The International Transmission of Money Market Fund Liquidity Shocks*

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Abstract

Do money market funds (MMFs) transmit liquidity shocks from overseas to North American firms? The eurozone banking crisis of 2011 provided an ideal test of that question, as concerns over the stability of European bank issuers contributed to outflows from U.S. MMFs. This paper develops an empirical framework for measuring a "lending channel" through MMFs. Results suggest that credit was available to North American firms; but demand for it weakened. Changes in financing during this period reflected U.S. corporations taking advantage of interest rate changes, rather than liquidity issues at MMFs. In fact, regressions indicate that MMFs most exposed to the eurozone tried to *increase* their purchases of North American debt as they reduced investments in Europe.

Key words: Money market funds; eurozone; lending channel; spillover; systemic risk.
JEL: G01, G18, G23, G28

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1 Introduction

Financial markets have become increasingly connected. While in many respects this is a positive development, one concern is that global financial links can put fundamentally sound economies at the mercy of a liquidity shock in a distant market. As a result, there is a growing interest in identifying and measuring the avenues through which a financial crisis originating abroad might be transmitted to a domestic economy. Several "bank lending channel" studies have identified international banks as one of those channels, finding that, for example, the 1998 Russian default impaired the ability of some international banks to lend to banks in Peru. This resulted in less financing available for Peruvian firms (Schnabl, 2012). It is conceivable that U.S. prime money market mutual funds (hereafter, "MMFs"), which have substantial foreign investments, act as another transmission vehicle.[1,2] Adapting methods from the bank lending literature to the short-term nature of money market financing, this chapter looks for robust evidence of a "money market fund lending channel" affecting North American companies during the eurozone crisis.

A negative credit shock can reduce the trading capacity of short-term markets.[3] Money market funds, banks, and other financial institutions faced extraordinary stresses in September 2008. Exposure to Lehman Brothers' debt and other troubled issuers prompted heavy outflows from MMFs (McCabe, 2010; Schmidt, Timmermann, and Wermers, 2014). Highly-rated, short-term securities suddenly became information-sensitive, raising adverse selection concerns and reducing liquidity. A flight-to-quality ensued. Investors shifted their short-term cash holdings into securities with lower information asymmetries, such as Treasury and agency securities. To meet these extraordinary redemptions, some prime MMFs sold portfolio securities before maturity to generate cash (Duygan-Bump et al., 2013). At the same time, a drop in lending by short-term market participants, including prime MMFs, contributed to a freezing of commercial paper markets, threatening the mechanism through which business make payrolls and finance their daily operations (Schapiro, 2012). In 2010, in an effort to improve the resiliency of MMFs to withstand severe market stresses, the Securities and Exchange Commission (SEC) adopted a number of wide-ranging reforms. These reforms enhanced portfolio disclosure rules, boosted MMFs' mandated liquidity, and further restricted maturities.

Despite the SEC's 2010 reforms, some regulators called for further regulatory changes. Proponents of further changes pointed to developments during the summer of 2011 (e.g., SEC, 2012; FSOC, 2012). At that time, concerns about eurozone banks heightened as financial and economic conditions deteriorated in the European periphery. Over June, July and August 2011, prime MMFs experienced outflows of $162 billion. Many argued that the size and timing

[1]Money market mutual funds (MMFs) are mutual funds that may only invest in short-term high quality money market instruments. With assets totaling $2.6 trillion, MMFs are an important investment and cash management vehicle for U.S. corporations and individuals. Moreover, they are an important component of the U.S. money market, holding 36 percent of commercial paper, 19 percent of repurchase agreements, and 53 percent of U.S. Treasury and agency securities as of March 2013.

[2]Prime MMFs are money market funds that invest in a range of money market securities, including commercial paper, bank CDs, medium-term and floating-rate notes, repurchase agreements (repos) and Treasury and agency securities. Government money market funds typically invest only in Treasury or agency securities or repos backed by Treasuries and agencies and therefore should be default-risk-free.

[3]For example, Dang, Gorton, and Holmström (2010) show that a negative shock that raises the value of information about a security's payout can generate adverse selection concerns, reducing trading and liquidity.

of these outflows indicated that MMF investors continued to react to, and perhaps exacerbate, stresses in the financial markets. For example, Chernenko and Sunderam (2014) argue that these redemptions were prompted by investors' concerns about the exposure of prime funds, through their investments in European banks, to the deteriorating eurozone financial conditions. More importantly, they argue that eurozone distress "spilled over" into the money markets as investors redeemed from prime MMFs, in turn, causing these funds to reduce their investments in creditworthy issuers outside of Europe. In other words, these authors argue that creditworthy issuers became "collateral damage" from eurozone events. Similarly, a New York Federal Reserve paper (McCabe, Cipriani, Holscher, and Martin, 2012) contends that eurozone-motivated redemptions from prime MMFs may have damaged the U.S. economy: "sizable redemptions from [prime] funds motivated by concerns about their exposures to European banks caused reductions in the availability of short-term funding for U.S. nonfinancial firms." Other regulators and academics have expressed similar concerns (e.g., Hanson et al., 2013; Duygan-Bump et al., 2013; Ennis, 2012; Scharfstein, 2012; Siritto, 2013).[4]

This narrative has influenced policy. In July 2014, the SEC, acknowledging eurozone developments and other factors, adopted additional reforms. In the final rule, the SEC writes: "Although money market funds' experiences differed in 2008 and in the Eurozone crisis, the heavy redemptions money market funds experienced in both periods appear to have negatively affected the markets for short-term financing in similar ways." (SEC, 2014).[5] Thus, the view seems to have solidified that MMFs acted as a kind of transmission channel through which events in the eurozone adversely affected issuers outside of Europe.

This narrative, however, faces potentially important challenges. Most fundamentally, it faces a challenge of timing. A number of factors, not just the eurozone crisis, influenced investors' decisions to redeem from prime MMFs during the summer of 2011 (SEC, 2012; Collins and Gallagher, 2015).[6] Notably, in July to early August 2011, the U.S. faced the very real prospect that a legislative impasse on the federal debt ceiling could lead to a Treasury to default, which even if only temporary or "technical" could have had unknown and far-reaching consequences. Media reports indicate this may have created outflows among MMFs in July to early August 2011 (Kell, 2011). According to Collins and Gallagher (2015), of the $162 billion flowing out of prime MMFs during the summer of 2011, less than half can be linked to investors' concerns about individual funds' exposures to eurozone banks. Eurozone-related outflow occurred almost entirely in the second half of June 2011. Meanwhile, much of the

[4]For example, Siritto (2013) states that "in 2011, the heavy exposures of MMFs to European financial institutions put the MMF industry at risk of transmitting distress from Europe to the U.S. short-term funding market and the outflows from the MMF industry worsened the situation of the Eurozone banks." Ennis (2012) argues that MMFs' "resiliency was questioned again in 2011 during the European sovereign crisis...Currently, a generalized concern exists that the instability of money funds may have systemic consequence."

[5]The July 2014 rules require institutional money market funds to adopt a floating net asset value. Additionally, non-government money market fund boards can impose liquidity fees and gates (a temporary suspension of redemptions) when a fund's "weekly liquid assets" falls below 30 percent of its total assets (the regulatory minimum). The final rules also include additional diversification, disclosure, and stress testing requirements, as well as updated reporting by MMFs. These rules come with a two-year transition period, requiring full implementation in 2016.

[6]This fact is not considered in Chernenko and Sunderam (2014), which treats the summer (June-August 2011) as a monolith in which outflows arose because of investors' concerns about eurozone banks.

remaining portion reflected investors' concerns about the U.S. federal debt ceiling crisis.[7]

Nuance in the factors driving outflow from MMFs complicates the identification of a lending channel. As is often noted in the bank lending literature (e.g., Chava and Purnanandam, 2011; Schnabl, 2012), a particular kind of setting is necessary to identify a vehicle through which a foreign-born liquidity shock enters a domestic market and has real effects. First and foremost, the researcher must find a setting in which multiple financial institutions – in this case, prime MMFs – have varying degrees of exposure to the liquidity shock – in this case, the eurozone crisis. Such a setting is needed to separate the influence of the eurozone crisis from other factors affecting a fund's supply of financing. Therefore, when measuring an international transmission channel, one must ensure that any liquidity shock is actually driven by the overseas crisis and not by domestic events. In our setting, these two factors are difficult to disentangle. This is because funds with greater allocations to international banks tend to be larger funds with more institutional investors – the very same types of funds that had heavier outflows during the U.S. debt ceiling impasse (Collins and Gallagher, 2014). Therefore, these two shocks (eurozone and debt ceiling) will be correlated at the fund-level. Although we can differentiate among funds based on eurozone bank exposure, it is not so easy to differentiate among funds based on exposure to a U.S. Treasury default. Clearly, any U.S. default could affect MMFs holding defaulted securities. More broadly, however, it is possible that a Treasury default would trigger a downgrade of U.S. Treasury debt, in turn, leading to a downgrade of U.S. banks whose securities MMFs hold. Thus, concerned investors may have redeemed from prime funds due to exposure to any number of security types.

To overcome this problem, this paper focuses on the change in lending patterns from May 31 to June 30 of 2011. This approach is reasonable because outflows motivated by individual funds' eurozone bank exposures were heavily concentrated in the second-half of June (SEC, 2012; Collins and Gallagher, 2015). Thus, given funds' need to meet redemptions on demand and the fact that roughly 50 percent of the average fund's portfolio matures within a month, any retraction in lending caused by eurozone-related liquidity stress should be evident by the end of June. Furthermore, this retraction should be largely independent of the U.S. debt ceiling crisis, which occurred several weeks later (i.e., June 25-August 1, 2011).

Another necessary condition to identify a transmission channel, it that supply-driven and demand-driven changes in lending relationships are differentiated. This is important since the same event generating the liquidity shock could also reduce firms' demands for financing. For example, funds with greater eurozone bank investments may also tend to invest in U.S. firms with closer export ties to the eurozone. Alternatively, eurozone-exposed funds might tend to invest in U.S. firms that have better borrowing prospects. If large funds can more efficiently research credits and, therefore, invest more in overseas banks, these same funds might also concentrate their U.S. holdings in firms that offer the best risk-reward tradeoff. During an overseas crisis, as U.S. bond markets become comparatively more attractive, these

[7] Although it is not dicussed in this paper, FDIC insurance was another potentially important factor. As global financial market conditions deteriorated in 2011, the FDIC was offering unlimited deposit insurance on non-interest bearing checking accounts. Media reports indicate that certain large banks were receiving a flood of new money into deposit accounts (Rieker, 2011). Absent this factor, the eurozone crisis may have encouraged fewer investors to shift assets from prime MMFs to bank deposits. This has policy implications.

firms may subsequently receive better financing offers and reduce their more costly financing ties. I address endogeneity challenges in two steps.

First, I use micro (issuer-fund relationship level) data to evaluate whether, within a given issuer, funds with greater exposure to the shock reduce their investment more than do other funds. This technique is not new. It was pioneered by Gan (2007) and Khwaja and Mian (2008) in the bank lending literature and also used by Chernenko and Sunderam (2014) to study MMFs. In this specification, an issuer's generalized credit demand for prime MMF financing is absorbed in the fixed effect, helping isolate supply-driven changes so that changes in financing can be tied to the liquidity shock, revealing the existence of (or lack of) a lending channel.

Second, unlike prior research on MMFs, I use the same micro dataset to identify shifts in credit *demand*. Holding fixed the fund, I ask whether issuers grow their financing more when the cost of that financing (i.e., the yield) is below the issuer's average. If the issuer's less expensive relationships grow and its more expensive relationships shrink, this would signal that changes in lending relationships were, at least partly, demand-driven. This is important because long-term interest rates fell markedly over 2011, encouraging companies to restructure their debt and reducing demand for uncompetitive short-term loans.

Critically, I adapt these regression specifications to the short-term nature of financing relationships between issuers and MMFs. I find that results depend heavily on how one measures *changes in financing relationships* (i.e., the dependent variable). Prior lending channel studies evaluate logged or percentage changes.[8] This is problematic in our setting. Issuer-fund relationships are often valued at zero dollars one month and several million dollars the next. Therefore, a variable measured in percentage changes will capture relationships that close but not those that open (due to division by zero). If funds with greater eurozone bank exposure are simply more likely to shift their financing from one domestic issuer to another over the period, which I show is indeed the case, this specification could result in selection bias. For this reason, among others, I use an alternative dependent variable detailed in Section 2.3.

Finally, the bank lending literature also states that, to identify a transmission channel, firm-level outcomes must be observed to determine whether firms offset interruptions in their supplies of financing. In much of the bank lending channel literature, researchers aggregate all of a firm's outstanding loans (e.g., Khwaja and Mian, 2008). If frictions in bank lending relationships exist, substitution should be more difficult. This is evidenced by a negative relationship between changes in a firm's aggregated loans and the average exposure of its banks to the shock. As numerous authors have noted, however, aggregated analysis is plagued with the problem of identifying shifts in credit supply from shifts in credit demand (e.g., Oliner and Rudebusch, 1995). In particular, this specification does not take into account reductions in an issuer's *demand* for financing, which could be correlated with the average exposure of its funds to the shock.

Thus, a more compelling specification would ask whether an issuer's aggregate prime MMF financing changes relative to its total short-term borrowing. If one assumes that there is nothing unique about MMF financing compared to other forms of short-term borrowing, the

[8]See, for example, Gan, 2007; Chava and Purnanandam, 2011; Schnabl, 2012; Khwaja and Mian, 2008. Chernenko and Sunderam (2014) import this technique, studying percentage changes in issuer-fund financing relationships after the shock.

intuition is straightforward: a shock to an issuer's demand for short-term financing should affect all credit providers equally. If an issuer experiences a decline in its total MMF financing that is disproportionately larger than that of its total short-term borrowing, this would signal that MMFs offered less financing to this issuer (i.e., a supply-driven reduction in financing). This is an idea first explored by Kashyap, Stein, and Wilcox (1993) when attempting to control for aggregate demand for bank loans following a monetary policy change.[9] To my knowledge, this paper is the first to apply Kashyap, Stein, and Wilcox's method to firm-level data to identify a lending channel.

Broadly speaking, this study attempts to provide a framework for evaluating movements in short-term funding arrangements between issuers and MMFs. Similar to an earlier study Chernenko and Sunderam (2014), I apply this framework to the portfolio choice of prime MMF managers during the eurozone crisis, investigating whether eurozone-related liquidity shocks at MMFs reduced the credit supply available to companies outside of Europe. However, unlike prior research, I also evaluate several demand-side factors, including an issuer's preference for the financing terms offered by particular MMFs or by longer-term creditors. In sum, my methods differ from prior research in three ways: (1) I respecify the models typically used in bank lending channel models. My simple but novel specifications are designed to better manage the fluctuating nature of issuer-MMF relationships and are less likely to be biased by changes in issuers' preferences for short-term, versus long-term, borrowing. (2) I run a number of robustness checks, including placebo regressions, to ensure my conclusions are not driven by seasonal influences. Furthermore, I confirm that my conclusions are consistent with observed changes in yields (i.e., prices) on issuer-fund financing relationships. (3) I restrict the period examined to keep results independent from the U.S. debt ceiling impasse and I only evaluate the financing outcomes of North American firms (rather than to all non-European firms). These restrictions allows me to more directly address the concerns of the U.S. regulators motivating this study (i.e., McCabe et al., 2012; Siritto, 2013).

My results provide little support for a "money market fund lending channel" during the eurozone crisis of 2011. I begin at a high-level, studying aggregate changes in MMF financing of issuers by region. I observe no aggregate declines in financing relationships between North American issuers and MMFs in June 2011, the period of interest, and, at best, very small declines in July 2011 (during the U.S. debt ceiling crisis). Instead, funds appear to have met redemptions by reducing their investments in European firms. In fact, prime MMFs reduced their investments in European companies by about $100 billion in June, which is more than their total outflows that month ($86 billion). I do find that nonfinancial domestic issuers financed by MMFs with greater eurozone exposure experienced reductions in their outstanding MMF financing over the period. However, these issuers also experienced similar reductions in their borrowing from other (non-MMF) short-term financing providers. At the same time, they significantly increased their long-term borrowing. This indicates that at least part of the decline may have been driven by a shift in credit demand toward longer-term financing. Analyst reports from this time period corroborate this interpretation, citing evidence that companies

[9] Kashyap et al. (1993) find that bank loans outstanding decline relative to commercial paper after a monetary contraction, signaling a bank lending channel.

were taking advantage of sharply declining long-term interest rates.

