ROBECO
The Investment Engineers

5-YEAR EXPECTED RETURNS

Triple Power Play

2024
2028

Sustainable Investing Expertise by
ROBECOSAM

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This document has been compiled by Laurens Swinkels and Peter van der Welle (September 2023). It represents the views of Robeco's Multi-Asset team, which are not necessarily shared by other teams at Robeco.
Please visit our website for more information.

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For an assessment of the long-term expected returns, please visit our website.

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Foreword

At the point where progress and conflict meet, our world evolves, echoing historical disputes that have shaped civilizations. As we step into a new era, marked by technological advancements and geopolitical shifts, it is crucial to interpret the complex interplay of forces that define our future.

This year's report examines three significant power dynamics. Firstly, the government's fiscal policies present a challenge to central banks, altering the balance between inflation and economic growth. Secondly, the dominance of capital as a production factor is being challenged by labor, driven by reshoring and climate concerns. And finally, we see a geopolitical showdown between the US and China over technological supremacy, that is reshaping global economics, alliances, and trade policies.

In financial markets, we are witnessing how these power plays are unfolding, shifting us from a world with low risk-free rates and high expected risk premiums to a world with higher risk-free rates, but lower expected risk premiums.

Expected returns are a vital element of any investor's strategic decision-making. The approach we take in this report is, as always, based on a five-year outlook, extending through to 2028. Our forecasts are used by Robeco's Sustainable Multi-Asset Solutions team and can be utilized to guide the investment plans of both institutional and professional investors. For example, our expected returns serve as input for the Danish Council for Return Expectations and will be used by Danish pension institutions to calculate pension projections and return expectations for their customers.

We pair our return forecasts for all major asset classes with related content to provide readers with a deeper understanding of the markets in which they are investing. This year, we focus our attention on the following: advancements in machine learning for emerging markets investors, how to incorporate the sustainable development goals in government bond portfolios, the trends that shape the future of thematic investing, and the natural rate of interest. In recent years, we have enjoyed rewarding conversations with our clients zooming in on the chapter dealing with the effects of climate change on expected returns.

For over 90 years, research has been at the heart of Robeco's investment strategies and that is why we have included numerous references to academic and non-academic publications for readers who wish to delve deeper into the topics discussed.

Join us as we explore the complexities of our triple power play economy, where conflict and progress come together, guiding investors in the ever-changing world.

Mark van der Kroft
Chief Investment Officer

EXPECTED RETURNS 2024-2028

1. Executive summary

Progress often precedes conflict. Take the birth of science during the age of enlightenment. One of the greatest controversies of the 17th century happened when Leibniz and Newton locked horns over who invented calculus first. Both men undoubtedly knew they were on to something and their intellectual legacy has proven just that, outliving them by centuries. Today calculus is used in computer science, engineering telecommunication and space exploration to name a few. While Newton was initially declared by the Royal Society as the winner, the tussle ended de facto in a posthumous stalemate when in the 1820s even the British mathematicians adopted the Leibnizian notation instead of the less effective Newtonian notation. The current consensus is that both geniuses invented calculus independently.

We live in a world of great progress as well as upheaval. We have made significant leaps in health care, as witnessed in May 2023 when the WHO declared the end of Covid-19 as a global health emergency. The March 2023 IPCC report on climate change outlined that global warming below 1.5 degrees Celsius is still feasible. The latest advancements in large language models like ChatGPT bode well for future productivity growth and have skyrocketed major technology stocks year to date. Inflation in G7 economies has peaked. Central banks have so far been successful in bringing down inflation without causing an increase in unemployment.

Goldilocks shines yet turbulence looms. It will prove difficult for central banks to take the sting out of (core) inflation without triggering a rise in unemployment that provides the required cooling of an overheated services sector. The hot war on the borders of Europe is unabating, partly sustained by the latest technology. The planned face-off between leading technology entrepreneurs Musk and Zuckerberg, after the latter launched an alternative social medium to X (formerly Twitter), is heavy with symbolism and echoes the infamous Newton-Leibniz priority dispute at the genesis of a new era. The surge in technological capabilities in today's economy has increased the stakes and upped the potential for dispute. In our view we are entering a power play economy. Specifically, we foresee a triple power play.

The rise of labor (capital vs labor)

The first power play we see developing is capital locking horns with labor. When it comes to the pursuit of profit, things have run smoothly for shareholders in recent decades. Companies have managed to grab an increasing share of the economic pie, judging by the corporate profit share of the total economy. In fact, corporate profit shares hit record highs in both the US and the Eurozone at the end of 2022. The flipside of this has been a steady fall in labor's share of the economy. We expect challenges for corporate profitability both from a secular (reshoring, climate change, taxation) as well as from a more cyclical origin.

Firstly, if the dawn of multipolarity spurs reshoring, it will likely increase domestic labor's bargaining power again, as long as reshoring relies on labor-intensive import substitution. There is a close-knit inverse relationship between the domestic labor share and global trade intensity. Secondly, the single-minded pursuit of maximizing profitability is increasingly being challenged by stakeholders pointing to the consequences. Increased internalization of companies' socio-ecological footprints through, for example, higher carbon taxes and spending on expensive green innovation to prevent or capture carbon emissions will also dent profitability. Firms that refrain from embracing SDGs will be faced with a higher cost of capital. Thirdly, a landmark deal in 2021 saw the imposition of a global minimum corporate tax rate of 15%, effectively ending a decades old race to the

bottom. The focus on increasing revenues from corporate tax also suggests the tide may be shifting in favor of labor once again. From a cyclical point of view, the outcome of the tussle between capital and labor over the next five years will most likely be determined by wage dynamics in a sticky inflationary environment.

At the time of writing the overall unemployment rate for the OECD stood at 4.8% – a record low. The Phillips curve, which depicts the trade-off between unemployment and wages, is typically steeper when trend inflation is rising (see, for instance, Hajdini 2023).[1] The Phillips curve has steepened since the pandemic not only in the US, but also in the UK and Eurozone. Ari et al. (2023) find that the Phillips curve also tends to be steeper when trade intensity is lower and digitalization is higher. Central bankers have taken note. Andrew Bailey, the governor of the Bank of England, asked workers to 'think and reflect' before asking for a pay rise. Yet so far, we have seen more of a price-wage spiral than a wage-price spiral as wages have clearly lagged overall price rises since the pandemic.

1. Trend Inflation and Implications for the Phillips Curve (clevelandfed.org)

The end of monetary lenience (fiscal vs monetary)

The second power play we have on our radar is fiscal authorities challenging their central banks. During the pandemic, the view that governments should provide strong countercyclical policy, with central banks acting as a fiscal financier (with unconventional monetary policy like the pandemic emergency purchase programme circumventing the binding zero lower bound), quickly became mainstream policy. However, as the inflationary aftermath of the pandemic stimulus shows, too much of a good policy mix can be a bad thing. BIS (2022) provides evidence that the pandemic has resulted in a shift from a monetary-led to a fiscally-led regime. Whether this shift towards more profligate governments will leave inflation structurally higher depends on the fiscal-monetary policy mix. BIS finds that the combination of a profligate government and a weak central bank with limited independence creates the highest inflationary impulse. By contrast, a strong independent central bank is able to act as a counterbalance to even a profligate fiscal authority, with the result that there should only be marginal upward pressure on prices.[2]

2. Fiscal deficits and inflation risks: the role of fiscal and monetary policy regimes (bis.org)

As such, the power play between fiscal and monetary authorities in an above-target inflation environment is important for asset allocators to consider. If a government were to prioritize security and climate change over a return to fiscal prudence it would be signaling to consumers that Ricardian equivalence (consumers postponing spending now in anticipation of tax hikes in the future) does not hold, and sticky inflation would be the natural outcome. A government that runs deficits for a prolonged period will not be able to avoid inflation and run into the crosshairs with central banks mandated to target 2% inflation. As long as inflation is significantly above target it is unlikely an independent central bank will facilitate sovereign profligacy by adopting an easy money stance. The potential for central banks and fiscal authorities locking horns looms even larger in a quantitative tightening regime. This is particularly the case where incurred losses from the central bank's selling of its stockpile of government bonds lower revenue for the Treasury while simultaneously raising government funding costs.

The dawn of multipolarity (US-China)

The third power play is of a geopolitical nature. In June 2023, during an interview to mark his recent 100th birthday, former US diplomat Henry Kissinger urged the US and China to step back from "the top of a precipice". The dawn of multipolarity is real. China and the US are both pushing the frontier of technological possibilities in their strategic competition for hegemony. The promise of generative AI has only raised the stakes. According to the Centre for New American Security,[3] the US added 519 entities to the entity list in 2022, prohibiting them from receiving US origin technology. A further erosion of trust between major economies will inhibit technology spillovers and lower trend growth in global GDP per capita. A European Central Bank study (2023) finds that if trade intensity were to fall to

3. https://www.cnas.org/

its mid-1990s level, the initial hit to the global economy would amount to about 5% of global GDP. Whatever one's view on the future balance of power, the peace dividend seems to be gone. Western governments' overriding concern with maintaining the status quo could have profound consequences in terms of more regulation, increased military spending and less laissez-faire economics.

Our scenarios

How does the triple power play shape our scenario thinking? Our previous outlook, titled 'The Age of Confusion' introduced a three-pronged approach to assess the macro landscape, explaining that investors needed to weigh up the wide variety of macro shocks, their persistence and their tendency to be self-reinforcing. This year we enrich this framework by introducing three major 'power plays' we believe will play a significant role in the global economy and can therefore be useful in developing various scenarios for strategic multi-asset allocation. The dynamic of these power plays is subject to the aforementioned elements of multiplicity, persistence and reflexivity.

Stalemate (base case)

Monetary policy works with long, but variable, lags. In the end, the recession signal that the deep inversion of the US yield curve has been flashing since spring 2022 is unlikely to prove false. After a mild recession in 2024, which sees headline inflation dip below 2%, we expect developed economies to transition towards trend growth and above-target inflation again, with consumer price inflation remaining on average around 2.5% towards 2029. In the US, we expect real GDP growth to average 2.3%, 20 bps below what the current S&P 500 stock market valuation entails. While the growth outlook is rather benign, it is unlikely to be a smooth ride, with macroeconomic volatility remaining well above pre-pandemic levels as the dislocations in labor markets resulting from the pandemic are yet to be fully resolved. A study by Bernanke and Blanchard (2023) shows that even if the 'job openings per unemployed' ratio reverts back to its equilibrium rate of 1.2, US inflation will probably converge towards 2.5% by 2027, which is above the Fed's inflation target. A cooling vacancy rate per unemployed towards its natural rate of 1.2 in the coming years would probably still mean annual growth in pay of 3.0-4.5% for US workers. Stronger demand for labor from domestic manufacturing because of subsidized reshoring, nominal wage rigidity, and a further decline in non-cyclical unemployment result in an increase in the labor share of GDP in developed economies at the cost of corporate profitability.

Central bankers, mindful of the post-pandemic surge in inflation, are reluctant to act as fiscal financiers once again. Yet governments are still running deficits and are in need of low policy rates. The tug of war between fiscal and monetary authorities means there is not enough monetary policy tightening to remove demand-pull inflation.

The Chinese economy manages to escape prolonged outright deflation because its move towards a more self-sufficient growth model results in expensive import substitution, which pushes up input costs. What's more, Chinese companies ultimately do not shift from the goal of profit maximization towards debt minimization, which characterizes a balance-sheet recession. However, key elements of Japanification – low growth, low inflation and low interest rates – surface on the back of partially forced deleveraging, falling trend growth and an aging population.

AI gets wings (bull case)

What if the current hype about artificial intelligence does not prove to be misplaced? In our bull case we see above-trend growth and at-target inflation emerging on the back of early adoption of AI and its rapid diffusion across sectors and industries. An AI-led productivity growth boost probably only appears in the official statistics after 2024 due to underreporting and measurement problems. In this scenario, AI technologies become

cheaper in light of increased competition and accessibility thanks to government regulation and targeted technology education efforts. As such, small and medium-sized companies also adopt them. Facing the existential threat of AI, high-income workers tone down their wage demands in exchange for job security and non-wage compensation, like tech education. Companies, especially those at the technological frontier, enjoy an increase in profitability as unit labor cost growth remains in check. The power play between capital and labor is convincingly won by capital in this scenario.

The result is an almost Goldilocks scenario in which things are running neither too hot nor too cold. Consumption volatility drops and returns to its pre-pandemic level of 1%. Central banks can take a break from tightening policy as benign disinflation emerges around 2025 due to the supply-side boost that the rapid diffusion of technology results in. This balances the increasing demand-pull inflation stemming from consumers remaining in strong shape thanks to a positive wealth effect (from rising house and stock prices), higher disposable income and solid real wage growth. The power play between fiscal and monetary authorities is at its least intense in this scenario. On the geopolitical plane, we expect a resurgence in mutual trust, leading to lower export controls, allowing positive technology spillovers to emerging economies.

De-risking (bear case)

Our bear case sees a vigorous display of the triple power play (US-China, capital vs labor, fiscal vs monetary). Governments are in the crosshairs of their central banks as they fuel goods inflation with massive military spending. Mutual trust between superpowers hits rock bottom, accelerating friendshoring and reshoring, thereby driving demand for domestic labor. Expensive import substitution of formerly outsourced inputs and AI-linked cyberwar threats compel companies to increase investments, denting profitability. Labor gains bargaining power in the goods sector but loses ground in the services sector. Ultimately, a turbulent environment results in growth of just 0.5% per year for developed economies, while inflation remains stubbornly high at 3.5% on average. A stagflationary environment emerges, intensifying the policy dilemma for central bankers.

Fatter tails, improved diversification

How should a multi-asset investor navigate the triple power play? A closing gap between the main contestants in the global economies' great power plays more likely creates fat tails in a return distribution. Extreme outcomes are more frequent compared to a steady state-like world, especially as we leave an era of ultra-low interest rates behind. Therefore, the compensation for exposure to systemic risk factors that a strategic portfolio seeks will vary notably depending on which scenario will materialize. In the bear case, developed equities will only see 2.5% geometric annualized return in euro, whereas the bull case eyes an 11% return. For a dollar-based investor, the swings are even more outspoken. The good news is that with the exception of our bear case, we expect inflation to average below 3% in the US which has historically coincided with a negative bond-equity correlation regime. Thus, especially for US-based investors, portfolio diversification opportunities over the next five years could increase after a tough spell for a traditional 60/40 portfolio during the heydays of the post-pandemic inflation surge.

Table 1.1: Expected returns 2024-2028

	5-year annualized return	
	EUR	USD
Fixed income		
Domestic cash	2.50%	3.25%
Domestic government bonds	2.50%	5.25%
Developed global government bonds (hedged)	3.50%	4.25%
Emerging government debt (local)	4.75%	5.75%
Global investment grade credits (hedged)	4.50%	5.25%
Global corporate high yield (hedged)	5.50%	6.25%
Equity		
Developed market equities	5.75%	6.75%
Emerging market equities	7.25%	8.25%
Listed real estate	5.50%	6.50%
Commodities	4.75%	5.75%
Consumer prices		
Inflation	2.50%	2.75%

Source: Robeco. September 2023. The value of your investments may fluctuate and estimated performance is no guarantee of future results.

Navigating the changing landscape of risk premiums and risk-free returns

While we have upgraded most asset classes compared to last year's estimates, we expect asset returns in EUR to remain below their long-term historical averages over the coming five years, with the exception of commodities. We are gradually moving away from a low-risk-free rate, high-realized-risk-premium world to a higher-risk-free-rate, lower-risk-premium world. Yet, despite the recent surge of >400 bps in risk-free rates in G7 economies, our below long-term historical average returns are mainly the result of below steady state risk-free rates and to some extent subdued risk premiums. We believe that taking equity market risk is somewhat less rewarded compared to fixed income risks at this stage of the cycle.

After a peak in policy rates has materialized, equity outperformance against riskier fixed income is notably weaker. The end of open-ended quantitative easing, rising policy uncertainty, margin compression and a relatively subdued ex-ante embedded equity risk premium in developed equity markets pose further headwinds. For a US dollar-based investor with an international portfolio, perspectives are rosier as we continue to expect other currencies to appreciate against the US dollar, albeit that headwinds for the dollar have eased compared to last year's expectations.

Lastly, investors shouldn't rule out the perceived underdog in each power play. Gottfried Leibniz, who initially appeared to lose the calculus priority dispute, was no less a genius than Newton. In 1679 he foresaw that his invention of binary coding would pave the way for an age of digital computing: "the human race will have a new kind of instrument which will increase the power of the mind much more than optical lenses strengthen the eyes". At the dawn of generative AI, some 344 years later, one can only appreciate the genius foresight it took to accurately predict the future instead of just attempting to minimize surprises. ●

EXPECTED RETURNS 2024-2028

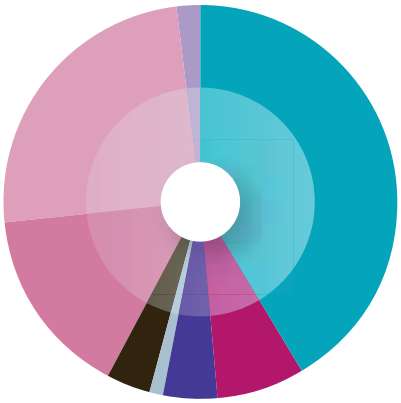
2. Valuation

While global investors saw the nominal value of their holdings fall by more than USD 25 trillion in the first half of 2022, wiping out over 15% of their portfolios, they have recovered about half of these losses since then. This rebound has mostly been driven by higher stock prices, with bonds making a limited contribution. This raises the question whether risky assets have become too expensive.

In this chapter we set out our views on the valuation of each asset class. In the following chapters, we examine whether these valuations correspond with our long-term macroeconomic outlook.

The global multi-asset market portfolio is the natural starting point for every investor as it shows how the average invested dollar is allocated across asset classes. Figure 2.1 shows the weight of each asset class in the global market portfolio at the end of 2022. Listed and private equity account for a combined weight of 48.8%, which is lower than the 52.0% average that Doeswijk, Lam and Swinkels (2014) observed over the 1959-2012 period. Government bonds, corporate bonds and real estate account for more of the portfolio now than they have historically. There is no reason for the weights of the market portfolio to revert to their historical averages as future weights depend on the prices of existing assets and net new issuance.

Figure 2.1: Composition of the global multi-asset market portfolio



Equities	41.5%
Private equity	7.3%
Real estate	4.3%
High yield bonds	1.2%
Emerging debt	3.7%
Investment grade credits	15.4%
Government bonds	24.8%
Inflation-linked bonds	1.8%

Source: Based on a paper by Doeswijk, Lam, and Swinkels (2014) and updated from the Erasmus University Data Repository of Laurens Swinkels: https://doi.org/10.25397/eur.9371741. The figure shows the market capitalization weights of each asset class at the end of 2022.

2.1 Government bonds

We assess the valuation of the major government bond markets according to three metrics: carry, the term premium and mean reversion.

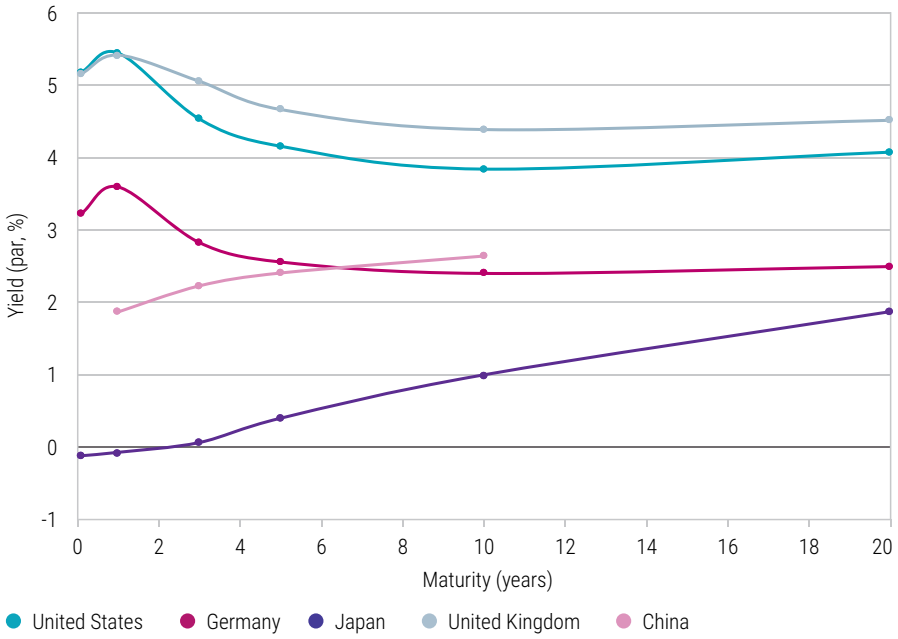
2.1.1 Carry

Instead of trying to predict interest rates to determine the value of government bonds, we can start by determining the return they would provide should the interest rate curve remain unchanged. The return in this case is what we call the carry. Here, we ignore the second-order effect of the rolldown. Since our long-run estimate for the excess return of government bonds relative to bills (in other words, the term premium) is 0.75% per year, we view a carry substantially higher than this as attractive, and a lower carry as unattractive.

Figure 2.2 shows the shapes of the par yield curves of the five main government bond markets on 30 June 2023. The carry, sometimes referred to as the term spread, is often defined as the 10-year yield minus the one-year yield. There is a lot of discussion about whether a negative carry is indicative of a recession; see Harvey (1988). The carry in the US is -1.60%, indicating that bond yields are relatively expensive, and that a US recession is in the offing. German yields are rather low, but the shape of the yield curve is similar to that of the US, albeit slightly less inverted at -1.20%. UK debt also provides negative carry of -1.02%.

From a carry perspective, the Japanese and Chinese yield curves are much more attractive. The 0.77% carry provided by China is close to our long-run term premium estimate of 0.75%, while Japanese carry is even higher at 1.07%.

Figure 2.2: Par yield curves for the five main government bond markets

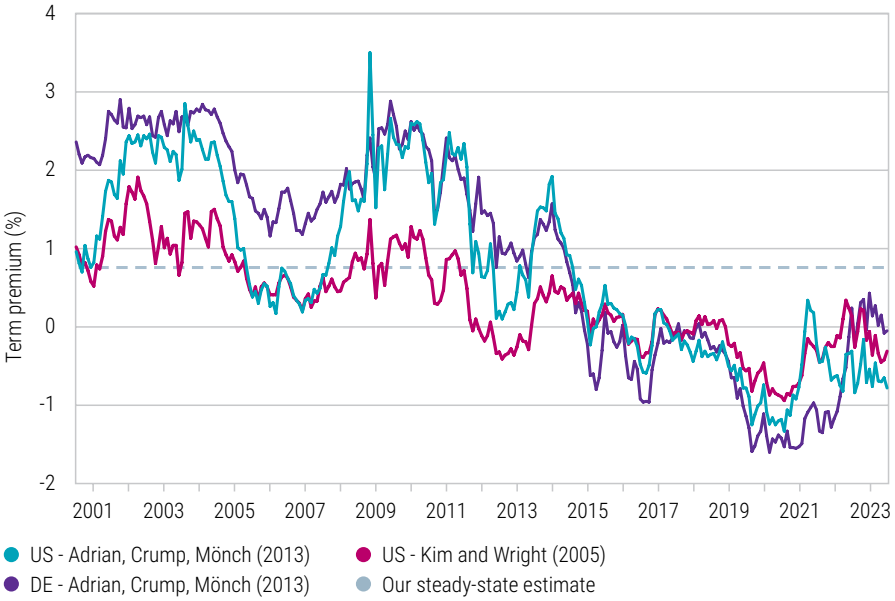


Source: Bloomberg, Robeco. As at 30 June 2023.

2.1.2 Term premium

The term premium refers to the additional return an investor expects to receive from holding a government bond to maturity rather than rolling over bills until the same maturity. Since the expected path of short-term interest rates cannot be observed, the challenge is to come up with a good estimate. For example, if the expected yield earned by rolling over the bills until bond maturity is the current bill yield, the term premium would be equal to the carry we discussed above. Another option would be to use market-implied forward interest rates as the expected future short-term rates. This would by definition lead to a term premium of zero; that is, the expected return of bonds equals the expected return of bills. This would contrast with the term premium of around 1% that has been observed since 1900.

Figure 2.3: Term premium estimates for 10-year government bonds



Source: Bloomberg, Federal Reserve, Robeco. Updated data from Adrian, Crump, and Mönch (2013) is maintained online by the Federal Reserve Bank of New York, and from Kim and Wright (2005) by the Board of Governors of the Federal Reserve System. Data updated to 30 June 2023. For Germany we use our own estimates based on the model by Adrian, Crump, and Mönch (2013).

Researchers have been making considerable efforts to determine the expected path of the short-term interest rate. See, for example, Adrian, Crump and Mönch's (2013) model at the New York Federal Reserve Bank, and Kim and Wright's (2005) model maintained by the Board of Governors of the Federal Reserve System, which are compared in more detail by Adrian, Crump, Mills and Mönch (2014). Figure 2.3 shows the US 10-year term premium resulting from both models, which has been updated to 30 June 2023. We show the 10-year term premium as this is what most economists consider. Although the general movement in term premium estimates is similar, the level of the term spread can be very different between the two models. For example, at the end of December 2009, the Adrian, Crump and Mönch model estimate was 2.7%, while for the Kim and Wright model it was 1.3%. The estimates have been similar overall since 2016, although during recent years there has been some divergence. The latest figures show estimates of -0.78% for the Adrian, Crump and Mönch model and -0.31% for the Kim and Wright model. These estimates are higher than in 2020, when they stood well below -1%, but both are still well below the 0.75% premium that we expect over the long run.

For the five-year term premium, which corresponds with the horizon of our outlook, the estimates of the term premium are close to the 10-year estimates, at -0.94% for the Adrian, Crump and Mönch model and -0.29% for the Kim and Wright model.
We are not aware of any external data providers that update these term premium models for other countries. Our own estimates, also displayed in Figure 2.3, indicate that the 10-year term premium for Germany according to the Adrian, Crump and Mönch model was -0.05% at the end of June 2023, while the five-year term premium was -0.32%. Our estimate for the Japanese term premium at the end of June 2023 is 0.26%. Except for Japan, the term premiums are negative, and all of them well below the 0.75% steady-state estimate. We do not have term premium models for the other major markets.

A term premium of zero indicates that investors expect the same return from investing in bonds as in bills. This seems like a bad deal for investors, but there could be several possible reasons that such a situation could occur. First, the investor base for bonds has changed over time. Central banks are now major players in government bond markets, and unlike typical bond investors, they aim to achieve their monetary goals rather than primarily seeking a particular risk-adjusted return for their investment portfolio. Second, regulation, due to which the liabilities of pension funds and life insurance companies are marked to market, ensures that long-dated bonds provide the risk-free rate for these investors. Instead, these investors need to be compensated to take on risk – in other words, by buying short-dated bonds. Third, as Campbell, Sunderam and Viceira (2017) argue, the correlation of bond returns with equity returns determines the existence of a term premium. A negative correlation implies that when equity markets fall, bond markets should rise in value. This type of insurance against adverse economic circumstances may be worth paying a premium for by all investors, even those who are price-sensitive. However, this last argument may not be as relevant today as the equity-bond correlation tends to increase in inflationary environments; see Molenaar, Sénéchal, Swinkels, and Wang (2023).

