Liquidity analysis of Bond and Money Market Funds

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Abstract

Monitoring liquidity risk of Money Market Funds (MMFs) and Investment Funds (IFs) is an important tool for the identification and assessment of systemic vulnerabilities. This paper highlights the importance of the definition of liquidity for the results of liquidity stress tests of IFs and MMFs. We present a prototype methodology for liquidity monitoring delineated on maturity, sector and credit ratings of securities held by a number of Irish-domiciled MMFs and bond funds. This analysis is facilitated by the granular, security-by-security portfolio holdings data collected by the Central Bank of Ireland on a monthly basis for MMFs and a quarterly basis for IFs. The methodology is inspired by the High Quality Liquid Assets (HQLA) classification framework which was initiated under Basel III. We compare HQLA to expected monthly redemptions and find the framework is appropriate for MMFs and sovereign bond funds who invest primarily in advanced economies, but less appropriate for more complex funds such as those who primarily invest in less developed (emerging) markets or lower credit quality (high yield) assets. By design emerging market and high yield funds are more likely to fail the test due to the fact that the HQLA framework applies heavy haircuts to the market value of any debt securities with lower than prime investment grade, regardless of the level of demand for such securities amongst investors. Future work will compare this methodology to a more market-based approach.

1 Introduction

Ireland is a significant global domicile of entities engaged in shadow banking activities (that is credit intermediation outside of the regular banking system). Thus, the Central Bank of Ireland take part in international monitoring exercises (such as the Financial Stability Board (FSB) Shadow Banking Monitoring Report, 2015, 2016) as well as completing risk

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analysis at both an individual firm and sector level. The risks associated with shadow banking include maturity transformation, liquidity transformation, excessive leverage, improper credit risk transfer and interconnectedness. In this letter we assess the appropriateness of tools for the analysis of liquidity as part of the Central Bank's overall monitoring strategy.

The FSB also highlight the fact that shadow banking entities and activities can become a source of systemic risk, either directly or via interconnectedness with the banking system. Investment Funds (IFs), in particular bond funds, and Money Market Funds (MMFs) make up a significant portion of Ireland's shadow banking sector. While Irish domiciled IFs and MMFs have limited links to the domestic economy, they have the potential to become a propagating force of stress in international financial markets due to their interconnectedness and the impact of their activities on financial markets' risk premia and in some cases price discovery. The International Monetary Fund (IMF) Financial Sector Assessment Program (FSAP) for Ireland (2016) supported our own existing work by recommending we increase monitoring of liquidity risk in Money Market Funds and Investment Funds. Specifically they suggested the use of minimum weekly liquidity ratios and monitoring the characteristics and concentration of the investor base. In addition, the IMF also recommend the development of frequent stress testing of MMFs and IFs, with respect to both market and liquidity risk.

In this letter, we present a simple methodology for assessing fund liquidity which builds upon the MMF liquidity risk analysis completed during the IMF FSAP. Our methodology is inspired by the Basel III High Quality Liquid Assets (HQLA) and Liquidity Coverage Ratio (LCR) methodologies (BCBS, 2013).

The HQLA classification methodology utilises a granular, security-by-security portfolio holdings dataset collected by the Statistics Division (STATS) of the Central Bank of Ireland for IFs and MMFs. The purpose of this exercise is to develop a liquidity metric which can be monitored at both a fund and aggregate (sector) level on a periodic basis and, thus, identify potential liquidity mismatches at a fund level and general trends in liquidity at an aggregate level.

Brunnermeier and Pedersen (2009) argue that feedback loops exist between market and funding liquidity[2] where market illiquidity leads to losses on existing positions and results in future funding difficulties. This loop is crucial for investment funds whose primary source of funding is through equity share issuance, which in many cases can be redeemed daily. If investors in the fund believe that a redemption shock will lead to a fire-sale of assets into an illiquid market and that resulting losses may trigger further redemptions, they have the opportunity to limit their losses by redeeming their shares (Chen, Goldstein and Jiang, 2010).