This interpretation is further validated by declines in average yields on issuer-MMF relationships. Assuming standard supply and demand curves, a retraction in the supply of financing available to issuers should push up yields (i.e., the price of financing), all else equal. Instead, the opposite occurs. The average yield on domestic firms' debt held by MMFs with top quartile eurozone bank exposure fell significantly in June, by 3.6 basis points, on average. This, again, indicates that issuers were substituting to cheaper financing sources.

Next, I turn to micro-level data and ask whether, funds with greater eurozone bank exposure reduced their holdings of a given issuer more than less exposed funds. I find no evidence of this. Instead, micro-level results lend support to the view that declines in financing relationships were predominately demand-driven. When a financing relationship cost the issuer relatively more (i.e., a higher yield than average), this relationship was more likely reduced. I ensure that results are not driven by a retreat by funds from riskier North American credits. In particular, nonfinancial firms appear to have been reducing their more expensive financing relationships and taking advantage of refinancing opportunities. Coincidentally, declines in MMF financing came disproportionately from their higher-cost relationships with eurozone-exposed funds.

Finally, I find no evidence that firms had difficulty substituting financing across MMFs during the eurozone crisis. Aggregating all of a firm's borrowing from MMFs, there is no indication that being financed by MMFs with greater eurozone bank exposure entailed a decline in outstanding loans from MMFs relative to other short-term credit providers. Instead, certain issuers appear to have demanded less financing from MMFs. Specifically, companies that used MMFs for a larger portion of their total borrowing and paid higher yields to MMFs were more likely to reduce their total MMF borrowing relative to other short-term borrowing. This finding casts doubt on the theory of financing frictions in short-term markets.

As a whole, these results challenge the current narrative that MMFs transmitted distress from the eurozone to domestic commercial paper markets. To the contrary, I find that funds with greater eurozone exposure tried to grow their investments in U.S. and Canadian nonfinacial firms' during this period – perhaps because these companies were relatively insulated from the eurozone crisis. I conclude that reductions in some firms' borrowing from MMFs were predominately caused by shifts in credit demand. These results deserve meaningful consideration in narratives of money market funds and financial stability.

The balance of the paper is structured as follows. Section 2 summarizes the data and gives a narrative description of events over the summer of 2011. Section 3 presents nonparametric results. Section 4 develops the main empirical framework and presents the results. Section 5 studies frictions in an issuer's ability to substitute financing. Section 6 concludes.

2 Data, Period, and Variables

In three parts, this section describes the data, the period of interest, and the key variables used to evaluate whether MMFs transmitted distress from the eurozone to North American firms.

2.1 Data

To evaluate changes in issuer-fund lending relationships during the eurozone crisis, one needs a dataset detailing each fund's investments in individual issuers. The eurozone crisis of 2011 occurred just after monthly MMF portfolio holdings data became available through Securities and Exchange Commission (SEC) Form N-MFP (introduced in November 2010). Using this detailed dataset, we can calculate each prime fund's exposure to eurozone banks. We can also attempt to separate supply from demand influences. Finally, we can evaluate whether issuers are able to substitute to other funds and, using a linked dataset of balance sheet information, compare issuers' capital structure, profitability, and investment outcomes. In sum, the confluence of a foreign-born crisis and newly available monthly holdings data makes possible the identification of a MMF lending channel.

In particular, I use monthly data collected from SEC Form N-MFP to construct datasets of the portfolio holdings of prime MMFs during 2011. Form N-MFP collects from all MMFs a wide array of information, such as a fund's assets, gross yield, and the fund's individual portfolio holdings. With respect to each portfolio security, the fund must report the name of the issuer, details about the issue (such as whether it is asset-backed or has a guarantee or demand feature), and the security's final legal maturity. I aggregate and cut this data in a variety of ways depending on the question being answered.

I use two main datasets throughout this analysis. The first is a dataset of portfolio holdings aggregated to the issuer-fund relationship level. This consists of one row for each unique issuer a fund holds at each month-end throughout 2011. I use this dataset to assess whether funds with higher eurozone bank holdings grew their investments in issuers lewerwerss than did other funds. The second dataset consists of portfolio holdings aggregated to the issuer-level, so that each issuer financed by prime funds occupies one row per month. This dataset is primarily used to assess whether issuers were able to substitute financing from one MMF with financing from another. To study changes in a nonfincnaial issuer's capital structure over time, this issuer-level data is joined with quarterly balance sheet information from Bloomberg.

In forming my two main datasets (i.e., issuer-fund relationship data and issuer-level data), I aggregate a prime fund's securities to the level of the issuer's ultimate "parent" company. For example, Wachovia, Village Green Finance, and Variable Funding Capital Company are all "issuers" under the parent company Wells Fargo. I thus aggregate a prime fund's investments in these three issuers along with securities issued by Wells Fargo itself (e.g., commercial paper issued by Wells Fargo) under the parent company Wells Fargo. I then classify parent companies by country, where "country" is taken to be the domicile of the parent company's headquarters. For example, I designate Wells Fargo as a "U.S." company. I classify Deutsche Bank as a "German" company, even though Deutsche Bank has worldwide operations, including very significant operations in the U.S.. This classification allows us to measure a prime fund's "credit exposure" to a given country or region of the world (e.g., the eurozone).

When evaluating spillovers, I keep only U.S. and Canadian firms that issue debt to prime MMFs in the dataset.[10] This approach also differs from that of Chernenko and Sunderam (2014), who keep all non-European firms in their analysis. I do this to avoid diluting results by

[10] Supranational, government, municipal, and government agency issuers are also excluded from this analysis.

including lending changes affecting issuers in Japan, Australia, and New Zealand. In aggregate, these issuers grew their MMF financing during the second-half of 2011, perhaps as funds sought to insulate their portfolios from credit risk by shifting assets from European banks to Asia-Pacific banks (Collins and Gallagher, 2014). Furthermore, in the aftermath of the eurozone crisis, U.S. regulators primarily expressed concern that the eurozone crisis had real effects on U.S. issuers. I permit the inclusion of Canadian firms because of their strong ties with the U.S. domestic economy and their sizable investments from U.S. MMFs. However, there are only eight of these Canadian firms, seven of which are financial companies, and their inclusion does not statistically change my results.

Finally, I adjust my two main datasets in a number of ways. I exclude variable annuities and MMFs used primarily for a fund company's internal cash management purposes. I also exclude 13 funds that were liquidated during 2011 or that reflected obvious data entry errors on Form N-MFP. I also remove a large number of issuers that primarily issue variable rate demand notes (VRDNs).[11] This leaves us with 191 prime money market funds investing in 217 U.S. and Canadian firms as of May-June 2011.[12] Due to data entry errors affecting particular security details, I am unable to obtain certain variables for all issuers. For example, yield is occasionally omitted from the security's title on Form N-MFP or recorded with obvious error.[13] When an issuer's outstanding securities have missing values for all yields, I omit the issuer. It is for this reason, that sample size changes slightly depending on the variables employed.

2.2 Period

Throughout this analysis, I focus on lending changes from the end of May to the end of June 2011 to avoid overlap with the U.S. debt ceiling crisis. This approach differs from Chernenko and Sunderam (2014), who average together lending relationships over the spring (March, April, and May) and over the summer (June, July, and August) of 2011, separately, and compare changes in lending between these two periods. A reasonable criticism of my approach is that focusing on one month might be too restrictive to assess whether fund liquidity shocks spilled over to issuers. However, I believe my approach is appropriate for three reasons: First, funds service resumptions on demand, meaning that liquidity stress should translate into spillovers immediately. Second, unlike most bank lending, a substantial portion (roughly 50 percent) of the average fund's debt holdings mature within a month. This means that each

[11] Companies issue VRDNs through a municipality, typically as part of a public works or economic development project. These issues must follow strict tax rules; as such they are issued for certain dollar amounts and must be used for certain projects. These issues are often designed to finance a specific one-off project, although some are much longer-term (i.e., a utility finances the purchase of pollution control equipment). Given their tax-status and the fact that they come with letters of credit from banks, VRDNs are highly sought after by MMFs. Additionally, these are often private placement bonds issued to just one or two select funds but capable of being sold between funds. As a result, these financing relationships likely operate under different economies than those typical to short-term financing offered by MMFs.

[12] I obtain fund net new cash flow data from the Investment Company Institute (ICI) and merge it with the funds in N-MFP data using a merge key also provided by the ICI. Thus, a firm must be a 1933 and 1940 Act-registered to remain in the dataset.

[13] Security yields are reported on Form N-MFP as of the date of purchase; therefore, value-weighted average yields on issuer-fund relationships will only change over time when securities are issued or sold, or when old securities mature and are either rolled-over or not. This happens frequently enough that the yield measures used in this paper should be representative of market yields, albeit imperfectly.

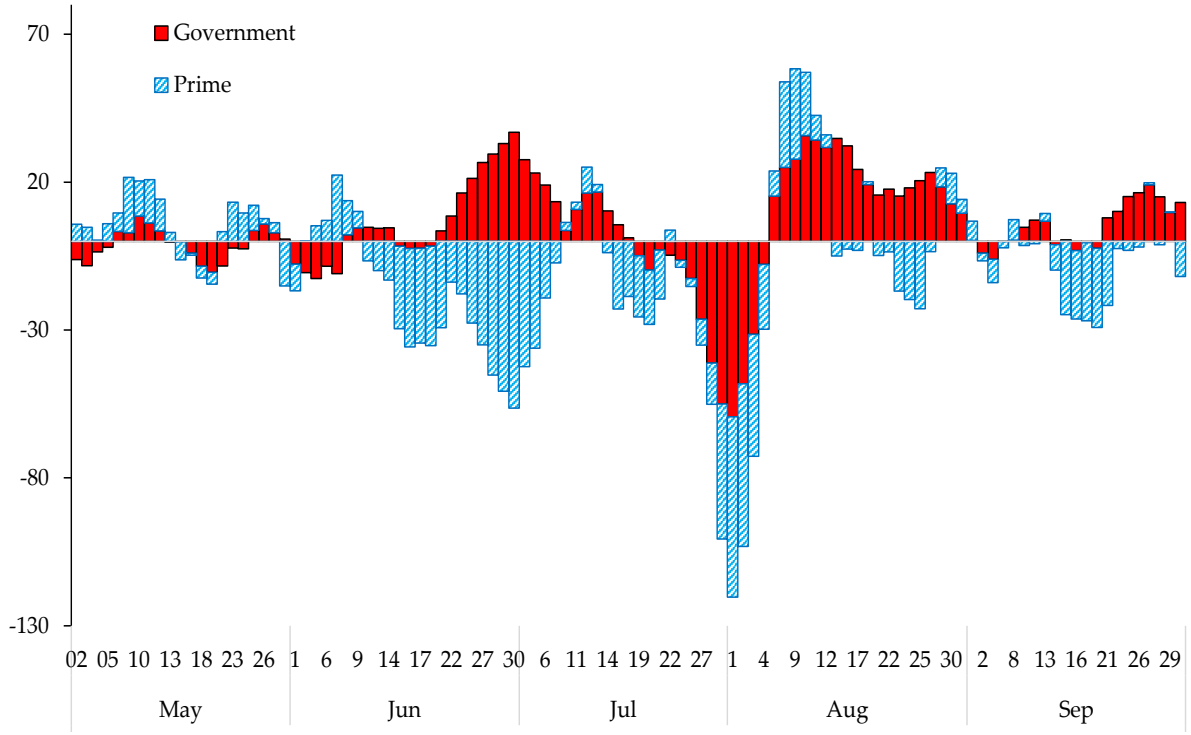
month, managers must decide whether to roll over, purchase, sell, and/or renegotiate yields on a large portion of their investments. These decisions will be reflected in month-over-month changes in the outstanding value of fund investments in issuers. Finally, and most importantly, there is compelling evidence that outflows from prime funds after June 2011 primarily reflected concerns about the federal debt ceiling crisis. In fact, Collins and Gallagher (2015) find that eurozone-related outflows from prime MMFs were heavily concentrated in June 2011, amounting to $69 billion, while outflows over the remainder of the summer were more likely driven by the U.S. debt ceiling crisis.

Evidence of this can be seen in Figure 1. This figure shows flows to prime MMFs during the summer of 2011 measured as a five-day moving sum (which helps smooth through noise in daily flows). For comparison, the figure also shows the 5-day moving sum of flows to government MMFs. As can be seen, prime funds experienced sizable outflows in the second half of July 2011. On July 15—the day after Standard and Poor's put the U.S. Treasury on credit watch and the same day that the Treasury began divesting the ESF—prime institutional funds experienced outflows of $20 billion, a level that is seasonally atypical. Cumulative outflows increased over the remainder of July 2011, peaking in the five-day period ending August 1. Of the $162 billion that flowed out of prime funds during June, July and August, 2011, nearly half ($72 billion) flowed out in the seven business days immediately before the debt ceiling impasse was resolved on August 2, 2011. The figure shows that in the days leading up to August 2, 2011, government MMFs, which have no unsecured eurozone bank exposure, also saw strong outflows. The fact that prime and government funds were experiencing significant outflows at exactly the same moment suggests that these outflows reflected debt ceiling developments rather than eurozone considerations. This view is bolstered by the fact that when Congress passed, and the President signed, legislation raising the debt ceiling on August 2, 2011, outflows from both prime and government MMFs immediately turned to inflows. At a minimum, this pattern indicates that the federal debt ceiling crisis was a very important factor motivating investors' redemptions during the summer of 2011. Unfortunately, the same types of funds (large institutional funds) that invest more abroad also were more likely to experience heavy outflows during the U.S. debt ceiling impasse. Therefore, it is difficult to fully disentangle spillovers caused by a fund's eurozone exposure from those caused by the federal debt ceiling crisis.

It is for these reasons I restrict my analysis to lending changes from May 31 to June 30, 2011. However, Appendix B shows results run over July 2011. These results are discussed breifly in Section 4.2.

Figure 1: Taxable MMF Flows

This is the 5-business day moving sum of the total daily change in assets for taxable MMFs, measured in billions of dollars, over May-September 2011.



Data source: Authors' tabulation of iMoneyNet data.

2.3 Key Variables

A fund's credit exposure to an issuer depends on more than just the issuer's name. For example, maturity matters. Market participants may consider two securities issued by the same issuer to have different credit risk if one has a shorter maturity than the other. Furthermore, market participants would assign different credit risks to two securities issued by the same company if one is collateralized and the other is not. Senior unsecured debt (i.e., commercial paper) of a particular firm likely has a different risk profile than a repurchase agreement ("repo") undertaken by an MMF with the same firm if the repo is fully collateralized by Treasury and agency securities. Collins and Gallagher (2015) find that not all types of eurozone bank exposure generated outflows from prime MMFs. During June 2011, they find a much stronger association between a fund's outflows and the portion of a fund's assets invested in uncollateralized, longer-dated eurozone bank securities. Chernenko and Sunderam (2014) observe something similar. Therefore, to ease identification of a transmission channel between the eurozone and domestic issuers, I focus on funds' "riskier" exposures. I define a fund's eurozone bank exposure (i.e., its exposure to the liquidity shock), $EURO_f$, as the percentage of a fund's assets invested in non-repo securities issued by eurozone banks and maturing in more that 5-business days.[14] Table 1 shows that the average fund had about 14.5 percent of assets in such investments as of the end of May 2011.

[14]My results hold when I instead define $EURO_f$ as a fund's exposure to to any security type or maturity issued by eurozone banks.

Table 1: Fund-level Summary Statistics

This table summarizes some key fund-level statistics. The first set of variables measure the dollar value of each fund's holdings of a particular type of issuer as a percentage of the fund's total assets as of the end of May 2011. $EURO_f$, is the key variable used to measure a eurozone-related supply shock in funds. It is a fund's holdings of eurozone bank securities (that are non-collateralized and maturing in over 1 week) as a percentage of the fund's assets as of the end of May 2011. "Net new cash flow" is a fund's net new cash flow over June as a percentage of the fund's the end of May assets.

Fund-level variables:	25th Pctl	Median	75th Pctl	Mean	Std. Dev.	N
Exposures:						
Asia-Pacific businesses	3.0	8.3	11.2	8.2	5.9	191
U.S. and Canadian businesses	14.9	21.7	32.6	25.1	15.3	191
Financial	12.3	17.0	24.7	19.8	12.4	191
Nonfinancial	0.0	1.8	5.2	5.4	9.5	191
European businesses	28.2	48.4	55.9	42.7	20.7	191
$EURO_f$	5.2	16.5	21.6	14.5	9.8	191
Net new cash flow	-6.1	-0.9	1.7	-2.9	8.4	191

Unlike long-term bank financing, relationships between issuers and MMFs fluctuate considerably in value from one month to the next. Table 2 shows a real example of this from the issuer-fund relationship dataset. I aggregate each security issued by Bemis Company that was held by prime funds from March through August 2011. I refer to this value as $M_{i,f}$ – this is the aggregate dollar value of all of fund f's investments in issuer i at a given time. I also calculate the May-to-June percentage change in those relationships. I refer to this percentage change value as $\%\triangle M_{i,f}$. Much of the lending channel literature examines log or percentage changes in firm-bank relationships.

