



Module: Risk Management

Hello everyone, my name is Jens van Egmond, Lead LDI strategist Netherlands at BlackRock and board member of Sportfondsen pension fund.

In this section, we will discuss long term economic and political risks and the influence on the investment portfolio and funding ratios. We will also consider the influence of central banks and the impact of tail risks. Lastly, we will discuss mitigation strategies.

Let's start by defining what we mean by risk in the context of investing. We define risk as the potential for a shortfall of the portfolio relative to its stated objectives. The impact of not meeting the objectives is more important and often better measurable than the likelihood of meeting the portfolio objectives.

The portfolio objectives are linked to a time horizon, which is an important parameter when assessing risk.

For short horizons, it is common to use volatility as the measure of risk. For example, when an investment has an expected return of 5% with a volatility of 15%, the volatility is the dominant variable. For long term horizons however, the expected return becomes the dominant variable as the volatility will average out relative to the expected return over time – the impact of returns grows exponentially, while the volatility impact grows with the square root of time. The estimation of the expected return thus becomes relatively more important than estimating volatility when the time horizon increases.

To illustrate the difference between short and long term horizons, we consider oil price and energy-related investments. The volatility of the oil price is known to be significant relative to other asset classes, and one element that should be considered when investing in oil companies for the long term is whether or not they are able to manage this volatility. However, what is probably much more important for the performance of the investment is whether oil will have a role in our future society or not – and thus whether there will be any demand for it in the long term. If the business model of the oil industry disappears the volatility of the oil price over a relatively short horizon will not matter too much.

In the case of oil, we have moved from a regime in which OPEC was united and controlled a majority of the oil market, to a regime in which the United States has become the largest oil producer in the world and no longer relies on imports from the Middle East. This is such a fundamental shift with geopolitical ramifications that any oil price model calibrated to the old regime is unlikely to work well



in the future. Add the climate change debate, technological progress in renewables and the rise of ESG investing and it becomes clear that any institutional investor has to rethink how to invest in energy-related assets and with which objective.

A fundamental shift such as in the energy market is known as a regime shift. Statistical analysis may yield very different results in different regimes, which is a risk when using data series that include a regime shift. On the other hand, if the data series are extremely long, we may be able to look through the regime shifts and observe a trend. A good example is the decline of interest rates over the past 800 years, as shown in this chart by the Bank of England. The chart also shows that we have been in a regime of falling interest rates for the past decades, but that the steep rise in interest rates post-WW2 was actually the anomaly, leading to the highest interest rates in peace time in history.

The high nominal interest rates of the 1970s can be directly attributed to another event never seen in history: sustained double digit inflation in advanced economies.

By subtracting inflation from the nominal rate, we can see the historical real interest rate in advanced economies.

We have to conclude that deeply negative real interest rates have been prevalent for multiple time periods. This means that savers and financial institutions with nominal liabilities, such as pension funds and insurers, are at risk of facing even lower interest rates that we see in today's economies.

Political risk may pose even further reaching consequences. A prime example for European investors is the risk of a Euro-breakup. It cannot be ruled out that the Eurozone may one day collapse under a sustained north-south divide or rise of nationalist political parties pursuing Brexit-like steps. The risks for investors have many dimensions including potential sovereign defaults, but are especially complicated in the case of interest rate and currency risk hedging. If derivative contracts reference a currency that no longer exists, there has to be a very clear fallback mechanism in the legal documentation to ensure that the economic exposure of the hedge remains intact. Strictly from an investment perspective, the risks could be very different for a Northern investor versus a Southern investor – it is imaginable that a Northern Euro or Dutch Guilder will gain a safe haven status comparable to the Swiss Franc, which would likely result in steep currency appreciation and deeply negative local interest rates.

The degree of globalisation is another variable that will be of major importance for how the world economy is structured and the kind of investments that will pay off. A combination of national security concerns, a desire for more resilience in supply chains following the Covid-19 shock and generic



nationalist tendencies, could potentially reverse the economic gains of free trade and globalisation of the past decades. This is an example of how political risk can hardly be separated from economic risk.