This first mover advantage occurs as a significant portion of the costs related to redemptions are borne by the remaining investors in the fund and not by those who have cashed out. Taken on aggregate, however, the first mover advantage scenario can cause self-fulfilling cycles related to feedback loops between redemptions and asset price decreases, precipitated by market illiquidity and can lead to systemic events. The risk of such damaging dynamics is increased where funds offer daily redemptions while investing in markets or securities which may not offer daily liquidity during stressed market conditions.

Our research highlights some potential hurdles to be overcome in order to meet the recommendation of the IMF FSAP with re-

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[2]Borio (2000) provides a working definition of a liquid market as one in which transactions can take place quickly with little impact on prices. Teo (2011) define funding liquidity quite simply as the ease with which investors/asset managers can obtain financing.

spect to monitoring minimum liquid asset ratios for MMFs and IFs. By analysing HQLA, net investor flows and LCR for different categories of bond funds, we find that HQLA and LCR type indicators may be most appropriate for monitoring liquidity risk in Advanced Sovereign bond funds and MMFs. Such measures appear to be less appropriate for other fund types such as those primarily investing in lower credit quality bonds or those with a financial sector investment focus. Deeper analysis into market depth and transaction costs may be required for these categories of funds.

The Letter continues as follows: Section 2 describes our data; Section 3 outlines our fund categorisation methodology and liquidity indicators; Section 4 provides results of our liquidity analysis by category of fund; Section 5 concludes.

2 Data

As of December 2016 Ireland has the largest share of Euro Area MMFs by Assets Under Management (AUM) and the third largest share of IFs, behind Luxembourg and Germany.[3] Our analysis focuses on bond funds and MMFs which comprise over 46% of the total Irish IF and MMF sector (Figure 1). The focus on bond funds and MMFs is due to their important role in credit intermediation and, thus, their direct links to the global real economy via markets based financing of corporates and governments, as well as indirect links via the banking system. Many of the funds in the remaining 54% are equity funds, or have large equity exposures. In this paper we do not look at hedge or other funds, which would be the next biggest holders of debt securities.

We restrict our sample to funds which are authorised under the Undertakings for Collective Investment in Transferrable Securities

(UCITS) regulations and which have a daily dealing frequency. This leaves a Q4 2016 sample of €501bn AUM for bond funds (79% of all bond fund assets) and €479bn AUM for MMFs (99% of all MMF assets). Figure 2 displays the evolution of our sample size for our analysis from Q1 2014 to Q4 2016.

The Statistics Division of the Central Bank collects security by security holdings data from all Irish authorised investment funds on a quarterly basis and for money market funds on a monthly basis, matching this data to the Centralised Securities Database (CSDB) maintained by the European Central Bank (ECB). This data allows us to build a point in time security by security balance sheet for investment and money market funds. Monthly data on total Net Asset Value (NAV) and investor subscriptions and redemptions of shares is also collected by STATS and allows us to calculate a monthly net subscription/redemption per fund.

3 Fund Categorisation and Liquidity Indicator

3.1 Fund Categorisation

Many bond funds are set up to give investors exposure to a specific region, credit quality or sector. In order to assess liquidity of assets for different types of bond funds, we categorise assets into granular groupings based on their portfolio weightings in different bond classes. We use seven different groupings, with a fund included in a particular category if greater than 70% of its assets are invested in a particular class of bonds. For example, a fund is included in a category such as Advanced Economy, Investment Grade if it has greater than 70% portfolio weighting in advanced economy bonds and greater than 70% portfolio weight-

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[3]Source: ECB Statistical Data Warehouse

[4]A bond is considered to be investment grade if its credit rating is BBB- or higher for Standard & Poor's or Baa3 or higher by Moodys. These bonds are considered to be more liquid and safer bonds (from a credit risk perspective)

ing in investment grade bonds.[4] Funds that have less than 70% portfolio weighting in all bond classes are classified as "Other".

