Liquidity and Shadow Banking

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Abstract

Using a unique dataset of detailed portfolio holdings we study the behavior of US money market mutual funds in the context of the European sovereign debt crisis. These important players in the shadow banking sector have proven particularly vulnerable to liquidity shocks in recent periods of market instability. We show that newly introduced liquidity requirements have increased the resilience of prime funds. We also see that funds increase their liquidity when uncertainty about investors' redemptions increases. Investors respond negatively to higher fund liquidity when markets are calm but react positively in crisis periods. However, this positive response is limited to funds that do not have highly risky portfolios.

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1. Introduction

Money Market Mutual Funds (MMMFs) are important suppliers of short-term funding[2]. They hold considerable amounts of debt instruments[3] issued by financial and non-financial institutions and governments. In addition, they serve as a valuable cash management apparatus for individuals, firms and governments. MMMFs have been understood to be safe havens for deposit-like investments and to provide higher returns than regular deposit-taking banks. Some researchers see them as "narrow banks" that are reliable liquidity providers even in the times of crisis (Miles 2001; Pennacchi 2006). Indeed, from 1983, when SEC rule 2a-7 was first introduced, until September 2008 when the Reserve Primary Fund lowered its share price below $1 due to its exposure to Lehman Brothers, only one fund broke the buck, in 1994. This perceived safety attracted a risk-averse shareholder base which has resulted in increased vulnerability to runs. Given the size of MMMFs and their important role in providing short-term financing, this inherent fragility poses a significant threat to the stability of the financial system. This was evident in the crisis that erupted in September 2008 which worsened already weak investor confidence in short-term credit markets. Large scale investor redemptions in MMMFs followed, specifically in the prime MMMFs that invest in corporate debt instruments. These large scale outflows caused short-term funding markets to shrink considerably resulting in a credit crunch (Board of Governors of the Federal Reserve System 2009; U.S. Securities and Exchange Commission 2009; President's Working Group on Financial Markets 2010). The damage caused by runs led to government interventions to support MMMFs.

These events were repeated, to a lesser extent, during the European sovereign debt crisis. In June 2011, as the Eurozone crisis worsened, concerns about substantial Eurozone bank exposures in US prime MMMFs increased, which led shareholders to withdraw approximately $162 billion between June and August. The substantial outflows risked straining money markets (FSOC 2011). According to Chernenko and Sunderam (2014), these redemptions squeezed short-term markets, which led to reduced lending to creditworthy non-European

[2] In this paper, we investigate US prime Money Market Mutual Funds (MMMF). In the US, MMMFs are registered under the Investment Company Act of 1940 and regulated by the Securities and Exchange Commission (SEC) under Rule 2a-7. This rule imposes liquidity and diversification requirements, maturity limits, portfolio quality restrictions, enhanced disclosure, and stress testing requirements. These funds invest in instruments such as US treasury bills, repurchase agreements, certificates of deposit, ABCP, commercial paper, bank notes, and corporate notes. A fund can invest in assets with remaining maturity of no more than 397 days.

[3] The global MMMF industry amounts to 4.7 trillion dollars of assets, out of which United States MMMFs account for 2.6 trillion dollars (ICI fact book 2015) or 58% of the market share. At the end of 2012, MMFs held 40 percent of dollar denominated financial commercial paper, and 29 percent of time deposits of banks issued in the United States (McCabe et al 2013).

issuers. McCabe et al (2013), also argue that redemptions from prime MMMFs caused a decrease in the supply of lending to US non-financial firms, hence adversely affecting the US economy. Such disruptions caused by MMMFs during crisis periods, prompted government[4], academics[5] and industry professionals[6] to call for regulatory reforms.

In response to these episodes, the Securities and Exchange Commission (SEC) introduced two reforms. The first one in May 2010 sought to improve the resilience and transparency of the funds. It was aimed at increasing liquidity, decreasing average portfolio maturity, requiring fund managers to understand the behaviour of the funds' investors, introducing stress testing procedures, and requiring funds to report detailed portfolio holdings data every month which were made available to the public after 60 days. After the repetition of runs during the sovereign debt crisis in 2011, the SEC adopted further reforms in 2014, and imposed further restriction on liquidity and portfolio concentration, improved reporting requirements and also introduced changes in the structure of MMMFs.

It is of great interest to know whether these reforms have proved effective at reducing the instability of prime money market mutual funds. In this paper, we specifically study the impact of reforms targeted at improving portfolio liquidity. We investigate the extent of changes that the funds have undergone in order to meet the liquidity requirements. In addition, we test whether such changes have provided more stability to money market funds. We collate a unique dataset, which includes detailed portfolio holdings of the funds before and after the 2010 amendments to the 2a-7 rule. This is the first paper to assess the effectiveness of the reforms using detailed pre- and post-reform data. Furthermore, we examine whether the funds are aware of the redemption behavior of their investors and change the liquidity holdings of their portfolio accordingly. We exploit large cross-sectional differences between liquidity holdings of MMMFs to examine fund and investor characteristics that determine observed liquidity levels. Finally, it is well known that investors use MMMFs to manage their cash and value the liquidity provided by such funds. However, there has not been empirical evidence that establishes a link between the liquidity of the funds and the response of investors to it during tranquil and crisis times. In this study we explore this issue and establish how liquidity can influence investment decisions of MMMF shareholders.

[4]Schapiro (2010, 2012), President's Working Group on Financial Markets (2010), and Financial Stability Oversight Council (2011).
[5] Squam Lake Group (2011), Hanson, Scharfstein, and Sunderam (2014) and Chernenko and Sunderam (2014).
[6] Goebel, Dwyer, and Messman (2011) and Mendelson and Hoerner (2011).

In this paper we investigate the effects of the 2010 reform. More specifically, the reform led to (1) an increase in liquidity holdings of prime funds by imposing a floor on daily and weekly liquidity levels. Funds are expected to hold at least 10% of their net assets in daily liquid assets and 30% of their net assets in weekly liquid assets[7]. (2) The weighted average life (WAL) is restricted to 120 days. (3) A "know your investor" requirement was introduced where funds are expected to assess the characteristics of their investors in order to determine their redemption behaviour and adjust the liquidity levels above the minimum requirements, accordingly.

There is abundant literature on the negative effects of outflows on remaining investors in the fund (Edelen, 1999; Nanda et al. 2000). Also, heavy redemptions impose cost on funds by forcing them to sell assets at fire sale prices (Nanda et al. 2000; Chen et al. 2010). During heavy redemption periods the funds could take a few days before their cash balances are fully restored, which may affect the investors who remain in the fund. Therefore, there is an incentive to withdraw earlier than others, which results in "self-fulfilling runs". Jank and Wedow (2015), argue that this negative externality could be worse in funds with higher illiquidity. They study Variable Net Asset Value (NAV) German money funds, and show that the funds with higher liquidity during good times have lower inflows, while such funds have lower outflows in the bad times. In other words, the liquid funds are unattractive to investors in times of high market liquidity but become attractive when the market illiquidity is high. We conduct a similar investigation for Stable NAV US prime money market funds and explore the role of liquidity in distressed funds during the crisis when the source of distress is endogenous to fund portfolios. We add to this literature by showing that if the source of risk is fund-specific (for instance, risk from the fund's portfolio holdings), keeping higher liquidity does not significantly impact the negative inflows for the funds that hold higher risk.

Koppenhaver (1999) shows that the portfolio characteristics of the funds affect the returns that investors receive and, as a result, influence the performance of the funds. For instance, increasing the share of commercial paper, which have considerably more credit risk than government securities, could increase the return. Furthermore, investing in longer maturities could also increase the performance of the fund. Additionally, Chernenko and Sunderam (2014) find that the funds that perform better receive higher inflows. Clearly, from the evidence presented above, the funds that hold higher liquidity in the form of short-term investments and

[7] See Appendix A for definitions of weekly and daily liquidity.

safer assets, such as government and agency securities, could lose out because they earn a lower yield and have lower inflows. Still we observe that the funds hold much more liquidity than prescribed by SEC rule 2a-7. We add to the literature by investigating the factors that lead to such a decision. We find that investor behavior plays a crucial role in funds' decisions about their level of liquidity. That is to say, the funds properly assess the characteristics of their investors and adjust their portfolio composition accordingly. Highly unpredictable redemption behavior leads to a higher liquidity cushion, which leads to lower returns. This implies that the investors' own behavior influences the decisions of the funds and the returns earned.

