Discussion Paper

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You can't always get what you want
(where you want it): cross-border effects
of the US money market fund reform

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Non-technical summary

Research Question

Money market funds (MMFs) are an important part of the growing segment of non-bank financial intermediaries. This paper contributes to this literature by analyzing the cross-border effects of the 2014 US MMF reform, which was implemented several years prior to the EU Regulation. We study whether euro area MMFs received inflows as a consequence of the reform and investigate the (unintended) economic effects on the basis of the non-synchronized implementation dates of the regulatory changes in the US and the EU.

Contribution

To the best of our knowledge, we are the first to examine the cross-border effects of the 2014 US MMF reform. Prior work has shown that the reform led to a substantial decline of the institutional prime segment in the US (MMFs that invest primarily in non-sovereign debt instruments). Moreover, these funds increased their risk-taking due to the increased competition and newly imposed liquidity restrictions left these funds more prone to large outflows (run risks).

Results

We document both positive and negative effects of the US reform on institutional MMFs in the euro area. These funds, particularly those from the prime segment, experienced substantial inflows from foreign investors around the implementation of the US reform and we show that these cross-border flows were largely motivated by the search for money-like instruments. While euro area MMFs reduced their risk-taking, the industry as a whole has become more concentrated and possibly more exposed to run risks. This risk materialized in the COVID-19 induced stress period during which these funds faced large outflows by foreign investors.

Nichttechnische Zusammenfassung

Fragestellung

Geldmarktfonds sind ein wichtiger Bestandteil des wachsenden Segments der Nicht-Banken-Finanzintermediäre. Die vorliegende Studie befasst sich mit den grenzüberschreitenden Auswirkungen der US Geldmarktfondsreform aus dem Jahr 2014, welche bereits einige Jahre vor der EU Reform implementiert wurde. Wir untersuchen, ob Geldmarktfonds im Euroraum aufgrund der US Reform Zuflüsse erhielten und analysieren die (unbeabsichtigten) ökonomischen Auswirkungen auf Basis dieser zeitlichen Diskrepanz der Reformen dies- und jenseits des Atlantiks.

Beitrag

Nach unserem Kenntnisstand ist unsere Studie die erste, welche die grenzüberschreitenden Auswirkungen der US Geldmarktfondsregulierung aus dem Jahr 2014 untersucht. Die bisherige Literatur zeigt, dass diese Reform zu einer erheblichen Schrumpfung des institutionellen Prime-Segments (d.h. Geldmarktfonds, die in primär in Unternehmensanleihen investieren) in den USA führte. Zudem erhöhten die betroffenen Fonds aufgrund des gestiegenen Wettbewerbs ihre Risikonahme und wurden durch neu eingeführte Liquiditätsmanagement-Instrumente anfälliger gegenüber großen Mittelabflüssen seitens der Fondsinvestoren (Run-Risiken).

Ergebnisse

Wir dokumentieren sowohl positive, als auch negative Auswirkungen der US Reform auf institutionelle Geldmarktfonds in der Eurozone. Hiesige Geldmarktfonds, insb. solche aus dem Prime-Segment, erhielten rund um die Implementierung der US Reform erhebliche Mittelzuflüsse von ausländischen Investoren. Diese grenzüberschreitenden Zuflüsse lassen sich größtenteils auf die Suche nach geldähnlichen Instrumenten von ausländischen Investoren zurückführen. Zwar reduzierten Geldmarktfonds in der Eurozone ihre Risikonahme, doch stieg auch die Konzentration innerhalb des Sektors und damit möglicherweise auch die Anfälligkeit gegenüber Run-Risiken. Diese Risiken materialisierten sich in der COVID-19 induzierten Stress-Episode in Form erheblicher Mittelabflüsse seitens ausländischer Investoren.

You Can't Always Get What You Want (Where You Want It): Cross-Border Effects of the US Money Market Fund Reform[*]

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Abstract

This paper documents significant cross-border effects of the 2014 US money market fund (MMF) reform on MMFs in the euro area. As US-based prime MMFs became less money-like due to the reform, euro area-based prime MMFs received large inflows from foreign investors. These cross-border flows were largely motivated by the search for stable net asset value instruments rather than by the introduction of gates and fees. Consistent with an easing of competitive pressure, institutional prime funds in the euro area reduced their risk-taking. However, the industry became more concentrated overall and more exposed to run risk from foreign investors. This risk materialized during the COVID-19-induced stress period.

Keywords: cross-border effects, regulation, money market funds, risk-taking.

JEL classification: E41, G23, G28.

1 Introduction

After witnessing runs on several US money market funds (MMFs) and the resulting break-down of certain money market segments at the height of the global financial crisis (e.g., Gorton and Metrick, 2012; Schmidt, Timmermann, and Wermers, 2016), regulators and policymakers sought to address structural vulnerabilities of MMFs. As a key example, the US Securities and Exchange Commission (SEC) announced new rules for US-based MMFs in July 2014, which became effective in October 2016. The reform aimed to stabilize the prime MMF segment, which invests primarily in non-sovereign short-term debt instruments. The two crucial changes were (i) the introduction of redemption gates and liquidity fees for all prime funds and (ii) institutional prime funds were forced to switch from a constant net asset value (CNAV) to a variable NAV (VNAV).[1]

Several papers have explored the resulting adjustments due to these regulatory changes *within* the US MMF sector. The switch from a constant to a variable NAV made the liabilities of affected funds more information sensitive and thus less money-like (in the sense of Gorton and Pennacchi, 1990). In line with the fact that the new regulation made prime MMFs less attractive to investors, the segment shrank dramatically with the introduction of the reform. In terms of investor behavior, Cipriani and La Spada (2021) document that institutional investors mainly shifted from prime to public debt CNAVs in order to preserve the money-likeness of their money market investment. Baghai, Giannetti, and Jäger (2021) show that the change in liability structure also had unintended consequences as affected institutional prime funds experienced an increase in the flow-performance sensitivity and engaged in more risk-taking. Moreover, Cipriani and La Spada (2020) and Li, Li, Macchiavelli, and Zhou (2021) find that the imposed liquidity restrictions (gates and fees) on investors left prime MMFs more prone to investor runs.

This paper is the first to assess the cross-border effects of the 2014 US MMF reform. We focus on MMFs located *outside* the US (commonly referred to as *offshore* funds) which

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[1]Throughout the paper we use the term "constant NAV" to also mean "stable NAV". Similarly we use the term "variable NAV" to also mean "floating NAV". Lastly, the term "public debt funds" also means "government funds".

may be accessible to international investors, including those from the US. Although these funds are not supervised by the SEC and thus not directly subject to the regulation, our findings suggest that they are indirectly affected through their role as competitors of US MMFs. While US prime MMFs become *less* attractive for investors and faced large outflows (Cipriani and La Spada, 2021), we show that euro area based institutional prime funds, in particular USD-focused prime CNAVs, become *more* attractive for investors and faced large cross-border inflows around the implementation of the US reform. Moreover, while the US reform led to *more* risk-taking by US-based prime funds (Baghai et al., 2021; Li et al., 2021), we show that it led to *less* risk-taking by euro area prime CNAVs because it effectively eliminated their overseas competitors. The euro area MMF sector as a whole, however, may have become less stable due to the US reform for two reasons. First, the euro area MMF sector has become increasingly concentrated after the US reform and such higher concentration could leave the sector more vulnerable to idiosyncratic shocks. Second, (prime) CNAV funds are more prone to run risks compared to VNAV funds due to stronger strategic complementarities (e.g. Cipriani and La Spada, 2021). Hence, the strong growth of these funds may leave the sector more vulnerable to sudden investor withdrawals in bad times. We provide tentative evidence along these lines for the COVID-19-induced stress episode in March 2020.

The first part of our paper is concerned with documenting significant cross-border flows into euro area MMFs due to the US reform. Cipriani and La Spada (2021) find that total prime outflows exceeded USD 1.3 trillion, the majority of which (up to 90%) were directed to US public debt funds. We highlight a second way through which investors could have avoided newly introduced fees and gates and possibly even preserved the money-likeness of their money market investment – cross-border flows into offshore prime MMFs in the euro area, specifically those with a USD focus and those that are registered as constant NAVs. In line with this reasoning, we show that institutional prime MMFs domiciled in the euro area received economically large inflows on the order of USD 63 billion (EUR 47 bn) – amounting to 30% of their pre-reform TNA – from foreign investors

around the implementation period. We present several pieces of evidence that suggest that these inflows are indeed driven by the US reform in that they are due to investors of former US-based prime CNAV funds searching for a close substitute that could still offer them a high degree of money-likeness. Using a difference-in-differences regression design, we first show that inflows are concentrated on euro area-based funds that focus on USD money markets. By further differentiating between prime funds with CNAV and VNAV, we find that these cross-border flows are mainly directed towards USD-focused prime CNAV funds. This suggests that the documented cross-border flows were mainly motivated by institutional investors' preference for money-like instruments rather than by the introduction of gates and fees (in which case there would be no significant flow differences between prime VNAVs and prime CNAVs). Assuringly, we can trace back the inflows into euro area prime CNAV funds to foreign investors from outside the euro area by using information from the European Securities Holding Statistics that allows us to decompose the dynamic ownership structure of our sample MMFs into different holder sectors.

Next, we analyze in more detail how investors reallocated their money in these cross-border transactions. Did they stay within the same fund family or switch between families? We find that the lion's share of the aggregate inflows into euro area funds is due to within-family flows in fund families with both US onshore and offshore prime funds. In line with previous work, this finding suggests that investors are faced with potentially large information acquisition costs when switching fund families. Interestingly, we find that fund families that were directly affected by the US MMF reform through their US prime funds tended to charge higher fees for their euro area-based prime CNAV funds once the regulatory change was adopted. This suggests that these fund families are indeed aware of their market power and are able to extract rents from their investor base.

In the second part of the paper, we analyze the economic consequences of the US reform in terms of the risk-taking behavior of euro area-based MMFs. The US MMF reform can be seen as a negative shock to competition for euro area-based prime CNAV

funds. For example, in the model of La Spada (2018) the US reform increases the general attractiveness of euro area-based prime CNAV funds (an increase in model parameter a), since institutional investors who would optimally want to invest in such funds have fewer options and may, therefore, be willing to sacrifice on fund performance to achieve the desired stability of their MMF investments.[2] As a result, the flow-performance relationship of institutional prime CNAV funds should become weaker as the US MMF reform reduces the competitive pressure in the euro area MMF industry. Consistent with this intuition, we find that euro area-based prime CNAV funds indeed display a weaker flow-performance relationship following the reform. Therefore, these funds should have fewer incentives to take risk (Chevalier and Ellison, 1997; Sirri and Tufano, 1998; La Spada, 2018), which is again what we find: relative to the control group, USD-focused prime CNAVs in the euro area increase their cash holdings and scale down their holdings of short-term debt of both non-financial companies and banks following the US MMF reform. In sum, this evidence suggests that the US reform had (unintended) stabilizing effects for prime CNAV funds in the euro area.

For the euro area MMF industry as a whole, however, the implications of the cross-border flows are rather different. To begin with, the euro area MMF sector became increasingly concentrated following the US reform. Moreover, the fact that prime CNAV funds gained in relative importance could make the euro area MMF sector as a whole more prone to run risks, in particular as foreign investors tend to be more flighty (Caballero and Simsek, 2020; Albertazzi, Cimadomo, and Maffei-Faccioli, 2021). We provide tentative evidence along these lines in a separate analysis for the COVID-19-induced stress episode. We find that during this period the vast majority of outflows were concentrated on institutional USD low-volatility NAV (LVNAV) funds – which are exactly those funds that were classified as prime CNAV funds prior to the EU MMF Regulation and which received the bulk of the US reform-driven cross-border flows. We do not observe the same run dynamics for EUR-denominated LVNAV funds which have a smaller foreign investor

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[2]In contrast, the US reform can be interpreted as an increase in competition for the set of US-based MMFs, since it reduces the general attractiveness of US MMFs (La Spada, 2018; Baghai et al., 2021).

base. This suggests that, for euro area MMFs, the level of foreign ownership serves as a catalyst for runs in times of distress. Finally, we find that the 2017 EU MMF Regulation did not lead to significant outflows from the sector, mainly due to the fact that investors appear to consider LVNAV funds as close substitutes of CNAV funds, at least during normal times. However, given the ongoing discussions about potential further regulatory changes in the MMF industry due to instabilities uncovered during the COVID-19 episode (Li et al., 2021; FSB, 2021; Schnabel, 2020), our findings call for more coordinated efforts of consistent regulations across jurisdictions and highlight the need to take potential cross-border effects more carefully into account.

Our paper adds to different streams of the literature. First and foremost, we contribute to the literature focusing on cross-border effects of financial regulation. A substantial body of literature examines regulatory arbitrage effects, mainly in the context of banking regulation. This literature provides evidence that banks avoid regulation by shifting activities to countries with looser regulation, using weaknesses of risk-weighting rules and exploiting other loopholes.[3] To the best of our knowledge, our paper is the first to study the cross-border effects of MMF regulations.

Notably, a nascent literature documents that non-bank financial intermediaries are becoming increasingly important for international capital flows (Hashimoto and Krogstrup, 2019; Committee on the Global Financial System, 2021). Our paper highlights a specific example where sizable capital flows are driven by differences in MMF regulations between different jurisdictions. More generally, a growing body of literature studies the increasing importance of non-bank financial intermediaries, with MMFs being an important part of the non-bank financial system, in terms of financial vulnerabilities and monetary policy transmission.[4]

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[3]See, for example, Houston, Lin, and Ma (2012), Tripathy (2020), Ongena, Popov, and Udell (2018), Boyer and Kempf (2020), Frame, Mihov, and Sanz (2020), Karolyi and Taboada (2015), Demirguc-Kunt, Detragiache, and Merrouche (2013), Kisin and Manela (2016).

[4]Several papers analyze the role of MMFs in the global financial crisis (Kacperczyk and Schnabl, 2016; Schmidt et al., 2016) the European debt crisis (Chernenko and Sunderam, 2014; Gallagher, Schmidt, Timmermann, and Wermers, 2020), the zero lower bound (Di Maggio and Kacperczyk, 2017; Bua, Dunne, and Sorbo, 2019), or the Covid-19 pandemic (Cipriani and La Spada, 2020; Li et al., 2021; Casavecchia, Ge, Li, and Tiwari, 2020).