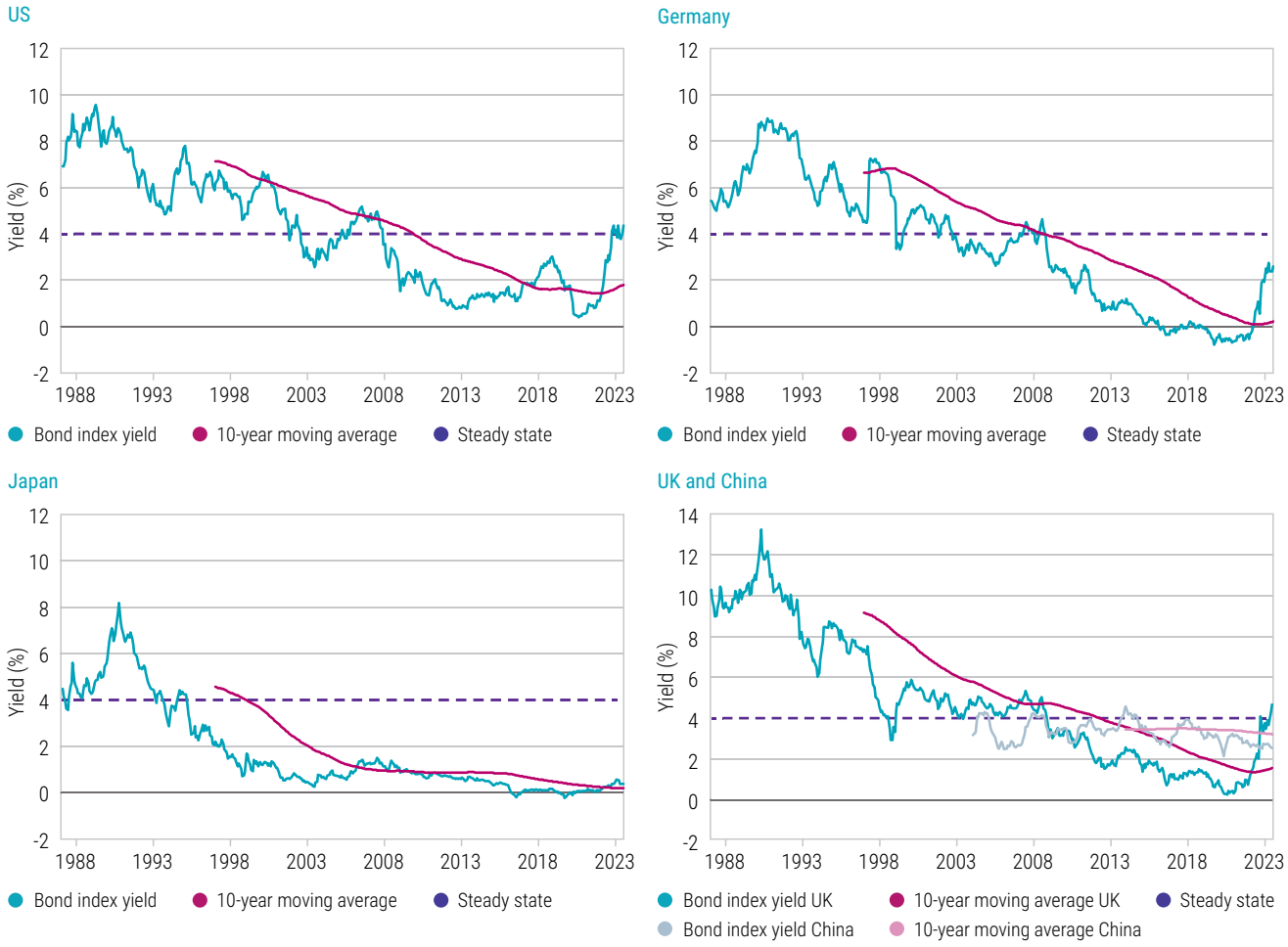
2.1.3 Mean reversion

Another popular way to look at valuation is to forecast a reversion to the mean. For example, Asness, Moskowitz and Pedersen (2013) use mean reversion as their main valuation signal. This is inspired by the excess returns documented by DeBondt and Thaler (1985) for equity strategies based on mean-reversion signals.

The challenge with mean-reversion signals is to determine the level the asset is supposed to revert to. To keep things simple, we compare the interest rate to its 10-year average rate. This is long enough for the average to cover business cycles, but short enough for it to adapt if there are persistent changes in the level of interest rates. An alternative would be to take the steady-state expected return of 4% as a starting point, but that would not account for persistent changes in the monetary environment that only revert over the very long term and not over the five-year horizon that is relevant to us.

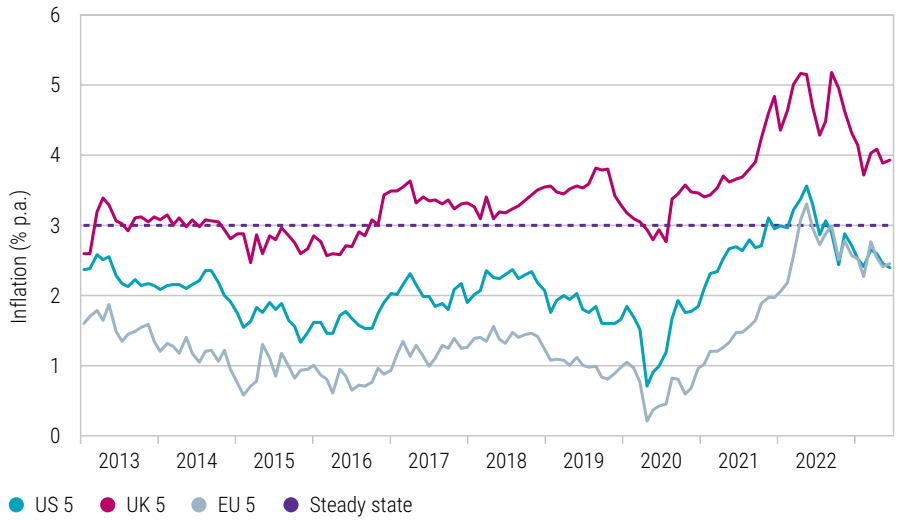
Figure 2.4 shows the government bond index yields of the five main markets together with the 10-year moving average and fixed 4% as the mean-reversion levels. The figure shows that US, German and UK yields are above their 10-year moving average, suggesting that these bond markets are currently relatively cheap according to this measure. Japan's yield is very close to its 10-year average and China's a little below. In the US and UK the bond index yields have risen slightly above the long-run average of 4%. So compared with the long run, these markets are no longer expensive. Even though the German bond yield has increased substantially over the past year, it is still more than 100 bps below the long-term average. Since we view the average yields of recent decades as a slightly more useful mean-reversion indicator than the 4% that we expect in the steady state, the mean-reversion signal indicates that the US, UK and German bond markets are cheap, while the Japanese and Chinese markets are fairly priced.

Figure 2.4: Mean reversion of government bond yields



Source: Bloomberg, Robeco. The yield to maturity of the Bloomberg Treasury indices for the US, Germany, Japan, the UK and China, and their 10-year moving averages.

Figure 2.5: Market-implied inflation



Source: Bloomberg, Robeco. Future inflation based on the inflation-swap market with maturity of five years. For the UK, the Retail Price Index is the reference index, while for the Eurozone it is the Harmonized Inflation excluding Tobacco Index.

Since bond yields tend to increase when expected inflation increases, Figure 2.5 gives a hint as to why interest rates have gone up in the US, UK, and Germany over the past two years. Market-implied average inflation for the next five years has increased a lot from its lows during the pandemic in early 2020. Average expected inflation for the UK over the next five years is 4%, down from 5% about a year ago. For the US and Eurozone, inflation is expected to be lower at 2.5%. As we saw that nominal interest rates in the US and the Eurozone are around 4% and 2.5%, this means that real interest rates in the US are around 1.5%, and in the UK and Eurozone nearly zero. The market-implied inflation rate in Japan is somewhat above 1%, suggesting that real interest rates there are negative. We do not have good estimates of market-implied inflation rates in China.

2.1.4 Summary

We have looked at three different ways to measure government bond valuations in the five main markets. Our conclusion is that overall, global government bonds have become substantially cheaper than they have been in recent years, but they are still expensive. Since real interest rates in the US are higher than in other major bond markets, US bonds seem to offer the most value, but the negative term premium estimates make US cash look more attractive than long-dated bonds.

2.2 Corporate bonds

The quality of bonds in the investment grade index has gradually fallen over time, especially in the euro-denominated market. By contrast, the credit quality of the high yield index has increased. Therefore, instead of considering the spreads of entire credit indices over time, we focus on the yields of bonds with specific ratings to judge whether corporate bonds are cheap or expensive. This keeps the credit quality constant – at least as judged by rating agencies.

Even though the companies issuing investment grade and high yield bonds are geographically quite diverse, the currencies in which they issue are limited. Corporate bond markets are dominated by US dollar issues, which account for 68% of the investment grade market and 76% of the high yield market. Euro issues come in second place, at 23% of the investment grade market and 21% for high yield, leaving very limited space for bonds issued in other currencies in the Bloomberg indices. Although many non-US companies issue bonds in US dollars, the indices are dominated by bonds issued by US firms, which account for 57% of the investment grade index and 62% of the high yield index.

Figure 2.6 shows that the credit spreads of investment grade (BBB) and high yield (B) corporate bonds have behaved similarly in recent years. They shot up because of the Covid-19 lockdowns across the globe, but after central banks provided liquidity to the market, contracted quickly again. More recently, spreads have increased substantially once more. As of 30 June 2023, USD BBB spreads were trading at 152 bps and EUR BBB spreads at 189 bps. For the US, this is just below the median spread of 161 bps. As spreads and defaults tend to be high during recessions, the current spread below the median indicates that a recession, if one is coming, should be mild. In Europe, spreads are a little higher than the median level of 161 bps. Meanwhile, USD B-rated bond spreads are 398 bps, while they are 522 bps for EUR B-rated bonds, compared with a median of 506 bps over the 1998-2023 period that we show in Figure 2.6. The difference between the US and Europe may be partially related to the uncertainty linked to the war in Ukraine and the lingering issues with European debt, which may resurface in the event of recession.

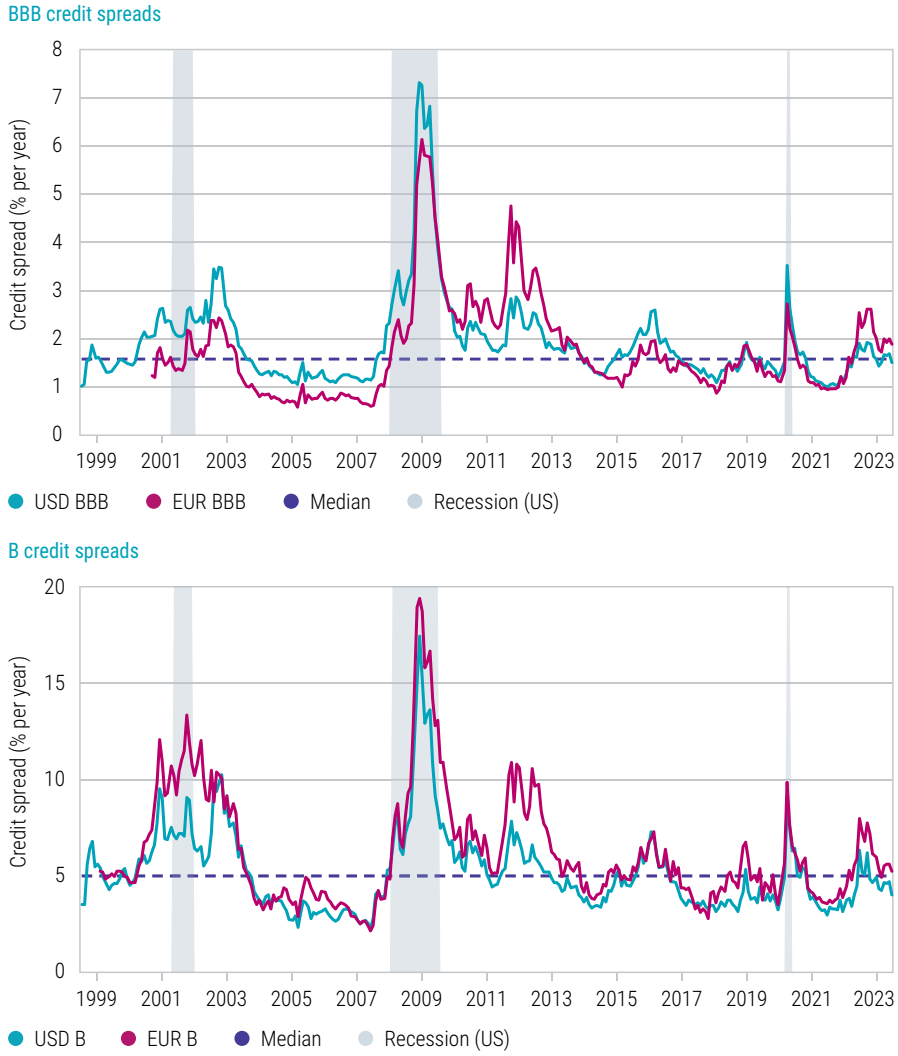
Although at the time of writing no recessions have been announced officially, many market participants expect a recession before the corporate bonds they are holding mature. The recession probability model of Chauvet (1998) indicates the probability of a recession in the US is still below 1%, but it is a real-time model used to indicate whether we are

currently in a recession rather than predicting the probability of a recession within the next five years; see Chauvet and Piger (2008). Recessions typically result in increased default rates and lower recovery rates, leading to higher expected losses for bond investors. At this stage, credit spreads do not yet seem to be pricing in a meaningful recession.

The global investment grade index's credit spread was 139 bps at the end of June 2023. Assuming that about half of this spread will be needed to cover losses due to default, investment grade's expected excess return relative to duration-matched government bonds is close to the neutral steady-state level of 0.75%. Meanwhile, the global corporate high yield index's credit spread is 417 bps. Even if half of this spread is lost due to defaults, the remaining credit return would still be above our neutral steady-state expected return of 1.75%.

From a valuation perspective, both investment grade and high yield corporate bonds look fairly valued.

Figure 2.6: Credit spreads of BBB- and B-rated corporate bonds

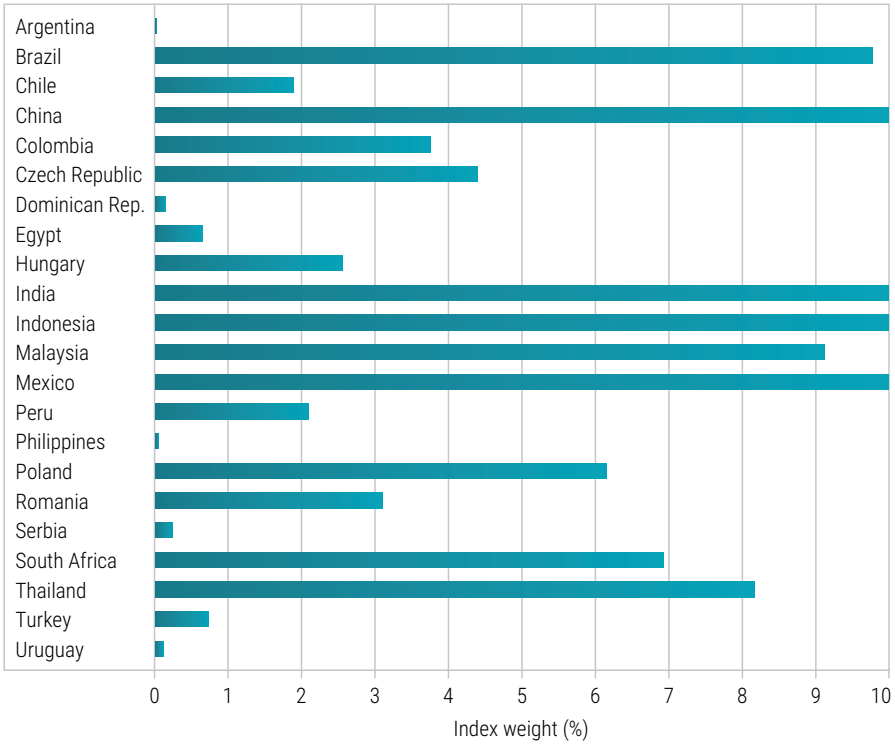


Source: Barclays Live, NBER, Robeco. The top figure shows the option-adjusted credit spreads of BBB-rated bonds in the Bloomberg Barclays US Corporate index and the Bloomberg Barclays Euro Corporate index. It also shows median credit spreads over the sample period. The bottom figure shows the option-adjusted credit spreads of B-rated bonds in the Bloomberg Barclays US High Yield index and the Bloomberg Barclays Euro High Yield index. It also shows median credit spreads over the sample period. Areas shaded grey indicate NBER contraction periods.

2.3 Local-currency emerging market debt

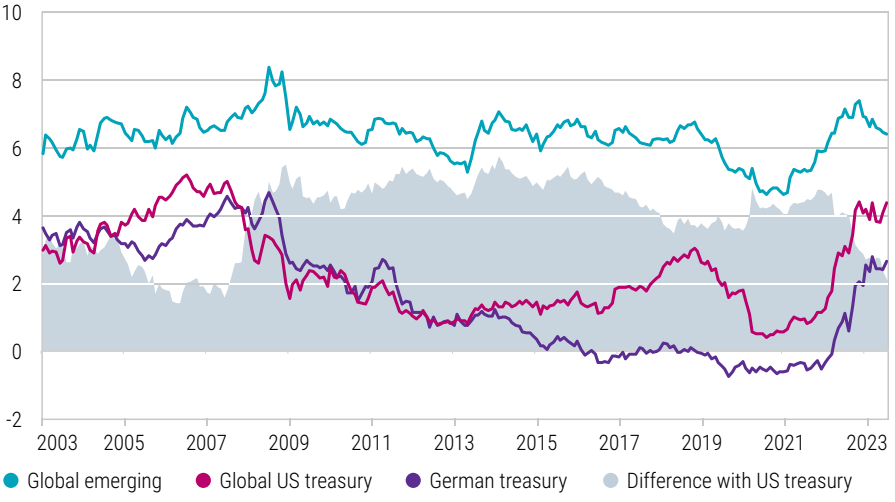
To assess the valuation of local-currency emerging market sovereign debt, we use the JP Morgan Government Bond Index-Emerging Markets (GBI-EM) Broad Diversified Index. The country breakdown of this index at the end of June 2023 is shown in Figure 2.7. The main constituents of the index are Brazil, China, India, Indonesia, Malaysia, Mexico and Thailand. Each of these countries accounts for over 8% of the index, which limits individual country weights to 10% for diversification purposes.

Figure 2.7: Country weights in the local-currency bond market index



Source: JP Morgan, Robeco. Index weights of the JP Morgan GBI – Emerging Markets Broad Diversified Index as of 30 June 2023.

Figure 2.8: Yield to maturity of global emerging market bonds and US and German government bonds (%)



Source: JP Morgan, Bloomberg, Robeco. Yield to maturity of the JP Morgan GBI – Emerging Markets Broad Diversified Index ('Global emerging'), the Bloomberg US Treasury Index, and the Bloomberg Germany Treasury Index. Difference between the yield of global emerging markets and US Treasuries.

Figure 2.8 shows the yield to maturity of US and German government bonds and emerging debt markets, and we can see that the nominal yield of emerging markets has always been higher. Since 2003, emerging debt markets have yielded around 6% per year, with a short-lived spike above 8% during the Global Financial Crisis. Emerging market yields then fell back towards 5%, but the 2013 taper tantrum saw rates jump back up to 7%. After dipping below 5% in 2020, emerging market yields have since risen above 6% again.

We can see from the chart that the difference in yield between emerging debt and US Treasuries has increased since 2006, mainly due to lower interest rates in the US and the addition of riskier countries to the local-currency government bond index. The nominal yield pick-up, or carry, provided by emerging market debt has fallen from 4.0% to 2.0% over the past year. There is still a 3.8% yield difference with Germany, but this is down from 6.0% last year.

Table 2.1: Differences in the real yields of local-currency emerging debt with US and German Treasuries

Yield	2016	2017	2018	2019	2020	2021	2022	2023	
Emerging	6.55%	6.26%	6.38%	5.33%	4.62%	5.91%	6.87%	6.40%	
United States	1.89%	2.19%	2.61%	1.80%	0.57%	1.23%	4.18%	4.37%	
– difference	4.67%	4.07%	3.77%	3.53%	4.04%	4.67%	2.69%	2.03%	
Germany	-0.18%	0.05%	-0.07%	-0.31%	-0.61%	-0.35%	2.54%	2.63%	
– difference	6.74%	6.21%	6.46%	5.64%	5.22%	6.26%	4.33%	3.76%	
Inflation									2024-2028
Emerging	3.22%	3.59%	2.78%	3.49%	2.22%	5.63%	8.45%	5.20%	3.15%
United States	2.20%	2.20%	1.90%	2.10%	1.60%	7.40%	6.60%	3.00%	2.02%
– difference	1.02%	1.39%	0.88%	1.39%	0.62%	-1.77%	1.85%	2.20%	1.13%
Germany	1.70%	1.60%	1.80%	1.70%	-0.60%	5.80%	9.80%	3.60%	2.04%
– difference	1.52%	1.99%	0.98%	1.79%	2.82%	-0.17%	-1.35%	1.60%	1.11%
Real yield									
Emerging	3.34%	2.67%	3.60%	1.84%	2.39%	0.28%	-1.58%	1.19%	3.25%
United States	-0.31%	-0.01%	0.71%	-0.30%	-1.03%	-6.17%	-2.42%	1.37%	2.35%
– difference	3.65%	2.68%	2.89%	2.14%	3.42%	6.45%	0.84%	-0.18%	0.90%
Germany	-1.88%	-1.55%	-1.87%	-2.01%	-0.01%	-6.15%	-7.26%	-0.97%	0.59%
– difference	5.22%	4.22%	5.48%	3.85%	2.40%	6.43%	5.68%	2.16%	2.65%

Source: IMF, JP Morgan, Robeco. The 2023 column shows yields from 30 June 2023. End-of-year inflation is from the IMF World Economic Outlook (April 2023). The country-level inflation rates are combined using JP Morgan Global Bond index weights at 30 June 2023.

Table 2.1 provides an indication of the attractiveness of local-currency emerging market debt from a yield perspective compared with US Treasuries and German Bunds. We subtract inflation from yields to obtain real yields for each region. Emerging market debt's real yield is 18 bps lower than that of the US at the end of June 2023 if we subtract the IMF's inflation expectations for the current year from the current yield, and 90 bps higher if we subtract inflation expectations for the next five years. Both levels are in stark contrast to the end of 2021, when emerging debt's real yield was 645 bps higher based on one-year inflation expectations. The differences with the German bond market are also much smaller than in 2021, at 216 bps and 265 bps, again depending on whether we use the current year's inflation or the IMF estimates for the next five years. Although nominal yields in emerging markets are higher than in both developed markets, higher expected inflation in the region partially offsets the difference.

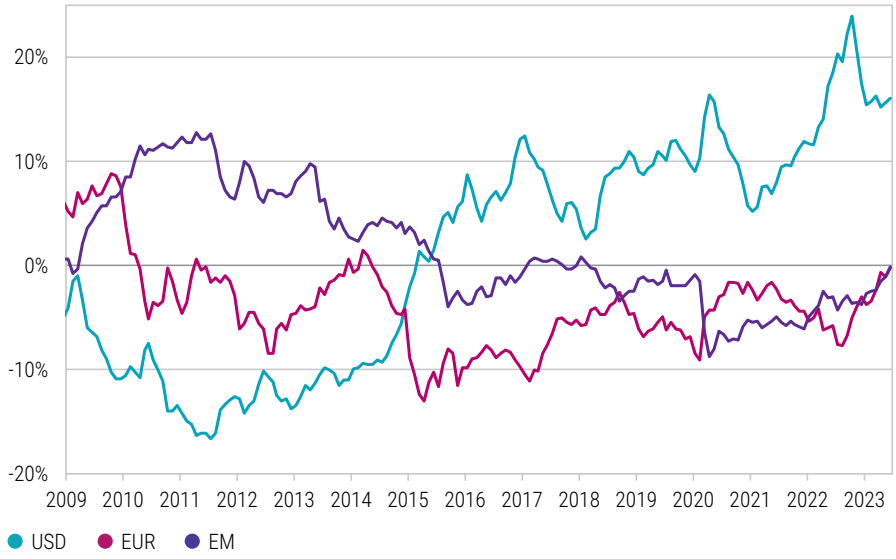
The difference in real yields may partially represent compensation for credit risk, even though there is virtually no credit risk on nominal debt issued by sovereigns that can print their own currency to pay off debt. However, such money printing would be expected to lead to inflation and currency devaluation. This means that the credit risk inherent in local-currency emerging debt should be viewed as a currency risk from the perspective of an investor from the US or Europe. Overall, the carry provided by emerging debt seems to be low.

2.3.1 Currencies

In assessing the overall valuation of local-currency emerging debt, we also need to consider currency valuations. To do so, we use Bank for International Settlements (BIS) real effective exchange rates (REERs) for the emerging market bond index based on its composition at the end of June 2023. We subtract its 15-year average from each of the REERs as we assume that such a long-term average is a good representation of its fair value.

In Figure 2.9, we compare the emerging market REERs with those of the US dollar and euro. From 2009 to 2014, emerging market currencies were overvalued, while the latest figures suggest that these currencies are close to fairly valued, on average. The valuation difference with the US dollar is 15%, as Figure 2.9 shows that the US dollar is 15% overvalued. Emerging currencies are valued similarly to the euro, suggesting that euro investors should not expect returns from currency appreciation when investing in local-currency emerging market debt.

Figure 2.9: Currency valuations using real effective exchange rates



Source: BIS, Robeco. The BIS real (CPI-based) effective exchange rates as of 30 June 2023 are compared with their 15-year historical averages. The lines for emerging markets are combined based on individual currencies' index weights in the JP Morgan Global Emerging Markets Bond indices on 30 June 2023. NB: BIS does not report REERs for the Dominican Republic, Egypt and Uruguay, so we have assumed all three are fairly valued.

2.3.2 Summary

We conclude that emerging market bonds are slightly expensive. Real yield differences are substantially below their historical average. A US dollar investor can expect to gain from emerging market currencies being cheaper than the US dollar, but this is not likely to be enough to offset the real yield differential being below the historical average. A euro investor cannot expect to gain much from the currency exposure, but real yield differences are somewhat higher than for a US dollar investor.

2.4 Developed market equities

There is evidence that the equity premium can be predicted, even though much of the variation in actual returns typically remains unexplained. One of the predictors that stands out is Campbell and Shiller's (1998) cyclically adjusted price-earnings (CAPE) ratio; see, for example, Ilmanen et al. (2021). This is the main indicator we discuss here in addition to Tobin's Q and the Buffett indicator.

These are measures of equities' absolute valuations and do not necessarily indicate how expensive stocks are relative to bonds. This might be important, because – all else being equal – higher bond yields result in lower equity prices due to there being a higher discount rate for future cash flows.

2.4.1 CAPE ratio

The CAPE ratio is a valuation measure that uses real earnings per share (EPS) over a 10-year period to smooth out fluctuations in corporate profits that occur over different periods of a business cycle. Jivraj and Shiller (2017) show that the CAPE's out-of-sample performance is strong compared with many of its competitor valuation signals. Table 2.2 contains the CAPEs for the largest developed equity markets. For most countries, the data history for the CAPE starts in December 1981, which means we have over four decades of international data. As structural differences between countries might lead to different CAPEs, we compare each country with its own valuation history.

Table 2.2: Cyclically adjusted price-earnings ratios for developed countries

Country	Start	Median	Current	Valuation	Weight
Australia	Dec-81	20.2	20.4	≈	2.1%
Canada	Dec-81	22.4	21.5	≈	3.3%
France	Feb-99	23.4	25.7	≈	3.5%
Germany	Dec-81	20.4	19.9	≈	2.4%
Hong Kong	Dec-81	19.9	15.2	↓	0.7%
Italy	Apr-93	21.0	20.1	≈	0.7%
Japan	Dec-81	36.5	22.7	↓	6.3%
Netherlands	Dec-81	17.5	33.2	↑	1.3%
Singapore	Dec-81	21.0	13.7	↓	0.4%
Spain	Jan-89	16.4	15.6	≈	0.7%
Sweden	Dec-81	22.8	19.9	≈	0.9%
Switzerland	Dec-81	24.0	25.0	≈	2.8%
UK	Dec-81	17.0	15.8	≈	4.1%
USA	Dec-81	24.1	30.9	↑	70.8%
World		**23.6**	**27.0**	↑	
Europe		**19.3**	**20.5**	≈	

Source: Barclays Research, MSCI, DataStream, Robeco. The CAPE ratio for each country has been calculated by Barclays Research using the levels of country-specific indices published by MSCI representing the equity markets for the relevant country, adjusted for inflation using data from DataStream. The 'Start' column indicates the start of the sample period, and the 'Median' column the monthly time-series median of the CAPE ratio from the start of the sample to June 2023. The arrows in the 'Valuation' column indicate whether the current CAPE ratio is above (red arrow up, indicating expensive), close to (black approximately equal sign) or below (blue arrow down, indicating cheap) the median. The last column, 'Weight', is the weight of the country in the MSCI World index at the end of June 2023. The row for Europe uses data from Barclays Research, but the row for World is a weighted average (using the weights in the final column) of each of the individual country figures.

Two years ago, CAPEs were elevated. Because of the sharp falls in the equity markets in the first half of 2022 and their partial recovery since then, the CAPEs for many countries are close to their historical medians. Four countries look cheap: Hong Kong, Japan, Singapore and Sweden. Asian markets seem cheaper than stocks from other parts of the world. Three countries look expensive: France, Netherlands and the US. France and the Netherlands only account for small weights in the global developed equity index, but the US is by far the largest index constituent, accounting for 70.8%. Because US equities are expensive, the global developed stock market index still looks somewhat expensive with a CAPE of 27.0, above its historical median of 23.6.

Bunn and Shiller (2014) show that when companies buy back shares, the original CAPE might be slightly artificially lower because the growth rate in EPS is positively affected by buy-backs. Shiller's data page therefore includes a 'total return CAPE' to adjust for this bias. While the traditional CAPE for the US was 30.8 at the end of June 2023, the total return CAPE stood at 33.3. While the current difference of 2.5 is a little lower than it has been historically, both versions of the CAPE signal that US equity markets are expensive.

2.4.2 Tobin's Q

Tobin's Q is the market value of equities divided by their net worth measured at replacement cost, which is typically a better fair-value metric than the historical cost, especially in times of high inflation. The natural 'fair value' of Tobin's Q is 1, in which case the stock market would be paying exactly the same for a company as the cost of replacing its assets, and an investor should be indifferent to buying the shares or setting up the same company from scratch.

However, it turns out that historically, the average figure has been in the range of 0.6-0.7. Estimates of Tobin's Q for the US from 1900 to 2002 are reported in Wright (2004) and are available from the archive of his website.[1] Figure 2.10 shows that Tobin's Q is currently 1.38, substantially above both its historical average and its theoretical value of 1.0, indicating that the US stock market is expensive. Replacement cost data is only available for the first quarter of 2023, but with stock markets rising in the second quarter it is not expected that Tobin's Q would be lower when second quarter data comes in.