It is difficult to convincingly assess spillovers using such a measure. First, when studying percentage changes, all relationships that close are given a value of -100%. Meanwhile relationships that open result in infinite percentage change values (due to division by zero) and, therefore, have missing values in the dataset. In this case, fund "E", has an infinite (therefore, missing) value. Ironically, fund "E", which opened a relatively large relationship with Bemis in June, also had the highest eurozone bank exposure of the funds financing Bemis ($EURO_{f="E"} = 29.8\%$), anecdotally undercutting the hypothesis that funds with greater eurozone bank exposure were forced to reduce lending to domestic issuers. This irony is discarded from regression results when studying percentage changes. In fact, this division by zero problem causes the exclusion of over 16 percent of issuer-fund relationships over the May to June 2011 period.

Second, studying percentage changes in issuer-fund relationships gives no indication of the relative importance of these relationships from the perspective of the issuer. For example, Bemis' relationship with fund "D" was valued at only $1 million in June. Comparatively, a retraction in lending from "B," worth $19 million, is much more likely to force Bemis to seek substitute financing or reduce its capital expenditures. Yet, this economic difference in Bemis' relationship value with fund "D" versus fund "B" is not reflected in percentage changes (i.e., $\%\triangle M_{i,f} = -100\%$).

Table 2: Issuer-Fund Dataset Example

This table is intended to highlight the problems with studying issuer-fund relationship outcomes using percentage changes. These are real observations from the issuer-fund relationship and issuer-level datasets. The fund names are anonymous for brevity. $EURO_f$ is the percentage of fund f's assets invested in eurozone banks as of the end of May 2011. $M_{i,f}$ is the dollar value of fund f's investments in issuer i at the end of the corresponding month. $\%\triangle M_{i,f}$ is the percentage change in fund f's investments in issuer i from the end of May to the end of June. $\%\triangle M_{i,f}$ is the key dependent variable used in prior research. $REL\triangle M_{i,f}$ is the main dependent variable. It is the change in fund f's investments in issuer i from the end of May to the end of June as a percentage of issuer i's total prime outstanding debt to prime MMFs as of the end of May ($M_i = \$25.3\,million$). Thus, $M_i = \sum_{f="E"}^{"A"} \left[M_{i,f}\right]$. Finally, $\bar{EURO}_i$ is the value-weighted average eurozone bank exposure of the funds financing the issuer in May, such that $\bar{EURO}_i = \sum_f \left[\frac{M_{i,f}}{M_i} \times EURO_f\right]$.

Corresponding time period:		*May*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*May to Jun*	*May to Jun*
Issuer-Fund Relationship Data										
Issuer i	Fund f	$EURO_f$	$M_{i,f}$ ($ millions)						$\%\triangle M_{i,f}$	$REL\triangle M_{i,f}$
Bemis Company, Inc.	A	27.8	0.0	0.0	0.0	0.0	0.0	2.0	.	.
	B	27.1	0.0	16.0	19.1	0.0	25.0	10.7	-100%	-75.5
	C	2.7	3.5	0.0	5.2	0.0	0.0	0.0	-100%	-20.6
	D	2.8	0.0	0.0	1.0	0.0	0.0	0.0	-100%	-4.0
	E	29.8	0.0	20.6	0.0	45.0	19.0	25.9	∞	177.9
Issuer-level Data										
Issuer i	All Funds	$\bar{EURO}_i$	M_i ($ millions)							
Bemis Company, Inc.	A through E	21.2	3.5	36.6	25.3	45.0	44.0	38.7		

This example demonstrates the need to develop a dependent variable specification that is well adapted to the money markets. To do this, I perform a simple transformation and call the new variable $REL\triangle M_{i,f}$. It is calculated as the May to June change in the value of fund f's investments in issuer i ($\triangle M_{i,f}$) expressed as a percentage of issuer i's total prime MMF financing as of the end of May (M_i). Thus, $REL\triangle M_{i,f,t} = \frac{\triangle M_{i,f,t}}{M_{i,t-1}}$. This measure both reduces missing observations and better captures the economic value of relationship changes. Now, as long as an issuer is financed by at least one fund in May (i.e., $M_i > 0$ in May), there will be a non-missing value for $REL\triangle M_{i,f}$ in June. As a result, I omit just a little over 1 percent of issuer-fund relationships due to division by zero (versus over 16 percent when using $\%\triangle M_{i,f}$). Also, if a financing relationship is reduced to zero, $REL\triangle M_{i,f}$ will be negative, but it will only be large (in absolutes) if that relationship represented a large portion of issuer i's recent financing needs.[15]

These and additional variables are defined in detail in Appendix A.

3 Nonparametric Results

In aggregate there is, at best, weak evidence that issuers outside of Europe lost access to MMF financing after May 2011. Figure 2 plots log changes (LHS) and dollar changes (RHS) in prime MMFs' investments in issuers by region. These changes are calculated relative to the end of May 2011, just before investors withdrew from MMFs due to eurozone concerns in June. The top panel (a) includes all prime MMFs in this calcualtion. The bottom panel (b) includes only those prime MMFs with top quartile eurozone bank exposures as of the end of May. The most obvious feature of these graphs is that funds dramatically reduced their holdings of European issuers after May. In fact, from May to June, sample prime MMFs reduced their investments in European companies by about $100 billion, which is more than their total outflows during June ($86 billion) and considerably more than outflows attributable to eurozone exposure (an upper bound of $69 billion, as estimated by Collins and Gallagher, 2015). Interestingly, funds with top quartile eurozone exposure reduced their European holdings by about $65 billion in June (bottom right graph), almost exactly the estimated maximum amount of eurozone-related outflows from all funds.

Perhaps it is because funds were able to meet redemptions from their European assets that little changed for issuers headquartered in North America and Asia-Pacific. Aggregate investments in U.S. and Canadian issuers held steady in June, the month of interest. There is a retraction of about 10% in July among funds with heavy eurozone investments; however, as previously discussed in Section 2.2, we cannot discern whether this was related to the eurozone or to events in the U.S. domestic economy (e.g., the federal debt ceiling crisis), nor can we determine whether this was driven by a contraction in credit demand. Furthermore, by the end of July, U.S. and Canadian issuers had about as much prime MMF financing as they did six months earlier (end-January), signaling that this decline is not indicative of a credit freeze.

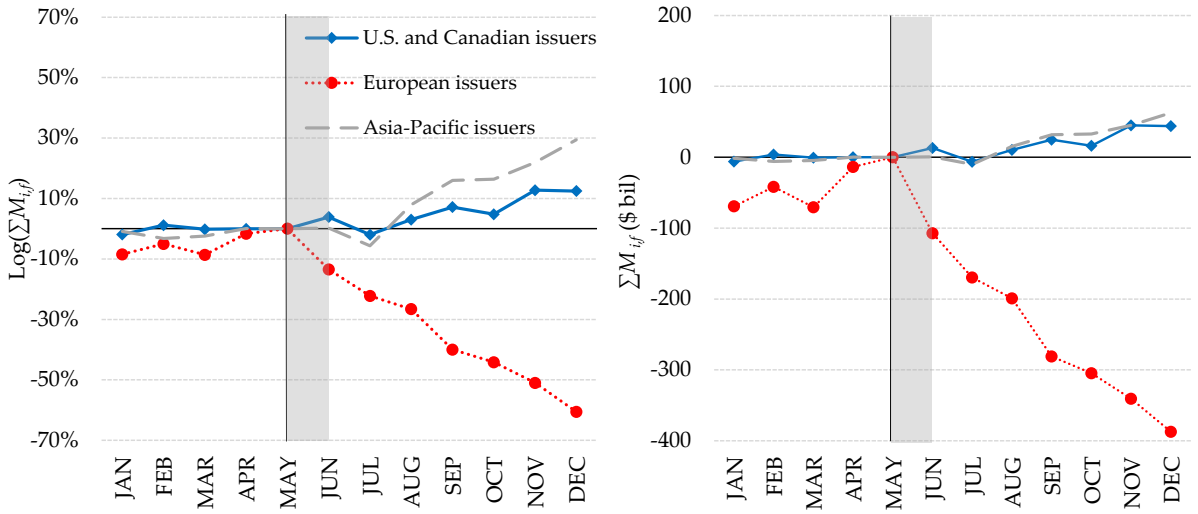
Nonetheless, it is possible that, in aggregate, little changed for U.S. and Canadian issuers

[15] In Table 2, this is observed by comparing the value of $REL\triangle M_{i,f}$ for Bemis' relationship with fund "D" (-4.0%) versus fund "B" (-75.5%).

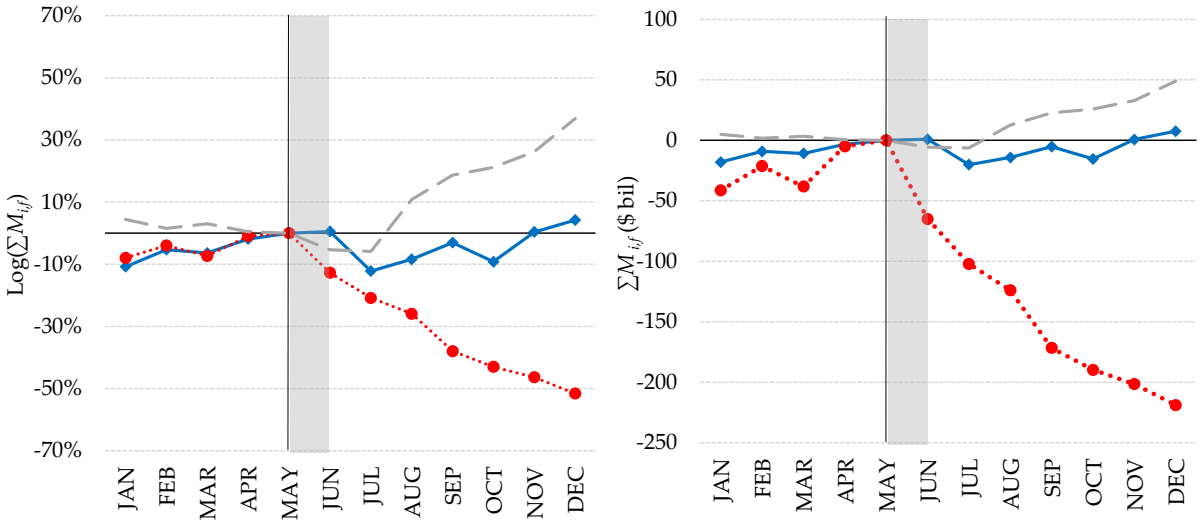
Figure 2: Changes in Aggregate MMF Investments in Firms, by Region, 2011

This figure plots the natural logarithm and the dollar value, respectively, of aggregated prime MMF investments in firms by region across 2011, monthly. I normalize the series to zero relative to May 31, 2011, the last observation before the eurozone crisis worsens in June. The change from May to June is emphasized because investors' eurozone-related redemptions from prime funds are concentrated in June. Figure 2a examines the investments of all sample prime MMFs. Figure 2b looks only at those funds with top quartile exposure to eurozone banks ($EURO_f$) as of May.

(a) Regional Investments of All MMFs



(b) Regional Investments of MMFs with Top Quartile $EURO_f$



because MMF investment merely shifted from one type of issuer to another, leaving those issuers that lost financing from eurozone-exposed funds unable to find substitutes.[16] To incorporate this kind of nuance, Figure 3 uses the issuer-level dataset (joined with quarterly balance sheet information) to study changes in issuers' capital structures from Q4 2010 through Q4 2012. Issuers are seperated based on their funds' average exposure to the shock ($E\bar{U}RO_i$). Changes are normalized relative to Q1 2011, the last quarter before the eurozone crisis worsens in June. To be conservative, these graphs depict only nonfinancial issuers, since these companies likely had fewer alternatives to MMFs for short-term financing. Financial companies, consisting mostly of banks, tend to grow their deposits during periods of market stress (Gatev and Strahan, 2006). The top left panel measures log changes in aggregate MMF investment in all U.S. and Canadian nonfinancial issuers (black line). The red dashed line depicts the same value for a subset of issuers that were financed by funds with greater eurozone bank exposure (i.e., top 25 issuers by $E\bar{U}RO_i$). There is direct evidence that issuers with greater indirect exposure to the shock experienced a reduction in MMF financing from Q1 to Q2 (-14%). On the surface, this indicates that domestic nonfinancial companies lost access to financing from eurozone-exposed MMFs and were unable to substitute to less exposed MMFs – making these firms "collateral damage" from the eurozone crisis.

The remaining three graphs cast doubt on this interpretation, however. For an MMF lending channel to exist, a substitution condition must hold. That is, firms cannot costlessly replace financing retractions from MMFs with other types of loans, such as other forms of short-term borrowing (e.g., from ultra short bond funds) or long-term borrowing (e.g., from banks). Therefore, if an MMF lending channel exists, we should find that short-term borrowing from non-MMFs either does not change or increases at a rate that is less than replacement (top right panel). Instead, there is a sharp decline in aggregate non-MMF short-term borrowing among the subset of issuers represented by the red-dashed line (-18% in Q2 2011). Also, this group of issuers markedly increases (+6% in Q2 2011) its long-term borrowing (bottom left panel). Meanwhile, the group's cash level remains roughly identical to that of the full sample of domestic nonfinancial issuers (bottom right panel).[17] These three graphs indicate that something compelled this group of issuers (those with more financing coming from eurozone-exposed MMFs) to reduce all types of short-term borrowing – not just the portion provided by MMFs – and to replace it with long-term borrowing.

Table 3 provides some indication of what might have encouraged this group of issuers to refinance. According to Panel B, the average yield ($Y\bar{IELD}_i$) on a nonfinancial issuer's securities was 21.9 basis points in May. However, among issuers financed by MMFs with greater eurozone bank exposure, $Y\bar{IELD}_i$ was 29.8 basis points. Meanwhile, this latter group of issuers tended to have more outstanding debt to MMFs and also issued securities at shorter maturities

[16] For example, in investigating a bank lending channel for monetary tightening, Oliner and Rudebusch (1995) argue that monetary contractions redirect credit from small firms to large firms.

[17] These observations are consistent with regression results presented in Chernenko and Sunderam (2014). In particular these authors show that firms with higher $E\bar{U}RO_i$ increased their long-term debt issuance in Q2, reduced their outstanding commercial paper, and experienced no significant change in their cash or capital expenditure levels compared to other firms. Unlike these authors, however, we also show an inverse relationship between $E\bar{U}RO_i$ and *non-MMF* short-term borrowing. This observation is difficult to reconcile with the theory that observed capital structure changes are driven by contractions in the amount of credit supplied by MMFs.

Figure 3: Changes in the Capital Structures of U.S. & Canadian Nonfinancial Issuers

This figure plots aggregated changes in the capital structures of U.S. and Canadian nonfinancial companies with debt held by prime MMFs, quarterly, from Q4 2010 through Q4 2012. I study the natural logarithms of sample issuers' total borrowing from prime MMFs, $Log\left(\sum M_{i,f}\right)$, total short-term borrowing excluding the portion coming from prime MMFs, $Log\left(\sum Other\ STB_i\right)$, total long-term borrowing, $Log\left(\sum LTB_i\right)$, and total cash and cash equivalents, $Log\left(\sum CASH_i\right)$. I normalize the series to zero relative to Q1 2011, the last observation before the eurozone crisis worsens in June. The change from Q1 to Q2 of 2011 is emphasized since investors' eurozone-related redemptions from prime funds are concentrated in June 2011. The black line represents all U.S. and Canadian nonfinancial businesses that issue to prime MMFs. The red line represents a subsample of the 25 issuers most heavily financed by prime MMFs with greater eurozone bank exposure as of May 2011 (i.e., the 25 issuers with the highest $\bar{EURO}_i$). I exclude General Electric due to their large capital restructuring program during this period and its extreme influence over the aggregate. Patterns are similar when calculated as mean or median changes in variable-to-asset ratios, although they are noisier.