Lastly, it is widely accepted that a key economic force at work in the fund sector is performance-related competition, which is closely related with risk-taking incentives (Chevalier and Ellison, 1997; Sirri and Tufano, 1998). Theoretical models that feature performance-based tournament selection have been shown to match many stylized facts (e.g., La Spada, 2018). Notably, the fund sector is often described as being an increasingly competitive market (Wahal and Wang, 2011) and many empirical studies therefore tend to focus on the economic effects of *increasing* levels of competition (e.g., Baghai et al., 2021). In contrast, we focus on a period with an exogenous *reduction* in competition and our empirical findings are also broadly in line with theoretical predictions.

The remainder of the paper is structured as follows: section 2 provides the relevant institutional background. In Section 3 we introduce our dataset and provide summary statistics. Section 4 documents significant cross-border flows due to the US MMF reform and Section 5 investigates the economic consequences of these flow dynamics. Section 6 examines flow dynamics of EU MMFs due to the EU MMF reform and during the Covid-19 stress episode in March 2020. Section 7 discusses policy implications. Section 8 summarizes and concludes.

2 Money Market Funds: Institutional Details

Money markets are a crucial part of the financial system and their proper functioning is important for both the implementation and transmission of monetary policy. A variety of economic agents, such as banks and non-financial corporations, engage in money markets for short-term liquidity management purposes. In line with the general growth of non-bank financial intermediaries over recent years, MMFs are regarded as a cornerstone in the intermediation of short-term funds between borrowers and lenders.

MMFs are a certain type of open-ended mutual fund. Similar to banks they provide both maturity and liquidity transformation. They refinance themselves by issuing shares to investors and can be classified according to their investors' profile into institutional and

retail MMFs. MMFs invest in different short-term money market assets and can be further grouped by the type of assets that they invest in. Prime MMFs mainly invest in debt issued by financial and non-financial corporations, like e.g. commercial paper, certificates of deposit, reverse repos, cash, and asset-backed securities. Public debt MMFs primarily invest in government securities and bonds issued by government agencies. MMFs are further classified as constant net asset value (CNAV) or variable net asset vale (VNAV). CNAV MMFs aim to offer investors a steady share price of one dollar for one dollar of investment. Thus, CNAV MMFs have a high degree of money-likeness and may be viewed by investors as a safe alternative to bank deposits. Crucially, however, a constant NAV fund does not guarantee its investors a truly stable NAV, which implies that CNAV funds might face investor runs when they "break the buck".[5] VNAV MMFs, on the other hand, have to value and redeem their shares at market prices of their portfolios' assets and are more similar to regular open-ended mutual funds.

2.1 MMFs in the Euro Area

MMFs have been gaining importance globally, with worldwide MMF total assets under management growing from EUR 4.2 trillion in 2013 and EUR 5.0 trillion in 2017 (or USD 4.9 trillion in 2013 to USD 5.9 trillion in 2017).[6] Total net assets of the MMF industry in the euro area have grown by more than 20% between the years 2013 and 2017 and amount to EUR 1.16 trillion (or USD 1.35 trillion) in 2017. In the US, total net assets of MMFs in 2017 amount to approximately EUR 2.44 trillion (or USD 2.85 trillion). Thus, the MMF sector in the euro area is sizeable and is dominated by three major fund domiciles, which account for around 97.5% of total net assets, namely Ireland (43.1%), France (30.7%), and Luxembourg (23.7%). In the euro area, MMFs hold 51% of all short term debt issued by non-financials and 45% of all short-term debt issued by banks (Bekaert and Breckenfelder

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[5]Technically, CNAV funds seek to maintain such a stable NAV using amortized cost accounting and accruing income and pay out investors or purchase additional fund shares. Amortized cost accounting means that assets are valued at acquisition cost and adjusted for amortisation of premiums (possibly negative) until maturity.

[6]Source: Investment Company Institute, Fact Book 2020.

(2019)).

Of the EUR 1.2 trillion of TNA in mid-2017, 45.6% are retail funds and 54.4% are institutional funds, which will be the main focus of this paper. Within the institutional segment, the share of funds investing in US money markets has been growing over time. For example, in January 2013 US-focused funds made up 46% of the aggregate TNA of institutional funds, while in May 2017 this number stood at 55%. Most importantly, in mid-2017 around 79% of euro area MMFs' TNA were held by foreign investors (see Figure 1). The remaining amount was being held mainly by euro area-based non-bank financial intermediaries (such as investment funds, insurance companies, and pension funds), non-financial corporations, and monetary financial institutions.[7]

The observation that foreign investors are the largest holding sector of euro area MMFs combined with the observation that euro area MMFs increasingly focus on US money markets will play an important role in our empirical analysis.

2.2 Regulation in the Euro Area and the United States

The incentive for cross-border flows that we investigate in this paper arises due to differences in the regulation of MMFs in the US and in the euro area.

More specifically, in the US MMFs are subject to the Rule 2a-7 of the Investment Company Act, which restricts their holdings to short-term securities with minimal credit risk.[8] Furthermore, until 2016, one key MMF feature was their money-likeness, i.e. MMFs were redeemable on a daily basis and sought to provide their investors a constant NAV. Due to the bankruptcy of Lehman Brothers in September 2008, the US-based Reserve Primary Fund suffered a drop in market value of its large Lehman Brothers commercial paper holdings, which triggered a run of the fund's investors. As a reaction, in a first

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[7]Strictly speaking, according to Regulation ECB/2013/33 of the European Central Bank, MMFs are part of the set of monetary financial institutions (MFIs). These "[...] are resident credit institutions as defined in European Union (EU) law, and other resident financial institutions whose business is to receive deposits and/or close substitutes for deposits from entities other than MFIs and, for their own account (at least in economic terms), to grant credits and/or make investments in securities."

[8]More specifically, until 2010 the weighted average maturity of prime MMFs was capped to 90 days and they were not allowed to hold more than 5% exposure to a single non-public issuer.

step the SEC tightened the requirement of MMF asset holdings to even higher quality in 2010 (SEC, 2010). On July 23, 2014 the SEC announced a second amendment to Rule 2a-7, with the aim to further reduce the probability of runs (SEC, 2014). This reform, which took effect on October 14, 2016, introduced two key changes. First, liquidity fees and redemption gates were introduced for all prime MMFs, i.e. in times of market stress those funds can or have to suspend redemptions temporarily. Second, institutional prime MMFs could no longer operate under a constant NAV but had to switch to a variable NAV. As a result, prime MMFs became less money-like.

Euro area MMFs are subject to the guidelines of the European Securities and Markets Authority (ESMA) that came into force in July 2011 (ESMA, 2010). The guidelines establish a classification into Short-Term MMFs (ST MMFs) and standard MMFs on the basis of certain key characteristics, such as the residual maturity of instruments, the weighted average maturity (WAM) and weighted average life (WAL).[9] The guideline restricts standard MMFs and ST MMFs to invest in high quality money market instruments, i.e. the assets should have one of the two highest available short-term credit ratings by a recognized credit rating agency. Whereas ST MMFs can operate either under a constant or variable NAV, standard MMFs must have a variable NAV. Given the fragility of the MMF industry that became apparent in the global financial crisis, the EU announced the new Money Market Fund Regulation (EU) 2017/1131 on June 14, 2017, which has since been phased in (EU, 2017). It has been applicable to newly established MMFs since June 2018 and to already existing MMFs since January 2019 and it has, among other aspects, introduced tighter rules on portfolio diversification and enhanced liquidity requirements. In addition, the reform has introduced three categories of ST MMFs, i.e. public debt constant NAV funds, variable NAV funds, and, a new category, low-volatility NAV funds (LVNAV MMFs). Hence, following the reform only MMFs that invest in public debt can operate under a constant NAV. Prime MMFs can, however, be run as LVNAV funds and operate under constant share or unit price as long as the fund does not breach certain

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[9]ST MMF (standard MMFs) should have a maximum WAM of 60 days (6 months) and a maximum WAL of 120 days (12 months).

NAV or liquidity triggers. If the portfolio level mark-to-market valuation exceeds the constant dealing NAV valuation by more than 20 basis points, the fund has to move to a floating NAV. Finally, the new regulation introduced liquidity-based fees and gates for both LVNAV and public debt CNAV funds, while VNAV funds are exempted from these requirements.

Figure 2 summarizes the important reforms of the MMF industry in the US and the EU. The incentive for cross-border flows should be particularly relevant between the announcement of the US reform in July 2014 until at least May 2017 (the month prior to the announcement of the EU MMF Regulation). During this time span, the US MMF reform drove a wedge between the money-likeness of US-based and euro area-based institutional prime MMFs. The former had to introduce liquidity fees and gates and had to abandon the stable NAV feature, while the latter were still allowed to operate with a constant net asset value and without liquidity-based fees or gates.

We study whether euro area MMFs received inflows as a consequence of the US MMF reform and investigate the (unintended) economic effects on the basis of the non-synchronized implementation dates of the regulatory changes in the US and the EU.

3 Data

We construct a unique dataset on institutional MMFs domiciled in the euro area, their portfolio holdings, and their dynamic ownership composition. Our main data on fund-specific characteristics (returns, flows, TNA, etc.) come from Morningstar Direct. MMFs in the euro area focus on a broad set of investment regions and currencies. Here we restrict ourselves to funds with the Morningstar Global Categories "Euro Money Market" or "US Money Market" that are denominated in Euro or US Dollar, respectively. This economically meaningful set of funds makes up around 80% of the euro area MMF industry's total net assets. Our analyses are conducted at the fund-level and we aggregate information that varies across share-classes (e.g., expense ratios) to the fund level using

TNA-weighted averages. We focus on funds for which all share-classes are denominated in the same currency and we label a fund as institutional if it has at least one institutional share-class, which is a standard procedure in the literature (e.g. Baghai et al., 2021). To ensure that our results are not driven by small funds with relatively noisy flows, we drop funds with an average full sample TNA below EUR 10 million.[10] Since Morningstar does not provide a classification of funds into constant and variable NAVs, we classify the funds based on other available information (see Appendix A for details). Monthly fund flows are calculated using the standard approach (e.g., Goldstein, Jiang, and Ng, 2017):

$$Flows_{f,t} = \frac{TNA_{f,t} - TNA_{f,t-1}(1 + Return_{f,t})}{TNA_{f,t-1}}, \tag{1}$$

where $TNA_{f,t}$ corresponds to the TNA of fund f in month t and $Return_{f,t}$ is the raw return. Following the literature, we winsorize flows at the 1st/99th percentile (Chen, Goldstein, and Jiang, 2010).

Following Baghai et al. (2021), we start our sample in 2013 to exclude the previous US MMF reform (2010) and the euro crisis (2011-12). We end our sample with the announcement of the EU MMF regulation in June 2017 (see Section 2) in order to ensure that our findings are not driven by this additional regulatory change. In Section 6 we also make use of a separate sample containing only data from June 2017 onwards to analyze both the EU MMF Regulation and the COVID-19-induced stress period in early 2020 in more detail.

Our main sample contains a total number of 121 unique funds and 5,102 fund-month observations. The vast majority of funds are domiciled in Luxembourg (63), France (27), and Ireland (42). The majority of funds focus on euro area money markets (84) and the rest (37) on US money markets. 31 prime funds operate under a constant NAV and 80 prime funds under a variable NAV. The remaining 10 funds are public debt funds with a constant NAV which we include as an additional control group in some of our

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[10]We also drop feeder funds, funds-of-funds, and MMFs with the Morningstar category "EAA Fund French PEA Eonia Swap".

analyses. There are 19 (12) institutional prime funds with USD (EUR) denomination that operate under a constant NAV and 11 (69) institutional prime funds with USD (EUR) denomination that operate under a variable NAV.

We also use data on funds' portfolio holdings from Morningstar. The data contains security-level information on the portfolio weight, holding type, holding country, and holding name of a fund's asset holdings. Although not all sample funds report such holdings information, we manage to collect the portfolio data for 87% of our sample funds. In sum, analyses with the matched Morningstar holdings dataset involve 106 unique funds and 3,125 fund-month observations.[11]

Table 1 reports summary statistics for the main variables of interest. For our sample funds, the bulk of their holdings are in cash, bonds, and commercial paper. On average during our sample period, MMFs hold 48% cash, 9% corporate non-financial bonds, 14% bank bonds, and 12% government bonds. Table 2 shows separate summary statistics for USD-denominated versus EUR-denominated MMFs in our sample. One important fact that becomes apparent in Table 2 is that although the number of USD-denominated funds is smaller, these funds are, on average, 2 times as large as the average EUR-denominated fund in our sample.[12]

Lastly, we complement the Morningstar data with quarterly MMF ownership information from the Securities Holding Statistics (SHS-S), which are available for our sample period 2013q4 to 2017q1. The SHS report portfolio holdings of all euro area-based investors by country of domicile and investor sector, according to the 2010 European System of Accounts.[13] Following Koijen, Koulischer, Nguyen, and Yogo (2021), we use the most important investor sectors for our sample funds, namely: monetary financial institutions (*MFIs*; which includes banks and money market funds), non-bank financial intermediaries (*NBFIs*; which includes insurance companies, pension funds, and investment funds),[14]

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[11]Another issue with the holdings data is that the data is only available relatively infrequently for some funds.

[12]Table IA.1 in the Online Appendix shows additional separate summary statistics for prime CNAV versus all other MMFs in our sample.

[13]See ECB (2021) for more information regarding this dataset.

[14]We aggregate these three investor groups since each of these groups is, taken by itself, relatively

non-financial corporations (*NFCs*), and a residual group (*Others*) that includes the remaining holdings of euro area-based investors which are not the main focus of this paper. The SHS-S contains only direct holdings, so all indirect holdings (for example, via investment funds) are not broken down to the ultimate holder (for example, households). The complement of the reported SHS holdings are holdings of investors outside the euro area (*Foreign*) and we define the holdings of this investor group as the difference between a given MMFs Morningstar TNA and the aggregate holdings reported in the SHS.[15] As illustrated in Figure 1, foreign investors are the largest investor group in euro area MMFs, with an average holdings share of 78% over our sample. NBFIs make up a share of 10%, and NFCs 5%. MFIs play only a relatively minor role (3%). All other investor groups combined make up an average share of 3%. After applying the data quality filters, analyses involving the matched SHS-Morningstar dataset are based on 94 unique funds with 1,069 fund-quarter observations.

The SHS data allow us to construct quarterly fund flows for the different investor groups:

$$Flows_{f,h,q} = \frac{TNA_{f,h,q} - TNA_{f,h,q-1}(1 + Return_{f,q})}{TNA_{f,h,q-1}}, \tag{2}$$

where $TNA_{f,h,q}$ corresponds to the TNA of fund f held by holder sector h at the end of quarter q. We winsorize the quarterly group flows at the 5th/95th percentile.[16]

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small.

