Effective financial risk management in unconventional times

Thomas Brophy, David Doran and Steve Kilkenny[1]

Abstract

In recent years, in particular after the Great Financial Crisis and the pandemic, the balance sheets of central banks have become more complex. This has been due not only to the provision of large amounts of liquidity into the financial system through traditional monetary policy lending, but also to implementation of unprecedented quantitative easing (QE) policies. These developments have enlarged central bank balance sheets while changing the composition of the asset base, creating the conditions for an interest rate mismatch in central bank balance sheets. Up until recently, this has coincided with a low and negative interest rate environment across many developed economies, where risk premia were compressed due in part to the above policies. However, in the post-pandemic period, a sustained inflationary environment has forced central banks to raise interest rates and tighten financial conditions, with knock-on effects on the yields of many sovereign markets. This had led to a higher cost of liabilities for many public investors relative to the income earned on assets. This paper presents examples of two approaches that public investors can adopt to identify and respond to the risks of this scenario for their investment assets in a manner that recognises the contemporaneous financial environment relative to the cycle. The first method entails adopting an "all-balance sheet" approach to assessing investment risk, in the light of material non-investment risks arising from QE. The second approach proposes a means of defining a risk appetite for a public investor, with the aim of balancing investment risk tolerance with changing risk environments over time, in the light of risks elsewhere on the balance sheet.

JEL classification: G32.

[1] The authors are Head of Financial Risk Management and Head of Organisational Risk Division and Head of Investment Policy & Risk Monitoring, respectively, in the Central Bank of Ireland. The views expressed in this article are solely the views of the authors and are not necessarily those held by the Central Bank of Ireland or the European System of Central Banks. The authors would like to thank Glenn Calverley and Eimear Keogh for helpful comments – any remaining errors or omissions are our own. Corresponding email: steve.kilkenny@centralbank.ie.

1. Introduction

Since the Great Financial Crisis (GFC) and up until the Covid-19 pandemic, the traditional investment universe of European public investors such as central banks, (principally reserve currency sovereign fixed income markets), was characterised by persistently low, and even negative nominal interest rates. This was largely the result of the non-standard asset purchase programmes of many central banks aimed at supporting the monetary policy stance of low interest rates and higher liquidity, which significantly increased the amount of very low or negative yielding securities on central bank balance sheets.

These developments posed a number of challenges in terms of how best to maintain effective investment risk management through the cycle, particularly as interest rates rise and the market pricing of risk premia begins to normalise. In the aftermath of the Covid-19 pandemic, as well as due to wider geopolitical developments, there has been a sustained increase in inflation rates across many global economies. A primary response of central banks to this inflationary environment, has been to tighten monetary policy through increasing policy rates and winding down QE policies. For many public investors, this is leading to a materialisation of losses due to a mismatch of interest rates on both the longer-term assets and the shorter-dated liabiliies of the balance sheet, arising from such non-standard monetary policy measures. This underscores the importance of using an all-balance sheet model when assessing the financial risk impact of exposures, including investment exposures, as well as employing scenario analysis incorporating the potential for higher interest rates. A balance sheet model is presented, that can be used for this purpose.

The post-GFC period of low and negative rates which had prevailed until end-2021 led many central banks and other public investors to diversify outside their normal investment universe, in an effort to maintain investment income and contribute towards covering operating costs and profitability. This was at a time when the effects of the record levels of systemic liquidity, coupled with record low interest rates and the impacts of asset purchase programmes, affected the extent to which market prices accurately reflected the range of financial risks (Albertazzi et al (2021)). This circumstance can lead to an unintendedly larger increase in the risk of investment exposures of a central bank as it seeks to generate better returns, but which could increase further as financial market conditions change.

The cyclical shift from a period characterised by financial market search for yield, against a backdrop of large amounts of liquidity and zero bound interest rates, conceivably created an environment conducive to a "Minsky moment" that public sector investment frameworks must guard against in a way that reflects the asset and liability dynamics of the whole balance sheet. Since 2022, there has been an increase in market volatility across most asset classes, as higher yields led to a materialisation of asset value adjustments across both fixed income and equity markets as well as other asset classes. Moreover, the recent policy rate tightening and a rise in nominal bond yields in advanced and emerging markets has altered the balance sheet asset and liability dynamics as well as the relative contribution of risk premia to asset prices, and any further tightening in monetary policy and financial conditions is likely to continue this trend.

