Regulatory constraints for Money Market Funds: The Impossible Trinity

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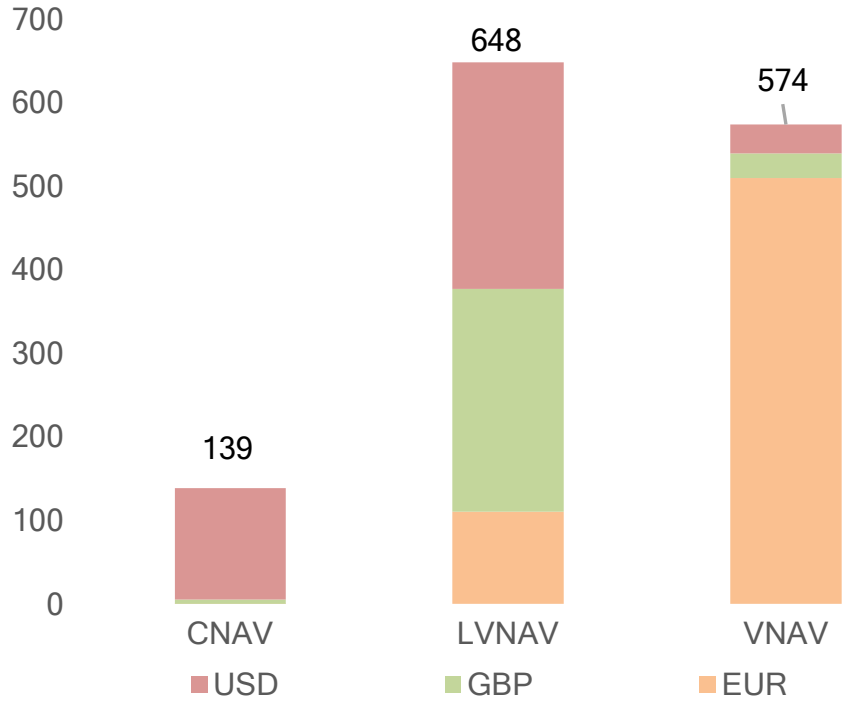
1. Motivation
2. Model
3. Calibration and first insights
4. Assessment of regulatory reforms

EU MMFs: an overview

- MMFs are key intermediaries in short-term funding markets
  - Funding to banks, including in non-EU currencies (USD, GBP)
  - Cash management vehicle for institutional investors
- Mainly private debt, foreign currency, constant NAV
- Low Volatility Net Asset Value (LVNAV)
  - Provide stable NAV (with a 20bps collar) and subject to 30% WLA (and 10% daily liquid asset requirement); fees and gates
  - Account for ~50% of EU MMFs assets (EUR 650bn), mainly in foreign currencies (USD and GBP)

EU MMF assets by types



Note: Net Asset Value of EU MMFs by regulatory types, in EUR bn, as of Dec. 2020.
Sources: AMF, CBoI, CSSF and ESRB.

Recent work on MMF vulnerabilities

MMF vulnerabilities

- Bouveret et al. (2022): Global historical perspective on MMF vulnerabilities incl. asset liquidity and liquidity transformation
- Bouveret and Danieli (2021): Risks related to portfolio similarity and market liquidity

Redemptions and weekly liquid assets

- Li et al. (2021): US prime MMFs with low WLAs had larger outflows
- Dunne and Giulana (2021): Similar results as Li et al. for EU LVNAVs

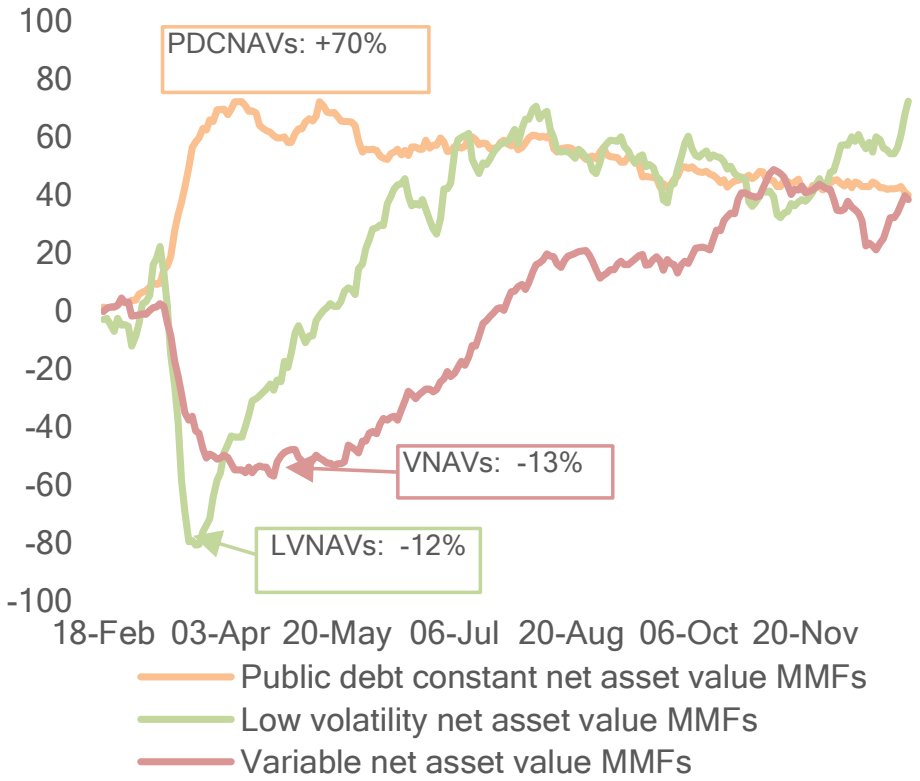
Investor outflows

- Cipriani and La Spada (2020): US institutional investors redeemed more
- Avalos and Xia (2021): Outflows from institutional investors high irrespective of weekly liquid assets