Recent literature focuses on risk spillovers from MMMFs during the global financial crisis and sovereign debt crisis. Wermers (2011) analyzes US MMMF before and after the global financial crisis and finds that the runs on the funds were not just due to panic but seemed to be stronger in the funds serving more sophisticated investors and the funds with lower liquidity. Chernenko and Sunderam (2014), Schmidt et al (2013) and Gallagher et al (2015) show that the runs in the funds that serve institutional investors were more likely than the funds that serve retail investors. McCabe (2010) analyzes portfolio risk, sponsor risk and investor risk that a fund is subjected to. He finds that the ability of the sponsor to absorb losses increased investor confidence in 2007 during the ABCP crisis. Indeed, even though some of these funds suffered capital losses, the investors did not respond by withdrawing their funds, because they believed the sponsors will absorb losses. Also, Strahan and Tanyeri (2015) and Schmidt et al (2013) argue that redemptions from the funds during crisis episodes are usually concentrated among the riskier funds. This shows that the investors are well informed about the quality of the portfolio and make their decisions to redeem investments accordingly. We add to the literature by studying the redemption behavior of investors in a crisis scenario, when the fund holds riskier securities in combination with higher liquidity. We show that investors are more concerned about the portfolio quality and risk characteristics of the funds rather than the funds' liquidity levels. That is, investors keep withdrawing from funds with risky investments regardless of their level of liquidity.

Our paper is related to the literature that investigates whether amendments to rule 2a-7 have proved effective in reducing the potential of money market fund runs. Gallagher et al. (2015) study whether the "know your investor" requirement has succeeded in reducing the run-like behavior in MMMFs, by investigating the redemption behavior of institutional and retail investors and the response of funds to such investors. They find out that funds catering to institutional investors experience more flow volatility and, therefore have higher holdings of

liquid assets. We add to this literature by assessing whether funds are aware of the redemption behavior of the investors they serve, and hold liquidity accordingly. We further divide the analysis into "calm" and "crisis" periods, and find that the funds are aware of the redemption behavior of their investors. They respond by holding higher liquidity if flow volatility is higher and increase their liquidity levels in crisis times, depending upon expected redemption patterns.

The paper is organized as follows. Section 2 provides a description of the data employed in the analysis. Section 3 presents the empirical analysis and the results. Section 4 concludes.

2. Data description

The paper utilizes detailed portfolio holding reports of Money Market Mutual Funds (MMMFs) which are filed with the Securities and Exchange Commission (SEC) monthly (N-MFP), quarterly (N-Q), semi-annually (N-CSRS) and annually (N-CSR). These forms are available publicly from the SEC EDGAR database. Before the amendments to rule 2a-7 in 2010, the funds' management companies were required to report portfolio holdings quarterly. They used N-Q in the first and third quarter and second and fourth quarter on N-CSRS. The amendments to Rule 2a-7 that were introduced in May 2010 required MMMFs to file monthly report on form N-MFP, which includes a detailed schedule of monthly portfolio holdings of money funds, starting from November 2010. Before November 2010, portfolio holdings data is available with quarterly frequency. We use quarterly (N-Q), semi-annual (N-CSRS) and annual (N-CSR) reports filed by the funds during the pre-reforms period (January 2009 -December 2009).[8] Restrictions on WAL and liquidity did not exist before SEC amendments to Rule 2a-7 in May 2010, so these are not reported on these forms. Therefore, we calculate these variables ourselves. Even though the measures are reported quarterly, these are comparable to the monthly portfolio holdings on N-MFP because both are the snapshots of the portfolio holdings on the reporting date.

Our final dataset includes data from January 2009 to December 2012. We divide the data into pre-reform (January 2009-December 2009)[9,10] and post-reform (February 2011-September

[8] N-Q, N-CSRS and N-CSR contain information about multiple funds managed by a management company. We make sure to extract only the relevant data for prime money market funds.

[9] This period has only four observations for each fund, and therefore is equivalent to having four-month data. This is one of the reasons why other periods are also divided into four-month period.

[10] We choose this period for two reasons. Before Q1 2009 in Q3-Q4 2008, during the time of Lehman bankruptcy the funds were in distress so that period is not very feasible for pre-reform period because we need to assess the characteristics of funds in normal times to correctly identify the true effect of regulatory changes. We do not use

2011). Post reform is further divided in "Calm" (February 2011-May 2011) and "Crisis" (June 2011 – September 2011) period[11].

To the best of our knowledge this is the first paper to use the detailed portfolio holdings of the MMMFs both before and after reforms to assess the impact of liquidity regulation on money market funds. We have complied the detailed portfolio holdings data from three different forms N-Q, N-CSRS and N-CSR, and built a pre-reform dataset which gives us snapshots of the portfolio data each quarter. The reporting on these forms, unlike N-MFP, is not standardized, and therefore partly required manual extraction. Then, an algorithm was used to create a standardized dataset. In the dataset, we focus on prime money market funds, as these funds are more vulnerable to risk spillovers because of their portfolio holdings in corporate debt. Moreover, during the 2011 crisis, distress was higher in this category of money funds, because they were the only ones who could hold substantial exposure to Eurozone banks, which were the main source of instability in the Summer of 2011. Our final dataset excludes feeder funds (i.e. funds that invest in other funds), internal funds, municipal funds, and variable annuities[12] which gives us total of 189 prime funds in the post-reform period.[13]

The amendments to Rule 2a-7 that were introduced in February 2010, required MMMFs to file form N-MFP every month. The form includes a detailed schedule of monthly portfolio holdings of money funds, starting from November 2010. This form provides information about fund-level variables like total net assets, assets of share classes, gross yield, and monthly shareholders subscriptions and redemptions. In addition, for each security held, it states issuer name, amount of principal, yield of security, legal maturity date, and the CUSIP number.

Next, we aggregate the issuer-level variables at the parent level. A fund, in a month, can hold more than one security from an issuer. Also, it can hold securities from subsidiaries and branches of the same parent. For instance, the securities issued by Bank of the West, Fortis funding LLC, Scaldis Capital LLC, Starbird funding corporation, as well the debt issued by

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the observations that are in Q1 2010, because the SEC regulations were introduced in February 2010 which became binding in May 2010, and therefore there is a possibility that the funds brought their level of liquidity and WAL in order to be able to meet the requirements if the policy. Included in regression could distort the results.

[11] The distress at MMMFs because from sovereign debt crisis worsened in June 2011 and its effects lasted until September 2011. Therefore, we conduct analysis for this period. This is another reason for four-month symmetric periods.

[12] The funds report their category in item 10. We keep the fund in the data if it reports itself as "prime" fund. Item 7 reports if it is a feeder fund. Variable annuities are reported in item 9. We also exclude two funds that hold only cash over the period of May-June 2011. Municipal funds are defined as funds that invest > 95% of their assets in municipal securities, such funds are dropped from the final dataset.

[13] Our final dataset includes prime funds with total of $ 1,670 billion in assets under management while they are $1,660 billion assets reported by ICI.

BNP Paribas SA are all aggregated under the parent company BNP Paribas SA.[14] Therefore, the issuer-level variables are aggregated at the parent level. Then, we designate the country names to the issuers, which is taken to be the country of incorporation of the parent issuer. So, for BNP Paribas SA the country is "France". This enables us to measure the total amount of investments in each country or a region. So, for instance we can measure the Eurozone bank share, EZB_{ft} of each fund.

We have done extensive sanitation checks and used alternative sources to correct data entry errors. For instance, the net yield of the funds provided on form N-MFP is occasionally incorrectly reported. We obtain the correct values for such funds from Bloomberg. Data for the LIBOR rate and treasury bills are sourced from the FRED database.