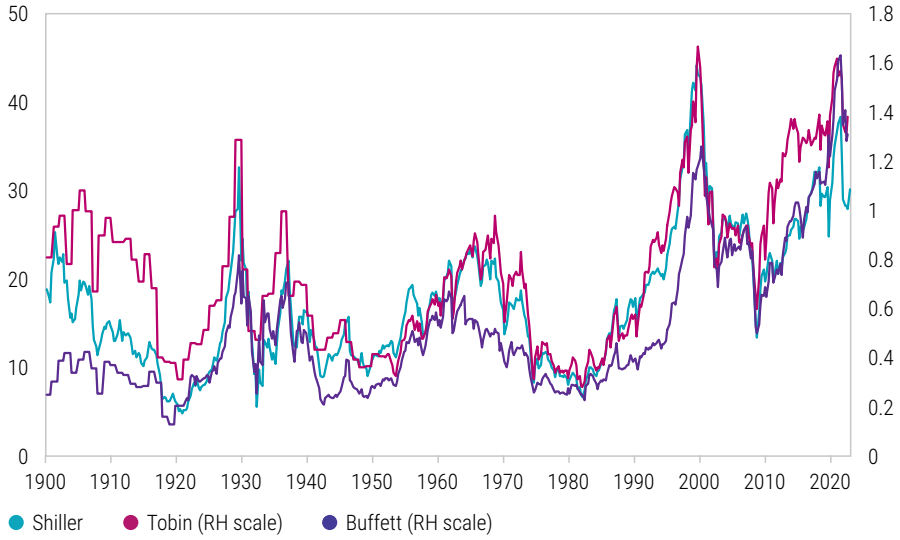
1. http://www.bbk.ac.uk/ems/faculty/wright/pdf/Wright2004dataset.xls

2.4.3 Buffett indicator

Warren Buffett popularized the market value of equities relative to the nominal GDP of a country as a measure of overvaluation or undervaluation. Lleo and Ziemba (2019) find that using this ratio in market timing can generate additional returns, mainly through predicting crashes rather than equity market rallies. Umlauft (2020) and Swinkels and Umlauft (2022) report on the long-term predictive powers of the Buffett indicator for the US and international markets, respectively. Figure 2.10 shows that the Buffett indicator has hovered around 1.3 over the past year after peaking above 1.6 in 2020. It is currently still well above its historical average, which also suggests that the US market remains overvalued.

An international comparison for this figure is challenging as it is affected by the percentage of companies that are publicly traded compared with those that are private, and whether a country is attractive to list in for multinational corporations. The ratio may also be more affected by new equity issuance than by valuation changes, even for an individual country over time.

Figure 2.10: Tobin's Q, Shiller CAPE and Buffett indicator for the US equity market



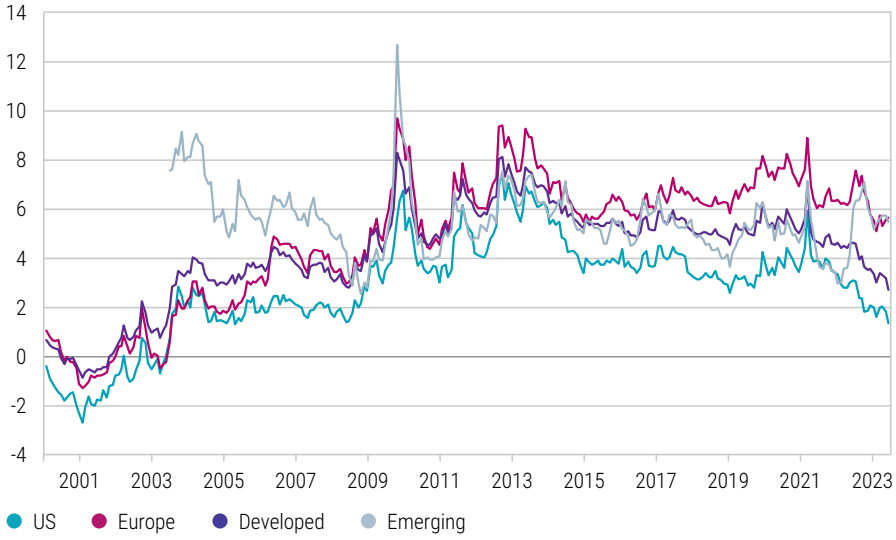
Source: Refinitiv, Federal Reserve, Robeco. The Tobin's Q is calculated using data from the Fed and from Wright (2004) before 1951. The Buffett indicator is the market value of S&P 500 companies divided by the GDP of the US. Before 1964, we use the market value of the NYSE divided by US GDP.

2.4.4 Implied equity risk premium

An obvious explanation for equity market valuations remaining above average is low interest rates, although the recent increase in interest rates helps to explain the reduction in valuations over the past two years. One way to put absolute valuations into perspective is to examine the equity risk premiums that are priced in by the market. Damodaran (2020) explains that there are several methods to determine the implied equity risk premium from observable data. Here we obtain the implied equity risk premium by dividing expected earnings by the price and subtracting the government bond yield. This method is also known as the Fed model.

The implied equity premium for the US is currently relatively low at just over 1.5%, especially compared with its level of 5.5% in Europe. Current implied US equity premiums show that expected returns for equity investors are only slightly above those of bond investors because of the increase in risk-free rates. Even though valuations are considerably lower today than they were a couple of years ago, the expected premium for investing in equities has gone down since then as interest rates increased faster than valuations fell. For developed markets as a whole, the implied equity premium stands at about 2.7%, which is about 200 bps lower than a year ago.

Figure 2.11: Implied equity risk premiums



Source: Refinitiv Datastream, I/B/E/S, Robeco. Forward earnings (12 months) to price minus the government bond yield. For emerging markets, Chinese government bond yields are used as a proxy.

Recently, Shiller introduced the 'excess CAPE yield', which is the inverse of the Shiller CAPE adjusted for long-term real interest rates. It serves as a proxy for the expected risk premium on equities. It currently stands at 2.1%, down from 3.1% a year ago. For more information about its predictive power for US equity markets, see Catanho and Saville (2022). Even though the model underlying the implied equity premium in Figure 2.11 and the excess CAPE yield are somewhat different, both methods currently predict a lower implied risk premium for US equities than a year ago, and lower than the long-run estimate of 3%.

2.4.5 Summary

Most developed equity markets are currently neutrally or cheaply valued, but the US is an outlier as it is expensive, albeit less so than at its peak valuation two years ago. Because the US accounts for more than two-thirds of developed world market capitalization, developed equity markets are still expensive overall.

2.5 Emerging market equities

The CAPE ratio for emerging market stocks has historically provided useful information about valuations in emerging markets; see Klement (2012).

Although the figures for developed and emerging markets are not entirely comparable because CAPE data for emerging markets starts substantially later than for developed markets, Table 2.3 shows that the weighted average CAPE for emerging equities is 15.4, lower than the 27.0 of developed markets.

There are several possible explanations for this. First, the higher systematic risk in emerging markets is reflected in higher discount rates, leading to lower prices for the same expected earnings. Second, emerging markets may not be fully financially integrated with the rest of the world, and this market segmentation leads to higher discount rates. Third, emerging equity markets may be tilted towards industries with lower growth potential and therefore lower valuations than developed markets. Therefore, for valuation purposes, it may be more relevant to compare each country to its own historic CAPE levels than comparing CAPEs across countries.

The CAPEs of all countries except India and Taiwan are currently below their historical median levels, and the CAPE ratios for China, Poland and Turkey are particularly low at around 10. The weighted average CAPE across all emerging markets is 15.4, slightly below the historical median of 18.0.

Based on this measure, emerging markets look cheap overall compared with their own historical levels. Compared with developed markets' CAPE of 27.0, emerging market equities seem even more attractively valued.

Note that Russia is not in Table 2.3 as the Russian market is no longer accessible to foreign investors due to sanctions. In our report two years ago, it was one of the most attractively valued markets within the emerging universe. This remains a good reminder that cheap assets may be cheap for a reason, and that investing based on valuation signals alone may not be enough.

Table 2.3: Cyclically adjusted price-earnings ratio for emerging countries

Country	Start	Median	Current	Valuation	Weight
Brazil	May-11	13.6	12.9	≈	6.4%
China	Oct-04	16.5	11.5	↓	34.2%
India	Aug-03	23.0	31.7	↑	16.9%
Israel	Sep-04	17.4	13.7	↓	1.7%
Korea	Sep-04	15.1	13.7	≈	14.2%
Mexico	Jan-01	23.3	19.4	↓	3.2%
Poland	May-04	13.2	9.3	↓	1.0%
South Africa	Aug-04	20.5	16.6	↓	3.7%
Taiwan	Jul-04	22.7	23.6	≈	18.0%
Turkey	Jan-01	12.0	10.7	≈	0.6%
Emerging		**18.0**	**15.4**	↓	

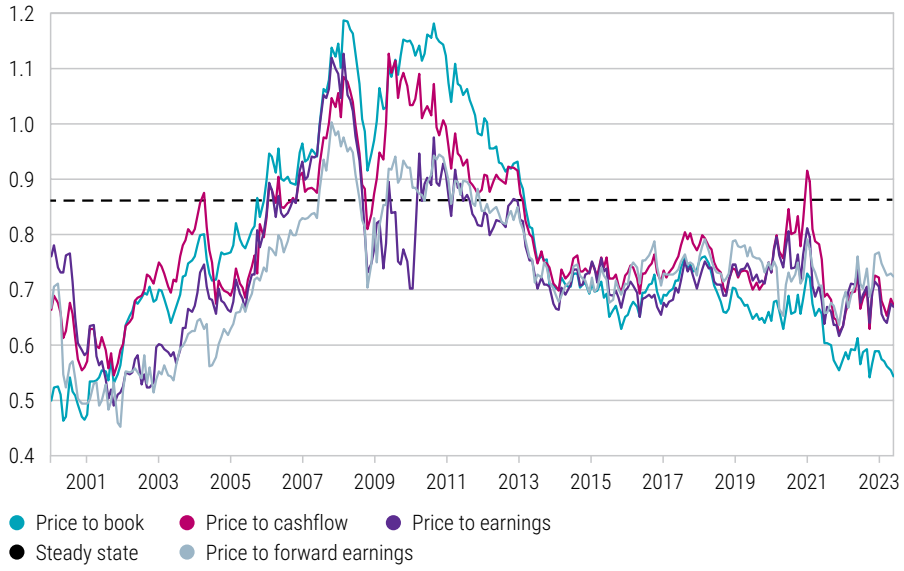
Source: Barclays Research, MSCI, DataStream, Robeco. The CAPE ratio for each country has been calculated by Barclays Research using levels of country-specific indices published by MSCI representing the equity markets for the relevant country, adjusted for inflation using data from DataStream. The 'Start' column indicates the start of the sample period, and the 'Median' column the monthly time-series median of the CAPE ratio from the start of the sample to June 2023. The arrows in the 'Valuation' column indicate whether the current CAPE ratio is above (red arrow up, indicating expensive), close to (black approximately equal sign) or below (blue arrow down, indicating cheap) the median. The last column, 'Weight', is the weight of the country in the MSCI Emerging Markets Index at the end of June 2023. The Emerging row uses a weighted average (based on the weights in the final column) of each of the individual country figures.

2.5.1 Other relative valuation measures

Figure 2.11 includes the implied equity premium for emerging markets. It has remained elevated at 5.5%, close to that of Europe. This suggests that emerging market equities are attractively valued. We also drew this conclusion based on the CAPEs in Table 2.3. To further test the robustness of these valuation measures, we also look at other bottom-up measures of value: price-to-book, price-to-cashflow, price-to-earnings and price-to-forward earnings ratios. Figure 2.12 shows that since 2014, valuations of emerging markets have been consistently below those of developed markets, trading at a discount of 20-30%. Just like with the CAPE, we expect the ratios to be below one on average. A long-term discount can be estimated when we use our assumption of a 0.5% higher cost-of-capital for emerging markets equities over the long term. Under the assumptions of the Gordon growth model, this leads to a relative valuation discount of 14% over the long run. As such, emerging equities' current discount of around 35% relative to developed equities appears high.[2]

2. See Swinkels and Yang (2023) for a more detailed analysis of emerging versus developed markets.

Figure 2.12: Emerging equity valuations relative to global equity valuations



Source: Refinitiv Datastream, MSCI, Robeco. Each month we divide the bottom-up-derived valuation ratio of the MSCI Emerging Markets Index by the same valuation ratio for the MSCI World Index. The MSCI World only contains developed markets.

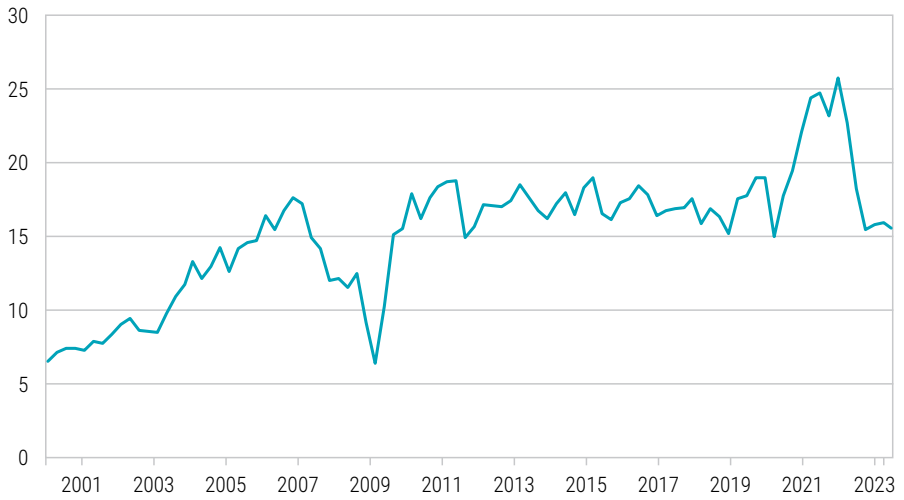
2.5.2 Summary

Compared to developed markets, emerging equities look attractively valued at present.

2.6 Listed real estate

We compare listed real estate valuations with those of global equities. Although the CAPE ratio is admittedly not an ideal measure for assessing the valuations of real estate investment trusts, it is one of the best available. The CAPE ratio of global real estate is currently 13.3, well below its average of 19.4 since 2000. The CAPE of global equities is more than twice as high at 27.0, making real estate look relatively cheap according to this measure.

Figure 2.13: REIT-specific valuation ratio for US REITs



Source: S&P Global Market Intelligence, Nareit T-Tracker, Robeco. The valuation ratio specific to US Real Estate Investment Trusts is the price (P) divided by the funds from operation (FFO).

A valuation measure commonly applied to real estate investment trusts involves comparing their price with their funds from operation (FFO). The FFO is calculated as net income plus depreciation and amortization minus gains on sales of properties. In the US, the price-to-FFO is reported at the market level. See Seok, Cho, and Ryu (2020) for more information about the reaction of US REIT prices to FFO announcements. They conclude that the market reacts more to FFO announcements than to other announcements, such as about net income.

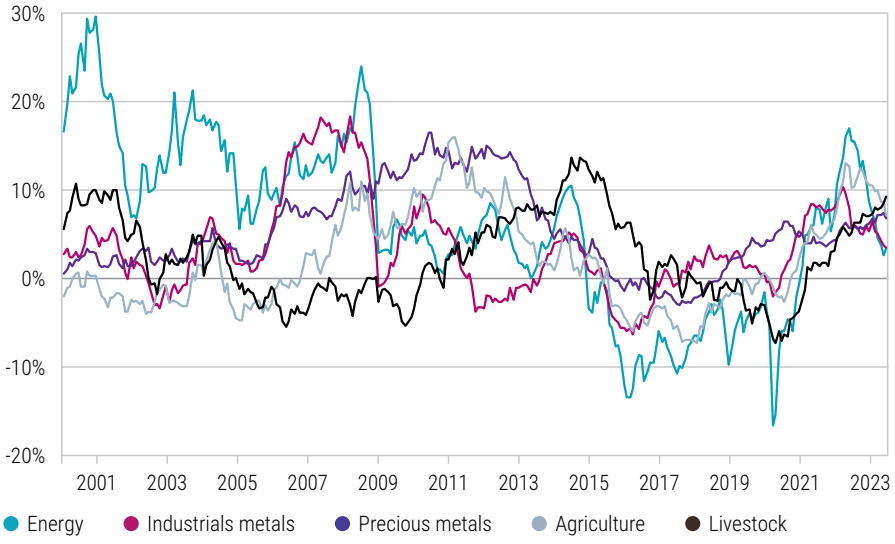
Figure 2.13 shows this valuation ratio up to the second quarter of 2023. In the third quarter of 2022 this measure fell from its record high at the end of 2021 of 25.7 to 15.5. Since then, it has remained relatively constant, with its second quarter figure also at 15.5. It is difficult to determine what a 'normal' ratio is given that this measure has only been available for a short time – since 2000. If we consider this limited data series, it appears that, according to this measure, real estate is neutrally valued compared with its past levels.

Based on real estate's relatively low CAPE, suggesting that it is cheap, and its neutral price-to-FFO ratio, we assess real estate to be cheaply valued compared to developed equity markets.

2.7 Commodities

Here we use the definition of commodity valuation presented by Asness, Moskowitz and Pedersen (2013). This involves comparing the current spot price with the average spot price from 4.5-5.5 years ago. The idea is to use the price five years ago, but averaging ensures that temporary outliers do not affect the valuation signal too much. Instead of calculating the valuation of each traded commodity separately, we consider the five main commodity categories: energy, industrial metals, precious metals, agriculture and livestock. If the commodity price is the same as five years ago, the signal would stand at 0% and suggest a neutral valuation. A number above zero means that the current price is higher than five years ago and indicates that the commodity group is expensive.

Figure 2.14: Valuation signals for commodities



Source: Refinitiv Datastream, S&P GSCI, Robeco. The figure shows the natural logarithm of the commodity category price index divided by the natural logarithm of the average of the same price index from 5.5 to 4.5 years ago, minus one. Monthly data in US dollars.

Figure 2.14 shows that energy commodities were in general overvalued from 2000 to 2014 as their price had increased relative to five years previously. In 2015 and 2020, however, they were more than 10% undervalued. After their strong recovery since the Covid-19 crisis and the war in Ukraine, they were more than 15% overvalued by the middle of 2022. But since then, energy prices have fallen substantially, such that their overvaluation had dropped to just 3% by the end of June 2023. Industrial metals are overvalued by a similar amount. The three other categories are somewhat more overvalued but are still below 10%.

Typical commodity indices have the highest exposures to energy, followed by agriculture. Therefore, we deem commodities to be only slightly expensive overall at present.

2.8 Currencies

We briefly referred to currency valuations in the section comparing local-currency government bonds from developed and emerging countries. We saw that the US dollar is expensive, whereas the euro and emerging market currencies are neutrally valued.

Table 2.4: Valuation signals for developed currencies

	BIS	Economist Big Mac		Interest rate
Country	Rel REER	Raw	GDP-adjust	5-year
Australia	-15.8	-4.6	-3.1	4.26
Canada	-19.7	-14.7	-11.8	4.04
China	**-15.8**	**-34.0**	**-21.8**	**2.41**
Euro area	-14.1	-1.4	8.4	2.52
Japan	-38.8	-41.2	-38.2	0.33
New Zealand	-12.0	-9.0	-2.8	4.70
Norway	-29.8	22.9	23.6	4.10
Sweden	-25.5	4.8	12.1	3.31
Switzerland	-10.9	35.4	37.3	1.88
United Kingdom	-8.8	-12.9	-7.2	5.32
United States	0.0	0.0	0.0	4.12

Source: BIS, The Economist, Barclays, Robeco. The first column, 'Rel REER', contains the real effective exchange rate (REER) relative to its 15-year history. The next two columns show the raw difference in the price of a Big Mac compared with one in the US and a GDP-adjusted price difference, updated in January 2023. The last column shows the five-year zero-coupon government bond yield of each country on 30 June 2023.

The first column in Table 2.4 contains the relative REER that we used in the previous section, but here it has been normalized such that the US dollar is at zero, enabling it to be more easily compared with the Big Mac Index, which uses the dollar as its base currency.

The Economist's Big Mac index should provide a figure that is comparable to the REER. However, there are two differences. First, since this index shows the relative price of one particular item – a Big Mac – across currencies, it can be interpreted as a relative valuation of currencies based on one item rather than a basket of items or standard exchange rates. By contrast, the REER considers a basket of consumption goods and services. This can lead to large differences in currency valuations. Nevertheless, it is a simple and straightforward way to measure currency valuation. Second, we report the REER relative to its 15-year history, so it is a comparison of where the currency is now relative to the past. The Big Mac index compares the price of the good today across countries and does not adjust for average price differences over history. It can therefore be seen as a measure of absolute purchasing power parity. This may be the reason why the valuation indicators for Norway, Sweden, and Switzerland are so different for relative

REER and the Big Mac index. While Big Macs have become relatively cheaper over the past 15 years in these countries, they are still more expensive than in the US.[3]

The column labeled 'Raw' in Table 2.4 shows price differences of the Big Mac index versus the price in the US, while the GDP-adjusted figure corrects this raw number for GDP per capita. This adjustment is necessary as countries with higher productivity tend to have higher prices of non-tradable goods and services (see Balassa, 1964; and Samuelson, 1964). Based on the Big Mac index, the US dollar is less overvalued than it is based on REER. The Big Mac index makes the Swiss franc and Norwegian krone look substantially overvalued compared with the US dollar. The Australian and New Zealand dollars, the Japanese yen and the UK pound are all cheap according to each currency valuation measure, with the Japanese yen looking extraordinarily cheap.

When we consider the relative strength or weakness of individual currencies, we might be tempted to hedge currencies that are overvalued and are therefore predicted to weaken. However, currency hedging comes at a cost, which is equivalent to the difference in interest rates between the foreign country and the investor's home country. Here, we use the difference in five-year zero-coupon government bond yields between the foreign country and the investor's home country as a proxy for currency hedging costs.

A European investor with savings worth USD 100 on their US bank account, on which they earn 4.12% interest, is exposed to changes in the USD/EUR exchange rate if they want to convert their savings back into the euro after a year. If they want to eradicate this currency risk, they can either buy a currency derivative or convert their US dollars to euros today and receive the 2.52% European interest rate on their bank account instead. The return on their savings, which was 4.12% in US dollars, falls by 1.60 percentage points to 2.52% in euros. This is the way currency forward contracts work. As such, the cost of hedging currency risks is approximately equal to the difference in interest rates between the two countries.

Since this outlook has a five-year horizon, we also include five-year bond yields in the last column. A Eurozone investor might choose to hedge their US dollar currency risk because they see that, based on the relative REER in the first column, the US dollar is 14% overvalued relative to the euro. They would see that the cost of doing so is just over 1.60% per year over the next five years as the US interest rate is 4.12% and that of the Eurozone 2.52%. If after five years the dollar's overvaluation has completely disappeared, the investor would have gained 14% thanks to the US dollar's depreciation and lost 8% on the interest rate differential, resulting in a 6% total gain. If half the currency overvaluation disappears, the currency hedger's loss is only 1%, with a gain of 7% on the currency more than offset by the loss of 8% on the interest rate. The early literature (Rogoff, 1996; Frankel and Rose, 1996) found that, on average, half the REER gap closed in about five years for developed currencies. More recent estimates by Rabe and Waddle (2020) find that half of the convergence occurs within three years. ●

3. According to the Big Mac index, the Norwegian krone, Swedish krona and Swiss franc were overvalued by 145.3%, 98.6% and 98.1% respectively in June 2008.

EXPECTED RETURNS 2024-2028

3. Climate

Robeco's Global Climate Survey 2023 showed that the longer-term trend of investors committing to portfolio decarbonization remains intact, with a large increase in those using active ownership techniques such as engagement to encourage oil and gas companies to switch to renewables. However, higher energy prices since the invasion of Ukraine and the record profits for the energy giants that resulted led some asset owners to maintain or even increase their holdings in old energy companies. The good news, though, is that the fall-out from the crisis has increased investors' conviction that renewable energy, particularly solar and wind power and green hydrogen, can put an end to the world's reliance on fossil fuels and improve energy security.

3.1 Reducing emissions requires green innovation

Are we on track to achieve the goals of the Paris Agreement? Last year we introduced the Kaya (1995) identity in this publication. An identity is an equation that is always true regardless of which values are substituted, and decomposes a variable – here, greenhouse gas emissions – into its drivers (four in this case):

$$GHG = \frac{GDP}{P} \times P \times \frac{E}{GDP} \times \frac{GHG}{E}$$

Where GHG is the total amount of global greenhouse gas emissions, GDP is the world gross domestic product, P is the world population and E is the total amount of energy used.

Any reduction of total greenhouse gas emissions has to come from one of the four sources on the right-hand side of the identity. It is unlikely that in a stable social environment a reduction in greenhouse gas emissions could result from a substantial and sustained decline in the standard of living or a drop in the size of the population. That means we must become more energy-efficient and generate cleaner energy – fast.

Figure 3.1 shows the cumulative increase in greenhouse gas emissions since 1965 along with changes in GDP per capita, population, energy intensity of GDP (energy/GDP) and the carbon intensity of energy (greenhouse gas emissions/energy).[1] All the lines depict global figures – see Penn (2022a) for regional and country-specific decompositions. Note that the Intergovernmental Panel on Climate Change has reported that in certain regions, absolute carbon emissions have fallen recently, even though economic growth has been positive – an example of so-called decoupling. The goal is to achieve this kind of decoupling at the global level. In addition to increasing greenhouse gas emissions, the two other rising lines on the chart show GDP per capita and population, while the two falling lines show the energy intensity of GDP and the carbon intensity of energy. The global population has increased from 3.3 billion to 7.9 billion over this period, an increase of 137%, while GDP per capita has increased from USD 4,200 to USD 11,000 (+160%).[2] This has caused a substantial increase in greenhouse gas emissions.

On the other hand, we now need less energy to generate a dollar of GDP than we did in 1965, with the energy intensity of GDP having fallen from 3.07 kWh to 1.90 kWh (-38%). What's more, carbon emissions per kWh generated have fallen from 0.258 kg to 0.206 kg (-21%). Taking these four factors together, it follows that global carbon emissions are up by more than 200% from an estimated 11.2 Gt in 1965 to 33.9 Gt in 2021.[3] As the global population and economy are expected to carry on growing, albeit more slowly than over previous decades, we need the carbon intensity of the economy to fall much faster than it

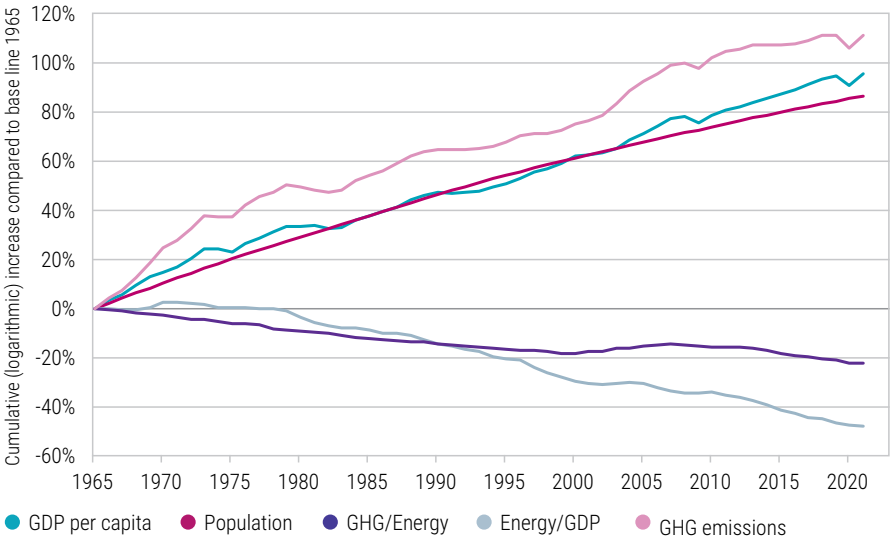
1. As the right-hand side of the Kaya identity is a multiplication, we show the cumulative natural logarithm of changes, such that a doubling of one factor and the halving of another leads to a net-zero overall effect on emissions, instead of a (misleading) +50%.

2. Productivity estimates differ across sources, for reasons including different methods used to convert GDP into USD.

3. Emissions estimates differ across sources, for reasons such as the varying inclusion of agricultural emissions and greenhouse gases other than carbon dioxide.

currently is to reduce carbon emissions. In other words, we desperately need more green innovation. Investors can contribute by providing much-needed funding as capital expenditure in green energy does not seem to be increasing fast enough; see Penn (2023).

Figure 3.1: Cumulative change in carbon emissions over time and their main drivers



Source: Refinitiv, World Bank. Population, GDP per capita, Energy efficiency of GDP, Carbon efficiency of energy, Total emissions.

3.2 The price of global carbon emissions

The concept of negative 'externalities' refers to the negative impacts that are borne not solely by those who produce or consume a good, but that are instead inflicted on wider society. When it comes to carbon emissions, negative externalities arise because the production and consumption of goods and services that emit greenhouse gases contribute to climate change, which has far-reaching and detrimental effects for society. Economists such as Arthur Pigou have long argued that we should 'internalize' these externalities by making producers and consumers pay for the carbon emissions they are responsible for. Some governments and regulators have introduced taxes on carbon emissions or developed carbon emissions trading systems. Taxes involve the advantage of the price of carbon emissions being fixed, but it is unclear how much emissions will reduce as a result of them. Emissions trading systems typically fix the total amount of emissions that are permitted, with the consequence that the price of carbon emissions can fluctuate because of changes in demand.