Stress in the money market fund sector

- Despite substantial regulatory reforms, private debt MMFs faced severe stress in March 2020, :
  - Massive redemptions (liability side)
  - Lack of liquidity and inability to sell assets (asset side)

EU MMF net flows by types

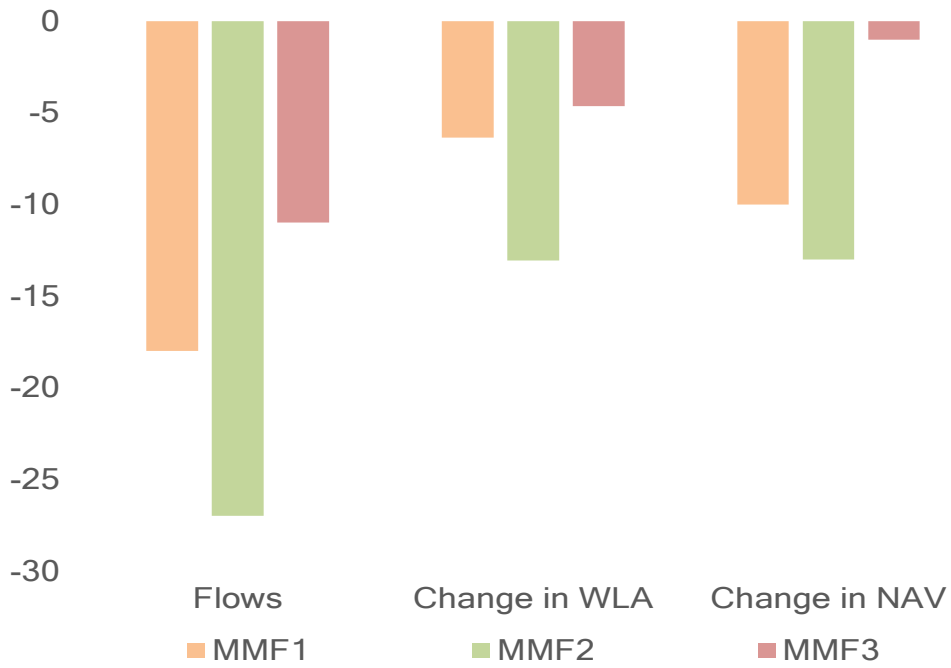


Note: Cumulated net flows in EUR bn since 18 Feb. 2020.
Sources: AMF, CBI, CSSF and ESRB.

Liquidation trade-offs for LVNAVs

- LVNAVs faced challenges to meet redemptions:
  - sell liquid assets (but risk of breaching WLAs) or sell less liquid assets (but risk of breaching NAV collar

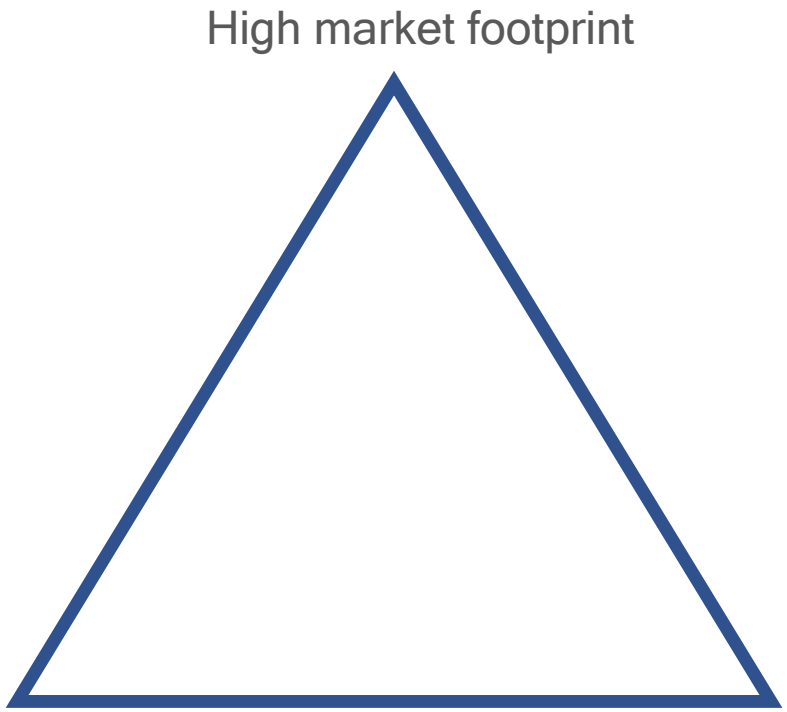
Flows and changes in WLA and NAV



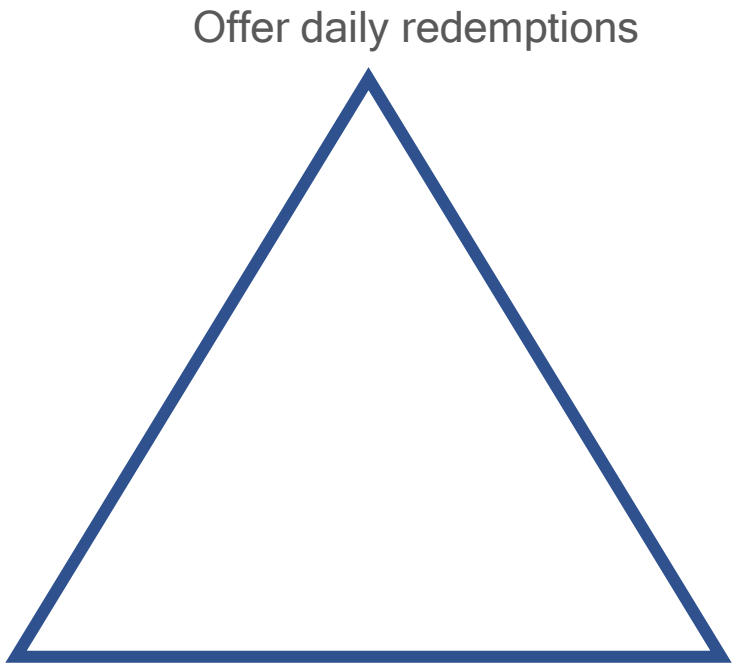
Note: 7D net flows in % of assets and weekly change in WLA (in pp) and NAV deviation (in bps) as of 25 March 2020.
Source: Crane.

