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Sturm und Drang in money market funds: when money market funds cease to be narrow

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Sturm und Drang in Money Market Funds: When Money Market Funds Cease to Be Narrow [‡]

Stephan Jank and Michael Wedow [*]

Abstract

This paper investigates the returns and flows of German money market funds before and during the liquidity crisis of 2007/2008. The main findings of this paper are: In liquid times money market funds enhanced their returns by investing in less liquid papers. By doing so they outperformed other funds as long as liquidity in the market was high. Investing in less liquid assets, however, widens the narrow structure of money market funds and makes them vulnerable to runs. During the shortening of liquidity caused by the subprime crisis illiquid funds experienced runs, while more liquid funds functioned as a safe haven.

Keywords: Money Market Funds, Liquidity Crisis, Strategic Complementarities, Runs, Narrow Banking

JEL: G12, G20, G21

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Non-technical summary

Money market funds (MMFs) are normally seen as an extremely safe investment, because they only invest in short-term, high-grade debt. Nevertheless, during the subprime crisis of 2007/2008 German money market funds faced severe outflows and falling returns. In this paper we investigate the reasons behind these developments and contribute to our understanding of the stability of financial intermediaries. The sample we are using includes all German retail MMFs starting in 1996 until the first half of 2008. Our results suggest that in a competitive environment, where investors react to good or bad performance, MMFs' managers have an incentive to invest in riskier assets in order to enhance their performance. The narrow structure of MMFs is thereby diluted and the probability of a run on the fund increases.

First, we look at persistence of money market funds' returns i.e. if the performance ranking of money market funds is repeated over subsequent years. Positive evidence for persistence permits a first inference on the reasons behind money market returns. Our main finding is that even though returns are overall persistent there are some periods that do not show persistence. Most importantly, the winning funds of 2006 (before the liquidity crisis) are the losing funds of 2007 (in the liquidity crisis) and vice versa. This provides a first indication of the impact of market liquidity for the returns of money market funds.

Second, we examine the causes for persistence in returns. We find that two factors drive persistence: expenses and portfolio liquidity. Thus, money market funds can enhance their returns by investing in less liquid assets. By doing so money market funds with less liquid portfolios can outperform more liquid funds. Sufficient market liquidity ensures that funds with less liquid portfolios can sell assets at any time. The long period of high market liquidity from 2002 to 2006 enabled illiquid funds to outperform persistently. The liquidity crisis of 2007, however, led to a reversal of performance. Funds with a less liquid portfolio were at a disadvantage due to the decline in market liquidity

Third, this article investigates flows into and out of MMFs. We find a significant flow-performance relationship, meaning that investors withdraw their money from funds that underperform and invest in funds that outperform. In times of low market liquidity people withdraw their money from less liquid funds and we observe run-like phenomenons. Liquid funds, on the other hand, show no significant outflows and continue to function as a safe haven.

Our results are subject to caveats. Credit as well as interest rate risk may also be behind our evidence. However, data limitations do not allow us any analysis of these aspects. Interest rate should play a limited role given the assets typically have a very short maturity. The developments during the subprime crisis have shown that previously save securities exhibited substantially larger credit risk and may thus also be present in MMFs. Also credit and liquidity risk are difficult to disentangle during times of market turmoil.

Nichttechnische Zusammenfassung

Geldmarktfonds gelten üblicherweise als sehr sichere Anlage, da sie ausschließlich in Wertpapiere mit sehr hoher Bonität und kurzer Laufzeit investieren. Dennoch verzeichneten deutsche Geldmarktfonds starke Abflüsse und fallende Renditen während der Liquiditätsengpässe im Zuge der Subprime-Krise. In diesem Diskussionspapier untersuchen wir die Ursachen für diese Ereignisse und analysieren die Stabilität von Finanzintermediären. Die verwendete Stichprobe enthält alle deutschen Publikumsgeldmarktfonds im Zeitraum 1996 bis zur ersten Jahreshälfte 2008. Unsere Ergebnisse weisen darauf hin, dass Investoren auf den Investitionserfolg von Geldmarktfonds mittels ihrer Anlageentscheidung reagieren. Somit haben Manager von Geldmarktfonds einen Anreiz in riskantere Anlagearten zu investieren, um ihre Erträge zu verbessern. Dies verwässert jedoch die sichere Struktur von Geldmarktfonds und macht einen Ansturm auf Geldmarktfonds durch die Investoren wahrscheinlicher.

In einem ersten Schritt untersuchen wir, ob die Renditen der Geldmarktfonds im Zeitablauf persistent sind, d.h. ob eine stabile Rangfolge der Geldmarktfonds hinsichtlich ihrer Renditen über mehrere Jahre erkennbar ist. Wir zeigen, dass Renditen zwar persistent sind, dass die Persistenz in einigen Zeitperioden aber unterbrochen wurde. Hierbei ist besonders hervorzuheben, dass die Geldmarktfonds mit der höchsten Rendite vor der Liquiditätskrise in den Jahren 2002 bis 2006, zu den Verlierern während der Liquiditätskrise 2007 und 2008 gehören. Dies stellt ein erstes Indiz für den Einfluss der Marktliquidität auf die Renditen der Geldmarktfonds dar.

In einem zweiten Schritt untersuchen wir die Gründe für persistente Renditen bei Geldmarktfonds. Unsere Ergebnisse weisen auf zwei Faktoren hin, die die Persistenz von Renditen bestimmen: Fondsgebühren und die Portfolioliquidität. Geldmarktfonds können ihre Renditen aufbessern, indem sie in weniger liquide Wertpapiere investieren. Fonds mit einem weniger liquiden Portfolio können daher Fonds mit liquidem Portfolio in der Rendite übertreffen. Eine ausreichende Marktliquidität gewährleistet, dass weniger liquide Fonds jederzeit Aktiva verkaufen können. Der Zeitraum vor der Krise (2002-2006) war von sehr hoher Liquidität geprägt und machte es möglich, dass weniger liquide Fonds kontinuierlich liquidere Fonds übertrafen. Die Liquiditätsengpässe während der Krise im Jahre 2007 führte allerdings zu einer Umkehr des Investitionserfolges. Aufgrund des deutlichen Rückgangs der Marktliquidität waren weniger liquide Fonds im Nachteil.

Drittens untersucht dieses Diskussionspapier die Mittelzu- und abflüsse von Geldmarktfonds. Als erstes Ergebnis ist festzustellen, dass Investoren auf den Investitionserfolg von Geldmarktfonds reagieren. Fonds mit einer positiven Überschussrendite verzeichnen Zuflüsse, während Fonds mit einer negativen Überschussrendite Abflüsse verzeichnen. Unser zweites Ergebnis ist, dass in Phasen von geringer Marktliquidität Investoren ihre Mittel aus weniger liquiden Fonds abziehen. Liquidere Fonds hingegen verzeichnen keine signifikanten Abflüsse und wurden somit von Investoren als sicherer Hafen wahrgenommen.

Einschränkend ist zu konstatieren, dass die Ergebnisse möglicherweise auch auf Kreditrisiken und das Zinsänderungsrisiko zurückgeführt werden können. Jedoch erlauben uns die Daten keine Untersuchung dieser beiden Aspekte. Das Zinsänderungsrisiko spielt bei Geldmarktfonds aufgrund der sehr kurzfristigen Laufzeiten der Aktiva nur eine eingeschränkte Rolle. Die Entwicklungen während der Subprime-Krise haben gezeigt, dass viele vormals als sicher eingestufte Wertpapiere ein deutlich höheres Kreditrisiko aufweisen. Zudem gehen während der Turbulenzen an den Märkten Kredit- und Liquiditätsrisiko eng miteinander einher.

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1 Introduction

Money market funds (MMFs) are normally seen as an extremely safe investment, because they only invest in short-term, high-grade debt. For this reason, MMFs should only have a minimum exposure to interest rate, credit or liquidity risk. Nevertheless, during the subprime crisis of 2007/2008 German money market funds faced severe outflows and falling returns. The aim of this paper is to investigate the reasons for the crisis of German money market funds.

Open-end mutual funds in general, similarly to banks, offer demand deposit contracts, meaning that investors can withdraw their money at any time. Withdrawals, however, impose a negative externality on the remaining investors in the fund (e.g. Edelen 1999, Nanda, Narayanan & Warther 2000). This is because facing outflows fund managers have to sell their assets at an unfavorable time. The expectation that other investors will withdraw their money can lead the remaining investors to follow, and can result in a panic-based run (Diamond & Dybvig 1983, Goldstein & Pauzner 2005, Chen, Goldstein & Jiang 2007). The likelihood of such a run increases if the negative externality increases. Therefore, runs are more likely in illiquid funds than in liquid funds.

Given that money market funds only invest in short-term, high grade debt, runs used to be considered as unlikely. Money market funds close the maturity gap that makes banks vulnerable to runs. By doing so MMFs can provide liquidity services without needing a socially costly deposit insurance. MMFs are therefore often considered to be "narrow banks".

