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Peter Dunne, Angelica Ghiselli, Frits Ledoux & Barra McCarthy

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Peter Dunne, Angelica Ghiselli, Frederik Ledoux, Barra McCarthy*

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Abstract

Over September-October 2022, the UK government bond (gilt) market experienced a severe disruption, as selling pressures amplified yield increases. At the centre of this dynamic were liability driven investment (LDI) funds, a product designed to manage interest rate and inflation risk for defined benefit UK pension funds. This *Note* details how sterling (GBP) denominated Irish-resident LDI funds, which have a significant footprint in the gilt market, were affected by, and contributed to, gilt market disruption over the period. Funds saw substantial declines in the value of their assets, which – in the presence of substantial leverage – posed a significant risk to funds' survival. Due to their use of leverage, funds faced modest demands for cash from margin calls, while collateral calls that could be met with securities were more substantial. Gilt sales by Irish-resident funds accounted for 30 per cent (£11 billion) of net sales by all LDI entities over the crisis period, but these funds raised more cash from investor subscriptions than gilt sales. LDI fund resilience has improved since the crisis, supported by supervisory interventions by the Central Bank of Ireland and other European authorities.

1 Introduction

In September 2022 there was a significant rise in UK government bond (gilt) yields, with particular volatility following the announcement of the UK Government's "mini–budget". Gilt yields were already increasing at a steady pace prior to this, as rising inflation and inflation expectations were accompanied by several interest rate increases by the Bank of England during 2022. However, on 23 September gilt yields rose sharply following the announcement of the new UK Government's "mini-budget", which outlined a number of economic policies and tax cuts. By 27 September, gilt yields had seen weekly increases in excess of 100 basis points (bps) across a range of maturities (see Chart 1 for a historical comparison of maximum weekly yield changes).

This significant and sudden increase in gilt yields was exacerbated by the sales of gilts by Liability Driven Investment (LDI) strategies – a type of investment strategy used by UK defined benefit pension schemes to hedge the effects of interest rate changes and inflation on the current value of their liabilities.[1] Through their investments in gilts and their use of derivatives (primarily swaps) and

*International Finance Division. barra.mccarthy@centralbank.ie. We thank Max O'Sullivan, Naoise Metadjer, Kitty Moloney, Neill Killeen, Cian Murphy, Fergal McCann, Mark Cassidy, Vasileios Madouros, Rosemary Hanna, James Leen, Philip Gaffney, Des Bodley and Brian Golden for helpful comments on earlier drafts. All views expressed in this *Note* are those of the authors alone and do not represent the views of the Central Bank of Ireland.

[1] Inflation risk hedging is not dealt with in detail in this *Note* as it was not the primary source of stress for LDI funds during the gilt market crisis. However, it is a key part of what is offered by the LDI product, and is hedged for using inflation swaps and index-linked gilts.

repurchase agreements (repos), LDI funds experienced shocks of varying intensity to the value of their assets (and, through that, the value of investors' equity), and to their liquidity.[2] As explained in the next section, these sharp increases in yields forced LDI funds to reduce leverage through a combination of requesting additional capital from investors and selling assets. This created the conditions for an amplification of selling pressure in the gilt market, with some LDI funds starting to sell gilts at distressed prices. Given the speed of developments and the potential for delays in the recapitalisation of LDI funds, there was an increased likelihood that more LDI funds would be forced to sell gilts, which could lead to a further fall in prices.

In order to give time for orderly recapitalisation, and against the backdrop of a lack of market liquidity on the buy-side and evidence of spill-overs to mortgage markets (Dunkley, Venkataramakrishnan, & Hammond, 2022), the Bank of England announced a temporary and targeted intervention in the gilt market on 28 September, running to 14 October. The programme was a financial stability intervention designed to address potential dysfunction in the gilt market. This intervention would see the Bank of England purchase up to £5 billion worth of gilts per day – increased to £10 billion on 10 October. Initially covering fixed-coupon gilts, it was extended to inflation index-linked gilts on 11 October.

A large share of GBP denominated LDI funds are located in Ireland. Industry estimates of assets under management (AuM) are not published, but the Investment Association (2022) estimates the UK LDI industry hedges £1.6 trillion of the notional value of defined benefit pension fund liabilities. Comparing the AuM of GBP denominated Irish-resident LDI funds (approx. £300 billion), this means Irish-domiciled LDI funds account for at least 20 per cent of the industry.[3][4] Within pooled funds (i.e. funds with more than one investor), which were particularly vulnerable to the shock (see Section 3), Irish-domiciled funds represent roughly 60 per cent of the total pooled GBP LDI fund assets.[5] Irish-resident LDI funds own a small but significant share of UK gilts –around 10 per cent of outstanding stock at end-August 2022.

This *Note* examines the characteristics of GBP denominated Irish-resident LDI funds and their role in the gilt market crisis. The *Note* discusses the business models of LDI funds and explains why they are vulnerable to sharp increases in gilt yields. It then describes the liquidity and leverage stress (including the associated risk of a negative net asset value) that LDI funds faced during the crisis period, and how they responded to that stress. The *Note* subsequently explores how significant Irish-resident LDI funds' contribution to the stress was, and concludes by assessing how the resilience of Irish-resident LDI funds has improved since the events of last autumn.