[15]As noted by Koijen et al. (2021), one shortcoming of the SHS is that we do not observe euro area investors' holdings through offshore investors outside the EA. In addition, foreign investors' portfolio holdings could be subject to double-counting issues. We handle the latter issue by dropping observations where the reported TNA in the SHS exceeds the Morningstar TNA by 5% or more. This affects only a very small number of observations.

[16]This broader winsorization is necessary because of the higher noisiness of the quarterly investor fund flows.

4 Regulation-Driven Cross-Border Flows: Empirical Evidence

This section documents significant cross-border flows into euro area MMFs due to the US reform. The majority of these flows originates from foreign investors and occurs within fund families.

4.1 Empirical Setup

As a consequence of the 2014 US MMF reform, US-based institutional prime MMFs had to (i) introduce liquidity-based fees and redemption gates and (ii) switch from a constant to a variable net asset value. Both regulatory changes aimed at reducing the instability of money market funds. However, both changes also lowered the money-likeness of US-based institutional prime funds. In the euro area, on the other hand, prime institutional MMFs were still more money-like as they continued to operate under a constant NAV and without liquidity-based fees and redemption gates at least up until June 2018. Under the assumption that the regulatory reform in the US had no effect on investors' preference for the money-like feature of MMFs, there is thus an incentive for institutional investors of US-based prime MMFs to shift their money into euro area MMFs, especially into funds that offer them the closest substitute to their previous investment.

To provide evidence for such regulation-driven cross-border flows, we proceed in several steps. First, we conjecture that inflows that can be traced back to the US reform should be particularly relevant for institutional prime funds denominated in USD. The reason for this is that US investors looking for alternative MMF investment most likely do not want to expose themselves to additional currency or investment area risk when shifting their money into offshore funds:

__Hypothesis 1__: Euro area-based prime MMFs denominated in USD receive larger inflows than MMFs denominated in EUR in the period surrounding the US reform.

Next, we further circle in on which of the regulatory changes caused the cross-border flows. In particular, we want to disentangle whether investors shifted their money into euro area MMFs in order to avoid liquidity fees and gates, or whether they did so in order to retain the stable NAV feature of MMFs. If cross-border flows are due to additional fees and redemption restrictions, we would not expect to see different flows for prime CNAV funds relative to prime VNAV funds as neither of these two fund types is subject to fees and gates prior to the EU reform. If, however, the stable NAV feature drives cross-border flows, we would expect larger inflows for USD-denominated CNAV funds relative to USD-denominated VNAV funds.

Hypothesis 2: *Euro area-based prime CNAVs denominated in USD receive larger inflows than other prime MMFs in the period surrounding the US reform.*

We formalize these ideas in a difference-in-differences regression setup where we compare (a) the period prior to the US reform with the period after the US reform and (b) euro area-based MMFs which are likely to be a target of investors engaging in cross-border transactions with those that should be of lesser interest for US-based investors. We analyze monthly percentage fund flows (as defined in Eq. (1)) as our dependent variable to pin down regulation-driven flows into the euro area MMF industry:

$$Flows_{f,t} = \beta_1 \times Post_t \times USD_f + \mathbf{X}'_{f,t-1} \times \gamma + \alpha_f + \alpha_t + \epsilon_{f,t} \qquad (3)$$

To test Hypothesis 1, the main variable of interest is the interaction term $Post_t \times USD$, where $Post$ is a dummy variable equal to one for the period after October 2015. Our choice to start the post-reform period between the announcement of the reform in June 2014 and the implementation of the reform in October 2016 is motivated by Cipriani and La Spada (2021), who find that the majority of within-US flows triggered by the US reform occurred in the year prior to the implementation of the reform.[17] Hence,

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[17]As noted by Cipriani and La Spada (2021), in December 2015 Fidelity converted three US-based prime MMFs into public debt MMFs as a direct consequence of the US reform. Such classification changes therefore occured well before the actual implementation of the reform.

we expect regulation-driven flows to pick up in the same period.[18] *USD* is a dummy variable taking the value of 1 for funds that are denominated in USD and 0 otherwise. In this specification, the treatment group consists of institutional prime funds (CNAV and VNAV) with a USD focus and the control group consists of their EUR counterparts. β_1 captures the total effect of the SEC regulation on euro area MMFs as the flow differential between USD and EUR prime funds. $X_{f,t-1}$ collects a number of time-varying fund-level variables as controls. Following the literature, we control for lagged values of the natural logarithm of fund size and fund family size, lagged fund flows, lagged fund flow volatility (calculated over the past 12 months), lagged expense ratio, and lagged fund age (in years). Moreover, the model includes fund fixed effects (α_f) to account for unobservable, time-invariant heterogeneity at the fund level, and time fixed effects (α_t) to account for different unobservable economy-wide developments that change over time. Standard errors are robust to heteroskedasticity, autocorrelation, and spatial correlation (HACSC) to account for correlation across and within funds.

We further disentangle how much of the cross-border flows are due to the constant NAV feature (as opposed to fees and gates) by running an enhanced specification that further differentiates between prime CNAVs and VNAVs. Hence, to test Hypothesis 2 we run the following model:

$$
\begin{aligned}
Flows_{f,t} = \quad & \beta_1 \times Post_t \times USD_f \times CNAV_f \\
& + \beta_2 \times Post_t \times USD_f + \beta_3 \times Post_t \times CNAV_f \\
& + \mathbf{X}'_{f,t-1} \times \gamma + \alpha_f + \alpha_t + \epsilon_{f,t}
\end{aligned}
\tag{4}
$$

The triple interaction term $Post_t \times USD \times CNAV$ estimates the importance of keeping a constant NAV in addition to avoiding gates and fees. The cleanest identification strategy additionally includes $Time \times USD$ fixed effects and $Time \times CNAV$ fixed effects, in which

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[18]In Table IA.2 in the Internet Appendix, we show that using separate Announcement/Implementation dummies does not affect our main results.

case the control group consists of USD VNAVs and EUR CNAVs.[19] The set of controls is the same as for regression (3).

4.2 Main Results

Table 3 shows the results of the regressions in Eq. (3) and (4). The first two columns provide evidence in line with Hypothesis 1: in column (1), we compare the flows of institutional funds with a USD focus (both prime and public debt) with their EUR counterparts. In column (2) we repeat this analysis using prime funds only, which gives us the overall effect of the US reform. As hypothesized, USD funds received statistically and economically significant additional monthly inflows of between 1.6 and 1.8 percentage points in the post-period.

The validity of the difference-in-differences setup hinges on the parallel trends assumption. In our setting, this means that fund flows between USD and EUR funds should not be significantly different from each other prior to the US reform. In order to test this assumption, we adapt our baseline specification by replacing the *Post* dummy with separate semester dummies.[20] Figure 3 plots the coefficient of interest, namely *USD x Semester*, for the sample with prime funds only. We define the first half of 2013 as the reference period. The coefficient in the period prior to the reform is insignificant, suggesting that the parallel trend assumption is indeed justified, in that no systematic difference in fund flows can be observed prior to the reform. Second, there is a significant difference in flows around the reform announcement (first half of 2014), suggesting that some investors immediately started to shift their assets into euro area-based USD funds. Third, the majority of flows occurred around the implementation of the reform, which is in line with the findings of Cipriani and La Spada (2021) who show that the bulk of flows occurs during the year prior to the implementation of the reform. Finally, the coefficients remain both economically

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[19]Given that monetary policy rates in the euro area turned negative during our sample period, we argue that it is important to allow for different slopes in the time fixed effects. Including only time fixed effects would not allow us to account for the fact that a MMF investing in the euro area might react differently to the introduction of negative policy rates than a MMF investing in the US.

[20]We choose half-year (semester) dummies instead of month dummies to obtain less noisy estimates.

and statistically significant *after* the US reform was implemented. This suggests that the documented regulation-driven flows remained an important driver of (cross-border) fund flows over an extended period of time.[21]

The last two columns of Table 3 provide evidence in line with Hypothesis 2: within the set of USD funds, flows were mainly directed towards prime CNAV funds, which received additional monthly inflows of 3.6 percentage points in the post-period. The estimated effect is both statistically and economically significant. Given that specification (4) is estimated for prime funds only and because we additionally include both Time $\times$ USD fixed effects and Time $\times$ CNAV fixed effects, the results suggest that the regulation-driven inflows are indeed strongly motivated by investors' preference for the money-like feature of prime CNAVs. Gates and fees appear to be of lesser importance, since otherwise the triple interaction term in this specification would be insignificant. To provide a cleaner setting, we exclude public debt CNAV funds from the rest of the regression analyses and restrict our attention to the different types of prime funds.[22]

4.3 How Important Were Foreign Investor Flows?

The key advantage of our matched SHS-Morningstar dataset is that we can track the sectoral ownership composition of individual MMFs over time. This allows us to provide evidence that the results in Table 3 are driven mainly by foreign investors, not by euro area-based investors. Given the absence of US investors' holdings statistics, this is the crucial additional piece of evidence in favor of our hypothesized regulation-driven cross-border flows.

To set the stage, the top panel of Figure 4 shows the cumulative quarterly net inflows (in EUR billion) for our sample of institutional funds, separately for the different fund types. The solid lines show the total cumulative flows and the dashed lines show the

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[21]In line with the results in Figure 3, Table IA.2 in the Internet Appendix shows that the additional inflows were concentrated around the implementation period of the reform, rather than the announcement period.

[22]For some figure plots, we include public debt CNAV funds. If this is the case, we explicitly label the figure accordingly.

contribution of foreign investors (as defined in Eq. (2), with h = Foreign). In line with the results in Table 3, prime funds received substantial inflows around the implementation period of the reform: prime CNAVs (prime VNAVs) received cumulative inflows on the order of EUR 60 (30) billion. The bottom panel shows separate results for USD funds, where it becomes clear that USD prime CNAVs received around 2/3 of the overall prime CNAV flows. In contrast, USD prime VNAVs (11 funds in our sample) received hardly any inflows, suggesting that prime VNAVs' flows were almost exclusively due to EUR prime VNAVs. Notably, flows to EUR prime VNAVs already started picking up in late 2014, which coincides with the period when euro area interest rates turned negative. In other words, flows to EUR VNAVs are unlikely to be related to the US reform – all the more so, since, to the best of our knowledge, EUR-oriented MMFs do not exist in the US. In line with this reasoning, we find that foreign investors' flows (dashed black line) do not contribute substantially to prime VNAVs overall inflows. On the other hand, prime CNAV flows in general and USD prime CNAV flows in particular (dashed red lines) were almost exclusively due to foreign investors.

These patterns are therefore in line with the idea of regulation-driven cross-border flows on behalf of foreign investors.[23]

4.4 Within- and Across-Family Flows

Next, we explore to what extent the cross-border flows we document happen within or between fund families. Cipriani and La Spada (2021) show that, in response to the US MMF reform, investors largely reallocated their funds from prime to public debt CNAV funds *within* the same fund family, in an attempt to save on information acquisition costs. To the extent that large fund families offer both on- and offshore US-focused prime funds, investors may have proceeded accordingly when reallocating part of their fund investments

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[23]To provide further evidence on the role of foreign investors, Table IA.3 in the Internet Appendix shows coefficient estimates of different regressions of Eq. (3) with the dependent variable defined as in Eq. (2), i.e. separate flows of each investor group h. The results indicate that, in line with the visual evidence in Figure 4, foreign investors are the main drivers of the observed inflows into USD-denominated institutional prime CNAVs.

cross-border.

In line with this reasoning, we find that the lion's share of the overall inflows into US-focused euro area MMFs comes from large fund families that offer both on- and offshore US-focused prime funds (cf. Figure IA.1 in the Internet Appendix). Specifically, we find that these funds receive total inflows on the order of EUR 35 billion compared with EUR 3.5 billion for funds from fund families without any US prime business. As in Figure 4, the vast majority of these flows are due to the group of foreign investors. Hence, in line with the findings of Cipriani and La Spada (2021), foreign investors moved most of their US-based fund investments offshore within-family.

We now analyze these within-family cross-border flows in more detail. Specifically, we wish to understand how the US dollar (in-)flows in our sample funds are related to aggregate US dollar (out-)flows of US-based prime funds within the same fund family. For this purpose, we run the following specification;

$$
\begin{aligned}
AbsFlows_{f,t} = \quad & \beta_1 \times Family\ US\ Outflow_{f,t-1} \times Post_t \times USD_f & (5) \\
& + \beta_2 \times Family\ US\ Inflow_{f,t-1} \times Post_t \times USD_f \\
& + \mathbf{X}'_{f,t-1} \times \gamma + \alpha_f + \alpha_t + \epsilon_{f,t},
\end{aligned}
$$

where $AbsFlows_{f,t}$ are the absolute US dollar flows of fund f in month t, and Family US Outflow and Family US Inflow are the aggregate US dollar out- and inflows of all US-based prime funds at the fund family level. As before, we include fund fixed effects, Time x CNAV and Time USD fixed effects and $\mathbf{X}_{f,t-1}$ includes the same set of controls as regression 3 (including lagged values of log(Fund Size), log(Fund Family Size), fund flows, fund flow volatility, age, and expense ratio). The main coefficient of interest is β_1, which tells us how flows of euro area-based funds with a USD focus depend on lagged aggregate family outflows of US-based prime funds and we expect $\beta_1 < 0$. Table 3 shows the results. In line with the documented cross-border flows, we find a significantly negative coefficient of $\beta_1 = -0.10$, which suggests that, in the post-reform period, an outflow of \$1 in the

US corresponds to a differential inflow of \$0.1 in the euro area. In specification (2) we further differentiate between prime CNAV and prime VNAV funds and we again find that the result is mainly driven by prime CNAVs with a USD focus. For these funds, in the post-reform period, an outflow of \$1 in the US corresponds to an additional inflow of \$0.16 in the euro area, compared to prime VNAV funds. Interestingly, we find no significant relationship for the Family US Inflow variable. These results provide further evidence that the documented inflows of euro area prime funds are far from independent from flows of their US-based counterparts.