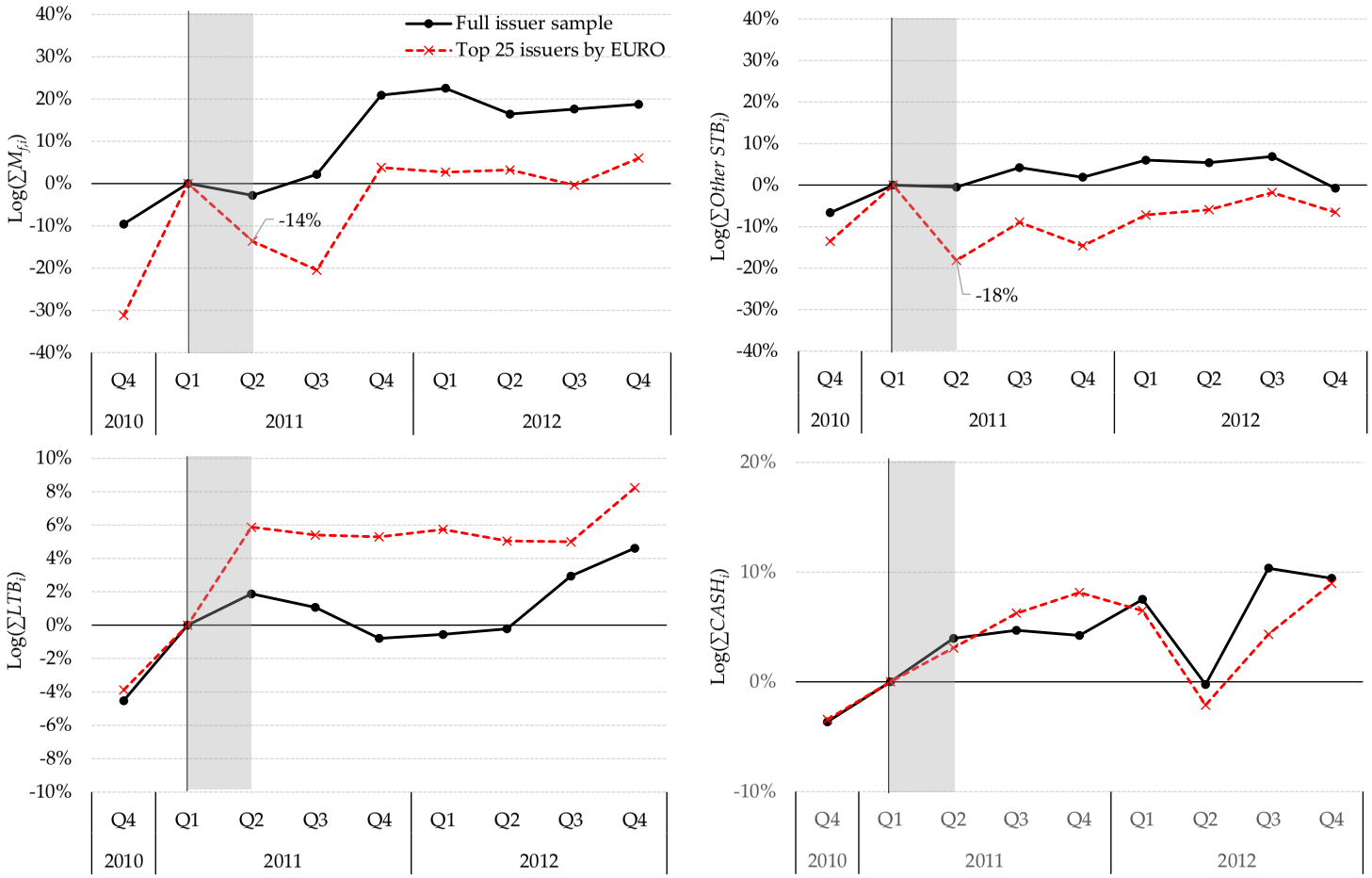


Table 3: Issuer-level Summary Statistics

This table summarizes some key issuer-level statistics and permits two comparisons of those statistics. The first comparison is May vs. June of 2011. The second comparison is all sample issuers vs. only those issuers predominately financed by funds with heavy eurozone bank exposures as of the end of May (i.e., top 25 issuers sorted by $\bar{EURO}_i$) . Panel A displays statistics for U.S./Canadian financial issuers and Panel B displays statistics for U.S./Canadian nonfinancial issuers. I show the simple mean, standard deviation, and number of observations. The variables studied include: M_i, an issuer's total outstanding debt held by prime MMFs; $\bar{YIELD}_i$, the value-weighted average yield on each of the issuer's securities held by prime funds; and $\bar{MATURITY}_i$, the value-weighted average days until the final legal maturity on the issuer's securities. I exclude General Electric due to its large capital restructuring program during this period and its extreme influence over the asset-weighted variables and averages. All variables are defined in more detail in Appendix A.

	All issuers			Top 25 Issuers by $\bar{EURO}_i$	
Issuer variables:	Mean	St.dev.	N	Mean	St.dev.
Panel A: U.S. & Canadian Financial issuers					
M_i ($ mil, May 2011)	2,368.9	7,800.7	124	10,966.8	14,765.9
M_i ($ mil, Jun 2011)	2,733.3	8,450.1	113	11,269.9	15,339.1
$\bar{YIELD}_i$ (bps, May 2011)	45.3	24.6	93	26.2	10.0
$\bar{YIELD}_i$ (bps, Jun 2011)	43.8	24.1	103	24.2	10.0
$\bar{MATURITY}_i$(days, May 2011)	103.0	108.2	104	77.4	87.5
$\bar{MATURITY}_i$(days, Jun 2011)	106.3	114.2	111	79.6	85.3
Panel B: U.S. & Canadian Nonfinancial issuers					
M_i ($ mil, May 2011)	215.5	485.0	82	301.1	626.7
M_i ($ mil, Jun 2011)	201.8	459.4	93	275.6	665.7
$\bar{YIELD}_i$ (bps, May 2011)	21.9	12.5	73	29.8	10.4
$\bar{YIELD}_i$ (bps, Jun 2011)	19.4	12.1	71	27.1	9.8
$\bar{MATURITY}_i$(days, May 2011)	57.8	87.6	82	38.1	67.5
$\bar{MATURITY}_i$(days, Jun 2011)	65.5	91.8	81	50.1	66.0

(38 days versus 58 days).[18] In sum, eurozone-exposed funds tended to invest in nonfinancial companies with relatively greater incentives to refinance. This result is echoed by issuer-fund relationship data in Table 4. Relationships with the least exposed funds yielded 17 basis points, while those with the most exposed funds yielded 28 basis points, on average.

Analyst reports from the time corroborate this interpretation. From April to August 2011, the BofA Merrill Lynch U.S. Corporate AAA Effective Yield had fallen by about one-third (Figure 4). The *Wall Street Journal* reported that around this time in 2011 a "parade" of companies issued bonds as long-term interest rates fell to very low levels (WSJ, 2011). This comment can be traced to individual issuers in our dataset that reduced their borrowing from MMFs with higher eurozone exposure during the summer of 2011. For example, Devon Energy Corporation is among the top 25 nonfinancial issuers with heavy investment from eurozone-exposed funds. On July 5, 2011, Devon completed a successful issuance of $2.3 billion of long-term bonds. Consequently, that same month Devon elected to reduce its supply of commercial paper to the market (Robinson and Catts, 2011). Google and Johnson & Johnson are also among this group of issuers in the dataset. As *The Financial Times* reported on May 20, 2011, "There was a sales boom this week in the corporate bond market as companies lined up to take ad-

[18] Barclay and Smith (1995) find that large firms typically have more access to long-term debt. This correlation likely reflects the role of collateral, with large firms having more collateralizable assets. Thus, assuming larger issuers to MMFs are also larger firms, these issuers may have more opportunities to substitute short-term for long-term borrowing.

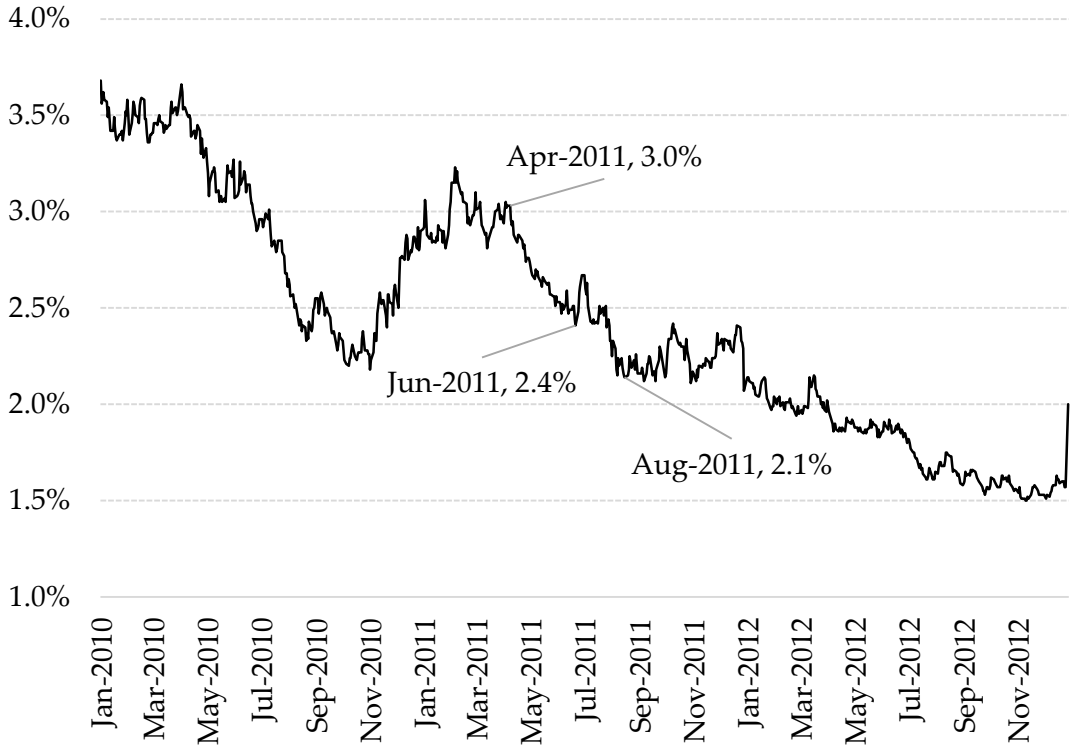
Table 4: Issuer-Fund Relationship Summary Statistics

This table summarizes some key issuer-fund relationship statistics and permits comparisons of those statistics between all relationships vs. those with funds with various degrees of eurozone bank exposure as of the end of May ($EURO_f$). Panel A displays statistics for U.S./Canadian financial issuers and Panel B displays statistics for U.S./Canadian nonfinancial issuers. I show the simple mean, standard deviation, and number of observations. The variables studied include: $\triangle M_{i,f}$, the end of May to the end of June dollar change in the size of a issuer-fund relationship; $REL\triangle M_{i,f}$, which is $\triangle M_{i,f}$ as a percentage of the issuer's total outstanding debt held by prime MMFs as of the end of May; For brevity, the remaining variables are defined in detail in Appendix A.

	All funds			Funds with $EURO_f$ in percentile:							
				<=25th		25th-50th		50th-75th		>75th	
issuer-fund variables:	Mean	St.dev.	N	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
Panel A: U.S. & Canadian Financial issuers											
$\triangle M_{i,f}$ ($ mil)	8.4	170.4	1,688	8.0	116.7	4.6	80.4	13.5	130.0	6.7	273.5
$REL\triangle M_{i,f}$ (%)	0.3	5.6	1,688	0.2	3.4	0.0	3.3	0.6	5.6	0.5	8.1
$YIELD_{i,f}$ (bps)	23.2	12.9	1,611	25.8	17.2	21.6	10.0	21.6	11.5	25.1	13.2
$\left(YIELD_{i,f} - \bar{YIELD_i}\right)$ (bps)	-2.9	12.0	1,611	-0.4	16.8	-3.8	10.4	-5.1	9.9	-1.2	11.5
$STRENGTH_{i,f}$	0.02	0.08	1,688	0.03	0.10	0.02	0.08	0.02	0.06	0.03	0.08
Panel B: U.S. & Canadian Nonfinancial issuers											
$\triangle M_{i,f}$ ($ mil)	-1.2	54.2	720	1.7	42.5	-1.0	50.9	-4.6	62.4	-8.6	84.5
$REL\triangle M_{i,f}$ (%)	1.7	11.8	720	1.2	10.1	1.8	8.8	1.8	13.0	3.5	19.5
$YIELD_{i,f}$ (bps)	19.8	14.6	630	17.0	13.1	19.2	14.1	22.2	17.8	27.9	11.8
$\left(YIELD_{i,f} - \bar{YIELD_i}\right)$ (bps)	-2.0	11.7	625	-3.3	11.6	-2.2	13.9	-0.3	10.9	1.0	6.8
$STRENGTH_{i,f}$	0.06	0.11	720	0.07	0.12	0.03	0.07	0.04	0.08	0.08	0.14

Figure 4: Corporate Bond Yields

This figure plots the BofA Merrill Lynch U.S. Corporate AAA Effective Yield, daily, from 2010 through 2012. The effective duration of this series is roughly 6.5 years. Declining mid-to-long term yields may have compelled some issuers to refinance toward longer-term debt.



Source: Federal Reserve.

vantage of cheap debt after a drop in U.S. borrowing costs...The chance to raise cheap debt has lured some of the biggest names in corporate America...Google and Johnson & Johnson, which has a rare triple A rating, achieved some of the lowest interest rates on portions of their bond sales this week" (Bullock, 2011).[19]

As a whole, these results indicate that at least some of the decline in issuers' MMF financing may have been driven by an inward shift in demand. An obvious way of testing this is to look at changes in average yields on issuer-MMF relationships. Assuming standard supply and demand curves, a retraction in the supply of financing available to issuers should push up yields (i.e., the price of financing), all else equal. Instead, the opposite occurs. As Figure 5, panel (b), shows, the average yield issuers paid to highly exposed prime funds fell significantly in June, by 3.6 basis points, on average. This, again, indicates that issuers were taking advantage of declining long-term interest rates or substituting to cheaper financing sources in June 2011.

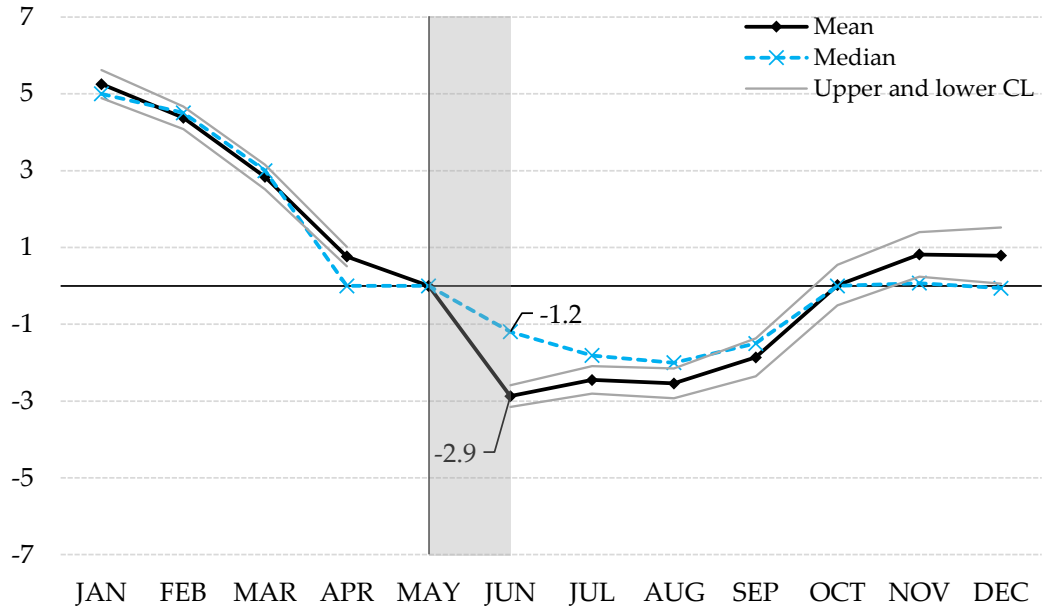
Finally, I check to see whether this substitution influenced issuers' capital expenditure or profitability outcomes. If so, this might indicate that unobserved frictions exist, making

[19]Media reports indicate that other issuers in the sample (e.g., CVS and IBM) had billions of dollars of cash on hand or had decided to lock in longer-term financing by issuing bonds (Zeiler, 2011; Standard & Poor's, 2011). For example, in July 2011, IBM, which experienced a reduction of $230 million from prime funds that month, sold $2 billion of 5-year notes, which, according to one analyst, allowed IBM to take "advantage of the market conditions to refinance short-term debt to extend maturities" (Maheshwari and Robinson, 2011).