Vulnerabilities in private debt MMFs

VNAVs and LVNAVs



LVNAVs



How to make MMFs more resilient?

- Resilience: Ability to meet redemptions while complying with regulations
- Consider resilience as an optimization problem
  - Maximum amounts of redemptions a fund can face subject to regulatory (and feasibility) constraints: R_{max}
  - R_{max} is a function of parameters (regulatory constraints, liquidity of underlying markets and behavioral factors)
- Main takeaways
  - Closed-form solution to the optimization problem
  - Estimate impact of regulatory reforms on R_{max}
  - Removal of stable NAV and countercyclical liquidity buffers have the largest impact on the resilience of MMFs

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A simplified model for intuition

We assume that the MMF invests in two asset classes: WLA (W) and non-WLA (Y), each of them with a constant price impact represented by a liquidity discount factor (c_W and c_Y, with $1 \geq c_W \geq c_Y$)

We can then optimize R_{max}

$$R_{max}(p_W, \nu) = \max \underbrace{(c_W T_W + c_Y T_Y)}_{Cash\ raised\ by\ sales}$$

s.t.

$$(1 - p_W)T_W - p_W T_Y \leq (1 - p_W)T_{W,max} - p_W T_{Y,max}\ \textit{WLA req. } (p_W = 30\%)$$

$$(1 + \nu - c_W)T_W + (1 + \nu - c_Y)T_Y \leq \nu\left(T_{W,max} + T_{Y,max}\right)\ \textit{NAV collar req. } (\nu = 0.002)$$

With T_W the value of WLA sold and $T_{W,max}$ the max value of WLAs that could be sold (and T_Y for non-WLAs).

ed model for intuition

We can then determine the optimal value of R_{max}

$$R_{max}(p_W, \nu) = \frac{(c_w - c_Y)((1-p_W)T_{W,max} - p_W T_{Y,max} + \nu(c_w T_{W,max} + c_Y T_{Y,max})}{1 + \nu - (1-p_W)c_Y - p_W c_W}$$

R_{max} is a positive function of:

- the liquidity of the markets (c_w and c_Y)
- the NAV deviation (ν)
- the initial holdings of WLAs ($T_{.,max}$)

- a negative function of liquidity requirements (p_W)

We get the optimal sales of WLA and non WLA

$$T_W^* = \frac{(1-c_Y)((1-p_W)T_{W,max} - p_W T_{Y,max}) + \nu T_{W,max}}{1 + \nu - (1-p_W)c_Y - p_W c_W}$$

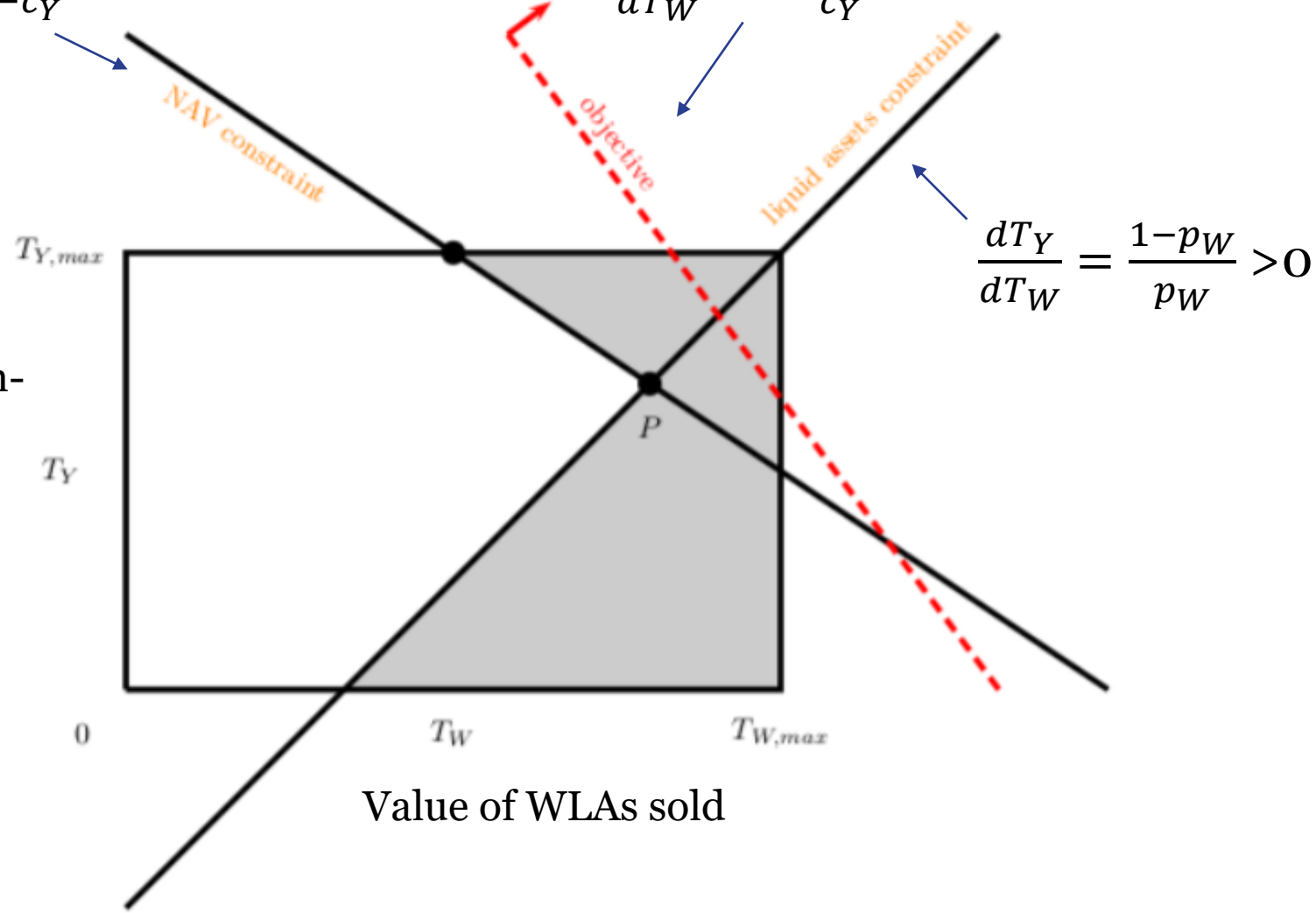
$$T_Y^* = \frac{(c_W - 1)((1-p_W)T_{W,max} - p_W T_{Y,max}) + \nu T_{Y,max}}{1 + \nu - (1-p_W)c_Y - p_W c_W}$$