This alternative form of liquidity provision is growing not only in the United States, but also in other countries. Since the first MMF was established in the US in the 70s, assets have grown to a total of USD 4,957 billion in 2007 worldwide. Overall, money market funds account for over 19% of all mutual fund assets in the world, which makes them the second largest group after equity funds.[1] The growing relevance of MMFs as financial intermediaries makes it important to investigate whether MMFs are indeed immune to runs in times of financial turmoil.

[1] Worldwide Fund Statistics of the Investment Company Institute (ICI)

In this article we use a panel of German retail MMFs and analyze their returns and flows before and during the shortening of liquidity which started with the US subprime crisis. First, we look at persistence of money market funds' returns. The performance of MMFs is usually highly persistent and mostly driven by the expense ratio. Our main finding is that even though returns are overall persistent there are some periods that do not show persistence. Most importantly, the winning funds of 2006 (before the liquidity crisis) are the losing funds of 2007 (in the liquidity crisis) and vice versa. Second, we examine the causes for persistence in returns. We find that not only expenses but also the portfolio structure drive performance persistence. While money market funds that invest in illiquid assets outperform during liquid times they underperform in illiquid times. Third, we investigate the flows into and out of MMFs. There exists a significant performance-flow relationship, meaning that investors withdraw their money from funds that underperform and invest in funds that outperform. In times of extreme illiquidity people withdraw their money from less liquid funds and we observe run-like phenomenons. Liquid funds, on the other hand, show no significant outflows and continue to function as a safe haven.

The results of this paper contribute to our understanding of the stability of financial intermediaries. Our results suggest that in a competitive environment, where investors react to good or bad performance, MMFs' managers have an incentive (*"Drang"*: drive, impulse, urge) to invest in riskier assets in order to enhance their performance. The narrow structure of MMFs is thereby widened and the probability of a run (ger.: *"Sturm"*) on the fund increases.

2 Related Literature

This article refers to several strands of literature: Persistence of MMFs' returns is a well known fact in the literature and documented by several studies (e.g. Domian & Reichenstein 1998, Christoffersen & Musto 2002, Dahlquist, Engström & Söderlind 2000). Performance persistence of MMFs is generally attributed to the strong persistence of expense ratios. Domian & Reichenstein (1998) find that expense ratio plus a dummy variable indicating whether a fund exclusively invests in government securities explain 87% of the cross sectional difference in net returns. They conclude that MMFs are a financial

commodity and best selected by the lowest expense ratio.

A logical question that follows is, how can in an competitive environment funds with high and low expense ratios coexist? Christoffersen & Musto (2002) argue that fund managers can charge different prices to their investors, because they face different demand curves. In particular, investors differ in their sensitivity to management fees. Therefore, fund managers are able to charge higher expense ratios without losing all existing investors. This allows some MMFs' managers to persistently have higher expense ratios and to underperform other funds.

Using a non-parametric method proposed by Brown, Goetzmann, Ibbotson & Ross (1992) we are able to have a disaggregate view on performance persistence of MMFs. Even though persistence in our sample is very strong and present in the majority of years we also find that several years show no persistence and a reversal in performance from one year to another. The persistence of expense ratios is not able to explain years without persistence or a reversal in performance. This result suggests that an additional factor is driving MMFs' return persistence.

Other studies argue that MMFs are not a mere commodity meaning that fund expenses are not the only determinant of returns. Koppenhaver (1999) shows in a cross-sectional regression that in addition to expenses also other portfolio characteristics affect returns. The share of agency securities and commercial papers is assumed to be a proxy for credit risk and has a positive effect on returns. Further, a higher weighted average maturity results in a higher return. In this sense, fund managers can offset the annual expenses and enhance returns by increasing credit or interest rate risk.

We follow this line of argument and investigate how money market fund managers can enhance their returns by investing in less liquid assets. This paper contributes to the literature above in showing that the impact of liquid assets is not constant over time but varies as a function of market-wide liquidity: money market funds with illiquid assets outperform in liquid times but underperform in illiquid times (See Acharya & Pedersen 2005, Massa & Phalippou 2005).[2]

[2]We primarily relate the performance of MMFs to liquidity risk and not to credit and

There exists a large literature on the negative effect of outflows on the remaining investors in the fund (e.g. Chordia 1996, Nanda, Narayanan & Warther 2000, Edelen 1999). Redemptions create costs, which include for example liquidity-based trading, price impact and commissions. In addition, the fund might be forced to deviate from its desired portfolio also resulting into costs. Therefore, fund managers set front- and back-end fees to dissuade redemptions and investors self-select themselves into a fund according to their liquidity needs (e.g. Chordia 1996). Since it usually takes some days for the fund manager to restore her cash balance, the costs of redemptions affect mainly the remaining investors in the fund. For this reason, withdrawals impose a negative externality on the remaining investors.

Chen, Goldstein & Jiang (2007) consider this negative externality in the context of strategic complementarities in mutual funds. In the framework of global games they are able to develop testable predictions about runs (Carlsson & van Damme 1993, Goldstein & Pauzner 2005). The expectation that other investors will withdraw their money can cause further investors to withdraw their money, resulting in a "self-fulfilling run". Since the negative externality increases with the illiquidity of the fund, illiquid funds are more likely to experience runs than liquid funds. Chen et al. (2007) argue further that the externality caused by withdrawals can be internalized if the number of investors is small enough. This article shows that strategic complementarities can even exist in relatively liquid sector of money market funds.

Finally, this article contributes to the literature concerned with the financial stability of narrow banking. Banks finance short-term deposits with long-term credits. This maturity intermediation makes banks vulnerable to runs (Diamond & Dybvig 1983). One remedy to avoid bank runs is to insure deposits and thereby establish trust in the bank. Deposit insurance, however, comes at a cost: it can lead to moral hazard because managers, insured against a bank run, may invest in riskier assets. A possible solution to this dilemma is the so called narrow banking approach (Gorton & Pennacchi 1992, Miller 1998). Since the key problem of bank runs is the maturity gap narrow banking sug-

other risks. MMFs typically invest in high grade assets which exhibit limited credit risk. However, the sudden and rapid downgrade of various asset classes during the subprime crisis uncovered previously unexpected credit risks. However, disentangling credit from liquidity risk is difficult given that particularly in times of market wide distress they go hand in hand.

gests to reduce or eliminate this gap. The narrow banking approach proposes that the two main functions of a bank, the deposit taking and lending function, should be separated into two firms. Instead of financing demand deposits with long term obligations narrow banks should be financed with short-term, high-quality securities. In theory, the reduction of the maturity gap would make narrow banks immune to bank runs and a (socially) costly deposit insurance would not be needed. In practice, money market funds are often considered to be a form of narrow banking. MMFs provide liquidity services to their investors by investing exclusively in high-grade debt with short maturity and the deposits are, in contrast to banks, not insured.

There are a number of papers that investigate whether MMFs are indeed immune against liquidity or credit shocks. Gorton & Pennacchi (1992) analyze in an event study, how a default in the commercial paper market affects the commercial paper spread and if this leads to withdrawals from money market funds. Their main result is that an individual commercial paper default has no significant impact on the commercial paper spread and does not result in a run on MMFs. In a similar study Miles (2001) compares the response of MMFs and commercial banks to monetary shocks. He finds that money market funds have no difficulties withstanding a monetary shock.

More recently, a debate evolved around the question if commercial banks have an advantage in hedging liquidity risk in comparison to other financial intermediaries such as MMFs. Gatev & Strahan (2006) argue that the advantage of commercial banks to hedge against liquidity risk originates from the fact that flows into banks co-vary with market illiquidity. In other words, following an illiquidity shock commercial banks experience inflows instead of outflows. Pennacchi (2006), however, finds a similar result for MMFs. Using vector autoregression (VAR) he finds that after a liquidity shock MMFs experience inflows and the dimension of these inflows is similar to those of large commercial banks.

This article contributes to the studies investigating financial stability of MMFs in two important ways: First, we use individual money market funds instead of aggregate data. Second, we investigate the stability of MMFs against liquidity shocks for a non-US sample. This permits us to gain insight, how the concept of MMFs works under a different regulatory setting.

3 Institutional Background

There are several differences between US and German money market funds. In this section we discuss the most important differences and their implications for the stability of MMFs.

While money market funds have existed for quite some time in the United States, they are fairly new in Germany and were only introduced in the mid nineties. As a consequence money market funds play only a minor role in the financial system of Germany. In the United States money market funds account for 25.8 % of all mutual fund assets. In comparison, in Germany money market funds represent only for 7.6 % of all mutual fund assets.[3]

The majority of US money market funds have a constant net asset value (CNAV) meaning that the value of one share, usually one dollar, remains unchanged. Income is reflected in an increase of the number of shares. In Germany MMFs have an accumulating net asset value (ANAV), meaning that they are priced market-to-market. Income of the fund is directly reflected by an increase of the share value. Gorton & Pennacchi (1992) argue that the popularity of constant net asset value in the US is mostly due to a simplified tax treatment.