Given that much of the economy is built on institutional concepts such as property rights this should not come as a surprise. Logically, we identify the risk of expropriation as a tail risk in economic terms as it entails the violation of property rights by a government. We would expect this risk to increase in times of social-economic stress, leading to potentially disastrous outcomes such as the economic obliteration of Zimbabwe and Venezuela.

The ultimate outcome under different economic scenarios is strongly influenced by the response of the central bank and by fiscal policy. One could argue that after the deflationary contraction of 2008, central bank policy has targeted inflationary growth but what actual happened has more resemblance to deflationary growth.

**

In this section, we assess the role of central banks in the economy, in particular the impact the size of central bank balance sheets has on financial markets.

The current size of the balance sheet of central banks is determined by the amount of financial assets that were bought during past expansions. The main expansion took place after the Global Financial Crisis in 2008, as can be seen in this chart from the Bank for International Settlements (BIS). Central banks across the globe have purchased assets to support their respective economies or currencies and to influence interest rates.

The assets bought are mainly government and government related bonds but can also include corporate bonds and even equity Exchange Traded Funds (ETFs) in the case of the Bank of Japan. In April 2020, the Federal Reserve announced that certain high yield and municipal bonds will be included in its asset purchase program following the Covid-19 crisis, in addition to government bonds, Investment Grade Credit and Mortgage Backed Securities.

Central banks have policy objectives that are usually tied to keeping inflation under a certain limit. Some central banks have added objectives, such as the Federal Reserve, which has a dual objective of price stability and maximum employment. For any central bank, an overheating economy and inflation fears may induce it to restrain financial conditions.



Another potential reason for central banks to restrain financial conditions is the risk of creating zombie companies. Zombie companies arise when the efficient allocation of capital in financial markets gets distorted by prolonged periods of low interest rates. This ensures that borrowing costs remain at (artificially) low levels, allowing companies to survive that do not actually have a right to exist if they were to finance themselves at the higher interest rates that would apply without central bank intervention. Zombie firms are less productive and crowd out investment in, and employment at, more productive firms¹. The flipside for the central bank is that by restraining financial conditions it risks pushing these companies into default.

If the central bank moves from expanding or stable balance sheet conditions to a situation in which it is reducing its balance sheet, the market has to deal with a significant seller of assets. All else equal, this should reduce asset prices and increase interest rates. Central banks reducing their balance sheet also impacts liquidity in the financial system. The central bank sells assets in exchange for cash, therefore reducing liquidity in the economy.

A problem that could arise, is that the market has become used to the excess liquidity that the central bank provided during the expansion phase. A complex interplay of leverage in the financial system, banking and shadow banking regulation and asset prices determine how the decreasing liquidity is absorbed by the market.

An example of the market not coping well with absorbing decreasing liquidity took place in 2019. The reduction of the balance sheet of the Federal Reserve led to frictions in the US repo market, which broke down following a combination of real money needs such as corporates having to pay their taxes (thereby liquidating government bond holdings), limits to bank leverage available for repos and leveraged investors forced to refinance at any rate.

Repo rates spiked as high as 10% which forced the Federal Reserve to intervene, but not before certain investors had to liquidate positions because they could not refinance their repo positions. This is a prime example of liquidity risk that can impact portfolio returns. It shows how it is not obvious how central banks can effectively shrink their balance sheet without distorting financial markets. An incident like this may specifically hurt leveraged investors or institutions with maturity mismatches between assets and liabilities. A long-only portfolio of an investor with a long time horizon does not necessarily get impacted, and fundamental valuations do not necessarily change. However, it is in the

¹ Bank for International Settlements (2018)



interest of all financial market participants that the plumbing of the markets is robust and can be relied upon in every aspect.