al representation

$$\frac{dT_Y}{dT_W} = -\frac{1+\nu-c_W}{1+\nu-c_Y} < 0$$

$$\frac{dT_Y}{dT_W} = -\frac{c_W}{c_Y} < -1$$

$$\frac{dT_Y}{dT_W} = \frac{1-p_W}{p_W} > 0$$



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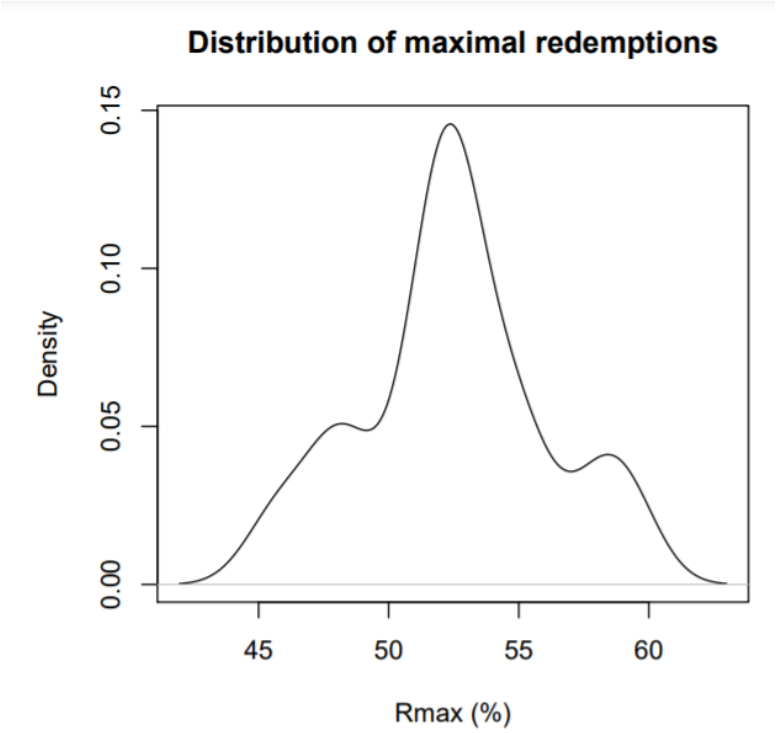
Data used

- MMFs:
  - Sample of 14 USD LVNAVs USD 280bn (possible to apply to US Prime retail)
  - Full portfolio holdings as of February 2020 (Crane data)
- Price impact:
  - Liquidity discount factors taken from 2020 ESMA MMF Stress Test Guidelines
  - Estimation based on corporate bonds with short residual maturity (not CP/CDs)
  - Stylized two asset model: $c_W = 0.998$ and $c_Y = 0.995$
  - Annex discusses calibration of liquidity discounts

Resilience across MMFs

- R_{max} ranges between 40% and 65% of NAV, driven mainly by initial holdings of WLAs
- High portfolio overlap across MMFs: liquidation costs likely to be underestimated



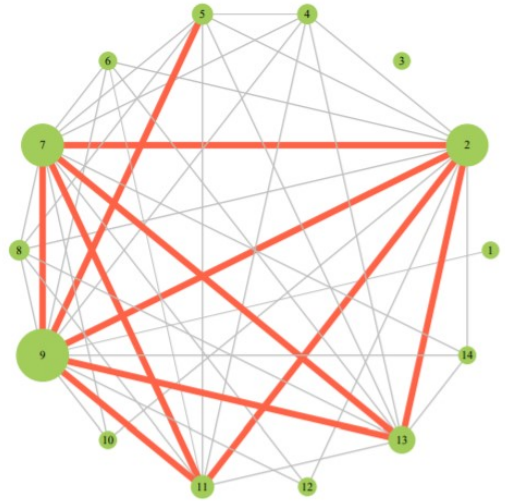


Figure 4: Five out of the fourteen MMFs in our sample hold very similar portfolio holdings and are thus potentially exposed to mark-to-market losses generated by the price impact of each others' distressed sales.

System-wide stress test

- Assume 20% outflows for all LVNAVs (~USD 55bn)
- Vertical slicing: each fund sells WLA and non-WLAs in proportion

$$T_W^* = \frac{R}{c_W} \cdot \frac{T_{W,max}}{(T_{W,max} + T_{Y,max})} \qquad T_Y^* = \frac{R}{c_Y} \cdot \frac{T_{Y,max}}{(T_{W,max} + T_{Y,max})}$$

- Liquidation:
  - Repo and deposits: 11.6bn
  - Weekly CP and CDs: 11bn
  - Non-WLA CP and CDs: 27bn
  - Other instruments: 5bn
- NAV deviation would increase by 14bps (<20bps collar)
- PWG (2020): Reduction in CP exposures by USD35bn