The categorisation is completed based on each fund's Q4 2016 portfolio. Completing the analysis based on the Q4 2016 categorisation introduces a survivorship bias into the sample. However, having also completed the analysis by recategorising funds in each quarter, we find that this method leads to less volatile results while leaving the overall conclusions unchanged. Moreover, it removes the effect of changes in aggregate level liquidity caused by funds switching categories over time. The categories are as follows;

1. Advanced Sovereign - Advanced Economy, Investment Grade, Sovereign/Sub-Sovereign. Example: A US Treasury bond fund.

2. Advanced Financial - Advanced Economy, Investment Grade, Financial Sector. Example: A bond fund primarily investing in mainstream large European banks

3. Advanced Corporate - Advanced Economy, Investment Grade, Non-Financial Corporate. Example: A bond fund primarily investing in Japanese non-financial corporates

4. Advanced Mixed - Advanced Economy, Investment Grade, Mixed Sector. Example: A bond fund investing in a mix of UK corporates and financials

5. Emerging Markets - Emerging Markets. Example: A bond fund primarily investing in the Brazilian bond markets

6. High Yield - Advanced Economy, High Yield. Example: A bond fund primarily investing in European corporates and financials which have higher credit risk

7. Other. Example: A bond fund which does not match any of the other six categories

Figure 3 displays the number of bond funds per category from Q1 2014 – Q4 2016. The largest numbers of funds are in the Advanced Mixed, Advanced Sovereign and Advanced Financial categories. High Yield, Emerging Markets and Other all have similar numbers with between 40 and 75 funds in each category over the sample period. There are only a small number of funds (< 10) in the Advanced Corporate category.

3.2 High Quality Liquid Assets

The IMF (2016) methodology for defining liquid assets in MMFs broadly follows the credit rating agency convention (and IMMFA code of practice) by including overnight cash and repo, securities maturing within one week, and sovereign debt securities with a credit rating of AA or above. Liquid assets are then compared to large historical weekly redemption levels experienced by the individual MMFs, assessing whether each MMF would have sufficient portfolio liquidity to meet a first or fifth percentile redemption shock. While such a definition of liquid assets is appropriate for MMFs, due to their business model, it may be overly restrictive for other fund categories. Analysis completed by the European Banking Authority (EBA) (2013) finds that a wider range of assets can be defined as providing liquidity during stressed market conditions, provided an appropriate haircut is applied.

Under Basel III and CRD IV[5] European banks are required to hold sufficient liquid assets to survive a significant period of stress. This is operationalized in the liquidity coverage ratio (LCR) which is defined as the stock of HQLA divided by the total expected cash outflow over the next thirty calendar days (Basel Committee on Banking Supervision

[5]Regulation 573/2013 of the European Parliament and of the Council.

(BCBS), 2013). HQLA stock consists of cash or assets that can be converted into cash at little or no loss of value in private markets. In order to assess the liquidity of investment funds, we categorise investment fund portfolios into liquid and illiquid assets using a method inspired by the BCBS (2013) HQLA definition. For the purposes of the investment fund liquidity indicator, HQLA and the relevant haircuts are split into the following levels.

Level 1 – 0% haircut:

1. Cash and cash equivalents

2. Assets maturing within the stress period

3. Debt securities issued or guaranteed by sovereigns, central banks, the BIS, the IMF, multilateral development banks and the European Community with a credit rating of at least AA-

Level 2a – 15% haircut:

1. Debt securities issued by or guaranteed by sovereigns, central banks, the BIS, the IMF, multilateral development banks and the European Community with a credit rating between A+ and A-.

2. Corporate debt securities not issued by financial institutions. Includes commercial paper and covered bonds with credit rating of at least AA-

Level 2b – 50% haircut:

1. Corporate debt securities not issued by financial institutions. Includes commercial paper and covered bonds with credit rating between A+ and BBB-.

2. Common equity shares in advanced economies which are not issued by financial institutions.

A caveat of the methodology is that the classification is based on the country, sector, maturity and credit ratings information reported by the investment funds and MMFs. These data fields are not currently validated using third party data. Further refinements of the HQLA based classification will be completed as new data sources become available for validation and supplementation of reported data.

The above HQLA levels are adapted from the BCBS (2013) definition. For example, Level 2 assets can only make up 40% of the total stock of HQLA for inclusion in the BCBS (2013) LCR, whereas, we include all HQLA eligible securities. We include all Level 2 assets as our methodology is not designed to be a liquidity stress test, rather it is designed as an indicator for potential liquidity mismatches in open-ended funds. Thus, as Level 2 assets are deemed to provide liquidity (once an appropriate haircut is applied) it is appropriate to include them in a liquidity indicator.

