Derivative margin calls: A new driver of MMF flows?

Linda Fache Rousová [*], Maddalena Ghio [†], Dilyara Salakhova, and Germán Villegas Bauer

European Central Bank [‡§]

February 1, 2022
Preliminary and incomplete - please do not circulate

Abstract

This paper investigates whether the significant volatility in MMF flows in the March 2020 market turmoil was driven by investors' liquidity needs related to derivative margin payments. We combine three highly granular unique data sets (EMIR data for derivatives, SHSS data for investor holdings of MMFs and Refinitiv Lipper data for daily MMF flows) to construct a daily fund-level panel data spanning from February to April 2020. We estimate the effects of variation margin paid and received by the largest holders of EUR-denominated MMFs on flows of these MMFs. The main findings suggest that variation margin payments faced by some investors holding MMFs were an important driver of the flows of EUR-denominated MMFs domiciled in euro area. Margins posted have a stronger effect on MMF outflows that margins received on MMFs inflows.

Key words: derivatives, variation margin, liquidity risk, money market funds, big data.

JEL classification: G13, G15, G23.

[*]Contact author: linda.fache_rousova(at)ecb.europa.eu

[†]Maddalena Ghio mostly worked on the paper when affiliated with the ECB.

[‡]This paper should not be reported as representing the views of the European Central Bank (ECB). The views expressed are those of the authors and do not necessarily reflect those of the ECB or the Eurosystem.

[§]Acknowledgements: We would like to thank Simon Kordel and Sebastiano Michele Zema for helpful data support in drafting this paper and XXX for comments and suggestions. We remain solely responsible for any errors or omissions.

1 Introduction

During the coronavirus-related market turmoil in March 2020, money market funds (MMFs) across the globe experienced significant volatility in flows. Between 13 and 20 March 2020, euro area MMFs experienced outflows of nearly 8% of assets under management (Boucinha et al., 2020), while prime MMFs in the US recorded outflows of 11% of their assets over March 2020 (FSB, 2020). The unprecedented responses by central banks, followed by other public policy responses, helped stabilise the outflows. But the experience raises questions about the potential drivers and amplifiers of such volatility in MMF flows.

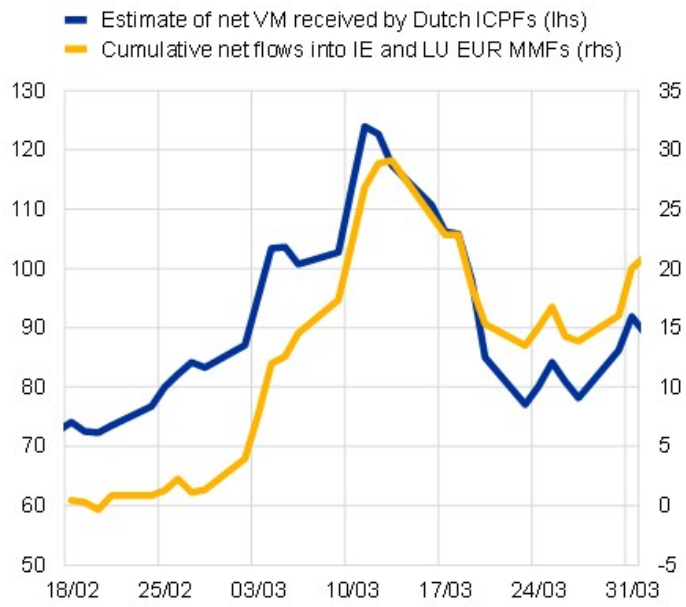
In this paper we investigate the reasons behind the MMF flows paying particular attention to investors, their liquidity needs and the use of MMFs as a source of liquidity in stressed periods. We start from a stylized fact in Figure 1 documenting a strikingly strong correlation (over 80%) between variation margin (VM) payments on derivative portfolios of euro area insurance companies and pension funds (ICPFs) and MMF flows held by ICPFs facing these payments (Fache Rousova et al., 2020)[1]. We then analyse in more depth whether VM payments of various sectors were one of the drivers of the observed MMF flows. Based on market intelligence, some other studies also point out to the importance of VM payments in MMF flow dynamics (BlackRock, 2020; Bank of England, 2020).

Investigating the effects of margin payments on the financial system in general and MMFs in particular is very important in view of the recent regulatory reform in the derivatives market, which has introduced the daily exchange of margin for the vast majority of derivative exposures and thus has profoundly changed the functioning of the derivative markets. Existing studies on MMF outflows during the March market turmoil, on the contrary, mainly focus on drivers related to the MMF characteristics. de Guindos and Schnabel (2020) and Boucinha et al. (2020) suggest that the outflows from USD-denominated MMFs domiciled in the euro area were driven by a flight-to-safety reason as investors withdrew particularly from riskier LVNAV and moved investments into safer CNAV funds, also USD-denominated. Furthermore, Capotă et al. (2021) underlined the role of a number of weaknesses in European MMF regulatory framework related to non-public debt funds, the LVNAV structure and MMF liquidity requirements.

To study the relationship between VM payments and MMF flows, we estimate the effects of margins paid and received by the largest holders of EUR-denominated MMFs on flows of these MMFs. To do this, we combine three unique and very granular data sets.