To maintain a fixed asset value American MMFs use the so called amortized cost valuation. This method can lead to arbitrage possibilities, when the valuation method deviates from the market-to-market value. For further details on the method and the magnitude of arbitrage see Lyon (1984). If the market price decreases and the amortized cost valuation overprices the share value substantially there is an incentive for investors to withdraw their money. In this sense, a fixed net asset value makes MMFs more vulnerable to runs. On the other hand, market discipline forces MMFs with constant net asset value to reduce the risk of their portfolio.

In both the US and Germany MMFs have to invest in securities with a

[3]Figures refer to the end of 2007. Sources: Investment Company Institute (ICI) Fact Book 2008 and Deutsche Bundesbank Capital Market Statistic (Kapitalmarktstatistik).

maximum maturity of one year. In the US the weighted average maturity of a money market fund is not allowed to exceed 90 days. This regulation was introduced by the Securities and Exchange Commission (SEC) in 1991 in an effort to increase stability of MMFs (Gorton & Pennacchi 1992). Unlike the US there is no regulation concerning the average maturity of German MMFs.

Probably the most important difference between US and German money market funds is that US MMFs are subject to an implicit insurance. Issuers of money fund promise to never "break the buck". This means that the fund issuer guarantees that the value will never fall below one dollar. Hence, an investor can be sure to get at least the money back she invested. This is no legal obligation, but historically the sponsoring organizations have bailed out their money market funds in trouble (Gup 1998). Bailouts of US money market funds have also taken place during the subprime mortgage crisis. In the course of the subprime crisis at least 17 financial companies have bought low-valued securities from their MMFs to avoid a negative return.[4] German issuers of money market funds do not provide an insurance for their funds or at least do not announce it a-priori. The lack of an implicit insurance increases investor uncertainty which may ultimately contribute to runs.

4 Empirical Analysis

4.1 Data and Descriptive Statistics

Our sample contains a survivorship bias free sample of all German retail money market funds.[5] In order to make funds comparable we only consider MMFs which invest in Euro denominated securities. Our main data source is the monthly capital market statistic (Kapitalmarktstatistik) of the Deutsche Bundesbank. Further, data on the monthly returns was obtained from Thomson Financial Datastream and data on the annual expense ratios originates from the German Federal Association of Investment Companies (Bundesverband Deutscher Investmentgesellschaften, BVI).

Returns are calculated assuming that dividends are reinvested immediately.

[4] See *The New York Times*, July 11, 2008, p.8

[5] There are a number of MMFs registered in Luxembourg and marketed in Germany. Unfortunately, we do not have any data on these funds.

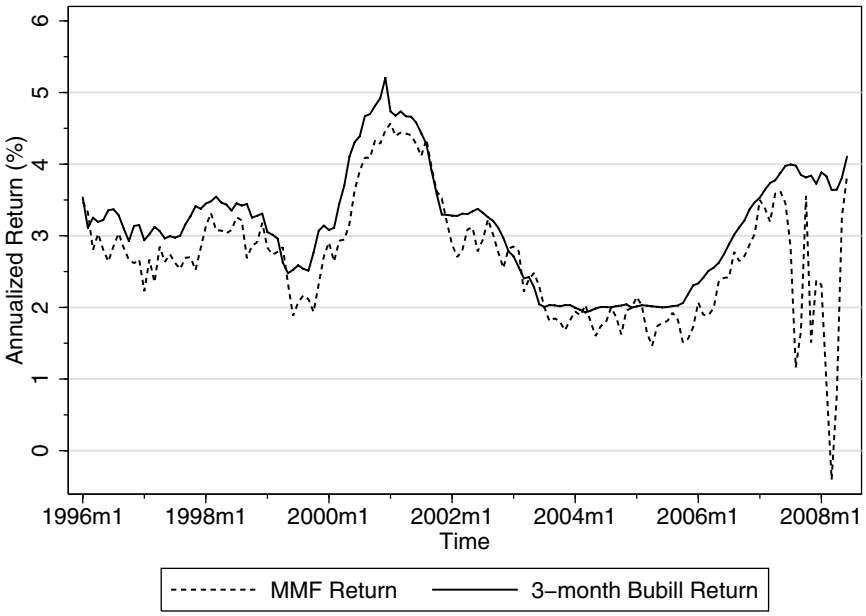


Figure 1: Return of Money Market Funds and 3-month Bubill Return

The figure shows the monthly (annualized) return of an equally weighted portfolio of German retail money market funds (MMFs) in comparison to a German government bill (Bubill) maturing in 3 months.

Figure 1 displays the annualized returns of German MMFs in comparison to the return of a 3-month German treasury bill (Bubill) in the period 1996/01 - 2008/06. The returns of MMFs follow usually closely the returns of short-term government securities. During the subprime crisis, however, we observe a sharp drop in the mean MMFs' return.

Figure 1 highlights that the 3-month Bubill rate can serve as a natural benchmark to compare the performance of MMFs. Therefore, we calculate excess returns by subtracting the 3-month Bubill rate from the funds' net returns. Other studies (e.g. Dahlquist et al. 2000, Christoffersen & Musto 2002) use a relative benchmark (i.e. an index of all money market funds) to compare the performance of MMFs. Since the average performance of MMFs dropped sharply during the second half of 2007 using a relative benchmark is not adequate for our purposes.

Table 1: Summary Statistics

This table shows summary statistics to the fund specific variables. Excess return is the annualized net return minus the 3-month Bubill rate in percentage points. Relative net flows are inflows minus outflows in relation to total assets (in percent). Commercial papers are defined as short term securities issued at a discount from financial and non-financial issuers. Treasury bills include all European government securities. Debt securities are all securities that are neither commercial papers nor treasury securities. Debt securities include floating and fixed rate securities and also asset-backed securities. All asset classes are measured as share of total assets. Age is measured in years since inception. Size is the log of total net assets. Expense ratio is the operating expenses divided by the average assets under management. Data sources are Thomson Financial Datastream, the capital market statistic of the Deutsche Bundesbank (BBK) and the German Federal Association of Investment Companies (Bundesverband Deutscher Investmentgesellschaften, BVI)

	Mean	Variance	25th Percentile	75th Percentile	Source
Excess Return	-0.463	2.641	-0.651	0.055	Datastream
Rel. Net Flow	0.967	422.84	-2.894	3.240	BBK
Debt Securities	0.736	0.056	0.621	0.919	BBK
Commercial Papers	0.067	0.018	0.000	0.068	BBK
Treasury Securities	0.004	0.001	0.000	0.000	BBK
Other Assets	0.025	0.005	0.005	0.014	BBK
Bank Deposits	0.167	0.040	0.038	0.208	BBK
Age	7.07	12.19	4.58	9.92	BBK
Size	18.84	3.63	17.44	20.17	BBK
Expense Ratio	0.546	0.038	0.400	0.650	BVI

The mean excess return is -46.3 basis points (See Table 1). A negative average excess return is at first sight surprising, but MMFs generally earn less than short term treasury securities and more than insured bank deposits (Koppenhaver & Sapp 2005). This is due to management fees which are necessary to run the fund. The investor values these intermediary services such as diversification, active maturity management and liquidity services, that she is willing to pay the fees instead of directly investing in treasury securities.[6]

Figure 2 displays the median, 25th and 75th percentile of MMFs' excess returns in the period 1996/01 - 2008/06. The figure shows that the median money market fund generally underperforms a 3-month Bubill. However, there are funds that outperform other funds and achieve a return equal or higher

[6]Koppenhaver & Sapp (2005) estimate the value for intermediary services to be around 43 basis points for an US sample of treasury money market funds in the period 1995-2001.

than the treasury security return. Starting in the second half of 2007 we observe a drop in median excess return. But funds are not equally affected by the crisis. While some funds' performance drops considerably other funds manage to achieve a return at or above the benchmark. It also can be seen that some funds dropped below zero percent return, meaning that investors actually faced negative returns.

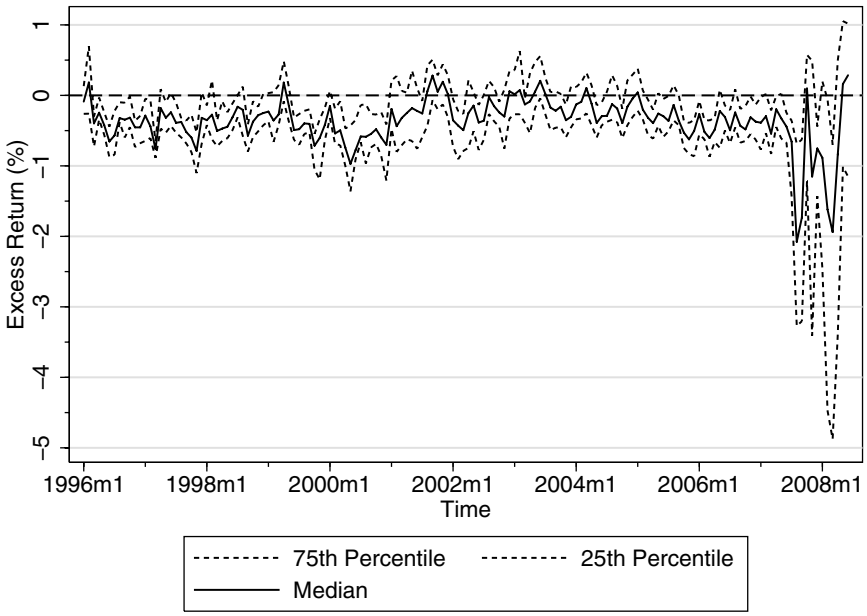


Figure 2: Excess Returns of Money Market Funds
This figure shows the distribution of annualized excess returns (in percentage points) of German retail money market funds. The graph displays median, 25th and 75th percentile.