3.3 Liquidity Coverage Ratio

A fund-level LCR can be calculated as the ratio of HQLA to expected funding outflows during a stress period.

$$LCR = \frac{HighQualityLiquidAssets}{Expected 30 days StressedOutflows} \quad (1)$$

The denominator of the LCR comprises the expected funding outflows over a stressed period of thirty calendar days. Funding outflow combines redemption shocks and run-off of liabilities which mature during the stress period.[6] In the current version of the test derivative liabilities are not included in the funding outflow. A -10% monthly redemption shock is also applied. An initial analysis reveals that a -10% redemption shock is sufficiently conservative

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[6]The run off of short term liabilities assumes that all debt securities, securities lending, overdrafts and loans which mature during the stress period cannot be replaced

for all categories of funds, and perhaps over conservative for certain categories of funds.

Table 1 below provides a first and fifth percentile redemption shock for each category of funds. Redemption shocks are given as negative percentages of Net Asset Value (NAV) as they represent outflows from the fund. The shock was calculated by taking the Q4 2016 categorisation of funds, tracking their monthly redemptions back to January 2007 and calculating a weighted average redemption[7] for each category in each month. As discussed above, keeping the Q4 2016 sample constant introduces a significant survivorship bias. This is particularly pronounced due to the 10 year monthly time series used to calculate the investor flows. However, it gives us some indication of the size of monthly shocks which were experienced in each category over the period from 2007.

The largest shocks are experienced by MMFs, Advanced Corporate bond funds, High Yield bond funds and Other bond funds with first percentile shocks of -9.2%, -12.2%, -8.4% and -10.2% respectively. As there are only four funds in the Advanced Corporates category, the size of the shock will be heavily affected by idiosyncratic fund flows which may be unrelated to stress events. The magnitude of the MMF first percentile shock may be related to the fact that the period under analysis includes the run on money markets in September 2008. Alternately, it may be related to the use of MMFs for treasury operations by large corporations. In such cases, large redemptions are often signalled to the fund well in advance and, therefore, should not pose a liquidity risk.

In future stress testing exercises, where redemption shocks are calibrated on historical redemptions, treasury operations may need to be taken into account when calculating an appropriate shock level for MMFs. An analysis of the investor base of the MMF may indicate which investors are more likely to flag

large scale redemptions. For example, a MMF whose investor base is small in number and corporate in nature may be using the MMF for treasury operations and may flag when they are planning a large redemption. As opposed to a MMF which has a diverse retail investor base, whose redemptions may be more connected to market sentiment and macroeconomic indicators. Thus future stress testing analysis should look at the composition of liabilities as well as assets. In this letter, we simply apply a -10 per cent shock on all funds as an initial analysis to test the methodology.

Table 1: Monthly Redemption Shock (% NAV)

Category	1st Percentile	5th Percentile
MMF	-9.2%	-2.9%
Advanced Sovereign	-3.2%	-2.1%
Advanced Financial	- 5.4%	-3.0%
Advanced Corporate	-12.2%	-4.3%
Advanced Mixed	-6.1%	-2.7%
Emerging	-5.6%	-2.5%
High Yield	-8.4%	-4.8%
Other	-10.2%	-2.9%

4   Results

The results of the HQLA liquid asset classification are provided in Figure 4 from Q1 2014 to Q4 2016. Unsurprisingly, Advanced Sovereign bond funds and MMFs have the highest levels of liquid assets. Both categories of funds have experienced an increase in liquid assets over the past two years, with the trend particularly noticeable for MMFs. High Yield funds tend to have the lowest levels of liquid assets, followed closely by Advanced Financials. There is very little difference, on average, between Advanced Corporate, Advanced Mixed and Other bond funds. Liquid assets also appear to be trending upwards in Advanced Mixed and Advanced Corporate bond funds over recent quarters.

