of fund f to issuer i between the pre and post periods. $\Delta\overline{Outstanding_{i,f}} = \frac{T_{post}^{-1} \sum_{t \in post} Outstanding_{i,f,t}}{T_{pre}^{-1} \sum_{t \in pre} Outstanding_{i,f,t}} -$ 1. Winsorized at the 5th and 95th percentiles.
Portfolio maturity$_{f,t}$	The fund's dollar-weighted average portfolio maturity.
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.
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.
Strong relationship (in-sample)$_{i,f}$	Binary variable equal to 1 whenever *Relationship strength (in sample)*$_{i,f}$ is greater than its median value for issuer i.
Strong relationship (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 N-Q and N-CSR filings made during this period.

Table AI—*Continued*

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).

Table AII
Identifying Spillovers to Non-European Issuers: Top 10 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 models 1–3, the dependent variable is $\Delta\overline{Outstanding}_{i,f}$, the relative 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 modells 4–6, the dependent variable, $Exit_{i,f}$, is equal to 1 if $\Delta\overline{Outstanding}_{i,f}$ is equal to -100%, and is equal to 0 otherwise. 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 funds filing form N-MFP during the March–August 2011 period, excluding a) funds that exclusively serve the internal cash management needs of their mutual fund family and b) variable annuities. The sample is limited to the 10 most commonly held issuers during the pre period. Issuer fixed effects are included in all specifications. Pre period is March–May 2011. Post period is June–August 2011. 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%.

	$\Delta\overline{Outstanding}_{i,f}$			$Exit_{i,f}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Portfolio share$_{i,f}$	-13.588^{***}	-13.580^{***}	-13.588^{***}	-0.021^{***}	-0.021^{***}	-0.021^{***}
	(1.833)	(1.839)	(1.832)	(0.004)	(0.004)	(0.004)
Fund Euro share$_f$	-0.093	-0.095		0.002	0.002^{*}	
	(0.256)	(0.254)		(0.001)	(0.001)	
Yield$_{i,f}$		0.070			-0.003^{***}	
		(0.229)			(0.001)	
Unsecured Euro share$_f$			-0.118			0.000
			(0.317)			(0.001)
Repo Euro share$_f$			-0.015			0.007^{***}
			(0.561)			(0.003)
Constant	50.976^{***}	49.154^{***}	51.018^{***}	0.069^{**}	0.136^{***}	0.072^{***}
	(6.863)	(9.363)	(6.865)	(0.027)	(0.033)	(0.027)
Issuer FE	+	+	+	+	+	+
N	1,133	1,133	1,133	1,133	1,133	1,133
Adjusted R^2	0.103	0.102	0.102	0.040	0.052	0.053

Table AIII
Identifying Spillovers to Non-European Issuers: Value-Weighted Results

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 models 1–3, the dependent variable is $\Delta\overline{Outstanding}_{i,f}$, the relative 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 modells 4–6, the dependent variable, $Exit_{i,f}$, is equal to 1 if $\Delta\overline{Outstanding}_{i,f}$ is equal to -100%, and is equal to 0 otherwise. 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 funds filing form N-MFP during the March–August 2011 period, excluding a) funds that exclusively serve the internal cash management needs of their mutual fund family and b) variable annuities. Issuer fixed effects are included in all specifications. Value-weighted regressions use average fund-issuer exposures during the pre period as weights. The 10 most commonly held issuers during the pre period are excluded. Pre period is March–May 2011. Post period is June–August 2011. 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%.