4.5   Fund Fees

The fact that the vast majority of cross-border flows appear to happen within-family suggests that investors are faced with potentially large information acquisition costs when switching fund families. An important question is whether fund families are aware of their market power and are able to extract rents from their investor base. Put differently, we ask whether MMFs differentially altered their fees in response to the US reform. On the one hand, funds might reduce fees in order to either maintain investors (within fund families) or to attract new investors (across fund families) which may be looking for an alternative to the reform-induced lack of institutional prime CNAVs in the US. On the other hand, fund companies might as well increase the fees they charge to investors. A potential reason for the increase in fees might be that funds are attempting to exploit their increased market power.[24]

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[24]We should note that the existing empirical literature provides mixed evidence on the relationship between mutual fund fees and competition. For example, focusing on US equity funds during the period 1980 until 2017, Cooper, Halling, and Yang (2021) note that – despite an increasing number of mutual funds and thus presumably increased competition – average fees decreased only slightly. On the other hand, Parida and Tang (2018) find a positive relationship between fund fees and competition among US equity funds for the period 2000 until 2015.

To investigate this trade-off, we choose a similar setup as before:

$$Fund\ Fee_{f,t} = \qquad \beta_1 \times Post_t \times USD_f \times CNAV_f \qquad (6)$$

$$+\beta_2 \times Post_t \times USD_f + \beta_3 \times Post_t \times CNAV_f$$

$$+\mathbf{X}'_{f,t-1} \times \gamma + \alpha_f + \alpha_t + \epsilon_{f,t}$$

As our dependent variable we take a fund's expense ratio in month t. Our main coefficient of interest is β_1, which tells us how USD-focused prime CNAV funds changed their fees relative to the control group (USD VNAVs and EUR CNAVs) after the reform. $\mathbf{X}'_{f,t-1}$ includes lagged values of log(Fund Size), log(Fund Family Size), fund flows, fund flow volatility, and fund age. In the baseline specification across all prime funds, the results in Table 5 show no significant effect regarding the fees of prime CNAV funds with a USD-focus. However, when we further differentiate between funds in families with or without US prime business, we find that in the latter category the funds of interest actually charge lower fees, by about 10 basis points (column (2)), for their prime CNAV funds compared to their VNAV funds in the post-period. This finding is consistent with the idea that families without US prime business have stronger incentives to charge lower fees after the US reform in an attempt to attract cross-border flows from new investors. On the other hand, funds in families with prime US business tend to slightly increase their fees by 3 basis points, even though this result is insignificant (column (3)). In relative terms, however, column (4) shows that the fees of USD-denominated CNAV funds in families with US prime business are significantly higher in the post-period. While the evidence suggests that these families do not necessarily actively charge higher fees, the decision to keep fees more or less stable is, of course, an active decision nonetheless. Overall, these findings suggest that these fund families are indeed aware of their market power and are able to charge relatively higher fees to their investors.

5 Regulation-Driven Cross-Border Flows: Consequences

As a next step, we turn to the implications of the documented reform-induced cross-border flows. Our starting point is to take the reform as an exogenous *reduction* in competitive pressure for euro area-based funds. This can be rationalized, for example, based on the model of La Spada (2018): when the general attractiveness of MMFs increases (model parameter a increases), MMFs compete with each other over a larger pool of investors. This makes the intra-industry competition less fierce and reduces a fund manager's incentives to take risk. It seems plausible that the US reform *increases* the general attractiveness of euro area-based MMFs, since institutional investors who want to invest in prime CNAV funds have fewer options and may therefore be willing to sacrifice on fund performance to achieve the desired stability of their MMF investments.[25] According to the model of La Spada (2018), the reduction in competitive pressure for euro area-MMFs should, therefore, lead to a reduced performance sensitivity of investors' flows and a decrease in fund risk-taking. This section provides empirical evidence consistent with this reasoning.

5.1 Flow-Performance Relationship

We begin with an analysis of the standard flow-performance relationship (FPR), with assesses how sensitive investor flows are to (past) fund performance. Conceptually, the strength of the flow-performance relationship can be viewed as a proxy for the level of competition among funds as it serves as an implicit incentive contract for fund managers to provide their customers with reasonable performance (Chevalier and Ellison, 1997).

We start with a non-parametric estimation of the FPR and construct the fractional rank of a fund, which is the fund's gross return decile ranking relative to other funds during the previous month.[26] We are interested in the nonparametric function $G()$ of the

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[25]In contrast, as noted by (La Spada, 2018), the US reform *reduces* the attractiveness of US-based MMFs. Moreover, given that institutional prime CNAVs converted to a variable NAV, this increased the information-sensitivity of MMF liabilities, which arguably also increases competition between fund managers to produce high returns (Chevalier and Ellison, 1997; Sirri and Tufano, 1998; Baghai et al., 2021).

[26]We winsorize the gross return at the 1% and 99% level before we calculate the rank to reduce the

following specification that we run at monthly frequency:

$$Flows_{f,t} = G(FRANK_{f,t-1}) + \mathbf{X}'_{f,t-1} \times \gamma + \epsilon_{f,t}, \tag{7}$$

where $FRANK$ denotes the fractional performance rank (within each CNAV-USD combination) based on funds' gross returns. All definitions of the other variables and the setup of the model are as before. Figure 5 shows the results for the set of prime funds in our sample (the shaded areas show the 90% confidence intervals). The upper panel suggests that the FPR essentially disappeared for USD-focused institutional prime CNAV funds after the reform (blue line). Prior to the reform, there was a positive relationship. The bottom panel of Figure 5 shows the results for prime VNAVs, where the relationship remains remarkably stable before and after the reform.

Next, we conduct a more formal analysis of the flow-performance relationship and estimate the following model for the set of prime funds:

$$
\begin{aligned}
Flows_{f,t} = \quad & \beta_1 \times FRANK_{f,t-1} \times Post_t \times USD_f \times CNAV_f \tag{8} \\
& + \beta_2 \times FRANK_{f,t-1} \times Post_t \times USD_f + \beta_3 \times FRANK_{f,t-1} \times Post_t \times CNAV_f \\
& + \mathbf{X}'_{f,t-1} \times \gamma + \alpha_f + \alpha_t + \epsilon_{f,t}
\end{aligned}
$$

In the actual estimation, we include all lower-order interactions between FRANK and the Post, USD, and CNAV dummies. All definitions of the other variables and the setup of the model are as before. We are mainly interested in the coefficient β_1, which is the differential effect of the US reform between USD-denominated prime CNAVs and VNAVs.

Table 6 shows the coefficient estimates of Eq. (8). In line with the visual evidence in Figure 5, we obtain a negative and significant coefficient estimate for β_1. Hence, the FPR becomes significantly weaker for the funds which received the bulk of the regulation-driven cross-border flows. To account for potential non-linearities in the FPR, column (2) shows the results from a standard piecewise decomposition of the fractional rank (e.g., Ferreira,

influence of outliers.

Keswani, Miguel, and Ramos (2012)). This allows us to distinguish whether the weaker FPR is driven by investors' sensitivity to good, mediocre, or poor performance. More specifically, we create the following ranking variables and include them in Eq. (8):

$$
\begin{aligned}
Low &= min(0.2, FRANK) \\
Medium &= min(0.6, FRANK - Low) \\
High &= FRANK - (Low + Mid)
\end{aligned}
$$

The results in Table 6 indicate that the change in FPR is mainly due to a decreased sensitivity of investors to good performance. This suggests that competitive pressure over fund performance indeed decreased and there should be fewer incentives for fund managers to take additional risks (since ending up in the high performance group is not followed by investor flows). We focus on fund risk-taking in more detail in the next subsection.

We should, however, mention another possible interpretation of the above results. Not only is there a larger investor base for euro area MMFs, but the composition of funds' investor base might have changed as well. The FPR results suggest that the "new" investors in USD CNAV funds are willing to sacrifice fund performance (especially at the top end of fund performance) to preserve the money-likeness of their investment, and more so than the "new" investors in VNAV funds. With the data at hand, we cannot completely disentangle how much the FPR results were driven by fund managers' response to a less competitive environment and how much by changes in marginal fund investors' preferences. However, it seems plausible that both explanations could be at work, as these explanations are not mutually exclusive.

5.2 Fund Risk-Taking

Given the fact that fund manager compensation is usually based on funds' assets under management, fund managers have incentives to engage in risk-taking to maximize revenues. If a fund manager anticipates the cross-border flows coming from the different

treatment of money market funds across jurisdictions, she might respond to the opportunity by increasing her risk-taking in order to capture a larger chunk of these flows.

Hypothesis 3a: *More risk-taking because the US MMF reform increases the risk-taking incentives of euro area fund managers seeking to capture regulation-driven cross-border flows.*

On the other hand, using a tournament-selection model, La Spada (2018) shows that MMF risk-taking depends on the competitive pressure they face. More specifically, each fund faces competitive pressure only from funds with higher default costs and consequently outperforms these funds by taking on more risk. As noted throughout this paper, the US reform can be seen as an exogenous decrease in competitive pressure for euro area funds. Fund managers would then optimally take on less risk in response to the US reform as the rise in attractiveness of euro area-based MMFs decreases their incentives to take risk to outperform their competitors.

Hypothesis 3b: *Less risk-taking because the US MMF reform is an exogenous decrease in competition for CNAV funds. Euro area fund managers face less competitive pressure and need to take on less risk in order to outperform their competitors.*

We test these two hypotheses by estimating the following regression model:

$$Risk_{f,t} = \beta \times Post_t \times USD_f \times CNAV_f + \mathbf{X}'_{f,t-1} \times \gamma + \alpha_f + \alpha_t + \alpha_{f,t} + \epsilon_{f,t} \qquad (9)$$

The empirical design follows that of regression (3) and includes the lower-order interaction terms as well as fund, Time x USD, and Time x CNAV fixed effects. The variable *Risk* is meant to capture different dimensions of risk-taking and we follow previous work (Di Maggio and Kacperczyk, 2017) by focusing on the following measures: *Holdings Risk*, which is the difference in fund portfolio weights between bank obligations and corporate bonds (riskiest asset class) and government bonds and cash (safest asset classes); *Spread*, which is the difference between the fund return and the T-bill rate, and *Spread Squared*,

which is the squared spread and therefore a proxy of the variance of the spread. We further look at the funds' portfolio shares of *Bank Holdings*, i.e. bonds issued by monetary financial institutions, *Corporate Holdings*, i.e. securities issued by non-financial corporations, *Cash Holdings*, which also include repos, *Government Holdings*, i.e. government bonds, and the *Portfolio Maturity*, which is funds' portfolio maturity (in years). The coefficient of interest is β, which allows us to identify the effect of the regulation-driven cross-border flows on risk-taking by looking at the difference between USD prime CNAV funds and the control group (USD VNAV and EUR CNAV funds).

In columns (1)-(4) we find that, after the reform, USD prime CNAV funds decrease their holdings risk, reduce their bank obligations and their corporate holdings, and increase their cash holdings. In economic terms, USD prime CNAV funds decrease their bank holdings (corporate holdings) by 15 percentage points (8.3 percentage points) more compared to the control group after the US MMF reform. Cash holdings increase by a staggering 18.8 percentage points relative to the control group. We do not find a significant effect for government bond holdings (column 5), but find that USD prime CNAV funds decrease their average portfolio maturity by approximately one month (0.081 x 12 months) relative to the control group. Column (7) shows a negative but insignificant coefficient for *Spread*, while column (8) shows that *Spread Squared* becomes significantly smaller for USD prime CNAV funds, suggesting a substantial reduction in the second moment (i.e., variance) of their spreads. In other words, USD prime CNAV funds display slightly smaller but substantially less volatile spreads after the US reform.[27]

Together with our previous result of the weaker flow-performance relationship for the funds of interest, these results point to less risk-taking and are lean toward Hypothesis 3b. Due to the exogenous shock to competition caused by the US reform, fund managers are faced with less competitive pressure, which, against the background of a weaker flow-

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[27]These results could be interpreted as broadly in favor of the alternative explanation for the weaker FPR in the previous subsection: if the average investor in USD CNAV funds has become relatively less sensitive to performance and relatively more sensitive to money-likeness, we should observe a reduction in the relative spread of CNAVs and VNAVs. In other words, the average investor is willing to accept lower returns to preserve the money-likeness of her investment.

performance relationship, reduces the incentive for risk-taking behavior. This is even more remarkable given that the reform appears to have had the opposite effect for the set of treated funds in the US (e.g., Baghai et al. (2021)).

5.3 Did Within-Sector Concentration in the Euro Area Increase Due to the US Reform?

The results presented so far indicate that the US MMF reform had unintended consequences in that it made euro area institutional prime CNAV funds both more attractive (substantial inflows) and more stable (weaker FPR and less risk-taking). Taken by themselves, however, these results do not necessarily imply that the reform made the MMF sector as a whole more robust. One aspect that must be taken into account is that the US reform forced MMFs to switch to a variable net asset value mainly because the stable NAV feature made them subject to elevated run risks. The observation that euro area MMFs *with* a stable NAV received substantial inflows due to the US reform and thus gained in relative importance within the sector suggests that run risks for the euro area MMF sector as a whole may have increased. On top of that, the growth of CNAV funds is mostly fueled by foreign investors. A larger foreign investor base might further increase run risks because foreign capital may be more fickle in times of distress (Albertazzi et al., 2021; Caballero and Simsek, 2020). Our analysis of the COVID-19-induced stress episode in the next section provides tentative evidence along these lines.

In addition, we find evidence that the level of concentration within the institutional euro area MMF sector has increased substantially over the sample period. Figure 6 shows three different measures of TNA concentration, namely the standard Hirschman-Herfindahl Index and the TNA share of the largest 5 and 10 funds, respectively, both calculated over fund TNAs separately for each cross-section. The blue lines show the results for all (institutional) funds in our sample and the red lines show the results for prime funds only. Not surprisingly, the level of concentration is higher for the subset of prime funds. More importantly, we observe a strong increase in the concentration levels for

each concentration measure, particularly so around the second vertical line corresponding to the implementation of the US reform in October 2016. We should highlight that this increased within-euro area concentration is different from the negative competition shock due to the reform. As explained in different parts of the paper, the latter implies that the general attractiveness of euro area-based prime CNAVs increased due to the US reform. The documented increase in within-sector concentration in Figure 6 tells us that the reform-driven inflows into the sector were not distributed equally across all funds, but rather that some funds received relatively more inflows even within the prime segment. From a financial stability perspective, these higher concentration levels could be relevant in that this makes the sector more prone to the behavior of (and shocks to a) relatively small number of funds.