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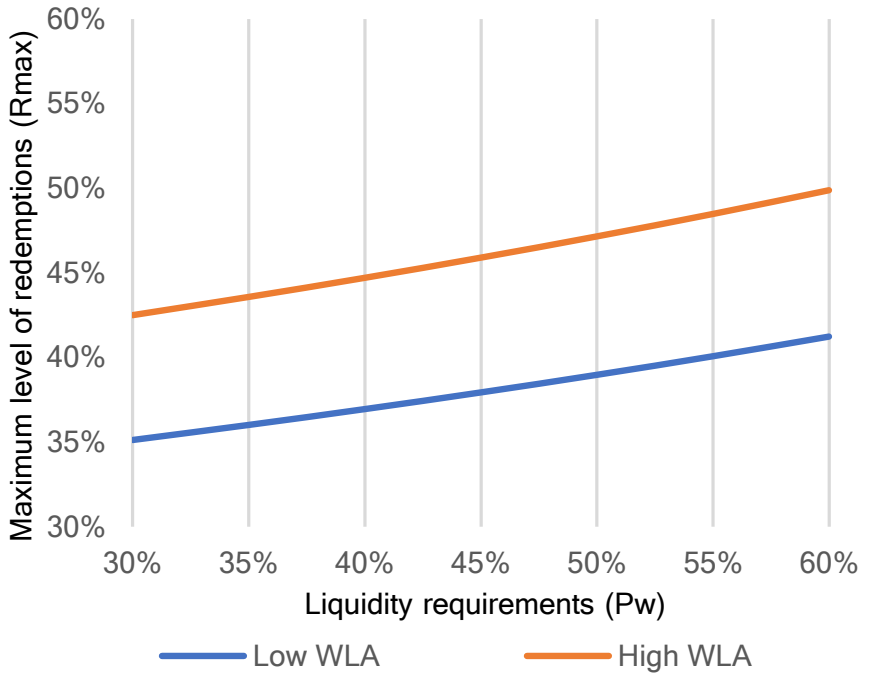
Framework

- Two MMFs: low (WLA=35%, R_{max}=35%) and high WLAs (WLA=50%, R_{max}=42%)
- Different reforms
- Higher liquidity requirements:
  - Increase levels of WLA
  - Change composition of WLAs
- Change NAV deviation
- Countercyclical liquidity buffers (discretionary/subject to Macropru authority decision, delinking of fees and gates)
- Combination of options

Higher liquidity requirements

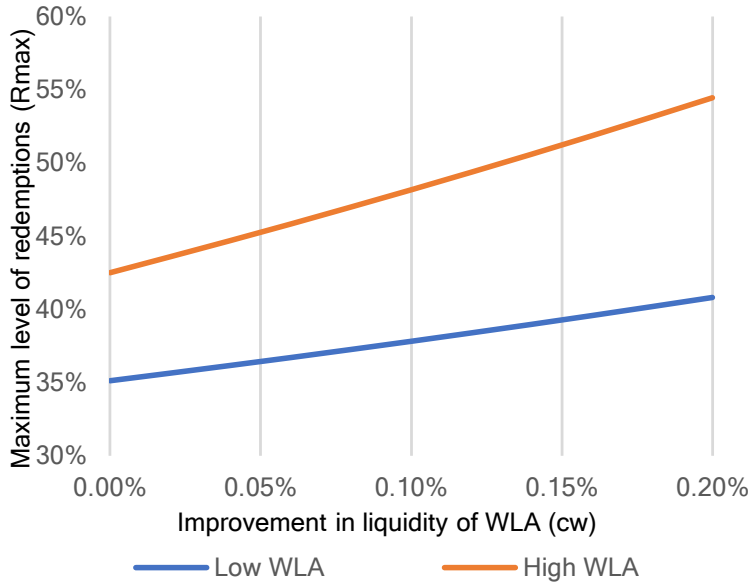
- Increase p_W and $T_{W,max}$ by same amount
- Relatively low impact: +10pp WLA increases R_{max} by only 2pp



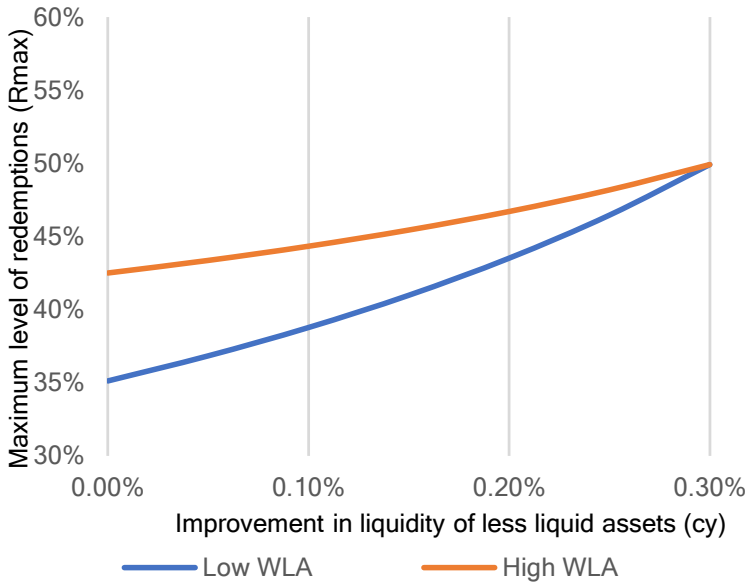
Note: Maximum level of redemptions for a LVNAV MMF as a function of weekly liquid assets requirements.