Therefore, we present a framework for assessing financial risk that uses the traditional risk metrics such as expected shortfall and value-at-risk, as compared with

financial buffers, but complements it with a novel environmental score that seeks to account for changes in the financial risk environment, including the impact of geopolitical risks on the central bank's investment universe. The parameters of this score can be calibrated to reflect variables such as a public investor's risk appetite, as well as other parts of the balance sheet where there is potential for financial risk. This facilitates the application of scenario analysis, to allow the public authority to assess the potential riskiness of its portfolio or balance sheet, relative to its risk appetite, in prescribed future states.

The paper is structured as follows:

Section 2 sets out the recent period of financial market risk pricing uncertainty, set against the prevailing interest rate environment. Section 3 introduces a balance sheet model, and how it can be used as an investment risk tool in light of interest rate mismatch risk. Section 4 outlines a novel approach to assessing investment risk that operates as a through-the-cycle indicator of risk levels and helps to guide asset allocation decisions. Section 5 presents conclusions.

2. Interest rate cycles and pricing of financial risk

2.1 Low interest rate environment

Traditionally, the investable universe of public investors, in particular central banks, has focused on highly liquid and highly rated fixed income assets. This is reflective of the low risk appetite characteristic of public investors, as well as the role that such assets play in the delivery of mandates related to exchange rate and macroeconomic stability, ie these assets need to be sellable within a reasonable timeframe and close to current market price (Doran et al (2020)). Other roles for investment assets include being able to help cover the operating costs of a public investor, as part of contributing to central bank policy independence.

In the midst of the exceptionally long period of low and often negative interest rates for the assets until end-2021, as mentioned above, public investors' investment frameworks faced acute challenges as returns became increasingly difficult to generate within their risk appetite. In addition to historically low interest rates, asset purchase programmes transmitted accommodative monetary policy across the yield curve as well as reducing asset availability due to the scale of asset purchase programmes.

In particular, the advent of negative interest rates across much of public investor's traditional universe created something of a paradox, challenging the ability to adhere to conservative investment policy principles. Also, given the scale and extended time frame of the asset purchases undertaken during this period, the availability of suitable investments became increasingly constrained. In the context of a policy principle of avoiding losses, this became incompatible with investing in highly liquid and highly rated fixed income assets. This was particularly the case for public investors, who use their investment assets to help cover their operating costs.

This forced public investors to question their risk appetite and to consider purchasing new or additional asset classes, often with lower credit quality and liquidity than they would otherwise have done, in order to generate return and keep investment losses to a minimum.

2.2 Pricing of financial risk

One of the drivers of the low and negative interest rate environment that public investors have faced was the QE policies implemented by several global central banks (ECB (2015)). These policies involved large-scale purchases of government bonds or other financial assets, in order to stimulate economic activity or to achieve a price stability mandate. The policies were intended to operate through a number of channels, one of which was the portfolio rebalancing channel. Through this channel, as central banks purchased eligible assets and expanded the excess liquidity in the financial system and lower yields, investors were encouraged to rebalance towards riskier assets as demand for "safer" assets increases (Albertazzi et al (2021), Bua and Dunne (2017)). This could then have the effect of increasing the demand and prices for riskier assets and, all else being equal, reduce the risk premia being offered to investors.

This compression of risk premia had the effect of de-anchoring asset prices from fundamentals in some cases. In these areas of the financial markets, risk premia were forgone in lieu of seeking assets that offered some level of nominal return. An example is the S&P 500 index, which from peak to trough rose almost sevenfold between 2009 and end-2021. Another example is the corporate bond market, where yields on many issuers fell, with some turning negative in recent years.[2]

2.3 Effect on public investors' universe

The portfolio rebalancing channel described above also affected the investable universe of public investors, and any relevant risk-return trade-offs. Until recently, returns have been compressed across many of the traditional assets that public investors use to construct their portfolios.

By way of example, in the Central Bank of Ireland's (CBoI) case, its discretionary investment assets were wholly denominated in euros prior to the beginning of QE and the period of sustained low interest rates. Partly in reflection of the low and negative interest rate environment, the CBoI made efforts to progressively diversify its investment assets to ensure a robust variety of income sources and to help cover its operating costs and contribute towards financial independence (CBoI (2022)). This involved the creation of a number of foreign currency (FX) portfolios, an equity portfolio as well as increasing holdings of physical gold. These actions were intended to enhance the resilience of income over the longer term, and help to safeguard financial independence, notwithstanding some potential for variability in returns over the short term.