Figure 3.2 shows that in 2013, just 8% of global emissions were priced. This level has increased substantially in the years since, with the biggest jump occurring in 2022, when China introduced its emissions trading system. By 2023, around 22.5% of global emissions were covered by pricing systems. The global price was generally below USD 10 per ton until it started to rise in 2017, hitting around USD 18 just before the onset of the pandemic. The price then fell before spiking to USD 30. When China introduced its emission trading system it enforced a relatively low price for carbon, so the global price of emissions fell back to around USD 20 as a result. Since then, the global price of carbon has hovered around USD 25.

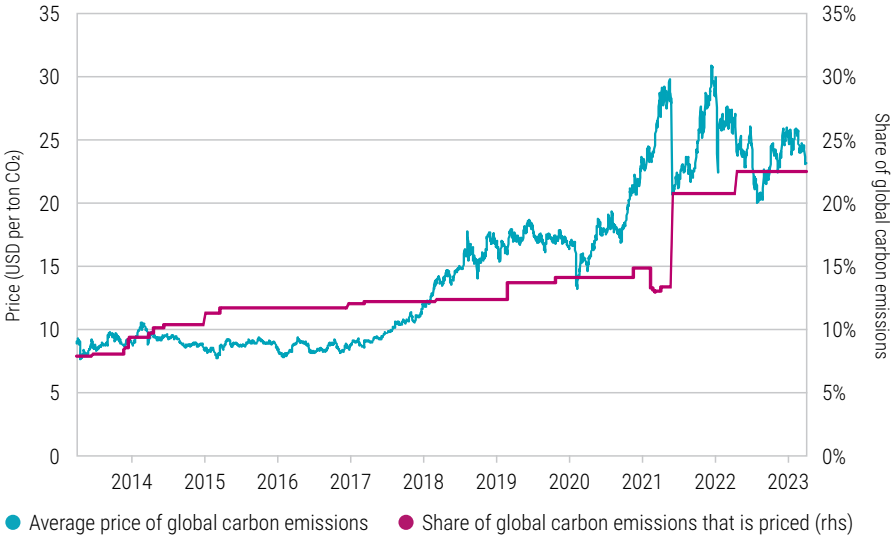
It's important to bear in mind that these prices exclude unpriced carbon emissions. As almost 80% of global carbon emissions are unpriced, the price of total global carbon emissions is actually around USD 5 per ton. It is believed that the global price of carbon needs to increase to USD 100 for externalities to be priced in appropriately. The price of

mandatory carbon credits in Europe is, at around USD 100, close to reaching that level already.[4] Azlen, Gostlow and Child (2022) collected global carbon price predictions for 2030 from several climate models and report a wide range, from USD 55 to USD 249, with a median of USD 125.

4. See Swinkels and Yang (2023).

What's more, the European Union is planning to impose a carbon border tax on imported products that have emitted carbon during their production process. To avoid paying this tax, exporting countries can impose a similar price on carbon emissions to the European Union. This policy may spur other countries to start pricing carbon emissions, driving up the proportion of carbon emissions that is priced and, as a result, the global price of carbon. But how can we measure this potential risk at the company level, and has it already been priced into different asset classes?

Figure 3.2: The global price of carbon and the proportion of global carbon emissions that are priced since 2013



Source: The Monash/C2Zero Real Carbon Price Index, Robeco.

3.3 How should we measure climate risk?

Later in this chapter we provide tables showing various measures of climate change risk, including physical climate risk (the risk of damage resulting from extreme weather events) and transition risk (risks linked to the switch from fossil fuels to renewable energy). Transition risks may be spurred by higher carbon prices. But how can we measure how these two sources of climate risk are already embedded in asset prices?

One straightforward method to measure carbon risk is to examine businesses' past carbon emissions. In doing so it is common to use direct emissions (Scope 1) and the emissions from energy purchases (Scope 2). More recently, the emissions associated with the entire value chain of a product have been used to determine carbon emissions, including the raw materials and inputs involved in producing it (Scope 3 upstream) and the emissions related to its use and disposal (Scope 3 downstream). Inevitably, this leads to double counting of emissions. However, including Scope 3 encourages companies to innovate such that carbon emissions along the value chain are reduced to zero. Since not all companies report greenhouse gas emissions accurately themselves, data providers may have to estimate carbon emissions. These days, data providers offer quite uniform figures for Scope 1 and 2 emissions for equities, but there can be substantial differences for fixed income portfolios and for Scope 3 (especially downstream) emissions.[5]

5. See Markwat and Swinkels (2023).

The major disadvantage of using carbon emissions as a measure of carbon risk is that they are backward-looking. Therefore, data providers and asset managers like us have come up with forward-looking estimates of climate-change risk. Examples include Climate Value at Risk (VaR) and Implied Temperature Rise (ITR). MSCI's Climate VaR incorporates forward-looking climate scenarios and estimates the potential losses and gains for companies resulting from climate-related factors. It considers physical risks, such as extreme weather events, and transition risks associated with the shift to a low-carbon economy. MSCI's ITR aims to estimate the implied temperature rise of a portfolio based on the carbon intensity and emissions trajectory of the assets it contains. It quantifies the potential contribution of a portfolio to global warming by estimating the increase in average global temperatures that would result if all companies in the world were to follow the behavior of the companies in the portfolio. The main disadvantage of both of these forward-looking measures is their dependence on assumptions and projected scenarios.

More recently, alternative measures have been suggested. For example, one could create portfolios of stocks of companies with high and low carbon emissions, and refer to the difference in investment returns of the two portfolios as a carbon factor. An asset's exposure, often referred to as a beta, to such a carbon factor would determine its carbon risk.[6] Others have proposed designing a climate risk factor by measuring the amount of content about climate change that is published in newspapers and forming portfolios based on stocks that perform poorly and well during periods in which there is lots of bad news about climate change.[7] The difference in the returns of these two portfolios could be viewed as a climate risk factor, and companies' exposures to this factor can then be estimated and viewed as a measure of climate risk. Advances in neurolinguistic programming (NLP) make it possible for algorithms to quickly scan newspapers for climate-related news and categorize it as positive or negative. Such techniques can also be used to detect whether climate risk comes up as a topic during quarterly corporate earnings calls. A corporate climate change risk measure has already been developed using this kind of automated assessment.[8]

6. See Huij, Laurs, Stork, and Zwinkels (2023), Bauer, Huber, Rudebusch, and Wilms (2022), and Hsu, Li, and Tsou (2023).

7. See Engel, Giglio, Kelly, Lee, and Stroebel (2020) and Ardia, Bluteau, Boudt, and Inghelbrecht (2023).

8. See Sautner, Van Lent, Vilkov, and Zhang (2023).

This overview shows that exposure to climate change risk is a multifaceted concept and can be measured in different ways. As this is still a developing area, it is unclear which metrics are most useful in managing a portfolio's climate risks. We therefore show several complementary measures of climate risk to gauge climate risk at the asset-class level.

3.4 Is climate change risk already priced in?

The results of a questionnaire sent to academics in July 2021 showed that most think that the risk linked to climate change is underestimated by market participants.[9] Since there are so many different metrics that have been proposed to measure climate change risk, and many of these metrics only have low correlations with each other, it is far from certain that climate risks are already fully priced in by the financial markets.

9. See Stroebel and Wurgler (2021).

Researchers typically need long time-series of data before they can make confident statements about the existence of risk premiums that are backed up by statistics. Since most climate change risk measures are only backed up by data of sufficient quality dating back at most a decade, and investors have only shown widespread interest in the climate since the Paris Agreement in 2015, there is not much representative historical data to examine. It therefore comes as no surprise that evidence of the existence of a climate change risk premium is weak and sometimes even contradictory.

For example, two papers, one covering the US and one assessing a global sample, find that firms with higher absolute emissions produce higher investment returns than other stocks due to a positive carbon risk premium.[10] The way they measure absolute emissions has been criticized, however, and when carbon risk is defined as carbon intensity

10. See Bolton and Kacperczyk (2021, 2023).

(emissions relative to revenues), there is no difference in the returns of companies with differing carbon risk.[11]

11. See Aswani, Raghunandan, and Rajgopal (2023).

This raises a question: which of the two carbon measures is more important to investors – absolute carbon emissions or carbon intensity? A practical example looking at absolute emissions is provided by Climate Action 100+, which initially focused on the 100 companies emitting the most carbon in absolute terms. However, carbon intensities are used in the management of many portfolios and even in regulation in certain jurisdictions. So both absolute emissions and carbon intensity are used as measures of climate change risk in practice. Research suggests that risk linked to absolute carbon emissions is already partially priced in, but that it is not for carbon intensity.

There are also studies that focus on changes in the cost of capital for firms with high carbon emissions. A higher cost of capital means that it is more expensive for firms to attract fresh capital to undertake new investments, potentially preventing them from embarking on new polluting projects at all. For equity markets, the earnings yield, the inverse of the price-earnings ratio (P/E), is often used as an estimate of the cost of capital. A high earnings yield (in other words, a low price-earnings ratio) indicates a high cost of capital. For investors, a high cost of capital implies a high expected return on their investment. If brown firms have a higher cost of capital than green firms, this could be interpreted as evidence of the existence of a carbon risk premium going forward. These studies tend to find that for equity markets, the price-earnings ratio of high carbon emitters is currently substantially lower than that of low carbon emitters, suggesting that the cost of capital for high carbon emitters has increased since the Paris Agreement.[12]

12. See Bolton, Halem, and Kacperczyk (2022) and Choi, Gao, Jiang, and Zhang (2023).

This is confirmed in Figure 3.3, which shows that the price-earnings ratios of the traditional (red) and alternative (purple) energy sector indices were similar at the end of 2014, but very different by 2023. The broad market has had a price-earnings ratio between 15 and 20 most of the time since 2015. The energy sector's P/E has spiked above 30 twice: in 2016 and during the pandemic. Oil prices suddenly declined on both occasions, putting pressure on the following year's earnings, with the result that the estimated cost of capital decreased. Since the pandemic, the P/E of the energy sector has gradually declined and is currently well below 10, which means the cost of capital for traditional energy companies is currently high.

We see an almost opposite pattern for the alternative energy sector. Until the pandemic its valuation was not very different from that of the overall market, but it then increased to over 30 in 2021. Its P/E has since fallen to around 25, but this is still well above that of the broad market. As such, this low estimate of the cost of capital for green firms and the high cost of capital for brown firms suggest that a carbon risk premium is currently priced in.

A disadvantage of using valuation measures as a proxy for the cost of capital is that in addition to the cost of capital, stock prices also incorporate expectations of long-term earnings growth as well as the following year's earnings. What's more, the following year's earnings forecasts are sensitive to energy prices, which can be volatile from year to year. Finally, green and brown firms may be listed in different countries, such that regional differences in the cost of capital may affect the comparison.

In summary, even though the different cost of capital estimates of green and brown firms suggest that a carbon risk premium is currently priced into the equity markets, the P/E metric on which it is based is indirect and the differences may also be influenced by other factors unrelated to the cost of capital.

Figure 3.3: P/E of traditional and alternative energy companies and the broad market

Source: MSCI, Refinitiv, Robeco. Market is MSCI AC World IMI, Energy is MSCI AC World IMI Energy, and Alternative Energy is MSCI Global Alternative Energy. The price-earnings ratio is the current stock price divided by the estimated earnings for the next year.

An alternative to using the price-earnings ratio as a measure of the cost of capital is the interest rate that companies have to pay on the bonds they issue. One might expect that the interest rate that conventional energy ('red') firms have to pay would be higher than what alternative energy ('purple') firms pay, all else being equal.

To examine this further, we investigated all 103 investment grade bond issuers in a US sub-sector for which climate change risk is material: electric utilities. Each issuer is represented by one dot in the four panels of Figure 3.4, where the y-axis of each panel shows the credit spread – the interest rate a company pays on a bond with five-year maturity on top of the risk-free rate.

The top-left panel shows that there is a clear relationship between a bond's credit rating and the credit spread. Unsurprisingly, bonds that are considered to be safer by rating agencies pay a lower interest rate. The correlation between credit ratings and credit spreads is 0.71.

In the top-right panel, the x-axis shows a backward-looking measure of carbon footprint. There is a slight tendency for higher emitters to pay a higher spread, but the relationship is weak and the correlation between carbon footprint and credit spreads is only 0.13.

The bottom-left panel shows the relationship between credit spreads and the implied temperature rise, a forward-looking climate risk measure. Again, the link between the two is weak, but it is now in the opposite direction – overall, companies with a higher implied temperature rise pay slightly lower interest rates.

The bottom-right panel shows the relationship between Robeco's Sector Decarbonization Pathway (SDP) score and credit spreads.[13] The Robeco SDP methodology is designed to measure the position of each company relative to its sector in terms of carbon emission reduction targets in order to identify the investments it needs to make in low-to-zero-emissions technologies, the possible regulatory penalties it may be subject to. Here, we would expect a negative correlation – a higher SDP score means a company is better aligned with the Paris Agreement and should be associated with a lower credit spread. This is indeed what we find, but again the correlation is weak at -0.15.

13. For more details on Robeco's proprietary sector decarbonization pathway methodology, see the article 'Pioneering in climate analytics with Robeco's Sector Decarbonization Pathway methodology' on our website.

Our conclusion based on the findings of Figure 3.4 is that credit spreads are closely linked to perceived credit risk, but are only weakly correlated with measures of climate change risk. As such, either the cost of capital is not much affected by climate change risk or climate risk is not sufficiently priced into these corporate bonds. Alternatively, none of these three measures of climate risk may be good indicators of the real climate risk that companies face. Our findings are consistent with much recent literature,[14] but there are also some studies that do find that assets that are exposed to more carbon risk have higher spreads.[15] This topic is an interesting area for further research.

More recently, biodiversity loss has become another important theme within sustainable investing and the first papers are emerging on how it affects stock prices. Since data about biodiversity is scarce and has an even shorter track record than most climate change metrics, the challenges are even bigger than for climate change. However, several of the methodologies that are used to measure climate change risk, such as using NLP to scan news on biodiversity loss and company reports, have recently been applied to this topic as well.[16] The empirical evidence so far suggests that there is not yet a biodiversity risk premium in the equity markets.

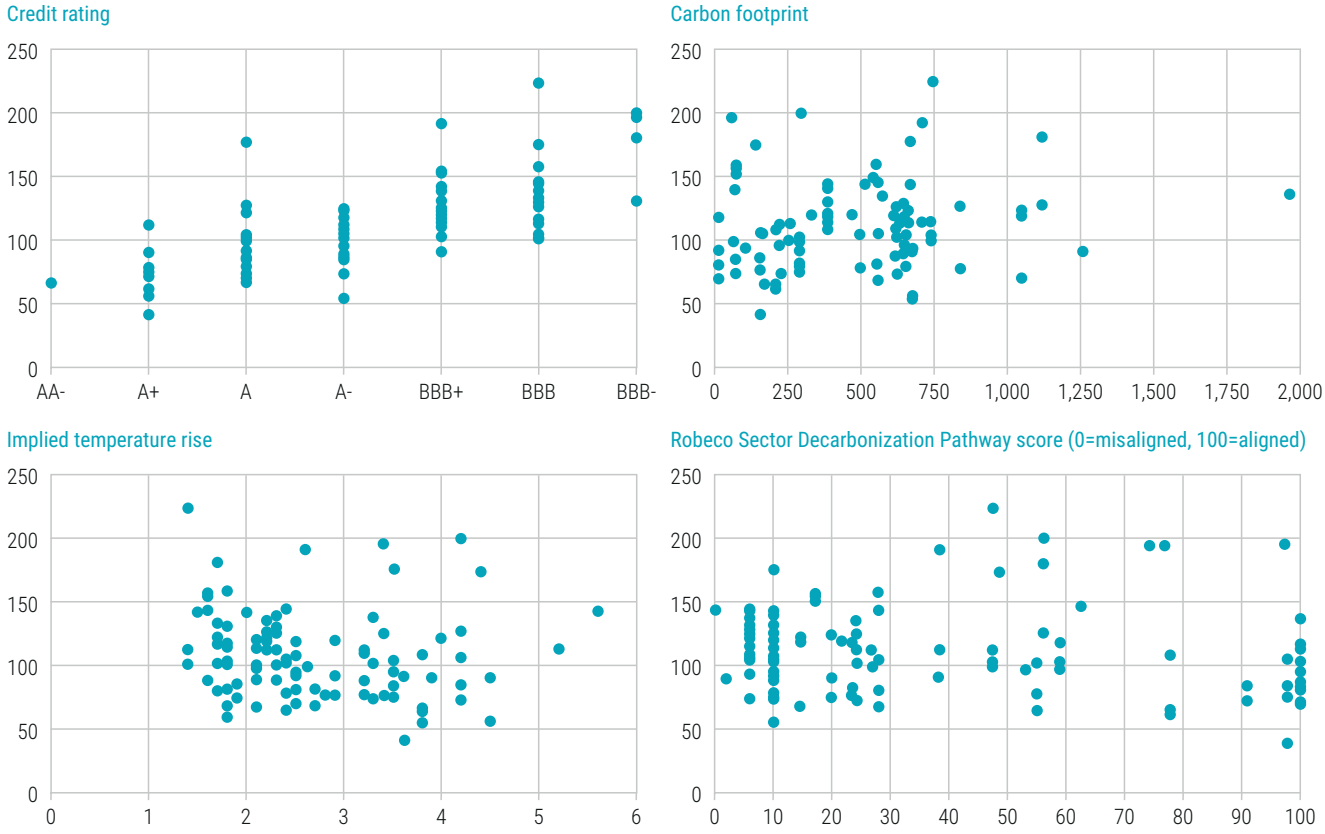
In summary, we believe that climate change risk has not been sufficiently priced in by the financial markets. Since the number of investors concerned with climate change continues to grow, the price of carbon emissions is expected to increase substantially in the coming years, and as better measures of the different dimensions of climate change risk are developed, we expect it to be priced into asset prices more during the next five years. As such, we believe that exposure to climate change risk will have a negative effect on asset classes' expected returns over the next five years.

14. See Mastouri, Mendiratta, and Giese (2022).

15. See Huynh and Xia (2021) and Javadi and Masum (2021).

16. See Coqueret and Giroux (2023), Flammer, Giroux, and Heal (2023), Garel, Romec, Sautner, and Wagner (2023), Giglio, Kuchler, Stroebel and Zeng (2023) and Hoepner, Klausmann, Leippold and Rillaerts (2023).

Figure 3.4: Climate change risk and corporate bond spreads of US electric utilities



Source: Robeco, Bloomberg, Moody's, S&P, Fitch, TruCost, MSCI. The y-axes shows the five-year implied corporate credit spread derived from a corporate bond with close to five years maturity. The x-axes show credit rating, carbon footprint, implied temperature rise and Robeco's proprietary sector decarbonization pathway score.

3.5 The impact of climate change on asset classes

Even though measuring climate change risk is difficult, it may affect expected returns at the asset class level, and therefore needs to be considered by asset allocators. In this section we examine the climate change risks the main asset classes are exposed to and the implications for their expected returns.

What is the cost of climate change if no climate action is taken? The answer to this question depends on many assumptions: whether temperature increases lead to tipping points, how temperature increases translate into severe weather events, how much damage these severe weather events cause, and how costly it is to adapt to climate change, including geopolitical tensions due to mass migration away from less habitable parts of the world. These expected costs of no action must be offset against the cost of enacting climate policies.[17] Both options are costly, so we expect that economic growth will be lower over the coming decades than when carbon emissions were deemed to be harmless and were free. Many researchers believe that reducing carbon emissions in the near future will on balance be cheaper than taking no action.[18] Fortunately, the no-action scenario is becoming less likely as more governments are committing to net-zero ambitions. However, the pace of climate action is still insufficient in many regions.[19]

17. See Lomborg (2020).

18. See Rebonato, Kainth, and Melin (2022).

19. See Boehm et al. (2022).

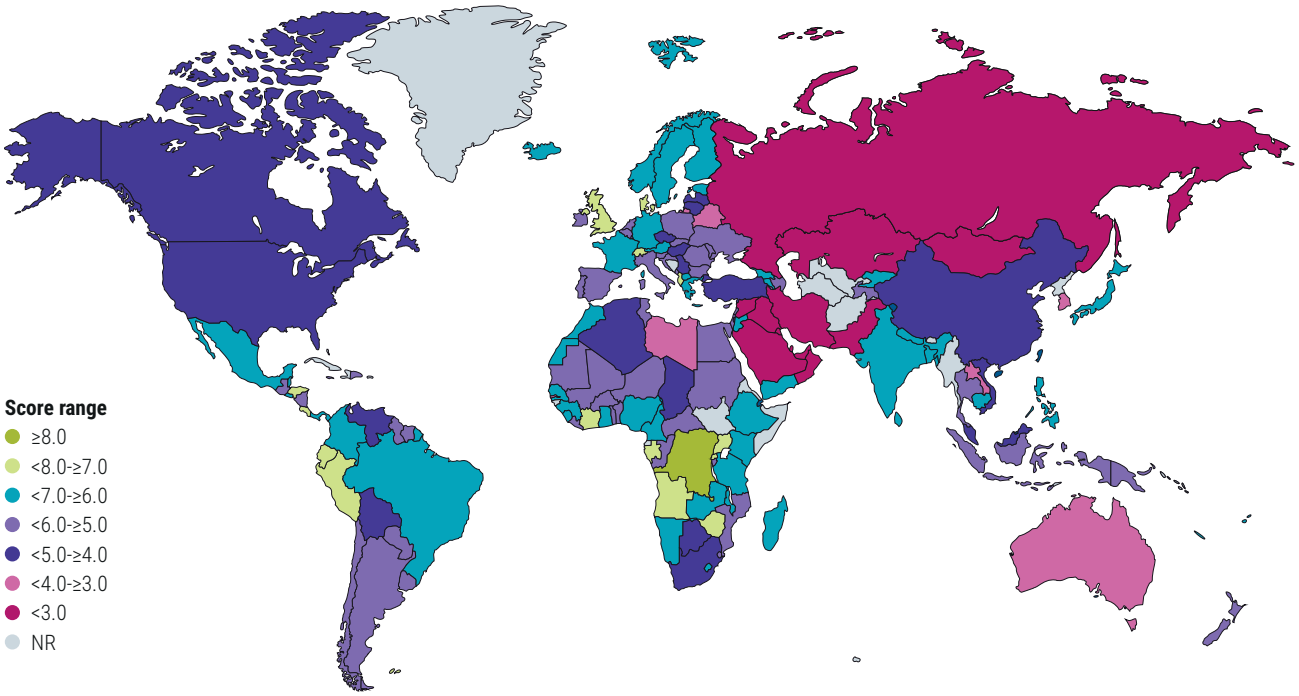
3.5.1 Government bonds

To understand the impact of climate change on government bond returns, we need to determine whether climate change will affect economic growth. Penn (2022b) surveys 55 academic studies looking into the effects of climate change on economic growth and finds that the estimates of the impact of climate change on economic growth vary considerably depending on the methodology used and the region being assessed. It seems realistic to assume that economic growth will be 30 bps per year lower than it would have been without climate change, although this estimate is still surrounded by considerable uncertainty.

Government bond yields in developed markets tend to be lower when economic growth is lower. Since the energy transition is costly, it reduces economic growth. This means that interest rates will be lower than in a scenario in which carbon emissions did not lead to climate change. Taking no climate action would lead to more natural disasters that would result in even lower economic growth and therefore bonds yields would be even lower in such a scenario.

However, as we discussed in last year's chapter on 'climateflation', the energy transition is likely to lead to somewhat higher and more volatile inflation. To compensate for this, investors tend to demand higher bond yields, which add to nominal government bond returns. On balance, therefore, we believe that climate change will have a neutral overall impact on the returns of developed market government bonds.

Figure 3.5: Robeco's country climate and energy scores



Source: Robeco. Scores range from 1 (worst) to 10 (best). Scores as of April 2023.

3.5.2 Emerging market debt

It is difficult to separate climate change risk from other factors that impact government bond yields, especially for emerging markets where government bond yields are often not considered to be risk-free. Nevertheless, several studies claim that there is a positive relationship between the two.[20]

Not every government is equally vulnerable to physical climate risk and energy transition risk. Therefore, Robeco's Country Sustainability Ranking contains a 'climate and energy' sub-score, which we show in Figure 3.5. It is based on indicators such as a country's carbon efficiency, the proportion of renewable energy in its energy mix and various climate risk indicators. The weighted average score of the largest developed markets is 5.4, dragged down by relatively poor scores for the US and Canada.[21] The weighted average score for emerging markets is also 5.4.[22] China, Malaysia and South Africa are the worst performers, while Colombia and Peru score highest.

These scores suggest there is no difference in the climate change risk embedded in developed and emerging government bonds. However, emerging markets have less access to foreign capital markets to deal with the negative impacts of climate change risk. As such, we would expect their spreads relative to developed markets to increase somewhat over the coming five years, at least from a climate risk perspective. This means there is a negative climate signal for emerging market government debt.

3.5.3 Corporate credit

We collect several climate change risk measures for investment grade and high yield bonds. This year, we have also added a biodiversity risk measure.

20. See Beirne, Renzhi and Volz (2021) and Boehm (2022).

21. Country weights from the Barclays Global G7 Treasury Index at the end of June 2023.

22. Country weights from the JP Morgan GB-EM Broad Diversified Index at the end of June 2023.

Table 3.1: Climate change risk metrics for corporate bonds

	Index weight (%)		Carbon footprint		Climate VaR (%)		Temperature rise		Climate score		Biodiversity footprint	
	IG	HY	IG	HY	IG	HY	IG	HY	IG	HY	IG	HY
Total	**100.0**	**100.0**	**66.7**	**124.0**	**-16.9**	**-25.2**	**2.4**	**3.0**	**-0.39**	**-0.74**	**-3.5**	**-2.8**
Banking	26.6	5.0	0.3	0.6	-9.1	-13.3	1.6	2.3	-0.47	-0.62	-3.0	-2.9
Basic industry	2.9	6.0	329.6	465.9	-51.8	-66.8	3.2	4.2	-1.05	-1.58	-15.1	-6.9
Brokerage, asset managers, exchanges	1.4	0.8	1.2	2.2	-4.6	-8.3	1.7	1.8	-0.07	-0.54	-3.4	-0.7
Capital goods	4.6	9.6	126.3	180.0	-7.5	-19.3	3.3	2.9	-0.67	-1.05	-3.2	-2.6
Communications	7.7	14.6	7.6	7.5	-19.3	-18.9	1.4	1.6	0.55	-0.01	0.0	0.0
Consumer cyclical	7.2	21.6	16.7	29.1	-9.1	-15.2	2.5	2.6	-0.33	-0.60	-4.4	-3.1
Consumer non-cyclical	13.6	11.6	16.7	31.5	-15.1	-20.3	1.7	2.2	0.08	-0.62	-7.4	-4.2
Electric	6.9	2.7	381.8	1,081.5	-26.8	-23.7	2.1	2.4	-0.89	-1.02	-1.3	-1.9
Energy	5.8	9.1	244.7	229.9	-65.4	-68.0	4.0	6.2	-2.24	-2.09	-7.7	-7.1
Finance companies	1.0	2.0	1.9	3.3	-1.5	-6.4	2.5	1.7	-0.41	-0.32	-0.1	-0.5
Financial other	1.5	2.7	7.5	20.2	-17.3	-14.0	1.7	1.6	-0.38	-0.31	-0.7	-1.4
Industrial other	0.7	1.5	29.3	75.4	-34.8	-11.9	3.4	2.3	-0.84	-0.55	-2.4	-2.0
Insurance	5.9	1.5	5.5	1.8	-15.1	-15.7	1.4	1.4	-0.08	-0.58	-1.3	-0.4
Natural gas	1.2	0.1	156.3	178.5	-53.3	-95.1	2.7	4.1	-1.90	-2.15	-2.3	-6.2
REITs	2.6	1.4	4.7	10.1	-9.5	-22.3	1.7	1.8	-0.08	-0.14	-0.4	-0.3
Technology	6.8	5.5	6.5	10.2	-3.6	-7.9	1.7	1.7	0.28	-0.35	-0.4	-0.2
Transportation	2.9	3.4	90.2	327.5	-30.9	-73.9	1.8	1.7	-0.28	-0.74	-1.8	-1.0
Utility other	0.5	0.3	171.1	482.7	-26.1	-28.9	1.6	1.5	-0.47	-1.29	-0.4	-0.6

Source: Robeco, Robeco Indices, Refinitiv Datastream, MSCI, TruCost, MSCI ESG Research, Iceberg Data Labs. The data was obtained in June 2023. Certain information ©2023 MSCI ESG Research LLC. Reproduced by permission. Trucost Carbon footprint is measured in tons of CO2 equivalent per USD 1 million invested. MSCI Climate VaR is a percentage change in company value. MSCI Implied Temperature Rise is the expected degree increase in temperature relative to the pre-industrial area if all companies in the world were to follow the decarbonization plans of the companies in the (sub-)index. The Robeco Climate Score is a score ranging from -3 to +3, calculated at the company level, combining current emissions, forecast future emissions and climate solutions. The biodiversity footprint is a score to measure the impact of the (sub-)index on biodiversity, where a more negative score means a more negative impact.