Require more liquid assets in WLA

- Equivalent to improvement in market liquidity, market support or minimum sov. debt holdings (assuming higher liquidity)
- Different impact: +0.1% in liquidity discount leads to +3pp for low WLA MMF and +5pp for high WLA
- Opposite for improvements in non-WLA assets: +4pp for low WLA and +1.5pp for high WLA MMF



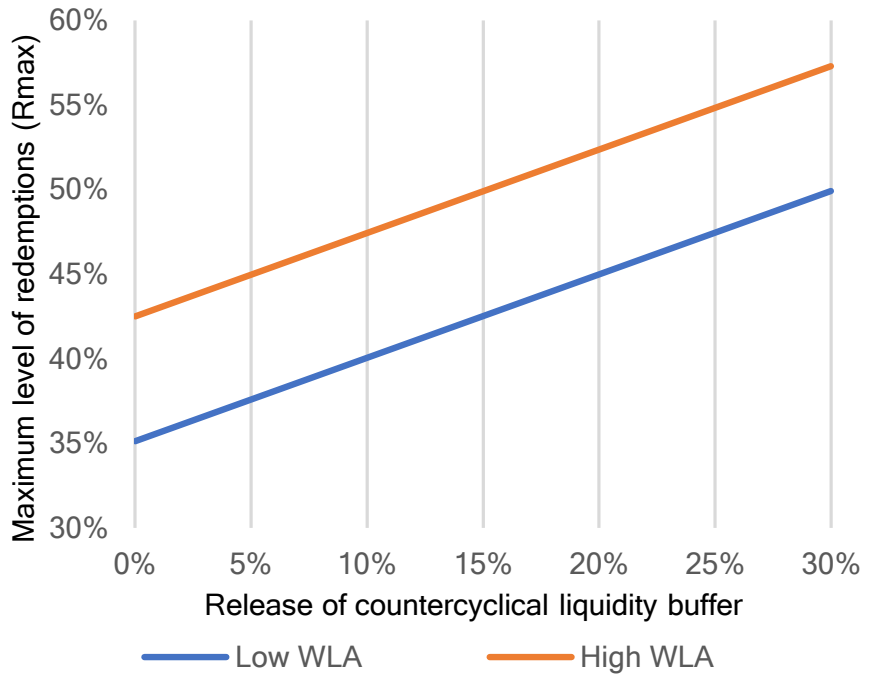
Note: Maximum level of redemptions for a LVNAV MMF as a function of the liquidity discount factor of WLAs



Note: Maximum level of redemptions for a LVNAV MMF as a function of the liquidity discount factor of non-WLAs

Countercyclical liquidity buffers

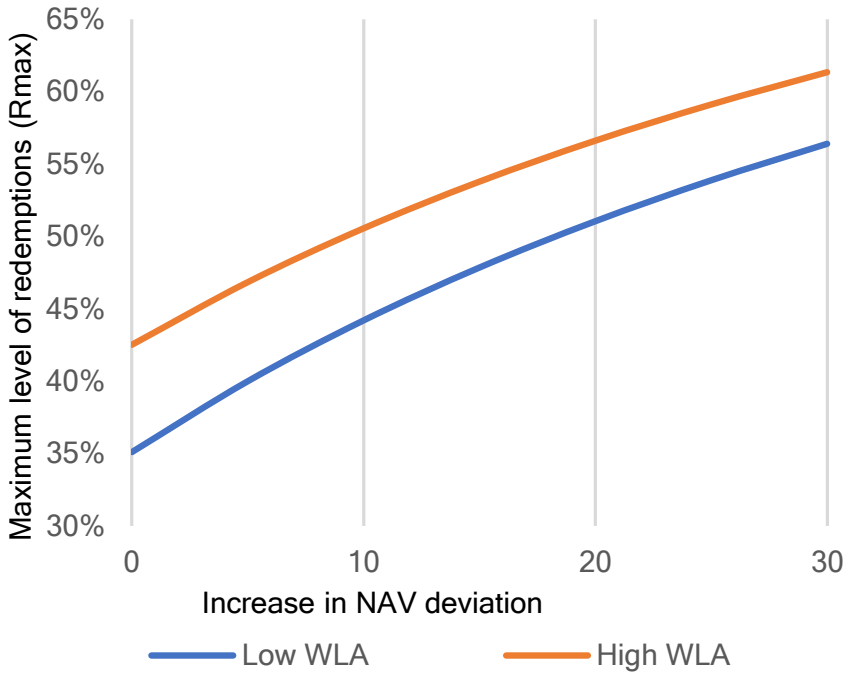
- Increase WLA requirements and then release them (increase $T_{W,max}$)
- Relatively high impact: +10pp CCLB increases R_{max} by 5pp



Note: Maximum level of redemptions for a LVNAV MMF as a function of the countercyclical liquidity buffer.

Increase NAV deviation

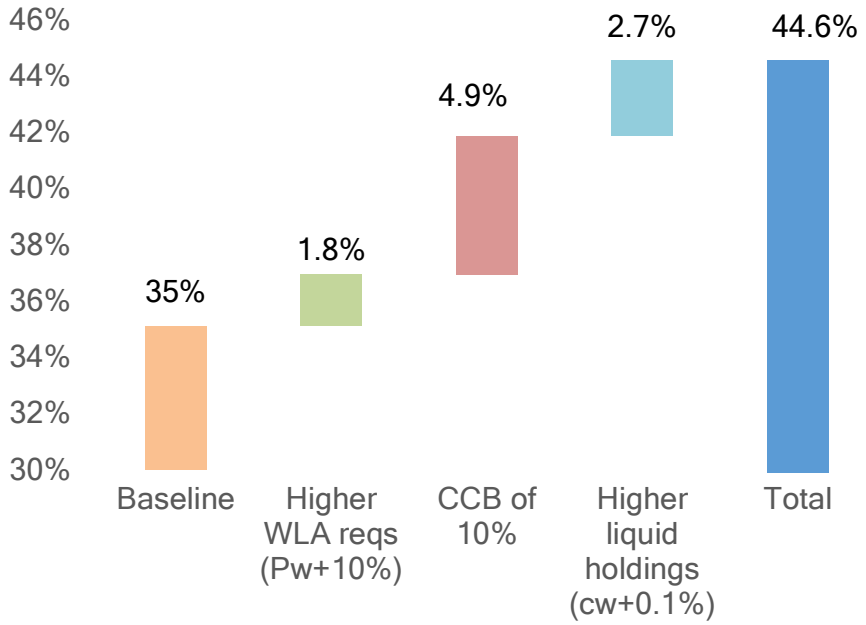
- Mechanically relaxes the NAV constraint
- Very high impact: Move NAV collar from 20 to 30bp increases R_{max} by 8pp. $\lim_{\nu \to \infty} R_{max}(p_W, \nu) = c_W T_W + c_Y T_Y$ (VNAV)
- Given side effects of larger NAV deviations, floating NAV as main option