In the Eurozone, a lot of emphasis has been placed on borrowing costs of Southern European economies and the associated sustainability of sovereign debt levels. The ECB has, with the announcement to do “whatever it takes” to save the Euro and the subsequent purchases of government debt effectively pushed down borrowing costs for indebted member states. These purchases have grown the ECB balance sheet to around 40% of Eurozone GDP. If the ECB wants to reduce its balance sheet to pre-crisis levels, it will face a trade off with debt sustainability concerns of some of its member states.

While we were all expecting central banks to start reducing their balance sheets, the extent of the pandemic crisis became apparent in March 2020. Most governments announced unprecedented support packages to keep the economy afloat in the necessary lockdown. Among a stock market crash, borrowing costs between Eurozone economies diverged widely again, which led the ECB to announce the 750 billion euros Pandemic Emergency Purchase Program. In the light of these developments, any debate on balance sheet reduction appears far away.

Investors are now faced with the daunting uncertainty of the economic impact of the Covid-19 pandemic and lockdowns versus the untested effectiveness of the combined response of governments and central banks.

In this section, we consider the consequences of fat tail risks that threaten the investment portfolio or degree of funding, as well as possible mitigation strategies.

Investors are exposed to fat tails because statistical models only offer an imperfect description of the world. Financial markets do not behave according to a normal distribution, despite the fact that a normal distribution is often assumed because it makes calculation easier. In practice, this can lead to the underestimation of risk as shown in this chart.

Volatilities and correlations are unstable and cannot be reliably predicted. They tend to increase under extreme conditions. One could argue that rather than classifying financial markets as risky, it is more accurate to classify them as uncertain. Acknowledging uncertainty in financial markets recognises that we lack quantifiable knowledge of the future and cannot possibly capture the future in a statistical confidence interval based on currently known parameters.



As discussed in the first section, the risks of an investment portfolio have to be measured relative to the portfolio objectives. For growth assets the risk is usually defined as underperformance relative to some return target.

The risks relating to interest rates also have to be contextualised relative to the portfolio objectives. In particular, interest rate risks should be evaluated on a relative duration basis. If an investor is long duration, for example through holding long term bonds to earn the term premium, relative to a shorter term objective, the risk scenario is a material rise in interest rates. The fat tails this investor should be worried about is an unexpected spike in inflation for instance caused by central bank balance sheet expansion, or an unexpected spike in issuer defaults due to sustained economic headwinds. In the latter case, the risk free interest rate may fall, leading to a profit, but if spreads of the bonds in the portfolio rise this may lead to losses as well.

If a liability driven investor is overall short duration, the funding ratio, defined as assets divided by the value of the liabilities, is at risk. In order to assess these risks, we consider a high level balance sheet of a pension plan with nominal liabilities. The present value of the pension payments can accurately be calculated by discounting them against a risk free interest rate, usually the swap curve. The colour of the assets indicates the expected hedge effectiveness.

The above balance sheet is exposed to a multitude of risks. The most important risk being the duration mismatch: if the interest rate sensitivity of the assets is significantly lower than that of the liabilities the investor is short duration. This means that the funding ratio will move up and down with the level of interest rates. The second most important risk is that growth assets, which can be subject to significant volatility, can move in another direction than the matching assets and liabilities.

It does not really matter whether the tail risk is caused by a Euro-breakup, a global pandemic or a Chinese hard landing – it is the movement in these two risk factors that will matter most.

The secondary risks that could add to the downside potential are spread risks on the matching assets relative to the liabilities and unhedged foreign currency exposure. In the case of a pension plan with conditional indexation, inflation risk could also be included in the analysis. Both in the case of nominal and inflation-linked liabilities, the definition of the matching portfolio should be clear and any secondary risks arising from assets with both a matching and a return objective should be managed.