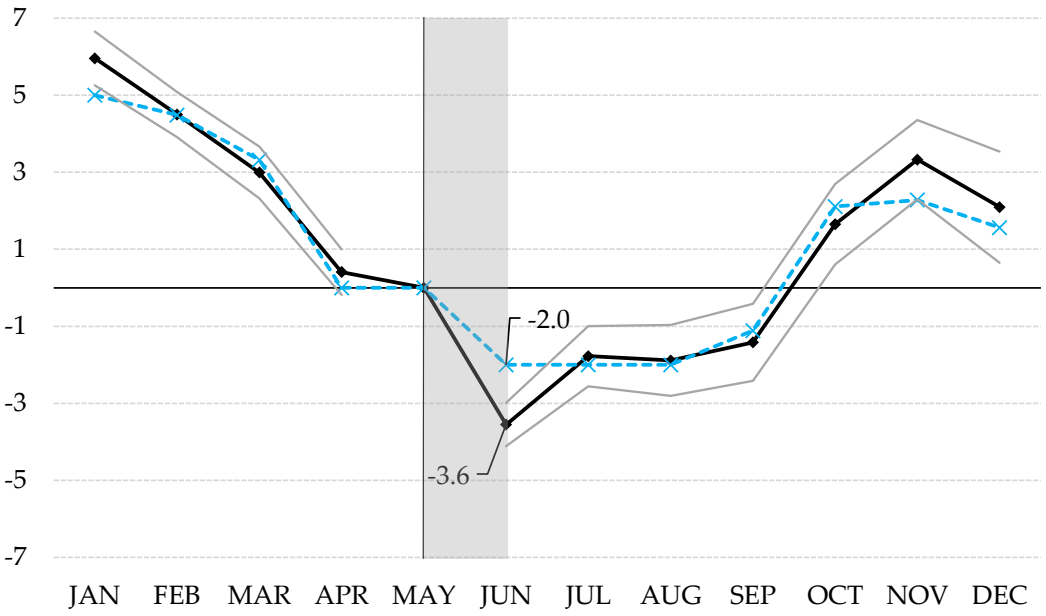
Figure 5: Changes in Issuer-Fund Weighted Average Yields, 2011

This figure plots monthly changes over 2011 in value-weighted average yields on issuer-fund financing relationships ($YIELD_{i,f}$, in basis points) between prime MMFs' and firms headquartered in the U.S. and Canada. I normalize changes in yields relative to May 31, 2011, the last observation before the eurozone crisis worsens in June. Only issuer-fund relationships that existed as of May 31, 2011 are studied. Plots show the mean, median, and 95 percent confidence interval around the mean across issuer-fund relationships at each month-end. The change from May to June is emphasized since investors' eurozone-related redemptions from prime funds (i.e., the catalyst for a possible supply shock) are concentrated in June. The bottom panel keeps only prime funds with top quartile exposure to eurozone banks as of the end of May ($EURO_f$). Patterns are similar when only nonfinancial issuers are examined (not shown).

(a) Full Sample



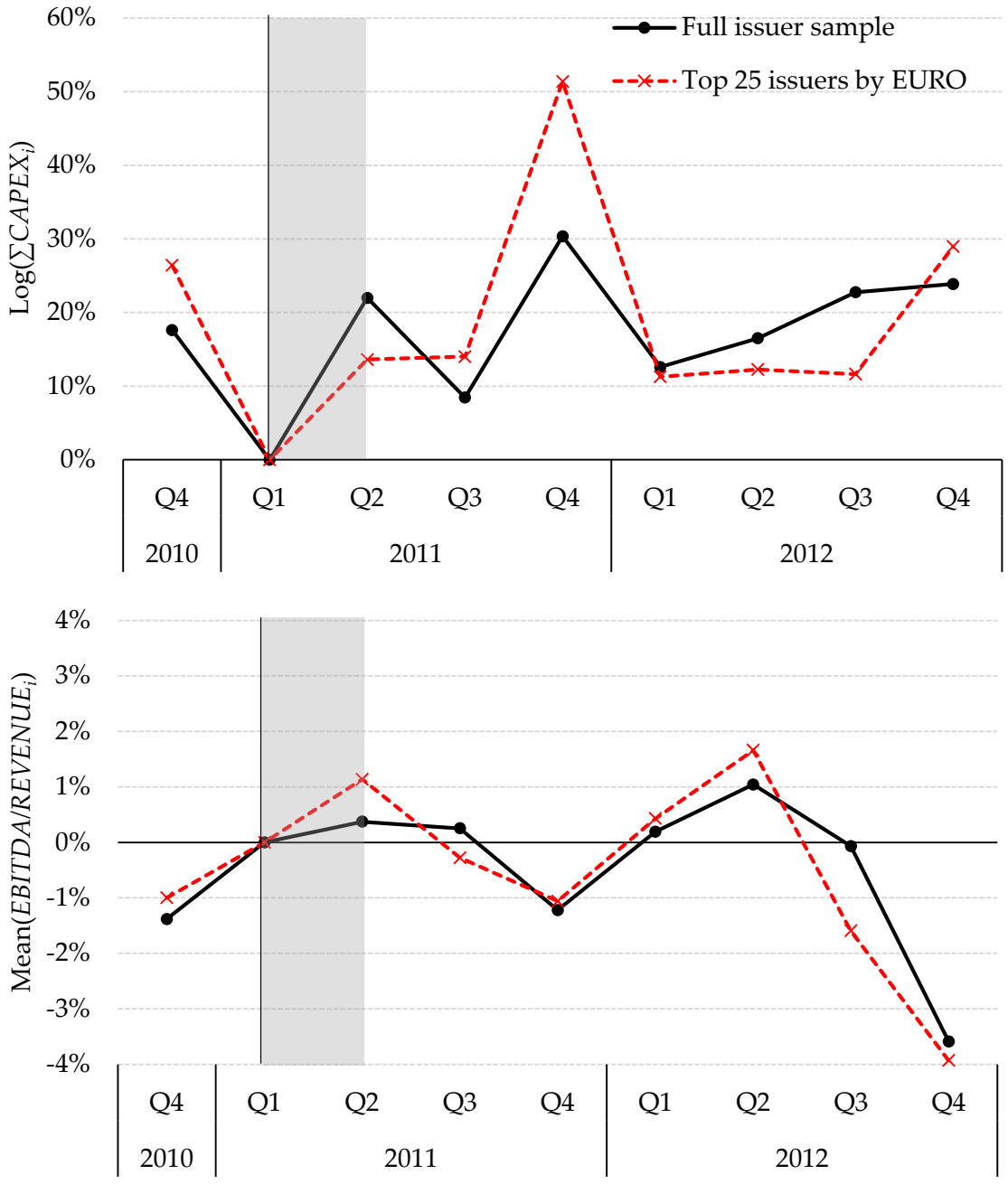
(b) Prime Funds with Top Quartile $EURO_f$



substitution costly. In Figure 6, I aggregate issuers' capital expenditures and average their EBITDA-to-Revenue ratios, a commonly used measure of firm profitability. As before, I compare all U.S. and Canadian nonfinancial issuers (black line) with a subsample of those issuers predominately financed by eurozone-exposed funds (red line). I find no qualitative differences between the two groups, indicating that these capital restructurings did not adversely affect firm outcomes.

Figure 6: Investment and Profitability Outcomes for Domestic Nonfinancial Issuers

This figure plots the investment and profitability outcomes of U.S. and Canadian nonfinancial companies held by prime MMFs as of May 2011. The balance sheet data shown is quarterly, from Q4 2010 through Q4 2012. I measure investment outcomes using the natural logarithms of issuers' total capital expenditures, $Log\left(\sum CAPEX_i\right)$. I measure profitability outcomes from the average issuer EBITDA-to-revenue ratio, $Mean\left(EBITDA/REVENUE_i\right)$. I normalize the series to zero relative to Q1 2011, the last observation before the eurozone crisis worsens in June. The change from Q1 to Q2 of 2011 is emphasized since investors' eurozone-related redemptions from prime funds are concentrated in June 2011. The black line represents all U.S. and Canadian nonfinancial businesses with debt held by prime MMFs as of the end of May 2011. The red line represents a subsample of the 25 issuers most heavily financed by prime MMFs with greater exposure to eurozone banks as of May 2011 (i.e., the 25 issuers with the highest $EURO_i$). I exclude General Electric due to its large capital restructuring program during this period and its extreme influence over the aggregate.



4 Main Results: Demand or Supply?

Although it is useful from a financial stability perspective to analyze lending changes using aggregate data, aggregate data allows identification of credit supply and demand effects only if there are not certain types of heterogeneities across funds and issuers (Kashyap et al., 1996). For example, it could be that the supply of money fund financing to domestic issuers shifted from riskier to less risky companies, netting in aggregate. At the same time, certain domestic issuers may have reduced their demand for more expensive forms of short-term financing. To separate these sorts of dual effects I need micro-level data. This section is devoted to using micro-level data to strip supply-side from demand-side factors influencing firms' financing outcomes during the eurozone crisis.

4.1 Empirical Framework

To capture evidence of a lending channel using loan-level data, the regression specification pioneered by Gan (2007) and Khwaja and Mian (2008) in the bank lending literature is shown in Equation (1) below. It involves regressing normalized changes in aggregated loan amounts between lenders and borrowers ($\triangle Q_{i,f}$) on the lender's exposure to the liquidity shock (S_f). A negative and significant coefficient on the shock (β_1) signifies that shifts in supply are driving changes in outstanding loan quantities ($\triangle Q_{i,f}$). Meanwhile, X_i represents issuer characteristics, both observed and unobserved, such that $X_i = O_i + U_i$. Unobserved characteristics (U_i) include changes in an issuer's demand for financing from MMFs. Since an issuer's demand for financing is not fully observed, β_1 will be biased in cases where $Corr(S_f, U_i) \neq 0$. In my setting this could happen if, for instance, funds that reduced their supply of loans also happened to invest in domestic firms with greater export ties to the eurozone and, therefore, weakening demand for financing. A contraction in demand from these issuers would be correlated with the contraction in fund supply, biasing coefficient estimates in a direction that exaggerates the supply effect. Gan (2007) and Khwaja and Mian (2008), along with studies that come after (e.g., Chava and Purnanandam, 2011; Schnabl, 2012; Chodorow-Reich, 2014), use borrower-fixed effects to absorb U_i and identify β_1.

$$\triangle Q_{i,f} = \beta_1 S_f + \beta_2 X_i + \varepsilon_{f,i} \tag{1}$$

However, this method relies on the assumption that borrower demand for financing is not lender specific. It is conceivable that issuer demand for the financing varies by fund. For example, an issuer might value relationships with funds that more consistently roll over their investments at maturity or constitute a larger portion of the issuer's total borrowing. This fund-specific component of issuer demand, $U_{i,f}$, will not be absorbed in the issuer-fixed effects. This component might also be correlated with the fund liquidity shocks, $Corr(S_f, U_{i,f}) \neq 0$. For example, funds with the economies of scale needed to invest in often higher yielding international credits (e.g., eurozone banks) may also earn higher yields from their domestic issuers. If issuer demand for financing shifts inward, the higher-yielding (more costly) relationships might be the first to decline. Again, this correlation could exaggerate the negative influence

of the supply shock (eurozone exposure) on financing outcomes. To control for this, I insert certain relationship characteristics that might influence an issuers' demand for fund-specific financing. Thus, to isolate a "lending channel" I run the following regression:

$$\triangle Q_{i,f} = \delta_i + \beta_1 S_f + \beta_3 C_{i,f} + \varepsilon_{f,i} \tag{2}$$

...where δ_i represents the issuer-fixed effects and $C_{i,f}$ represents two separate credit demand controls: $\left(YIELD_{i,f} - \bar{YIELD}_i\right)$, which measures the cost of a given financing relationship relative to the issuer's other prime MMF financing as of the prior month-end (May 31, 2011), and $STRENGTH_{i,f}$, which is the average portion of issuer i's total prime MMF financing that is provided by fund f (averaged over the eight-month period November through June). Large positive values of $\left(YIELD_{i,f} - \bar{YIELD}_i\right)$ signal that the relationship is comparatively expensive for the issuer. On a scale from zero to one, values of $STRENGTH_{i,f}$ closer to one signal that the fund consistently represents a large portion of the issuer's total outstanding debt to MMFs. All variables are defined in more detail in Appendix A.

I use three instruments to measure the link between the supply shock (S_f) and changes in issuer-fund relationships over June. The first and most relevant instrument is $EURO_f$ – the eurozone bank exposure of the fund as of the prior month-end (May 31, 2011). This variable directly ties changes in financing outcomes to the eurozone crisis. For illustrative purposes, I also explore whether a fund's flows ($INFLOW_f$ and/or $OUTFLOW_f$) contribute to changes in its investments over June. Finally, I use a measure similar to one proposed by Chodorow-Reich (2014), called $\triangle M_{-i,f}$. This measures the change in the value of loans made by fund f to all borrowers other than issuer i. A large positive estimate on $\triangle M_{-i,f}$ would signal a strong generalized (non-issuer-specific) supply effect on issuer-fund financing outcomes, such that funds that invest more in other issuers are also more likely to grow their investment in issuer i. I use these three instruments ($EURO_f$, $OUTFLOW_f$, and $\triangle M_{-i,f}$) to evaluate whether changes in financing outcomes in June were influenced by movements in fund supply and, more specifically, by the eurozone crisis.

We must also formulate a measure for the dependent variable – changes in the value of issuer-fund relationships ($\triangle Q_{i,f}$). Prior studies use log or percentage changes in the dollar values of loans between financial institutions and firms during the shock. As discussed in Section 2, such a specification is not well adapted to the money markets. By their nature, issuer-MMF relationships are short-term and vary with the cash needs of the issuer. A specification that normalizes loans by the size of the loan in the prior period excludes a large number of lending relationships that open (because of division by zero). Furthermore, the economic meaning behind such a specification is questionable. To circumvent these problems, I normalize changes in issuer-fund relationships in June by the issuer's total borrowing from prime MMFs as of the end of May. I call this $REL\triangle M_{i,f}$.

Finally, in a separate set of regressions, I explore how shifts in an issuer's *demand* for financing influence relationship outcomes. To do this, I alter the regression in Equation (2). Now, holding fixed the fund (i.e., δ_i becomes δ_f), I ask why certain domestic issuers received more financing than others during June 2011. I evaluate whether funds might have become more risk averse over this period, only growing relationships with those issuers perceived to

be of comparatively lower risk (i.e., $\left(YIELD_{i,f} - \bar{YIELD}_f\right) \leq 0$). In a horse race, I let this possibility compete with an alternative: that issuers only accepted financing that was comparatively less expensive (i.e., $\left(YIELD_{i,f} - \bar{YIELD}_i\right) \leq 0$). This set of regressions also measures the influence of an issuer's generalized (non-fund-specific) credit demand on financing outcomes. This is measured using $\triangle M_{i,-f}$, which is the change in issuer i's outstanding debt held by all prime MMFs excluding fund f. A large positive estimate on $\triangle M_{i,-f}$ would signal a strong generalized credit demand effect, such that issuers that grew their financing from other funds were also more likely to garner additional financing from fund f.

4.2 Empirical Results

Regression results do not support the narrative that credit supply shifts at MMFs resulted in less investment in U.S. and Canadian companies in June 2011. Table 5 shows regression results from the model in Equation (2).[20] Holding fixed the issuer, I ask whether financing relationships with funds holding more eurozone debt decline relative to those with funds holding less eurozone debt. Among financial issuers, there is no relationship between $EURO_f$ and financing outcomes, as measured by $REL\triangle M_{i,f}$ (column 1). Among nonfinancial issuers, the relationship is actually significantly positive (column 4) – indicating that eurozone-exposed funds sought to invest *more* in domestic nonfinancial issuers in June 2011. The economic magnitude is moderate – a one standard deviation increase in a single fund's eurozone exposure in May (9.8%) is associated with a 1.3 percentage point increase in the issuer's total borrowing from MMFs during June.[21] While this seems small, when compounded over multiple funds with higher levels of eurozone exposure, an issuer could experience a large increase in its outstanding borrowing from MMFs. As an extreme example, since the average nonfinancial issuer is financed by about 17 funds, if each of these 17 funds has eurozone exposure one standard deviation above the mean, this would translate into a 22 percentage point (1.3×17) increase in the issuer's MMF financing during June.

Using a placebo regression over June 2014, I confirm that these results are not caused by seasonal trends (column 4PLB).[22] In particular, eurozone exposure has no influence on financing outcomes in June 2014. This result suggests that as prime funds pulled back from the eurozone during the 2011 crisis, they reallocated their investments to nonfinancial companies in regions presumably more insulated from the eurozone crisis, including the U.S. and Canada.

In fact, these regressions provide no evidence that MMF supply shifts, whether eurozone-related or not, influenced North American companies in June 2011. The small and insignificant

[20] In all issuer-fund relationship level regressions, only issuers financed by at least two funds in May and at least one fund in June remain in the dataset. This is done in order to calculate fixed-effects and compare within issuer changes in fund investment.