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[2] Interest rate swaps and inflation swaps are not distinguished in the data used in this analysis. Interest rate swaps are a type of derivative allowing the counterparties to swap a fixed interest rate for a flexible interest rate, on a notional principal over an agreed term, where the flexible rate is typically linked to a benchmark daily interest rate such as the Sterling Overnight Index Average (SONIA). With inflation swap contracts, the floating rate payments are linked to the inflation rate. LDI investors usually get exposure to interest rate (inflation) risk by paying the flexible (inflation) rate and receiving the fixed rate. Repurchase agreements (repos) allow the borrowing counterparty to a repo transaction to borrow cash using an asset such as gilts as collateral (reverse repos allow the collateralised lending of cash). The repo involves the borrower of the cash selling the asset to the cash lender with an agreement to repurchase the asset at an agreed price and repay the loan at an agreed future date. In this way the pricing of the repo determines the cost for the cash borrowing which is usually more favourable than the interest cost for unsecured borrowing. Repo also allows LDI funds to leverage positions in gilts as they can plan settlement of gilt purchases to coincide with the receipt of repo funding.

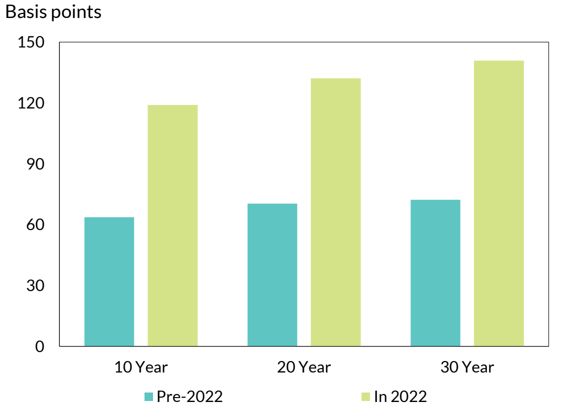
[3] The "notional value of liabilities hedged" is the sum of AuM and notional on derivatives.

[4] In addition, there are a smaller number of euro denominated LDI funds as well. There are a total 27of 31 such funds with assets of around €12 billion at end-2021

[5] See ESRB's EU non-bank financial intermediation monitor 2023 (ESRB, 2023). The pooled LDI industry, that is LDI funds with multiple investors and includes funds domiciled in Ireland and elsewhere, comprised around 10-15 per cent of the total LDI fund industry, i.e. around £200 billion, according to Breeden (2022) at the end of 2021. In EU terms, Ireland is the largest domicile for GBP denominated LDI funds, accounting for an estimated 85 per cent of EU-domiciled GBP denominated LDI funds at end-2021 in NAV terms.

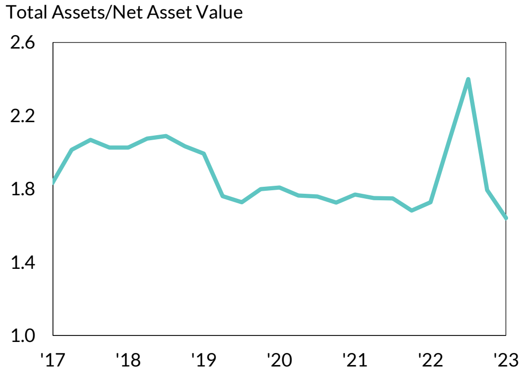
This analysis adds to the growing literature on the gilt market crisis of 2022. The Bank of England published a detailed account of the crisis, covering market liquidity, investor behaviour and price dynamics over September – October 2022 (Pinter, 2023), building on material published in the December 2022 Financial Stability Report (Bank of England, 2022). Pinter (2023) analysis finds that LDI funds' use of repo before the crisis was a predictor of sales during it, that sales were concentrated amongst a narrow group of market participants, and that LDI gilt sales drove market dysfunction and illiquidity. Further descriptive analysis of last year's crisis has recently been published, with additional details on how gilt sales allowed LDI funds to deleverage (Henning et al, 2023). This *Note* instead focuses only on the experience of the Irish-domiciled LDI funds industry.

Chart 1: Maximum weekly changes in gilt yields by maturity, pre and post 2022



Source: Refinitiv-Datastream
Notes: Maximum increases calculated from data covering 1989-2022.

Chart 2: Median On-Balance Sheet Leverage of LDI Funds, 2020- Mar 2023



Source: MMIF Return, Central Bank of Ireland and authors' calculations
Notes: Data covers GBP denominated Irish-resident LDI funds.

2 LDI Funds' Business Models and Associated Vulnerabilities

LDI funds are investment products designed to match the duration risk of defined benefit pension schemes. Defined benefit pension schemes aim to ensure that the value of their assets matches the present value of their liabilities. To achieve this, they seek to invest in assets whose value moves in the same direction as their liabilities when interest rates change. LDI funds provide a product that meets these needs by investing in such assets.

A majority of GBP denominated LDI funds invest in gilts. They do so because pension fund liabilities are discounted with UK gilt yields as per UK pension fund regulation, so as interest rates change the value of gilts and pension liabilities move in tandem.[6] Alternatively, or in combination with their gilt holdings, LDI funds take positions in interest rate swaps (where LDI funds take the short side paying the floating leg) to gain the same kind of exposures to interest rates as available via gilt holdings. LDI funds invariably will be holding gilts, interest rate swaps or some combination of both.[7]

[6] The UK's Occupational Pension Scheme Regulation of 2005 specifies: "The rates of interest used to discount future payments of benefits must be chosen prudently, taking into account either or both, (i) the yield on assets held by the scheme to fund future benefits and the anticipated future investment returns, and (ii) the market redemption yields on government or other high-quality bonds". This regulation produces a direct correlation between the value of gilts and pension fund liabilities with similar maturities and it makes investment in gilts an obvious hedge against discount rate

[7] This is a simplified account of LDI funds. Further detail on them can be found in briefings to UK Parliament (Cunliffe, 2022), the Bank of England's account of the crisis (Pinter, 2023) including the NIESR speech in June

Beyond the assets in which they invest, a key characteristic of LDI strategies is their use of leverage. LDI funds often borrow (leverage) to purchase gilts, using funding from repurchase agreements (a form of short-term loan, also known as repo). This allows pension fund investors to match their pension liabilities with a smaller amount of capital (interest rate swaps also share this quality). This frees-up capital, which pension fund investors can invest in other assets with better returns on average (i.e. growth assets).[8]