Table 3.1 shows the various risk measures at the market index level and for each sector.[23] The carbon footprint is represented by carbon emissions divided by enterprise value including cash, which has become the default measure of carbon footprints in Europe.[24] The investment grade universe has a substantially lower carbon footprint (66.7 tons of CO_2e per USD million invested) than the high yield index (124.0). However, this measure is purely backward-looking. The climate value at risk measure provides a forward-looking, returns-based assessment of the climate-related risks and opportunities an investment portfolio is exposed to. At the market index level, it also suggests that investment grade is less exposed to climate change risk than high yield, with a value at risk of -16.9% for investment grade compared with -25.2% for high yield. The implied temperature rise reflects a company's future emissions plans and translates them into a projected global temperature rise if every company were to follow the same emissions path. The figure we show here is the aggregate implied temperature rise at the portfolio level. The energy and basic industry sectors are primarily responsible for the implied temperature rise at the index level, which is why decarbonization efforts are likely to have the greatest impact by focusing on those sectors. Again, high yield has a substantially larger implied rise than investment grade. Robeco's climate scores also contain forward-looking information, such

23. We do not address differences in climate risk across maturities, nor the increased incentives to decarbonize that investors can provide to companies by investing in short-dated bonds; see Koekkoek and Swinkels (2023).
24. Due to data quality issues this is currently limited to Scope 1 and 2, but in the future it will also include Scope 3 emissions.

as climate transition pathways. Note that these climate scores are still in a pilot phase and that they are subject to change. The scores range from -3 (high greenhouse gas emitters, weak decarbonization targets) to +3 (green solutions providers, exacting decarbonization targets), and high yield (-0.74) again scores worse than investment grade (-0.39). The natural gas, energy and basic industry sectors have the worst climate scores.

We source corporate biodiversity footprint data from Iceberg Data Labs. A score of zero means no impact on biodiversity, while the more negative the number, the worse the negative impact on biodiversity a company has. We aggregate these effects to the sector level. Interestingly, the biodiversity footprint is somewhat better for high yield (-2.8) than for investment grade (-3.5). This highlights that biodiversity risk is not necessarily closely correlated with climate change risk, although the energy sector has a large impact on both.

Since the implied temperature rise for investment grade credit is around 2.4 degrees, which is not too far off the targets of the Paris Agreement, and investors are exposed to the relatively safe part of the capital structure when they own corporate bonds, we assign investment grade credit a neutral climate signal. Each of the climate change risk measures for the high yield universe is worse, leading us to give a negative climate signal to this asset class.

3.5.4 Developed market equities

The key questions for equity investors to consider are how climate change will affect companies' ability to generate the cashflow and the cost of capital of the typical company in their assessment of net present value. Future cashflows might fall as a result of physical risk, such as when droughts or floods damage a company's production facilities, or due to transition risk linked to new energy sources, investments it needs to make in clean technology or higher prices of carbon emissions. Companies involved in developing innovations in support of the energy transition may actually benefit from climate change risk.

In the long run, one would expect earnings growth to equal long-run economic output growth. If growth in GDP is structurally impaired by climate change, there could also be repercussions for companies' long-term earnings growth potential. We stated earlier that a reduction in global economic growth due to climate change of 30 bps per year is plausible, and since GDP and corporate earnings have similar growth rates in the long term, we would expect earnings growth to be 30 bps lower per year than it would otherwise have been. This is clearly bad news for equity investors. However, it is not only growth in cashflows that matters, but also the rate at which they are discounted.

Uncertainty about temperature shocks is associated with increases in the cost of equity of 20 bps per year.[25] Over the long run, this would mean the equity risk premium should rise by 20 bps per year. Over the medium term, as more equity investors start to scrutinize the downside risks that could result from climate change, an increasing cost of capital due to a higher climate risk premium would be a negative signal for equity markets.

25. See Balvers, Du and Zhao (2016).

We assess the climate change risks of the broad developed and emerging equity markets and for each sector within them, using the same metrics as for the corporate bond market. The carbon footprint of developed markets is down from 53.9 last year to 42.8. The climate value at risk figure is -11.7%, up from -10.7% last year. This reduction in carbon footprint is predominantly driven by a reduction in carbon emissions within industries, and not by a changing industry composition of the market. The three equity sectors with the worst footprints and highest climate value at risk are utilities, energy and materials. The implied temperature rise for developed equity markets is 2.5, considerably above the target of the Paris Agreement. The Robeco Climate Score of -2.6 for the energy

sector is much more negative than those of materials and utilities. The biodiversity footprint of the developed markets index is -3.3, close to that of investment grade credit. According to this measure, the consumer staples sector has a particularly detrimental impact on biodiversity.

Climate risk as measured by the carbon footprint and climate value at risk of developed equity markets (42.8 and -11.7) is lower than for investment grade credit (66.7 and -16.9). However, we expect the impact of climate risks to be higher for equity returns than for bond returns as equities are the first assets to suffer when risks materialize. As such, we expect a negative impact on developed equity returns from the repricing of climate risk over the next five years.

Table 3.2: Climate change risk metrics for equities

	Index weight (%)		Carbon footprint		Climate VaR (%)		Temperature rise		Climate score		Biodiversity footprint	
	Dev	Emerg	Dev	Emerg	Dev	Emerg	Dev	Emerg	Dev	Emerg	Dev	Emerg
Total	**100.0**	**100.0**	**42.8**	**150.1**	**-11.7**	**-27.6**	**2.5**	**3.0**	**-0.11**	**-0.11**	**-3.4**	**-4.9**
Communication services	7.2	9.7	3.3	9.7	-10.8	-16.5	1.4	1.4	0.17	0.48	-0.1	0.0
Consumer discretionary	10.7	12.8	10.5	20.4	-5.1	-14.4	2.2	2.9	-0.17	-0.60	-3.5	-4.8
Consumer staples	7.5	6.3	21.4	52.2	-18.3	-28.1	2.0	2.3	0.05	-0.59	-11.3	-14.6
Energy	4.6	4.9	259.3	564.4	-69.2	-94.1	4.2	4.7	-2.60	-2.62	-8.0	-11.3
Financials	14.6	21.9	5.7	3.4	-8.6	-20.8	1.5	1.8	-0.10	-0.41	-2.9	-4.5
Health care	13.1	4.0	4.2	16.3	-7.6	-13.7	1.5	1.7	0.11	-0.75	-3.0	-0.6
Industrials	10.8	6.3	31.3	139.5	-4.9	-35.1	3.0	2.9	-0.42	-1.03	-2.4	-7.6
Information technology	22.2	21.3	3.0	36.1	-1.3	-15.6	1.6	2.0	0.49	-0.35	-0.2	-1.7
Materials	4.1	8.3	291.1	740.2	-39.7	-59.1	3.4	3.8	-0.78	-1.26	-15.2	-17.6
Real estate	2.4	1.7	5.1	17.5	-13.5	-19.1	1.7	1.8	-0.21	-0.59	-1.0	-0.7
Utilities	2.9	2.6	371.9	1,369.2	-28.4	-70.9	2.2	4.3	-0.67	-1.37	-1.3	-2.4

Source: Robeco, Robeco Indices, Refinitiv Datastream, MSCI, TruCost, MSCI ESG Research. The data was obtained in June 2023. Certain information ©2023 MSCI ESG Research LLC. Reproduced by permission. See Table 3.1 for more information on the climate change risk measures.

3.5.5 Emerging market equities

Table 3.2 shows that climate risk metrics are generally worse for emerging markets than for developed markets, except for the Robeco Climate Score, which has the same slightly negative score for both regions. The carbon footprint of emerging market equities is 150.1, more than three times higher than the 42.8 for developed markets. Emerging equities' climate value at risk is more than twice as high as for developed markets. And the implied temperature rise of emerging markets is half a degree above that of developed markets. An important reason for these findings is that on average production processes in emerging markets are less clean than those in developed markets.

The biodiversity footprint of emerging markets is also worse at -4.9, compared with -3.4 for developed markets. Consistent with developed markets, the consumer staples sector scores worst when it comes to biodiversity, even though it does not perform particularly poorly on any of the climate metrics.

As most of these metrics suggest that emerging market equities are more vulnerable to climate change risk than developed markets, we assign a negative climate signal for emerging markets relative to developed markets.

3.5.6 Real estate

The carbon footprint of real estate is relatively low, as we can see in Table 3.2. Note that this only includes Scope 1 and 2 emissions, and Scope 3 is not included. However, carbon footprint may not be the best measure to evaluate the climate change risk that real estate is exposed to. There are two other reasons why real estate may be vulnerable to climate change. First, real estate may be negatively impacted by the estimated 30 bps per year reduction in global economic growth resulting from climate change, just like other asset classes. Second, physical climate risks are also high for real estate, with the potential for extreme weather events such as flooding to directly impact buildings. There has been limited research on the impact of climate change on real estate. That said, several papers have found that properties in coastal or hurricane-prone areas have fallen substantially in value recently, although some of these falls reversed after the implementation of credible plans to prevent or deal with future disasters.[26]

26. See Clayton, Devaney, Sayce and Van de Wetering (2021).

The climate change risk that real estate is exposed to is in large part dependent on the exact location of the properties in question. Nevertheless, we assign a neutral climate signal overall for global real estate, suggesting its risk is comparable to that of developed equity markets. This is because lots of valuable properties are located in areas threatened by climate change.

3.5.7 Commodities

Climate change seems to be a double-edged sword for commodities. On the one hand, demand for commodities is likely to decrease as global economic activity slows. On the other, increased physical risks resulting from climate change could result in more frequent negative supply shocks hitting commodities, especially agricultural commodities. The overall impact on expected commodity returns under a business-as-usual scenario could therefore be neutral.

However, if progress is made towards the Paris climate targets and the green energy transition, the commodity intensity of economic activity could increase. This is because the battle against climate change is resulting in increased demand for certain commodities used to produce wind turbines, solar panels and batteries. This rise implies that a greener economy could, at least in the medium term, be beneficial for commodity prices.

On balance, we assign a positive climate signal to commodity markets as we expect the battle against climate change to exert upwards pressure on commodity prices. ●

Special topics

Long-term investors generally face long-term challenges. In this section, however, we address four topics that institutional investors may very well be facing right now or in the near future.

SPECIAL TOPIC | EMERGING MARKETS

Capitalizing on the AI advantage in emerging markets

Despite being around for quite a while, machine learning algorithms have recently surged in popularity when it comes to asset management. This can be attributed to greater computing power, increased data availability, decreased data storage costs, and recent algorithmic innovations. What does this mean for emerging market investors?

In this special topic, we explore how machine learning algorithms and models also have large potential for investing in emerging stock markets.[1] We do this by analyzing all non-micro emerging market stocks, meaning more than 15,000 stocks from 32 emerging markets over the period 1990 to 2021. We discovered that machine learning models excel at detecting financially material non-linear relationships between company characteristics, a feat challenging for human researchers, and that ensembling (i.e. 'wisdom of the crowd' for machine learning models) could increase expected returns net of trading costs by up to 1% per annum for emerging markets equity investors.

1. This special topic is a summary of Hanauer and Kalsbach (2023).

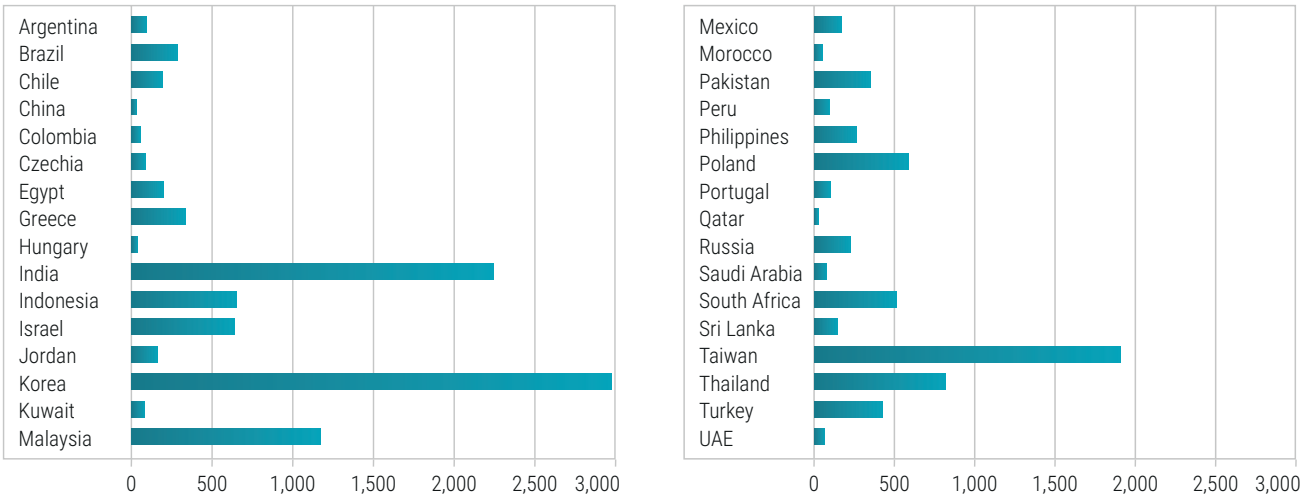
In this topic, we first briefly describe the data we used to carry out the analysis. We then introduce the optimization problem we want to solve. We first look at the traditional linear regression model and then dive deeper into the various non-linear machine learning models we tested. Then we describe the results – namely, which characteristics were important to the models – and then elaborate on our out-of-sample test to see what the results actually mean for investment performance when we backtest portfolios.

Overview of country and characteristic selection

Figure 1 shows that the largest countries in our sample of over 15,000 stocks are Korea (2,972), India (2,238), Taiwan (1,912), and Malaysia (1,173). This suggests a tilt towards Asian stock markets. This sample contains only B-shares from the Chinese equity market, purposely excluding Chinese A-shares that were only accessible to local investors for the majority of the sample period. Our findings align with a machine learning analysis specifically on the domestic Chinese A-shares market.[2]

2. See Leippold, Wang, and Zhou (2022).

Figure 1: Number of stocks in the sample from each country



Source: Robeco, Hanauer and Kalsbach (2023).

The 36 firm characteristics we examine have been studied both in developed and emerging markets.[3] We opted not to introduce new and potentially relevant characteristics to this study. Instead, our goal is to highlight the added value that machine learning techniques can bring to conventional ways of constructing factors, ensuring that any additional performance isn't just the result of novel data. The firm characteristics include well-known factors such as low-risk, valuation, momentum, and quality.

3. See Windmüller (2022).

Methodology: From linear regression to neural network

In order to predict the performance we're investigating, we look at emerging market stock i in country c in period $t+1$, $R_{i,c,t+1}$, relative to its own country market index in period $t+1$, $\bar{R}_{c,t+1}$. We want to find the function $f(.)$ which uses the 36 firm characteristics x at time t to give the best prediction of future excess returns. For the quantitatively oriented reader, in mathematical formulation:

$$E_t\left\{R_{i,c,t+1} - \bar{R}_{c,t+1} \middle| x_{i,t}\right\} = f(x_{i,t})$$

The conventional method of linear regression would then result in

$$R_{i,c,t+1} - \bar{R}_{c,t+1} = x_{i,t} \cdot \beta + \varepsilon_{i,t}$$

However, this method assumes that each of the firm characteristics is linearly related to the stock's outperformance. This method does not account for clear non-linearities, prompting researchers to manually adjust certain variables. For example, instead of the market capitalization, the logarithm of market capitalization is typically used, rendering the relationship with returns log-linear. This transformation, often referred to as human 'domain knowledge', can have a large impact on the outcome.

Here we describe the machine learning methods we use to improve upon this straightforward linear regression.

Elastic net

This method aims to reduce the number of characteristics (36 in our case) by eliminating those with the lowest or no forecasting ability. It also lowers the coefficients of the in-sample linear predictive relationship to minimize the potential noise that may be present in-sample that could impair out-of-sample predictive performance. This method does not detect data-driven non-linear relationships or interaction effects.

Tree-based regressions

Unlike the aforementioned linear methods, tree-based methods such as random forests and gradient-boosted regression trees don't require the researcher to manually specify any potential non-linearities or interactions. Instead, these are included by construction. Regression trees follow the idea of sequentially partitioning the underlying data into groups of firm characteristics similarly related to the future return. This method effectively grows the tree, creating new branches each time the data is separated. At each new branch, the characteristic that generates the biggest separation in the database is selected, with the tree growing as high as the researcher allows, ending in a leaf.

To avoid overfitting, we limit the number of branches in the final prediction model using bootstrap aggregation or gradient boosting, two commonly applied algorithmic enhancements for these types of prediction models. Bootstrap aggregation, or 'bagging', involves training multiple models on different subsets of the data and combining their predictions to make a final prediction. Gradient boosting is an ensemble method where the models are built sequentially, with each new model attempting to correct the mistakes made by the previous models.

Neural networks

Neural networks are inspired by the biological brain's network of interconnected neurons. They are flexible, parametric models that can effectively perform tasks by connecting multiple layers. A typical feed-forward neural network consists of an input layer (comprising firm characteristics), at least one hidden layer (comprising activation functions), and an output layer (which aggregates the outcome of the final hidden layer into a return prediction). When a model uses more than one hidden layer, it's sometimes referred to as a deep learning model. For the purposes of this study, we use neural networks with up to five hidden layers and present the ensemble of the networks with one to five hidden layers.

With 1990 to 2001 as our initialization period, we use data from the first half for training and the second half for validation. We train the models on our entire set of emerging market stock returns and refrain from developing country-specific models, because some evidence suggests country-specific models may lead to overfitting, which reduces out-of-sample performance.[4]

4. See Cakici, Fieberg, Metko, and Zaremba (2023)

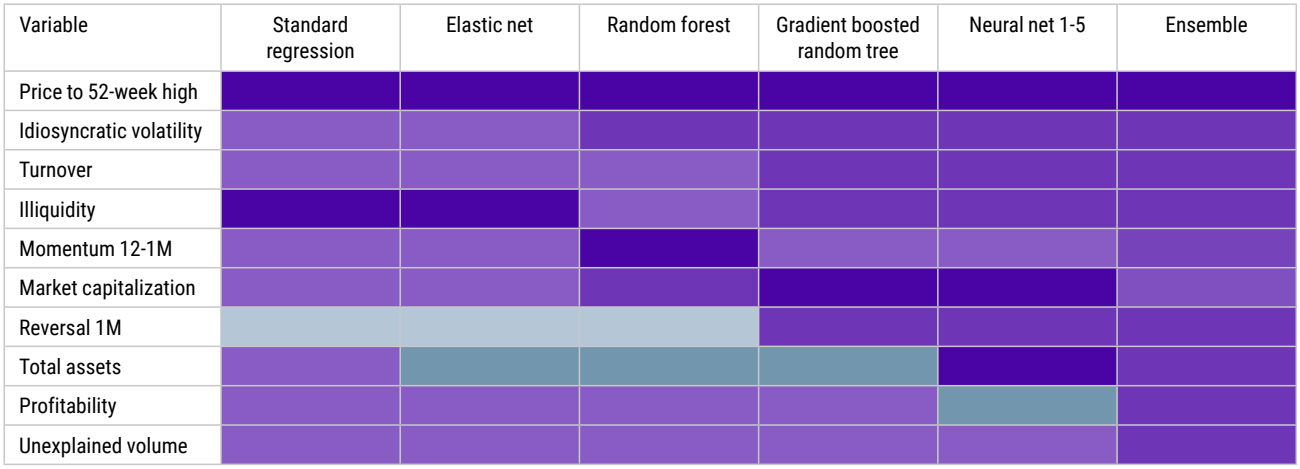
We use the best models of each type to predict monthly returns starting in 2002. To predict the monthly returns in 2003, we retrain and validate the machine learning models with data including 2002. This way, we obtain out-of-sample forecasts over the period 2002-2021, in which only data up to the previous year is included for forecasting, ensuring we don't misuse future information for prediction purposes.

We can then rank each of the 36 variables in order of their importance by evaluating the negative impact on prediction performance when the variable is left out and the rest of the model remains unchanged.

Results: Which characteristics matter, according to the machines?

Figure 2 shows a selection of how each machine learning model ranked the characteristics. We can see, for example, that the models make similar choices regarding the most influential characteristics, with price to its 52-week high, idiosyncratic volatility, and turnover being the three most important. Momentum and short-term reversal are also among the top fifteen, as well as the price/earnings ratio and profitability.

Figure 2: Machine learning methods and characteristic importance

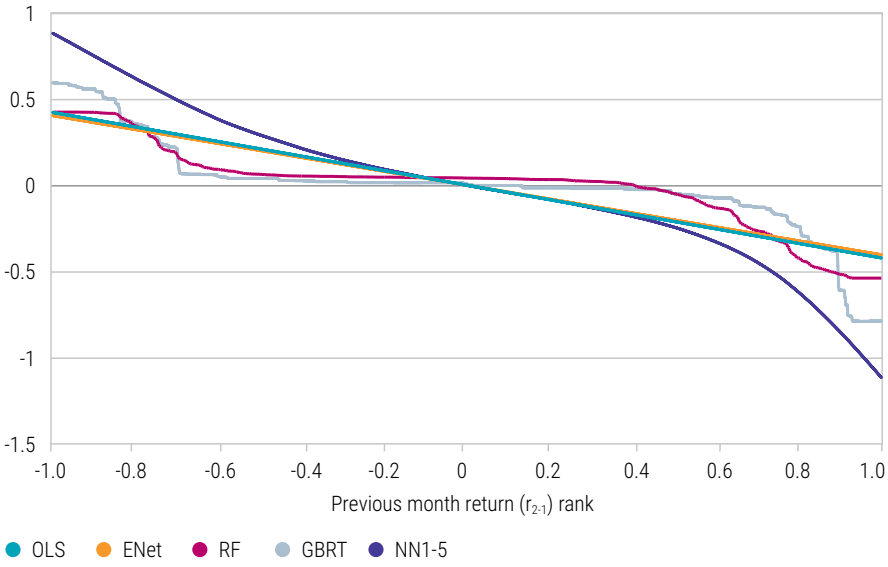


Source: Robeco, Hanauer and Kalsbach (2023). This figure shows the top part of the ranked characteristic importance for the variables in each model. Characteristic importance is an average over all training samples and importance within each model is normalized to sum to one. The rows are ordered by the characteristic importance of the machine learning ensemble (ENS).

We can clearly see the advantages of non-linearity in predictive models in Figure 3. The vertical axis contains the normalized expected return, and the horizontal axis the normalized value of the reversal characteristic. Stocks with a low return in the previous month are to the left of the horizontal axis, and on the right are those with a high previous month's return. The two linear prediction models (shown in 'blue' and 'orange') indicate that low returns in the past month are associated with high returns in the next month. By definition, the prediction linearly declines and stocks with a high return in the previous month have a relatively low expected return for the next month.

The non-linear tree-based models in 'red' and 'grey' suggest that only extremely low or extremely high returns in the previous month carry predictive power for next month's return. The line in the middle is flat at zero, indicating no predictive power in that region. The neural network in 'purple' has the most extreme return signals derived from previous month's return, and although it is also downward sloping in the middle, it is much steeper at the extremes. This example suggests that linear models can be restrictive, and allowing for non-linear predictive relationships may improve stock return predictions, also in emerging markets.

Figure 3: The impact of reversal on predicted returns

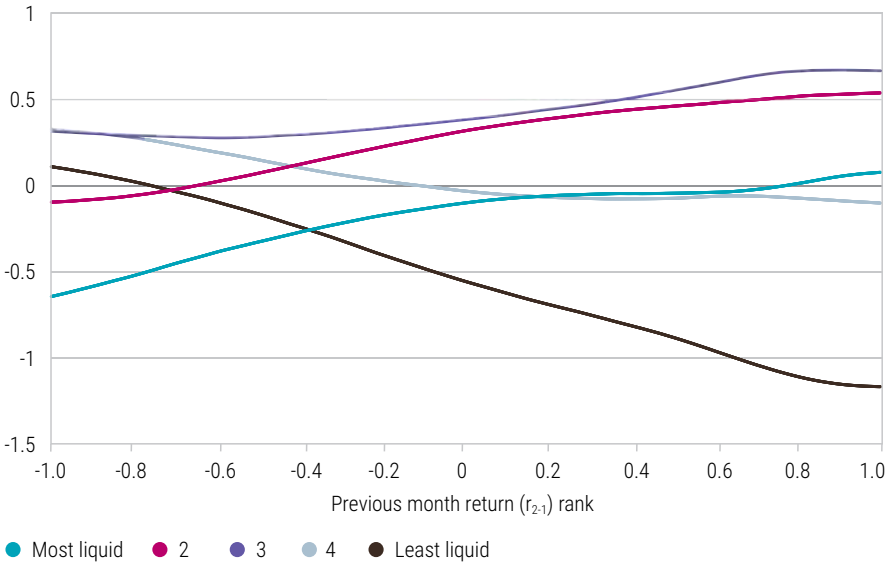


Source: Robeco, Hanauer and Kalsbach (2023). The figure shows the sensitivity of expected returns (vertical axis) to the short-term reversal characteristic (holding all other covariates fixed at their median values).

In Figure 4, we display the interaction effects for reversal and illiquidity. Using the same format as Figure 3, here the five different lines contain information about the liquidity of the stock, with black being the most illiquid stocks and blue the most liquid stocks.

We see that the negative relation between the previous and next month's return is heavily dependent on the liquidity of the stock. The reversal effect is strong for the least liquid stocks. However, for stocks with average or better liquidity, the return in the previous month is positively related to future returns. In other words, we observe short-term *momentum* for liquid stocks and short-term *reversal* for their illiquid counterparts.

Figure 4: The impact of interaction effects: reversal and illiquidity



Source: Robeco, Hanauer and Kalsbach (2023). The figure shows the sensitivity of the expected returns (vertical axis) to interaction effects for illiquidity in model NN1-5 (holding all other characteristics fixed at their median values of 0).

While detecting interaction effects between each of the 36 variables like the ones described above is incredibly time-consuming and difficult for a human researcher, a machine learning model can find these relationships quickly and systematically. But how do these interaction effects actually impact investment performance? We explore this pertinent question in the next section.

Investment performance

So far we've focused on the ability of machine learning models to predict returns, evaluating which characteristics were important for prediction. For investors, it may be more relevant to backtest the signals coming from these models, allowing us to compare the risk and return of portfolios.

Starting in our out-of-sample period from January 2002, we form five portfolios based on the machine-predicted excess returns of each stock relative to its country index. We then calculate the return in the next month, using market capitalization-based portfolio weights within each portfolio. We repeat this for each month until December 2021, when our sample ends. Figure 5 shows the difference in average returns between the portfolio with the highest and the portfolio with the lowest predicted returns.

Figure 5 shows that on average, the returns of the long-short portfolio derived from the two linear models, namely regression and elastic net, are around 0.8% per month. This is substantial and shows that conventional quantitative models are able to generate excess returns in emerging stock markets, confirmed by earlier studies on factor investing in emerging markets.[5]

5. See Van der Hart, Slagter, and Van Dijk (2003), De Groot, Pang, and Swinkels (2012), and Hanauer and Lauterbach (2019).

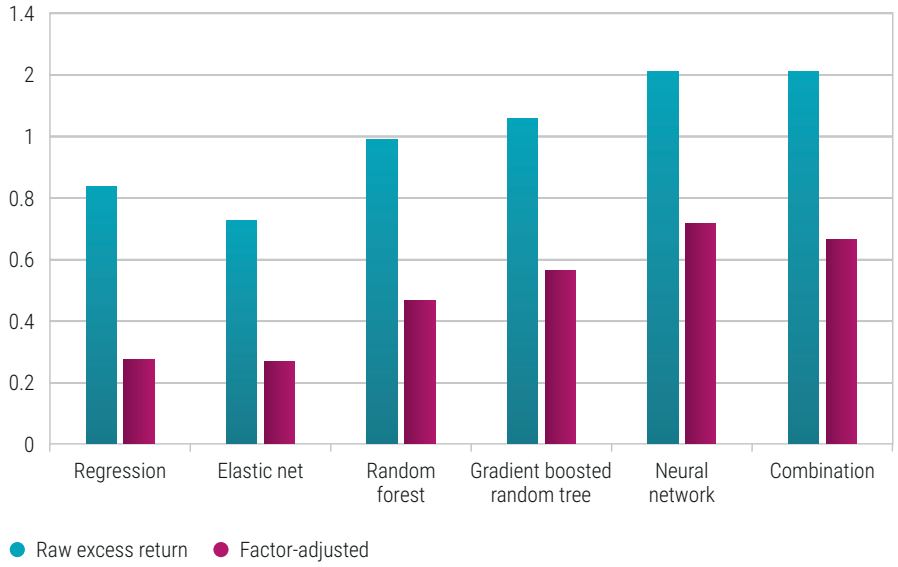
However, here we see investors can do even better. The random forest and gradient boosted regression tree methods generate around 1.0% per month returns: about 25% higher than the linear models. The neural networks, and the combination of all machine learning models deliver 1.2% return per month. Linear models are good, machine learning models are better.