Money market funds report their holdings on a monthly basis to the Bundesbank. Summary statistics are displayed in Table 1 and the asset composition at the end of each calender year is displayed in Table 2. Commercial papers are defined as short term securities issued at a discount by financial and non-financial issuers and *do not* include asset-backed securities. Treasury securities are all securities issued from European governments and play only a minor role in our sample. All securities which are neither commercial papers nor treasury securities are summarized under debt securities. This class is the majority of assets held by MMFs and consists mainly of fixed rate and floating

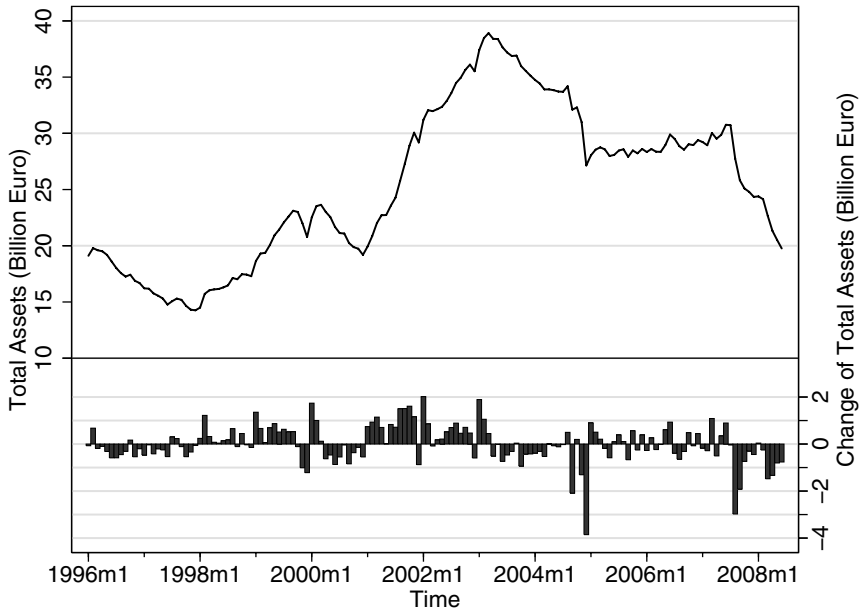


Figure 3: Total Net Assets of Money Market Funds
The figure displays the total net assets of German retail money market funds (left-hand side) and the monthly change of total net assets (right-hand side).

rate securities and also asset-backed securities. Further, bank deposits play an important but declining role for MMFs.

As can be seen in Table 2 MMFs increased their share of debt securities continuously until 2006 up to 81%. Supposably, they did so because these assets earned a higher return than alternative assets (i.e. bank deposits or commercial papers). With the start of the liquidity crisis in 2007 total net assets decreased by an amount of around 10 billion Euro, which accounts for a third of all MMFs assets under management (See also Figure 3). In the crisis MMFs reduced their share of debt securities and increased the share of more secure assets such as commercial papers or bank deposits.

The capital market statistic enables us to directly observe inflows and outflows. We therefore calculate the relative net flows the following way:

$$(Rel.)\ Netflow_{i,t} = \frac{Inflow_{i,t} - Outflow_{i,t}}{Total\ Assets_{i,t-1}}. \tag{1}$$

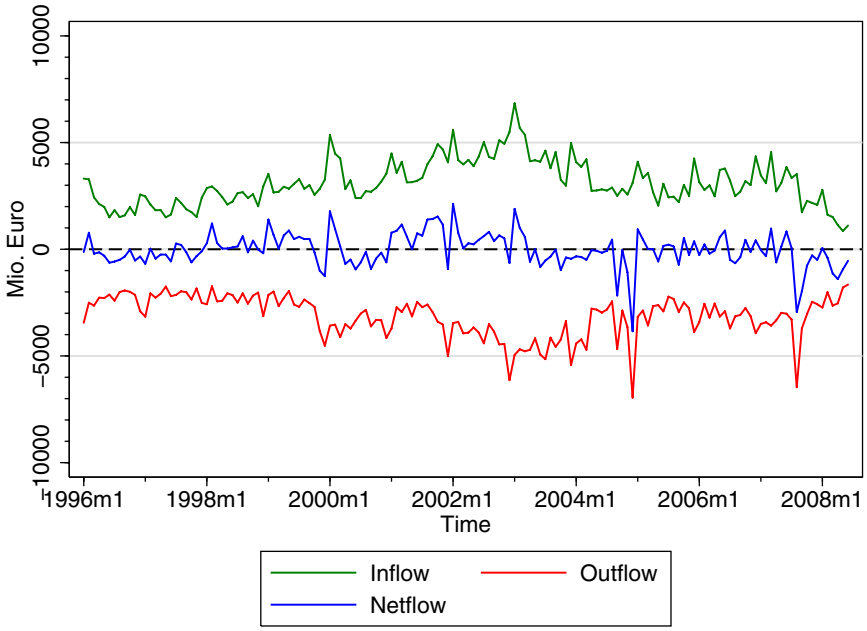


Figure 4: Flows of Money Market Funds
The figure shows in, out and net flows (in Mio. Euro) of German retail MMFs over time.

Aggregate in, out and net flows are displayed in Figure 4. During the 2007/2008 liquidity crisis we observe increased outflows and a reduction in net flows. Note, that MMFs also experienced outflows in earlier periods, for example during the year 2004. These outflows, however, did not have a negative impact on the returns, supposably because the money market was relatively liquid at that time. Such outflows could have been motivated by the low absolute return of MMFs at that time or by other more attractive investment opportunities.

We approximate aggregate money market liquidity by the spread between the 6-month Euribor (Euro Interbank Offered Rate) and the 6-month Bubill rate. The spread between interbank loans and government bonds can generally be assigned to both credit or liquidity risk. We follow Grinblatt (2001), who argues that an interbank loan is essentially risk free and the spread between the two assets has to be attributed to their differences in liquidity. An interbank loan is rather illiquid, because it cannot easily be converted back. A government bond, on the other hand, can more easily be sold before it matures. The difference in return between interbank rate and government bonds

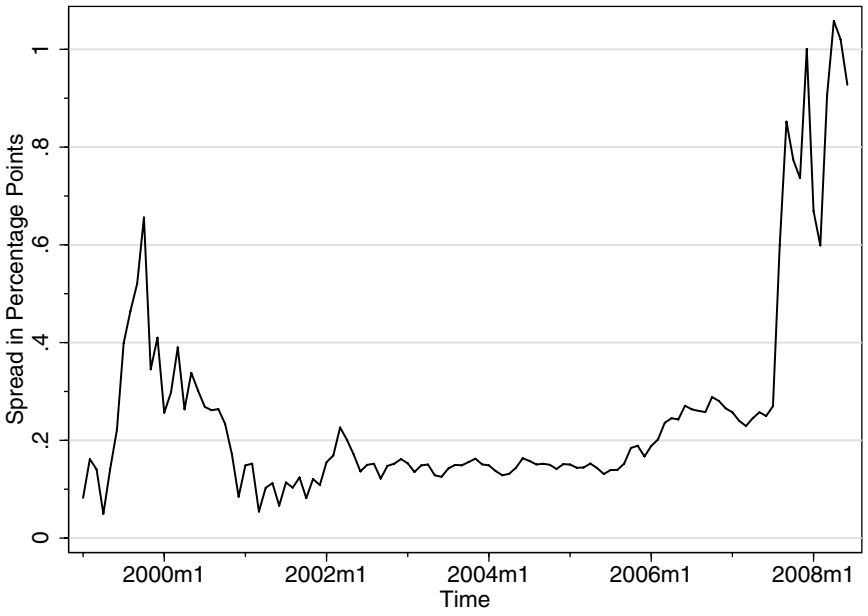


Figure 5: Euribor-Bubill Spread
This figure shows the monthly average spread between the 6-month Euribor and a German government bond maturing in 6 months.

is therefore referred to as convenience yield. Recent empirical studies (e.g. Fontaine & Garcia 2007, Feldhütter & Lando 2007) find that the majority of this money market spread can be attributed to a liquidity premium.