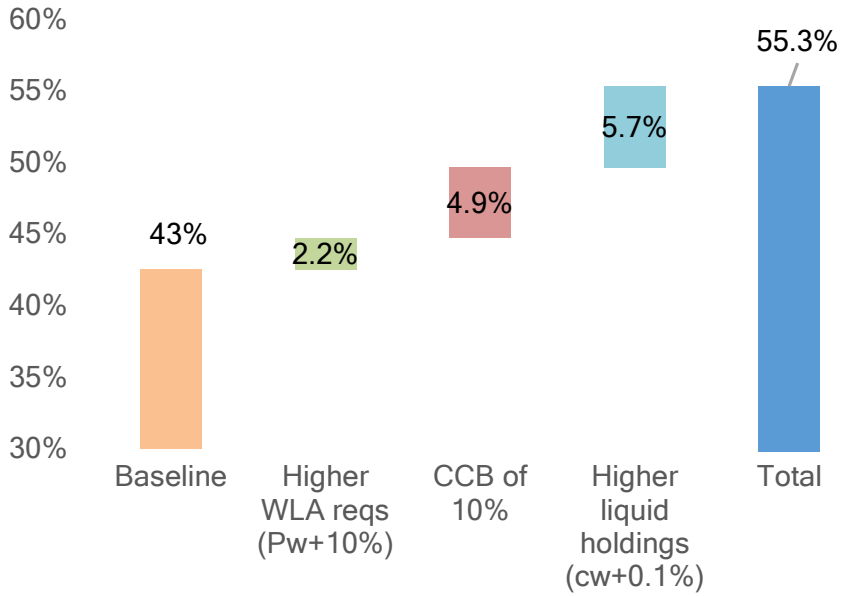
Note: Maximum level of redemptions for a LVNAV MMF as a function of the increase in the NAV collar (in bps).

Combination of options

- 10pp increase in WLA, 10pp CCLB and higher liquid holdings
- Increase R_{max} by 9pp (low WLA) and 12pp (high WLA)



Note: Maxmimum levels of redemptions for a 'low WLA' LVNAV MMF after a ccombination of reforms.



Note: Maxmimum levels of redemptions for a 'high WLA' LVNAV MMF after a ccombination of reforms.

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Improving the resilience of LVNAVs

- Method: Propose a model to estimate the resilience of individual MMFs based on portfolio holdings and market parameter
- Uses: Risk analysis, stress testing (reverse ST, system-wide ST) and supervision
- Assessment of regulatory reforms
  - Reforming stable NAV has the largest impact…
  - Followed by improvements in the liquidity of assets…
  - and introduction of a countercyclical liquidity buffer
  - Increasing WLAs has a small impact

Additional slides

EU MMFs: an overview

- EU Money Market Fund Regulation (MMFR) entered into force in July 2018
- No harmonized framework before MMFR
- 1980s: launch of MMFs in France (regulatory arbitrage)
- Early 1990s: MMF ratings as pre-requisite in IE, development in LU
- Mid-2000s: development of enhanced MMFs (investments in ABCP, CDOs etc.)
- 2007-2008 GFC: suspension of redemptions, sponsor support etc.

EU MMFs: an overview

- Main provisions of MMFR
  - Extensive reporting requirements
  - Prohibition of sponsor support
  - Internal credit risk assessment
  - Liquidity requirements
  - Stress test requirements (run yearly by ESMA)
  - New types of MMFs
  - Scope: apply to any type of fund irrespective of regulatory framework (incl. UCITS~mutual funds and AIFs~'Private Funds')

EU MMFs: an overview

- Different types of MMFs:
  - Standard MMFs (VNAVs): longer maturity (WAM: 180d/WAL: 365d), floating NAV (~US ultra short bond funds); 15% WLA, 7.5% DLA
  - Short-term MMFs (WAM: 60d/WAL: 120 days):
    - Public debt CNAV: 30% WLA, 10%DLA, fees and gates, 99.5% invested in public debt, constant NAV
    - Low Volatility Net Asset Value (LVNAV): 30% WLA, 10% DLA, fees and gates, private debt, constant NAV with 20bps collar (above redemptions at floating NAV). Govies with maturity<190days included in WLA (up to 15pp)
    - Variable Net Asset Value (VNAV): 15% WLA, 7.5% DLA, no fees and gates, floating NAV

Vulnerabilities relate to market liquidity are not new!

- Amortised cost:
  - "*The Commission is concerned that the use of the amortized cost method… may result in overvaluation or undervaluation of the portfolios of [MMFs]… [so that] investors purchasing or redeeming shares could pay or receive more or less than the actual value of their proportionate shares of the funds' current net assets. The effect of such sales or redemptions may therefore result in inappropriate dilution of the assets and returns of existing shareholders*" (SEC, 1977).
- Liquidity of CP and CD markets:
  - "*Market quotations are not readily available for many money market instruments in these funds' portfolios because they are generally held to maturity, thereby eliminating a meaningful secondary market*" (SEC,1975).