But are they really? One question that comes up is whether this is just a fancy way to pick up the conventional quantitative factors already employed in the investment industry for decades. To answer this, Figure 5 also contains 'factor-adjusted' returns, where we regress the performance of each investment strategy on the returns from the Fama and French six-factor model with the market, size, value, investment, profitability, and momentum factors.[6]

6. See Fama and French (2018).

Indeed, a substantial part of the raw excess returns can be explained by these well-known factors. On the one hand, this is good news as it indicates that conventional quantitative researchers and investors have indeed been able to find company characteristics that can predict future returns. On the other hand, this factor-adjusted performance of investment strategies based on machine learning models gives us further, economically important insight. The linear models show there is about 0.2% per month of alpha left to capture, which increases to 0.5% per month for the tree-based models, and 0.7% per month for the neural network method and the machine learning ensemble. Hence, using machine learning signals is more profitable than conventional factor investing alone.

Figure 5: Investment performance

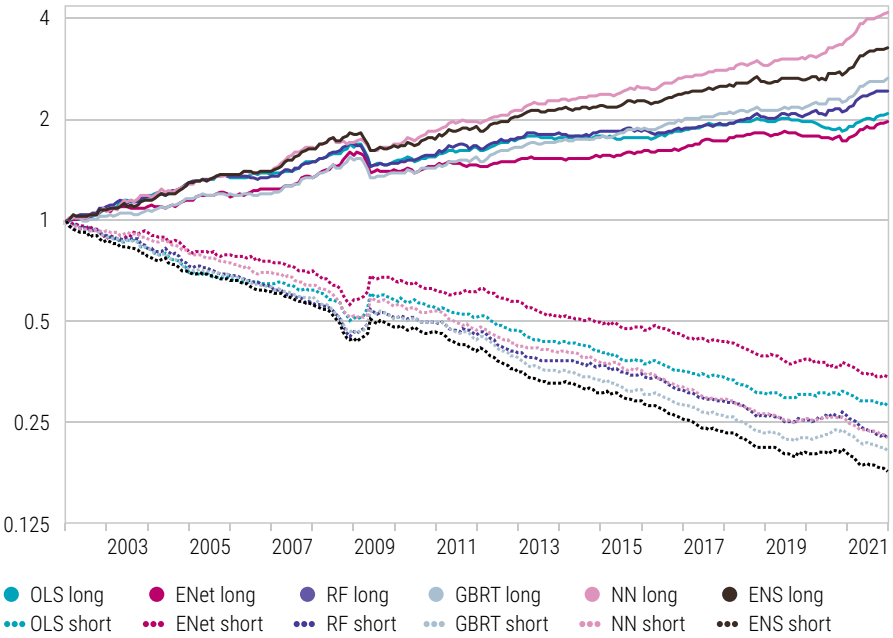


Source: Hanauer and Kalsbach (2023), Robeco. The blue bars show the raw returns and the orange bars show the Fama and French (2018) six-factor models alphas for various machine learning long-short portfolios. Stocks are sorted into country-neutral and value-weighted quintiles based on their predicted returns for the next month. The sorting breakpoints are based on big stocks only, which are in the top 90% of a country's aggregated market capitalization. The sample period is from January 2002 to December 2021.

While Figure 5 contains the average out-of-sample performance over the past 20 years, we also want to see if the performance is due to specific periods or obtained consistently over the years. Long-only investors will also want to know if the performance is obtained through the outperformance of the top portfolio or only through the underperformance of stocks in the bottom portfolio. The latter are typically expensive to sell short, hampering long-short implementation.

Figure 6 shows the performance of the top and bottom portfolios for each of the machine learning methods, clearly demonstrating that the excess returns of the long portfolio increase consistently over time, barring the global financial crisis. The bottom portfolio consistently underperforms, with the same exception for 2008-2009. These results suggest that long-only investors can use these signals to boost their performance in emerging equity markets.

Figure 6: Cumulative relative performance over time of the long and short machine learning portfolios



Source: Robeco, Hanauer and Kalsbach (2023). The figure shows the cumulative log returns in excess of the market of portfolios sorted on out-of-sample machine learning return forecasts. The solid and dashed lines represent long (top quintile) and short (bottom quintile) portfolios, respectively. The long and short portfolios are market-capitalization weighted. The sample period is from January 2002 to December 2021.

To render these results even more accurate and realistic, we can also estimate and include trading costs and restrict our sample to large stocks. In practice, some predictive signals generate high turnover and therefore high trading costs. This is to be expected, as these company characteristics were selected for one-month performance without considering trading costs.

In order to reduce these costs, we can use trading rules that slow down trading and turnover. The gross outperformance relative to the market reduces then to 0.48% per month, and including 0.14% trading costs, the net performance is still 0.34% per month. This is almost double the 0.19% for the linear regression model.

Conclusion

This special topic has compared the out-of-sample predictive power of various machine learning models for a broad sample of 32 emerging market countries and a 20-year out-of-sample period. Having established that the algorithms identify similar characteristics, we also observe that tree-based methods and neural networks identify non-linearities and interactions of characteristics that further improve return prediction.

Furthermore, return forecasts based on machine-learning models lead to economically and statistically superior out-of-sample long-short returns compared to conventional linear models. Even accounting for transaction costs and short-selling constraints, we see that this type of forecast can lead to significant net outperformance over the market, at least when efficient trading rules are applied. ●

SPECIAL TOPIC | R-STAR

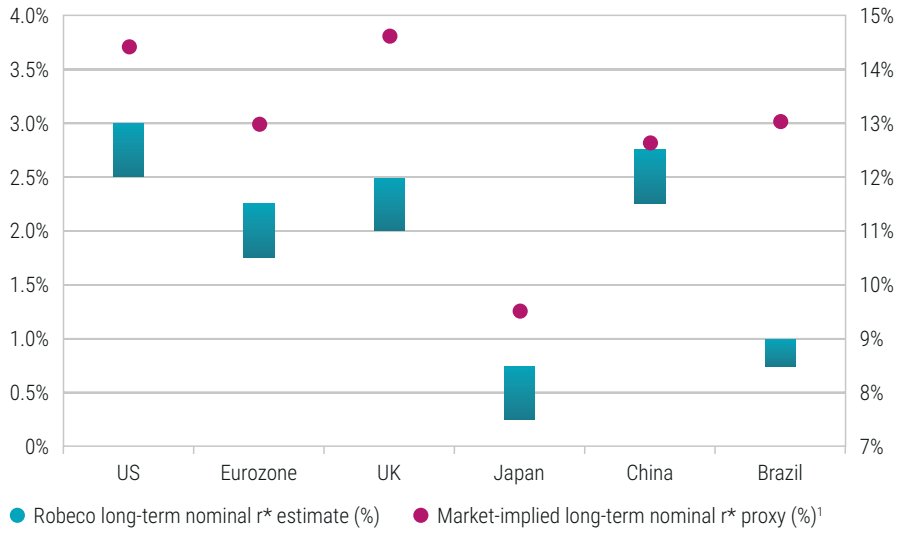
The invisible hand that guides bond markets

ECB and Fed policymakers frequently refer to the neutral rate or r* these days, confirming that central banks see it as a guide for interest rate policy. Understanding this theoretical concept is crucial not only for grasping cross-market differences in longer-term bond yields and yield curves, but also for identifying investment opportunities. However, because of its theoretical nature, this is a complicated process.

For any given market, r* estimates depend on a host of assumptions encompassing factors such as inflation, growth, fiscal prudence and demographics. In this special topic we discuss the drivers of r* and its direction of travel and present our own estimates of r* and compare these with market implied proxies.

Our r* estimates are below those of the market. While we agree with the view that an easier post-pandemic fiscal stance may be a factor in halting the secular downtrend in the neutral rate, we believe demographic shifts could keep it low, by historical standards, over the next five to ten years. This is particularly true for advanced economies.

Figure 1: Robeco long-term nominal r* vs market-implied nominal r*



1. 5y OIS 5y forward, except for China & Brazil (5y5y sovereign yield)

Source: Bloomberg, Federal Reserve, ECB, BoE, BoJ, BIS

Introducing r*

Many central banks are in the final stage of their tightening cycles, which were initiated to curb inflation. How high policy rates will go depends on incoming macro data, however, if central banks succeed in steering inflation back towards their targets, policy rates are likely to reduce over time. Indeed, this is what financial markets are discounting, and in the long run, after the economy has adjusted to any cyclical fluctuations, policy rates are expected to assume their *equilibrium*. This is the level at which monetary (interest rate) policy is considered neither accommodative nor contractionary, i.e. it neither stokes nor slows economic growth.[2]

2. In the remainder of this text, note we take this 'longer-run' perspective on the equilibrium interest rate.

The difficulty for investors is that this long-run equilibrium policy rate, also called the neutral rate, or r*, is an unobservable theoretical construct and therefore must be estimated. Even so, it can – in the words of BoE governor Andrew Bailey – "provide an indication of the general outlook for interest rates over the coming years," especially because central banks use it as a point of reference. Indeed, ECB policymakers have frequently referenced the neutral rate in speeches over recent quarters, as have US Fed officials, including Chair Powell.

R* is often referred to in 'real' or inflation-adjusted terms, as consumer and business investment decisions are typically affected by the level of borrowing costs that takes into account the inflation expected to prevail during the life of the investment. Converting r* into a nominal variable thus implies adding a measure of inflation expectation. A good example would be a central bank's prevailing inflation target. An r* perspective can help to understand cross-market differences in longer-term bond yields and yield curves – and in assessing their future evolution.

Drivers of r* and its direction of travel

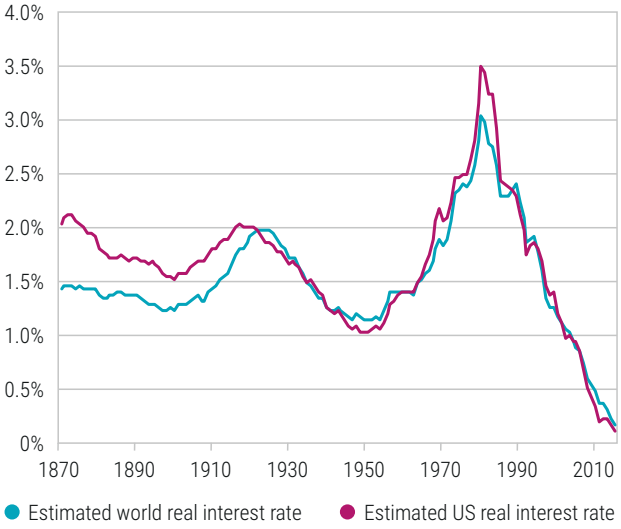
Put simply, r* depends on the interplay between the supply of savings and the demand for savings to fund investment. Exactly how this works is discussed in the box at the end of this section.

Many studies have documented that, due to an excess of desired savings over investments,[3] r* has been on a secular downtrend since the end of the 1970s – this is reflected in Figure 2. A recent study by BoE researchers[4] postulates that, from a global point of view, this decline was predominantly driven by (i) an increase in longevity, that pushed up desired savings of would-be retirees and (ii) a slowdown in productivity growth, that reduced demand for capital at a given interest rate because of lower potential returns on new investments (see Figure 3). Good examples of countries where these two effects are evident are Japan and China.

3. As desired saving outstripped desired investment, the real rate of interest fell to equilibrate actual demand and supply of capital.

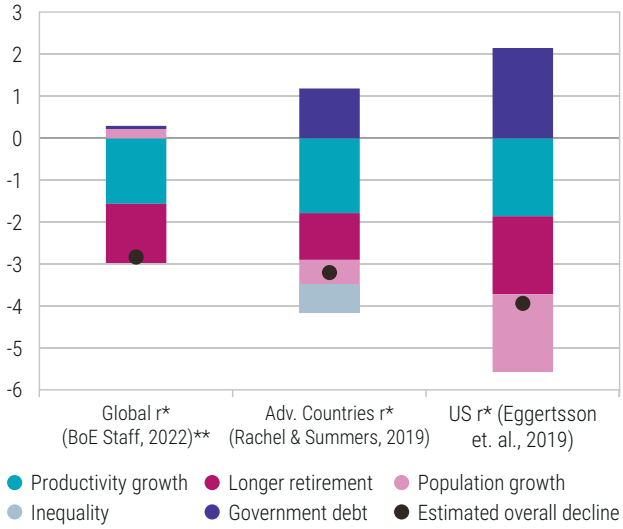
4. BoE Staff Working Paper, *Decomposing the drivers of Global R**, July 2022

Figure 2: Trend in world and US real interest rate



Source: Del Negro et al. (2019)

Figure 3: Drivers behind the change in r* between 1970-2017



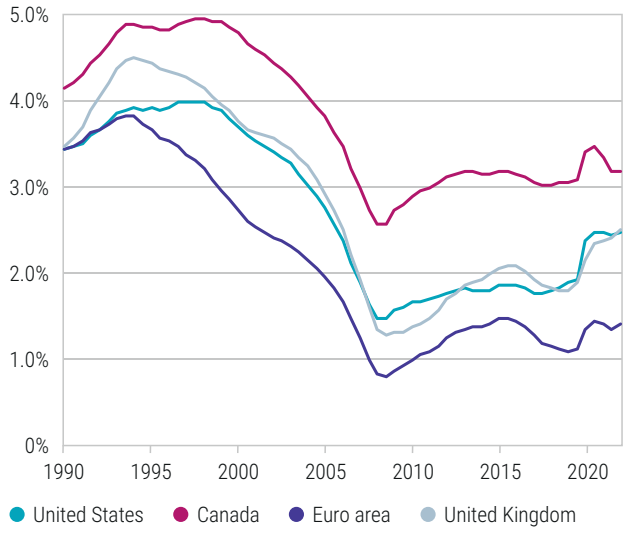
Source: BoE (2022), Rachel & Summers (2019), Eggertsson et al. (2019)

Meanwhile, Rachel and Summers (2019) reveal that in advanced economies, a decline in population growth and increased inequality have amplified the decline in r*. The latter is believed to have been due to the increased marginal propensity of higher income/wealth cohorts to save. They also estimate that increased government debt since the 1970s has dampened the secular decline in r*. Such findings are corroborated by estimates from

Eggertsson et al. (2019) and Ferreira and Davin (2022). The latter study also shows that increased sovereign debt supply between 2008 and 2019 has worked to push up the long-run r* in the US, Canada, the UK, and the Eurozone from earlier lows. A further rise in government debt since the pandemic may have reinforced this, as also suggested by two recent Fed studies (see Figure 4 and 5). This finding contrasts with the view that high and rising government debt tends to push down r* by increasing economic agents' desire to save out of fear of future tax rises. We do suspect though, that at higher debt levels, financial stability could come under pressure at lower interest rate levels than otherwise would be the case.[4]

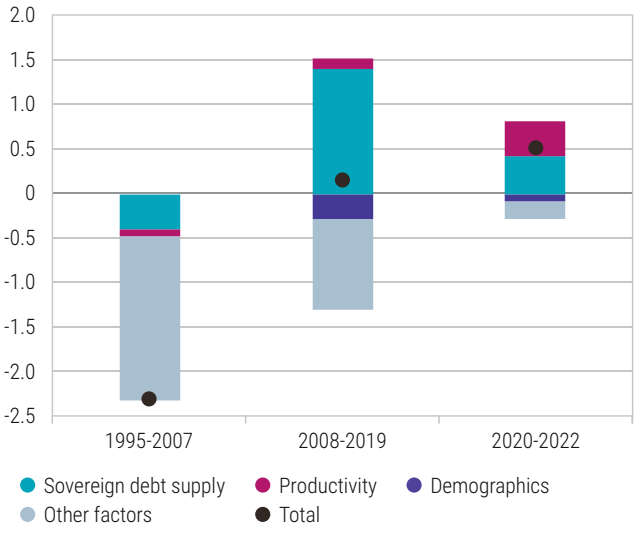
4. See "The Financial (In)stability real interest rate, R**", Fed New York, May 2023

Figure 4: Nominal long-run r* across selected economies



Source: Ferreira & Davin, *Longer-Run Neutral Rates in Major Advanced Economies*, FEDS Notes, December 2022.
Baker K. et al (2023), "The Evolution of Short-Run r* after the Pandemic"; Federal Reserve Bank of New York Liberty Street Economics, 10 August, 2023.

Figure 5: Drivers of change in US longer-run r* since 1995



Source: Ferreira & Davin, *Longer-Run Neutral Rates in Major Advanced Economies*, FEDS Notes, December 2022.

Studies for EM countries confirm the positive relationship between government debt and the level of r*, although here the causation seems to run via the credibility channel of monetary policy as highlighted by Ruch (2021) and Clarida (2019). Typically, countries with relatively high levels of government debt and twin deficits (i.e. a fiscal and current account deficit) run the risk of high imported inflation and it is up to the central bank to credibly prevent this. Fiscal policy loosening will thus require a firm response by the central bank to counterbalance potential inflationary impulses and prevent the current account from weakening further by trying to keep the currency stable. Hence, r* is higher in such economies relative to those with lower government debt and more sound fiscal metrics (For example Brazil compared to Germany).

Looking ahead, we concur with the view that a generally looser fiscal regime since the pandemic may have helped break the secular downtrend in r*. One additional consideration, also flagged by the IMF in 2022, is the upward effect on r* from accelerating global investment to address climate change.[5] Nonetheless, in light of the lingering demographic trends[6] we suspect that r*, certainly in advanced economies and by historical standards, is likely to remain low over the next five to ten years.

In the next section we provide our latest r* estimates for four selected G-10 markets (US, UK, Eurozone, and Japan) and two EM markets (China and Brazil) and compare these with the latest official r* estimates as well as market proxies.

5. This upward effect might be tempered, as Andrew Bailey has argued, by increased precautionary saving of households given the "uncertainty about the transition path towards carbon neutrality."

6. Indeed, simulations by the BoE Staff as well as Rachel and Summers (2019) are consistent with the notion that demographics will continue to dampen r* in advanced economies for quite some time to come.

R* AND THE INTERPLAY BETWEEN SAVINGS AND INVESTMENT

The Loanable Funds Model helps clarify the interaction between the demand for funds for investment purposes and the supply of funds through savings. It also measures the impact this has on the equilibrium level of real interest rates. This is the 'IS' part of IS-LM models made famous by economist John Hicks.

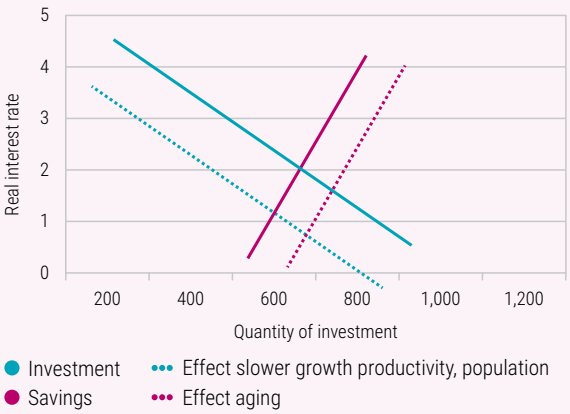
The investment function in this model links the desired amount of investment funds to the level of interest rates. As it is assumed that a lower cost of borrowing will increase the desired amount of investment, the investment function can be described as a downward-sloping line (see the figure below). The supply of loanable funds, or savings, is assumed to have a positive relationship with the level of interest rates, illustrated by an upward-sloping line. The crossing over of both lines gives the equilibrium level of real interest rates, r*.

Figure 6: Investment and savings curve

Source: Robeco, 2023

With this in mind, we can investigate examples of the drivers of r*. In an economy experiencing slowing productivity, for example because it has moved to a higher stage of economic development (e.g. DMs vs. EMs), the potential return on new investment should come down. Hence, the propensity to invest will be lower, leading to a downward shift in the desired investment function. Lower population growth can cause a similar decline in potential returns which also results in a downward shift.

Figure 7: Investment and savings curve



Source: Robeco, 2023

Aging is an example of a factor that directly influences the propensity to save, as an older population is more prone to saving. This should push the savings curve towards the right, driving a lower equilibrium rate and higher investment. The lower equilibrium rate may dominate as aging will also lead to lower population growth and a downward shift of the investment function.

Increased fiscal borrowing leads to an upward shift of the savings curve, hence a higher r*. However, private sector agents may realize they have to pay for that borrowing later, this follows Ricardian equivalence theory. Any such effect will push the savings curve downward and thus temper the rise in r*.

R* estimates for selected DM and EM markets

Table 1 presents our latest estimates of long-run r* rates in six selected markets. To ease the comparison vis-a-vis the market (the final column on the right), the estimated range is expressed in nominal terms. R* estimates by official institutions or academics – which are typically expressed in real or inflation-adjusted terms – are converted into nominal terms by adding long-term inflation expectation figures (second column).

Before we discuss the estimates per market, two caveats should be made. Firstly, some official r* estimates, notably those for China and Brazil, are based on studies from a few years ago. Given recent developments these seem somewhat high, in the case of China, or somewhat low in the case of Brazil. Secondly, where available, market-implied proxies of r* are either derived from 5-year overnight indexed swap (OIS) rates, 5 year forward swap rates or from sovereign forward yields. Such forwards typically contain risk premia, notably for inflation uncertainty. This is especially the case for markets with weaker debt fundamentals and large current account deficits, therefore caution is needed when interpreting the differences between our long-term r* estimates and the market's.

Table 1: Long-run r* estimates vs market proxies

	Official long-term real r* estimate (%)	Long-term inflation expectations (%)	Official long-term nominal r* estimate (%)	Robeco long-term nominal r* estimate (%)	Market-implied long-term nominal r* proxy (%)
US	0.25 to 1.00	2.00	2.25 to 3.00	**2.50 to 3.00**	3.7
Eurozone	-1.00 to 0.00	2.00	1.00 to 2.00	**1.75 to 2.25**	3.0
UK	0.00 to 1.00	2.00	2.00 to 3.00	**2.00 to 2.50**	3.8
Japan	-1.00 to -0.50	1.00	0.00 to -0.50	**0.25 to -0.75**	1.2
China	2.00	2.00	4.00	**2.25 to 2.75**	2.8
Brazil	3.00 to 3.50	4.50	7.50 to 8.00	**8.50 to 9.00**	13.0

Source: Robeco, 2023

– US. The Fed's nominal r* estimate has declined from 4% in 2014 to 2.5% in 2019 but has been stable since 2019. The decline in r* can be explained by a slowing of productivity growth and an ageing population. An upward effect on r* should be incorporated owing to a potential structural increase in fiscal deficits. Between 2009 and 2019 the 10-year average of the deficit has risen from 2.5% to 4.5% GDP, only to have climbed further during the pandemic. We do notice that r* declined during 2009-2019. Thus, the upward impact from this factor should be limited and may prove temporary. The change in the Fed's monetary policy framework to a flexible inflation target in 2019 may have added to expected inflation. Market prices of forward inflation rates suggest this effect should be at maximum 0.25%. Adding these factors together leaves a modestly higher nominal r* estimate of 2.5-3.0%.

– Eurozone. Latest estimates from the Eurosystem point to a long-run real r* rate for the Eurozone of between -1% and 0%. Adding the ECB inflation target of 2% yields a nominal r* of between 1% and 2%. ECB governor Villeroy mentioned this range several times last year and more recently he argued that r* is closer to the top end of this range. This is also reflected in our estimated range of between 1.75% and 2.25%. The market seems to believe nominal r* is another 75 bps above this range. Importantly, r* within the Eurozone differs across countries, and both the ECB (2018) and IMF (2020) have shown that it is below average in southern Europe.

– UK. The BoE does not provide explicit estimates of the long-run real r* so we must rely on estimates from the academic and central banking world. These generally point to a level between 0% and 1%. With the inflation target set at 2% this equates to a neutral rate estimate in nominal terms between 2% and 3%. It is possible to derive an implied r* from the BoE's monetary policy forecasts regarding growth and inflation, this is subject to an assumed bank rate policy path. Such a rough estimate would yield a long-run r* in nominal terms in the order of 1.5% to 2%. Our UK estimates tend to be a bit higher and more inflation prone because of their dependence on imports and in general their tighter labor market.

– Japan. There are many estimates for Japan's r* rate depending on the model and the assumptions used. The majority put the long-run real r* somewhere between -1.0% and -0.5%. We do not add the official inflation target for Japan given their structural issues with inflation and the BoJ's track-record in meeting this target. Rather, we use a combination of surveys from the BoJ and 5y5y inflation swaps. That combination currently yields 1%, which implies that long-run r* in nominal terms is somewhere between 0% and 0.5%, which is closer to our estimate but well below the market's proxy.

– **China**. A BIS study from 2021 pitched the long-run real r* at close to 2% in 2018. In nominal terms, after adding the 5-year moving average inflation rate of 2% (the PBoC does not have a formal inflation target), this equates to a rate of 4%. With an ageing population, demographics is a key reason we believe nominal r* is currently much lower in China, as vindicated by a recent IMF study.[7] Our estimated range of 2.25-2.75% is roughly in line with the actual policy rate corridor, but also below the market-implied proxy of 2.8%.

– **Brazil**. Banco Central do Brasil (BCB) frequently publishes estimates of the long-run real r* with the most recent estimate set at 3.0-3.5%. Taking into account long-run inflation expectations in Brazil of 4.5%, the nominal long-run r* is estimated at between 7.5% and 8.0%, which is below our estimate. The relatively high neutral rate estimate is explained by the following, Brazil is: very prone to inflation, possesses strong wage growth, has relatively poor fiscal and debt metrics and the BCB's has a poor historical inflation track record. Note the significant difference between the BCB's assumptions and market nominal r* estimates, which are around 13% for Brazil. We also wish to highlight the market is discounting a large inflation risk premium, likely overstating the market implied r* proxy. ●

7. See IMF World Economic Outlook, April 2023, Chapter 2, The natural rate of interest: drivers and implications for policy.

SPECIAL TOPIC | SUSTAINABLE DEVELOPMENT GOALS

A roadmap for SDG integration in government bond portfolios

The government financing gap in achieving the United Nations' Sustainable Development Goals (SDGs) by 2030 amounts to an annual shortfall of USD 2.6 trillion: 2.7% of global output.[1] With the burden falling disproportionately on poorer nations, there is a need to explore additional funding sources beyond public and multilateral financing. The private sector, including traditional financial institutions, can play a crucial role in bridging this gap.

In this special topic, we first describe our SDG Framework, and then take the reader through the rationale behind creating two different example portfolios, showing how one in particular can bridge that gap and help support the governments that are demonstrably most willing to advance the SDGs.[2]

1. See Gaspar, Amaglobeli, Garcia-Escribano, Prady, and Soto (2019).

2. This special topic is a summary of Van Zanten, Swinkels, Scholten, and Schieler (2023).

Introduction

Sovereign debt, specifically government bonds, is becoming a significant financing channel for sustainable development, yet research on its role in this area is sparse. To bridge this gap, we suggest a framework evaluating countries on their SDG policies, their finance needs for sustainable development, and their sustainability commitments. Those satisfying these criteria are prioritized inclusion in SDG-aligned government bond portfolios.

Using this framework, we've established 170 national SDG scores, which allows us to create a hypothetical SDG-aligned sovereign bond portfolio. Current existing sovereign ESG ratings, while useful for managing ESG-related financial risks, don't guide investors supporting the SDGs, and tend to favor wealthier nations, neglecting those in greater need of funds.[3] Consequently, a rating system specifically directing investors towards bonds that promote the SDGs is essential.

3. See Gratcheva, Gurgy, Emery, Wang, Oganes, Linzie, Harvey, Marney, Murray, and Rink (2021)

Robeco's country SDG Framework

Our framework conducts a three-step evaluation of each country's adherence to the SDGs: (1) policy assessment, (2) analysis of access to capital markets, and (3) screening for controversial actions conflicting with the SDGs. Countries are assigned an SDG score from -3 to +3 based on this assessment.

In step one, we measure a country's SDG-related policies using 71 indicators linked to SDG targets. Depending on the indicator, we use different evaluation methods. For instance, we measure SDG 3 (Good Health and Wellbeing) via indicators like maternal mortality rates and health expenditure to GDP ratio. A country's performance on SDG 8 (Decent Jobs and Economic Growth) is gauged by assessing children's workplace rights.

Each country's score for the 17 SDGs is tallied, producing an overall score ranging from -3 to +3. If the sum of negative scores is below a threshold, the total score ranges from -3 to -1. Similarly, if the sum of positive scores exceeds a threshold, the sum of positive scores is translated into a score of +1 to +3. In other cases, the country scores a neutral zero score.

Step two assesses if countries need additional capital to attain the SDGs. We consider income classification and corruption levels. Lower-income countries with moderate corruption receive a +1 score, indicating the need for more capital.

In step three, we screen for behaviors contradicting the SDGs. Factors like poor governance, autocracy, sanctions, violations of political rights, and high political instability negatively impact the score, ranging from -1 to -3.