[1]Variation margin is collateral exchanged by two counterparties to a derivative transaction, which reflects the price movement of such a transaction or a portfolio of such transactions.

Figure 1: Co-movement of ICPF variation margin and flows in EUR-denominated MMFs domiciled in Ireland and Luxembourg.



Notes: Values in billion euros.

First, we use transaction-by-transaction EMIR data to compute margin payments by all types of investors located in the euro area, further enriched by sector classification from Lenoci and Letizia (2021). Second, we use Securities Holdings Statistics at sector level (SHSS) to identify holdings of MMFs by investors. Finally, we use Refinitiv Lipper data to obtain daily MMF flows at a fund level. Since SHSS data provides investor information only at a country-sector level, e.g., holding of funds A, B and C by the whole German investment funds sector, we aggregate variation margin at a country-sector level.

The resulting dataset contains a daily fund-level panel data where the dependent variable is daily flows in individual MMFs domiciled in France, Ireland and Luxembourg, and the explanatory variables of interest are variation margins posted or received by major investor country-sectors holding the respective MMFs. The panel spans over three months: February, March and April 2020. Since the margin payments in euro currency are by far the largest, we only focus on these margin payments and EUR-denominated MMF flows. Furthermore, we focus on VM payments (as opposed to initial margin payments) as VM is typically paid by cash, while inital margin payments can also be met by non-cash collateral.

Our results suggest that variation margin payments faced by some - but not all - investors holding MMFs were an important driver of the flows of EUR-denominated MMFs domiciled in euro area. In line with expectations, the results are typically more pronounced for MMF investors facing large margin payments than MMF investors facing

relatively limited margin payments. Specifically, we distinguish between MMF outflows and MMF inflows. We show that margin posted tends to increase MMF outflows, indicating that some MMF investors quickly redeemed MMF shares to meet the margin payments. Margin received is found to increase inflows in MMFs domiciled in Ireland and Luxembourg, while this is not the case for French MMFs. This suggests that some MMF investors may either take time before reinvesting liquidity from margin payments in MMFs or they may also use other instruments to store the liquidity.

Overall, the results support the hypothesis that some MMF investors - such as investment funds, insurance companies and pension funds - used MMFs to manage liquidity related margin calls in the March 2020 market turmoil. Moreover, these results are by and large robust for all EUR-denominated MMFs domiciled in the euro area as they apply to EUR-denominated MMFs domiciled in all three countries with such MMFs, i.e. France, Ireland and Luxembourg. Furthermore, we find these results despite the fact that the unavailability of the data does not allow us to conduct the analysis on firm-to-MMF level but only at a less accurate country-sector-to-MMF level.

The rest of the paper is structured as follows. Section 2 describes the data and provides some key descriptive statistics with focus on the March 2020 market turmoil. Section 3 presents the empirical model. Section 4 discusses the results. Section 5 briefly concludes.

2 Data

In this paper, we combine three highly granular and unique data sets. First, we use transaction-by-transaction EMIR data to compute variation margins for investors, which are further enriched by sector classification developed by Lenoci and Letizia (2021). Second, we use Refinitiv Lipper data to obtain daily MMF flows at a fund level. Finally, linking the two, we use Securities Holdings Statistics Sector (SHSS) data to identify the sectors, which hold each individual MMFs. Since SHSS data provide investor information only at a country-sector level, e.g., holding of funds A, B and C by the whole German investment funds sector, we aggregate variation margins at a country-sector level.

2.1 Variation margin payments from EMIR data

EMIR data is transaction-by-transaction data on derivatives collected under the European Market Infrastructure Regulation (EMIR). It has been reported by entities resident in the EU since February 2014 and includes the details of each individual derivative transaction conducted by these counterparties. For each derivative transaction more than 120

data fields are available. The information includes the type of derivative, the underlying, the price, the amount outstanding, the execution and clearing venues of the contract, the valuation, the collateral and life-cycle events.

In this paper we work with EMIR data that is accessible to the ECB, i.e. with a sub-sample that is restricted to the trades reported by counterparties located in the euro area. We enrich the reported data with sector information of the reporting entity applying the classification algorithm of Lenoci and Letizia (2021), which combines information from four official lists (ECB's lists of monetary financial institutions and investment funds, EIOPA's list of insurance undertakings and ESMA's list of CCPs) and four other data sources (ECB's RIAD, Orbis, Refinitiv Lipper and Bank Focus). Since EMIR data is highly granular and complex, we also extensively manipulate and clean the data. In particular, the data is initially reported by both counterparties to a trade and, therefore, we pair the two legs of the trade (where possible and applicable). Furthermore, we run various quality checks and remove outliers. Despite this processing, the final data is still subject to some data quality limitations (such as missing values, some transactions remain unpaired, or possible under-reportings).