Low levels of liquid assets in High Yield funds using this methodology are not sur-

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[7]individual fund redemption shocks are weighted by fund AUM as a percentage of AUM for the category

prising since sub-investment grade assets are not included in the HQLA classification. Advanced Financial bond funds also appear to have quite low levels of liquid assets. Similarly to sub-investment grade bonds, debt securities issued by the financial sector are deemed not to have sufficient liquidity during stress periods and are not included in HQLA. Advanced Financial bond funds, however, have higher levels of liquidity buffers on average than High Yield bond funds.

Figure 5 provides a breakdown of HQLA per fund category by Level 1 and Level 2 liquid assets. Level 1 can be seen as the narrow definition of liquid assets, those which are included with no haircut.[8] Advanced Sovereigns and MMFs hold very high levels of Level 1 assets and therefore can be seen as highly liquid. Liquid assets held by Advanced Corporate and Emerging Market bond funds are predominantly Level 2, and are included with a haircut to reflect the potential for negative market movements during stress periods.

The results of the LCR analysis are presented in Figure 6. Each point on the graph represents an individual fund, with the size of the point representing the AUM of that fund. The black line in the chart indicates $LCR = 1$, with funds below the line having a potential liquidity mismatch. The largest funds by AUM are predominantly in the MMF and Advanced Mixed categories of funds.

In most fund categories, the majority of funds reside above the $LCR = 1$ line, indicating relatively low levels of liquidity mismatches. High Yield bond funds again stand out due to their high levels of liquidity transformation, with the vast majority of funds in this category residing below the black line in all time periods. However, even for Advanced Mixed and Advanced Financial bond funds, a significant minority of funds have $LCR < 1$. We suggest future work would measure the

liquidity of these funds using market and trading information (such as bid ask spreads, daily volumes etc.), and the comparison of these results with the analysis here. The results indicate that, particularly for High Yield funds, a simple liquid assets classification methodology based on credit ratings, maturity and sector may not be appropriate for ongoing liquidity monitoring.

5 Conclusion

A key finding of this analysis is the clear delineation of Advanced Sovereign and High Yield bond funds from the other bond fund categories, in terms of both HQLA and LCR. While this finding is not entirely surprising given a certain level of overlap in the HQLA classification and the fund categorisation methodologies, it highlights the need for separate methods for analysing liquidity mismatches in these categories. A simple liquid assets ratio such as that outlined in IMF (2016), or the LCR framework presented in this paper, appears to be appropriate for Advanced Sovereign bond funds and MMFs but is less appropriate for High Yield bond funds. However, the methodology does highlight low levels of cash/liquidity buffers in High Yield funds which are invested in historically less liquid markets while offering daily redemptions to investors.

Liquidity indicators based on credit ratings and sector do not take into account market depth, trading volume, price impact or transaction costs; which are common elements of liquidity metrics in the literature.[9] Thus, a HQLA type classification methodology may be too blunt to capture the liquidity of complex debt security portfolios, for example excluding all securities issued by financial sector companies. Further research is required into more appropriate measures of portfolio

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[8] Level 1 assets are broadly consistent with the IMF (2016) definition of liquid assets
[9] See for example Sarr and Lybek (2002)

liquidity, particularly for funds focusing on sub-investment grade and financial sector debt securities, while taking into account the effect of investor composition on stressed outflows. Furthermore, future research is warranted into the development of methodologies which take a more holistic view of the risks associated with the funds industry (e.g. liquidity risk, solvency risk and interconnectedness), capturing interactions which could inform stress tests and systemic risk analyses.