6 A Closer Look at the EU MMF Regulation and COVID-19

The empirical analyses presented so far were based on our main dataset that covers the period January 2013 up until May 2017. This specific cutoff was chosen to reduce the potential effect of the EU MMF Regulation that was officially announced in June 2017. In this section, we investigate what happened to our funds of interest (i) around the implementation of the EU MMF Regulation and (ii) during the COVID-19-induced market stress episode in early 2020. For this purpose, we construct a separate dataset (drawing upon the same sources as for our main dataset) that covers the period June 2017 up until June 2020 for those funds that were also included in our main dataset. As noted in section 2, the EU MMF Regulation was implemented in June 2018 (for newly established funds) and in January 2019 (for existing funds), such that the latter date is of particular relevance for funds in our sample.

As a mirror image of the US reform, the EU regulation should have reduced the overall attractiveness of euro area-based prime CNAV funds, since these were forced to

become low-volatility NAV (LVNAV) funds and had to adopt liquidity-based fees and gates. The fundamental question is whether the flows due to the US reform were offset by its European counterpart. One crucial difference to the US reform, however, is that these LVNAVs effectively operate as CNAVs as long as they satisfy certain conditions (see Section 2). As such, the reduction in the general attractiveness of prime CNAVs due to the EU regulation should be comparably small relative to the US MMF reform, given that LVNAV funds remain the closest substitute to prime CNAV funds.

The COVID-19-induced market stress episode makes it possible to assess the robustness of the US reform-induced inflows and to study how flighty they are. Arguably, our paper is not the first to study the run on MMFs in 2020. Li et al. (2021) and Cipriani and La Spada (2020) both show that liquidity fees and redemption gates exacerbated the run dynamics. Casavecchia et al. (2020) reach the same conclusion with regard to intraday redemptions. What makes our analysis different is the fact that we can look more closely at the role of foreign versus domestic investors to explain run dynamics during the COVID-19-induced stress period. In light of recent studies which show that foreign capital tends to be fickle in times of distress (Albertazzi et al., 2021; Caballero and Simsek, 2020), we expect foreign (domestic) investors to play a destabilizing (stabilizing) role during the money market run in March 2020. If in particular foreign investors redeem their fund shares after the shock, this would point to an increased run risk in the euro area MMF industry and put the overall effects of the cross-border flows into perspective.

We therefore study both events in more detail. First, Figure 7 provides evidence that the EU MMF Regulation did not lead to similarly large *outflows* from our sample funds. Specifically, the Figure shows the cumulative (quarterly) flows across the three different fund types in our main sample and, as in Figure 4 for our main sample, also shows the flows of foreign investors. Of particular interest is the middle panel, which focuses on institutional funds with a USD focus. If anything, USD prime CNAVs (which became LVNAVs in January 2019) displayed *inflows* between the announcement and the implementation of the reform (first and second vertical line). In other words, the EU MMF

Regulation does not appear to have triggered substantial outflows. Second, however, USD prime CNAVs displayed substantial outflows during the COVID-19-induced stress episode in the first quarter of 2020 and these outflows can be almost exclusively attributed to foreign investors. On the other hand, public debt CNAV funds received large inflows during the same period. At the same time, we do not observe large outflows for EUR-denomiated funds in the first quarter of 2020 in the bottom panel, irrespective of the fund type. Since flow dynamics in these funds are less dominated by foreign investors (as can be seen from the dashed lines), the figures indeed suggest that foreign (domestic) investment in MMFs is more (less) flighty in times of distress.

To study these patterns in more detail, Table 8 shows regression results from a similar regression as in Eq. (3) for monthly fund flows, with separate dummies around the announcement and the implementation of the EU MMF Regulation (and a dummy for the COVID-19 period). Specifically, we define "Announcement EU Regulation" as a dummy variable taking the value of 1 between June 2017 and November 2018 and 0 otherwise. Since we focus on funds that were established before June 2018, we define "Implementation EU Regulation" as a dummy variable taking the value of 1 between December 2018 and May 2019 and 0 otherwise.[28] "COVID-19" is a dummy variable taking the value of 1 in March and April 2020 and 0 otherwise. Table 8 shows the regression results when including only the EU regulation dummies (column 1), only the COVID-19 dummy (column 2), and all dummies (column 3). In line with the dynamics in Figure 7, neither the announcement nor the implementation of the EU MMF Regulation led to significant outflows from USD prime CNAVs. On the contrary: we find strong evidence of large outflows of USD prime CNAVs (i.e., LVNAVs since January 2019) during the COVID-19-induced stress episode. This is in line with prior work that documented that outflows during this period were particularly large for USD LVNAV funds (e.g., Cipriani and La Spada (2020)) – which are exactly those funds that are of particular interest in this paper. This finding suggests that the US reform-induced inflows from foreign investors appear to be more

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[28]The results are robust to alternative definitions of the two EU Regulation dummies.

fickle in periods with pronounced market stress.

7 Policy Discussion

It is widely documented that non-bank financial intermediaries, including MMFs, have been gaining importance in the global financial system over recent years. The changing composition may alter the transmission of shocks within the financial system but also monetary policy transmission. From this perspective, our paper carries important policy implications.

Fueled by instabilities that became apparent during the COVID-19 stress episode (Li et al., 2021), there have been ongoing policy discussions about further regulatory changes in the MMF industry (FSB, 2021). For example, on March 26, 2021, the European Securities and Markets Authority launched a consultation on potential reforms for EU MMFs. One crucial aspect in this consultation was the review regarding the status of LVNAV funds and whether these would continue to exist in their current form. Relatedly, on December 15, 2021, the US Securities and Exchange Commission published proposed amendments to the MMF regulation. Among other things, these amendments would remove the activation of both liquidity fees and redemption gates when a fund's liquidity drops below a defined threshold. Moreover, the proposal would require institutional prime MMFs to implement swing pricing policies.

As documented in this paper, the 2014 US MMF reform was associated with both positive and negative effects for euro area MMFs. We believe that potential cross-border effects of future reforms must be taken into account more carefully. Looking forward, we believe that the analysis of cross-border effects of regulations in the non-bank financial sector are a particularly fruitful avenue of future research, even more so in light of calls for systemic regulation of this strongly growing and highly diverse part of the global financial system (BIS (2021)). As noted by the Financial Stability Board (FSB, 2021), "*[a]s with prioritising individual options, the optimal combination of measures should take*

account of jurisdiction-specific circumstances and policy priorities, as well as cross-border considerations including to prevent regulatory arbitrage that could arise from adopting divergent approaches across jurisdictions." While we find little evidence that the 2017 EU MMF Regulation itself led to sizeable outflows, it would be interesting to investigate the cross-border effects of this regulatory change as well.

Lastly, a nascent literature documents that non-bank financial intermediaries are becoming increasingly important for international capital flows (Hashimoto and Krogstrup, 2019; Committee on the Global Financial System, 2021). Our paper highlights a specific example where sizable capital flows are driven by differences in MMF regulations across jurisdictions. The fact that foreign investments appear to be more fickle in periods with pronounced market stress is in line with a vast body of literature on international capital flows, and it is widely acknowledged that this fickleness may justify macroprudential regulation (e.g., Caballero and Simsek (2020)). More specifically, investors' incentives for the type of cross-border flows documented in this paper would be mitigated if MMF regulations were harmonized across jurisdictions.

8 Conclusion

We explore the cross-border effects of the 2014 US MMF reform on the euro area MMF sector. Our main result is that euro area funds whose US-based counterparts were particularly affected by the reform, most importantly institutional prime CNAV funds, received substantial inflows around the implementation of the reform. Several pieces of evidence indicate that these flows were indeed driven by the US reform, and we document that euro area-based MMF risk-taking decreases after the US reform, consistent with an easing of competitive pressure. On the other hand, we provide further evidence suggesting that the euro area MMF sector has become more concentrated due to the US reform and that the larger importance of prime CNAVs may lead to elevated run risks for the sector as a whole. Overall, our findings suggest that the US reform had significant (unintended) ef-

fects for the euro area MMF sector and highlight the need to carefully assess the potential cross-border effects of future reforms.

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Figures and Tables

Figure 1: Total Net Assets of Euro Area-based Institutional MMFs by Investor Group

The figure displays the quarterly total net assets (TNA) held by major investor groups for the institutional MMFs in our sample. The sample includes euro area-based institutional MMFs denominated in either USD or EUR. The relevant groups are monetary financial institutions (MFIs), non-financial companies (NFCs), non-bank financial institutions (NBFIs), all other investor groups based in the euro area (Others), and a residual group comprised of investors from outside the euro area (Foreign). The two vertical dashed lines represent the announcement and implementation month of the US MMF reform, respectively. Note: NBFIs comprise investment funds, insurance companies, and pension funds.
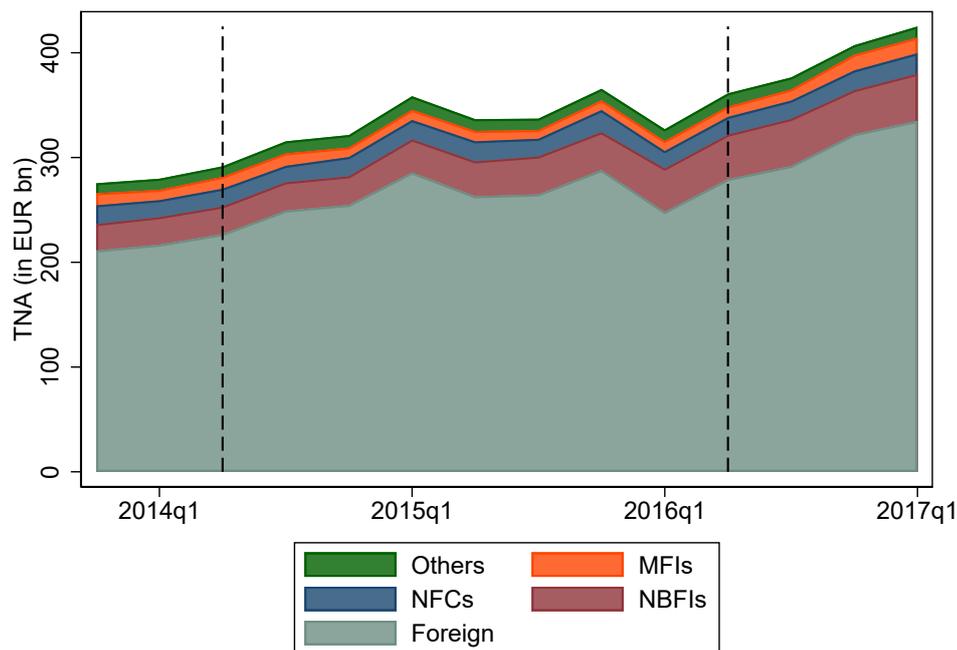
Figure 2: Timeline of US and EU MMF Reforms

The figure displays a timeline with important dates of different reforms of the money market funds industry in the US and the EU.
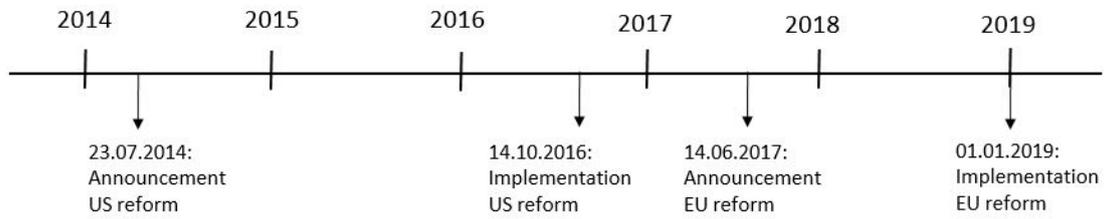
Figure 3: Coefficient Plot – Parallel Trends Assumption

The figure plots the coefficients of the interaction USD x Semester together with the 90% and 95% confidence intervals. The vertical dashed lines mark the announcement and implementation of the US reform

USD x Semester FE (90/95% CI)
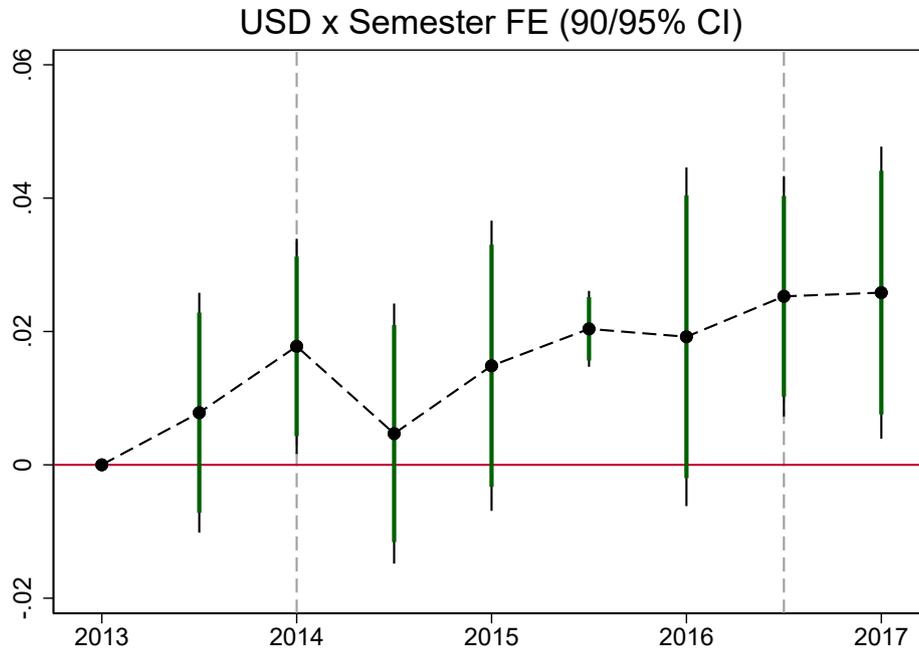
Figure 4: Cumulative Flows and Foreign Investors

The figure displays the quarterly cumulative flows of institutional MMFs domiciled in the euro area separately for the different NAV types. The sample includes euro area-based institutional MMFs denominated in either USD or EUR. The solid lines show the respective total cumulative flows, whereas the dashed lines depict the respective contribution of foreign investors. The two vertical dashed lines represent the announcement and implementation month of the US MMF reform, respectively.