While EMIR data is reported at transaction level, VM is computed and reported at portfolio level. This implies that for all trades belonging to the same collateral portfolio, the reporting counterparty provides the same value for the VM received and posted (see an illustrative example in Table 1). For paired trades, when one counterparty receives (posts) VM, the other counterparty, sharing the same portfolio, will post (receive) the same amount. VM in EMIR data is reported in stocks, i.e. as the cumulative value since the starting date of the contract. The value of the flow of margin payments exchanged on a given day t, call it D_t, can then be derived from stocks by taking the difference between the value of the margins' stock at day t, say V_t, minus the value at the previous day $t-1$, say V_{t-1}, that is $D_t \doteq V_t - V_{t-1}$.

Table 1: Illustrative example of how VM is reported in EMIR data after pairing of the two legs of a trade for a given portfolio.

LEI 1	LEI 2	Trade ID	Port. Code	Notional	VM Rc.1	VM Ps.1	VM Rc.2	VM Ps.2
ABC	DEF	111	ABCDEF00	100	200	0	0	200
ABC	DEF	222	ABCDEF00	500	200	0	0	200

Notes: The representative portfolio (identified by the collateral portfolio code ABCDEF000) consists of two contracts (identified by the trade IDs 111 and 222 and respectively with notional values 100 and 500) between two counterparties (identified by their LEIs ABC and DEF). While the two contracts have different trade IDs and notional values, they share the same values for the VM received by ABC from DEF (200), posted by ABC to DEF (0), received by DEF from ABC (0) and posted by DEF to ABC (200), since they belong to the same collateral portfolio. The total notional value of this portfolio is equal to 600.

To compute margins from transaction level data, we first define a reliable and unique collateral portfolio code for each pair of counterparties sharing a portfolio of derivatives

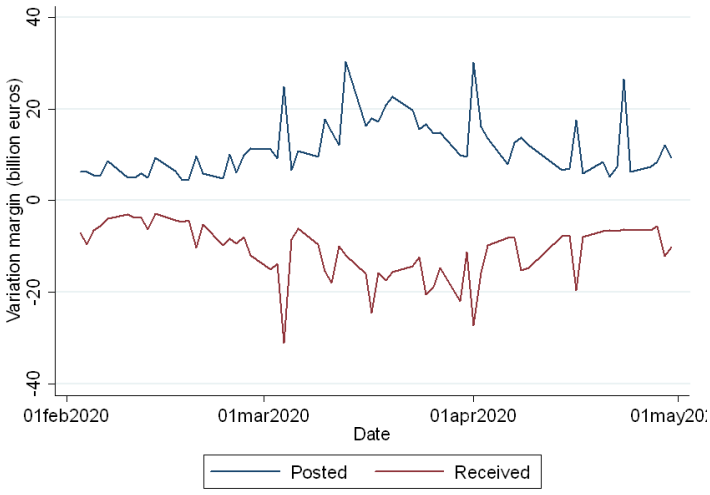
by concatenating the legal entity identifiers (LEIs) of the two counterparties with the reported collateral portfolio codes. If one of the latter does not exist, then it is replaced by the reported VM value. To filter out potential outliers with suspiciously high VM values, we drop portfolios, for which the VM value exceeds 80% of the total notional value of the portfolio (computed as the sum of the notional of the single contracts in the portfolios).

We work with net posted margins, computing them as the difference between VM posted and VM received on each day and for each collateral portfolio. From net posted margins, we isolate the positive part, signalling a net outflow of cash, where the positive part of the margin is defined as the value of the net posted margin if the margin is positive, and zero otherwise. By the same token, we isolate the negative part, signalling a net inflow of cash. While net posted VMs can assume both positive and negative values, the positive and negative parts always retain the same sign. This has an impact on the aggregation of the margins at sector level (needed because of SHSS data - see Section 2.3). We perform the aggregation after having isolated the positive and negative parts of the net VMs, which reduces information loss. If the aggregation was done before the separation, positive and negative values of net posted VMs by different entities would offset each other.

To each portfolio, we also assign a currency for the received and posted VMs in order to be able to filter out only portfolios where margins are posted/received in EUR. Since in principle it is possible to receive or post margins in multiple currencies for contracts belonging to the same portfolio, we use values converted to EUR and define that a portfolio receives (posts) margin in a given currency if the outstanding notional of the contracts receiving (posting) margin in that currency exceeds an 80% threshold of the total outstanding notional of the portfolio. Overall, around 60% of the VM flows over the period is in EUR.

Figure 2 shows that during the March 2020 market turmoil, the daily VM payments of euro area non-bank entities increased more than fivefold, from around €5 billion in the first half of February 2020 to more than €20 billion in March 2020, with peaks of over €30 billion (see also Fache Rousova et al. (2020) for similar evidence on VM faced by investment funds). We exclude from the chart VM of CCPs and banks, since CCPs positions are fully balanced (VM received equals VM paid) and banks/large dealers usually pay VM not only for their own trading purposes but also on behalf of their clients, which complicates the analysis. Banks are also not large holders of MMFs (see also Section 2.3 and Table 2).

Figure 2: Variation margin payments (flows) of euro area non-bank entities.



Notes: VM payments are the result of the aggregation of the flows of posted and received margins that we derive from the reported stocks of margins in the data.