An often overlooked risk in pensions and life insurance is longevity risk, which is the risk that the mortality of the members is different from what was actuarially anticipated. Longevity risk materialized in the late 2000's when it turned out that life expectancy in retirement had increased and



appeared to be on an increasing path. This increases the liabilities and thus lowers the funding ratio. Longevity risk has hit Dutch pension schemes especially hard because it turned out that life expectancy increased at a time when interest rates were falling. A higher life expectancy translates into a higher duration of the liabilities and thus a lower interest rate hedge. This is unfavorable when interest rates fall. Like interest rate risk and inflation risk, longevity risk can be hedged with a swap. Longevity swaps are however rare and often customized to a specific population, rather than a standardized liquid instrument.

Looking forward using scenario analysis, possible economic regimes can be assessed by considering what could happen with economic growth and inflation. There are multiple ways of getting in every corner of the quadrant: in a Euro-breakup for example, the country where you live could be affected inflationary or disinflationary depending on the status of their new currency. The application of scenario analysis on the portfolio can be helpful to test the impact under different extreme, although plausible scenarios. Depending on the objectives of the portfolio the impact of some scenarios may be more severe than others. The ultimate goal is to achieve portfolio resilience: bringing the outcome of the investment strategy to an acceptable level in all scenarios.

When balance sheet risks are roughly evenly distributed over interest rate risk and growth asset risk, it can easily be shown that the tail risk for most pension funds and life insurers is a combined fall in growth assets and interest rates, which is the red area in the chart. A scenario in which growth assets fall but interest rates increase or vice versa cannot be a tail risk because of the offsetting effects.

The global financial crisis is sometimes referred to as a perfect storm for pension funds and life insurers, as growth assets and interest rates fell while longevity increased materially. How can investors mitigate the fat tail risks in their portfolios?

The financial institution should first define its risk budget or maximum loss under every extreme scenario it deems plausible, thereby incorporating fat tail risks and time varying and state dependent correlations and volatilities. The strategic asset allocation can then be filled in such that the risk allocation is consistent with the relative attractiveness of the risk factors. It can be valuable for the institution to plan ahead any actions it will take should a tail risk scenario materialize, as this will reduce response time at a time speed is of the essence. Potential actions could include decreasing risk, increasing risk, or switching risk between risk factors. Increasing risk is usually only possible under some regulatory constraints and only if the risk budget was consciously under-utilized. Keeping some risk budget to be able to add risk in stress scenarios can be a useful tool but must be weighed against the opportunity costs of being underinvested in certain risk factors in normal times.



There can be multiple reasons why the desired risk allocation cannot be achieved by simply reallocating assets during either normal times or dynamically in tail risk scenarios. In this case, it can be more efficient to use derivatives. Derivatives can be used to adjust the risk allocation without materially changing the asset allocation. The best known example are interest rate derivatives to hedge interest rate risk for pension funds. By using interest rate swaps or bond futures, a pension fund can hedge a significant amount of its interest rate risk without using all of its assets. This is known as using leverage. The assets that are freed up by using leverage can be invested in another risk factor such as growth assets.

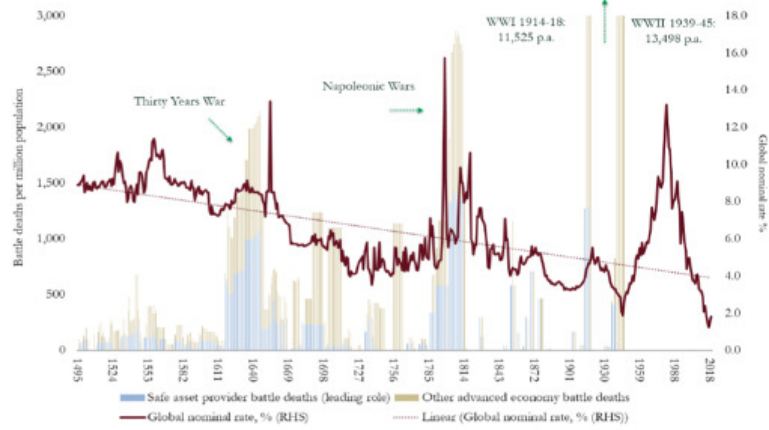
It is also possible that an investor mainly invests in fixed income assets and wants to gain exposure to the equity market. This is possible using futures on an equity index. The investor could also spend a small amount of capital to gain non-linear exposure to equity markets. Equity call options can be a useful instrument to gain exposure to rising equity markets while limiting potential losses. Conversely, the investor could use put options to protect its existing growth assets against tail risks. It should be noted, however, that the benefit of the non-linear payoff profile of option strategies comes at the cost of having to pay the option premium that will be a drag on expected returns. Because the term of an option contract is finite, roll risk is introduced into the portfolio consisting of the risk that an existing position can't be extended at the end of the term by entering into a new contract. This should be carefully managed to limit losses in extreme scenarios.