As with other euro area central banks, the purpose of asset diversification was to build the resilience of the balance sheet through the economic cycle, reducing concentration and gaining exposure to different interest rate cycles. Additionally, the recent sustained increase in inflation across many of the traditional public investor markets, with a related increase in central bank policy rates and nominal rates, has meant that some of the markets, such as in the euro area, have become a more compelling investment case.

[2] The ICE BofA 1-10 Year AAA-A Euro Corporate Index was negative-yielding on a number of occasions over 2019–21.

3. Balance sheet perspective on investment risk

3.1 Interest rate mismatch risk

The effect of monetary policy asset purchase programmes has been that central banks (including the CBoI) have purchased large amounts of medium- to longer-dated sovereign bonds. In the case of the Eurosystem, this has been taking place since 2015, and these holdings are accounted for at amortised cost. Typically, due to the prevailing interest rate environment, these bonds were purchased at low or negative rates, and will likely remain on public investors' balance sheets for some time, given the long-dated nature of the holdings.

These transactions correspond with a sizeable increase in the liabilities of central banks' balance sheets. These liabilities are remunerated at variable interest rates linked to short term policy rates. Given this balance sheet structure, central banks such as the CBoI are exposed to an interest rate mismatch between income earned on assets, and the cost of funding attached to liabilities. This mismatch can have a material impact on income should the cost of liabilities increase significantly (Donnery et al (2015)) while income from assets is slower to adjust. The recent sustained increase in inflation has led many central banks to respond by increasing their policy rates, in order to deliver on their price stability mandate. As a result, the anticipated interest rate mismatch risk has materialised, with many central banks expecting to experience a period of very low profitability or losses.

3.2 Central Bank of Ireland balance sheet model

Given the interest rate mismatch on the CBoI balance sheet, a quantitative analysis is undertaken on a regular basis to assess the required level of financial provisions to be held against this risk, as well as other financial risks. In order to complete these analyses, the CBoI uses an in-built model that incorporates both the current and expected structure of the balance sheet over a 10-year horizon. This is combined with a scenario-based approach to key financial market and economic variables, which allows the CBoI to compute a breakdown of profitability outcomes across various potential future states.

The quantification is also supported by an assessment made according to the prevailing financial environment and the applicable accounting rules. Supporting this assessment, the model identifies a range of risk sensitivities, using financial market and economic scenario data generated from both a historical and market-implied perspective. It is important to note here that it is a statistically driven quantification exercise, and does not involve taking a specific market view on scenarios.

Using this balance sheet information as well as the scenario data, the CBoI can project forward both the profitability and balance sheet positions for 10 years. A scenario can then be chosen at the relevant percentile for the assessment of provisions (eg the 99th percentile). This is completed by aggregating losses across the 10-year horizon, to help quantify the provision that is required. This is described as a gross cumulative loss estimate. As required, this analysis can be supplemented by internally developed scenarios to further validate assumptions and judgments in respect of the anticipated evolution of idiosyncratic financial risks.

3.3 Investment risk in the context of balance sheet

While the balance sheet model described above was developed primarily for provisioning exercises and estimating interest rate mismatch risk, it can also be used to assess investment risk for both current and prospective investments. It can help analysts and decision-makers to better understand the interaction between investment risk, and the other risks present on the balance sheet, particularly interest rate mismatch risk.

In order to illustrate this in a hypothetical way, we can consider the baseline balance sheet position against a number of changes in investment strategy:

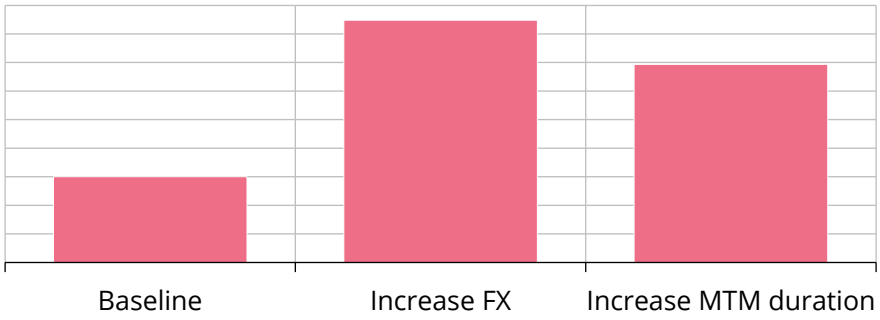
1. *Increase duration of portfolios*: In this example, the duration, or sensitivity to changes in the interest rates, is increased for all relevant marked-to-market portfolios.
2. *Increase the size of FX portfolios:* In this example, the size of the overall foreign denominated currencies, is increased, funded by a reduction in euro-denominated assets, but the composition and other parameters remain unchanged.