[21] For context, the average $REL\triangle M_{i,f}$ for nonfinancial issuer-MMF relationships was -1.7 percentage points in June with a standard deviation of 11.8 percentage points (Table 4).

[22] Large corporate tax payments trigger outflows from MMFs in June of most years. For example, during the week ended June 17, 2014, MMF assets declined $29.43 billion (iMoneyNet, 2014). Therefore, I use June 2014 for my placebo tests. This ensures that my results are not driven by these types of seasonal tax events. I choose 2014 because I must choose a June from a year when SEC Form N-MFP data is available (i.e., after November 2010). Since the money markets may have also been affected by the eurozone crisis in June 2012 and bond markets were affected by Fed policy announcements in June 2013, I believe June 2014 best represents "normalcy" in the money markets.

coefficients on $\triangle M_{-i,f}$ (columns 2 and 5) signal that funds that grew investments in other companies were no more, or less, likely to increase their investment in a particular company i. Either issuers or MMFs were selective about the financing terms underlying their relationships. Surprisingly, I also find no relationship between fund outflows ($OUTFLOW_f$) and financing outcomes (columns 3 and 6). These results are robust to controlling for a fund's liquidity and the portion of its assets originally invested in domestic firms (not shown). Overall, these estimates suggest that June outflows from MMFs, whether eurozone-related or not, did not generate sufficient liquidity stress to cause noticeable withdrawals from U.S. and Canadian firms.

Instead, there is some indication that issuers may have been actively reducing their more expensive financing relationships during this period. In all regressions, the coefficients on $\left(YIELD_{i,f} - \bar{YIELD_i}\right)$ – the spread between the issuer-fund relationship yield and the issuer's average yield – is negative and statistically significant. The statistical and economic magnitude of this effect is much larger for nonfinancial issuers. The coefficient of -0.137 in column (4) signifies that a fund that commands a one standard deviation (11.7 bps) higher yield provides 1.6 percentage points less of the issuer's MMF financing during June. Again, when compounded the effect may be large. Imagine, for example, that six of the funds financing a given issuer in May charge yields of one standard deviation above the issuer's average; this group of funds is predicted to provide nearly 10 percentage points less of the issuer's total credit from MMFs during June. At the same time, some portion of this financing is replaced by the issuer's lower-cost relationships. In placebo regressions (columns 3PLB and 6PLB), I find no such relationship between differential yield and relationship outcomes in 2014. Thus, this cost-based shifting by U.S. and Canadian firms was unique to the June 2011 period.

It could be that funds, rather than issuers, were driving this reduction in higher yielding relationships. Perhaps the eurozone crisis caused funds to become more risk averse, shunning higher yielding relationships with domestic issuers in favor of safer (lower yielding) relationships. In Table 6, holding fixed the fund, I evaluate whether funds only grew relationships with those issuers perceived to be of comparatively lower risk (as measured by yield). Presumably, comparatively lower (higher) risk relationships have more negative (positive) values of $\left(YIELD_{i,f} - \bar{YIELD_f}\right)$. I allow this possibility to compete with the alternative hypothesis that issuers only accepted financing that was comparatively less expensive (i.e., where $\left(YIELD_{i,f} - \bar{YIELD_i}\right) \leq 0$). For financial companies, neither hypothesis appears to statistically dominate the other (columns 1). The magnitude and direction of the coefficient on $\left(YIELD_{i,f} - \bar{YIELD_f}\right)$ suggests a limited degree of risk aversion on the part of funds. This makes sense considering U.S. banks were arguably at greater risk of eurozone contagion than nonfinancial companies. However, the statistical value of this result remains low even outside of the horse race and controlling for the issuer's average yield (i.e., "riskiness") (column 2). For nonfinancial firms, the alternative hypothesis is significantly stronger. Nonfinancial issuers appear to have been substituting away from their more expensive relationships (column 4). This result strengtheners when I control for the issuer's average yield, suggesting that this reallocation is not unique to issuers with higher average yields (column 5). For nonfinancial firms, the economic magnitude is similar to that of of the regressions in Table 5.

Table 5: Relative Changes in Issuer-Fund Relationships - Supply Effects

These are cross-sectional regressions measuring one month changes (May 31 to June 30, 2011) in issuer-fund relationships. Regressions are run separately for financial and nonfinancial issuers. The dependent variable is $REL\triangle M_{i,f}$, the June change in fund f's investments in issuer i as a percentage of issuer i's total prime MMF financing as of the end of May. Key explanatory variables include three instruments designed to capture movements in a fund's supply of financing ($EURO_f$, $\triangle M_{-i,f}$, and $OUTFLOW_f$) . I control for an issuer's fund-specific demand for financing using the yield spread between a particular relationship and the issuer's overall average, ($YIELD_{i,f} - \bar{YIELD_i}$), and using a measure of relationship strength ($STRENGTH_{i,f}$). All variables are described in detail in Appendix A. In all regressions, the intercept is allowed to vary by issuer (i.e., issuer-fixed effects are used). The dataset includes only issuers that are financed by at least two funds in May and at least one fund in June. Results are robust to removing the 10 most widely-held U.S./Canadian issuers (not shown for brevity). Column (3PLB), (4PBL), and (6PLB) shows the results of placebo regressions run over June 2014. The dependent variable, $REL\triangle M_{i,f}$, is winsorized at the 1st and 99th percentiles. Standard errors are clustered by fund. Estimates with a p-value below 0.10, 0.05, and 0.01 are marked with a *, **, and ***, respectively.

Dependent variable: $REL\triangle M_{i,f}$

Issuer samples:	North American Financials				North American Nonfinancials				
Independent variables	(1)	(2)	(3)	(3PLB)	(4)	(4PLB)	(5)	(6)	(6PLB)
$EURO_f$	0.014				0.134**	0.048			
	(0.016)				(0.061)	(0.049)			
$\triangle M_{-i,f}$		-0.004					0.013		
		(0.003)					(0.016)		
$INFLOW_f$			0.019	0.020				-0.008	-0.027
			(0.027)	(0.019)				(0.186)	(0.083)
$OUTFLOW_f$			0.003	-0.030				-0.093	0.054
			(0.019)	(0.020)				(0.115)	(0.077)
$(YIELD_{i,f} - \bar{YIELD_i})$	-0.015*	-0.015*	-0.020**	0.009*	-0.137***	-0.005	-0.122***	-0.119***	-0.005
	(0.008)	(0.008)	(0.008)	(0.006)	(0.046)	(0.008)	(0.045)	(0.045)	(0.008)
$STRENGTH_{i,f}$	-8.798	-8.709	-8.541	-3.568	-0.173	-1.491	0.199	-1.011	-1.837
	(5.351)	(5.383)	(5.417)	(3.805)	(5.228)	(6.833)	(5.489)	(5.625)	(7.080)
F.E.	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer
N	1,611	1,611	1,611	1,787	625	488	625	625	476
Adj. R^2	0.12	0.12	0.13	0.14	0.10	0.20	0.09	0.08	0.20

Table 6: Relative Changes in Issuer-Fund Relationships - Demand Effects

These are cross-sectional regressions measuring one month changes (May 31 to June 30, 2011) in issuer-fund relationships. Regressions are run separately for financial and nonfinancial issuers. The dependent variable is $REL\triangle M_{i,f}$, the June change in fund f's investments in issuer i as a percentage of issuer i's total prime MMF financing as of the end of May. Explanatory variables include $(YIELD_{i,f} - \bar{YIELD}_f)$, which measures the yield on the relationship relative to the fund's yield. I let variable compete with $(YIELD_{i,f} - \bar{YIELD}_i)$, which measures the yield on the relationship relative the average yield on all of the issuer's debt to prime MMFs. $\triangle M_{i,-f}$ is the change in issuer i's outstanding debt held by all prime MMFs excluding fund f. I include the logged value of the issuer's total outstanding as of the end of May, $log(M_i)$. I also control for the number of unique funds that financed the issuer at some point during the period from November 2010 to June 2011 ($NUMFUNDS_i$). All variables are described in detail in Appendix A. In all regressions, the intercept is allowed to vary by fund (i.e., fund-fixed effects are used). To be consistent with the sample used in Table 5, the dataset includes only issuers that are financed by at least two funds in May and at least one fund in June. Columns (3PLB) and (6PLB) show the results of a placebo regression run over May-June 2014. The dependent variable, $REL\triangle M_{i,f}$, is winsorized at the 1st and 99th percentiles. Standard errors are clustered by issuer. Estimates with a p-value below 0.10, 0.05, and 0.01 are marked with a *, **, and ***, respectively.

Dependent variable: $REL\triangle M_{i,f}$

Issuer samples:	North American Financials				North American Nonfinancials			
Independent variables	(1)	(2)	(3)	(3PLB)	(4)	(5)	(6)	(6PLB)
$(YIELD_{i,f} - \bar{YIELD}_f)$	-0.121	-0.056	-0.038	-0.001	-0.026			
	(0.077)	(0.041)	(0.030)	(0.009)	(0.033)			
$(YIELD_{i,f} - \bar{YIELD}_i)$	0.065				-0.146*	-0.171**	-0.174**	0.029
	(0.045)				(0.079)	(0.077)	(0.079)	(0.042)
$\bar{YIELD}_i$		-0.065	-0.029	-0.002		-0.026	-0.034	0.154
		(0.045)	(0.024)	(0.014)		(0.033)	(0.039)	(0.111)
$\triangle M_{i,-f}$			0.026***	0.008***			-0.009	0.010*
			(0.003)	(0.003)			(0.016)	(0.006)
$NUMFUNDS_i$	0.011	0.011	-0.009*	0.003	0.052**	0.052**	0.053**	-0.001
	(0.015)	(0.015)	(0.005)	(0.004)	(0.020)	(0.020)	(0.021)	(0.020)
$log(M_i)$	-0.509	-0.509	0.423	-0.155	-2.638***	-2.638***	-2.757***	-0.168
	(0.694)	(0.694)	(0.292)	(0.203)	(0.766)	(0.766)	(0.839)	(0.852)
F.E.	Fund	Fund	Fund	Fund	Fund	Fund	Fund	Fund
N	1,698	1,698	1,780	1,719	654	654	654	482
Adj. R^2	-0.02	-0.02	0.03	0.01	0.05	0.05	0.05	-0.01

Finally, I look at whether an issuer's generalized (non-fund-specific) demand for MMF financing ($\triangle M_{i,-f}$) influenced borrowing outcomes. In June 2011, a financial company that grew its financing from other MMFs was more likely to also grow its financing from fund f (column 3). This implies a generalized credit demand effect on financing outcomes. Simply put, a North American financial issuer that wanted credit in June, typically got it at whatever the current terms were. The smaller coefficient on the placebo estimate in column (3PLB) indicates that this generalized credit demand effect was particularly strong in June 2011. In contrast, nonfinancial issuers appear condition the amount of financing received from fund f on yield incentives (column 6). The 2014 placebo regressions in column (6PLB) further supports the notion that June 2011 was a period of capital restructuring for North American nonfinancial firms.

The estimates on the issuer-level control variables, $NUMFUNDS_i$ and $log(M_i)$, also signal that North American nonfinancial issuers were reevaluating their financing structures during 2011. In particular, a nonfinancial issuer that is financed by a greater number of funds at some point over the prior 8 months reduces (grows) its relationship with a given fund by less (more). A likely explanation is that a company with more financing relationships has more negotiating power and, therefore, is less inclined to restructure. Similarly, large issuers (as measured by$log(M_i)$) typically have greater access to long-term borrowing options and may be better able to substitute away from MMFs (Barclay and Smith (1995)). The placebo regression in column (6PLB) supports this interpretation.

For the most part, these results persist into July 2011. For reasons outlined in Section 2.2, a detailed study of MMFs' portfolio choices during July 2011 is beyond the scope of this paper because; however, Appendix B, Tables 9 and 10, show the same micro-level regressions run over July 2011 to see if anything changes. Similar to June, there is no relationship between a fund's eurozone bank exposure and its investment in financial companies. Also like in June, funds with greater eurozone bank exposure are significantly more likely to grow their investments in North American nonfinancial issuers. This is consistent with a desire on the part of funds to insulate themselves from global economic trouble. Nonfinancial companies were relatively insulated from events in the eurozone as well as from the U.S. federal debt ceiling crisis. Unlike in June, however, there is an economically weak but statistically negative relationship between MMF outflows and investments in U.S. and Canadian financial issuers. This finding could help explain the small dip in aggregate financing observed during July 2011 in Figure 2a. Portfolio managers may have been concerned that a U.S. Treasury default, albeit temporary, could adversely affect the credit standing of U.S. banks. Perhaps, funds experiencing outflows chose not to roll over investments in these banks until the crisis passed. Finally, the strong yield-based substitution effect among nonfinancial companies weakens in July. This is not unexpected. Nonparametric results in Section 3 show that the drop in yields paid by issuers to MMFs occurred mostly in June (Figure 5) and the movement toward longer-term financing plateaus after June (Figure 3).

The findings presented above differ from prior research on this topic. Chernenko and Sunderam (2014) found strong evidence of a micro-level negative relationship between fund eurozone bank exposure and financing outcomes for issuers. I do not. These two contrasting

results are reconciled in Appendix C. The evidence suggests they diverge, at least in part, because of a different dependent variable specification. Specifically, Chernenko and Sunderam (2014) import from the bank lending literature the approach of studying percentage changes in issuer-fund relationships ($\%\triangle M_{i,f}$). I study "relative" changes in issuer-fund relationships ($REL\triangle M_{i,f}$). For reasons detailed in Section 2.3, I believe the specification used in this paper is better adapted to the nature of money market financing.

5 Issuers' Short-Term Financing Outcomes

The previous section indicates that funds with greater exposure to the eurozone did not withdraw financing from U.S. and Canadian issuers. Instead, these issuers reduced their more costly relationships with prime funds. This section asks whether this result persists when all of an issuer's outstanding loans to MMFs are aggregated together (i.e., to the issuer-level). These results have implications for theories of frictions in short-term lending markets.

5.1 The Mechanism: Correlation Between Eurozone Exposures and Yields

There is aggregate evidence that some firms restructured their debt over the summer of 2011. Whether this restructuring was forced (e.g., by a restriction in the supply of short-term credit) or voluntary is the subject of this paper. In particular, Figure 3 shows that companies financed by MMFs with greater eurozone bank exposure appear to have undergone larger restructuring programs – reducing their short-term borrowing (both from MMFs and from other credit providers) and increasing their long-term borrowing. At the same time, we find no micro-level evidence that MMFs with more eurozone exposure pulled financing from North American companies (Section 4). Therefore, if not driven by fund supply shocks, why is there an association between being financed by MMFs with more eurozone exposure and reductions in aggregate MMF investment?

One theory is that funds with greater eurozone exposure tended to invest in those firms with the strongest incentives to refinance their debt over the summer of 2011. Table 7 shows cross-sectional, issuer-level regressions, where the dependent variable is the average eurozone bank exposure of all MMFs that invest in a given issuer as of May, $\bar{EURO_i}$. The independent variables measure the average terms of an issuer's financing relationships, $\bar{YIELD_i}$ and $\bar{MATURITY_i}$, and the total amount of investment the issuer receives from MMFs, $log(M_i)$, as of May. The regression results show that funds with greater eurozone bank exposure typically invested in companies that paid higher yields for a given average maturity. For example, a nonfinancial company that offers an average yield of 10 basis points more (about one standard deviation) is financed by MMFs with 5.3 percentage points higher eurozone bank exposure. This is a large effect considering the average fund had just about 15 percent of assets invested in eurozone banks in May 2011 (Table 1). Funds with greater eurozone bank exposure also tended to invest in companies that issued large amounts of debt to MMFs.

It is conceivable that the higher yields paid by these issuers became less competitive as long-term interest rates declined. If true, this would explain why, in aggregate, nonfinancial

Table 7: Eurozone Exposure and Heterogeneity Across Issuers

These are cross-sectional regressions across U.S. and Canadian issuers. The goal is determine how issuers financed by eurozone-exposed funds differ from those financed by funds with little eurozone bank exposure. The dependent variable is $EU\bar{R}O_i$. It is the value-weighted average eurozone bank exposure ($EURO_f$) of funds financing issuer i as of May 31, 2011. Explanatory variables include the value-weighted average yield, $YI\bar{E}LD_i$, and maturity, $MAT\bar{U}RITY_i$, on the issuer's debt held by prime funds as of May 31, 2011. I also control for the logged total dollar value of the issuer's oustanding debt to prime funds, $log(M_i)$, as of May 31, 2011. Due to my small sample size and some outliers, robust regression estimates are shown (M-estimators). Estimates with a p-value below 0.10, 0.05, and 0.01 are marked with a *, **, and ***, respectively.