3. Empirical Analysis

3.1. Portfolio Composition before and after the 2010 reforms

In May 2010, amendments to rule 2a-7 required funds to hold no less than 30% of total assets in liquid securities, and restricted Weighted Average Life (WAL) of the portfolio to no more than 120 days. Before these amendments, no such requirements were in effect. To meet these requirements, funds were expected to make changes in their portfolio composition. Our primary aim is to assess the impact of the new liquidity requirements on the funds' portfolio composition in the post-reform period. To do so, we examine the mean level of the variables of interest before and after the reforms.[15]

In our sample, there is large cross-sectional variation in the pre-reform liquidity holdings of the prime funds. Several funds already held more than 30% of their assets in liquid investments while others were brought to the required minimum level as a result of the reforms. We assume that the funds that already meet the liquidity requirements are not affected by this amendment. So, we group these funds separately. The funds that hold at least 30% of assets in liquid

[14] The N-MFP fund does not specify the country of the issuers, so we use variety of other datasets to identify the country, industry, and parent of the issuers. Since the CUSIP number of the issuers is given, we use it to link the data extracted from N-MFP forms with other datasets. We use CUSIP master file (Source: WRDS database) which Amadeus, Bankscope, Osiris, and Bloomberg to procure information about industry, parent and country of the parent issuer.

[15] We conduct robustness test for table 1, by estimating two-way panel fixed effects estimator, similar in spirit to difference-in-differences estimator, to clearly identify the impact of the reforms. In effect, the model compares changes overtime in the "treated" funds that were affected by the policy intervention, to the "control" group which are deemed to be not affected, while controlling for time-constant differences across funds using fund fixed effects, and secular changes across time using time fixed effects. The estimation results reinforce the findings presented in table 1.

securities before and after the reforms are included in the "control" group. In contrast, the funds that hold lower levels of liquidity before the reforms are included in the "treated" group. These are the funds that are expected to be affected by 2010 amendments.

The reforms required the funds to hold more liquidity by imposing a liquidity floor, to enable them to meet high redemptions in distress. Moreover, by prescribing a weighted average life ceiling the reforms aim to keep funds from investing considerable amounts of money in longer dated maturities, which would result in higher risk. In this section, we assess the extent of the changes that have occurred in the portfolios of funds after the 2010 reforms, and how such changes have influenced the risk profile of the portfolios.

We examine the extent of the changes on weekly liquidity, LIQ_{ft} and weighted average life, WAL_{ft}, which are liquidity indicators as defined by the Securities and Exchange Commission (SEC). Of course, we would expect LIQ_{ft} to increase, and WAL_{ft} to decrease after the reforms, because of the required LIQ_{ft} floor and WAL_{ft} ceiling. Next, we divide weekly liquidity holdings into US treasury security, $GOVLIQ_{ft}$, government agency securities, $AGCYLIQ_{ft}$, and liquidity in the form of short-term securities, excluding government/agency securities, that mature within a week, $OTHLIQ_{ft}$. We do this, to find the type of instruments that funds utilize to meet liquidity requirements. Furthermore, we split the outstanding amount of investments into various categories based on the maturity of the instruments. $OA_{ft}^{1-90\ days}$ captures the amount invested in instruments that mature within 90 days, and $OA_{ft}^{270-397\ days}$ captures instruments that mature within 270 - 397 days. $WIY_{ft}^{1-90\ days}$ and $WIY_{ft}^{270-397\ days}$ measure the average issuer yield of the respective maturities, weighted by the outstanding amount of each instrument. In addition, we also examine the policy impact on the size of the funds, $SIZE_{ft}$.

Table 1, reports the means and statistical significance of the variables of interest. The results are reported for both the "treated" and "control" groups for the before reform (BR) and after reforms (AR) periods. Column. (3), shows that, on average, the treated funds increased their post-reform liquidity by approximately 14%. This is not surprising as the reforms set a liquidity floor for the funds and we expect an increase in liquidity in the funds that did not meet the requirement before the reform. In other words, the results capture the added liquidity in the average fund after the reforms. Furthermore, the funds can hold liquid assets in the form of cash, US treasury securities, US government agency securities and other short-term securities

that mature within a week. The table indicates that the funds have increased their liquidity in the form of government and agency securities as well as non-government securities. However, they hold lower liquidity in the form of government securities possibly because funds earn a lower yield on such securities than they can gain by holding riskier securities such as commercial paper and certificates of deposits. Therefore, they prefer to hold liquidity in short-term securities other than those issued by the government and agencies.

Clearly, in response to the reforms, funds on average have increased their demand for short-term securities by 14 % which is a considerable change. The 2010 amendments set the ceiling of WAL_{ft} to 120 days. To conform to these requirement, the treated funds decrease their WAL_{ft} by approximately 22 days. The coefficient for $OA_{ft}^{1-90\ days}$ indicates that the funds have increased their investments considerably in short-term securities maturing within three months. This is because of an increase in liquid securities holdings. The results for $OA_{ft}^{270-397\ days}$ indicate that the funds have decreased investment in securities that mature within 270 - 397 days which is what we would expect as a consequence of the required lower WAL_{ft}.

Increase in liquid assets is expected to translate into lower portfolio yields. Thus, we examine the impact on the average yield of the treated funds. The funds have decreased the average issuer yield, $WIY_{ft}^{1-90\ days}$ by 28 bps. This is the result of increased holdings of very short-term non-government securities and agency securities. In response to such a decrease, it is possible that the funds increased investment in higher yielding securities, to compensate for the drop in the earnings. We test this hypothesis and find that the funds, on average, are earning 33 bps higher yield from the investments in longer dated securities, $WIY_{ft}^{270-397\ days}$, after the reforms. These results are interesting, especially if combined with the previous findings that the amount invested in the longer maturity securities have decreased considerably. Therefore, the increase in the average issuer yield indicates that while the funds invest less in longer dated securities they are also investing in riskier securities. This is one of the unintended consequences of the reforms. The funds are offsetting the sharp decrease in yield earned from short-term securities by investing in higher yielding securities. This could, in times of distress, translate into higher tail risk for the funds and higher instability for the financial system as a whole. Next, columns (4-6) present results for the control group. After reforms, they have decreased their weekly liquidity holdings, apparently by significantly decreasing $OTHLIQ_{ft}$. One reason for this behavior could be that the funds use the new measure of weekly liquidity, provided by the SEC, as a benchmark for safer liquidity levels. As a result, they lower their

liquidity holdings. The control group, on average, increases the WAL_{ft}. But the average WAL_{ft} still remains lower than that of the treated funds. The control funds decrease average $WIY_{ft}^{1-90\ days}$ by 22 bps. This is possibly the consequence of a large drop in non-government short-term securities, $OTHLIQ_{ft}$, and of an increase in agency liquidity in the after-reform period (column 5). On average, the size of funds has not been influenced significantly. Column 9, shows the extent to which both groups have become (dis)similar, after the reforms. Overall, both groups have moved towards similar liquidity levels in the post-reform period (column 9). The control funds change their portfolio composition differently than treated funds, but still keep higher liquidity levels and lower average maturity than treated funds. In summary, we find that there have been considerable changes in the portfolio composition of funds. These changes have resulted in decreased portfolio yields and seem to have made funds less attractive to investors. These results are not surprising, but were to be expected following the 2010 reforms, and are a consequence of the objective to make funds more resilient. Next, we investigate whether the reforms indeed achieved this end.

3.2. Impact on resilience of funds

In the Summer of 2011, the sovereign debt crisis worsened and concerns about substantial Eurozone bank exposures of US prime MMMFs increased. This crisis period represents a natural experiment to test the effectiveness of the 2010 amendments in making funds more resilient. The investors withdrew extensively from the funds in the period from June – September 2011. Therefore, we focus on this period for our analysis.