The UK 'mini-budget' drove down the value of outstanding gilts, with leverage amplifying the effect of these valuation declines on the net asset value (NAV) of LDI funds (i.e. investors' capital in LDI funds). These valuation declines also directly increase the leverage of LDI funds (the mark-to-market value of total assets relative to NAV). When leverage increases above funds' internal risk thresholds, LDI managers will request that the LDI funds' investors provide more capital so the fund can maintain its leveraged positions (swaps or repos), and reduce funds' leverage. However, if recapitalisations are not expected to arrive when required, or in sufficient quantity, then a NAV going to zero, or below, becomes a significant risk to LDI funds' survival.[9] Given the uncertainty around recapitalisation from their investors, some LDI funds chose to sell assets and deleverage in advance of reaching a negative NAV, crystallising losses on the assets sold as a consequence.

LDI fund's use of leverage (swaps and repo) also created liquidity shocks for LDI funds as interest rates rose and gilts prices declined following the UK 'mini-budget'. LDI funds use repo funding to purchase gilts, which then act as collateral for the repo funding. When gilt values decline, funds must post additional collateral, which can come in the form of existing gilts not already pledged as collateral (i.e. unencumbered), assuming these gilts had not depreciated in value. Margin calls to maintain swap positions will generally require additional cash to be posted. Where LDI funds did not, or anticipated not having, enough unencumbered gilts for repo collateral calls or cash for margin calls, and were unable raise capital from investors to meet them, they responded by selling gilts to raise liquidity or wind down repo and/or swaps.

The ease with which LDI funds can raise new capital is determined by three factors. The first is how frequently investors can redeem or subscribe shares in the fund (i.e. dealing frequency). The longer this is, the more exposed a fund may be to a sudden change in financial conditions, holding all else equal. A minority of LDI funds offer a daily dealing frequency, with most having a weekly or lower frequency. The second consideration is whether a LDI fund has multiple investors (referred to as 'pooled') or has a single investor. Multiple investor funds typically serve smaller pension fund investors, whose processes to meet LDI funds' recapitalisation requests were more likely to struggle with the pace and volume of recapitalisation during the crisis. A third factor, beyond the control of the LDI funds, is whether their pension fund investors have sufficient cash available to allocate more capital to LDI strategies when called upon.

It is important to note that our analysis focuses on GBP denominated Irish-resident LDI fund behaviour and differs from that of Pinter (2023) which incorporates LDI fund investors. The wider perspective is important since the coordinated investment in gilts by pension funds, and the choice of leverage used, is largely determined by the underfunded nature of defined benefit UK pension investment schemes.

3 Leverage and Liquidity Stress for LDI Funds

The median leverage of GBP denominated LDI funds domiciled in Ireland increased over the course of 2022, reaching its peak in September. Funds' on-balance sheet leverage (total assets/net asset

2023 by Jonathan Hall (external member of the Bank of England's Financial Policy Committee), and the ESRB's EU non-bank financial intermediation monitor 2023 (ESRB, 2023).

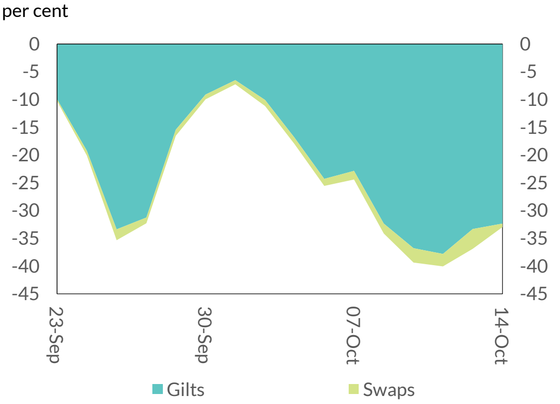
[8] This would typically include long-term investments such as real estate, private equity, private credit, etc.

[9] A negative or zero NAV prevents investors from investing more capital because at this point the funds' shares have a price of zero, which is effectively no price. This threatens the survival of the fund because it will no longer be able to meet collateral calls on repo or swaps from its counterparties, meaning it defaults and its collateral is liquidated by the counterparty, at which point the fund should wind down.

value) averaged around 1.7 over the course 2021, but as interest rates continued to increase over the course of 2022, leverage began to increase. From the start of the year to September it increased from 1.7 to 2.5 (see Chart 2).

This increase in on-balance sheet leverage arose as the fall in the value of LDI funds' assets due to rising interest rates was not accompanied by a matching increase in subscriptions or declining use of repo. At end June-2022, repo accounted for approximately 50 per cent of total liabilities. Total assets of GBP denominated Irish-resident LDI funds declined by approximately 12 per cent between March and June 2022, while the outstanding volume of repo declined by less than 3 per cent, meaning leverage increased as a share of total assets. This suggests that many of these LDI funds made a decision to allow their leverage to rise in response to rising rates and falling asset valuations between March and June 2022, rather than to wind down repo or recapitalise to maintain a steady leverage ratio.

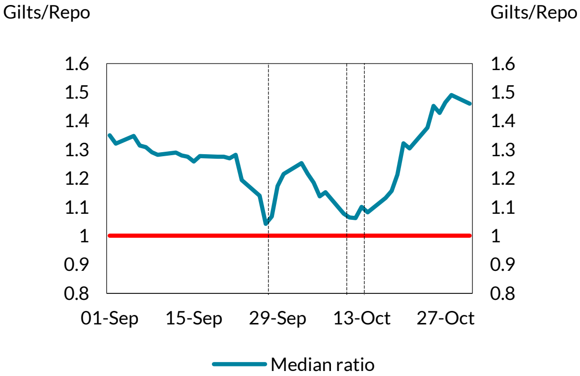
Chart 3: Cumulative valuation change in gilts and interest-related swaps as per cent of end-August NAV



Source: EMIR, Industry Survey, Central Bank of Ireland and authors' calculations

Notes: Data cover all GBP denominated Irish-resident LDI funds. As not all LDI funds use interest rate swaps or hold gilts, valuation movements will be more extreme for subpopulations. "Interest rate swaps includes inflation swaps.