Figure 5 shows the spread between the 6-month Euribor and the 6-month Bubill rate for the period 1999/01 - 2008/06.[7] In the period of 2001 until the first half of 2007 the money market experienced a time of relatively high liquidity. With the beginning of the second half of 2007 we observe an increase in money market spread of more than 60 basis points.

[7]Since the Euribor was only established in 1999 we will only use the reduced sample in our further investigation.

Table 2: Asset Composition of German Retail Money Market Funds

This table shows the aggregate portfolio positions in million Euro. The sample includes all German retail money market funds investing in Euro denominated assets. All positions are end of year except for 2008. The percentage to total net assets is given in parentheses. Commercial papers are defined as short term securities issued at a discount from financial and non-financial issuers within the scope of a specified volume. Treasury bills include all European government securities. Debt securities are all securities that are neither commercial papers nor treasury securities. Debt securities include floating and fixed rate securities and also asset-backed securities.

Year	No. of obs.	Total Net Assets	Debt Securites		Commercial Papers		Treasury Bills		Other Assets		Bank Deposits		Liabilities	
1996	30	16.895	8.360	(49.5 %)	1.423	(8.4 %)	0.047	(0.3 %)	1.251	(7.4 %)	5.829	(34.5 %)	0.016	(0.1 %)
1997	31	14.258	8.284	(58.1 %)	1.079	(7.6 %)	0.012	(0.1 %)	0.609	(4.3 %)	4.286	(30.1 %)	0.012	(0.1 %)
1998	32	17.291	10.247	(59.3 %)	1.553	(9.0 %)	0.006	(0.0 %)	0.467	(2.7 %)	5.069	(29.3 %)	0.050	(0.3 %)
1999	30	20.781	13.239	(63.7 %)	2.694	(13.0 %)	0.052	(0.2 %)	0.811	(3.9 %)	4.026	(19.4 %)	0.041	(0.2 %)
2000	33	19.208	13.500	(70.3 %)	1.595	(8.3 %)	0.098	(0.5 %)	0.315	(1.6 %)	3.707	(19.3 %)	0.008	(0.0 %)
2001	39	29.186	21.110	(72.3 %)	2.706	(9.3 %)	0.171	(0.6 %)	0.674	(2.3 %)	4.846	(16.6 %)	0.320	(1.1 %)
2002	36	35.519	25.265	(71.1 %)	2.173	(6.1 %)	0.241	(0.7 %)	0.589	(1.7 %)	7.272	(20.5 %)	0.021	(0.1 %)
2003	38	35.129	24.456	(69.6 %)	3.415	(9.7 %)	0.001	(0.0 %)	0.621	(1.8 %)	6.695	(19.1 %)	0.059	(0.2 %)
2004	37	27.144	19.213	(70.8 %)	2.923	(10.8 %)	0.043	(0.2 %)	0.427	(1.6 %)	4.590	(16.9 %)	0.054	(0.2 %)
2005	37	28.612	22.082	(77.2 %)	3.168	(11.1 %)	0.000	(0.0 %)	0.164	(0.6 %)	3.237	(11.3 %)	0.038	(0.1 %)
2006	38	29.398	23.929	(81.4 %)	3.634	(12.4 %)	0.039	(0.1 %)	0.242	(0.8 %)	1.829	(6.2 %)	0.275	(0.9 %)
2007	38	24.350	16.912	(69.5 %)	5.351	(22.0 %)	0.018	(0.1 %)	0.242	(1.0 %)	2.017	(8.3 %)	0.189	(0.8 %)
2008 (June)	39	19.763	13.073	(66.1 %)	5.262	(26.6 %)	0.000	(0.0 %)	0.235	(1.2 %)	1.391	(7.0 %)	0.199	(1.0 %)

4.2 Persistence of Returns

Money market funds' returns generally show a strong persistence, which has been documented in several studies (Domian & Reichenstein 1998, Christoffersen & Musto 2002, Dahlquist et al. 2000). We estimate the first-order autocorrelation of annual returns using the Fama-MacBeth method. The autocorrelation coefficient is 0.54 and significantly different from zero (See Table 3).[8] We therefore reject the the null hypothesis that past performance is unrelated to future performance. Persistence also holds for several sub-samples, however, in the sub-sample including the crisis year 2007 significance weakens.

In addition, we employ a non-parametric method, suggested by Brown et al. (1992) and Brown & Goetzmann (1995), to measure performance persistence. This method allows us to obtain a disaggregate view on persistence. In a first step, we separate for each year the sample into winning and losing funds. Winners are defined as funds which are above the median return and losers are smaller or equal the median return. In a second step, we consider repeated winners and losers. Winner-Winner (WW) denotes funds that were winners in the last year and are also winners in the current year. In the same way further groups are established: Loser-Loser (LL), Winner-Loser (WL) and Loser-Winner (LW). Table 4 shows the contingency tables for each year. It further reports the number of new funds in the sample and the funds that drop out of the sample.[9] We also distinguish whether the fund was a winning fund the period before dropping out (Winner-Gone) or a losing fund (Loser-Gone). For each year we calculate the odds-ratio (OR):

$$\text{OR} = (WW \cdot LL)/(WL \cdot LW) \tag{2}$$

Under the null hypothesis that performance in the previous year is unrelated to the performance of the current year the odds-ratio equals one. The logarithm

[8] For details on the estimation method see Grinblatt & Titman (1992) or Horst & Verbeek (2000)

[9] The difference in the number of funds in comparison to Table 2 originates from the fact that a fund has to exist for two whole calender years.

Table 3: Performance Persistence of Money Market Funds: First-Order Autocorrelation

This table shows the first-order autocorrelation of MMFs' annual returns. We estimate the first order autocorrelation using the Fama-MacBeth method. For each year we run a cross sectional regression of lagged return on return and average the coefficients over time. The results are displayed for the whole sample and two sub-samples. Fama-MacBeth standard errors are given in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% level respectively.

Sample Period:	1996 - 2007	1996-2001	2002-2007
Exc. Return$_{t-1}$	0.537***	0.564***	0.510*
	(0.11)	(0.11)	(0.21)
Constant	-0.977**	-1.030*	-0.925
	(0.37)	(0.51)	(0.58)
No. of Obs.	359	152	207
No. of Years	12	6	6
R^2	0.348	0.335	0.362

of the odds-ratio is normally distributed under the null hypothesis:[10]

$$\frac{\ln(OR)}{\sigma_{\ln(OR)}} \sim N(0,1) \tag{3}$$

Table 4 summarizes the results. In the majority of years, seven out of eleven times, we reject the null hypothesis of independence on a 10% significance level. This means that in the majority of years the winners of last year are also the winners of the current year.

To assess the overall significance we employ Pearson's p_λ-Test (e.g. Rao 1952, p.44). Under the null hypothesis the p-values p_i from the individual tests are equally distributed on the [0,1] interval. It follows that $\lambda = \sum_{i=1}^{k}(-2 \cdot \ln(p_i))$ has a χ^2 distribution with 2k degrees of freedom where k is the number of individual tests. The overall test rejects the null hypothesis

[10]We follow Brown & Goetzmann (1995, p. 687) and approximate the standard error of the log odds-ratio the following way:

$$\sigma_{ln(OR)} = \left(\frac{1}{WW} + \frac{1}{LL} + \frac{1}{WL} + \frac{1}{LW}\right)^{(1/2)}$$

of independence on conventional significance levels. This is in line with the results found in the Fama-MacBeth regression (See Table 3).

Both the parametric an non-parametric method give us strong evidence for *overall* performance persistence. The advantage of contingency tables is that we are able to *disaggregate* the test and investigate persistence *period by period* (Brown et al. 1992). In the years of extremely high market liquidity (2002-2006) performance persistence is high. In the year 2005 there are 18 winning funds. 16 out of these 18 winning funds are also winners in the year 2006. In contrast to this we find a reversal in outperformance during the subprime crisis: Most winners of 2006, a year of extremely high market liquidity, are losers in 2007, a year of extremely low market liquidity.

This result suggests that outperformance of money market funds is a group phenomenon depending on market-wide liquidity as a state variable. In the next section we will investigate more closely the determinants of performance persistence in money market funds.