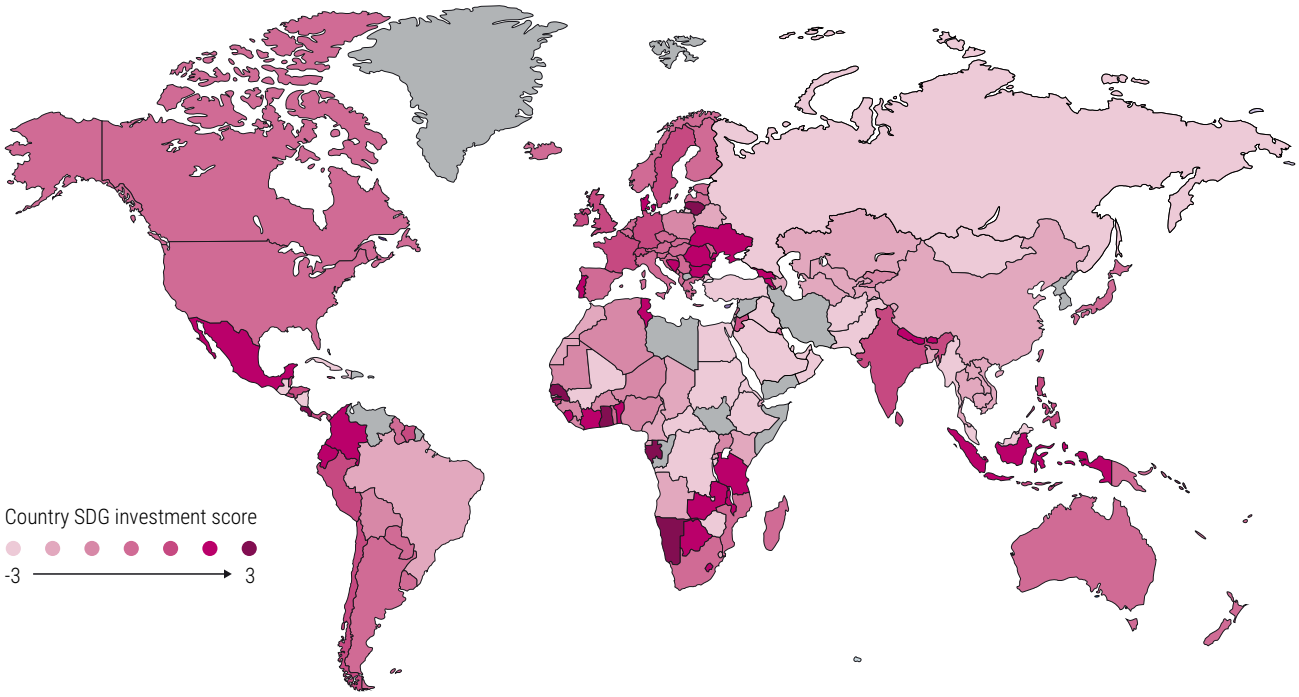
After compiling the scores from all three steps, each country receives a final SDG score. Countries with negative scores in any stage receive the lowest score, denoting subpar policies or conflicting actions. A neutral score from step one and no negatives from step three results in a total score of zero. Positive scores in step one are amplified by adding step two's score. Even with a negative total score, a country could still have effective SDG policies, just as a country with a positive total score might have negatives in some areas.

Overall, our framework provides an exhaustive evaluation of countries' SDG policies, financial needs, and alignment with SDG principles. This results in SDG scores that guide investors towards government bond investments that support the SDGs. By addressing data scarcity on governmental policies for sustainable development, our framework offers a standardized, comparable measure of countries' SDG progress.

The SDG scores

Of the 170 countries that we analyzed with this framework, 34% receive a positive score, 22% a neutral score, and 44% a negative score. Among the positive scores, 14 countries (8%) receive a +3 score, 24 (14%) a +2 and 19 (11%) a +1. Figure 1 maps the distribution of SDG scores.

Figure 1: Distribution of country SDG scores



Source: Robeco. This chart shows how Robeco's country SDG scores are distributed globally. Countries shown in darker colors have more positive scores than countries in lighter shades. Countries that lack a score, due to data unavailability, are shown in grey. Date: 2022.

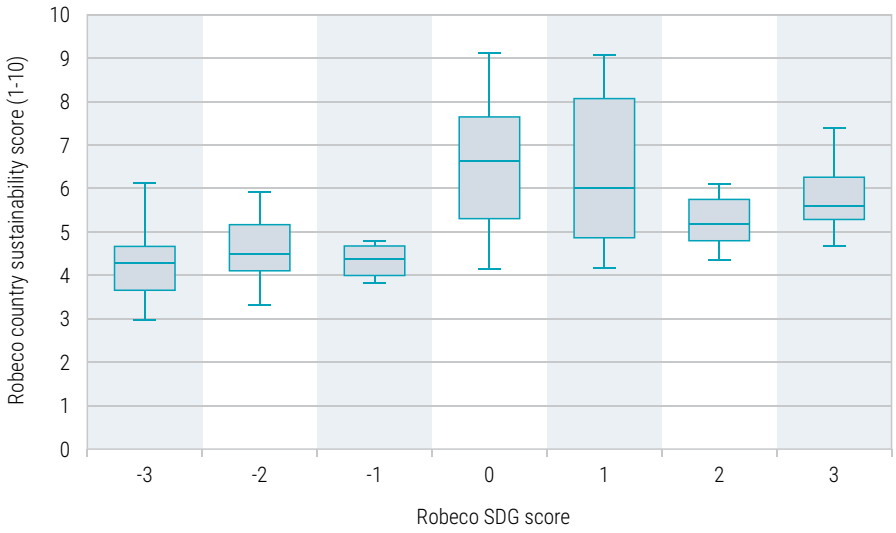
It's crucial to distinguish between Robeco's country SDG scores and ESG scores. Figure 2 illustrates both metrics, with SDG scores from -3 to +3 on the horizontal axis, and ESG scores from 1 to 10 on the vertical axis. If these two metrics were similar, we would expect low ESG scores to align with negative SDG scores and high ESG scores would correspond with high SDG scores. However, Figure 2 shows this is not the case, despite some overlap between the lowest scores in both categories, which are primarily due to penalties for similar controversial behaviors.

Countries with considerable progress in SDG attainment, higher wealth, and better ESG ratings often receive neutral SDG scores. This correlation mirrors the SDG scoring methodology, which aims to recognize countries with strong policies and financial needs, rather than strictly evaluating their current SDG achievement level.

Robeco's country SDG score also shows low correlation with the 2022 SDG Index,[4] which measures countries' performance towards SDG achievement. The index's high-income bias suggests that high-scoring countries tend to pay lower interest to investors.[5] Our score, however, prioritizes countries requiring financing to progress on SDGs, maximizing the reward to SDG progress per invested euro.

4. This index is developed by Sachs, Lafortune, Kroll, Fuller, & Woelm (2022).
5. See Ten Bosch, Van Dijk, and Schoenmaker (2022).

Figure 2: Comparing Robeco's country SDG score to Robeco's country ESG score



Source: Robeco. The figure compares a Robeco country SDG score to its Robeco country ESG Ranking. Date: 2022.

Examples of applying Robeco's SDGs scores to government bond portfolios

Investors might consider incorporating country SDG scores into their government bond portfolio construction as a supplemental strategy to engaging with governments.[6] Application methods may vary due to diverse investment goals, risk tolerance, and portfolio restrictions.

6. See Van Zanten, Sharma, and Christensen (2021) for more on sovereign engagement.

We present a straightforward investment framework incorporating SDG scores in government bond portfolios. It's key to distinguish the two conventional roles of such portfolios: diversification in a multi-asset portfolio and the enhanced returns provided by government bonds from issuers with a higher default risk.[7] Accordingly, we suggest creating an 'SDG Core' portfolio with relatively low default risk and high liquidity, and an 'SDG Focus' portfolio, accommodating greater default risk to boost the SDG profile and expected returns. Investors can allocate more to either portfolio based on their safety requirements.

7. See Adler (1983).

Bond markets

We gather country index data on government bonds; of the 170 countries with an SDG score, 111 are covered by these indices. This indicates that 59 countries (35%) lack a functional bond market. The five primary government bond issuers are the US, Japan, China, the UK, and France.

We use bond market size, credit rating, and SDG score data to create an example portfolio based only on rules for SDG Core and SDG Focus. This setup could be improved with extra measures for a more efficient rules-based portfolio,[8] or investors might choose to actively manage the portfolio, incorporating various additional information sources for bond selection.

8. See for example Piljak and Swinkels (2017).

SDG Core portfolio

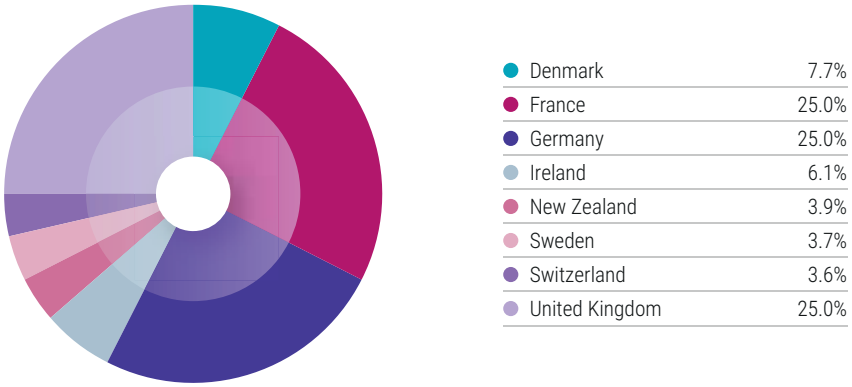
Step 1: Determine the list of 'safe and liquid' sovereigns

The main measure for 'safe and liquid' is whether the sovereign is considered a 'safe haven'. It is standard market practice to label Germany, Japan, the United Kingdom, and the United States as safe havens. We then add countries with a AAA or AA credit rating and a bond market of at least USD 50 billion, leading to a set of 21 countries.

Step 2: Determine which SDG scores are eligible for inclusion

We give zero weight to countries with a negative or neutral SDG score. This excludes 13 out of the 21 sovereigns, including the US and Japan. This step has therefore major consequences for the SDG Core strategy. If we had only excluded the three sovereigns with a negative SDG score, the portfolio would be much less affected and would still have included the US and Japan.

Figure 3: SDG Core portfolio composition



Source: Robeco. Country SDG scores as of 2022. Market capitalization as of October 2022.

Step 3: Determine the portfolio weights

Essentially, we want to invest relatively more in the government debt of countries with a higher SDG score and include a certain level of diversification, all while recognizing that larger bond markets have more investment capacity and liquidity. To achieve this, we multiply a country's nominal bond market with a factor that depends on the SDG score: 1.00 for an SDG score of +3, 0.50 for an SDG score of +2, and 0.25 for an SDG score of +1. To ensure diversification, the maximum allocation to a sovereign is 25%.

Figure 3 contains the resulting portfolio. The UK, France, and Germany each account for the maximum of 25% allocation. Denmark, the only country with an SDG score of +2, has an 11% allocation. The SDG Core portfolio is heavily tilted towards European government bonds. A way to increase geographical diversification is to lower the SDG standards to include also neutral-scoring sovereigns, or to decrease the safety and liquidity rules by allowing lower-rated and smaller countries to enter the portfolio.

SDG Focus portfolio

For the SDG Focus portfolio, the emphasis is on the SDGs, with safety, liquidity, and credit ratings requirements seen for this purpose as secondary concerns. This results in a riskier portfolio compared to its SDG Core counterpart. We follow a three-step procedure similar to the one described above.

Step 1: Determine the list of eligible sovereigns

All sovereigns with a bond market covered by our index provider are in principle part of the investment universe, except for those that already qualify for the SDG Core portfolio.

The size of the bond market needs to be at least USD 1 billion. Investors who care more about liquidity may use an alternative threshold where the bond market's size for example needs to be above USD 10 billion. The minimum credit rating should be B3 or better, allowing us to avoid buying debt from countries in the process of defaulting. This leaves 71 countries eligible for inclusion in the SDG Focus portfolio.

Step 2: Determine which SDG scores are eligible for inclusion

To create a government bond strategy with maximal positive exposure to the SDGs, we include only those governments with an SDG score of +2 or +3. While including SDG scores of +1 would create more diversification, it would also lower the portfolio's SDG score. Here, we opt to generate a portfolio with higher SDG scores. This criterion further reduces the sample from 71 to 22 eligible countries.

Why only 22? Even though 67 countries have a +2 or +3 rating, unfortunately only 22 of those have functional bond markets. This means only a third of the countries that warrant investment from an SDG perspective are accessible for the global investment community.

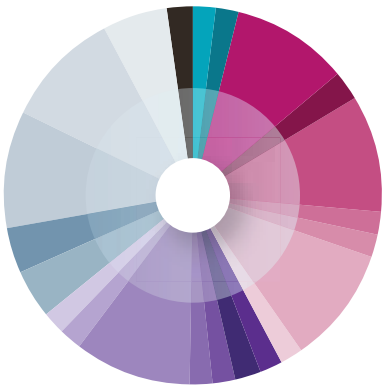
While we focus on bond markets covered by index providers in this section, the impact potential would be even greater if investors could include government bonds from countries with less established bond markets, or even help these countries establishing such new markets. This would give those governments more access to international financial markets, lowering their cost of borrowing and therefore enabling a significant step for their further development. We are aware that pursuing such a strategy is not a realistic option for every investor.

Step 3: Determine the portfolio weights

Once again, in essence we want to invest relatively more in the government debt of countries with a higher SDG score, while recognizing that larger bond markets have more investment capacity and liquidity. In this example, we multiply a country's total bond market capitalization with a factor of 1.00 for an SDG score of +3, and 0.50 for an SDG score of +2. To avoid allocations that are too small, the minimum weight is 2%, and to ensure diversification, the maximum weight is 10%.

The result of this three-step process is the SDG Focus allocation presented in Figure 4. This is capped at 10% for India, Indonesia, and Mexico. There are 15 countries at the lower bound of 2%. This means that the portfolio is well diversified across countries, although returns could still suffer from a high correlation in risk-off episodes. Note that this is not simply an emerging markets government bond portfolio loading on default risk. We also see a large and developed country like Portugal, as well as Slovenia and Lithuania, with an A-rating.

Figure 4: SDG Focus portfolio composition



Armenia	2.0%	Bulgaria	2.0%
Bolivia	2.0%	Honduras	2.0%
Colombia	10.0%	India	10.0%
Costa Rica	2.4%	Jamaica	2.0%
Indonesia	10.0%	Macedonia	2.0%
Ivory Coast	2.0%	Morocco	4.1%
Lithuania	2.0%	Peru	3.8%
Mexico	10.0%	Philippines	10.0%
Senegal	2.0%	Portugal	10.0%
Bangladesh	2.0%	Romania	5.7%
Benin	2.0%	Slovenia	2.0%

Source: Robeco. Country SDG scores as of 2022. Market capitalization as of October 2022.

Conclusion

This special topic outlines an approach for aligning investment strategies in sovereign debt with the SDGs. Unlike dedicated sustainability instruments such as green or social bonds, conventional government bonds support various national activities without specifying their use. The framework developed in the paper nevertheless allows us to gain insight into whether governments support the SDGs, by examining their policies, access to capital, and adherence to sustainable development principles. The scoring range helps prioritize such countries for SDG-aligned government bond investment strategies. Despite the challenges posed by a small universe of investable countries, we demonstrate the feasibility of such strategies and suggest that implementing such an approach can support countries in accessing financing, close the SDG financing gap, and foster positive sustainable development outcomes. ●

SPECIAL TOPIC | THEMATIC INVESTING

Thematic overboard, finding value within long-term trends

Thematic investing fell out of favor in 2022 as decelerating growth and rising rates drove valuation multiples lower. However, the underlying trends that support key themes such as digital transformation and the green transition remain a constant presence. With a more attuned focus on durable themes and the capacity to sort through the flotsam, we believe there are opportunities for thematic strategies to build long-term value.

Despite a strong recovery through mid-2023, we are in a 'man overboard' period for thematic investing. To further this maritime analogy, it has been more like a capsizing, no theme remained dry in 2022. For this reason, we apply the analytical process outlined in Michael Mauboussin's paper on evaluating sharp price drops in individual portfolio holdings[1] to our broader thematic investing thesis.

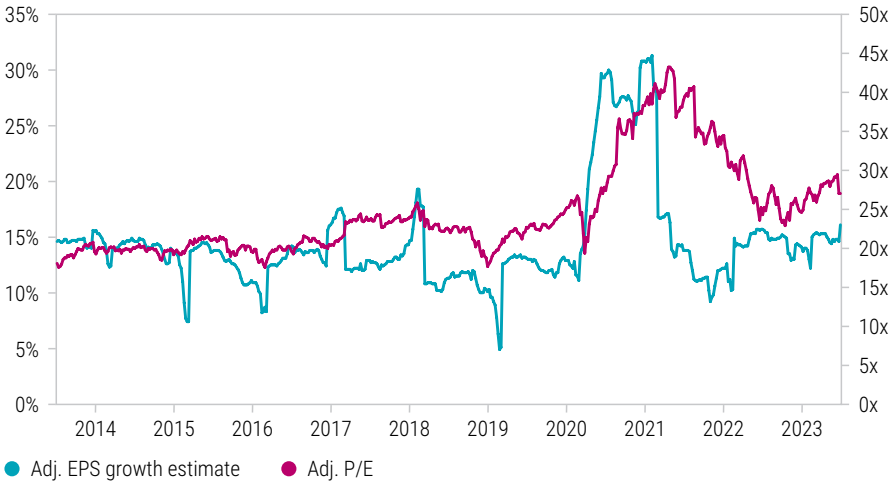
1. See Mauboussin (2015)

After rising eight-fold over five years and throughout 2021, thematically orientated assets under management tumbled by nearly a third in 2022. Growth orientated themes were particularly hard hit. After delivering annualized returns of 14.3% in the ten years leading up to and during 2021, the MSCI All World Growth Index fell 29.7% in 2022. Comparatively, the corresponding value index which generated annualized growth of 6.7% through 2021, fell 8.8% in 2022. Sorting through this wreckage, we find that the fundamentals for broad structural themes across digital innovations, shifting demographics, and sustainable solutions remain buoyant.

A perfect storm

Three key factors contributed to the steep correction of thematically orientated equities in 2022. Firstly, valuations were high as illustrated by the MSCI All World Growth index that started the year at 34x forward earnings against a pre-Covid average of 21x. Secondly, after expanding 35% Y/Y in 2022, growth decelerated by more than half, and forward earnings growth estimates for the MSCI All World Growth index fell to 14% in 2022. Thirdly, monetary policy began to shift from exceptional easing to aggressive tightening, with the Federal Reserve raising the benchmark interest rate seven times from near zero to more than four percent by the end of the year. In hindsight, the results were predictable – valuation multiples collapsed.

Figure 1: MSCI All World Growth Index, earnings growth and price-to-earnings ratio

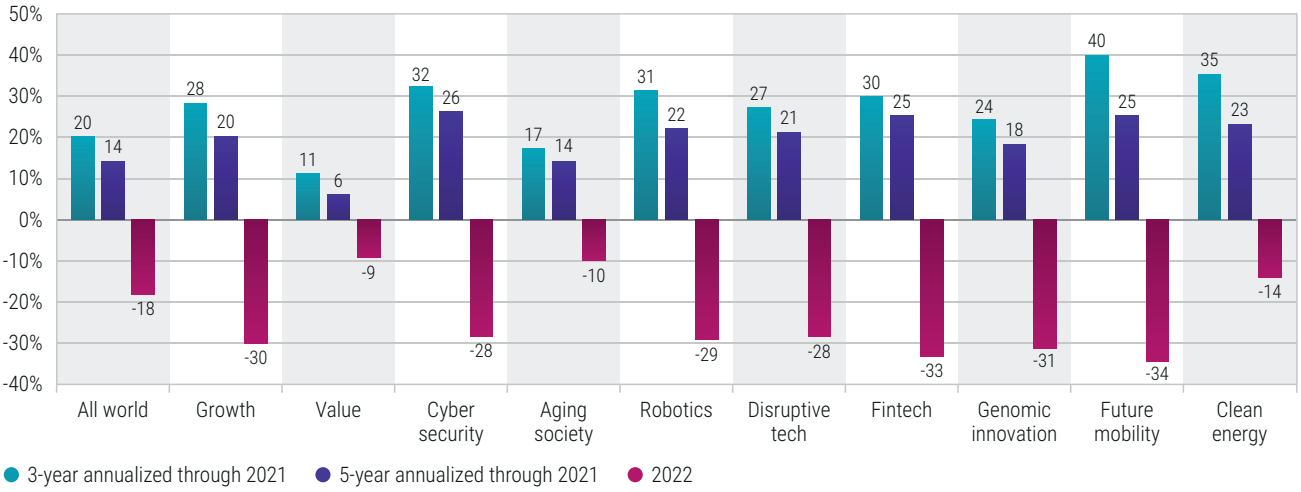


Source: Bloomberg, MSCI

Broad-based correction

A dramatic shift in the narrative around underlying structural drivers contributed to the pressure on thematic investing. The imbalanced view that Covid had permanently altered how people work and live, quickly shifted towards a consensus that everything would return to normal. Key trends, from e-commerce to software's transition to the cloud, were all called into question as economies reopened and digital service growth slowed. Consequently, the correction in 2022 impacted every major theme.

Figure 2: Thematic & style index performance



Source: Bloomberg, MSCI

A thematic purpose

Change, as the Greek philosopher Heraclitus said, is constant. Throughout history, society has been shaped by evolving structures, this is true for the agrarian age, the industrial age and more recently the information age. Each era is susceptible to change from within as priorities shift. For example, within the information age, innovation shifted from mainframe computers to personal computers, and then to the internet, mobile phones, and the cloud. Thematic investing seeks to capture the value creation potential of long-term trends and structural shifts that result from transformative technologies, changing socio-demographics, and society's imperative to preserve the earth.

Transformative shifts in the economy, society, and the environment are not immediate and are likely to transpire over extended periods of time. Given the seemingly slow pace of structural change, people tend to anchor their expectations to the current state. As a result, the magnitude of structural change, when it reaches an inflection point, often comes as a surprise. This recency bias coupled with high levels of invested capital in assets and processes makes it difficult for incumbents to recognize the change as it forms and it becomes more difficult to respond to once the change materializes. Thematic investing, with a central focus on change, seeks to capture the upside from trends and avoid the downside risks posed by disruptive forces.

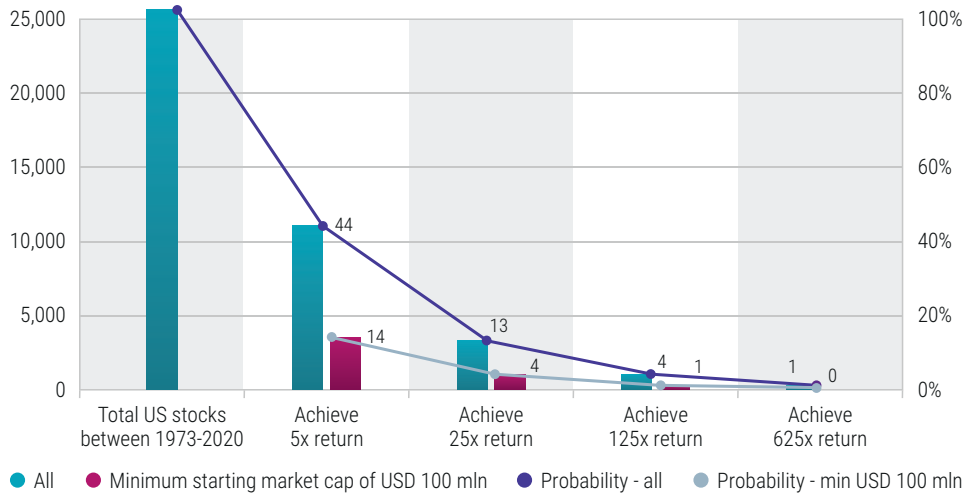
The impact of structural change is rarely limited to any one sector or place, especially in the age of globalization. This is clearly the case with climate change as the emissions from one country can spread across borders and the most acute effects are unpredictable and seemingly disconnected. As a result, a systems level approach is required to build solutions and identify structural winners. For example, electric vehicles are comprised of a complex array of disciplines including chemistry, metallurgy, semiconductors, software, robotics, and supply chain management. Finding the expertise to assemble and scale those disparate technologies, within the confines of profitable established business models, has proven a challenge for incumbents and entrants alike.

Value capture & structural winners

While the impacts of structural changes and transformative shifts are broadly felt, there are typically few beneficiaries. According to a study by Hendrik Bessembinder from Arizona State University, a typical stock listed in the US from 1926 to 2019 had a buy-and-hold return of negative 2.8% over its entire lifetime.[2] Furthermore, out of 25,000 stocks listed between 1973 and 2020 in the US, 13% achieved a 25x return.[3] In the case of companies with a capitalization of at least USD 100 million before the 5x return is achieved, just 4% achieved a 25x return. Another Bessembinder study found that when examining the returns of 64,000 global stocks, the top performing 2.4% of companies accounted for 100% of the USD 75.7 trillion in wealth creation between 1990 and 2020.[4]

2. See Bessembinder (2020)
3. See Bessembinder (2021)
4. See Bessembinder (2023)

Figure 3: Distribution of US equity market returns between 1973 & 2020



Source: H. Bessembinder, Arizona State University, 2021.

Building value

Given the focus on structural trends and the response of companies to build new solutions to address evolving needs, thematic investing portfolios often have higher exposure to the growth factor and lower exposure to profitability.[5] As a result of their high growth profile, and tendency to be in the earlier stages of profit scaling, many thematic portfolios include companies that trade at multiples above the market average. However, both the higher growth rate and the higher valuation of thematic investments should reflect the shifting trends within any given industry. While both the expected forward growth rates and the valuation are susceptible to exaggeration, in many cases, higher multiples will reflect the expectations for underlying fundamentals.[6]

5. See Blitz (2021)

6. See Bergakker (2017)

The distinction between growth and value is difficult to decipher. For example, during the 2022 reconstitution of S&P 500 style indices there was a record turnover of companies with 31% and 32% of market capitalization of the value and growth indexes, resulting in a change in classification.[7] Incidentally, as technology earnings slowed post-pandemic and the outlook of energy suppliers improved, several leading internet companies were removed from the pure growth index and were replaced by an unlikely cohort of energy companies. Although changes to the index components reflected temporal conditions in the market, rather than structural shifts, the event underscores a key feature of the thematic investing approach that looks beyond style and industry classification in search of opportunity.

7. See Preston (2023)

Furthermore, a company's current valuation multiple, whether high or low relative to the market average, does not singularly provide information regarding the company's longer-term outlook. Ultimately, a company's valuation should reflect a combination of its current state operations, its prospect for future value creation, and its cost of capital. A company with a high current valuation multiple may indicate initial stages of operation, where reported profits might be low because of investment in growth initiatives. Through this reinvestment process, growth companies can build and compound value over time. The greater the spread between the cost of capital and the returns on incremental investments, and the longer a business retains its competitive advantage, the higher the justified multiple. Conversely, a company with a low valuation multiple may reflect the outlook of a business at the late stages of its lifecycle, where expectations suggest declining future prospects.

LONG-RUN RETURNS

"Over the long term, it's hard for a stock to earn a much better return than the business which underlies it earns. If the business earns six percent on capital over forty years and you hold it for that forty years, you're not going to achieve much different than a six percent return – even if you originally buy it at a huge discount. Conversely, if a business earns eighteen percent on capital over twenty or thirty years, even if you pay an expensive looking price, you'll end up with one hell of a result."[8]

The longer one's investment horizon (the higher is N), the more dominant the return on capital becomes and the less the entry and exit multiples matter. Although the practical holding period for most investors is less than the forty years Munger suggests, it drives home the point that for true long-term investors, the return on invested capital a company is likely to earn is of primary importance, and whilst still relevant, the price paid is of secondary importance.

8. See Munger (1995)

Munger's statement rests on the following mathematical proof:

→ Investor's Annualized % return

$$= \left[\left(\frac{M_{exit} * E_1 * \left(1 + \frac{ROC}{100}\right)^N}{M_{entry} * E_1} \right)^{\frac{1}{N}} - 1 \right] * 100$$

$$= \underbrace{\left[\left(\frac{M_{exit}}{M_{entry}} \right)^{\frac{1}{N}} * \left(1 + \frac{ROC}{100}\right) - 1 \right] * 100}$$

converges to ROC as $N \longrightarrow \infty$
regardless of M_{entry} and M_{exit}!

ROC = return on capital N = holding period in years E = earnings
M_{exit} = exit multiple M_{entry} = entry multiple

Well-supported themes

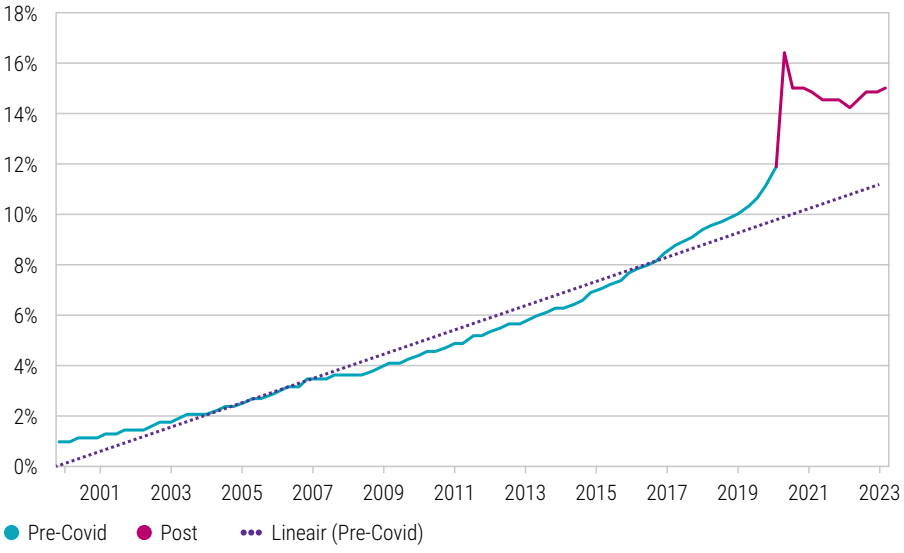
The science fiction author William Gibson once noted that "The future is already here. It's just not evenly distributed yet." Although thematic investing is forward looking and positions portfolios to benefit from long-term structural change, the strategy does not require managers to predict the future. Whilst thematic portfolios can include an allocation to earlier stage ideas, the largest and most profitable opportunities often reside within trends that are already set in motion. With this in mind, the underlying trends that support the three broad themes that we are concerned with, namely transformative technologies, changing socio-demographics, and the imperative to preserve the earth, all remain firmly intact.