First, we ask what would have happened if the funds had maintained the same level of liquidity they had before the reforms. For this we construct a counterfactual excess liquidity measure, C_EXLIQ_{ft} which is defined as the lagged average daily liquidity in excess of absolute outflows. This variable captures the amount of excess liquidity (or shortfall, if with a negative sign) that the funds would have maintained during the crisis, had they continued to hold the same level of liquidity they had before the reforms. We also calculate the actual excess liquidity, $EXLIQ_{ft}$ which is the difference between the absolute outflows and lagged daily liquidity.[16] We employ these to analyze the actual and counterfactual excess liquidity in treated

[16] In doing so, we are making two assumptions: First, we assume all the outflows reported for the month happen in a single day; Second, funds keep same level of daily liquidity in a specific month.

and control funds during the crisis. Together, we use these to capture the extent to which funds are more stable compared to the pre-reform period.

Columns (1-3) of Table 2 show that the treated funds have 19.44% excess liquidity $EXLIQ_{ft}$, after servicing the redemptions which, in the absence of reforms, would have been 5.85%. These figures show that there has been a considerable increase in the liquidity cushion, which was the primary aim of the requirements. Columns (4-6) show that the control funds have approximately 31% excess liquidity in the post-reform period, which would have been 27% had they kept the same amount of pre-reform average daily liquidity.

The results show that the funds have improved resilience against redemptions in the post-reform period and on average there was no shortfall of liquidity during the sovereign debt crisis. Moreover, as columns (2 and 5) indicate, even in the absence of reforms the funds held enough liquidity to service the redemption requests comfortably. However, it should be noted that the liquidity levels were set in response to the redemption behaviour of investors during the global financial crisis (2007-2008), a time when the funds experienced much higher distress than the episode under study. These results point towards decreased instability in the funds, following the reforms, during periods of instability. The funds are more resilient when under sustained pressure from high redemptions, as compared to their pre-reform condition.

In the previous two sections, we have focused on changes in the funds' portfolio composition and resilience, which could be attributed to the liquidity floor prescribed in the 2010 amendments. However, many funds tend to hold more liquid assets than the minimum regulatory requirements. Thus, we investigate further the fund characteristics that explain high levels of liquid assets even though such holdings lead to lower portfolio yields and make such funds less attractive. As there is considerable cross-sectional variation in the amount of liquidity that the funds hold, we are able to identify the factors that play a part in creating such heterogeneity.

3.3. Factors influencing liquidity holdings

In this section, we assess the features that influence the decision of funds to hold higher liquidity. At least half of the funds hold more liquidity than the 30% of net assets required by the 2010 amendments. One possible explanation could be that the funds maintain more liquidity in response to regulation that requires funds to "know your investor". Thus, the funds

that serve investors that are more unpredictable and sensitive to risk changes are expected to hold more liquidity, to comfortably service redemption requests.

The main explanatory variables include $FLOW\ VOLATILITY_{ft}$, which measures the risk the funds face due to shareholders' behaviour (uncertainty of inflows/outflows) and $PORTFOLIO\ VOLATILITY_{ft}$, which measures the extent to which a fund's $SPREAD_{ft}$ changes from month to month. Since we expect those funds that anticipate higher outflows to hold more liquidity we also employ $EXPECTED\ OUTFLOWS_{ft}$ to capture a fund's expected redemption levels. We also analyze how the funds adjust their liquidity levels if they expect more inflows. Hence we consider the variable $EXPECTED\ INFLOWS_{ft}$, which captures a fund's expected subscriptions.

The literature argues that the investors respond differently in tranquil and crisis times (Jank and Wedow, 2015; Jacklin and Bhattacharya, 1988). During periods of distress, investors could rebalance their assets as the risk characteristics of such assets change. Given that the funds are expected to maintain liquidity to meet the redemptions that arise from such behavior of investors, we also expect funds to behave differently in tranquil and crisis periods. Therefore, we divide our sample into "Calm" (September-December 2012) and "Crisis" (June -September 2011) periods[17]. We assess how the above mentioned factors influence the weekly liquidity, LIQ_{ft} of the funds. In all regressions, we control for fund size, $SIZE_{ft}$ and institutional share, $INST\ SHARE_{ft}$.

Table 3 shows regression results. The dependent variable is LIQ_{ft}. We find that in eq. (1), funds with higher $FLOW\ VOLATILITY_{ft}$ hold more liquid assets. This shows that the funds that serve investors with highly unpredictable investment behavior tend to hold more liquidity even during calm periods. This illustrates that the funds are aware of the investment behavior of their investor base and consequently make appropriate arrangements that would suit the needs of their shareholders without putting excessive pressure on the portfolio of the fund. Our results are consistent with the findings of SEC (2015), where mutual funds (excluding MMMFs) with higher $FLOW\ VOLATILITY_{ft}$ are found to hold more liquidity. Funds' $SIZE_{ft}$,

[17] Ideally, we would like to analyze the period from February-May 2011 for "Calm" period, as we later would in the rest of paper, it is not possible to do it here because we use November 2010 – May 2011 to calculate the explanatory variables use in the regression analysis. Therefore, instead we use September-December 2012 for "Calm" period.

$INST\ SHARE_{ft}$ and $PORTFOLIO\ VOLATILITY_{ft}$ do not play an important role in determining the liquidity of the funds during the "Calm" period. Eq. (2), shows that the coefficients on $EXPECTED\ OUTFLOWS_{ft}$ and $EXPECTED\ INFLOWS_{ft}$ are insignificant, which shows that funds do not seem to care significantly about expected outflows and inflows during calm times. Eq. (3), shows the full model.

Next, we look at the "Crisis" period. Eq. (4), shows that during the crisis the funds hold higher liquidity in response to higher $FLOW\ VOLATILITY_{ft}$. In addition, funds with riskier portfolios, as proxied by $PORTFOLIO\ VOLATILITY_{ft}$, increase their liquidity levels. This demonstrates that, depending upon their portfolio risk and redemption risk, the funds actively adjust their liquidity in times of distress. In eq. (5), the funds with higher $EXPECTED\ OUTFLOWS_{ft}$ increase their liquidity. This shows that funds have a more cautious attitude in stressful times, and respond by increasing their liquidity cushion to meet redemptions. In the full model (eq. 6), all the above variables remain significant.

3.4. Changes in Liquidity of funds

In the previous section, we gain insight on the factors that cause funds to maintain higher levels of liquidity. Next, we study how funds change their weekly liquidity holdings during a crisis. In order to investigate whether the funds prefer to hold certain types of liquid assets, we also consider alternative liquidity holdings.

The role of MMMFs exposed to higher risk from Eurozone banks during the sovereign debt crisis has been the focus of recent academic studies and new regulatory measures. The latter have resulted in several changes in the operations and structure of the funds. Therefore, we now proxy fund-specific risk with the proportion of investments in Eurozone banks, EZB_{ft}, during the crisis.

Table 4 presents the regression results. The dependent variables are changes in weekly liquidity, ΔLIQ_{ft}, change in government liquidity, $\Delta GOVLIQ_{ft}$, changes in agency liquidity $\Delta AGCYLIQ_{ft}$, and changes in non-government liquidity $\Delta OTHLIQ_{ft}$. Eq. (1-4) show that during the tranquil period the change in liquidity holdings was not significant. This confirms our previous results that funds do not hold more liquidity in tranquil periods. The coefficient of agency liquidity in eq. 3, however, is positive and significant.

Next, we assess the changes in portfolio liquidity during the sovereign debt crisis. Eq. (5-7), indicate that the distressed funds with higher lagged Eurozone bank share, EZB_{ft} increase the proportion of liquid assets during the crisis period. This change is mostly driven by increased government $\Delta GOVLIQ_{ft}$ and agency securities $\Delta AGCYLIQ_{ft}$. These results show that the funds prefer to hold less risky government and government agency securities to keep their portfolios safer during the crisis. However, the funds decrease their non-government liquidity holdings, $\Delta OTHLIQ_{ft}$ (eq.8). This is possibly because the funds with risky portfolios use these short-term non-government liquid securities to meet redemptions, without attempting to increase such holdings to maintain liquidity levels. In addition, during the crisis, the funds with higher WAL_{ft}, increase their liquidity holdings significantly across all models.

Overall, the analysis shows that the funds prepare for redemption pressure by adjusting their liquidity, which is in line with our previous results. We next study whether increase in liquidity increases investors' confidence in the funds.