Table 4: Performance Persistence of Money Market Funds: Repeat Winners and Losers

Note: Funds are classified into winners (annual return above median) and losers (annual return below median) for each year. Winner-Winner indicates that a fund was is a winner in the current year (t) and was also a winner the previous year (t-1). New Fund indicates the number of new funds in t. Winner-Gone (Loser-Gone) shows the number of funds that were Winners (Losers) the previous year (t-1), but are not observed in the current year (t). We test the null hypothesis that past winners are unrelated to present winners by calculating the odds-ratio: (Winner-Winner · Loser-Loser)/(Winner-Loser · Loser-Winner). An odds-ratio of 1 corresponds to independence. To evaluate the overall rejection/acceptance of the null hypothesis we report Pearson's p_λ-Test

Year	Total	Winner-Winner	Winner-Loser	Loser-Winner	Loser-Loser	New Funds	Winner-Gone	Loser-Gone	Odds-Ratio	z	p-value
1996	24	.	.	.	.	24	.	.	.	.	
1997	30	6	6	6	6	6	0	0	1.0	0.00	1.000
1998	31	8	7	6	9	1	0	0	1.7	0.73	0.466
1999	30	10	3	5	11	1	2	0	7.3	2.34	0.019
2000	30	12	3	3	12	0	0	0	16.0	3.04	0.002
2001	33	7	8	7	8	3	0	0	1.0	0.00	1.000
2002	36	9	5	5	11	6	2	1	4.0	1.77	0.076
2003	35	12	6	5	12	0	0	1	4.8	2.15	0.032
2004	37	13	4	4	13	3	0	1	10.6	2.92	0.004
2005	37	13	5	5	14	0	0	0	7.3	2.68	0.007
2006	37	16	2	2	17	0	0	0	68.0	3.98	0.000
2007	34	7	10	10	7	0	1	2	0.5	-1.02	0.306
Total	**394**	**113**	**59**	**58**	**120**	**44**	**5**	**5**			
Pearson's p_λTest:											
$\lambda \sim \chi^2(22)$:		76.2									
p-value:		0.000									

4.3 Outperformance and Liquidity Risk

The persistence of fund returns is generally attributed to the strong persistence of expense ratios (See e.g. Domian & Reichenstein 1998, Christoffersen & Musto 2002). Since investors face costs when switching from one fund to another fund managers are able to charge higher fees without loosing existing investors. For this reason, some funds can persistently underperform others without loosing their investors.

The year by year inspection of performance persistence showed clearly that persistence is not common in all years. There are years without persistence and most notably a reversal in performance from the year 2006 to 2007. This happened without a change in expense ratios. Therefore the expense ratio alone cannot be the sole explanation for performance and persistence of MMFs.

Koppenhaver (1999) finds that in addition to expenses the portfolio composition also determines MMFs' returns. Fund managers can therefore enhance their returns by increasing the riskiness of the portfolio. In this line of argument we want to analyze the cross-sectional differences of money market fund returns with respect to the liquidity of their portfolio. We therefore run the following cross-sectional regression for each month:

$$\begin{aligned} Exc.\ Return_{it} &= \beta_0 + \beta_1 Liq.\ Assets_{i,t-1} + \\ &\quad \beta_2 Size_{i,t-1} + \beta_3 Expense\ Ratio_i + \varepsilon_{i,t}, \end{aligned} \tag{4}$$

where $Liq.\ Assets_{i,t-1}$ is the share of treasury securities, bank deposits and commercial papers. These traditional money market instruments are arguably the most liquid assets in the portfolio of a money market fund. Most importantly, this share does not include asset-backed securities which bear a higher liquidity risk because the market has only recently been established in Europe. To account for possible economics of scale we include $Size_{i,t-1}$, the logarithm of total assets of the fund (Domian & Reichenstein 1998). Further we include the $Expense\ Ratio_i$ of the fund as a control, which is the average expense ratio of the fund.[11]

[11] Taking the average for each fund is justified by the fact that expense ratios do almost not vary over time in our sample. The main part of the overall variation (standard deviation: 0.194) can be attributed to cross sectional variation (standard deviation: 0.183).

This regression is similar to the one of Koppenhaver (1999), but we extend this regression by taking into account that the relationship between portfolio and return may vary over time as a function of market-wide liquidity. Acharya & Pedersen (2005) report that liquid assets have superior performance in illiquid times and inferior performance in liquid times. We follow Massa & Phalippou (2005) who argue that the relationship of portfolio liquidity and performance varies over time as a function of market-wide liquidity. This leads to our first testable hypothesis:

Hypothesis 1: Funds that hold illiquid assets outperform in liquid times and underperform in illiquid times.

To test this hypothesis we run the cross-sectional regression displayed in equation 4 for each month. Afterward, we sort the months by market-wide liquidity into four quartiles and average the coefficients for each of the four groups. The results of this Fama-MacBeth regression are displayed in Table 5. The impact of liquid assets varies across the four quartiles. In the most liquid months (1st quartile) the share of liquid assets has a negative impact on performance. The negative impact of liquid assets on performance decreases for the less liquid assets (2nd and 3rd quartile). In times of extreme illiquidity (4th quartile) liquid assets even have a positive impact on excess return. We find no evidence for economics of scale.

For robustness and to better measure how market illiquidity and portfolio liquidity interact we run the following fixed effects regression displayed in equation 5. We now ask the question how a specific money fund manager can enhance her return by changing the portfolio. Using fixed effects we account for possible endogeneity that might result from a correlation of unobserved fund specific attributes with the regressors. The empirical model is specified as follows:

$$\begin{aligned} Exc.\ Return_{it} &= \alpha_i + \beta_1 Liq.\ Assets_{i,t-1} + \beta_2 Spread_t + \\ &\quad \beta_3 Liq.\ Assets_{i,t-1} * Spread_t + \beta_4 Size_{i,t-1} + \varepsilon_{i,t}, \end{aligned} \tag{5}$$

Table 5: The Influence of Portfolio Liquidity on Returns: Cross Sectional Regressions

Note: All observations are sorted by money market illiquidity (spread between 6-month Euribor and 6-month Bubill rate) and grouped into four quartiles. The table reports average coefficients of monthly cross sectional regressions. Liquid assets include the short term government securities, commercial papers and bank deposits. Size is measured as the log of total assets. Expense ratio is the ratio of annual expenses divided by average assets. Fama-MacBeth standard errors are given in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% level respectively.

	Money Market Liquidity			
	(liquid)			(illiquid)
	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile
Liq. Assets$_{t-1}$	-0.444***	-0.268**	-0.194*	2.043***
	(0.08)	(0.12)	(0.10)	(0.69)
Size$_{t-1}$	0.020	0.000	-0.007	-0.050
	(0.01)	(0.01)	(0.02)	(0.04)
Expense Ratio	-0.627***	-0.937***	-1.018***	0.245
	(0.14)	(0.17)	(0.14)	(0.44)
Constant	-0.00766	0.361	0.319	-0.591
	(0.30)	(0.27)	(0.33)	(0.88)
No. of Obs.	895	1000	980	949
No. of Funds	27	28	28	30
R^2	0.189	0.241	0.287	0.202

where $Liq.\ Assets_{i,t-1}$ is, as mentioned before, the share of traditional money market instruments (i.e. bank deposits, treasury securities and commercial papers). The share of liquid assets enters directly and in interaction with our measure for market illiquidity $Spread_t$ into the regression equation. Hypothesis 1 suggests a negative β_1: in very liquid times liquid assets should have a negative impact on performance. It also follows from hypothesis 1, that the coefficient of the interaction term β_3 is positive: in illiquid times liquid assets should have a positive effect on performance.

We again control for economics of scale by including the log of total assets $Size_{i,t-1}$. Unobservable fund characteristics are captured by the individual effect α_i. This includes also the expense ratio which is, as shown before, largely invariant over time.

The results are displayed in Table 6. First, we estimate equation 5 without

Table 6: The Influence of Portfolio Liquidity on Returns: Fixed Effects Regression

The table shows the fixed effect regression of explanatory variables on excess return. Size is measured in log of total assets, Liq. Assets is the share of traditional money market instruments (government securities, commercial papers and bank deposits). Money market spread is the spread between the 6-month Euribor and the 6-month Bubill rate. The regression is performed for two sample periods: the time before the liquidity crisis (1999-2006) and the full sample (1999-2008). Robust standard errors clustered at the fund level are given in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% level respectively.

	(1)	(2)	(3)	(4)
	1999-2006		1999-2008	
Liq. Assets$_{t-1}$	-0.217**	-0.402***	0.655**	-0.861**
	(0.11)	(0.13)	(0.29)	(0.34)
Spread$_t$		-1.799***		-3.361***
		(0.19)		(0.83)
Spread$_t$* Liq. Assets$_{t-1}$		1.323***		5.378***
		(0.44)		(1.75)
Size$_{t-1}$	0.0767**	0.0724**	0.155*	0.09
	(0.03)	(0.03)	(0.08)	(0.06)
Constant	-1.677**	-1.274**	-3.537**	-1.37
	(0.65)	(0.61)	(1.61)	(1.18)
No. of Obs.	3358	3355	4050	4046
No. of Funds	45	45	49	49
Within R^2	0.011	0.058	0.008	0.118

considering market illiquidity for two different samples: the sample before the liquidity crisis on the money market (1999-2006) and the full sample (1999-2008). Results can be found in columns (1) and (3). It becomes obvious, that omitting market illiquidity, is problematic. In the first sample period liquid assets have a negative impact on returns. This first period was characterized by relative high market liquidity as can be seen in Figure 5. In the full sample liquid assets do have a positive impact. This is at first sight counterintuitive, however, driven by the extreme market illiquidity since the middle of 2007. Controlling for market liquidity is apparently important.