All

USD
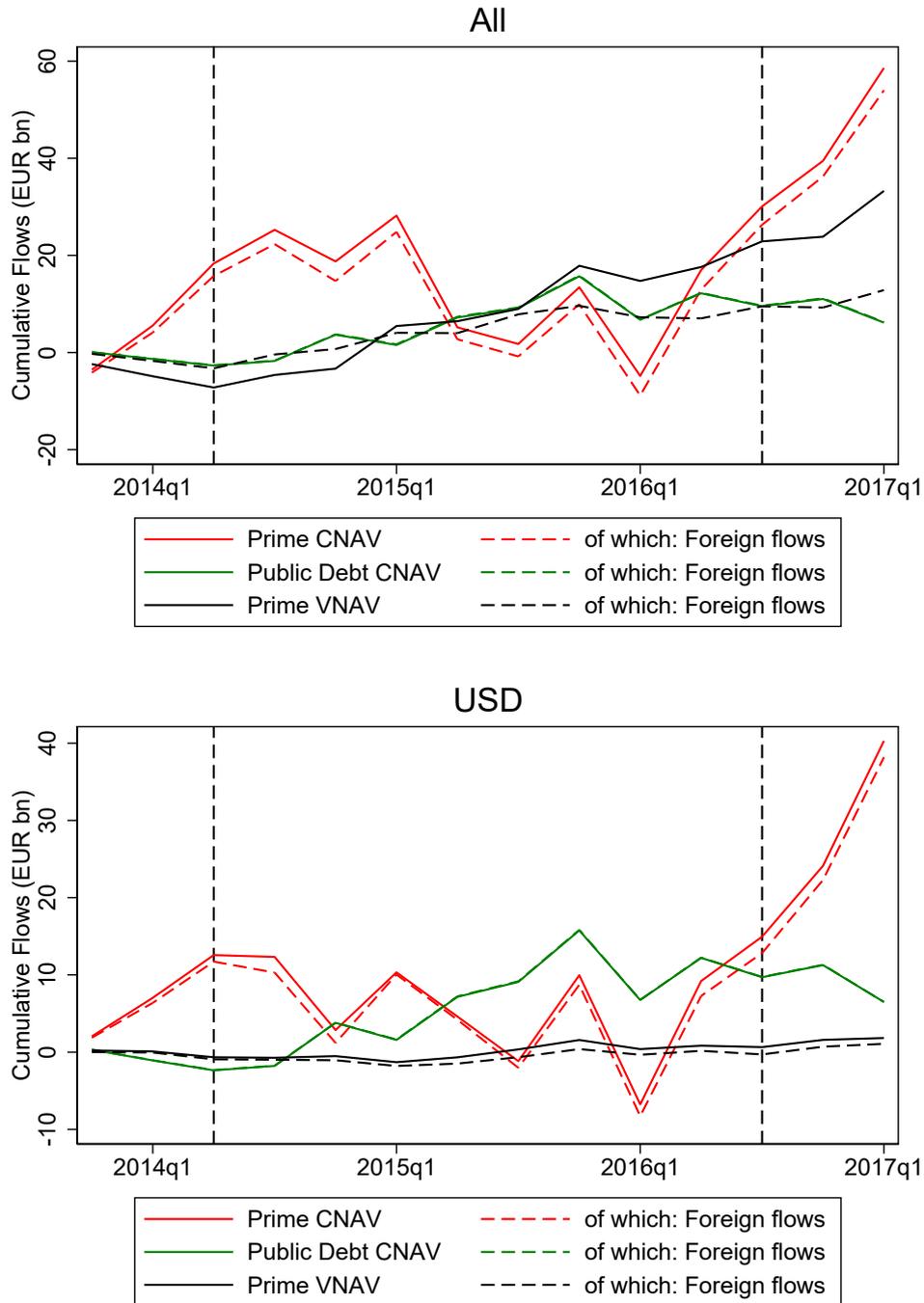
The figure displays the flow-performance relationship for USD-denominated institutional prime CNAV funds (upper figure) and prime VNAV funds (lower figure) for the pre- and post-period.
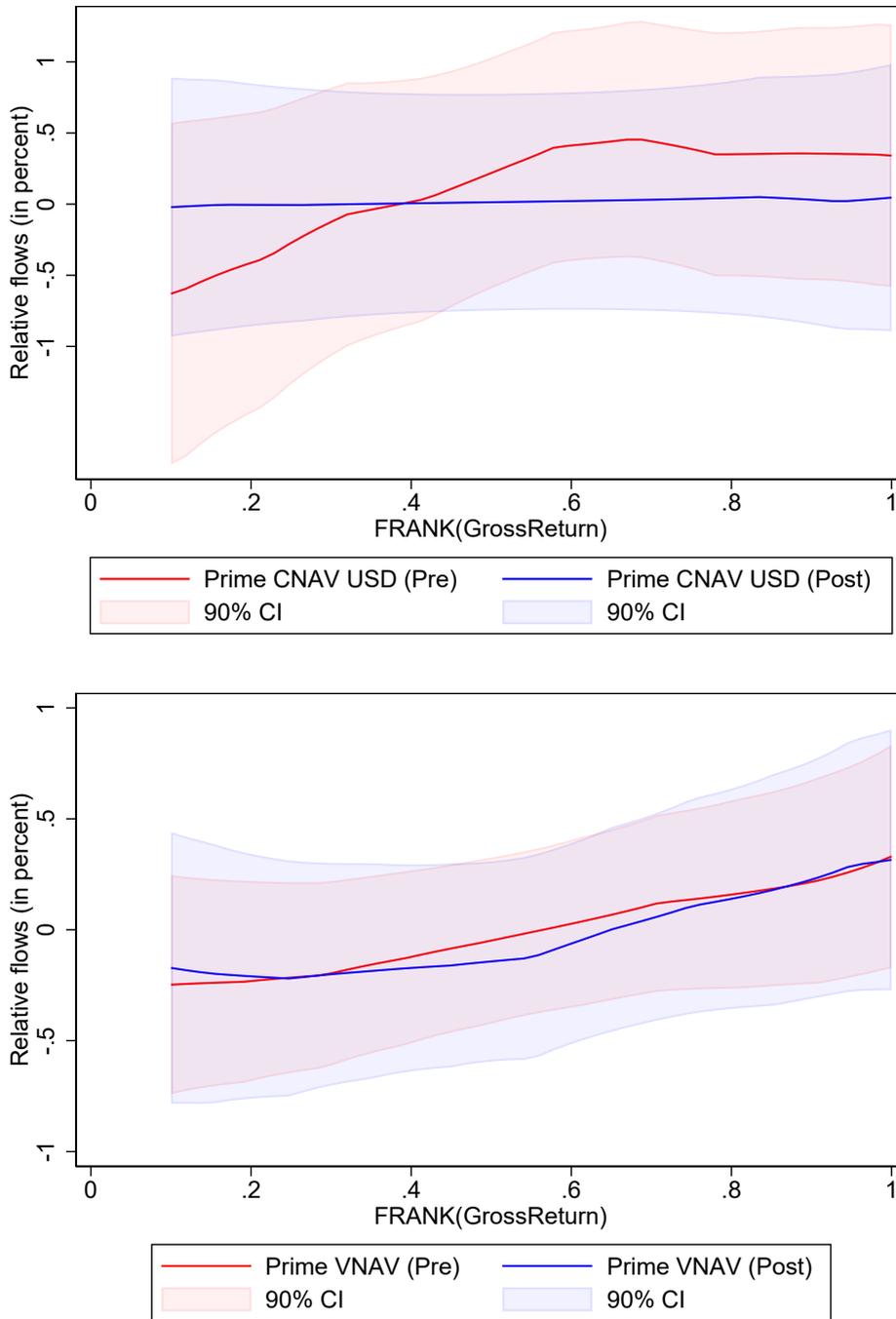
Figure 6: Concentration of Euro Area-domiciled institutional MMFs

The figure displays different concentration measures for our sample MMFs' TNA. The sample includes euro area-based institutional MMFs denominated in either USD or EUR. The upper panel shows the Hirschman-Herfindahl Index (HHI) and the lower panel shows the TNA share of the top 5 and top 10 funds at each point in time. The blue lines are based on all sample funds and the red lines on prime funds only. The two vertical dashed lines represent the announcement and implementation month of the US MMF reform, respectively.

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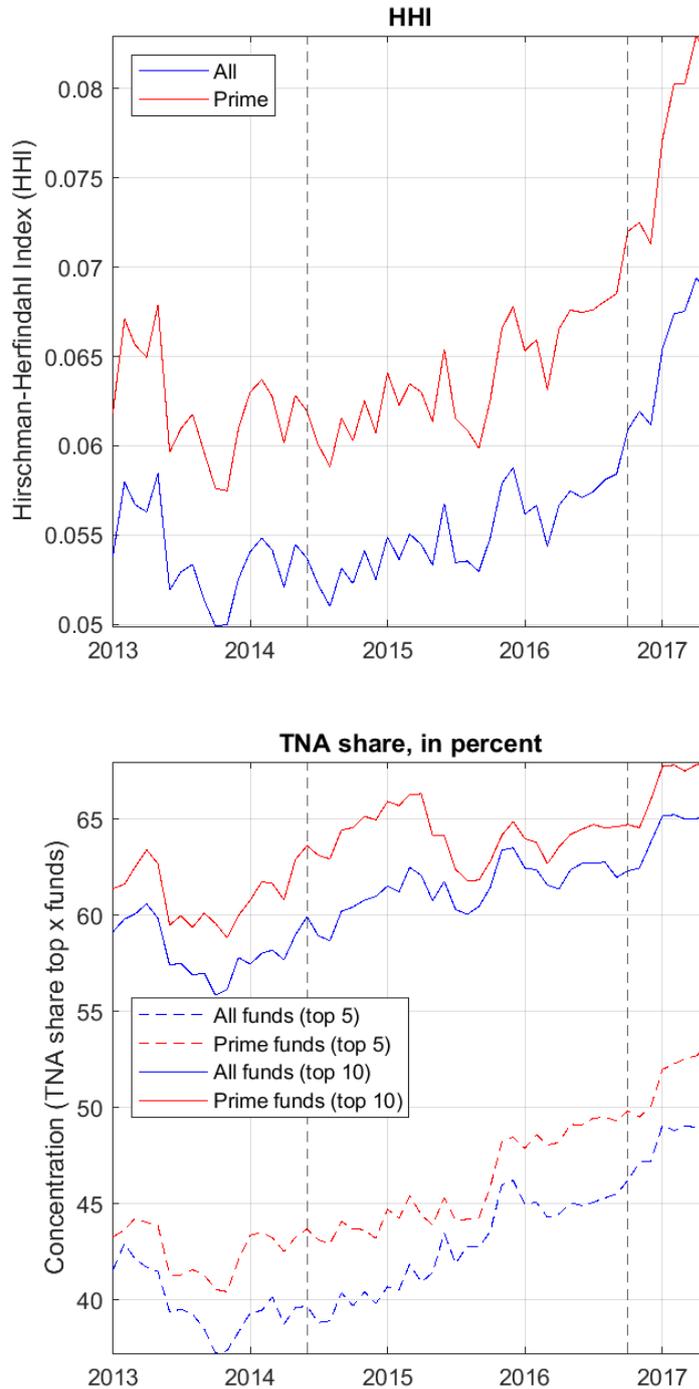
Figure 7: Cumulative Flows and Foreign Investors – After May 2017

The figure displays the quarterly cumulative flows of MMFs domiciled in the euro area separately for the different NAV types for the period after May 2017. The sample includes euro area-based institutional MMFs denominated in either USD or EUR. The solid lines show the respective total cumulative flows, whereas the dashed lines depict the respective contribution of foreign investors. The vertical lines denote the announcement of the EU Reform (2017q2), the implementation for existing funds (2019q1) and the COVID-19-induced stress episode (2020;q1), respectively.
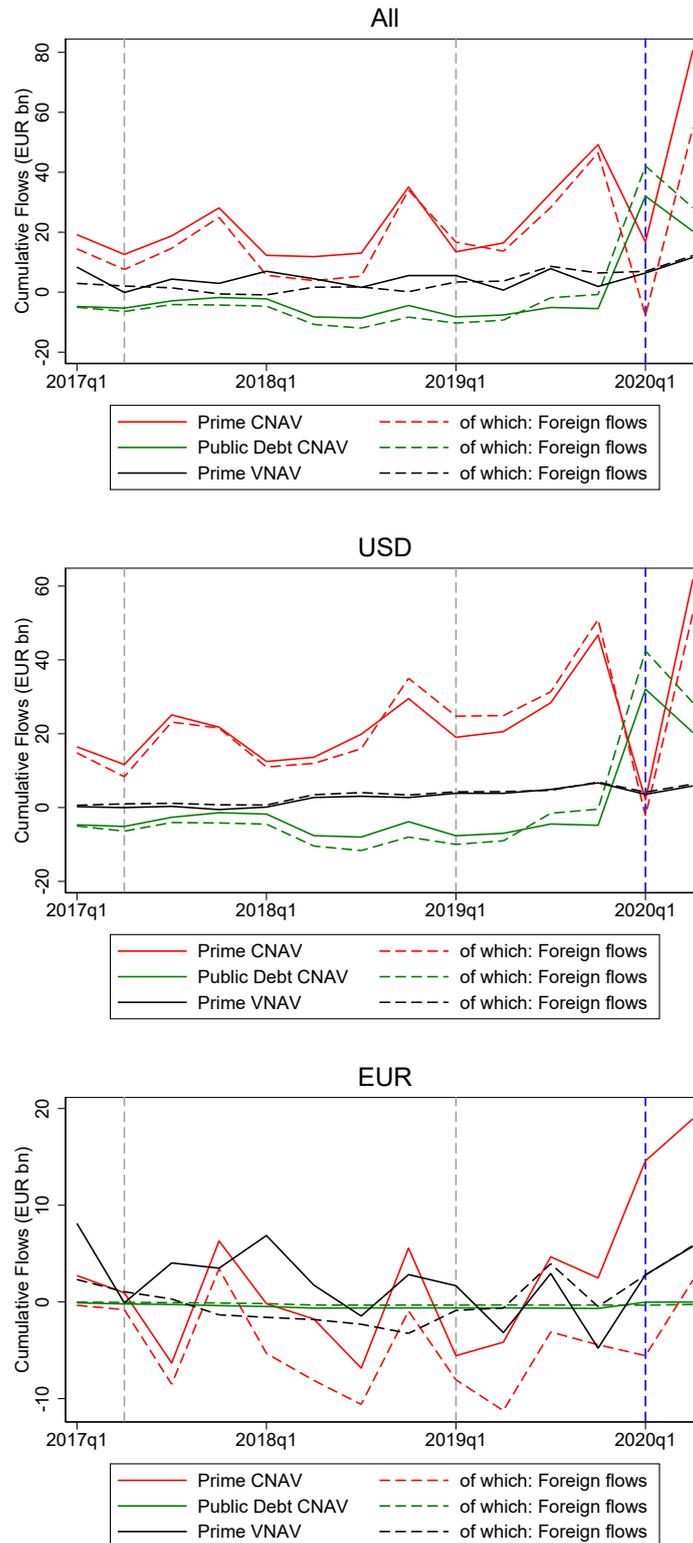
Table 1: Summary Statistics