The analysis from these different options can be assessed on a standalone basis, but also in conjunction with the overall balance sheet risk.

3.4 Interaction of investment risk and interest rate mismatch risk

It can be seen from Graph 1 below that changes in investment strategy, as described in the previous section, can impact on the gross cumulative loss estimates that are produced over a 10-year horizon, although interest rate mismatch risk remains the predominant risk on the balance sheet. In the hypothetical examples presented, the increase in FX holdings and duration would increase the cumulative loss estimate relative to the baseline (ie status quo) scenario.

Cumulative balance sheet loss estimates under different strategies Graph 1



Source: authors' elaboration.

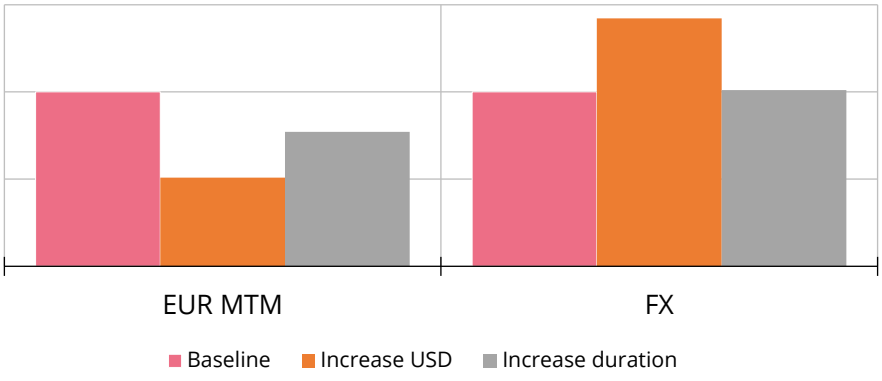
For the increase in FX, over the 10-year period overall income is expected to be higher across the scenarios on average. However, when focusing on the gross cumulative loss estimate (which includes only years where losses materialise at an

overall balance sheet level), the scenarios where losses are expected due to interest rate mismatch risk, these risks can be amplified by the potential for adverse moves in foreign exchange rates. This incremental increase in risk is, however, less than the increase in standalone risk estimates shown below, illustrating the benefits of diversification.

For the increase in duration, the negative impact on the marked-to-market portfolios, through capital losses on fixed income holdings, coincides with the scenarios where an increase in interest rates leads to a materialisation of interest rate mismatch risk. It is important to note here that this analysis assumes an increase in duration over the full 10 years, with no adjustments made in response to market conditions at any one point in time. This illustrates the importance of fully considering the balance sheet perspective in respect of investment strategy, and the interaction of investment and interest rate mismatch.

As can be seen below in Graph 2, such hypothetical changes in investment strategy can increase the standalone risk estimates for a type of risk. This chart shows, for each of the two hypothetical scenarios as well as the baseline, the impact on the standalone cumulative loss estimates, for the euro marked-to-market portfolio and FX portfolios respectively. For example, the increase in FX can reduce the EUR MTM risk, but can lead to a greater exposure to adverse FX rate movements. This underscores the importance of being aware of the potential for higher volatility and potential for valuation losses, over shorter time horizons, in specific asset classes.

Standalone loss estimates under different strategies, for EUR MTM and FX portfolios respectively — Graph 2



Source: authors' elaboration.

4. Defining an investment risk appetite for a public investor

4.1 Interest rates and pricing of risk: The Minsky hypothesis

As outlined in Section 2, up until end-2021, public investors operated in an environment of historically low interest rates and record low levels of risk pricing. A

combined effect of these factors created an environment for potentially hidden investment risks.

The Minsky hypothesis considers that, when markets are overly benign, risks may be underrepresented or underpriced In Danielsson et al (2018), the authors' key conclusion is that low volatility is a strong predictor of financial crises. In such a financial crisis, volatility can be expected to increase significantly, and can do so suddenly. In Bhattacharya et al (2015), the authors construct a model to demonstrate that optimism among investors and associated risk-taking can be accompanied by lower risk premia, facilitating the build-up of excessive risk, which can materialise at a later point in the cycle. In Fostel and Geanakoplos (2014), the authors describe the concept of a "leverage cycle", whereby low volatility for an extended period of time can lead to an increase in leverage, which can then increase the vulnerability of economies and markets in a downturn.