The ultimate exposure to tail risks is determined by the total exposure of the physical assets and the derivative positions combined. One should always keep in mind that, as for example with repos, derivative contracts come with operational and liquidity risks that may create other risks for the investor, especially under extreme scenarios that might occur in tail risks. Further, there is the systemic risk of a clearing house or exchange being unable to meet its obligations. These risks can be mitigated through counterparty limit policies and monitoring of liquidity risks at total portfolio level under different scenarios.

APPENDIX

MiFID II
Stay Compliant Program

Development Global Historical Interest Rates

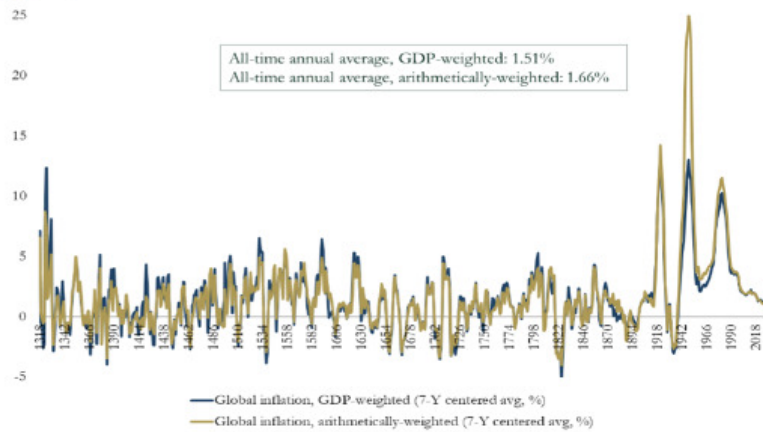


Source: Schmelzing, P. (2020)



MiFID II
Stay Compliant Program

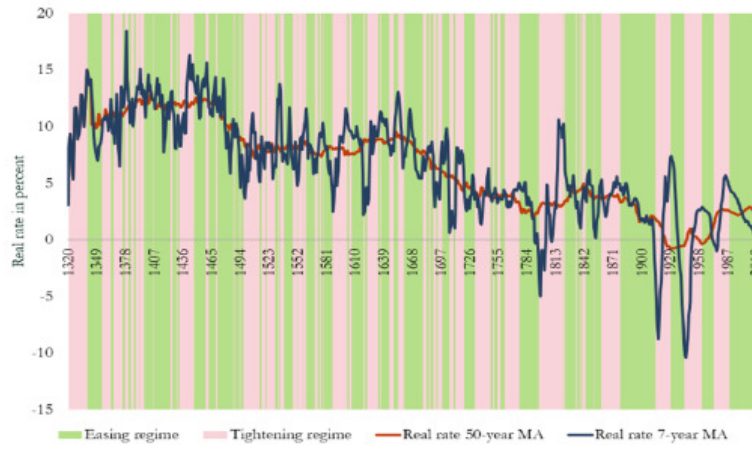
Development Global Historical Inflation



Source: Schmelzing, P. (2020)