2.2 MMF flows from Refinitiv Lipper data

The euro area MMF sector has assets with a total value of around €1.3 trillion. MMFs domiciled in Ireland, Luxembourg and France represent the lion's share of the sector in the euro area. The sector is highly diverse. Funds are available in different currencies (euro, pounds sterling or US dollars) and types (CNAV, LVNAV, VNAV)[2].

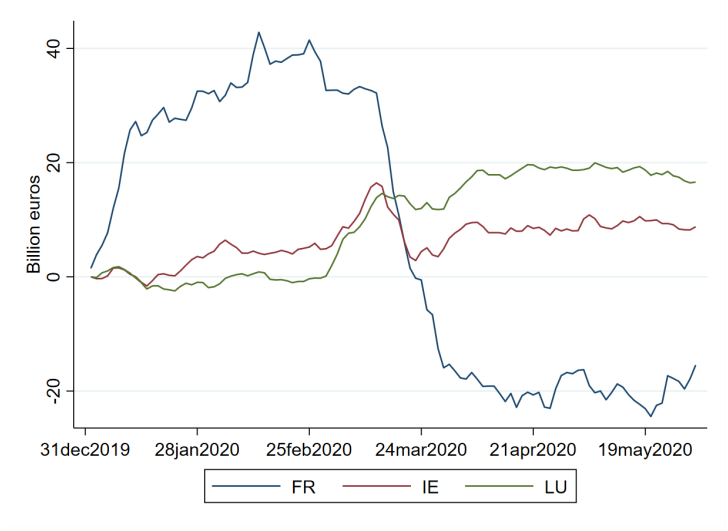
Since the majority of variation margin payments by euro area investors are done in euro, we focus on MMFs denominated in euro. These represent around 41% of the euro area MMF total net assets, with French MMFs making up two thirds of the EUR-denominated MMF assets. We use Refinitiv Lipper daily data on MMFs' total net asset value (NAV) to compute daily flows at a fund level by taking the difference between the net asset values on two consecutive days. We do not take into account funds' performance as MMFs are supposed to have a very stable NAV.

Figure 3 shows cumulative flows into EUR-denominated MMFs domiciled in France, Ireland and Luxembourg from January to June 2020. A well-observed pattern for Irish MMFs is the inflows preceding the most turbulent weeks of the March market turmoil, followed by large outflows after 12 March, and lastly stabilisation and a resumption of inflows towards the end of March. Flows to Luxembourgish MMFs show a similar pattern but with a much lower amplitude for outflows. Flows of French MMFs have a

[2]There are three categories of short-term money market funds (MMFs): public debt Constant NAV (CNAV), Low Volatility NAV (LVNAV), and short-term Variable NAV (VNAV). Each category has different regulatory requirements in terms of pricing, shares of public debt, and shares of weekly liquid assets, among others. For more information on the requirements refer to Capotă et al. (2021).

very different behavior from Irish and Luxembourgish MMFs, with strong inflows from the beginning of 2020 and then strong outflows from mid-March to mid-April.

Figure 3: Cumulative flows into euro-denominated money market funds



2.3 Investors' holdings of MMF shares from SHSS

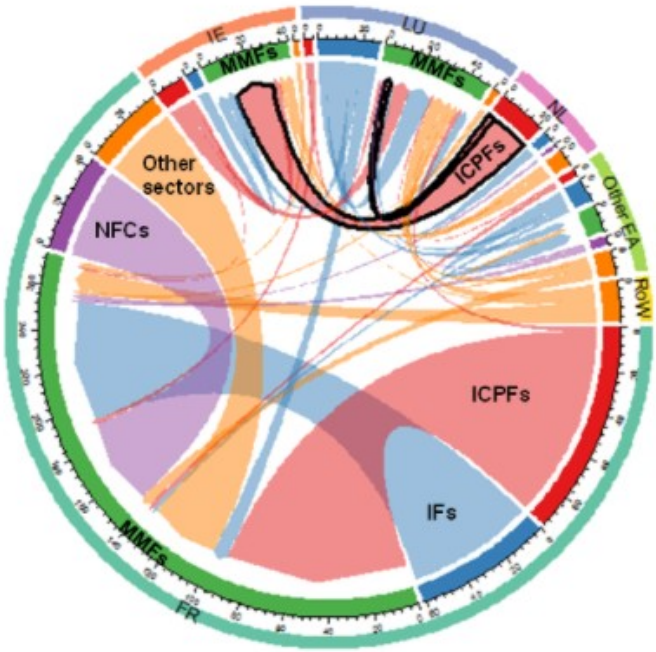
To link the variation margin data to the MMF data, we use information on sector holdings of MMFs from the Securities Holdings Statistics by Sector (SHSS) dataset. SHSS data provide quarterly information on investor holdings of each individual fund, where investors are aggregated at a country-sector level. Since there are 19 euro area countries[3] and 10 sectors[4], the sector-country combinations provide us with 190 different investor groups.

In our study we focus on EUR-denominated MMFs domiciled in the euro area. Figure 4 depicts the main holders of such MMFs, i.e. holders of EUR-denominated MMFs domiciled in France, Ireland and Luxembourg. For French MMFs, the largest holders are French insurers (ICPFs), French investment funds (IFs) and French non-financial firms (NFCs). For Irish funds, these are Dutch ICPFs, while for Luxembourgish MMFs the largest holders are Irish ICPFs, Luxembourgish IFs and the rest-of-the-world investors.