The results of the fully specified model can be found in column (2) and (4). The coefficient of $Liq.\ Assets_{i,t-1}$ β_1 is, as hypothesized, negative: funds with liquid assets underperform in liquid times. Liquid funds, however, out-

perform in illiquid times. The interaction coefficient with market illiquidity β_3 is significantly different from zero and positive. Including market-wide liquidity directly and as an interaction term also increases the model's explanatory power measured by the within R^2 considerably. The pre-crisis sample (1999-2006) shows that this result is not driven by the crisis only.

Since money market liquidity was persistently high from 2001 until the first half of 2007 illiquid MMFs persistently outperformed liquid MMFs. Persistence of MMFs' returns is therefore not only driven by *persistence of expense ratios* but also by the portfolio structure and the *persistence of market-wide liquidity*.

Enhancing returns by investing in illiquid assets, however, comes at a cost. If market-wide liquidity drops managers face problems, when investors want to redeem their shares. They have to sell relatively illiquid assets at fire sale prices, which results in a reduction of returns. This in turn might lead to further outflows. An illiquidity shock can therefore trigger a self-fulfilling run. For this reason, we now move to analyze the flows in and out of MMFs resulting from a market-wide illiquidity shock.

4.4 Market Illiquidity and Fund Flows

A market-wide liquidity shock can a-priory have two effects on investors (See Gorton & Pennacchi 1992, Pennacchi 2006, Miles 2001): On the one hand, investors can see money market funds as a safe haven, which would lead to inflows into money market funds. On the other hand, a sudden drop in liquidity can cause investors to withdraw their money because they are concerned about a value reduction. If other investors fear a reduction in value caused by the initial redemptions, the liquidity shock can lead to a self-fulfilling run.

The likelihood of a run depends crucially on the liquidity of the portfolio. A withdrawal in illiquid times results in costs, because the fund manager has to sell her assets at a bad time and can only achieve a smaller price. Since it usually takes some days for the fund manager to restore her cash balance, these costs affect mainly the remaining investors in the fund. Therefore, redemption impose a negative externality on the remaining investors. If this externality

becomes sizable, the expectation of other investors withdrawing their money can cause the remaining investors to also withdraw their money, resulting in a self-fulfilling run. The negative externality and consequently the likelihood of a run increases with market illiquidity and the illiquidity of the portfolio. Our second testable hypothesis therefore is:

Hypothesis 2: In illiquid times funds that hold illiquid assets are more likely to experience a run than funds that hold liquid assets.

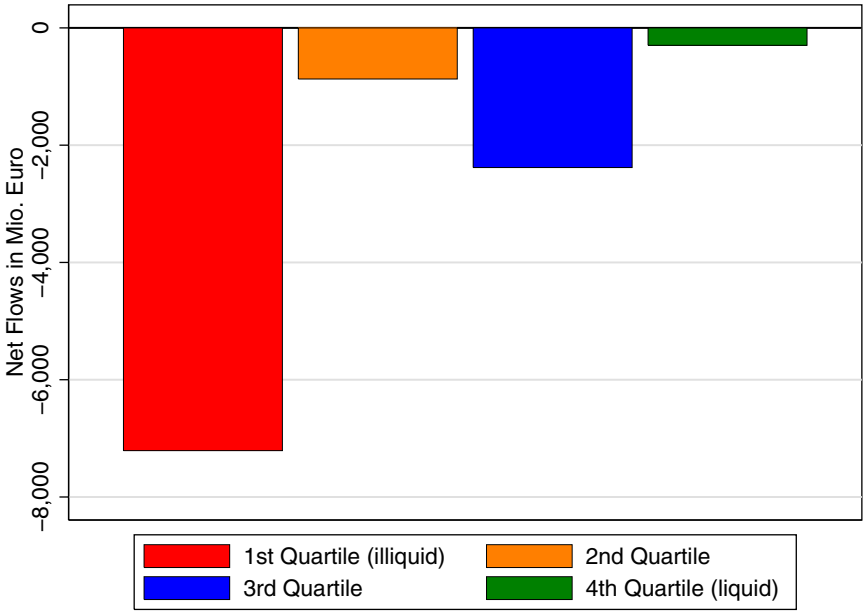
As a first test of this hypothesis we examine the cumulative net flows of German MMFs during the subprime crisis (2007/07 - 2008/06) in Figure 6. Money market funds are sorted in 2007/06 into four groups according to their share of liquid assets.[12] Overall, money market funds lost 10.8 billion Euro in the crisis period (Compare also Figure 3). The most illiquid quartile of funds lost around 7.2 billion Euro, which accounts for the majority of all outflows. In relation to their total assets before the crisis (2007/06) the quartile of the most illiquid funds lost around 60% of their assets. It can clearly be seen, that the intensity of outflows decreases with portfolio liquidity. The most liquid funds only experienced outflows of around 5%.

To evaluate the impact of market liquidity shocks on MMFs' flows more closely we specify the following empirical model:

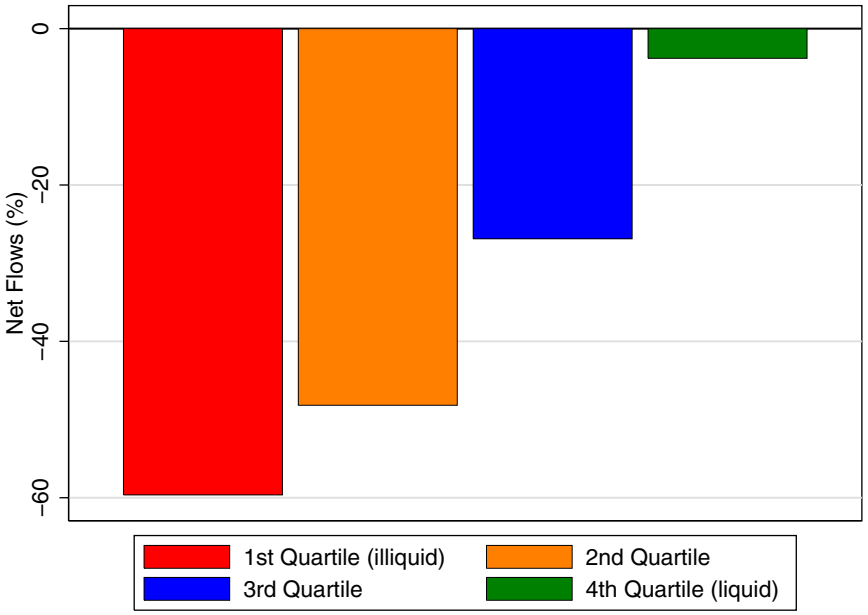
$$\begin{aligned} Netflow_{it} &= \alpha_i + \beta_1 Liq.\ Assets_{i,t-1} + \beta_2 Exc.\ Return_{i,t-1} + \beta_3 Spread_t \\ &\quad + \beta_4 Spread_t * Liq.\ Assets_{i,t-1} + \beta_5 Spread_t * Exc.\ Return_{i,t-1} \\ &\quad + \beta_6 Size_{i,t-1} + \beta_7 Age_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{6}$$

where $Netflow_{it}$ is the relative net flow of fund i in period t. The flow is measured relative to total assets of the previous month. $Liq.\ Assets_{i,t-1}$ is our previously used proxy for portfolio liquidity. We include past excess return $Exc.\ Return_{i,t-1}$ because investors of mutual funds typically react to good or

[12] Share of liquid assets by quartile (valuation date 2007/06): Q_{25}: 0.04, Q_{50}: 0.10, Q_{75}: 0.16, Q_{100} : 0.65



(a) Net Flows 2007/07 - 2008/06



(b) Relative Net Flows 2007/07 - 2008/06

Figure 6: Net Flows by Portfolio Liquidity

Money market funds are grouped in 2007/06 into four quartiles according to their liquidity. We use the share of treasury securities, bank deposits and commercial papers as proxy for liquidity. Figure 6(a) shows the cumulated net flows (inflows minus outflows) for the four groups of funds in million Euro. Figure 6(b) shows the net flows in relation to total net assets of 2007/06.

bad performance of the fund (e.g. Sirri & Tufano 1998). More recently a performance flow relationship has also been documented for MMFs (Koppenhaver & Sapp 2005). Market illiquidity $Spread_t$ is again measured by the spread between the Euribor and the Bubill rate, both maturing in 6 months.

This money market spread enters directly and as interaction term with portfolio liquidity into the regression equation. Hypothesis 2 suggest that investors react differently to a market-wide liquidity shock depending on the liquidity of the portfolio. An increase in the money market spread alone should lead to outflows, which should result in a negative β_3. Liquid funds, on the other hand, should experience less outflows when facing market illiquidity. We expect therefore the coefficient of the interaction term β_4 to be positive. The regression equation also includes an interaction term of market illiquidity with past excess return to test whether the performance flow relationship changes in liquid and illiquid times.