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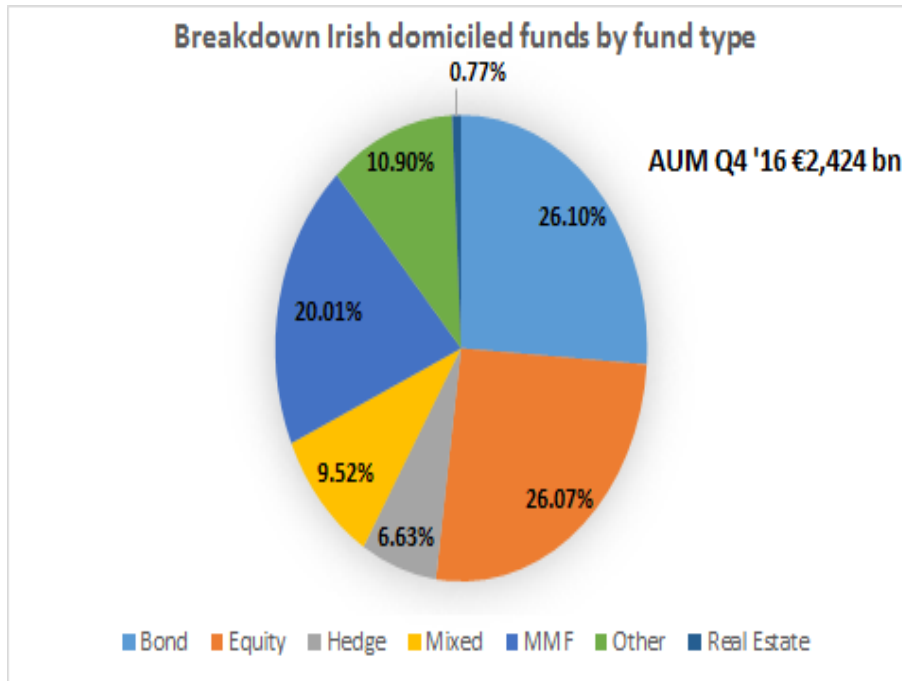
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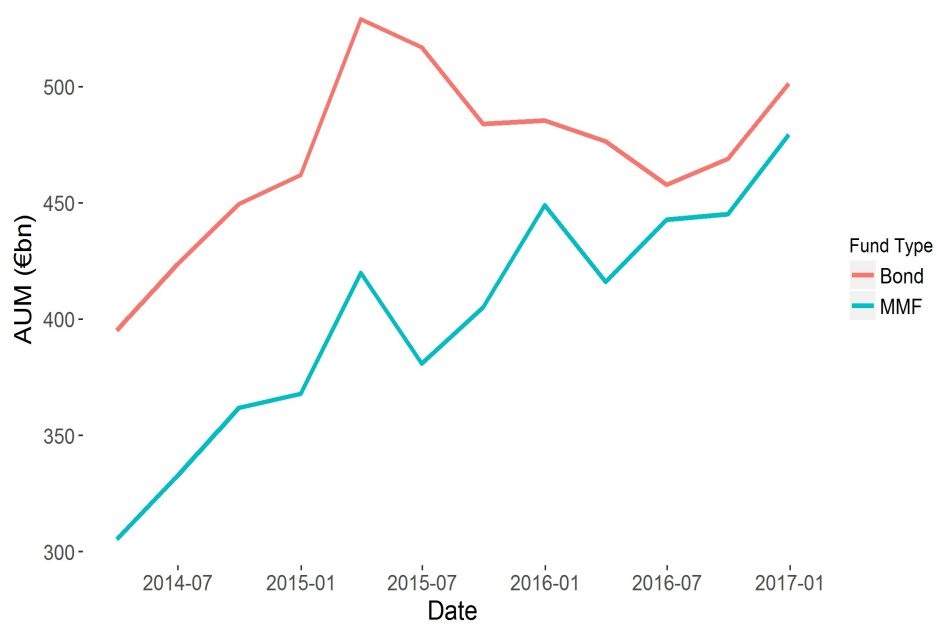
Figure 1: Irish Domiciled Investment Funds: Q4 2016