[3]Spain, Luxembourg, France, Italy, Germany, Netherlands, Portugal, Austria, Finland, Ireland, Greece, Latvia, Lithuania, Cyprus, Belgium, Malta, Slovenia, Estonia, and Slovakia.

[4]The sectors are Banks; Central Clearing House (CCP); Government; Insurance Corporations (IC); Investment Funds (IF); National Central Banks (NCB); Non-Financial Corporations (NFC); Other Financial Institutions (OFI); Others; and Pension Funds (PF).

Figure 4: Holders of EUR-denominated MMFs domiciled in the euro area.



Notes: Holdings in billions euros at the end of March 2020. Colours of the outer circle corresponds to a country; colours of the inner circle corresponds to a sector: ICPFs (red), IFs (blue), NFCs (violet), MMFs (green) and other sectors (orange). Links go from holders to issuers with thickness of a link being proportional to the absolute exposure amount in billions of euro. Example, a thick black-framed red link going from Dutch ICPFs to Irish MMFs indicates that Dutch ICPFs hold around 19 billion euro of MMFs domiciled in Ireland.

3 Empirical model

Compiling all the data together, we obtain a daily fund-level panel where the dependent variable is daily flows in individual MMFs and the explanatory variables of interest are variation margin payments of sectors in different euro area countries, which hold individual MMFs. Since we expect that variation margin posted (received) drives MMF outflows (inflows), we run separate regressions for MMF outflows and inflows. Specifically, we estimate the following empirical specifications:

$$Outflows_{i,t} = \alpha + \sum_{g} \beta_g * VM\ posted_{g,t} * held_{g,i} + I_i + T_t + \epsilon_{i,t} \quad (1)$$

$$Inflows_{i,t} = \alpha + \sum_{g} \beta_g * VM\ received_{g,t} * held_{g,i} + I_i + T_t + \epsilon_{i,t} \quad (2)$$

where i denotes the MMF, g the investor group at sector-country level, and t the date. $VM\ posted_{g,t}$ refers to VM posted by investor group g at time t, while $VM\ received_{g,t}$ is VM received [5]. $held_{g,i}$ is a dummy equal to one if the investor group g holds MMF i. To

[5]More specifically, $VM\ posted_{g,t}$ is the positive part of the net posted margins, and $VM\ received_{g,t}$

control for any MMF-specific characteristics, we also include fund fixed effects, denoted as I_i. Similarly, to control for market volatility over time, we include time fixed effects and denote them as T_t. The variable $Outflows_{i,t}$ equals to MMF outflows when they are positive, and to zero when they are negative (that is, when there are inflows). Similarly for the variable $Inflows_{i,t}$.

We run the regressions separately for each MMF domicile, which help us further control for the potential differences in the type of MMFs (e.g., many EUR-denominated MMFs domiciled in Ireland and Luxembourg are LVNAV, while French MMFs are typically VNAV[6]). More importantly, the main investor groups for each domicile are different. As mentioned in Section 2.3, investors are classified into groups, which reflect all possible combinations of 10 sectors in 19 countries, i.e. 190 investor groups. To reduce the high dimensionality, we focus in the regressions on the most important investor groups for each MMF domicile, and among them the ones that are subject to large VM payments. First, for each MMF domicile, we rank investor groups according to the share of total net assets (TNA) of MMFs that they hold, and we restrict to the top five investor groups. Second, among the top five investor groups for each MMF domicile, we select three with the largest VM flows, given that we are interested in the effect of VM on MMFs' flows. Table 2 shows the top five investor groups in terms of the share of MMFs' TNA held for each domicile, where the three investor groups with the largest mean values of VM posted and received are highlighted in bold.

In addition to the simultaneous effects of VM payments on MMF flows, we also run regressions with lead (forward) and lagged values of VM payments to capture the potential dynamics over time. We carefully distinguish between VM posted and received and their respective outcomes (outflows/inflows). If margin is called today, it is to be posted today, tomorrow or the day after tomorrow, so we expect margin posted today or in the next few days to have an impact on MMF outflows today.[7] Therefore, we add two leads (forwards) of VMs posted to regression 1. For margin received, we expect a different timing: investors receiving margins may deposit the funds to MMFs not only on the same day, so we add one and two lags of VMs received to regression 2.

Positive and significant coefficients for contemporaneous/lead margins posted and contemporaneous/lagged margins received would confirm our hypothesis that investors use MMFs for liquidity purposes and particularly to pay margin calls. When investors receive margins, they buy MMFs shares, while when they have to pay margins, they withdraw from MMFs.

is the negative part, as described in Section 2.1

[6]See ESMA (2021).

[7]The exact timing when margin is to be posted depends on whether the portfolio is cleared or uncleared by a CCP. Furthermore, the EMIR reporting may also not allow for the exact identification of a date when margin were posted/received.