Chart 4: Median value of gilts held relative to repo loans at fund level



Source: SFTR, Industry Survey, Central Bank of Ireland and authors' calculations.

Notes: Data cover all GBP denominated Irish-resident LDI funds. Repo is considered as the gross value of repo loans outstanding. The red horizontal line identifies the point where funds gilts have equal value to their repo loans. Dashed lines represent Bank of England interventions (28/09 and 11/10) and end of gilt market operations (14/10).

The sharp rise in yields after 22 September resulted in modest cash-based liquidity demands for LDI funds. Data suggest that from 23 September to October 14, LDI funds posted a maximum cumulative £6 billion of cash to maintain repo and swap positions. Holdings of cash and money market fund (MMF) shares at end-June and end-September were in aggregate significantly larger than the cash posted to maintain repo and IRS positions.[10] Thus, the data do not suggest that the fulfilment of liquidity demands with cash was the primary driver of gilt sales by LDI funds. LDI funds also faced collateral calls from repo positions that could be met with gilts, which were larger than cash-based liquidity demands.[11] Funds would only sell gilts in response to these calls if they were concerned about not having sufficient unencumbered gilts to meet them, at which point they would also have a negative NAV.

Sharp decreases in the value of gilts and, to a lesser extent, interest rate swaps, put stress on NAV valuations. As a cohort, LDI funds saw maximum cumulative losses on gilts and swaps equivalent to approximately 40 per cent of their NAV at end-August over the crisis period (see Chart 3). These valuation changes were primarily accounted for by changes in the value of gilts held, largely due to

[10] A degree of liquidity mismatch likely occurred for some LDI funds.

[11] These collateral calls can be estimated in terms of collateral demanded and in terms of collateral delivered (i.e. posted). Neither approach is necessarily superior, so for this *Note* it is only remarked that either figure was larger than what was posted in cash for repo and interest rate swaps.

derivatives forming a smaller part of LDI funds' portfolios. These valuation declines would have increased fund leverage significantly between the quarter-ends for which data are available. More extreme valuation losses occurred at the individual LDI fund level, with roughly a quarter of all LDI funds seeing valuation declines on gilt holdings in excess of 80 per cent of their end-August NAV (see Chart 5). This suggests that a significant minority of LDI funds saw their survival threatened, and in the absence of recapitalisations, many would have had to wind-down.

Further evidence of stress on LDI funds' NAV valuations is evident when considering the ratio of gilt holdings to repo loans at the individual fund level (see Chart 4). As this ratio approaches 1, a negative NAV becomes more likely, but is not certain as this measure does not consider other assets. However, it would indicate a NAV close to zero as LDI funds that hold gilts have limited holdings of other assets. Due to the concurrence of a negative NAV and funds having insufficient collateral to meet collateral calls, the ratio also provides insight on the tightness of gilt collateral availability i.e. the value of gilts remaining, which can be pledged as collateral.[12] [13] The median of this ratio dipped close to 1 with the onset of the crisis in September, and remained close to that level over most of the crisis period (see Chart 4).

The valuation declines and increased liquidity demands led many LDI funds to see their leverage and liquidity move past their own internal limits. As some LDI funds outline in their prospectuses, there are internal leverage limits past which they may take certain actions to deleverage or leverage-up. If the LDI fund manager judges that leverage is below the fund's minimum level, they may provide dividends or require redemptions. If leverage moves above the maximum level, they may take actions to deleverage, first by requesting recapitalisations from investors, and if they are not forthcoming, by selling assets to unwind repo/derivative transactions. Likewise, some LDI funds maintain a certain amount of liquidity/collateral for their usual needs.

4 How LDI Funds Responded to the Stress

To reduce leverage and to fulfil increased liquidity demands, LDI funds would have had to raise new cash from investors or sell assets. LDI funds should, in normal market conditions, hold sufficient liquid assets, namely cash, MMF shares or unencumbered gilts (for repo) to meet liquidity requirements from repo and interest rate swap positions. If this is not sufficient, then LDI funds can call on their investors to commit additional capital to the fund via share subscriptions. LDI funds also raise new capital from investors to decrease their leverage. If recapitalisations are not possible, LDI funds may resort to selling gilts, which can raise liquidity and/or reduce leverage (if proceeds are used to wind down repo). Selling gilts or recapitalising is equivalent for raising liquidity, but recapitalisations and selling gilts to wind down repo do not reduce leverage by the same amount. Recapitalisations reduce on-balance sheet leverage (total assets to investors' subscriptions) by more than selling gilts to wind down repo where existing leverage is above a certain threshold (>2).[14] LDI funds preferred to receive new capital to reduce their levels of leverage to within their internal limits, but some sales of assets were also needed.

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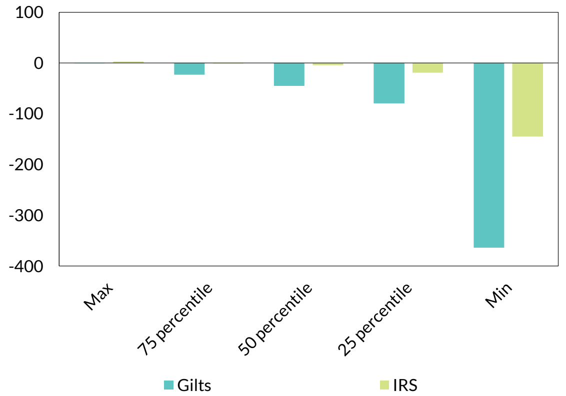
[12] LDI funds are typically required to settle repo collateral requests met with securities by t+1 or t+2. Therefore, what is presented is the availability of collateral at t+0 to meet collateral calls that occurred at t-1 or t-2.