3.5. Investor response and liquidity

In this section, we examine shareholder behavior, as proxied by $NET\ INFLOWS_{ft}$ in relation to levels of fund liquidity. We are asking whether the funds that hold higher liquidity in distress periods are more stable than others.

Table 5 presents the results. The dependent variable across all regressions is $NET\ INFLOWS_{ft}$. In Panel A, we assess the response of investors to higher liquidity during calm and crisis periods and its role in stabilizing funds with riskier portfolios. In eq. (1) the results indicate that the funds that hold higher level of liquid assets during tranquil times receive lower $NET\ INFLOWS_{ft}$. The investors are not attracted to funds that have more liquidity because this leads to lower returns. In normal times, investors seek riskier investments to boost yields. This is consistent with the previous literature that finds evidence of a performance-flow relationship in money market mutual funds (Chernenko and Sunderam 2014; Christoffersen 2001; Christoffersen and Musto 2002; Kacperczyk and Schnabl 2013). Jank and Wedow (2015) document a similar negative relationship between liquidity and inflows in their study of German MMMFs.

We are interested in assessing the role of liquidity for the funds with higher credit risk from Eurozone banks. To the best of our knowledge this is the first study to conduct such an analysis.

However, we first test whether a fund with higher Eurozone banks share in its portfolio attracts more investors, which is similar to Chernenko and Sunderam (2014). The results in eq. (2) show that a 10% increase in EZB_{ft-1} increases $NET\ INFLOWS_{ft}$ by 2.5%, which is consistent with the results of Chernenko and Sunderam (2014). Then, in eq. (3) we include $LIQ_{f,t-1}$, and its interaction with liquidity $LIQ_{f,t-1} * EZB_{f,t-1}$ to assess the response of investors to funds that hold high $EZB_{f,t-1}$ as well as higher LIQ_{ft1}. The sign and significance of $LIQ_{f,t-1}$ and $EZB_{f,t-1}$ do not change. But, the coefficient of the interaction term is insignificant. In eq. (4) we include other controls which can influence the decision of investors to inject or withdraw money from the fund. Our previous conclusions remain unaltered. The coefficient of share of institutional investors is negative and highly significant. A possible explanation is that such investors use these funds for temporary cash management and hence withdraw more frequently to run day to day operations.

Eq. (6) shows that the funds deemed riskier have more outflows when the sovereign debt crisis worsened, which is consistent with the findings of Chernenko and Sunderam (2014). Next, in eq. (7) we include $LIQ_{f,t-1}$ and the interaction term $LIQ_{f,t-1} * EZB_{f,t-1}$. The coefficient on $LIQ_{f,t-1}$ remains positive but becomes insignificant. $EZB_{f,t-1}$ remains negative and significant, which shows that the funds with higher credit risk from exposure to Eurozone banks consistently face redemption pressure during the crisis. Our results are not consistent with Jank and Wedow (2015) who argue that holding higher liquidity during market illiquidity (crisis) leads to positive inflows. Eq. (8), presents results with other controls. Funds that serve institutional shareholders suffer significantly more outflows, which is consistent with the previous literature (Wermers 2011, Chernenko and Sunderam 2014).

4. Conclusion

This paper explores the impact of new liquidity requirements that are designed to improve the stability of money market funds. We show that these requirements have brought about substantial changes in the composition of fund portfolios. As expected, the liquidity levels of the funds have increased while the average portfolio maturity has decreased. This has put a downward pressure on portfolio returns. Funds have responded by investing in higher yielding securities, which could result in increased tail risk. Moreover, our results show that during the sovereign debt crisis funds met redemption pressure easily and had excess liquidity. The funds seem to be well acquainted with the redemption behavior of their shareholder base and keep

higher liquidity when serving investors with more uncertain redemption behavior. They also dynamically respond to crisis periods by changing the liquidity of their portfolios. Further, investors in tranquil periods move away from funds with higher liquidity and are attracted to such funds in times of crisis, which is consistent with a risk-seeking and risk-averse behavior during calm and crisis periods, respectively. In summary, our assessment of the new reforms is that they have achieved the intended objective of increasing money market funds' ability to meet redemptions in periods of market distress. However, they have also generated incentives for higher risk taking. Thus, whether money market funds are indeed more resilient to financial crises remains an open question.

TABLE 1: PORTFOLIO COMPOSITION BEFORE AND AFTER REFORMS 2010

	"TREATED (T)"			"CONTROL (C)"			"T- C"		
Mean	**BR**	**AR**	**Diff**	**BR**	**AR**	**Diff**	**BR**	**AR**	**Diff**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
LIQ_{ft}	16.84***	31.36***	14.52***	47.84***	39.56***	-8.28**	-31.00***	-8.2***	22.80***
	(1.108)	(1.548)	(1.906)	(2.845)	(2.189)	(3.511)	(1.763)	(1.451)	(2.284)
$GOVLIQ_{ft}$	2.816***	7.641***	4.825***	8.289***	7.663***	-0.626	-5.473***	-0.022	5.45***
	(0.519)	(1.053)	(1.102)	(2.760)	(1.304)	(3.251)	(1.763)	(1.005)	(1.582)
$AGCYLIQ_{ft}$	3.720***	9.753***	6.033***	15.48***	18.99***	3.516	-11.76***	-9.24***	2.517
	(0.641)	(1.074)	(1.286)	(2.017)	(2.151)	(2.484)	(1.366)	1.125	(1.770)
$OTHLIQ_{ft}$	10.30***	13.97***	3.661**	24.07***	12.90***	-11.17***	-13.77***	1.07	14.83***
	(0.996)	(1.176)	(1.413)	(3.157)	(1.381)	(3.164)	(1.502)	1.236	(1.945)
WAL_{ft}	88.13***	66.83***	-21.30**	43.76***	58.35***	14.59***	44.37***	8.48*	-35.89***
	(8.578)	(2.800)	(8.786)	(4.181)	(3.936)	(4.879)	(5.733)	4.638	(7.374)
$OA_{ft}^{1-90days}$	70.69***	86.22***	15.52***	84.77***	87.97***	3.197	-14.08***	-1.75	12.32***
	(2.806)	(0.597)	(2.811)	(2.393)	(1.569)	(2.260)	(1.785)	1.430	(2.288)
$OA_{ft}^{270-397days}$	8.031***	2.322***	-5.709***	4.037***	5.082**	1.045	3.994**	-2.76*	-6.75***
	(1.069)	(0.203)	(1.088)	(0.977)	(2.069)	(1.450)	(1.903)	1.531	(2.442)
$WIY_{ft}^{1-90days}$	58.06***	29.58***	-28.48***	49.90***	27.87***	-22.03***	8.16**	1.71	-6.45
	(4.579)	(1.156)	(4.515)	(5.104)	(1.516)	(5.656)	(3.475)	2.516	(4.290)
$WIY_{ft}^{270-397}$	106.5***	139.6***	33.08**	86.21***	89.42***	3.202	20.29	50.18*	29.878
	(16.93)	(22.50)	(15.67)	(11.45)	(16.94)	(14.00)	(24.60)	18.12	(30.55)
$SIZE_{ft}$	20.74***	20.94***	0.206	20.61***	20.95***	0.340	0.13	-0.01	-0.134
	(0.255)	(0.220)	(0.227)	(0.329)	(0.272)	(0.289)	(0.229)	0.188	(0.296)

*The table shows means of the variables before reforms (BR is the period from Jan-Dec 2009 with quarterly reported data compiled from forms N-Q, N-CSRS and N-CSR), and after reforms (AR is the period from Feb-May 2011 with monthly reported data compiled from form N-MFP. Treated funds are the funds that held less than 30% LIQ_{ft}, before reforms. Control funds include the funds that held more than 30% LIQ_{ft}, before reforms. T-C represents difference between the Treated and Control group. Diff is the difference between BR and AR. LIQ_{ft} represents weekly liquid assets of the fund as a percentage of total assets. It includes i) any security excluding government/agency instruments maturing in 5 days, $OTHLIQ_{ft}$ ii) US government agency securities maturing in less than 60 days, $AGCYLIQ_{ft}$, iii) US securities maturing with any maturity, $GOVLIQ_{ft}$. WAL_{ft} is Weighted Average Life calculated as average days to maturity weighted by the investment weight of each security. $OA_{ft}^{1-90\,days}$ and $OA_{ft}^{270-397\,days}$ measure the aggregate investment weight of portfolio securities of stated maturities. $WIY_{ft}^{1-90days}$ and $WIY_{ft}^{270-397\,days}$ measure average issuer yield weighted by investment weight of securities with stated maturities. $SIZE_{ft}$ is log of net assets. Significance levels are indicated by *** p<0.01, ** p<0.05, * p<0.1.*