Table 2: Summary statistics (million euros)

		Share held of MMFs' TNA			5th ptile	Median	95th ptile	Mean	Std. Dev.	Share of non-pos. obs.
	Irish MMFs			Outflows	0.00	0.02	68.86	18.52	115.72	41%
	(50 MMFs)			Inflows	0.00	1.34	151.63	32.36	121.56	63%
Top 5 investor groups	**Irish IF**	3.00%	Variation margin	Posted	84.87	241.77	708.28	310.04	224.05	
				Received	100.96	219.98	751.64	310.09	201.72	
	Luxemb. IF	2.93%		Posted	491.68	1073.86	2337.15	1175.95	582.52	
				Received	427.66	1150.45	1928.57	1140.82	485.00	
	Dutch PF	2.16%		Posted	424.86	1626.28	4134.36	1852.17	1206.59	
				Received	366.46	1783.74	3831.44	1862.89	1171.76	
	Irish IC	1.56%		Posted	2.60	28.73	153.50	39.19	42.48	
				Received	2.00	26.36	126.91	38.01	49.16	
	Italian IC	1.19%		Posted	5.73	33.19	91.26	37.38	26.64	
				Received	1.02	28.40	101.44	37.81	35.95	
	Luxembourg MMFs			Outflows	0.00	0.11	70.22	15.31	73.59	40%
	(262 MMFs)			Inflows	0.00	0.65	103.98	21.13	90.68	67%
Top 5 investor groups	**Luxemb. IF**	11.21%	Variation margin	Posted	491.68	1073.86	2337.15	1175.95	582.52	
				Received	427.66	1150.45	1928.57	1140.82	485.00	
	Italian IC	9.40%		Posted	5.73	33.19	91.26	37.38	26.64	
				Received	1.02	28.40	101.44	37.81	35.95	
	Irish IC	6.18%		Posted	2.60	28.73	153.50	39.19	42.48	
				Received	2.00	26.36	126.91	38.01	49.16	
	Dutch IF	4.59%		Posted	5.01	28.49	92.73	34.49	27.41	
				Received	1.99	18.64	78.02	29.69	40.88	
	German IF	2.72%		Posted	206.28	722.47	2636.57	900.15	729.15	
				Received	122.78	621.22	1957.93	805.12	688.88	
	French MMFs			Outflows	0.00	0.02	14.22	4.18	25.26	47%
	(250 MMFs)			Inflows	0.00	0.13	42.98	8.82	38.67	62%
Top 5 investor groups	**French IC**	26.39%	Variation margin	Posted	26.01	70.72	300.70	118.25	93.61	
				Received	12.05	113.81	321.35	136.51	107.57	
	French IF	18.99%		Posted	198.11	366.20	1350.47	468.17	328.00	
				Received	156.47	364.07	1017.05	446.67	305.35	
	French NFC	11.99%		Posted	8.22	46.84	309.84	92.55	234.09	
				Received	15.35	50.52	319.52	99.65	252.83	
	Luxemb. IF	2.49%		Posted	491.68	1073.86	2337.15	1175.95	582.52	
				Received	427.66	1150.45	1928.57	1140.82	485.00	
	Italian IC	1.81%		Posted	5.73	33.19	91.26	37.38	26.64	
				Received	1.02	28.40	101.44	37.81	35.95	

Notes: The table reports statistics on inflows and outflows of EUR-denominated MMFs by domicile. For outflows, the statistics are based on the observations where their values are positive, and the last column reports the share of observations when they were non-positive, that is, when there were either zero flows or inflows. Similarly for inflows. It also reports, for each MMF domicile, their top five investor groups, the share of the MMFs' TNA from those domicile that each investor group holds, and statistics on the variation margins posted and received by each investor group. Among the top five investor groups for each MMF domicile, we bold the three with the largest mean values of variation margins posted and received. The time period used is beginning of February to end of April 2020.

4 Results

We estimate equations 1 and 2 (incl. specifications with lead and lagged VM) using panel regressions with standard errors clustered at fund level. The results are reported in Tables 3 and 4 respectively.

For MMF outflows, we expect that investors withdraw funds at date t from MMFs to post margins either at date t or during the following few days. The results reported in Table 3 confirm that this is indeed the case, especially regarding withdrawals on the same day when VM is posted. Investors with larger holdings of MMFs and larger exposures to derivatives have a significant effect on MMF outflows: Dutch PF on Irish MMFs, Luxembourgish IFs on Luxembourgish MMFs (see also Table 2). The effect of VM posted by Luxembourgish IFs on French MMFs is somewhat more surprising as LU IFs are not among the three main investors in French MMFs, ranking fourth in terms of investment in French MMFs.

The effects are not only statistically but also economically significant. For instance, for Irish MMFs, the estimated coefficient for VM paid by Dutch pension funds equals 0.011, which means that when Dutch PFs post EUR 1 billion in VM, Irish MMFs held by them are estimated to suffer outflows of around EUR 11 million (on average over the February to April 2020 period). The fact that we can use in the regressions only country-sector level data on VM (rather than VM for each individual investor) means that our results are likely to suffer a measurement error downwards bias, because the individual firm-level variability in the data is dampened by the aggregation. Therefore, our estimates represent a lower bound for the actual effects.