The table shows the summary statistics of the main variables used in the empirical analysis. The sample includes euro area-based institutional MMFs denominated in either USD or EUR. Variables are monthly and winsorized at the 1% and 99% levels. The variable *Flows* are monthly fund flows as defined in Eq. (1) measured in percentage terms (in decimals). *Fund TNA* and *Family TNA* are measured in EUR bn. *Post*, *USD*, and *CNAV* are indicator variables (i.e. 0 or 1). The variable *Expense Ratio* is measured in percent. *Age* and *Portfolio Maturity* are denoted in years. The *Holdings* variables denote the funds' portfolio weights of the respective asset class, i.e. the percentage holdings of cash (including repos), corporate non-financial bonds, bank bonds, and government bonds measured in decimals. *Holdings Risk* is the difference of the fund portfolio weights between the riskiest asset class (bank obligations) and the safest asset class (government bonds and cash). *Spread* is the difference between the (annualized) fund return and the T-bill rate and *Spread Squared* is the squared spread.

|	Mean	Std. Dev.	P25	P50	P75	Num. of Obs.
Flows	-0.001	0.103	-0.045	-0.008	0.038	5,102
Fund TNA	3.317	6.87	0.233	0.9	3.03	5,102
Family TNA	25.723	35.797	1.324	7.205	39.992	5,102
Post	0.344	0.475	0	0	1	5,102
USD	0.345	0.475	0	0	1	5,102
CNAV	0.356	0.479	0	0	1	5,102
Controls:						
log(Fund TNA(t-1))	20.551	1.731	19.274	20.617	21.828	5,102
log(Family TNA(t-1))	22.529	2.082	21.006	22.687	24.412	5,102
Flows(t-1)	0	0.102	-0.045	-0.007	0.039	5,102
Std. Dev. Flows(t-1)	0.128	0.24	0.051	0.08	0.121	5,102
Expense Ratio(t-1)	0.195	0.116	0.11	0.173	0.257	5,102
Age(t-1)	14.662	7.875	7.75	14.917	20.167	5,102
Fund portfolio holdings:						
Holdings: Cash	0.481	0.329	0.144	0.53	0.776	3,125
Holdings: Corporate Non-Financials	0.085	0.103	0.004	0.045	0.129	3,125
Holdings: Banks	0.137	0.157	0.014	0.072	0.221	3,125
Holdings: Government	0.12	0.226	0	0.031	0.118	3,125
Holdings Risk	-0.378	0.518	-0.866	-0.499	0.067	3,125
Portfolio Maturity	0.102	0.14	0.007	0.042	0.145	3,125
Spread	0.137	0.403	-0.006	0.193	0.354	3,125
Spread Squared	0.181	0.271	0.028	0.075	0.215	3,125

Table 2: Additional Summary Statistics

The table shows the summary statistics of the main variables used in the empirical analysis (as described in Table 1) for USD-denominated funds and EUR-denominated institutional funds in our sample. Variables are winsorized at the 1% and 99% levels.

	USD=0				USD=1			
	Mean	Std. Dev.	P50	Num. of Obs.	Mean	Std. Dev.	P50	Num. of Obs.
Flows	-0.004	0.105	-0.011	3,341	0.004	0.099	-0.004	1,761
Fund TNA	2.505	4.7	0.578	3,341	5.091	10.69	0.717	1,761
Family TNA	22.98	34.84	4.491	3,341	31.21	37.84	15.9	1,761
USD	0	0	0	3,341	1	0	1	1,761
CNAV	0.186	0.389	0	3,341	0.677	0.468	1	1,761
Post	0.342	0.474	0	3,341	0.348	0.477	0	1,761
Controls:								
log(Fund TNA(t-1))	20.501	1.617	20.678	3,341	20.647	1.926	20.373	1,761
log(Family TNA(t-1))	22.343	2.079	22.439	3,341	22.883	2.044	23.473	1,761
Flows(t-1)	-0.002	0.104	-0.01	3,341	0.004	0.099	-0.004	1,761
Std. Dev. Flows(t-1)	0.125	0.215	0.084	3,341	0.135	0.283	0.075	1,761
Expense Ratio(t-1)	0.178	0.113	0.151	3,341	0.226	0.115	0.2	1,761
Age(t-1)	13.904	7.946	14	3,341	16.101	7.532	16.083	1,761
Fund portfolio holdings:								
Holdings: Cash	0.429	0.323	0.454	2,208	0.605	0.31	0.638	917
Holdings: Corporate Non-Financials	0.087	0.103	0.048	2,208	0.08	0.101	0.036	917
Holdings: Banks	0.135	0.155	0.07	2,208	0.141	0.161	0.081	917
Holdings: Government	0.132	0.248	0.037	2,208	0.089	0.157	0.016	917
Holdings Risk	-0.34	0.524	-0.454	2,208	-0.471	0.491	-0.609	917
Portfolio Maturity	0.108	0.147	0.048	2,208	0.089	0.121	0.031	917
Spread	0.046	0.425	0.134	2,208	0.355	0.224	0.304	917
Spread Squared	0.183	0.289	0.068	2,208	0.176	0.222	0.093	917

Table 3: Fund Flows – MMF Reform

The table shows coefficient estimates of regression Eq. (3) for the period Jan. 2013 until May 2017. The sample includes euro area-based USD and EUR institutional MMFs. The dependent variable is monthly fund flows as defined in Eq. (1) of each fund f in month t. *Post* is a dummy variable taking the value of 1 after October 2015 and 0 otherwise. *USD* is a dummy variable which identifies funds with a US investment focus. *CNAV* is a dummy variable that takes the value of one for CNAV funds. All monthly control variables are lagged by one month and include the natural logarithm of fund size and fund family size, fund flow volatility (past 12 months), expense ratio, fund age (in years), and fund flows. Fund fixed effects, time fixed effects, time x USD fixed effects, and time x CNAV fixed effects are either included (Yes), not included (No) or absorbed by other fixed effects (-). Standard errors are HACSC robust from Driscoll and Kraay (1998) with 5 lags and corresponding t-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) All	(2) Prime	(3) Prime	(4) Prime
Post x USD	0.0180**	0.0158**	-0.0050	
	(2.28)	(2.01)	(-0.58)	
Post x CNAV			-0.0005	
			(-0.03)	
Post x USD x CNAV			0.0364**	0.0359**
			(2.15)	(2.05)
log(Fund TNA(t-1))	-0.0144	-0.0121	-0.0132	-0.0133
	(-1.51)	(-1.39)	(-1.62)	(-1.55)
log(Family TNA(t-1))	-0.0187*	-0.0192*	-0.0213**	-0.0202**
	(-1.93)	(-1.96)	(-2.50)	(-2.49)
Std. Dev. Flows(t-1)	0.0076	0.0036	0.0035	0.0054
	(1.01)	(0.54)	(0.53)	(0.80)
Expense Ratio(t-1)	-0.0166	-0.0152	-0.0077	-0.0126
	(-0.43)	(-0.39)	(-0.19)	(-0.31)
Age(t-1)	0.0135	0.0134	0.0144	0.0142
	(1.00)	(1.00)	(1.07)	(1.05)
Flows(t-1)	-0.0888***	-0.0882***	-0.0880***	-0.0851***
	(-3.49)	(-3.48)	(-3.46)	(-3.28)
adj. R2	.0160	.0148	.0165	.0150
Obs	5102	4667	4667	4667
Fund FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	-
Time x USD FE	No	No	No	Yes
Time x CNAV FE	No	No	No	Yes

Table 4: Fund Flows - Within Family Flows

The table shows coefficient estimates of regression Eq. (3) for the sample of funds that do have a US-based prime fund within their fund family for the period Jan. 2013 until May 2017. The sample includes euro area-based USD and EUR institutional prime MMFs. The control group consists of institutional prime VNAV funds. The dependent variable is monthly fund flows as defined in Eq. (1). *Post* is a dummy variable taking the value of 1 after October 2015 and 0 otherwise. *USD* is a dummy variable which identifies funds with a US investment focus. *CNAV* is a dummy variable that takes the value of one for CNAV funds. *Family US Outflow* and *Family US Inflow* are variables that capture outflows or inflows of the US-based prime fund families. These two variables are constructed using information on US-based fund families' aggregate netflows from Morningstar. We define *Family US Outflow* (*Family US Inflow*) as the actual family flow for positive (negative) values and zero otherwise. All monthly control variables are lagged by one month and include the natural logarithm of fund size and fund family size, fund flows, fund flow volatility (past 12 months), expense ratio, and fund age (in years). Fund fixed effects, time fixed effects, time x USD fixed effects, and time x CNAV fixed effects are either included (Yes), not included (No) or absorbed by other fixed effects (-). Standard errors are HACSC robust from Driscoll and Kraay (1998) with 5 lags and corresponding t-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, 1nd 1% levels, respectively.

	(1)	(2)
Family US Outflow(t-1) x Post x USD	-0.1153*	-0.0212
	(-1.82)	(-0.36)
Family US Inflow(t-1) x Post x USD	0.0109	0.0032
	(0.13)	(0.06)
Family US Outflow(t-1) x Post x USD x CNAV		-0.1807***
		(-2.89)
Family US Inflow(t-1) x Post x USD x CNAV		0.1452
		(1.33)
Family US Inflow(t-1) x Post x CNAV		-0.1257
		(-1.36)
Family US Outflow(t-1) x Post x CNAV		0.0575
		(1.20)
adj. R2	.005405	.006225
Obs.	1309	1309
Fund FE	Yes	Yes
Time FE	Yes	-
Time x USD FE	No	Yes
Time x CNAV FE	No	Yes

Table 5: Fund Fees

The table shows coefficient estimates of regression Eq. (6) for the period Jan. 2013 until May 2017. The sample includes euro area-based USD and EUR institutional prime MMFs. The control group consists of institutional prime VNAV funds. The dependent variable is the funds' expense ratio in month t. Columns (1) and (4) report results for the baseline sample. In columns (2) and (3) the sample is split. Column (2) includes all funds that do not and column (3) includes all funds that do have a US-based prime fund within their fund family. *Post* is a dummy variable taking the value of 1 after October 2015 and 0 otherwise. *USD* is a dummy variable which identifies funds with a US investment focus. *CNAV* is a dummy variable that takes the value of one for CNAV funds. *Has US Prime* is a dummy variable that takes the value of one for funds that have a US-based prime fund within their fund family. All monthly control variables are lagged by one month and include the natural logarithm of fund size and fund family size, fund flows, fund flow volatility (past 12 months), and fund age (in years). Time x USD x Has US Prime fixed effects, and time x CNAV x Has US Prime fixed effects are included (Yes). Standard errors are HACSC robust from Driscoll and Kraay (1998) with 5 lags and corresponding t-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Baseline	(2) Has No US Prime	(3) Has US Prime	(4) Interaction
Post x USD x CNAV	-0.0447	-0.0914**	0.0263	-0.0822*
	(-1.54)	(-2.21)	(1.17)	(-1.94)
Post x USD x CNAV x Has US Prime				0.1077**
				(2.17)
adj. R2	.07081	.06486	.1245	.06494
Obs.	4667	3331	1336	4667
Controls	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes
Time x USD FE	Yes	Yes	Yes	–
Time x CNAV FE	Yes	Yes	Yes	–
Time x USD x Has US Prime FE	No	No	No	Yes
Time x CNAV x Has US Prime FE	No	No	No	Yes

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Table 6: Flow-Performance Relationship

The table shows coefficient estimates of regression Eq. (8) for the period Jan. 2013 until May 2017. The sample includes euro area-based USD and EUR institutional prime MMFs. The control group consists of institutional prime VNAV funds. The dependent variable is monthly fund flows as defined in Eq. (1) of each fund f in month t. *FRANK* denotes the lagged fractional performance rank of the fund. "Post" is a dummy variable taking the value of 1 after October 2015 and 0 otherwise. "Post" is interacted with the variable "USD", which identifies funds with a US investment focus. "CNAV" is a dummy variable that takes the value of one for CNAV funds. In Column (2) we apply a piecewise decomposition to the fractional performance rank. *Low, Medium* and *High* are defined as in Ferreira et al. (2012). All monthly control variables are lagged by one month and include the natural logarithm of fund size and fund family size, fund flows, fund flow volatility (past 12 months), expense ratio, and fund age (in years). Time x USD fixed effects, and time x CNAV fixed effects are included. Standard errors are HACSC robust from Driscoll and Kraay (1998) with 5 lags and corresponding t-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Baseline	(2) Piecewise
FRANK x Post x USD x CNAV	-0.1240*	
	(-1.89)	
FRANK x Post x USD	0.0483	
	-1.73	
FRANK x Post x CNAV	0.0792	
	-1.22	
FRANK x USD x CNAV	0.0667**	
	2.12	
FRANK x Post	-0.0323***	
	(-2.78)	
FRANK x USD	-0.0156	
	(-1.13)	
FRANK x CNAV	-0.0446**	
	(-2.24)	
FRANK	0.0296**	
	(-2.46)	
High x Post x USD x CNAV		-0.0402**
		(-2.38)
Medium x Post x USD x CNAV		-0.0085
		(-1.05)
Low x Post x USD x CNAV		-0.0089
		(-0.25)
adj. R2	.021	.018
Obs	4598	4598
Controls	Yes	Yes
Fund FE	Yes	Yes
Time x USD FE	Yes	Yes
Time x CNAV FE	Yes	Yes

Table 7: Fund Risk Taking

The table shows coefficient estimates of regression Eq. (9) for the period Jan. 2013 until May 2017. The sample includes euro area-based USD and EUR institutional prime MMFs. The control group consists of institutional prime VNAV funds. The dependent variable *Holding Risk* is the difference in fund portfolio weights between bank obligations and corporate holdings on the one hand and government bonds and cash on the other hand. *Bank Holdings*, *Corporate Holdings*, *Cash Holdings* (including repos), and *Government Holdings* are the funds' portfolio weights in these asset classes. *Portfolio Maturity* is funds' portfolio maturity (in years). The variable *Spread* is the difference between the fund return and the T-bill rate and the variable *Spread Squared* is the square of *Spread*. *Post* is a dummy variable taking the value of 1 after October 2015 and 0 otherwise. *Post* is interacted with the variable *USD*, which identifies funds with a US investment focus. *CNAV* is a dummy variable that takes the value of one for CNAV funds. All monthly control variables are lagged by one month and include the natural logarithm of fund size and fund family size, fund flows, fund flow volatility (past 12 months), expense ratio, and fund age (in years). Time x USD fixed effects, and time x CNAV fixed effects are included. Standard errors are HACSC robust from Driscoll and Kraay (1998) with 5 lags and corresponding t-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Holdings Risk	(2) Bank Holdings	(3) Corp. Holdings	(4) Cash Holdings
Post x USD x CNAV	-0.4384***	-0.1497***	-0.0829*	0.1880**
	(-2.71)	(-3.39)	(-1.90)	(2.18)
adj. R2	.05756	.05111	.02431	.04123
Obs.	3125	3125	3125	3125