[13] Repo contracts can require the borrower to post collateral in excess of the amount they are borrowing, with difference between the two figures known as a haircut. If LDI funds repo contracts included haircuts, LDI funds would run out of collateral before the ratio of gilt holdings to repo borrowing hit 1. Typically, haircuts on sovereign debt tend to be low, and up to 35 per cent of UK bilateral repo transactions (the type LDI funds use) have a haircut of zero (Julliard et al., 2022). SFTR data suggest the overwhelming majority of repo LDI funds used for gilts had a zero haircut.

[14] Consider the following example: If a fund has €100 of gilts, €40 of investor subscriptions and €60 worth of repo, then it has leverage of 2.5. If it chooses to deleverage by selling €10 euro of gilts and winding down €10 of repo, it has leverage of 2.25 (=90/40). If it chooses to deleverage by taking in new subscriptions of €10 and buying a further €10 worth of gilts, then it will have leverage of 2.2 (=110/50). This result holds providing on balance sheet leverage is >2.

Chart 5: Distribution of maximum cumulative valuation declines across LDI funds, by instrument type

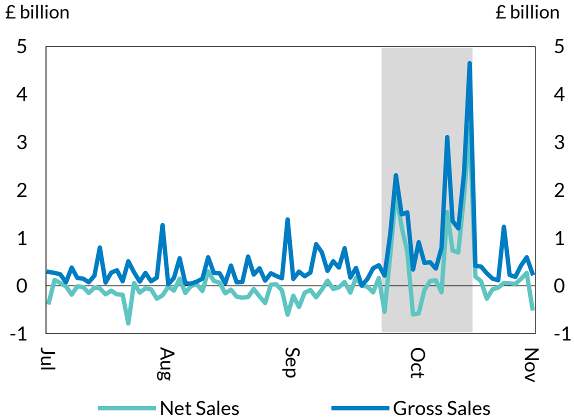
per cent of August NAV



Source: EMIR, Industry Survey, Central Bank of Ireland and authors' calculations

Notes: Data cover all GBP denominated Irish-resident LDI funds. IRS refers to interest rate swaps. Number represent cumulative value change of portfolio as per cent of Aug NAV.

Chart 6: Gross and Net Sales of Gilts by GBP LDI funds, Jul-Oct 2022



Source: Industry Data, Central Bank of Ireland and authors' calculations

Notes: Data cover all GBP denominated Irish-resident LDI funds. Shaded period covers 23 September-14 October. Negative figures represent net purchases of gilts, positive figures net sales.

Over 23 September – 14 October, LDI funds sold approximately £23 billion of gilts on a gross basis, and £11 billion on a net basis (i.e. sales – purchases).[15] Sales were more concentrated during the time window of the Bank of England's market operations, with around 77 per cent of gross sales occurring between 29 September and 14 October (see Chart 6). While gilts did not see one-day price declines as large as that before the intervention, October did see sustained sales of gilts and sustained, and still substantial, price declines.

The sales were concentrated amongst LDI funds with more than one investor, funds that used repo and funds with higher levels of initial leverage.[16] Pooled LDI funds saw £15 billion in gross sales over the crisis period, almost double the amount sold by single investor funds. In addition, leverage type seems to have been important for gilt sales. Of all gilts (gross) sold over the crisis period, more than 80 per cent were in use as collateral in repo transactions as at 22 September. It was not just the form of leverage that mattered, but also the level. Funds with leverage above the median level at the end of August sold a much greater percentage of their gilts (relative to their initial holdings) over the crisis period (see Chart 7).

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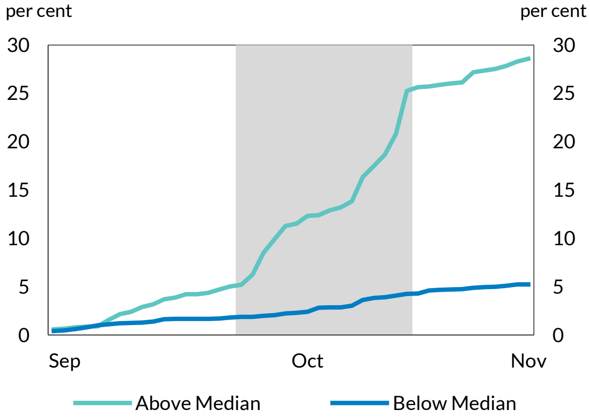
[15] This data come from an Industry Survey. The survey requested daily transactions data for individual securities (bonds and fund shares) from all LDI funds resident in Ireland. Transactions are recorded on a traded basis. This was a once-off request.

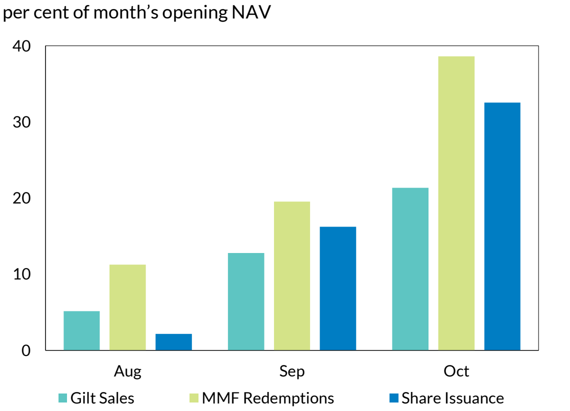
[16] Repo was part of the business model of many multi-investor funds, as it would allow pension funds to hedge a larger portion of their members' liabilities with a smaller amount of capital.