Similarly, we expect that when investors receive variation margins, they deposit funds into MMFs either the same day or during the following few days. The results in Table 4 are in line with this expectation. Again, we find the strongest results for VM received on the same day as MMF inflows, though there is some evidence of deposits to MMFs being made a day later. The effect of margins received on MMFs inflows is potentially smaller for two reasons: First, investors may not immediately reinvest received margins in a stressed market period, especially if they expect a market reversal. Second, investors may invest received margins in MMFs only partially, while diversifying the storing of liquidity across different asset types.

The results are also economically significant for MMF inflows. For Luxembourgish MMFs, the estimated coefficient for VM of Irish insurance corporations (t-1) equals 0.040, which means that when Irish ICs receive EUR 1 billion in variation margin, the next day Luxembourgish MMFs held by them are estimated to receive EUR 40 million of inflows.

Table 3: Regression results for MMF outflows and VM posted

Dependent variable: MMF outflows (t)								
Irish MMFs			Luxemburg MMFs			French MMFs		
*Independent variables: Margin posted * MMF held*								
Luxembourg IF			*Luxembourg IF*			*French IC*		
(t)	0.001	0.002	(t)	**0.002****	**0.003****	(t)	-0.026	-0.024
	[0.816]	[0.670]		[0.043]	[0.023]		[0.197]	[0.207]
(t+1)		-0.001	(t+1)		-0.000	(t+1)		-0.003
		[0.781]			[0.920]			[0.856]
(t+2)		-0.001	(t+2)		-0.001	(t+2)		0.014
		[0.786]			[0.454]			[0.378]
Irish IF			*Irish IC*			*French IF*		
(t)	-0.004	-0.009	(t)	0.013	0.011	(t)	0.003	-0.007
	[0.578]	[0.281]		[0.576]	[0.672]		[0.545]	[0.320]
(t+1)		0.003	(t+1)		0.002	(t+1)		-0.003
		[0.621]			[0.838]			[0.488]
(t+2)		0.007	(t+2)		0.009	(t+2)		**0.013***
		[0.509]			[0.254]			[0.084]
Dutch PF			*German IF*			*Luxembourg IF*		
(t)	**0.011*****	**0.011*****	(t)	0.002	0.002	(t)	**0.015*****	**0.016*****
	[0.009]	[0.009]		[0.382]	[0.434]		[0.000]	[0.001]
(t+1)		0.002	(t+1)		-0.000	(t+1)		0.003
		[0.652]			[0.933]			[0.459]
(t+2)		0.003	(t+2)		0.000	(t+2)		-0.003
		[0.347]			[0.821]			[0.610]
Fund FE	Yes	Yes	Fund FE	Yes	Yes	Fund FE	Yes	Yes
Date FE	Yes	Yes	Date FE	Yes	Yes	Date FE	Yes	Yes
Obs	3,055	2,805	Obs	15,803	14,727	Obs	15,218	14,158
R-sq	0.263	0.246	R-sq	0.216	0.221	R-sq	0.297	0.300

Notes: The table shows regression results of MMFs' outflows against the interaction between variation margins posted by investor groups and a dummy equal to one when the investor groups holds the MMF. Investor groups included in the regressions are the three with the largest mean values of variation margins received among the top five investor groups. The time period used is beginning of February to end of April 2020. Standard errors are clustered at the fund-level. P-values in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4: Regression results for MMF inflows and VM received

Dependent variable: MMF inflows (t)								
Irish MMFs			Luxemburg MMFs			French MMFs		
*Independent variables: Margin received * MMF held*								
Luxembourg IF			*Luxembourg IF*			*French IC*		
(t)	0.003	**0.009***	(t)	**0.003*****	**0.002***	(t)	-0.000	-0.012
	[0.383]	[0.090]		[0.001]	[0.087]		[0.976]	[0.191]
(t-1)		-0.005	(t-1)		0.002	(t-1)		0.006
		[0.286]			[0.110]			[0.331]
(t-2)		-0.004	(t-2)		-0.001	(t-2)		0.021
		[0.316]			[0.427]			[0.135]
Irish IF			*Irish IC*			*French IF*		
(t)	0.000	0.005	(t)	0.007	0.003	(t)	0.003	0.001
	[0.991]	[0.665]		[0.507]	[0.732]		[0.395]	[0.809]
(t-1)		0.000	(t-1)		**0.040*****	(t-1)		-0.003
		[0.976]			[0.010]			[0.402]
(t-2)		-0.012	(t-2)		0.009	(t-2)		0.002
		[0.192]			[0.456]			[0.427]
Dutch PF			*German IF*			*Luxembourg IF*		
(t)	0.005	0.004	(t)	0.001	0.000	(t)	-0.003	-0.006
	[0.145]	[0.178]		[0.276]	[0.812]		[0.338]	[0.190]
(t-1)		0.001	(t-1)		0.003	(t-1)		0.004
		[0.833]			[0.115]			[0.230]
(t-2)		0.002	(t-2)		0.001	(t-2)		-0.001
		[0.570]			[0.474]			[0.652]
Fund FE	Yes	Yes	Fund FE	Yes	Yes	Fund FE	Yes	Yes
Date FE	Yes	Yes	Date FE	Yes	Yes	Date FE	Yes	Yes
Obs	3,055	2,905	Obs	15,803	15,257	Obs	15,218	14,672
R-sq	0.241	0.245	R-sq	0.288	0.293	R-sq	0.162	0.158