TABLE 2: EXCESS LIQUIDITY DURING SOVERIGN DEBT CRISIS

	"TREATED (T)"			"CONTROL (C)"			"(T-C)"		
VAR:	$\boldsymbol{EXLIQ_{ft}}$	$\boldsymbol{C\_EXLIQ_{ft}}$	**Diff**	$\boldsymbol{EXLIQ_{ft}}$	$\boldsymbol{C\_EXLIQ_{ft}}$	**Diff**	$\boldsymbol{EXLIQ_{ft}}$	$\boldsymbol{C\_EXLIQ_{ft}}$	**Diff**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mean (%)	19.44***	5.849***	13.59***	30.54***	27.09***	3.449**	-11.10***	-21.25***	10.14***
	(1.033)	(0.832)	(1.175)	(1.420)	(1.145)	(1.616)	(1.756)	(1.415)	(1.998)
N	396	396	396	396	396	396	396	396	396

The table shows means of the stated variables, during the sovereign debt crisis (June-September 2011). $\boldsymbol{EXLIQ_{ft}}$ *is fund portfolio liquidity in excess of outflows, after the reforms.* $\boldsymbol{C\_EXLIQ_{ft}}$ ***is*** *counterfactual excess liquidity which the funds would have had in the absence of reforms. (Please see appendix A for the definition of variables.)* ***Diff*** *is the difference between* $\boldsymbol{EXLIQ_{ft}}$ *and* $\boldsymbol{C\_EXLIQ_{ft}}$ **.** *Significance levels are indicated by *** p<0.01, ** p<0.05, * p<0.1.*

TABLE 3: WHY EXCESS LIQUIDITY?

	"CRISIS" (June-Sept 2011)			"CALM" (Sept-Dec 2012)		
DEP VAR: LIQ_{ft} (%)	(1)	(2)	(3)	(4)	(5)	(6)
$FLOW\ VOLATILITY_{f,t-1}$	0.5202***		0.4323**	0.6393***		0.6410***
	(0.1697)		(0.1765)	(0.2069)		(0.2150)
$EXPECTED\ OUTFLOWS_{f,t-1}$		2.6636***	1.5309*		1.5474	-0.1442
		(0.9320)	(0.8698)		(1.7932)	(1.6528)
$EXPECTED\ INFLOWS_{f,t-1}$		1.0543	0.3489		-3.6138	-7.7809
		(2.4010)	(2.3376)		(15.9981)	(12.0378)
$PORTFOLIO\ VOLATILITY_{f,t-1}$	0.1678***	0.1866***	0.1684***	0.0024	0.0449	0.0005
	(0.0548)	(0.0485)	(0.0517)	(0.0770)	(0.0759)	(0.0774)
$SIZE_{f,t-1}$	-0.1241	-0.6766	-0.5137	-0.6591	-0.9021	-0.7839
	(1.0734)	(1.1394)	(1.1961)	(0.8410)	(0.9848)	(1.0330)
$INST\ SHARE_{f,t-1}$	0.0001	0.0089	-0.0034	-0.0114	-0.0015	-0.0128
	(0.0441)	(0.0424)	(0.0434)	(0.0366)	(0.0365)	(0.0359)
Constant	24.5609	34.5992	31.6150	55.9112***	62.2183***	59.3478***
	(22.8988)	(24.7330)	(25.9146)	(17.9233)	(21.2146)	(22.3055)
Time FE	YES	YES	YES	YES	YES	YES
Observations	560	560	560	560	560	560
R-squared	0.1597	0.1334	0.1665	0.0819	0.0200	0.0804

This table presents results for panel regression with time fixed effects to control for global risks. The dependent variable is LIQ_{ft} (%). LIQ_{ft} (%) represents weekly liquid assets of the fund as a percentage of total assets. It includes i) any security excluding government/agency instruments maturing in 5 days, $OTHLIQ_{ft}$ (%) ii) US government agency securities maturing in less than 60 days, $AGCYLIQ_{ft}$ (%), iii) US securities maturing with any maturity, $GOVLIQ_{ft}$(%). $FLOW\ VOLATILITY_{ft}$ (%) is rolling standard deviation of $NET\ INFLOWS_{ft}$ of a fund with fixed window of 7 months (window starts from November 2011), and is winsorized at 1st and 99th percentile to remove outlier. $EXPECTED\ OUTFLOWS_{ft}$ (%) are absolute value of forecasted outflows. . $EXPECTED\ INFLOWS_{ft}$ (%) are forecasted value of inflows. (Please refer to Appendix A for formulation). $SIZE_{ft}$ is log of net assets. $INST\ SHARE_{ft}$ (%) is the percentage of a fund's net assets held by institutional shareholders. $PORTFOLIO\ VOLATILITY_{ft}$ (bps) is rolling standard deviation of $SPREAD_{ft}$ (bps) of a fund with fixed window of 7 months. The analysis is divided into "Crisis" (June- September 2011) and "Calm" (September-December 2012) period. Ideally, we would like to analyze the period from February-May 2011 for "Calm" period, as we later would in the rest of paper, it is not possible to do it here because we use November 2010 – May 2011 to calculate the explanatory variables use in the regressions. Therefore, instead we use September-December 2012 for "Calm" period. In all regressions, the standard errors are clustered by fund. Significance levels are indicated by *** p<0.01, ** p<0.05, * p<0.1.

TABLE 4: CHANGES IN LIQUIDITY IN RESPONSE TO CRISIS

	"CALM" (Feb-May 2011)				"CRISIS" (June-Sept 2011)			
DEP VAR:	ΔLIQ_{ft}	$\Delta GOVLIQ_{ft}$	$\Delta AGCYLIQ_{ft}$	$\Delta OTHLIQ_{ft}$	ΔLIQ_{ft}	$\Delta GOVLIQ_{ft}$	$\Delta AGCYLIQ_{ft}$	$\Delta OTHLIQ_{ft}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$EZB_{f,t-1}$	0.1158	-0.0156	**0.2460*** **	**-0.1111***	**0.3134*** **	**0.2558** **	**0.3730*** **	**-0.3629*** **
	(0.1056)	(0.0609)	(0.1030)	(0.0778)	(0.1257)	(0.1293)	(0.1204)	(0.1538)
$WAL_{f,t-1}$	**0.1308*** **	**-0.0937*** **	**0.0956** **	**0.1223** **	**0.3830*** **	**0.0843** **	**0.1104** **	**0.1727*** **
	(0.0547)	(0.0366)	(0.0427)	(0.0585)	(0.0661)	(0.0401)	(0.0586)	(0.0589)
$INST\ SHARE_{f,t-1}$	**-0.4795** **	**-0.4426** **	0.1387	-0.1760	**0.5279***	0.0067	-0.5179	**1.1268*** **
	(0.2399)	(0.1848)	(0.2098)	(0.3734)	(0.3674)	(0.2490)	(0.3626)	(0.4017)
$NET\ YIELD_{f,t-1}$	0.1505	-0.1452	-0.0563	0.3325	-0.1085	0.0384	-0.1558	0.1872
	(0.2195)	(0.2032)	(0.3050)	(0.2412)	(0.3213)	(0.3030)	(0.2651)	(0.3896)
Constant	-10.34***	2.6269	-8.5863**	-4.1248	-12.991***	-3.7763	-12.2042***	4.6344
	(3.9583)	(2.4640)	(3.5831)	(3.7926)	(3.2653)	(2.8876)	(3.2038)	(3.0517)
Fund FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	652	652	652	652	668	668	668	668
Adjusted R^2	0.0308	0.0368	0.0299	0.0260	0.1099	0.0474	0.0519	0.0365