For public investors, this can mean that, if they change their asset allocations in a more benign risk environment, future risk levels could increase substantially due to materialisation of a "Minsky moment". Thus, the potential for such a development should inform risk appetite today.

In the period between the GFC and Covid-19, risk assets experienced a benign risk environment, as outlined in Section 2. Arguably, features of this Minsky hypothesis are currently materialising, as central banks increase policy rates and tighten monetary policy in response to a sustained inflationary environment and against a backdrop of elevated geopolitical risks. Since the GFC, this has led to a fall in the value of riskier assets, an overall increase in market volatility, as well as the increased potential for greater movements in asset values.

The investment risk frameworks of public investors should therefore be calibrated to look through these changes in risk conditions and capture all relevant environmental factors, as well as anticipating the effects of price normalisation on risk appetite. In this way, the risk appetite of the public investor is protected, to the extent possible, from changes in financial market regimes, and associated repercussions for risk levels, and seeks to protect against the paradigmatic changes in risk dynamics which characterise a Minsky moment.

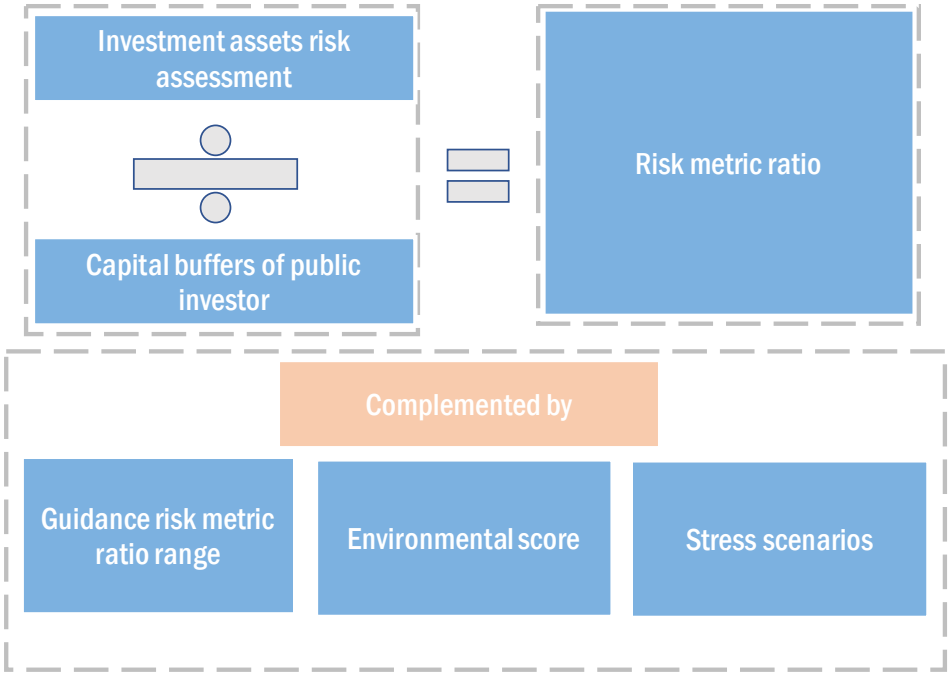
The implication of this from a risk appetite or risk-budgeting perspective is that there should not be a full utilisation of risk appetite in benign market conditions. This is to avoid the risk exposure increasing substantially above risk appetite, should the risk environment shift in an adverse manner. Conversely, when markets are under severe stress, it could be expected that the full risk appetite is utilised (thereby avoiding a harmful fire sale of assets or inefficient use of capital), as this would be considered an appropriate risk level in the context of the prevailing environment.

The CBoI has developed a framework ("risk metric framework") that seeks to incorporate measures to represent the risk-taking capacity of the investment assets. The framework takes into account risks present elsewhere on the balance sheet and the wider risk environment while also considering an element of future directional dynamics. The features of this framework may also be relevant to other public investors, with a number of parameters customisable to the specifics of the investor.

4.2 Risk metric approach – key elements

The risk metric framework consists of a number of key elements, which are described below (see also Table 1). These elements can be tailored for any public investor, according to their mandate and risk appetite.

Key elements of the risk metric approach — Table 1



Source: authors' elaboration.