	(5) Gov. Holdings	(6) Portfolio Maturity	(7) Spread	(8) Spread Squared
Post x USD x CNAV	0.0033	-0.0809***	-0.0880	-0.2580**
	(0.10)	(-2.82)	(-1.37)	(-2.57)
adj. R2	.0110	.0195	.0214	.0356
Obs.	3125	3125	3125	3125
Controls	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes
Time x USD FE	Yes	Yes	Yes	Yes
Time x CNAV FE	Yes	Yes	Yes	Yes

Table 8: Fund Flows - EU MMF Regulation and COVID-19

The table shows coefficient estimates of a regression similar to the one in Eq. (3) for the period Jun. 2017 until May 2020. The sample includes euro area-based USD and EUR institutional prime MMFs. The control group consists of institutional prime VNAV funds. The dependent variable is monthly fund flows as defined in Eq. (1). *Announcement EU Regulation* is a dummy variable taking the value of 1 between June 2017 and November 2018 and 0 otherwise. *Implementation EU Regulation* is a dummy variable taking the value of 1 between December 2018 and May 2019 and 0 otherwise. *COVID-19* is a dummy variable taking the value of 1 in March and April 2020 and 0 otherwise. These dummies are interacted with the variables "USD" and "CNAV". All monthly control variables are lagged by one month and include the natural logarithm of fund size and fund family size, fund flows, fund flow volatility (past 12 months), expense ratio, and fund age (in years). Time x USD fixed effects, and time x CNAV fixed effects are included. Standard errors are HACSC robust from Driscoll and Kraay (1998) with 5 lags and corresponding t-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) EU Reform	(2) COVID-19	(3) Both
Announcement EU Regulation x USD x CNAV	0.01		-0.01
	(0.51)		(-0.26)
Implementation EU Regulation x USD x CNAV	0.03		0.02
	(1.24)		(0.59)
COVID-19 x USD x CNAV		-0.09**	-0.09**
		(-2.42)	(-2.26)
adj. R2	.0325	.03506	.0341
Obs.	2,936	2,936	2,936
Controls	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes
Time x USD FE	Yes	Yes	Yes
Time x CNAV FE	Yes	Yes	Yes

Internet Appendix

A   Fund Classification

Morningstar does not provide a classification of CNAV and VNAV funds. Therefore, we classify funds based on available information according to the procedure outlined below:

1. Morningstar Category: Distinction between *Standard* and *Short-Term* money market funds. *Standard* money market funds have to value their assets mark-to-market, i.e. we label the following categories as Prime VNAV funds: EAA Fund EUR Money Market, EAA Fund GBP Money Market, EAA Fund USD Money Market. The remaining short-term money market funds include public debt, prime CNAV funds, and prime VNAV funds. We gather additional information to distinguish between these three types of funds as described next.

2. CNAV funds are based in Luxembourg and Ireland (ESRB, 2012). Hence, we label all funds remaining after step 1 which are domiciled in countries other than Luxembourg or Ireland as Prime VNAV funds (mostly French funds).

3. For the remaining funds, we consider fund names and label the funds (if possible) as prime VNAV funds if the name contains "VNAV", as public debt CNAV funds if the name contains "CNAV", and as prime CNAV funds if the name contains "LVNAV" (assuming that prime CNAV funds converted to LVNAV under the 2017 EU MMF Regulation). Moreover, we label a fund as a public debt CNAV if the fund name contains one of the following terms: Treasury, Govt Secs, Gov Liq, Gilt, Treas Secs, Sovereign.

4. For the remaining funds, we consider data on daily NAVs and label a fund as Prime CNAV if the NAV stays constant within a month for more than 50% of months within our sample period.

5. For the remaining funds, we label a fund as Prime CNAV if it is denominated in USD and as Prime VNAV if it is denominated in EUR. Anecdotal evidence suggests that most non-Euro funds based in Luxembourg or Ireland are CNAV funds.

B   Additional Figures and Tables

Figure IA.1: Cumulative Cross-Border Flows – Within- versus Across-Families

The figure displays the quarterly cumulative flows of the MMFs domiciled in the euro area separately for the different NAV types. The solid lines show the respective total cumulative flows, whereas the dashed lines depict the respective contribution of foreign investors. The top panel shows cumulative within-family cross-border flows in fund families with both US- and euro area-based prime funds. The bottom panel shows across-family cross-border flows in fund families with no US-based prime. The two vertical dashed lines represent the announcement and implementation month of the US MMF reform, respectively. funds.

(a) Within-family (families with both US-based and Euro Area-based prime funds)
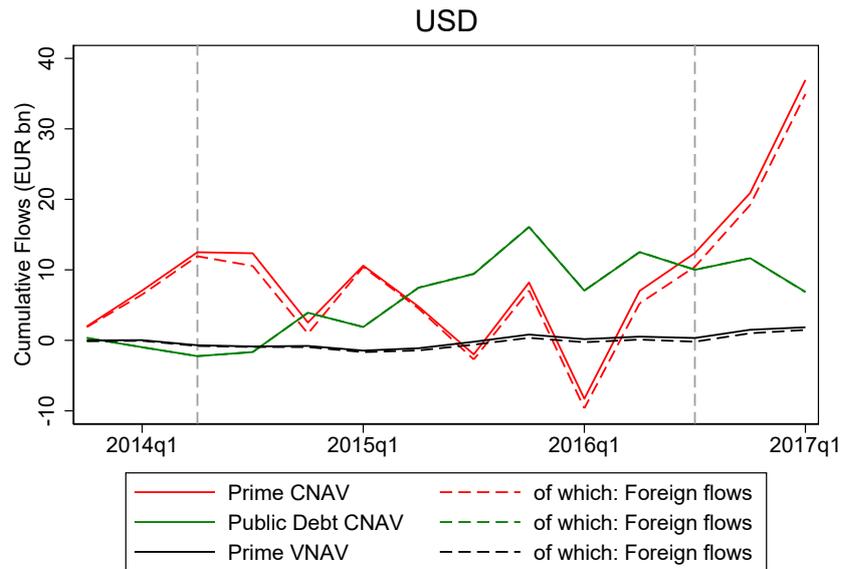
(b) Across-family (families without US-based prime funds)

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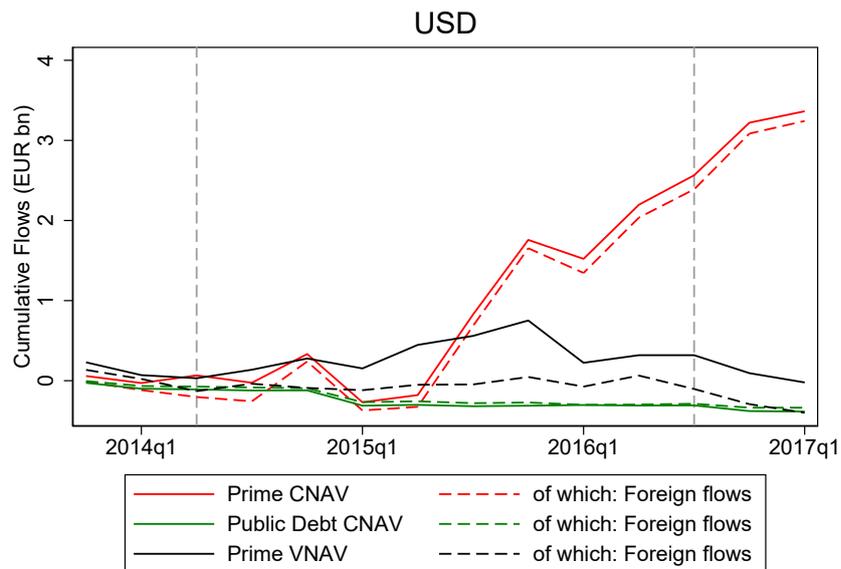
Table IA.1: Additional Summary Statistics – CNAV

The table shows the summary statistics of the main variables used in the empirical analysis (as described in Table 1) for prime institutional funds that operate under a constant NAV and all remaining institutional funds. The sample includes euro area-based institutional MMFs denominated in either USD or EUR. Variables are winsorized at the 1% and 99% levels.

	Prime CNAV= 0				Prime CNAV=1			
	Mean	Std. Dev.	P50	Num. Of Obs.	Mean	Std. Dev.	P50	Num. Of Obs.
Flows	-0.003	0.1	-0.01	3,723	0.005	0.111	-0.002	1,379
Fund TNA	2.095	4.898	0.578	3,723	6.617	9.745	2.821	1,379
Family TNA	23.413	36.434	4.491	3,723	31.957	33.237	24.818	1,379
USD	0.239	0.426	0	3,723	0.632	0.482	1	1,379
CNAV	0.117	0.321	0	3,723	1	0	1	1,379
Post	0.343	0.475	0	3,723	0.348	0.477	0	1,379
Controls:								
log(Fund TNA(t-1))	20.256	1.531	20.176	3,723	21.35	1.972	21.76	1,379
log(Family TNA(t-1))	22.27	2.11	22.222	3,723	23.231	1.831	23.935	1,379
Flows(t-1)	-0.003	0.099	-0.01	3,723	0.006	0.11	-0.001	1,379
Std. Dev. Flows(t-1)	0.116	0.204	0.079	3,723	0.161	0.316	0.084	1,379
Expense Ratio(t-1)	0.196	0.113	0.178	3,723	0.193	0.123	0.166	1,379
Age(t-1)	15.013	7.973	14.917	3,723	13.716	7.525	14.833	1,379
Fund portfolio holdings:								
Holdings: Cash	0.384	0.309	0.347	2,242	0.727	0.235	0.787	883
Holdings: Corporate Non-Financials	0.102	0.108	0.067	2,242	0.042	0.071	0.011	883
Holdings: Banks	0.166	0.168	0.109	2,242	0.062	0.086	0.024	883
Holdings: Government	0.129	0.248	0.027	2,242	0.097	0.156	0.038	883
Holdings Risk	-0.244	0.525	-0.296	2,242	-0.72	0.297	-0.848	883
Portfolio Maturity	0.129	0.154	0.074	2,242	0.034	0.05	0.012	883
Spread	0.132	0.418	0.183	2,242	0.151	0.36	0.201	883
Spread Squared	0.192	0.288	0.081	2,242	0.152	0.22	0.056	883

Table IA.2: Fund Flows – MMF Reform (Announcement/Implementation)

The table shows coefficient estimates of regression Eq. (3) for the period Jan. 2013 until May 2017. The sample includes euro area-based USD and EUR institutional MMFs. The control group consists of institutional prime VNAV funds. The dependent variable is monthly fund flows as defined in Eq. (1) of each fund f in month t. Rather than using the *Post* dummy, here we include two dummy variables that capture the announcement and the implementation periods of the US reform. *Announcement* is a dummy variable taking the value of 1 between July 2014 and September 2016 and 0 otherwise. *Implementation* is a dummy variable taking the value of 1 from October 2016 onwards. These are interacted with the variable *USD*, which identifies funds with a USD focus, and with *CNAV*, which identifies CNAV funds. All monthly control variables are lagged by one month and include the natural logarithm of fund size and fund family size, fund flow volatility (past 12 month), expense ratio, fund age (in years), and fund flows. All specifications include time x USD and time x CNAV fixed effects. Standard errors are HACSC robust from Driscoll and Kraay (1998) with 5 lags and the corresponding t-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) All	(2) Prime	(3) Prime	(4) Prime
Announcement x USD	0.0075	0.0063	0.0038	
	(1.03)	(0.97)	(0.60)	
Announcement x CNAV			-0.0147	
			(-0.84)	
Announcement x USD x CNAV			0.0158	0.0147
			(1.06)	(0.97)
Implementation x USD	0.0137**	0.0136*	-0.0116	
	(2.02)	(1.78)	(-1.30)	
Implementation x CNAV			-0.0160	
			(-0.76)	
Implementation x USD x CNAV			0.0552***	0.0532***
			(3.20)	(2.93)
adj. R2	.01472	.01374	.01469	.01444
Obs	5102	4667	4667	4667
Fund controls	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	-
Time x USD FE	No	No	No	Yes
Time x CNAV FE	No	No	No	Yes

Table IA.3: Fund Flows - SHS Ownership Data

The table shows coefficient estimates of regression Eq. (3) for the period 2013q4 until 2017q1. The sample includes euro area-based USD and EUR institutional prime MMFs. The control group consists of institutional prime VNAV funds. The dependent variables are quarterly fund flows as defined in Eq. (2) of each fund f held by holding sector h in quarter q. Column (1) shows estimates for total flows across all investor groups, column (2) for foreign investors, column (3) for non-bank financial intermediaries, column (4) for non-financial corporations, column (5) for monetary financial institutions, and column (6) for all other euro area-based investors as the dependent variable. *Post* is a dummy variable taking the value of 1 after October 2015 and 0 otherwise. *USD* is a dummy variable which identifies funds with a US investment focus. *CNAV* is a dummy variable that takes the value of one for CNAV funds. All quarterly control variables are lagged by one quarter and include the natural logarithm of fund size and fund family size, fund flows, fund flow volatility (past 12 month), expense ratio, fund age (in years). Fund fixed effects, time x USD, and time x CNAV fixed effects are included. Standard errors are HACSC robust from Driscoll and Kraay (1998) with 5 lags and corresponding t-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Total	(2) Foreign	(3) NBFIs	(4) NFCs	(5) MFIs	(6) Others
Post x USD x CNAV	0.10**	0.05*	0.01	-0.01	0.00	0.02
	(2.28)	(1.97)	(0.62)	(-1.47)	(1.01)	(1.57)
adj. R2	.0343	.0435	.0105	.1164	.0388	.0467
Obs.	1069	1053	852	728	694	932
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time x USD FE	Yes	Yes	Yes	Yes	Yes	Yes
Time x CNAV FE	Yes	Yes	Yes	Yes	Yes	Yes