Dependent variable: $EU\bar{R}O_i$

Issuer type:	North American Financials	North American Nonfinancials
Independent variables	(1)	(2)
Constant	-4.355	-22.266**
	(5.029)	(9.023)
$YI\bar{E}LD_i$	0.163***	0.527***
	(0.040)	(0.070)
$MAT\bar{U}RITY_i$	-0.044***	-0.023
	(0.007)	(0.018)
$log(M_i)$	0.906***	1.229**
	(0.215)	(0.509)
N	93	72
R^2	0.23	0.29

issuers financed by MMFs with greater eurozone exposure (i.e., issuers paying higher yields on their short-term debt) saw declines in their outstanding to both MMF and other short-term credit providers over Q2 2011. It would also explain why their long-term borrowing grew comparatively more. Finally, it is consistent with observed movement in these issuers' cash levels, which grew at a rate similar to that of other issuers (Figure 3).[23]

5.2 Short-Term Financing Outcomes: Empirical Framework

The theory that cost-incentives, rather than money fund supply shifts, dominated issuers' financing outcomes would be more compelling if confirmed with regression evidence. The kind of firm-level specification typically used to explore this question in the bank lending literature relies on establishing a connection between the average exposure of a firm's banks to the shock and subsequent log (or percentage changes) in the firm's total outstanding bank loans. A negative association would indicate that firms are unable to replace financing once exposed banks reduce their supply of credit. However, as is often noted, this specification relies on the assumption that credit supply shifts are orthogonal to credit demand shifts (e.g., Schnabl, 2012). In issuer-level regressions, issuer-fixed effects can no longer be used absorb shifts in an issuer's general demand for MMF financing (due to having only one observation per issuer).

[23]These observations about changes in firms' capital structures over Q2 2011 are documented both in Section 3 of this paper, through nonparametric analysis, and also in Chernenko and Sunderam (2014) (pg. 1743), through firm-level regressions. The interpretation of these results differs between the two studies, however. Unlike Chernenko and Sunderam (2014), this paper also examines changes in firms' *non-MMF* short-term borrowing. The fact that issuers with greater $EU\bar{R}O_i$ also reduced their non-MMF short-term borrowing indicates a demand-driven contraction encouraged by the costlier terms of the financing offered by funds with greater eurozone exposure. Table 7 supports this interpretation.

This limitation is particularly troublesome in our setting. If a company financed by MMFs with greater eurozone exposure was more likely to restructure its debt for reasons unrelated to the eurozone crisis (e.g., to take advantage of lower cost financing offers), this could generate a spurious relationship between eurozone exposure and declines in the firm's total outstanding debt held by MMFs.

To get around this identification problem, I borrow an idea first proposed in Kashyap, Stein, and Wilcox (1993) when studying aggregate demand for bank loans after a monetary policy shock and I apply this idea to the study of firm-level outcomes. Specifically, I examine the factors driving changes in an issuer's total prime MMF financing relative to its total short-term borrowing. This specification is based off the assumption that MMF financing is equivalent to other forms of short-term borrowing; therefore, a change in an issuer's demand for short-term financing will affect all types of credit providers equally. If an issuer experiences a decline in its total MMF financing that is disproportionately larger than that of its total short-term borrowing, this could signal that MMFs restricted their supplies of credit to this issuer. Such a negative association could not be explained away by an issuer demanding less financing from MMFs due to a restructuring. Therefore, I run the following regression in Table 8:

$$\triangle \frac{M_i}{STB_i} = \alpha + \beta_1 \bar{S}_i + C_i + \varepsilon_i \tag{3}$$

...where the dependent variable ($\triangle M_i/STB_i$) is the Q1 to Q2 2011 change in the ratio of the issuer's total MMF borrowing to its total short-term borrowing. $\bar{S}_i$ represents the possible supply shock (i.e., $\bar{EURO_i}$). C_i symbolizes three controls: M_i/TB_i, $log(ASSETS_i)$, and $\bar{YIELD_i}$. The first control, M_i/TB_i, measures the issuer's aggregate financing from MMFs as a percentage of its total borrowing as of Q1 2011. Presumably, issuers that are over-weight on MMF financing may be more likely to rebalance. Next, $log(ASSETS_i)$ controls for the issuer's size since smaller companies, with fewer collateralizeable assets, may have fewer substitution opportunities (Barclay and Smith, 1995). Finally, in the last specification I include $\bar{YIELD_i}$. This variable helps absorb cases where an issuer pays higher yields to MMFs, encouraging the issuer to substitute to other credit providers.[24] In these issuer-level regressions, the analysis is limited to nonfinancial issuers since the primary concern is whether nonfinancial companies' can substitute financing after a possible supply shock.

[24]Interpreting the coefficient on $\bar{YIELD_i}$ is not simple. The dependent variable is measured relative to short-term borrowing. Therefore, ideally, we would measure the yield on an issuer's MMF financing relative to the yield on the issuer's non-MMF short-term borrowing. Issuers paying relatively higher yields to MMFs would be expected to reduce their MMF borrowing more than their other short-term borrowing. Unfortunately we do not have data on the yield paid to non-MMF lenders. Therefore, in our setting, a negative coefficient estimate signals that funds that pay higher yields to MMFs (and, perhaps, pay lower yields to non-MMF short-term creditors) are more likely to substitute to other short-term credit sources. At the same time, a coefficient near zero does not necessarily imply a weak economic significance of yield incentives on short-term borrowing outcomes. Instead, it likely reflects measurement error.

5.3 Short-Term Financing Outcomes: Empirical Results

Results indicate that reductions in U.S. and Canadian companies' outstanding debt held by MMFs over Q2 2011 were more likely demand-driven. In columns (1)-(3), the coefficient on $\bar{EURO_i}$ is statistically zero. Thus, any restrictions in fund supply appear to have netted out at the firm-level. Meanwhile, the coefficients on M_i/TB_i indicate that there was a possible demand effect at work. A one standard deviation larger weight toward MMF borrowing, compared to total borrowing, is associated with a two percentage point reduction in the issuer's ratio of MMF-to-short-term-borrowing. Starting at the median, this amount of increase in an issuer's M_i/TB_i would put the issuer in the bottom 19th percentile of the dependent variable ($\triangle M_i/STB_i$). One possible interpretation is that companies that had grown more reliant on MMF financing were more likely to rebalance by reducing their MMF borrowing relative to their other short-term borrowing. In columns (4) and (5), I exclude $\bar{EURO_i}$ since, as is documented in Section 5.1, it is highly correlated with $\bar{YIELD_i}$.[25] This reveals a negative and marginally significant relationship between the issuer's average yield, $\bar{YIELD_i}$, and its MMF financing (relative to its short-term borrowing). A one standard deviation larger $\bar{YIELD_i}$ (12.5 basis points) is associated with a one percentage point reduction in an issuer's MMF-to-short-term-borrowing ratio. While this effect seems small, starting at the median, such a reduction would put the issuer in the 26th percentile of the dependent variable ($\triangle M_i/STB_i$). These results signal that, over Q2 2011, nonfinancial companies paying higher yields to MMFs or relying more heavily on MMFs for their borrowing were more likely to reduce their outstanding debt to MMFs compared to other short-term creditors.

In sum, results at the issuer-level are consistent with the nonparametric evidence shown in Section 3 as well as with the relationship-level results presented in Section 4. North American nonfinancial issuers appear to have been taking advantage of better financing terms. Inward shifts in credit demand disproportionately affected issuers' relationships with eurozone-exposed MMFs because the terms of these loans tended to be more costly (Tables 3, 4, Panel B, and 7). As such, these relationships were less likely to be rolled over.

[25] The Pearson correlation coefficient between $\bar{YIELD_i}$ and $\bar{EURO_i}$ is 0.55 and statistically significant (p-value < 0.01).

Table 8: Issuer Substitution Following the Liquidity Shock

These are cross-sectional regressions across U.S. and Canadian nonfinancial issuers. The goal is to explore whether issuers were able to substitute financing across MMFs following a fund liquidity shock. To do this, I use $\triangle M_i/STB_i$ as the dependent variable. This is the Q1-Q2 ratio change in an issuer's total oustanding debt to MMFs over its total short-term borrowing. The key explanatory variable is $\bar{EURO}_i$, measured as of the end of May 2011. Controls include the issuer's aggregate financing from MMFs as a percentage of its total borrowing as of Q1 2011 (M_i/TB_i), the issuer's size as of Q1 2011 ($log(ASSETS_i)$), and the average yield an issuer pays to MMFs as of the end of May 2011 ($\bar{YIELD}_i$). All variables are defined in more detail in Appendix A. Due to my small sample size and several outliers, robust regression estimates are shown (M-estimators). Estimates with a p-value below 0.10, 0.05, and 0.01 are marked with a *, **, and ***, respectively.

Dependent variable: $\triangle M_i/STB_i$

Issuer type:	North American Nonfinancials				
Independent variables	(1)	(2)	(3)	(4)	(5)
Constant	0.593	-1.712	-3.103	2.106*	-2.588
	(0.737)	(4.052)	(4.414)	(1.097)	(4.474)
$\bar{EURO}_i$	-0.023	-0.001	0.039		
	(0.056)	(0.049)	(0.062)		
M_i/TB_i		-0.515***	-0.498***		-0.502***
		(0.122)	(0.122)		(0.124)
$log(ASSETS_i)$		0.301	0.541		0.526
		(0.397)	(0.437)		(0.443)
$\bar{YIELD}_i$			-0.073	-0.084*	-0.065*
			(0.048)	(0.045)	(0.039)
N	65	62	55	58	55
R^2	0.01	0.11	0.15	0.03	0.14

6 Conclusion

This paper looks for evidence of a international transmission channel through U.S. prime MMFs during the eurozone crisis of 2011. In June 2011, MMFs experienced abnormally large outflows due to their individual eurozone bank exposures. One theory is that these redemptions strained the amount of financing available to credit-worthy issuers outside of Europe. If true, this would support the view that MMFs, like banks, transmit foreign-born liquidity shocks to domestic markets and may propagate real economic effects. This study offers a rigorous analysis of whether such a spillover effect occurred during the eurozone crisis.

Both aggregate and micro-level evidence consistently point to a credit demand effect driving changes in the capital structures of U.S. and Canadian issuers during the eurozone crisis. In particular, certain nonfinancial companies were actively restructuring their debt over Q2 2011 – lowering their short-term borrowing and locking-in longer-term credit at historically low rates. In contrast, this paper finds no support for the view that eurozone-related liquidity shocks at MMFs slimmed the financing available to U.S. and Canadian companies.

The eurozone banking crisis was an acid test for the hypothesis of international transmission of liquidity shocks through MMFs. At the start of the crisis, the median prime MMF had nearly half of its assets invested in European businesses. Given this, the fact that such a transmission did not occur indicates that the future risk of transmission is slight. These findings point to the stabilizing impact of reforms to MMFs enacted by the SEC in 2010. Nonetheless, it is conceivable that an even deeper crisis might expose a spillover mechanism. Funds typically

had more European holdings than they did outflows. This fact along with the short-maturities of MMF holdings and the moderate pace of the crisis allowed funds to meet redemptions by reducing European investments. Had outflows far surpassed European assets, funds might have curtailed financing available to issuers headquartered in North America. However, this scenario has not yet occurred.

Given this finding, rather than focus on the implications of fund eurozone investment, future researchers might better explore how to insulate funds from the effect of Treasury exposure should Federal debt limit crises become recurring events. Since the objective of this paper is to identify an "international" transmission channel, attention is restricted to the eurozone crisis of June 2011. However, prior research suggests that the U.S. debt ceiling stalemate of late-July and early-August 2011 drove outflows from MMFs at nearly twice the rate of the eurozone crisis. Evidence in this paper lends some circumstantial support to the possibility that liquidity constrained funds pulled back from U.S. banks over the weeks preceding the debt ceiling resolution. Quantifying the real economic effects of such a pull-back might have interesting political implications – encouraging compromise and deterring future crises.

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A Variable Definitions

Quantity Measures:

- $M_{i,f}$: This is the aggregate value (in dollars) of all of fund f's investments in issuer i at a given point in time.
- M_i: This is issuer i's total outstanding debt held by prime funds at a given point in time, such that $M_i = \sum_f M_{i,f}$.
- $\%\triangle M_{i,f}$: This variable measures percentage changes in issuer-fund relationships. It is calculated as the end of May to the end of June change in the value of all of fund f's investments in issuer i expressed as a percentage of that value as of the end of May. Thus, $\%\triangle M_{i,f} = \frac{\triangle M_{i,f,t}}{M_{i,f,t-1}}$.
- $REL\triangle M_{i,f}$: This measure captures the value of relationship changes from the perspective of the issuer. It is calculated as the end of May to the end of June change in the value of all of fund f's investments in issuer i expressed as a percentage of issuer i's total prime MMF financing as of the end of May. Thus, $REL\triangle M_{i,f} = \frac{\triangle M_{i,f,t}}{M_{i,t-1}}$.
- $EXIT_{i,f}$ and $ENTER_{i,f}$: These binary variables equal one if a issuer-fund relationship closed or opened, respectively, and zero otherwise. The snapshots used for comparison are as of the end of May and the end of June. Thus, for example, if fund f held \$500 thousand of issuer i's debt as of the end of May ($M_{i,f} = \$500,000$) but had no investments in issuer i as of the end of June ($M_{i,f} = \$0$), then $EXIT_{i,f} = 1$.
- $\triangle M_i / STB_i$: This is the Q1 to Q2 2011 change in the ratio of issuer i's total borrowing from prime funds (M_i) over its total short-term borrowing (STB_i). This variable is expressed in percentages.

Price Measures:

- $YIELD_{i,f}$: This is the value-weighted average yield on all of fund f's investments in issuer i ($YIELD_{i,f}$) as of the end of May. In cases where the financing relationship opened in June, such that fund f's investment in issuer i was zero in May and non-zero in June, the end of June value of $YIELD_{i,f}$ is employed. This is done so that issuer-fund relationships that open for the first time in June do not have missing values.
- $\bar{YIELD}_i$: This is the value-weighted average yield on all prime funds' investments in issuer i measured as of the end of May. Thus, $\bar{YIELD}_i = \sum_f \left[\frac{M_{i,f}}{M_i} \times YIELD_{i,f}\right]$.
- $\bar{YIELD}_f$: This is the fund's 7-day simple gross annualized yield.

Key Explanatory Variables:

Fund Supply Proxies

- $EURO_f$: This is a prime fund's exposure to the "riskier" securities issued by eurozone banks as of the end of May. It is measured as the percentage of a fund's assets invested in non-repo securities issued by eurozone banks with maturities of greater than one week.
- $\bar{EURO}_i$: This is the value-weighted average eurozone bank exposure ($EURO_f$) of the funds financing the issuer as of the end of May. Thus, $\bar{EURO}_i = \sum_f \left[\frac{M_{i,f}}{M_i} \times EURO_f\right]$, where all variables are measured as of the end of May. Therefore, the eurozone exposure of a fund that opens a relationship with the issuer in June is not included in this measure.
- $INFLOW_f$ and $OUTFLOW_f$: These measures are derived from a fund's net new cash flow in June as a percentage of its end of May assets. This value is split apart such that: $INFLOW_f$=$NETFLOW_f$ if $NETFLOW_f > 0$ and zero otherwise; $OUTFLOW_f$=$NETFLOW_f$ if $NETFLOW_f < 0$ and zero otherwise.
- $\triangle M_{-i,f}$: This is the value of debt outstanding between fund f and all U.S. and Canadian issuers in the sample (both financial and nonfinancial) excluding issuer i as of the end of June expressed as a percentage change relative to the average value over the prior 3 months (March-May). It is intended to capture a fund's generalized supply of loans.
- $\left(YIELD_{i,f} - \bar{YIELD}_f\right)$: This variable measures the return on a given financing relationship relative to the fund's gross yield as of the end of May. Large positive values signal a relatively higher yielding (and, perhaps, riskier) relationship compared to the fund's average.

Issuer Demand Proxies

- $\triangle M_{i,-f}$: This is the value of issuer i's debt outstanding to all prime funds excluding fund f as of the end of June expressed as a percentage change relative to the average value over the prior 3 months (March-May). It is intended to capture an issuer's generalized demand for prime fund financing.
- $\left(YIELD_{i,f} - \bar{YIELD}_i\right)$: This variable measures the cost of a given financing relationship relative to the issuer's other prime fund financing as of the end of May. Large positive values signal a relatively expensive relationship from the perspective of the issuer.

Other Variables and Controls:

- $NUMFUNDS_i$: This counts the number of unique funds that financed an issuer at some point during the period from November 2010 to June 2011. It is a measure of the issuer's substitution opportunities within MMFs.
- $\bar{MATURITY}_i$: This is the value-weighted average final maturity (in days) on issuer i's outstanding debt to prime funds as of the end of May.