Breakdown Irish domiciled funds by fund type

AUM Q4 '16 €2,424 bn

0.77%
10.90%
26.10%
20.01%
9.52%
6.63%
26.07%

■ Bond ■ Equity ■ Hedge ■ Mixed ■ MMF ■ Other ■ Real Estate
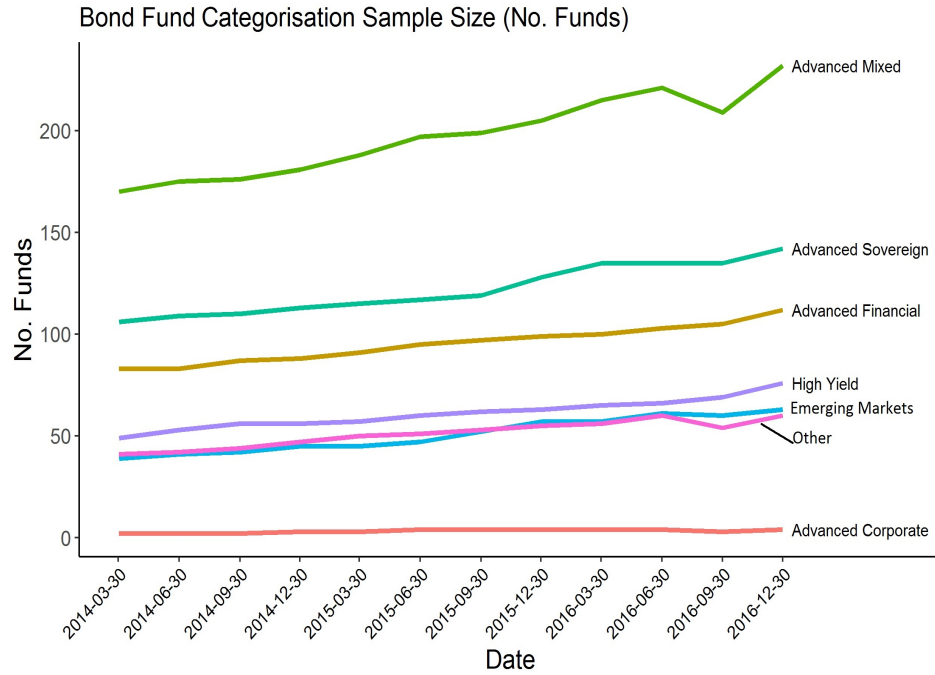
Source: Central Bank of Ireland: MMIF Return

Figure 2: UCITS Investment and Money Market Funds (daily dealing)

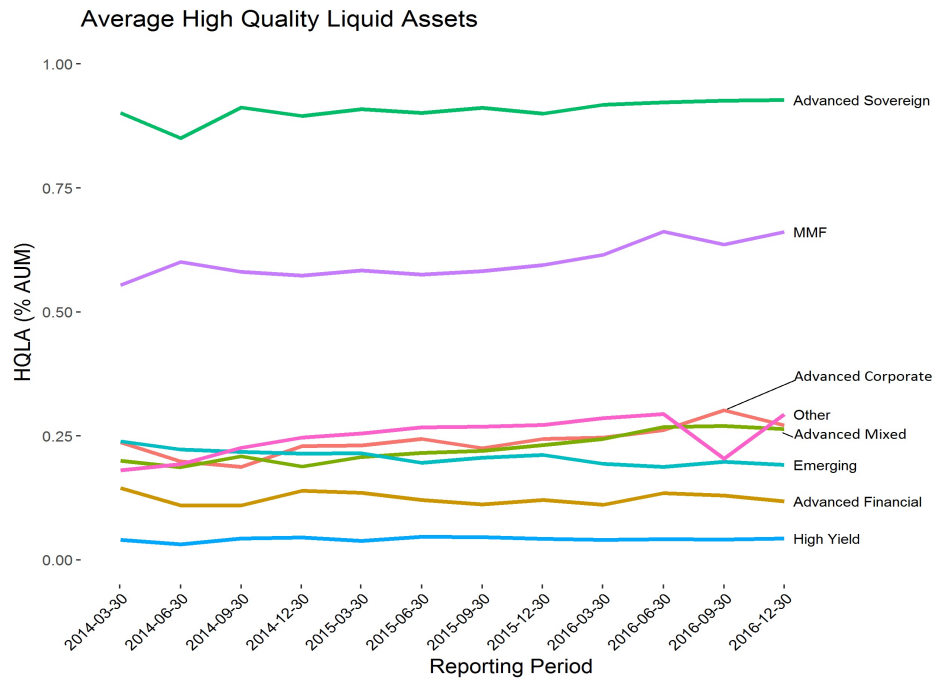
Sample Size for UCITS Funds with Daily Dealing