Again, the log of of total net assets is added as a control. It is generally found that small funds grow faster than large funds. Similarly, we include the age in years as a control variable into the regression. Older funds are also associated with less inflows (Sirri & Tufano 1998). We only include funds which existed for at least two years. Recently founded funds usually experience very large inflows in relative terms. This can lead to an outlier problem and skew the results (Berk & Tonks 2007).

The results are displayed in Table 7. We estimate equation 6 first using the fund fixed effects (Panel A) and second using fund and time fixed effects (Panel B). The control variables $Size_{i,t-1}$ and $Age_{i,t-1}$ have the expected negative sign. We find a positive performance flow relationship. A increase in excess return leads to an inflow and a decrease in performance leads to an outflows of funds. The performance sensitivity of investors might be the reason why fund managers increased the risk of their portfolio and enhanced their funds in the first place. Similarly, we find some evidence that liquid assets lead to outflows in liquid times. This is in line with the positive performance flow relationship. Liquid assets earn less return in good times and investors respond by withdrawing their money.

A sudden increase in market illiquidity has a negative effect on flows, which

confirms the hypothesis of a run on illiquid funds. An increase in liquid assets limits outflows and counteracts this first effect. Funds with a large amount of liquid assets will therefore not experience significant outflows after an illiquidity shock. Figure 7 plots the marginal effect of market illiquidity on net flows as a function of portfolio liquidity.[13] Money market funds with less than 30% of liquid assets experience significant outflows after an illiquidity shock (at the 5% significance level). In contrast, there are no significant outflows after an illiquidity shock for funds with a share of above 30%.

This result shows the crucial importance of portfolio liquidity in preventing runs. MMFs that are truly narrow are immune against runs and thus there is no need for deposit insurance. By contrast, MMFs that enhance their returns by deviating from the narrow to a wider portfolio structure expose themselves to the risk of a run.

[13]The marginal effect and its variance is calculated as follows (For details see e.g. Greene 2003, 123-124):

$$\begin{aligned} \frac{\partial Netflow}{\partial Spread} &= \beta_3 + Liq.Assets \cdot \beta_4 \\ \text{Var}\left[\frac{\partial Netflow}{\partial Spread}\right] &= \text{Var}[\beta_3] + Liq.\ Assets^2 \cdot \text{Var}[\beta_4] + 2 \cdot Liq.\ Assets\ \cdot \text{Cov}[\beta_3, \beta_4] \end{aligned}$$

Table 7: The Influence of Market Illiquidity on Fund Flows

Note: The table shows a fixed effects regression of fund net flows (measured in relation to total assets). Liquid Assets is the portfolio share of treasury securities, bank deposits and commercial papers. Excess return denotes the annualized return in excess of the 3-month Bubill rate, spread is the spread between the 6-month Euribor and the 6-month Bubill rate and serves as a proxy for money market illiquidity. Size measured as the log of total assets and and age in years are added as control variables. In Panel A we control for fund fixed effects and in Panel B we additionally control for time fixed effects. The sample contains money market funds from 1999/01 - 2008/06. We only include funds with an age above two year so that the large growth rates of young funds do not skew the results. Robust standard errors clustered at the fund level are given in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% level respectively.

Panel A: Fund Fixed Effects

	(1)	(2)	(3)
Liq. Assets$_{t-1}$	-2.742	-5.036*	-5.052*
	(2.23)	(2.83)	(2.85)
Exc. Return$_{t-1}$	0.744***	0.538***	1.170**
	(0.16)	(0.16)	(0.46)
Spread$_t$		-6.224***	-6.579***
		(1.77)	(1.74)
Spread$_t$ * Liq. Assets$_{t-1}$		11.75**	12.18**
		(4.70)	(4.70)
Spread$_t$ * Exc. Return$_{t-1}$			-0.74
			(0.45)
Size$_{t-1}$	-1.058*	-1.297**	-1.309**
	(0.57)	(0.57)	(0.57)
Age$_{t-1}$	-0.478***	-0.315**	-0.310**
	(0.13)	(0.13)	(0.13)
Constant	25.02**	29.70***	30.08***
	(10.88)	(10.87)	(10.95)
Fund Dummies	Yes	Yes	Yes
Time Dummies	No	No	No
No. of Obs.	3687	3687	3687
No. of Funds	44	44	44
Within R^2	0.027	0.033	0.033

(continued)

Table 7 -Continued

Panel B: Fund and Time Fixed Effects

	(1)	(2)	(3)
Liq. Assets$_{t-1}$	-2.248	-5.585*	-5.495*
	(2.39)	(2.78)	(2.79)
Exc. Return$_{t-1}$	0.569***	0.500***	1.100**
	(0.17)	(0.16)	(0.49)
Spread$_t$		-	-
Spread$_t$ * Liq. Assets$_{t-1}$		13.19**	13.30**
		(5.08)	(5.06)
Spread$_t$ * Exc. Return$_{t-1}$			-0.699
			(0.48)
Size$_{t-1}$	-1.044*	-1.157*	-1.159*
	(0.60)	(0.59)	(0.60)
Age$_{t-1}$	-0.873***	-1.099***	-1.108***
	(0.23)	(0.26)	(0.26)
Constant	28.00**	31.30***	31.41***
	(10.85)	(10.85)	(10.90)
Fund Dummies	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes
No. of Obs.	3687	3687	3687
No. of Funds	44	44	44
Within R^2	0.086	0.088	0.089

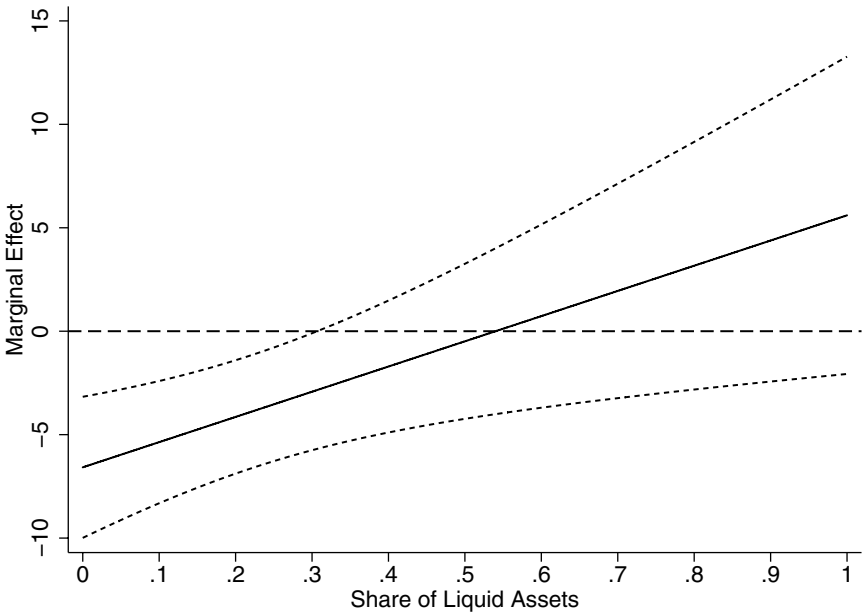


Figure 7: Marginal Effect of Market Illiquidity on Net Flows

This figure displays the marginal effect of market illiquidity on net flows as a function of portfolio liquidity (solid line). 95 % confidence intervals are also provided (dotted lines). Estimates are taken from Table 7, Panel A, Column (3). Market illiquidity is measured by the Euribor-Bubill spread and portfolio liquidity is approximated by the share of traditional money market instruments.

5 Conclusion

This paper showed that in liquid times some MMFs' managers enhanced their returns by investing in less liquid assets. We give evidence that this drive (ger.: "Drang") to higher returns is motivated by investors reacting to bad performance and withdrawing their money. By investing in illiquid assets funds can outperform other funds as long as liquidity in the market is high. Investing in less liquid assets, however, widens the narrow structure of money market funds and makes them vulnerable to runs. During the liquidity crisis of 2007/2008 we observe runs (ger.: "Sturm") on money market funds with enhanced and illiquid portfolios. Money market funds with more liquid portfolios, in contrast, had no significant outflows and functioned as a safe haven.

The study shows the risk involved in investing in illiquid assets when a

open-ended structure is involved. Most importantly, this paper gives evidence that runs are even possible in the, usually highly liquid, money market segment.

The results raise the question of how to ensure the stability of money market funds. Additional regulations with regard to permitted assets and maturity are not necessarily the right solution. Increasing transparency would already help private investors to gain better insight in the risks they are taking when investing in money market funds. Up to now asset composition of German MMFs is only scarcely available to the public and not standardized. Higher transparency should allow investors to select funds given their liquidity and risk preferences.

Further, an insurance provided by the fund issuer might play an important role in the stability of MMFs. During the course of the subprime crisis MMFs' assets have increased in the US, where an implicit insurance is provided. Gorton & Pennacchi (1992) argue that an implicit insurance can reduce the risk of a run on MMFs in two ways: From the investor's perspective, an insurance can establish trust in the money market fund and thus avoid a self-fulfilling run. From the manager's perspective, the insurance payed by the fund issuer gives an incentive to reduce the riskiness of the portfolio

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