- $STRENGTH_{i,f}$: This variable measures the strength of the financing relationship between issuer i and fund f. It is the average portion of issuer i's total prime MMF financing that is provided by fund f, averaged over the 8 month period November through June. Thus, $STRENGTH_{i,f} = \frac{1}{8}\sum_{t=1}^{8}\left[\frac{M_{i,f,t}}{M_{i,t}}\right]$. This measure incorporates both the relative value and consistency of the relationship.

- $log(ASSETS_i)$: This is the log of an issuer's total assets as reported on its Q1 2011 balance sheet.

- M_i/TB_i: This the ratio of an issuer's aggregate borrowing from prime MMFs over the issuer's total borrowing. It is measured as of Q1 2011 (i.e., March 31, 2011). Large values signal that the issuer is either more reliant on or overweight on prime MMF financing. This variable is expressed in percentages.

B July 2011 Regressions

Table 9: July 2011 Relative Changes in Issuer-Fund Relationships - Supply Effects

These are cross-sectional regressions measuring one month changes (June 30 to July 31, 2011) in issuer-fund relationships. Regressions are run separately for financial and nonfinancial issuers. The dependent variable is $REL\triangle M_{i,f}$, the July change in fund f's investments in issuer i as a percentage of issuer i's total prime MMF financing as of the end of June. Key explanatory variables include three instruments designed to capture movements in a fund's supply of financing ($EURO_f$, $\triangle M_{-i,f}$, and $OUTFLOW_f$) . I control for an issuer's fund-specific demand for financing using the yield spread between a particular relationship and the issuer's overall average, ($YIELD_{i,f} - \bar{YIELD}_i$), and using a measure of relationship strength ($STRENGTH_{i,f}$). All variables are described in detail in Appendix A (however, in this robustness check, all variables are measured one month ahead). In all regressions, the intercept is allowed to vary by issuer (i.e., issuer-fixed effects are used). The dataset includes only issuers that are financed by at least two funds in June and at least one fund in July. The dependent variable, $REL\triangle M_{i,f}$, is winsorized at the 1st and 99th percentiles. Standard errors are clustered by fund. Estimates with a p-value below 0.10, 0.05, and 0.01 are marked with a *, **, and ***, respectively.

Dependent variable: $REL\triangle M_{i,f}$

Issuer samples:	North American Financials			North American Nonfinancials		
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
$EURO_f$	-0.022			0.127*		
	(0.013)			(0.071)		
$\triangle M_{-i,f}$		0.004			-0.005	
		(0.003)			(0.009)	
$INFLOW_f$			0.022			0.069
			(0.016)			(0.084)
$OUTFLOW_f$			-0.039**			-0.090
			(0.018)			(0.077)
$(YIELD_{i,f} - \bar{YIELD}_i)$	0.016***	0.016***	0.016***	-0.002	0.017	0.021
	(0.006)	(0.006)	(0.006)	(0.023)	(0.020)	(0.018)
$STRENGTH_{i,f}$	12.896	12.977	12.705	-6.705	-7.019	-6.668
	(10.594)	(10.604)	(10.420)	(15.291)	(15.138)	(14.781)
F.E.	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer
N	1,748	1,745	1,672	734	734	715
Adj. R^2	0.22	0.22	0.23	0.30	0.30	0.30

Table 10: July 2011 Relative Changes in Issuer-Fund Relationships - Demand Effects

These are cross-sectional regressions measuring one month changes (June 30 to July 31, 2011) in issuer-fund relationships. Regressions are run separately for financial and nonfinancial issuers. The dependent variable is $REL\triangle M_{i,f}$, the July change in fund f's investments in issuer i as a percentage of issuer i's total prime MMF financing as of the end of June. Explanatory variables include $(YIELD_{i,f} - \bar{YIELD}_f)$, which measures the yield on the relationship relative to the fund's yield. I let variable compete with $(YIELD_{i,f} - \bar{YIELD}_i)$, which measures the yield on the relationship relative the average yield on all of the issuer's debt to prime MMFs. $\triangle M_{i,-f}$ is the change in issuer i's outstanding debt held by all prime MMFs excluding fund f. I include the logged value of the issuer's total outstanding as of the end of May, $log(M_i)$. I also control for the number of unique funds that financed the issuer at some point during the period from November 2010 to June 2011 ($NUMFUNDS_i$). All variables are described in detail in Appendix A (however, in this robustness check, all variables are measured one month ahead). In all regressions, the intercept is allowed to vary by fund (i.e., fund-fixed effects are used). The dataset includes only issuers that are financed by at least two funds in June and at least one fund in July. The dependent variable, $REL\triangle M_{i,f}$, is winsorized at the 1st and 99th percentiles. Standard errors are clustered by issuer. Estimates with a p-value below 0.10, 0.05, and 0.01 are marked with a *, **, and ***, respectively.

Dependent variable: $REL\triangle M_{i,f}$

Issuer samples:	North American Financials			North American Nonfinancials		
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
$(YIELD_{i,f} - \bar{YIELD}_f)$	0.004	0.024**	0.024**	-0.039		
	(0.036)	(0.012)	(0.011)	(0.074)		
$(YIELD_{i,f} - \bar{YIELD}_i)$	0.020			-0.038	-0.077**	-0.066*
	(0.034)			(0.083)	(0.033)	(0.033)
$\bar{YIELD}_i$		-0.020	-0.007		-0.039	-0.002
		(0.034)	(0.023)		(0.074)	(0.048)
$\triangle M_{i,-f}$			0.015**			0.008**
			(0.007)			(0.004)
$NUMFUNDS_i$	0.007	0.007	0.006	0.101**	0.101**	0.054*
	(0.007)	(0.007)	(0.007)	(0.040)	(0.040)	(0.031)
$log(M_i)$	-0.409	-0.409	-0.276	-4.532***	-4.532***	-2.103*
	(0.415)	(0.415)	(0.369)	(1.618)	(1.618)	(1.175)
$F.E.$	Fund	Fund	Fund	Fund	Fund	Fund
N	1,748	1,748	1,748	734	734	734
Adj. R^2	0.00	0.00	0.02	0.21	0.21	0.20

C Reconciliation with Prior Research

The findings presented in Section 4 differ from those of prior research on this topic. While Chernenko and Sunderam (2014) found strong evidence of a micro-level negative relationship between fund eurozone bank exposure and financing outcomes for issuers, I do not. This Appendix attempts to reconcile the two results, finding that they diverge, at least in part, because of a different dependent variable specification. Specifically, Chernenko and Sunderam (2014) import from the bank lending literature the approach of studying percentage changes in issuer-fund relationships ($\%\triangle M_{i,f}$). For reasons detailed in Section 2.3, I study "relative" changes in issuer-fund relationships ($REL\triangle M_{i,f}$).

Table 11 shows results from a regression specification similar to that employed in prior research.[26] This specification follows the framework of Equation (2) but uses percentage changes in issuer-fund relationships ($\%\triangle M_{i,f}$) as the dependent variable. A fund's eurozone bank exposure ($EURO_f$) and controls for yield and issuer-fixed effects are on the right side. The sample size declines relative to the regressions in Table 5 for two reasons. First, due to division by zero, percentage changes will only be defined for issuer-fund relationships that were nonzero in May. Thus, relationships that opened in June are excluded (e.g., Bemis' relationship with fund "E" in Table 2). Second, the 10 most widely held domestic issuers are excluded to be consistent with Chernenko and Sunderam (2014), who argue that relationships with MMFs are likely to be less important for these issuers.[27,28]

Although, for financial issuers, there is no association between $EURO_f$ and $\%\triangle M_{i,f}$, for nonfinancial issuers, the association is negative and large in magnitude – an MMF with a 10% larger (roughly one standard deviation) exposure to eurozone banks reduces its exposure to a given issuer by 17.8 percent more. Interestingly, if this same regression is run over June 2014, a period when the eurozone was relatively stable, a similar association appears (column 2PLB).[29] Clearly, this specification is reflecting information that is unrelated to fund supply shocks. The question is what.

Chernenko and Sunderam (2014) write that their results hinge on the portion of issuer-fund relationships that close over the summer of 2011. To verify that this phenomenon also applies here, in columns (2) and (4), I repeat the regression after removing those observations that closed in June (i.e., where $\%\triangle M_{i,f} = -100\%$). Indeed, the negative association between fund eurozone exposure and percentage changes in relationships with nonfinancial issuers becomes statistically zero. Perhaps, there is some characteristic of financing relationships between issuers and funds with greater eurozone bank exposure that causes them to be closed in June.

[26] My sample differs from these researchers in several ways. Notably, I have restricted my issuer sample to only U.S. and Canadian firms, rather than all non-European firms, and limited my analysis to the month before the U.S. debt ceiling impasse. However, the variables and sample restrictions employed in this table are chosen to be at least somewhat consistent with Chernenko and Sunderam (2014).

[27] The top 10 most widely held U.S. and Canadian firms are J.P. Morgan Chase, Citigroup, Bank of Nova Scotia, Royal Bank of Canada, Bank of America, General Electric, Toronto-Dominion Bank, Bank of New York Mellon, Bank of Montreal, and Goldman Sachs.

[28] Removing the 10 most widely held U.S. and Canadian issuers only makes my results from Section 4 stronger (not shown for brevity).

[29] In fact, during 2014, I also find a negative association between a fund's eurozone holdings and its relationships with financial issuers (column 1PLB).

Table 11: Reconciliation - Percentage Changes in Issuer-Fund Relationships

These are cross-sectional regressions measuring one month changes (May 31 to June 30, 2011) in issuer-fund relationships. Regressions are run separately for financial and nonfinancial issuers. The dependent variable is $\%\triangle M_{i,f}$, the June change in fund f's investments in issuer i as a percentage of fund f's investments in issuer i as of the end of May. Explanatory variables include $EURO_f$ and $(YIELD_{i,f} - \bar{YIELD}_i)$. All variables are described in detail in Appendix A. In all regressions, the intercept is allowed to vary by issuer (i.e., issuer-fixed effects). The dataset includes only issuers that are financed by at least two funds in May and at least one fund in June. In all columns, the 10 most widely held issuers are removed (to be consistent with Chernenko and Sunderam (2014)). Columns (1) and (2) include all sample issuer-fund relationships that were non-zero as of the end of May. Columns (1P) and (2P) show the results of a placebo regression run over May-June 2014. Columns (1H) and (2H) exclude issuer-fund relationships that completely closed during June (i.e., $\%\triangle M_{i,f} = -100\%$). The dependent variable, $\%\triangle M_{i,f}$, is winsorized at the 5th and 95th percentiles. Standard errors are clustered by fund. Estimates with a p-value below 0.10, 0.05, and 0.01 are marked with a *, **, and ***, respectively.

Dependent variable: $\%\triangle M_{i,f}$

Issuer type:	North American Financial			North American Nonfinancial		
Independent variables	(1)	(1PLB)	(2)	(3)	(3PLB)	(4)
$EURO_f$	0.294	-0.679**	0.163	-1.782***	-1.253**	-0.457
	(0.284)	(0.331)	(0.295)	(0.496)	(0.606)	(0.504)
$(YIELD_{i,f} - \bar{YIELD}_i)$	0.472**	0.631***	0.124	0.477	0.593***	-0.237
	(0.213)	(0.189)	(0.205)	(0.448)	(0.178)	(0.388)
F.E.	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer
N	547	748	492	418	294	337
Adj. R^2	0.12	0.10	0.06	0.19	0.20	0.17

Table 12 explores some possible fund characteristics driving this result. These are logistic regressions evaluating the extensive margin across fund relationships with nonfinancial issuers. In particular, holding fixed the issuer, the regressions ask whether relationships with funds with greater eurozone bank exposure are more likely to be closed and/or entered during June 2011. The dependent variable, $EXIT_{i,f} \in \{0,1\}$, equals 1 if an existing relationship is completely zeroed-out in June. The other dependent variable, $ENTER_{i,f} \in \{0,1\}$, equals one if a relationship opens in June (i.e., the relationship did not exist in May). Column (1) implies that relationships with funds with more eurozone investments are indeed more likely to be exited. Compared to a fund with no eurozone bank exposure, a fund with 20% of assets invested in eurozone banks (roughly the 75th percentile) would have a 9 percent $[exp(0.117 \times 20) - 1) * 100\%]$ greater odds of closing its relationship with a given issuer. This result weakens in column (2), however, when over 130 relationships that opened in June 2011 are no longer excluded.[30] Now, a relationship between an issuer and a fund with 20% exposure would have only 1 percent greater odds of being closed-out. Importantly, MMFs with greater eurozone exposure are also more likely to *enter* relationships with U.S. and Canadian nonfinancial issuers in June (column 4). Here, a fund with 20% exposure would have 5 percent $[exp(0.088 \times 20) - 1) * 100\%]$ greater odds of opening a relationship with the issuer in June.[31]

There are a few possible explanations. One is that funds with greater eurozone bank investments tend to be more discerning in their financing of issuers. Arguably, funds with the

[30] These are the 130 relationships that are omitted when the dependent variable is measured in percentage changes (due to division by zero). Since these relationships had zero value in May, they could not possibly have been exited (i.e., $EXIT_{i,f} = 0$ for these observations).

[31] As a side note, funds with greater outflows are also more likely to open relationships with North American nonfinancial issuers (column 5).

Table 12: Reconciliation - Extensive Margin and Consistency in Issuer-Fund Relationships

These are cross-sectional regressions studying relationships between MMFs and nonfinancial issuers. The regressions are logistic, where the dependent variables, $EXIT_{i,f}$ and $ENTER_{i,f}$, are binary, equaling 1 if the issuer-fund relationship was closed or opened, respectively, in June 2011 and equaling zero otherwise. Coefficients give the change in the log odds of the outcome for a one unit increase in the predictor variable. Explanatory variables include $EURO_f$, $INFLOW_f$,$OUTFLOW_f$, and $(YIELD_{i,f} - \bar{YIELD}_i)$. All variables are described in detail in Appendix A. In all regressions, the intercept is allowed to vary by issuer (i.e., issuer-fixed effects). The dataset includes only issuers that are financed by at least two funds in May and at least one fund in June. In all columns, the 10 most widely held issuers are removed (to be consistent with Chernenko and Sunderam (2014)). Column (1) includes only sample issuer-fund relationships that were non-zero as of the end of May (i.e., where $\%\triangle M_{i,f}$ is identified). Standard errors are clustered by fund. Estimates with a p-value below 0.10, 0.05, and 0.01 are marked with a *, **, and ***, respectively.

Issuer type:	North American Nonfinancial				
Dependent variable:	$EXIT_{i,f}$			$ENTER_{i,f}$	
Independent variables	(1)	(2)	(3)	(4)	(5)
$EURO_f$	0.117***	0.037**		0.088***	
	(0.026)	(0.017)		(0.018)	
$INFLOW_f$			0.039		0.032
			(0.044)		(0.039)
$OUTFLOW_f$			0.023		0.057***
			(0.022)		(0.022)
$(YIELD_{i,f} - \bar{YIELD}_i)$	-0.085***	0.006	0.006	-0.258***	-0.214***
	(0.032)	(0.017)	(0.017)	(0.037)	(0.035)
F.E.	Issuer	Issuer	Issuer	Issuer	Issuer
N	418	551	551	551	551
Adj. R^2	0.35	0.21	0.20	0.24	0.21

economies-of-scale required to research international credits (and invest more in the eurozone) are also able to research a wider array of North American firms. In turn, this could make them shift financing between issuers more opportunistically. A shift could happen if, for instance, one issuer begins to offer a comparatively higher yield at a shorter maturity. This possibility might work in tandem with another explanation: that eurozone-exposed MMFs tend to invest in those issuers that subsequently receive better financing opportunities. As these issuers became less willing to roll their outstanding loans, funds open relationships with other domestic nonfinancial issuers during June. The coefficients on $(YIELD_{i,f} - \bar{YIELD}_i)$ signal that, while relationships that close are not necessarily more expensive, relationships tended to open at a lower cost than the issuer's average. This observation is consistent with Figure 5b and with prior evidence that cost incentives drove financing outcomes during the summer of 2011.

Shifting across issuers by a subset of funds can make regression results misleading. Since the percentage change dependent variable ($\%\triangle M_{i,f}$) only captures relationships that close and not those that open, certain financiers will appear more likely to eliminate their investments in domestic issuers when, in fact, they are merely shifting their financing from one issuer to another. Measuring the the dependent variable in "relative" changes helps manage this selection bias.[32]

[32]This reconciliation is not intended to rule out the possibility that other differences in method, discussed in Sections 2, contribute to the disparity between this paper's results and those of prior research.