Resilience as a liquidation problem

Initial value of portfolio holdings: $V_t = \sum_{i=0}^{N} a_i$

MMF sells a portion γ_i and receives $\underbrace{a_i\gamma_i}_{Book\ value\ of\ sales} \times \underbrace{\psi_i(a_i\gamma_i)}_{Price\ impact}$

Portfolio book value after asset sales $\mathrm{V}(\gamma) = \sum_{i=0}^{N} a_i(1-\gamma_i)$

Constraints:

1. WLAs ($V^W(\gamma)$) above 30%: $V^W(\gamma) \geq p_W \mathrm{V}(\gamma)$
2. MTM NAV must be below 20 bps of the constant NAV

The change in MTM NAV is determined by the cost of sales ψ :

$$\underbrace{\sum_{i=0}^{N} a_i\gamma_i(1-\psi_i(a_i\gamma_i))}_{Amortised\ value\ of\ assets\ sold\ less\ actual\ value} \leq \nu \underbrace{\sum_{i=0}^{N} a_i(1-\gamma_i)}_{Amortised\ cost\ value}$$

3. Sales cover redemptions: $\sum_{i=0}^{N} a_i\gamma_i\psi_i(a_i\gamma_i) \geq R$

Resilience as a liquidation problem

The optimization problem can be written as minimizing the difference between the pre and post-sale value of the MMF:

$$\mathrm{L}(p_W, \nu, R) = min \sum_{i=0}^{N} a_i - \mathrm{V}(\gamma)$$

s.t.

$$V^W(\gamma) \geq p_W \mathrm{V}(\gamma)$$

$$\frac{\sum_{i=0}^{N} a_i \gamma_i (1 - \psi_i(a_i \gamma_i))}{\sum_{i=0}^{N} a_i (1 - \gamma_i)} \leq \nu$$

$$\sum_{i=0}^{N} a_i \gamma_i \psi_i(a_i \gamma_i) \geq R$$

Or equivalently we optimize the value of the post-sale portfolio:

$$\sum_{i=0}^{N} a_i - \mathrm{L}(p_W, \nu, R) = max \mathrm{V}(\gamma)$$

Sensitivity analysis

- Two asset case for a 'low WLA' MMF (WLA=35%)
  - A 10pp increase in WLA requirements would reduce R_{max} by 3.1%
  - A 10 bp increase in the NAV deviation would increase R_{max} by close to 11%
  - A 0.1% increase in the liquidity of WLAs would increase R_{max} by 2.5%
  - A 10pp increase in liquid holdings would raise R_{max} by close to 5%

$$\frac{\partial R_{max}}{\partial p_W} = (c_Y - c_W)(1+\nu)\frac{((1-c_W)T_{W,max} + (1-c_Y)T_{Y,max})}{(1+\nu-c_Y+p_W(c_Y-c_W))^2} \leq 0$$

$$\frac{\partial R_{max}}{\partial \nu} = (c_Y + (c_W - c_Y)\,p_W)\frac{((1-c_W)T_{W,max} + (1-c_Y)T_{Y,max})}{(1+\nu-c_Y+p_W(c_Y-c_W))^2} > 0$$

$$\frac{\partial R_{max}}{\partial T_{W,max}} = \frac{(c_W - c_Y)(1-p_W) + \nu c_W}{1+\nu-(1-p_W)c_Y - p_W c_W}$$

$$\frac{\partial R_{max}}{\partial c_W} = (1+\nu)\cdot\frac{\nu T_{W,max} + (1-c_Y)\left((1-p_W)T_{W,max} - p_W T_{Y,max}\right)}{(1+\nu-c_Y+p_W(c_Y-c_W))^2} > 0$$

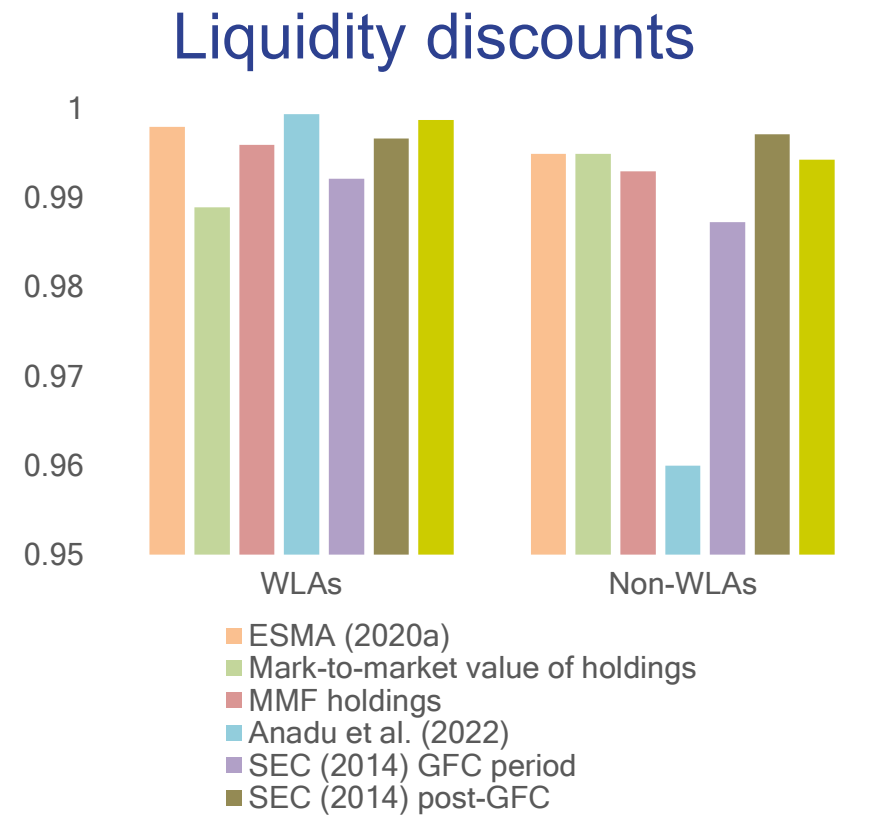
$$\frac{\partial R_{max}}{\partial p_W} = -0.31$$

$$\frac{\partial R_{max}}{\partial \nu} = 105.72$$

$$\frac{\partial R_{max}}{\partial c_W} = 25.58$$

Measuring liquidation costs of short-term instruments

- Price impact:
  - Baseline approach: ESMA ST parameters
  - Change in MtM value of holdings (as proxy for liquidity risk)
  - Change in MMF holdings, WLA and NAV deviation
  - Short-term ETF NAV discounts (Anadu et al., 2022)
  - Trading costs of bonds with short residual maturity (SEC, 2014)
- Results are quite similar



Note: Liquidity discounts on WLAs and non-WLAs.
Sources: Fidelity (2013), SEC (2014), ESMA (2020a), Anadu et al. (2022)

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