Notes: The table shows regression results of MMFs' inflows against the interaction between variation margins received by investor groups and a dummy equal to one when the investor groups holds the MMF. Investor groups included in the regressions are the three with the largest mean values of variation margins received among the top five investor groups. The time period used is beginning of February to end of April 2020. Standard errors are clustered at the fund-level. P-values in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

5 Conclusions

In this paper we investigate whether the significant volatility in MMF flows in the March 2020 market turmoil was driven by investors' liquidity needs related to derivative margin payments. We combine three highly granular unique data sets to construct a daily fund-level panel data spanning from February to April 2020 and estimate the effects of variation margin paid and received by the largest holders of EUR-denominated MMFs on flows of these MMFs.

Overall, the results support the hypothesis that some MMF investors - such as investment funds, insurance companies and pension funds - used MMFs to manage liquidity related margin calls in the March 2020 market turmoil. These results are by and large robust for all EUR-denominated MMFs domiciled in the euro area as they apply to EUR-denominated MMFs domiciled in all three countries with such MMFs, i.e. France, Ireland and Luxembourg. Furthermore, we find these results despite the fact that the unavailability of the data does not allow us to conduct the analysis on firm-to-MMF level but only at a less accurate country-sector-to-MMF level. Since significant netting of the margin payments occurs by aggregation to a sector level, the estimates can be considered as providing a lower bound to the actual size of the effects.

The findings bring about several policy implications. In the context of liquidity management of non-bank financial intermediaries such as investment funds, insurance corporations and pension funds, they highlight the risks of reliance on the cash-like properties of MMF shares as a reliable source of liquidity under stress. Although no MMF had to suspend redemptions in the March market turmoil, non-banks' liquidity management should account for the fact that the value of MMFs can sometimes decline and MMFs can suspend redemptions in exceptional circumstances. At the same time, MMFs should also be made more resilient to significant outflows, and the structure of their investor base should also be taken into account (see also ECB (2021)). Finally, the results also underline the importance of monitoring interconnectedness across markets, including from relatively small but volatile links, and across borders. This is particularly relevant in view of the recent regulatory reform in the derivatives market, which has introduced the daily exchange of margin for the vast majority of derivative exposures. While the exchange of margin in the form of high-quality collateral reduces counterparty credit risk, our results suggest that it increases liquidity risk in the financial system and creates spillovers across different markets.

While our paper is the first - to our knowledge - to empirically and systematically assess the role of margin for MMF outflows, it also opens the door and calls for further research in the area of interconnectedness between margin payments and other markets.

First of all, while we find that investors use MMF shares for liquidity management purposes related to margin payments, this is not their only source of liquidity. Anecdotal evidence suggests that non-bank financial intermediaries also used bank deposits and the repo market, while some of them even liquidated assets (e.g. bonds). Second, investors are subject not only to variation margin but also other types of margin payments, notably initial margin on derivative portfolios that also rose significantly during the March 2020 market turmoil. While initial margin can also be paid in high quality non-cash collateral, it is partially paid in cash and March 2020 was no exception to that. On the contrary, the share of non-cash collateral posted to some CCPs has increased. From this perspective, initial margin payments may also have had an effect on MMF flows and more broadly on the overall liquidity needs in the financial system. We leave both these areas for further research.

Bibliography

Bank of England (2020, August). Financial stability report.

BlackRock (2020, July). Lessons from covid-19: The experience of european mmfs in short-term markets.

Boucinha, M., L. Capotă, K. Cera, E. Faïk, J. Galléty, M. Giuzio, M. Grodzicki, I. Kerner, S. Kördel, L. Molestina Vivar, G. Nicoletti, E. Ryan, and C. Weistroffer (2020, May). Recent stress in money market funds has exposed potential risks for the wider financial system.

Capotă, L.-D., M. Grill, L. Molestina Vivar, N. Schmitz, and C. Weistroffer (2021, April). How effective is the eu money market fund regulation? lessons from the covid-19 turmoil.

de Guindos, L. and I. Schnabel (2020, April). The ecb's commercial paper purchases: A targeted response to the economic disturbances caused by covid-19.

ECB (2021). Eurosystem contribution to the european securities and markets authority (esma) consultation on the framework for eu money market funds.

ESMA (2021, March). Esma report on trends, risks and vulnerabilities.

Fache Rousova, L., M. Ghio, S. Kördel, and D. Salakhova (2020). Interconnectedness of derivatives markets and money market funds through insurance corporations and pension funds. *ECB Financial Stability Review* (Box 8).

Fache Rousova, L., M. Gravanis, A. Jukonis, and E. Letizia (2020). Derivatives-related liquidity risk facing investment funds. *ECB Financial Stability Review*.

FSB (2020, November). Holistic review of the march market turmoil.

Lenoci, F. D. and E. Letizia (2021). Classifying counterparty sector in emir data. In *Data Science for Economics and Finance*, pp. 117–143. Springer, Cham.