This table presents results for panel regression. The analysis is divided into "Calm" (Feb-May 2011) and "Crisis" (June-September2011). All regressions include fund fixed effects to control for fund-specific characteristics. .$\Delta\ LIQ_{ft}$ (%) *is first difference of weekly liquidity.* $\Delta\ GOVLIQ_{ft}$(%) *is first difference of government liquidity.* $\Delta\ AGCYLIQ_{ft}$(%) *is first difference of government agency liquidity.* $\Delta\ OTHLIQ_{ft}$(%) *is first difference of non-government liquidity.* EZB_{ft} (%) *is share of a fund's portfolio invested in Eurozone banks that were part of 2011 stress tests.* $INST\ SHARE_{ft}$ (%) *is the percentage of a fund's net assets held by institutional shareholders.* WAL_{ft} *is Weighted Average Life calculated as remaining time to maturity of the investment, weighted by its investment weight in fund portfolio.* NET $YIELD_{ft}$ *is the value-weighted average of the 7-day net yields of fund classes as reported on N-MFP forms. In all regressions, the standard errors are clustered by fund. Significance levels are indicated by *** p<0.01, ** p<0.05, * p<0.1.*

TABLE 5: INVESTOR BEHAVIOR AND LIQUIDITY

	"CALM" (Feb-May 2011)				"CRISIS" (June-Sept 2011)			
DEP VAR: $NET\ INFLOWS_{ft}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$LIQ_{f,t-1}$	**-0.1779***		**-0.1935****	**-0.1629***	**0.0803***		0.0543	0.0762
	(0.0943)		(0.0967)	(0.0946)	(0.0452)		(0.0473)	(0.0541)
$EZB_{f,t-1}$		**0.2529****	**0.2985***	**0.2874***		**-0.1927***	**-0.2925****	**-0.3011****
		(0.0984)	(0.1776)	(0.1725)		(0.0998)	(0.1273)	(0.1420)
$EZB_{f,t-1} * LIQ_{f,t-1}$			-0.0004	-0.0001			0.0031	0.0032
			(0.0032)	(0.0031)			(0.0028)	(0.0030)
$WAL_{f,t-1}$				0.0605				0.0941
				(0.0408)				(0.0585)
$INST\ SHARE_{f,t-1}$				**-1.3608*****				**-1.2000****
				(0.1882)				(0.4914)
$NET\ YIELD_{f,t-1}$				0.3296				-0.1812
				(0.3422)				(0.4059)
Constant	0.8602	-12.4724***	-5.4813	-9.9070*	-8.7548***	-0.1352	-5.4561	-10.7410*
	(3.9261)	(2.7571)	(4.8008)	(5.4623)	(2.7634)	(2.1940)	(4.7741)	(6.1189)
Fund FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	652	652	652	652	668	668	668	668
Adjusted R^2	0.0053	0.0136	0.0276	0.0794	0.0506	0.0535	0.0562	0.0758

The dependent variable is $NET\ INFLOWS_{ft}$ (%) $= (INFLOWS_{ft} - OUTFLOWS_{ft}) * 100/NET\ ASSETS_{ft-1}$. LIQ_{ft} *(%) represents weekly liquid assets of the fund as a percentage of total assets. It includes i) any security excluding government/agency instruments maturing within 5 days* (%) *ii) US government agency securities maturing in less than 60 day, iii) US securities maturing with any maturity.* EZB_{ft} (%) *is share of a fund's portfolio invested in Eurozone banks that were part of 2011 stress tests.* $SIZE_{ft}$ *is log of net assets.* $INST\ SHARE_{ft}$ (%) *is the percentage of a fund's net assets held by institutional shareholders.* WAL_{ft} *is Weighted Average Life calculated as remaining time to maturity of the investment, weighted by its investment weight in fund portfolio.* NET YIELD_{ft} *is the value-weighted average of the 7-day net yields of fund classes as reported on N-MFP forms. Robust standard errors in parentheses. All regressions include fund fixed effects. Significance levels are indicated by *** p<0.01, ** p<0.05, * p<0.1.*

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APPENDIX A: DEFINATIONS OF VARIABLES

VARIABLE	***DEFINATION***
$SIZE_{ft}$	$= log(NET\ ASSETS_{ft})$
$NET\ INFLOWS_{ft}$ (%)	$= \frac{(SUBSCRIPTIONS_{ft} - REDEMPTIONS_{ft}) * 100}{NET\ ASSETS_{ft-1}}$
LIQ_{ft} (%)	*It represents weekly liquid assets of the fund as a percentage of total assets. Assets include i) any security excluding government/agency instruments maturing in 5 days,* $OTHLIQ_{ft}$ (%) *ii) US government agency securities maturing in less than 60 days,* $AGCYLIQ_{ft}$ (%)*, iii) US securities maturing with any maturity,* $GOVLIQ_{ft}$*(%).*
$GOVLIQ_{ft}$ (%)	*It includes percentage of assets invested in US treasury securities of any maturity.*
$AGCYLIQ_{ft}$ (%)	*It includes percentage of assets invested in US government agency with maturity ≤ 60 days.*
$OTHLIQ_{ft}$ (%)	*It includes percentage of assets invested in securities maturing within 5 days excluding government and agency securities.*
WAL_{ft} (days)	$= \frac{\sum_i AMORTIZED\ COST_{it} \quad x \quad TIME\ TO\ MATURITY_{it}}{\sum_i AMORTIZED\ COST_{it}}$
SPREAD $_{ft}$ (bps)	$= GROSS\ YIELD_{ft} - TBILL_t$ *(* $TBILL_t$ *= 4-Week Treasury Bill: Secondary Market Rate, Percent, Monthly* $= \frac{\sum_{i=1}^{n} ISSUER\ YIELD_{it} \times OUTSTANDING\ AMOUNT_{it}}{\sum_{i=1}^{n} OUTSTANDING\ AMOUNT_{it}}$
$ISSUER\ YIELD_{it}$ (bps)	*The yield of invested security as reported on the form N-MFP filed with SEC.*
EXPECTED INFLOWS $_{ft}$ (%)	$= FORECASTED\ NET\ INFLOWS_{ft} \quad if\ NET\ INFLOWS_{ft} \geq 0$ $FORECASTED\ NET\ INFLOWS_{ft} = \alpha + \sum_{n=1}^{N=7} \beta_1\ NET\ INFLOWS_{f,t-n} + \sum_{n=1}^{N=7} \beta_2\ ISSUER\ YIELD_{f,t-n}$
EXPECTED OUTFLOWS $_{ft}$ (%)	$= \left\| FORECASTED\ NET\ INFLOWS_{ft} \right\| \quad if\ NET\ INFLOWS_{ft} < 0$ $FORECASTED\ NET\ INFLOWS_{ft} = \alpha + \sum_{n=1}^{N=7} \beta_1\ NET\ INFLOWS_{f,t-n} + \sum_{n=1}^{N=7} \beta_2\ ISSUER\ YIELD_{f,t-n}$
$FLOW\ VOLATILITY_{ft}$ (%)	$= Rolling\ Standard\ deviation\ of\ NET\ INFLOWS_{ft}$ *, calculated as fixed window of past 7 month observations.*
PORTFOLIO VOLATILITY $_{ft}$ (bps)	$= Rolling\ Standard\ deviation\ of\ SPREAD_{ft}$ *, calculated as fixed window of past 7 month observations.*
NET YIELD $_{ft}$ (bps)	$NET\ YIELD_{ft}$ *is the value-weighted average of the 7-day net yields of fund classes as reported on N-MFP forms.*
$INST\ SHARE_{ft}$ (%)	*The share of fund's assets in institutional share classes. We define institutional share class as the share classes that have minimum investment of $ 1,000,000 or that have "institutional" in the name of the class.*
EZB_{ft} (%)	$= \frac{\sum_{i \in EZB} OUTSTANDING\ AMOUNT_{fit}}{\sum_i OUTSTANDING\ AMOUNT_{fit}}$, $EZB = Eurozone\ Bank\ Share$, *this includes banks that were part of July 2011 stress tests.*