Development Global Historical Real Interest Rates

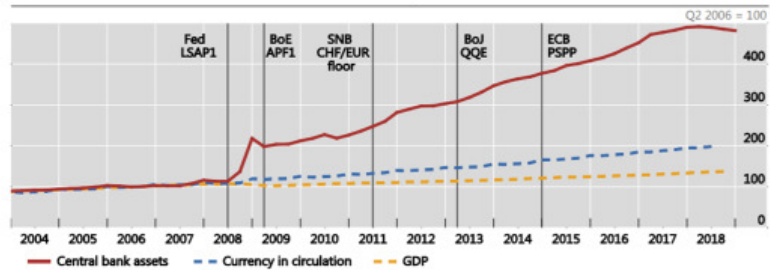


Source: Schmelzing, P. (2020)



Central Bank Balance Sheet Expansion

Expansion in central bank balance sheets since the global financial crisis Graph II.1



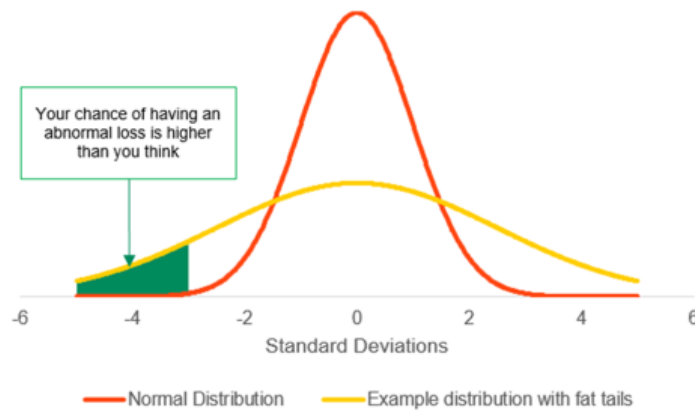
The graph aggregates across the six AE central banks that expanded their balance sheets the most over the period (SNB, BoE, BoJ, Fed, ECB/Eurosystem and Sveriges Riksbank). Weighted averages of euro area, Japan, Sweden, Switzerland, the United Kingdom and the United States, based on GDP and PPP exchange rates.

Sources: National submissions to CGFS/MC survey; study group calculations.

Source: Bank for International Settlements (2019)



The Normal Distribution and Fat Tails



High Level Pension Plan Balance Sheet

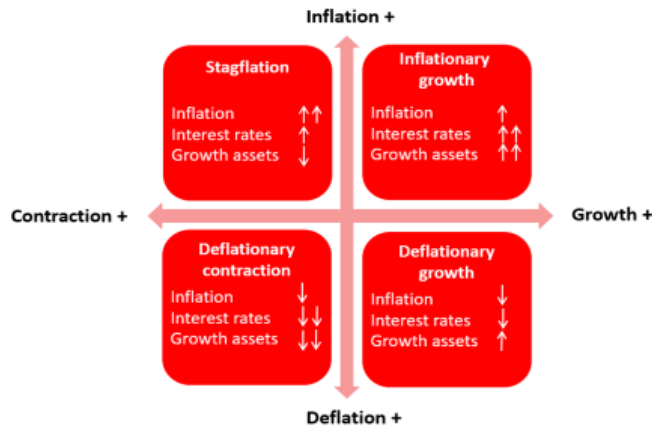
Assets (<i>duration x < y</i>)	Liabilities
Matching Assets <ul style="list-style-type: none"> • Interest rate derivatives • High quality Government bonds Assets with dual objective <ul style="list-style-type: none"> • Investment Grade Credit bonds • Mortgages Growth assets <ul style="list-style-type: none"> • High yield and Emerging Market debt • Equity and Alternative investments 	Nominal liabilities (<i>Duration Y</i>) <ul style="list-style-type: none"> • Pension payments

- Pension Liabilities
- High Correlation Matching Assets
- Medium Correlation Matching Assets
- Low Correlation Matching Assets



Different Economic Regimes

Effects on: Inflation, Interest Rates and Economic Growth



Pension Plan Balance Sheet Heatmap

Effects of Interest Rate movements and Growth Asset Returns