Chart 7: Cumulative Gross Sales of Gilts by Fund Leverage Level, Sep-Oct 2022



Source: Industry Data, NAV Returns, Central Bank of Ireland and authors' calculations.
Notes: Data cover all GBP denominated Irish-resident LDI funds. Shaded period covers 23 September-14 October. Above median refers to funds with leverage above the median level at the end of August, below median refers to those funds below the median. Leverage measured as Total Assets/NAV. Sales are relative to holdings of gilts on 31 August.

Chart 8: Sources of liquidity raised by LDI funds, Aug-Sep 2022



Source: NAV Return, Industry Data, Central Bank of Ireland
Notes: Data cover all GBP denominated Irish-resident LDI funds. All figures are in gross terms.

However, LDI funds raised more cash by drawing on existing sources of liquidity (MMF shares) or by raising new equity from investors than they did from gilt sales. In both September and October, cash raised from selling gilts was less than cash raised from new subscriptions from shareholders or from redemptions of MMF shares. Redemptions of MMF shares were the largest source of cash raised by LDI funds in September and October, and amounted to almost double the volume of gilt sales as a percentage of NAV in October (see Chart 8).[17] [18]

The ability to raise additional capital likely prevented a significantly greater level of gilt sales. As noted above, deleveraging by raising capital from investors requires less money than achieving an equivalent deleveraging by gilt sales when leverage is higher. From information submitted to the Central Bank for a cohort of LDI funds, it can be established that for many LDI funds, meeting their target leverage via gilt sales rather than equity issuance would have required a volume of sales that was between 2.2-2.8 greater than the equity raised. Using this information to conduct a rudimentary counterfactual of what volume of gilts would have been sold if LDI funds could not recapitalise, it is estimated that a maximum of £115 billion of gilt sales would need to have been sold.[19]

5 Were Irish-resident LDI Funds Contributors to Gilt Market Dysfunction, and Did They Transmit Stress to Other Funds?

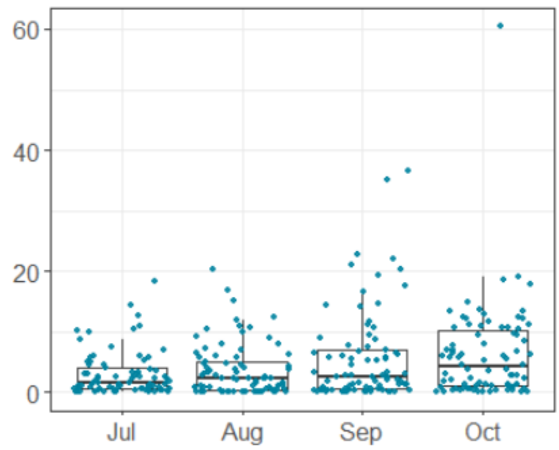
Available market data suggest that Irish-resident GBP LDI funds accounted for a sizable minority of gilt sales over the period. The Bank of England estimates that LDI firms[20] sold, in net terms, £36 billion of gilts between 23 September – 14 October (Pinter, 2023). This would imply that Irish-resident LDI funds accounted for around 30 per cent (£11 billion) of net sales of LDI firms over the

[17] Other sources of liquidity such as bank deposits are excluded from this comparison.
[18] To facilitate the subscriptions, some fund managers with weekly dealing frequency added further dealing dates.
[19] This requires an assumption that all investor subscriptions over September-October were used to meet leverage targets and that no recapitalisations were fulfilled by pension fund investors selling gilts.
[20] The Bank of England's definition of LDI firms includes LDI funds, LDI segregated accounts, non-LDI funds managed by LDI managers and investors in LDI strategies. Our definition includes only LDI funds, which means that the share of sales by Irish LDI funds as a per cent of all LDI funds sales may in fact be higher.

period.[21] This is a substantial minority, and somewhat greater than the proportion of LDI strategies accounted for by Irish-resident funds, likely reflecting the greater share of pooled funds resident in Ireland. But it also indicates the majority of gilt sales occurred elsewhere, either with funds' investors, or with non-Irish resident LDI funds and LDI segregated accounts.

Chart 9: Share of monthly gilt sales accounted for by LDI funds.

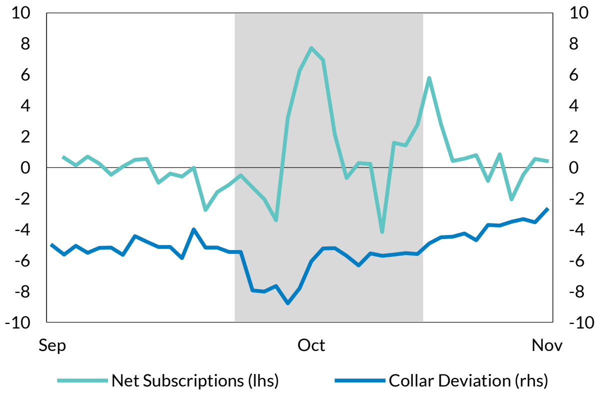
per cent sales accounted for by LDIs



Source: Markit, Industry Data, Central Bank of Ireland
Notes: Thick black line in the box is the median, thin lines are 25th and 75th percentile. Vertical lines reach out to 1.5 interquartile range. Blue dots are data points for individual gilts.

Chart 10: Daily Net Subscriptions and Basis Point Collar Deviation for GBP MMFs, Sep-Oct

£ billions | basis points



Source: Daily MMF Data, Central Bank of Ireland
Notes: Shaded grey area is 23 Sep- 14 Oct 2022. Net subscriptions are calculated as subscriptions – redemptions. Collar deviation is calculated for LVNAV funds only.