- **Investment assets risk assessment:** This risk assessment is based on the assessment and quantification of both market and credit risk of the applicable assets/portfolios, and the preferred CBoI risk estimate is expected shortfall at the 99th percentile, over a one-year horizon.[3] This quantification can be completed on an economic or accounting basis (eg if there are unrealised revaluation gains applicable to some assets). Under the *accounting basis*, the potential losses are estimated based on the worst simulated economic scenarios impacting the central bank's P&L over a one-year horizon *after* subtracting the applicable revaluation accounts. The economic basis does not subtract revaluation accounts from risk estimates, but includes them as part of capital buffers. The economic approach therefore reflects unrealised results on security portfolios that are revalued and on foreign currencies that would not necessarily be reflected in the P&L account.
- **Capital buffers of public investor:** This is used as a measure of the capacity of a public investor to bear risk, as these buffers could then be used to offset losses should they occur. This can reflect all financial

[3] This horizon is constructed through the "square root of time", using more frequent returns observations.

buffers (reserves and provisions) or just those have been apportioned to investment assets, on an ex ante basis.

- **Risk metric ratio:** This is computed as the first item above (investment risk assessment), divided by the second. This gives the overall risk of the investment assets, proportionate to the risk-taking capacity of the public investor.

The three elements above are also complemented by the following elements:

- **Guidance risk metric ratio range:** This would outline the range within which the risk metric ratio should sit, and can be interpreted as lower and upper bounds for a public investor's risk appetite for their investment assets. Another way of saying this is that the range captures the risk appetite in the most benign risk conditions up to the most severe. This range would also be heavily informed by other risks that are on the balance sheet ie the appropriate range would need to be assessed relative to other significant risks, such as interest rate mismatch risk. Conversely, where a public investor has large holdings of foreign reserves for exchange rate management, a higher guidance range may be necessary. As a public investor's balance sheet size and composition changes over time, this range should be re-examined to ensure it remains appropriate, and does not interfere with primary mandates and objectives (eg price stability, financial stability).
- **Environmental score:** This can be an internally constructed measure, which reflects the riskiness of the public investor investable universe, in a manner independent of actual holdings or strategy. It can also reflect the presence of geopolitical risk, through inclusion of asset classes that would not normally form part of a public investor's investable universe, but which are more sensitive to the geopolitical backdrop (eg commodities).
- **Stress scenarios:** The inclusion of prescribed market and credit shock scenarios can also help to illustrate the key risk sensitivities of the investment assets. In order to calibrate the market stress scenario, the most volatile exposures are subjected to a market shock at a certain VaR percentile level based on historical data, which obviates the need for assumptions on correlations. For the credit risk scenario, downgrades are modelled for the lowest rated issuers, as such events have the highest impact on the CBoI risk profile. These scenarios can then be approved by the governance bodies and computed on a periodic basis, for additional information to aid decision-making.

Bringing all the elements described above together, the risk metric ratio can be compared with the environmental score, at a point in time, to provide guidance to internal stakeholders as to the level of risk on the investment assets, relative to the risk environment prevailing, as well as the public investor's risk appetite. It is also possible to map associated colour coding onto directional guidance that can be provided to governance bodies, as an aid to investment asset decision-making.

Graph 3 below demonstrates all these features brought together. A risk matrix is constructed as a visualisation of the factors considered and is intended to help support discussion around the risk metric at a point in time given the prevailing risk environment and to inform investment decisions. In this example, two different

portfolio compositions are compared at two different points in time as different risk environmental scores apply. Using this hypothetical example, the following conclusions can be drawn:

- Portfolio Example B is riskier than Portfolio Example A – this is evidenced by the ES99 to capital ratio (the risk metric ratio) being higher.
- However, the risk of Example B was computed in a higher risk environment, this is demonstrated through the use of the environment/risk capacity score matrix. Therefore, in a higher risk environment, it would be expected that more of the risk appetite (ie a higher risk metric ratio) is utilised, as this would be considered appropriate in the context of the prevailing environment. In this context, both Portfolio A and B correspond to the same amber colour coding on the chart, meaning there may be only limited room for tactical (as opposed to strategic) changes in risk of the portfolios. A straight horizontal range for the risk metric ratio has been applied for ease of reference for internal decision-making, however, alternative ranges can be set to exclude the possibility of reaching the red zone (as defined below) at the top of the range in a benign environment. In any event, the framework can be used flexibly with the chosen range depending on the overall balance sheet risk profile (taking into account the monetary policy related assets) and income required to meet expenses.
- The application of stress scenarios or sensitivity analysis increases the risk of these portfolios further. These measures provide further contextual and dynamic or forward-looking information on the potential for a deterioration in the credit quality or market risks of the investment exposures, and how these risks correspond to the public investor's current risk appetite. Such scenarios serve to highlight how likely the CBoI is to breach the range in the event of stressed but plausible scenarios materialising, and are particularly useful when considering alternative strategies or a variations in the investment asset composition.
- The dotted lines provide the guidance range applicable. In both these examples presented, the risk levels of the portfolios are currently below the guidance range. Once the more severe stress scenarios are applied, the portfolios would fall within the guidance range applied.
- The colour coding of both portfolios are broadly similar, meaning that the same guidance applies at this level. This is irrespective of the lower risk metric ratio in Example A and is consistent with the finding that, when market conditions are benign, risks may be underrepresented and underpriced (Danielsson and Zhou (2016), Danielsson et al (2018)). Broadly speaking, the further towards red that the risk metric ratio moves, the lower the capacity to take on furher investment risk. The mapping of colour coding onto worded guidance is not intended to act as a hard constraint (although it could be used in that way), but more as a useful aid to decision-makers when interpreting the matrix and applying it to investment decision-making. The colour coding broadly corresponds to the following guidance:

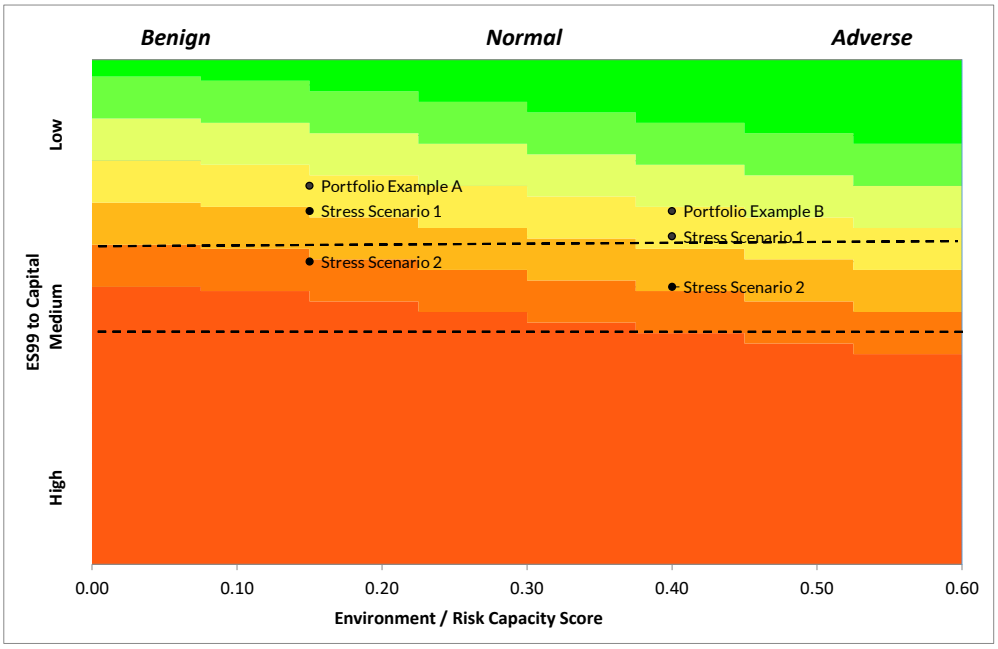
i) **Green**: additional strategic risk-taking may be considered for the investment assets. This could include additional exposure to foreign denominated fixed income holdings;

ii) **Yellow/amber**: there may be some scope for additional strategic risk-taking or adding tactical adjustments (such as increasing duration) to the investment strategy;

iii) **Red**: risk is at or above risk metric guidance, and the current levels of investment asset-related risk should be monitored closely or be formally reviewed.

If the risk metric ratio is persistently in the red zone, this could necessitate a discussion on the potential to either reduce the investment risk appetite, or to increase capital buffers, with either option potentially moving the metric out of this zone.

A risk metric assessment for two example portfolios — Graph 3



Source: authors' elaboration.

4.3 Reflections on framework in current environment

The importance of the preceding models and frameworks presented in the paper has been underpinned by the recent change in the economic and risk environment. In particular, the risk metric framework presented contributes to a more comprehensive through-the-cycle indicator of risk levels. This allows the public investor to factor in the current risk environment, which until the pandemic had been characterised by low volatility and supported by the accommodative monetary policies of many global central banks. However, the environmental score would have provided this context alongside investment decisions and led to a cautious approach in increasing the risk metric ratio in such benign conditions (thereby limiting the tendency to search for yield by lowering the minimum permissible credit threshold or diversifying outside

the more traditional investment universe for public investors). Consistent with this approach, the environmental score in the more recent risk environment would tolerate a higher risk metric ratio and avoid the need to de-risk an investment strategy that had been calibrated during a period of low volatility and against a calmer geopolitical backdrop.