$EXLIQ_{ft}$ *(%)*	$= \frac{DAILY\ LIQUIDITY\ _{ft-1} - \lvert OUTFLOWS_{f,t} \rvert}{NET\ ASSETS_{f,t-1}}$
C_EXLIQ_{ft} *(%)*	$= \frac{\overline{DAILY\ LIQUIDITY}\ _{f,t-1,pre-reform} - \lvert OUTFLOWS_{ft} \rvert}{NET\ ASSETS_{f,t-1}}$
$DAILY\ LIQUIDITY\ _{ft}$ *(%)*	*It represents daily liquid assets of the fund as a percentage of total assets. Assets include i) any security excluding government/agency instruments maturing in 1 day,* $OTHLIQ_{ft}$ *(%) iii) US securities maturing with any maturity,* $GOVLIQ_{ft}$*(%).*
WAL_{ft} *(days)*	$= \frac{\sum_i AMORTIZED\ COST\ _{it} \quad x \quad TIME\ TO\ MATURITY_{it}}{\sum_i AMORTIZED\ COST\ _{it}}$
$OA_{ft}^{1-90days}$ *(%)*	*The percentage of total assets invested in securities with maturities, M≤90days*
$OA_{ft}^{270-397days}$ *(%)*	*The percentage of total assets invested in securities with maturities ranging, 270 ≤ M ≤397 days*
$WIY_{ft}^{1-90days}$ *and* $WIY_{ft}^{270-397days}$ *(bps)*	$WIY_{ft}^{1-90days}$ *and* $WIY_{ft}^{270-397\ days}$ *measure average issuer yield weighted by investment weight of instruments with respective maturities*

APPENDIX B: SUMMARY STATISTICS

	"CALM" (Feb-May 2011)					"CRISIS" (June-Sept 2011)					
VARIABLES	Mean	SD	p25	p50	p75	Mean	SD	p25	p50	p75	N
$NET\ ASSETS_{ft}$ ($\$\ mil$)	8191	18390	442.7	1503	7461	7725	17340	452.1	1574	6753	720
$NET\ INFLOWS_{ft}$ *(%)*	0.231	6.960	-2.717	-0.533	2.443	-0.360	7.861	-3.521	-0.389	2.653	716
EZB_{ft} *(%)*	15.82	8.357	9.050	16.78	22.01	11.95	8.420	4.879	11.08	17.72	671
$NET\ YIELD_{ft}$ *(bps)*	5.690	6.983	1.000	2.000	9.302	3.961	5.301	1.000	1.000	5.475	720
$INST\ SHARE_{ft}$ *(%)*	65.90	36.32	24.93	87.51	100	65.83	36.25	24.27	85.55	100	720
LIQ_{ft} *(%)*	33.74	14.81	24.03	31.26	37.83	37.25	18.38	24.11	33.06	44.90	720
$GOVLIQ_{ft}$ *(%)*	7.408	9.077	0.825	4.476	10.89	7.711	10.05	0.570	4.810	9.872	720
$AGCYLIQ_{ft}$ *(%)*	12.48	12.04	2.864	9.308	18.90	13.37	13.27	2.560	10.27	20.61	720
$OTHLIQ_{ft}$ *(%)*	13.85	9.163	7.282	11.77	18.69	16.17	12.14	8.344	12.90	21.52	720
$DAILY\ LIQ_{ft}$ *(%)*	21.14	15.13	11.87	19.45	27.05	20.16	16.95	7.929	16.14	27.82	720
WAL_{ft} *(days)*	63.31	24.66	45	64	80	57.75	23.88	38	57.50	75	720
$FLOW\ VOLATILITY_{ft}$ (%)	5.964	6.451	1.729	3.774	8.317	6.974	8.893	2.261	4.589	8.015	560
$PORTFOLIO\ VOLATILITY_{ft}$ *(bps)*	32.65	22.74	18.08	26.58	39.83	43.14	26.55	30.17	35.81	49.82	560

APPENDIX C.1: CORRELATION MATRIX (Nov 2011-Dec 2012)

	Net Assets	*Net Inflows*	*Liquidity*	*Daily Liquidity*	*WAL (days)*	*Govt Liquidity*	*Agency Liquidity*	*Other Liquidity*	*Net Yield*	*Institutional Share*	*EZB*	*Flow Volatility*	*Portfolio Volatility*
Net Assets	1												
Net Inflows	0.02	1											
Liquidity	-0.02	0.08	1										
Daily Liquidity	-0.01	0.04	0.66	1									
WAL (days)	0.25	-0.06	-0.37	-0.22	1								
Govt Liquidity	0	-0.01	0.58	0.62	-0.1	1							
Agency Liquidity	-0.04	0.1	0.59	0.24	-0.23	-0.02	1						
Other Liquidity	0.01	0.01	0.22	0.06	-0.21	-0.19	-0.31	1					
Net Yield	0.26	0.05	0.07	0.07	0.1	-0.01	0.05	0.07	1				
Institutional Share	0.02	0.02	-0.01	0.02	-0.03	-0.07	-0.13	0.23	0.18	1			
EZB	0.16	-0.04	-0.12	0	0.1	-0.16	-0.15	0.14	0.12	0.15	1		
Flow Volatility	-0.07	-0.01	0.2	0.14	-0.17	0.04	0.14	0.1	0.29	0.13	0.07	1	
Portfolio Volatility	-0.1	0.02	0.19	0.25	-0.1	0.26	-0.04	0.05	-0.01	0.06	-0.14	0.14	1

APPENDIX C.2: CORRELATION MATRIX (CALM, Feb 2011 – May 2011)

	Net Assets	*Net Inflows*	*Liquidity*	*Daily Liquidity*	*WAL (days)*	*Govt Liquidity*	*Agency Liquidity*	*Other Liquidity*	*Net Yield*	*Institutional Share*	*EZB*
Net Assets	1										
Net Inflows	0.07	1									
Liquidity	-0.05	0.14	1								
Daily Liquidity	-0.03	0	0.68	1							
WAL (days)	0.3	-0.03	-0.37	-0.22	1						
Govt Liquidity	-0.02	-0.11	0.52	0.53	-0.05	1					
Agency Liquidity	-0.07	0.19	0.68	0.4	-0.27	0.09	1				
Other Liquidity	0.03	0.09	0.21	0.05	-0.19	-0.27	-0.3	1			
Net Yield	-0.03	-0.12	-0.25	-0.21	0.32	-0.09	-0.2	-0.04	1		
Institutional Share	0.25	0.2	0.17	0.19	0.13	0.03	0.11	0.1	-0.06	1	
EZB	0.04	0.12	-0.03	-0.01	-0.01	-0.11	-0.1	0.2	0.13	0.2	1

APPENDIX C.3: CORRELATION MATRIX (CRISIS, Jun 2011 – Sept 2011)

	Net Assets	*Net Inflows*	*Liquidity*	*Daily Liquidity*	*WAL (days)*	*Govt Liquidity*	*Agency Liquidity*	*Other Liquidity*	*Net Yield*	*Institutional Share*	*EZB*
Net Assets	1										
Net Inflows	-0.09	1									
Liquidity	-0.03	0.06	1								
Daily Liquidity	-0.02	0.08	0.6	1							
WAL (days)	0.27	-0.1	-0.4	-0.22	1						
Govt Liquidity	0	0.03	0.55	0.57	-0.11	1					
Agency Liquidity	-0.05	0.07	0.59	0.32	-0.25	0.1	1				
Other Liquidity	0	-0.01	0.41	0.09	-0.24	-0.1	-0.27	1			
Net Yield	-0.01	-0.02	-0.29	-0.14	0.39	-0.09	-0.25	-0.09	1		
Institutional Share	0.21	-0.1	0.03	-0.01	0.12	-0.01	0.03	0.02	0.01	1	
EZB	0.01	-0.04	0.04	0.05	-0.07	-0.07	-0.13	0.25	0.06	0.15	1