	$\Delta\overline{Outstanding}_{i,f}$			$Exit_{i,f}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Portfolio share$_{i,f}$	-6.153^{***}	-5.896^{***}	-6.386^{***}	-0.022^{***}	-0.024^{***}	-0.023^{***}
	(1.288)	(1.293)	(1.125)	(0.005)	(0.005)	(0.005)
Fund Euro share$_f$	-0.668^{***}	-0.662^{***}		0.003^{***}	0.003^{***}	
	(0.251)	(0.244)		(0.001)	(0.001)	
Yield$_{i,f}$		0.582^{**}			-0.005^{***}	
		(0.251)			(0.001)	
Unsecured Euro share$_f$			-0.734^{**}			0.003^{***}
			(0.285)			(0.001)
Repo Euro share$_f$			-0.184			0.005^{**}
			(0.676)			(0.002)
Constant	15.940^{***}	-1.081	15.950^{***}	0.042^{**}	0.175^{***}	0.042^{**}
	(4.969)	(8.785)	(4.849)	(0.019)	(0.046)	(0.019)
Issuer FE	+	+	+	+	+	+
N	3,837	3,837	3,837	3,837	3,837	3,837
Adjusted R^2	0.096	0.101	0.097	0.125	0.142	0.125

Table AIV
Relationships in Money Markets: Value-Weighted Results

Panel A reports the results of regressions of maturity and yield during the period on the existence of a strong fund-issuer relationship. $Maturity_{i,f}$ and $Yield_{i,f}$ are the average values during the pre period of the exposure of fund f to issuer i. Yield regressions in models 3–4 control for deciles of maturity. Panel B reports the results of regressions of changes in the exposure of fund f to issuer i on fund Euro share interacted with fund-issuer relationship strength. $\Delta\overline{Outstanding}_{i,f}$ is the relative change in the average exposure of fund f to issuer i between the pre and post periods. $Exit_{i,f}$ is a binary variable equal to 1 if $\Delta\overline{Outstanding}_{i,f}$ is equal to -100%, and equal to 0 otherwise. 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 funds filing form N-MFP during the March–August 2011 period, excluding a) funds that exclusively serve the internal cash management needs of their mutual fund family and b) variable annuities. Models 1–2 and 5–6 use the in-sample measure of relationship strength; models 3–4 and 7–8 use the out-of-sample measure of relationship strength. Issuer fixed effects are included in all specifications. Value-weighted regressions use average fund-issuer exposures during the pre period as weights. The 10 most commonly held issuers during the pre period are excluded. Pre period is March–May 2011. Post period is June–August 2011. Robust standard errors are reported. *, **, and *** indicate statistical significance at 10%, 5%, and 1%.

	(1)	(2)	(3)	(4)
Panel A: Maturity and Yield during the Pre Period				
	$Maturity_{i,f}$		$Yield_{i,f}$	
	In-Sample	Out-of-Sample	In-Sample	Out-of-Sample
Strong relationship$_{i,f}$	14.086***	13.594***	1.871***	0.288
	(3.704)	(3.490)	(0.552)	(0.463)
Constant	40.705***	43.459***	35.011***	36.566***
	(3.115)	(2.448)	(1.249)	(1.092)
Issuer FE	+	+	+	+
N	3,837	3,837	3,837	3,837
Adjusted R^2	0.555	0.557	0.707	0.703
Panel B: Changes in Exposure during the Post Period				
	$\Delta\overline{Outstanding}_{i,f}$		$Exit_{i,f}$	
	In-Sample	Out-of-Sample	In-Sample	Out-of-Sample
Portfolio share$_{i,f}$	−5.955***	−6.379***	−0.018***	−0.021***
	(1.118)	(1.031)	(0.005)	(0.005)
Strong relationship$_{i,f}$	−16.958	−10.669	−0.108**	−0.021
	(13.068)	(8.432)	(0.048)	(0.033)
Fund Euro share$_f$	−0.536***	−0.250	0.002***	0.002**
× Strong relationship$_{i,f}$	(0.207)	(0.219)	(0.001)	(0.001)
Fund Euro share$_f$	−1.282**	−1.209***	0.005**	0.005***
× Weak relationship$_{i,f}$	(0.498)	(0.317)	(0.002)	(0.001)
Constant	29.637**	21.499***	0.139***	0.066**
	(12.634)	(7.555)	(0.045)	(0.030)
Issuer FE	+	+	+	+
N	3,837	3,837	3,837	3,837
Adjusted R^2	0.097	0.107	0.195	0.146