Recent changes in the environment raises specific challenges for central banks. Firstly, the increase in interest rates has led to the materialisation of interest rate mismatch risks for many central banks, with knock-on implications for income and a potential for financial losses. In this scenario, public investors will require the use of their financial buffers in order to absorb these losses, and this could mean that the available capital or buffers for their investments could be lower than previously anticipated. This would imply a reduction in investment risk appetite, all else being equal.

However, set against this, many public investors hold investment assets primarily to help cover operating costs (in order to pursue their respective mandates) and to produce a reasonable return. Therefore, in the coming years, there could be a natural tension between the traditional financial risks that have been outlined in this paper, with a "financial independence" risk if a public investor perceives a risk to covering its costs (Jones (2016), Doran et al (2018)). In the event that operating costs are not matched by income, due predominantly to the materialisation of interest rate mismatch risk arising from the price stability mandate, this could lead to successive years of losses that could progressively deplete financial buffers and lead to concerns about credibility and financial independence. In this case, consideration could be given to reducing the investment risk appetite or the guidance risk metric ratio range in response, as compared with other options such as rebalancing the portfolio towards safer, less volatile assets, selling selected investment assets in order to realise revaluation gains or reducing expenditure.

5 Conclusion

This paper presented two examples of approaches public investors can adopt to more effectively identify and respond to the changes in risks to their investment assets which explicitly takes into account the implications of the contemporaneous financial environment relative to the cycle. Firstly, an all-balance sheet approach to assessing investment risk was presented, in light of material non-investment risks arising from purchase programmes associated with QE. The second approach proposed a means of defining a risk appetite for a public investor, which aims to balance investment risk tolerance with changing risk environments over time, in the light of risks elsewhere on the balance sheet. It was demonstrated that the environmental score (and therefore the guidance on future risk-taking capacity) can be similar for investment assets with varying levels of risk exposure when taking into account the stage of the current market cycle, and that this can be a useful tool in avoiding procyclicality when it comes to risk-taking for public investors.

References

Albertazzi, U, B Becker and M Boucinha, (2021): "Portfolio rebalancing and the transmission of large-scale asset purchase programs: Evidence from the Euro area", *Journal of Financial Intermediation*, vol 48, no 100896.

Bhattacharya, S, C Goodhart, D Tsomocos and A Vardoulakis (2015): "A reconsideration of Minsky's financial instability hypothesis", *Journal of Money, Credit and Banking*, vol 47, no 5, pp 931–73.

Bua, G and P Dunne (2017): "The portfolio rebalancing effects of the ECB's asset purchase programme", SSRN 2993136.

Central Bank of Ireland (2022): *Annual Report 2021*.

Danielsson, J and C Zhou (2016): "Why risk is so hard to measure", *DNB Working Papers*, no 494.

Danielsson, J, M Valenzuela and I Zer (2018): "Learning from history: volatility and financial crises", *The Review of Financial Studies*, vol 31, no 7, pp 2774–805.

Donnery, S, D Doran, R Gleeson and K Carroll (2017): "Non-standard monetary policy measures and the balance sheets of Eurosystem central banks", *Quarterly Bulletin*, no 3, pp 87–102.

Doran, D, R Gleeson, S Kilkenny and Š Ramanauskas (2018): "Assessing the financial risks and buffers of the central bank", Central Bank of Ireland, *Quarterly Bulletin*, pp 58–71.

Doran, D, S Kilkenny, Š Ramanauskas and A Shablov (2020): "An alternative approach to measuring the liquidity risk of public investors' investment assets", *Evolving Practices in Public Investment Management*, Proceedings of the Seventh Public Investors Conference.

European Central Bank (2015): "Box: The Governing Councils expanded asset purchase programme", *Economic Bulletin*, pp 15–18.

Fostel, A and J Geanakoplos (2014): "Endogenous collateral constraints and the leverage cycle", *Annual Review of Economics*, vol 6, no 1, pp 771–99.

Jones, B (2016): "Institutionalizing countercyclical investment: a framework for long-term asset owners", *IMF Working Papers*, no WP/16/38.