Looking at total transactions at the gilt level, the contribution of sales by Irish GBP LDI funds is relatively limited, although it increased in the months of the crisis period. Monthly data from Euroclear show that the median share of sales accounted for by Irish-resident LDIs (at the individual bond-level) increased from 2.2 per cent in August, to 2.6 per cent and 4.1 per cent in September and October. [22] At the 75th percentile, the corresponding figures are 7.0 per cent and 10.2 per cent, up from 5.1 per cent in August (see Chart 9).

While subscriptions by pension fund investors likely reduced the need for LDI funds to sell gilts, they may also have led those pension investors to transmit stress to the gilt market. GBP denominated Irish-resident LDI funds raised £41 billion in new equity subscriptions over September-October. Data from the Bank of England show UK pension funds sold £14 billion of gilts over the crisis period, which acts as an upper limit on the amount of gilts sold to provide subscriptions to LDI funds.

Ex ante, there is some evidence to suggest that LDI funds and LDI fund investors may have transmitted stress to other parts of the Irish funds sector. Some LDI funds allow pension investors to identify other fund investments that can be used by the LDI fund as an additional source of liquidity. Under certain conditions, this arrangement allows LDI fund manager to redeem shares from these other funds owned by the pension fund and use the proceeds for subscriptions into the LDI fund, issuing shares to the investors in return.[23] Similarly, LDI fund investors will also likely

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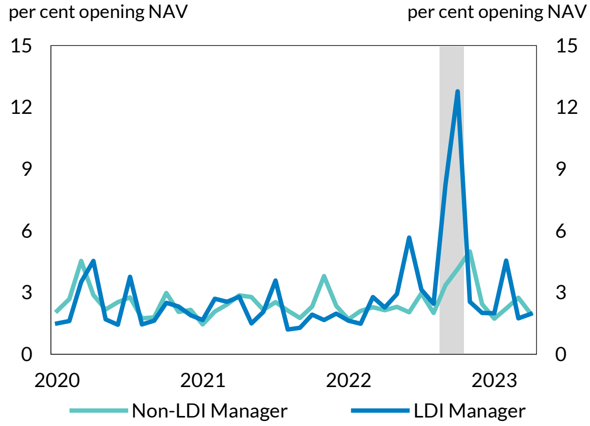
[21] An assumption underpinning the validity of this comparison is that all sales of gilts by Irish funds in the data used are included in the data used by the Bank of England.
[22] This data cover the universe of gilts owned by Irish-resident LDI funds, but lacks the granularity to assess whether these funds were particularly active sellers during periods shorter than a month. Not all gilt transactions are settled through Euroclear, so the estimates in the paragraph likely overestimate Irish LDI funds share of gilt trading. Comparing Euroclear data to the Debt Management Office's gilt market aggregate turnover data, Euroclear data accounts for 60 per cent of the total in September and 70 per cent in October.
[23] For more detail see '*Managing LDI portfolio hedges amid volatile markets – an overview*' (Pace & Williams, 2022).

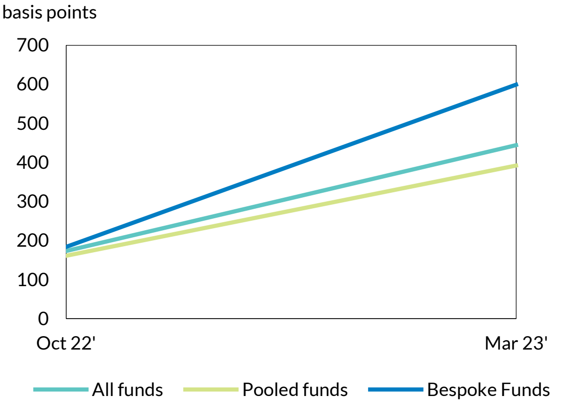
transmit the effects of providing extra capital to LDI funds through withdrawals from other investments, such as MMFs or other types of funds that are designed to provide their investors with liquidity and capital protection.

Chart 11: Redemptions for non-LDI funds managed by non-LDI and LDI managers.



Source: NAV Return, Central Bank of Ireland
Notes: Shaded grey area is Sep-Oct 2022. Only includes funds denominated in GBP. Excludes Money Market Funds.

Chart 12: Median yield buffer by LDI fund type



Source: LDI Data Collection, Central Bank of Ireland and authors' calculations
Notes: Covers all GBP denominated Irish-resident LDI funds. Pooled funds have more than one investor, bespoke funds have just one investor.

There is suggestive evidence of LDI funds spreading a degree of stress to other Irish-resident funds. Irish-resident GBP MMFs saw heightened redemptions at the start of the gilt market crisis, which reversed shortly after the Bank of England intervened. Irish-resident LDI funds net redeemed £3.2 billion from Irish-resident GBP MMFs over 23-29 September, before becoming net subscribers of MMF shares over the rest of the period (see Chart 10).[24] In total, there was £12.5 billion of net redemptions from Irish-resident GBP MMFs over 23-28 September. For low-volatility net asset value (LVNAV) MMFs, this redemption pressure, alongside broader weakness in UK fixed income assets, was associated with a modest increase in the average mark-to-market bps deviation in the value of MMF units from their constant unitary NAV (moving from 5.4 bps on 22 September to 8.8 bps on the 29 September). Outside of MMFs, Non-LDI funds managed by LDI managers saw a sharp increase in redemptions over September-October 2022 relative to non-LDI funds managed by other managers (see Chart 11).