Source: Central Bank of Ireland: MMIF Return
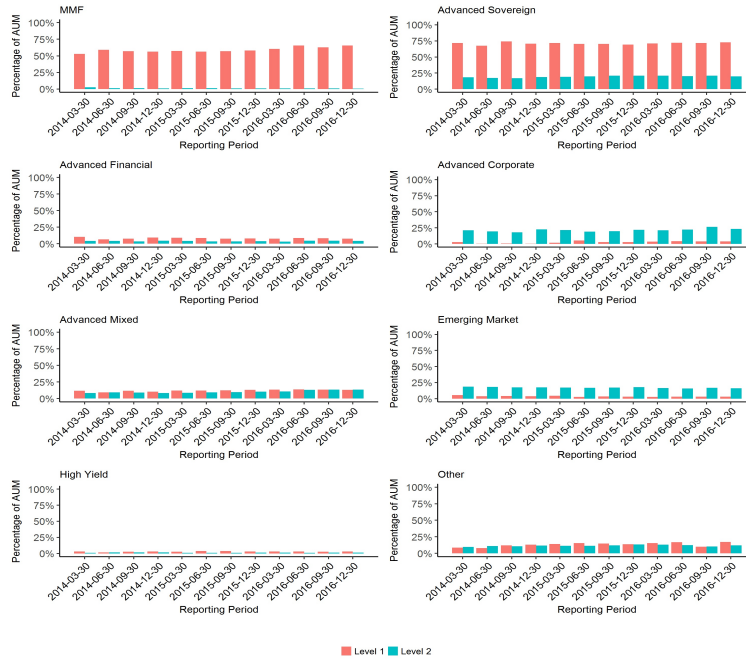
Figure 3: No. Funds per Category

Bond Fund Categorisation Sample Size (No. Funds)

Source: Central Bank of Ireland: MMIF Return

Figure 4: Average HQLA (% AUM)

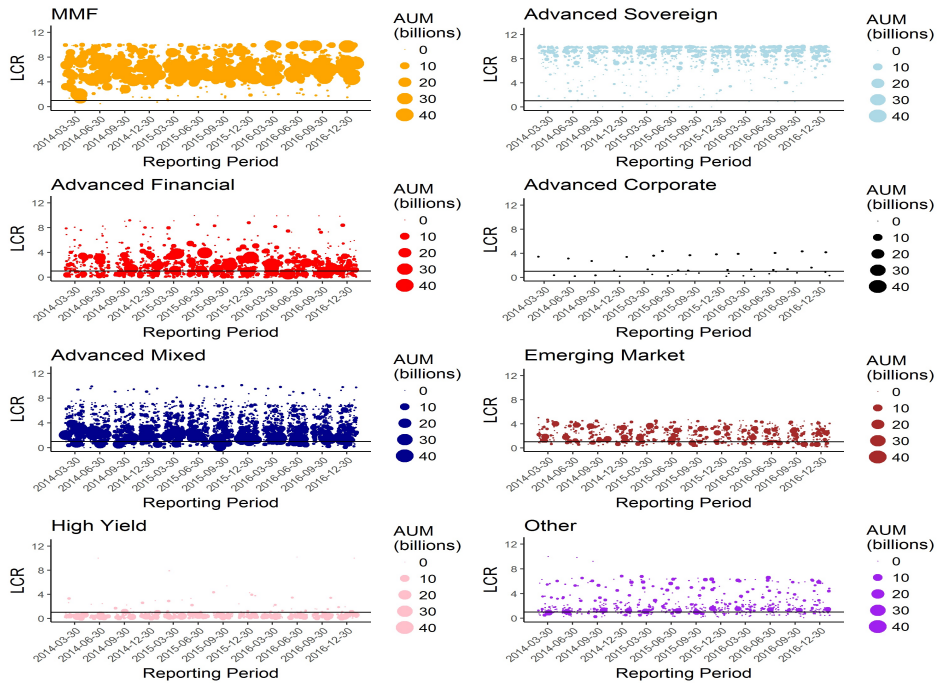
Average High Quality Liquid Assets

Source: Central Bank of Ireland: MMIF Return

Figure 5: HQLA Breakdown

Source: Central Bank of Ireland: MMIF Return

Figure 6: Liquidity Coverage Ratio

Source: Central Bank of Ireland: MMIF Return