6 How Has LDI Fund Resilience Improved?

The resilience of LDI funds has improved in a context of enhanced guidance from the Central Bank of Ireland, in coordination with other relevant national competent authorities (NCAs). In November 2022, the Central Bank set out a 300-400 bps yield buffer as a minimum safeguard to maintain the operational and financial resilience of GBP denominated Irish-resident LDI funds. This measure was introduced in coordination with the Commission de Surveillance du Secteur Financier (CSSF, Luxembourg's NCA), after interaction with the European Securities and Markets Authority (ESMA), as outlined in an industry letter.

Since the guidance was announced, there has been a considerable improvement in the yield buffer for GBP denominated Irish-resident LDI funds. The median reported buffer increased from 170 bps in October 2022 to approximately 440 bps in March 2023 (see Chart 12). Substantial improvement has occurred for both pooled funds and LDI funds with just one investor. This buffer means that in

[24] There were days over 30 September – 14 October when LDI funds net redeemed GBP MMF shares, but they were infrequent. In contrast, 23-29 September saw 5 days of consecutive net redemptions, amounting to £3.2 billion.

the event of a 300-400 bps increase in yields, the capital of the LDI fund will not be exhausted (i.e. it will not have a negative NAV). In large part, this has arisen from LDI funds reducing their leverage. The median ratio of total assets to investors' equity (on-balance sheet leverage) has fallen from 2.5 in September 2022 in to 1.7 in March 2023, roughly equal to the average over the period mid-2018 – end-2021 (see Chart 2).

LDI funds' holdings of cash and cash equivalents has not improved beyond its pre-crisis level, although it is above its longer run average. The median share of LDI funds' portfolio held as bank deposits and MMF shares increased from approximately 6 per cent in June 2022 to 11 per cent in December 2022 (see Chart 12). This fell back to 6 per cent by March 2023, which, although equal to its pre-crisis level, is still above its 2021 average. As cash-based liquidity demands were modest, and unlikely to be a significant driver of sales, this post crisis reduction is not necessarily a cause for concern.

Estimations of the yield buffer for August 2022 suggest that gilt sales during the crisis period were concentrated amongst LDI funds with a buffer below 300 bps. LDI funds with a yield buffer below 300 bps accounted for £10.1 billion of net sales over 23 September – 14 October, while funds above 300 bps accounted for £1.0 billion. If LDI funds with buffers below 300 bps had net sold the same proportion of their gilts as those with buffers above 300 bps, then their net sales would have amounted to £1.6 billion as opposed to £10.1 billion, reducing total net sales to £2.6 billion. This demonstrates the benefits of additional resilience built since the period before the shock.

On 29 March 2023, the Financial Policy Committee (FPC) of the Bank of England published recommendations for The (UK) Pension Regulator to improve the resilience of LDI funds. These recommendations are intended to ensure that LDI funds maintain a steady-state minimum level of resilience, which would allow them to withstand historical moves in gilt yields without the need to be forced sellers of gilts (Bank of England, 2023). The FPC judged that LDI funds need to maintain resilience to a minimum 250 bps increase in yields, in addition to a buffer that would allow them to operate under normal conditions. The (UK) Pension Regulator has followed this recommendation, and incorporated it into its guidance (The Pensions Regulator, 2023). Their guidance on risk management and operational management was also updated for pension trustees, with the Financial Conduct Authority publishing updating guidance on similar themes for LDI fund managers and investment advisors (Financial Conduct Authority, 2023).

The Central Bank of Ireland noted the FPC announcement and reaffirmed its expectations that the minimum safeguards highlighted in the November 2022 communication should continue to be observed for Irish-resident LDI funds denominated in GBP. The Central Bank will continue to work closely with regulators in the UK and across Europe as well as international regulatory bodies to ensure that all relevant investment and liquidity risks are managed effectively across the investment fund sector, including those in LDI funds.

7 Conclusion

GBP denominated Irish-resident LDI funds played a significant role in the gilt market crisis in 2022. They accounted for around 30 per cent of net gilt sales by LDI firms over the crisis period. Sales were concentrated amongst funds who faced a greater probability of a negative NAV (i.e. lower yield buffer), gilts used as collateral for repo and amongst pooled funds. By recapitalising via investor subscriptions and drawing on existing sources of liquidity, they averted greater volumes of gilt sales.

Our analysis suggests that the fulfilment of liquidity demands from repo and swaps with cash was not the primary driver of sales for GBP denominated Irish-resident LDI funds. Cash posted to maintain these positions cumulatively amounted to a maximum of £6 billion over the crisis period. This is in the context of gross gilt sales of £23 billion over the crisis period. Repo collateral calls met with gilts were more substantial, and would have generated sales where funds' were concerned about their NAV going negative/not having enough collateral to meet the calls.

The data suggest that the possibility of a negative NAV became a concern for a significant minority of GBP denominated Irish-resident LDI funds, as a quarter of these funds that held gilts saw the value of their gilts decline in excess of 80 per cent of their August NAV over the crisis period. Where LDI funds were unable to raise additional capital from investors, they likely resorted to selling gilts to wind down repo positions. These valuation declines led LDI funds to breach their own internal leverage limits. If the LDI funds could not manage to receive fresh capital from investors, they deleveraged via gilt sales to wind down repo positions to adhere to their own limits.

GBP denominated Irish-resident LDI funds are now more resilient to the type of shock that occurred during September – October 2022. The leverage of Irish-resident LDI funds has improved, returning below its pre-crisis level, and in line with its long term average. This suggests that if similar shocks were to reoccur LDI funds would be better able to withstand them, following the supervisory expectations on maintaining a yield buffer of 300-400 bps, announced in November 2022 and reaffirmed in March 2023.

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T: +353 (0)1 224 6000
www.centralbank.ie
publications@centralbank.ie

Bosca PO 559, Baile Átha Cliath 1, Éire
PO Box 559, Dublin 1, Ireland

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