All things digital

Digital services, a sector that thrived during the pandemic, were among the hardest hit in the 2022 correction and their growth slowed markedly as economies reopened. This led to a swift shift in the narrative from 'everything has changed' to 'it's all going back to normal.' Covid winners were thrown into the bin like yesterday's dot coms. However, it is worth remembering these innovations enabled the economy to function during the pandemic. Employees worked from home, schools taught pupils online, doctors met with patients on video calls, and food was delivered to our doorsteps. While the growth of these services has decelerated, digital innovations continue to make our lives better and more efficient. We now possess the knowledge that 2001 was the start, rather than the end, of the internet era.

E-commerce is a particular trend that saw rapid sales acceleration create unreasonable expectations and the subsequent deceleration led many to assume the lift was only temporary. In the years preceding the Covid pandemic, e-commerce sales in the US expanded at a constant rate, reaching 11.1% of retail sales by the fourth quarter of 2019. During the pandemic, the share of e-commerce jumped to 16.4% of retail during the second quarter of 2020. As restrictions eased, e-commerce sales decelerated, and its share of retail fell. However, in subsequent quarters, share gains resumed, and in the first quarter of 2023, e-commerce accounted for 15.1% of retail sales, a level well above the linear regression forecast based on pre-pandemic data.

Figure 4: US e-commerce sales as a percentage of total retail sales



Source: US Department of Commerce, May 2023

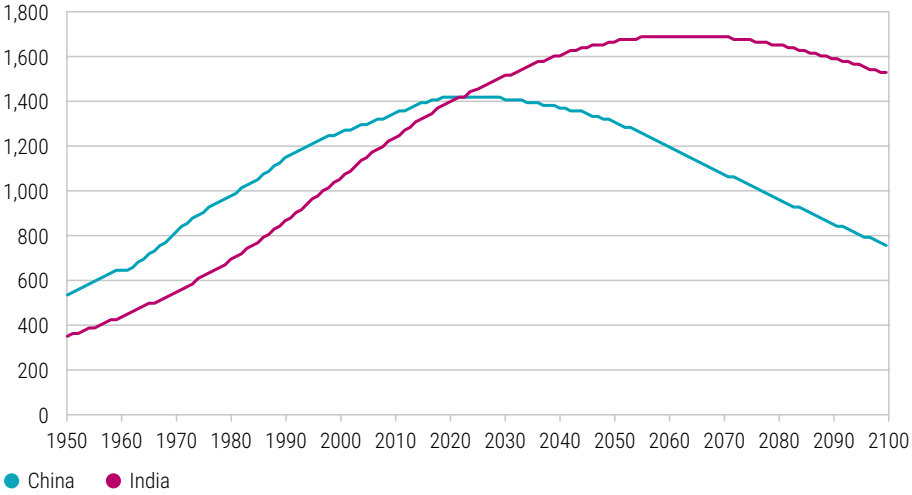
We see similar trends across multiple segments of the economy. Preceding the pandemic in 2018, in the finance industry cash accounted for nearly a third of all global payments, however, according to FIS Global in 2022 cash payments fell to 16%. In the workplace offices remain half empty as communication networks facilitate remote and hybrid work. In the technology sector, whilst the pace of migration to cloud software has decelerated, this segment continues to reshape the industry. According to data from Gartner and IDC, in 2023, worldwide spending on technology will expand 2.4% year on year with software expenditure up 9.3% and software as a service revenue rising 21%.

People on the move

Shifting global demographics also create opportunities and challenges across a broad range of sectors including energy, healthcare, nutrition, materials, security, and supply chains. Diverging trends among countries will drive an important demographic milestone this year as India is expected to surpass China in population, reaching nearly 1.43 billion people by middle of 2023. Furthermore, if birth rates remain constant, China's population may decline to 1 billion by the end of this century. These trends shift the focus from China and renew interest in the potential for India's economic growth underscored by a rising middle class, technological advancement, and its geopolitical position.

Notably, over the last ten years, the number of people in India without electricity has decreased from almost 300 million to just 30 million. Over that same period, the number of internet users has increased from 125 million to more than 800 million and the number of mobile cellular subscriptions rose from 900 million to 1.2 billion. Interestingly, while many of the west's largest technology and internet companies are led by chief executive officers of Indian descent, beyond an early wave of technology outsourcing service providers, the country has produced few global enterprises. A well-educated and technology savvy Indian population coupled with declining growth and increased trade tensions in China, sets the stage for a potential wave of Indian led investment and innovation.

Figure 5: Population trends in China and India (in millions)



Source: United Nations World Population Prospects, 2022

Sustainable solutions

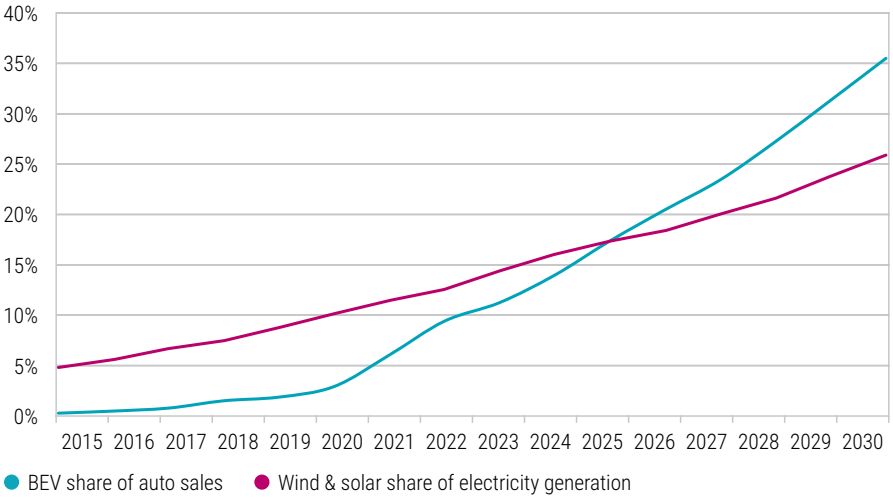
After declining almost 5% in 2020, in 2022 global carbon dioxide (CO_2) emissions from fossil fuels one again expanded. Concerningly, in June 2023, the European Union's Copernicus Climate Change Service reported a record global mean temperature that breached the 1.5 ºC above pre-industrial levels threshold. The effects of ongoing climate change are varied and expensive. According to the IPCC, global warming increases the

likelihood of extreme weather events such as storms and droughts. Insurer AON estimates that between 2011 and 2020, the economic costs of natural disasters totaled USD 2.97 trillion, a 44% increase from the previous decade.

On a positive note, in recent years, public sentiment, technological progress, and economic rationale have each reached a tipping point in favor of sustainably produced goods and services. Electric vehicles and renewable energy, are increasingly, not only the most climate friendly options, but the most economical. Over the last decade, renewable energy development costs have decreased substantially, according to Lazard, the unsubsidized cost of solar and wind energy is down 77% and 46% respectively. Combined, the average price of utility scale solar and wind power generation is 39% less expensive than gas, and 67% less expensive than coal. Similarly, while the upfront purchase price of a BEV is still comparatively higher than a petrol powered vehicle, given the lower costs of fuel (electricity), and lower maintenance costs (fewer moving parts) the annual running costs are close to 30% less.

Over the last five years, sales of passenger battery electric vehicles (BEV) rose at a 61% compound annual growth rate versus sales of petrol-powered vehicles which declined at a 5% CAGR over that period. In 2022, despite ongoing semiconductor shortages, Bloomberg New Energy Finance (BNEF) estimates BEV sales rose 66% year on year to 7.6 million, accounting for 9.4% of the global market. Similarly, with a 15.3% CAGR, wind and solar generation has expanded at more than 10 times the rate of total electric power generation over the past five years. BNEF estimates the combined share of those renewable energy sources reached 12.7% of global electric power in 2022 and will account for more than a quarter of the market by 2030.

Figure 6: Battery electric vehicle share of passenger vehicle sales & combined wind and solar share of electricity power generation, worldwide.



Source: Bloomberg New Energy Finance, 2023

In summary

After an extensive period of expansion driven by the favorable tailwinds of accelerated growth and low interest rates, thematic investing hit rough seas in 2022. However, the fundamental shifts that drive the three overarching themes we monitor — transformative technologies, evolving socio-demographics, and the urgent need to protect our planet— remain active. Against this backdrop, thematic investing continues to seek innovative and profitable businesses to address these disruptive forces and build value over the long term. ●

EXPECTED RETURNS 2024-2028

4. Macro

Physicist Niels Bohr once joked that forecasting is difficult, especially when it concerns the future. One might add that the age of confusion, as we called last year's publication, has made forecasting for economists even more challenging.

In our base case scenario it is unlikely that the recession signal indicated by the deep inversion of the US yield curve since spring 2022 will prove false. After a mild recession in 2024, we expect developed economies to transition towards trend growth and above-target inflation again. While the growth outlook is rather benign, it is unlikely to be a smooth ride, with macroeconomic volatility remaining well above pre-pandemic levels. Although the mild recession will be disinflationary and should take the sting out of inflation, this would not represent a victory for central bankers in developed economies.

First, the confusion about the origins of inflation is likely to persist for some time. While 'greedflation', a popular misnomer that has newly emerged, blames companies for the recent bout of inflation, some officials, out of fear of an erupting wage-price spiral, have mistakenly taken their aim at labor. Take, for instance, the verbal intervention by Bank of England governor Andrew Bailey, who asked workers to "think and reflect" before asking for pay rises. So far, we have seen more of a price-wage spiral than a wage-price spiral as wages have clearly lagged overall price rises since the pandemic.

Second, there has also been confusion about real activity. Are we experiencing a genuine business cycle post-Covid or a mere bullwhip effect? A recession in developed economies in 2023 has been widely forecast, but has not transpired as yet. Europe is the only region to have faced a technical recession so far, while other developed economies have merely been experiencing slowing growth, albeit expansion that is propped up primarily by services.

Traditional macro variables that have been flagging recession for some time, such as an inverted yield curve, have failed to take into account the atypical nature of the post-Covid business cycle – if what we are in can actually be called a genuine business cycle at all – it seems more like a whipsaw-like rebound. The Covid recession was not triggered by a traditional build-up of excesses on the demand side of the real economy, but rather by exogenous supply-side shocks. As such, the goods and labor markets experienced differing dislocations, both in nature and magnitude, in the aftermath of the recession.

There are several reasons why developed economies have proved resilient and a textbook recession has not yet materialized. For example, some growth engines that we believed were spluttering last year have, surprisingly, stabilized. Take consumption, for instance. The rise in real interest rates has been rather benign so far, partly as a result of sticky core inflation, and so has not disincentivized frontloading of consumption to the extent that we projected, even though we postulated that the economic slowdown would only really get going in the second half of 2023. It might even be the case that despite the most aggressive monetary tightening cycle the world has gone through in decades, the natural real rate of interest has risen, with the result that the amount of excess tightening that inhibits consumer demand has been more limited than widely anticipated.

Meanwhile, the Fed's market intervention during the US regional banking crisis in March has expanded the central bank's balance sheet once again, partly undoing the impact of its quantitative tightening program. Broad money growth has slowed, but is still above its pre-pandemic trend level. As a result, financial conditions have eased as we have progressed through 2023. Lower household leverage ratios than around the time of the Global Financial Crisis might also have created longer lags between net monetary policy tightening and any subsequent decline in aggregate demand. The housing market is a neat example. Last year we cited literature showing that every 10% drop in house prices has historically shaved 1.0-1.4 percentage points off annual consumption growth.[1] While global house prices have indeed fallen, price declines have been limited other than a few exceptions like in Sweden and Germany, where house prices have fallen by more than 10% since Q3 2022. These countries have also fallen into recession. Swedish retail sales were down by 11.6% year-on-year in March.

However, apart from a few overheated markets, such as Sweden, excesses in the global housing market do not seem to be as widespread as they were before the Global Financial Crisis. In fact, real house prices (house prices corrected for inflation) in countries like Spain and Italy are still well below their levels before the Great Financial Crisis.

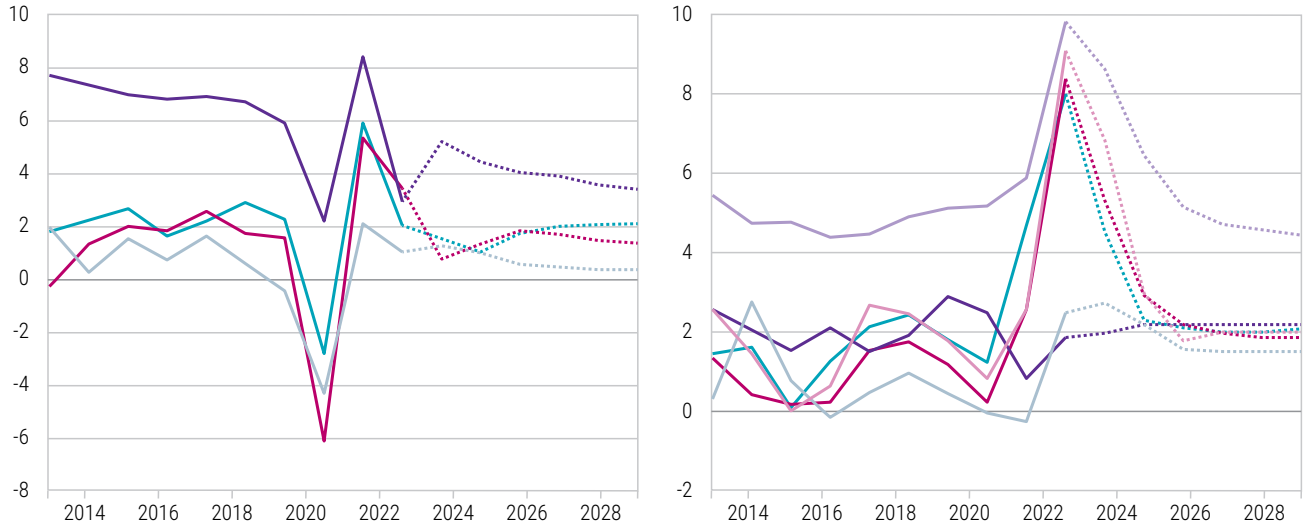
There are other reasons why traditional macro cycle thinking might have led economists astray in terms of when they thought a recession might begin. When it comes to the Eurozone, plain luck might be an explanation as an atypically mild winter on the continent limited the impact of higher energy prices on the economy. In fact, the economy's susceptibility to high energy prices might have been overestimated given the slow-but-steady decline in the energy intensity of developed economies' GDP (an element in the Kaya identity that we elaborate on in the Climate chapter).

1. See Cacares (2019).

Whether a mild recession materializes in late 2023 or 2024 is not a major consideration for a five-year outlook. Nonetheless, the recent shift in narrative towards a soft landing as a result of market participants' surprise at the resilience of the economy highlights the relevance of the framework we laid out in our 2023-27 publication, which is that shocks tend to cluster, prove more persistent than expected and exhibit reflexivity (in other words, they are self-reinforcing). These factors are interacting with usual business cyclicality and mean the post-pandemic macro landscape is particularly difficult to navigate.

Central bankers have been aiming to bring down inflation without causing a significant increase in unemployment. So far they have been successful, with US unemployment at 3.6% at the time of writing; a level seen in late 2019 but before that as far back as 1969. Judging by the latest IMF five-year growth and inflation projections for major economies, there should be further smooth progress. Excess demand should be eliminated due to recent tightening, while output gaps will close towards 2028 and growth will return to close to trend levels. The IMF believes that inflation will converge to a level close to, but below, 2% by the end of 2028.

Figure 4.1: IMF World Economic Outlook five-year outlook projections: 2024-28



Gross domestic product, constant prices (%YoY):

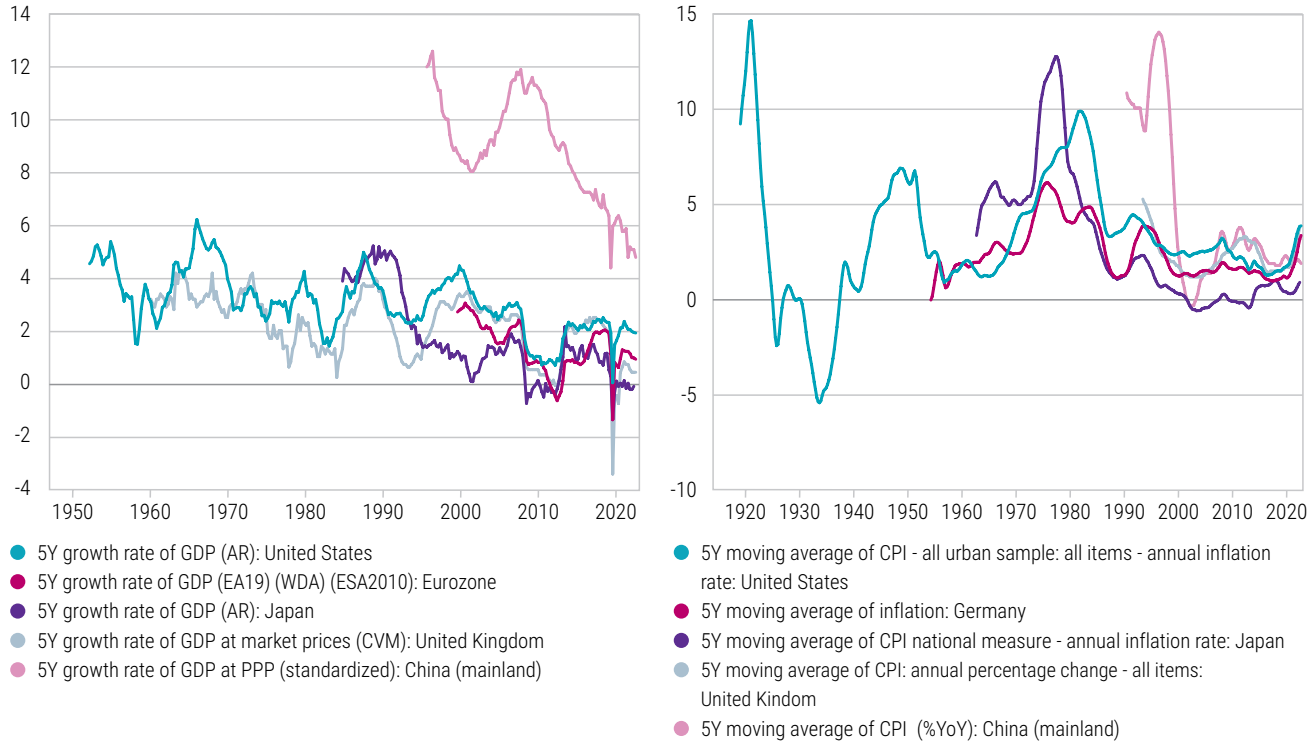
- United States
- Eurozone
- China (mainland)
- Japan
- United States - forecast
- Eurozone - forecast
- China (mainland) - forecast
- Japan - forecast

Inflation, average consumer prices (%YoY):

- United States
- Eurozone
- China (mainland)
- Japan
- United Kingdom
- Emerging and developing markets
- United States - forecast
- Eurozone - forecast
- China (mainland) - forecast
- Japan - forecast
- United Kingdom - forecast
- Emerging and developing markets - forecast

Source: Refinitiv Datastream

Figure 4.2: Trendspotting: five-year trends in GDP and inflation for major economies



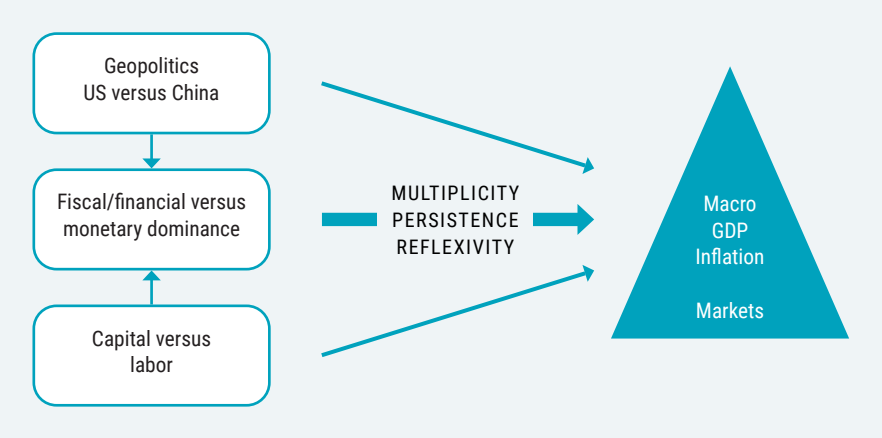
Source: Refinitiv Datastream

In our view, the road towards a so-called 'immaculate disinflation' – a term that has emerged in recent policy papers to express the possibility that getting inflation back to target involves no implications for economic activity (in other words, there is an economic soft landing) – looks bumpy, even though a steeper Phillips curve since the pandemic might have eased the trade-off between inflation and unemployment. The soft landing would require a steep drop in the number of job openings per unemployed without invoking the traditional inverse relationship between vacancies and unemployment rates. In other words, immaculate disinflation would only see the economy lose excess fat, not vital muscle. This would be a bold call by economists or central bankers. As we describe in our base case, a Pyrrhic victory for central bankers in the coming years looks more likely: we expect there to be modest job losses as a result of a policy rate overshoot, with inflation not fully reverting back to target. The victory for policymakers will be that the risk of stagflation gradually eases. While we agree with the IMF projections that China's growth will fall towards 3% over the next five years, growth in developed economies could roar back even stronger than the IMF expects after 2024.

4.1 A tripartite framework

Last year we introduced a three-pronged approach to assess the macro landscape, explaining that investors needed to weigh up the wide variety of macro shocks, their persistence and their tendency to be self-reinforcing. This year we enrich this framework by defining three major 'power plays' we see playing a part in the global economy and that can therefore be useful in developing various scenarios. The dynamic of these power plays is subject to elements of multiplicity, persistence and reflexivity.

Figure 4.3: The triple power play



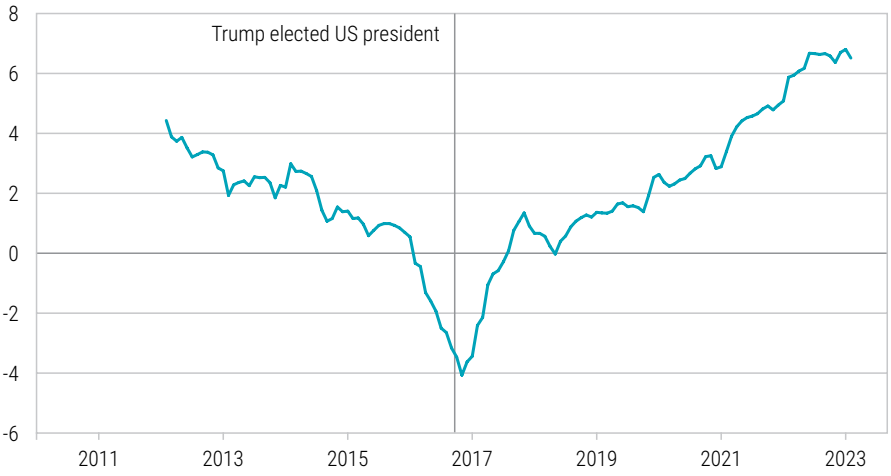
Source: Robeco, August 2023

4.2. Power play one: Geopolitics

In June 2023, during an interview to mark his recent 100th birthday, former US diplomat Henry Kissinger urged the US and China to step back from "the top of a precipice". Indeed, geopolitical tensions are heating up as the West has been forced to shrug off its naivety about a more assertive China and a belligerent Russia.[2] 'De-risking' has become a buzzword in Brussels, as has 'friendshoring' in Washington. Meanwhile, China has been de-risking by buying friends all along. Chinese net FDI flows already bottomed around the start of the Trump presidency that carried 'America First' as its key signature.

2. 'Things are heating up' refers to the subtitle of our 2021 publication.

Figure 4.4: China's net FDI troughed at the very start of the Trump presidency

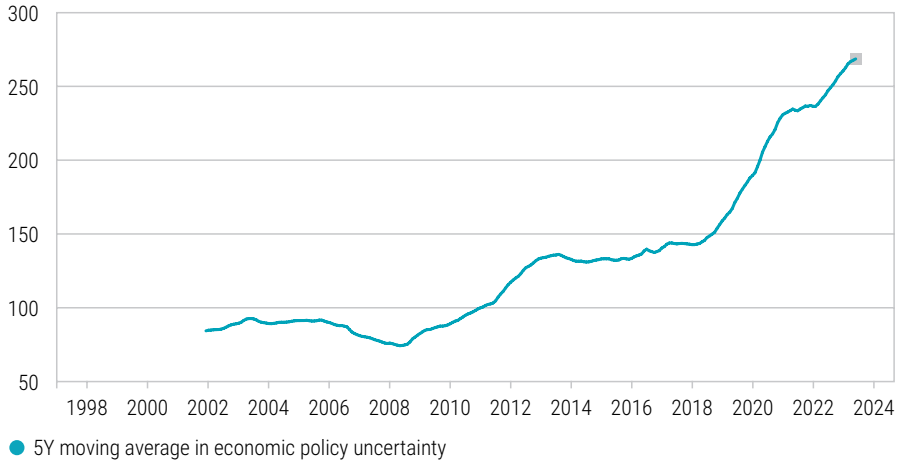


Source: Revinitiv Datastream, Robeco

Secondary powers such as India and Indonesia are keeping their options open by trying to appease both sides. The rising geopolitical clout of China and the war in Ukraine have shown we are at the dawn of a multipolar world and that neoliberalism's heyday has passed. Deregulation, cuts to government spending and free market forces are on the retreat. With the global economic architecture shifting, the five-year moving average of a measure of global economic policy uncertainty has been rising in recent years, and especially since the start of the Trump presidency[3] (see Figure 4.5).

3. For details of the construction of the index, see Baker, Bloom and Davis (2016).

Figure 4.5: Hard to ignore: the steadily rising trend in global policy uncertainty



Source: Refinitiv Datastream, Robeco

The rise in the global economic policy uncertainty metric, which is a proxy for geopolitical risk, will matter to economists and investors alike if it persists. According to the 2023 Edelman Trust barometer, trust is weakening amidst deepening divisions, with China and India in particular suffering from people in other countries not trusting them.[4] The erosion of trust is especially prevalent between foreign governments. Arrow pointed out as far back as 1972 that trust is the lubricant of economic exchanges in the absence of complete contracts and perfect information.[5] Lack of trust makes transactions more costly and volatile. Algan and Cahuc and others have shown there is a significant causal relationship between general levels of trust in a country and its GDP per capita.[6]

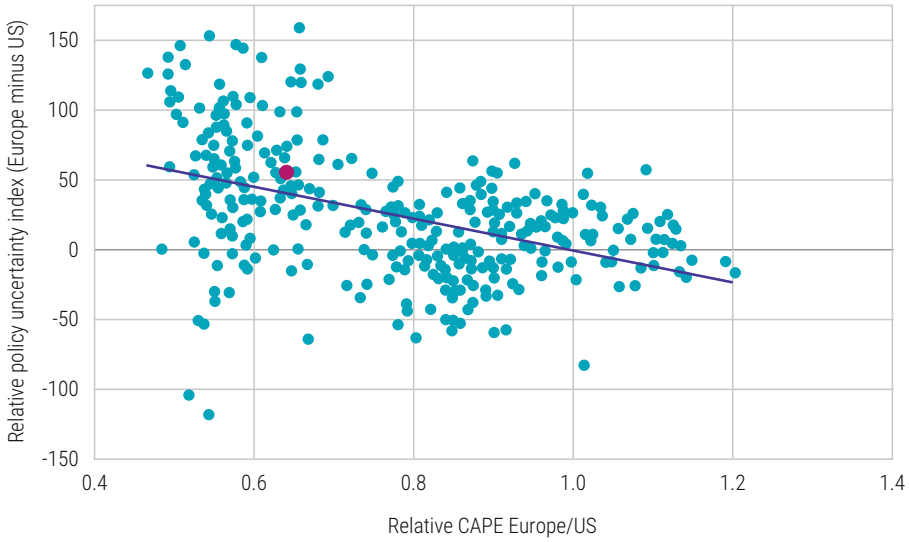
The dawn of multipolarity will therefore inhibit trend growth in global GDP per capita, and also coincides with persistent macro volatility. The volatility of consumption in developed economies has doubled to 4% on an annualized basis since the pandemic. Elevated macro volatility leads to higher earnings volatility and hence warrants higher discount rates. This explains why country-specific economic policy uncertainty is negatively correlated with a country's equity multiple (see Figure 4.6).

4. 2023 Edelman Trust Barometer Global Report FINAL.pdf

5. See Arrow (1972).

6. See Algan and Cahuc (2014).

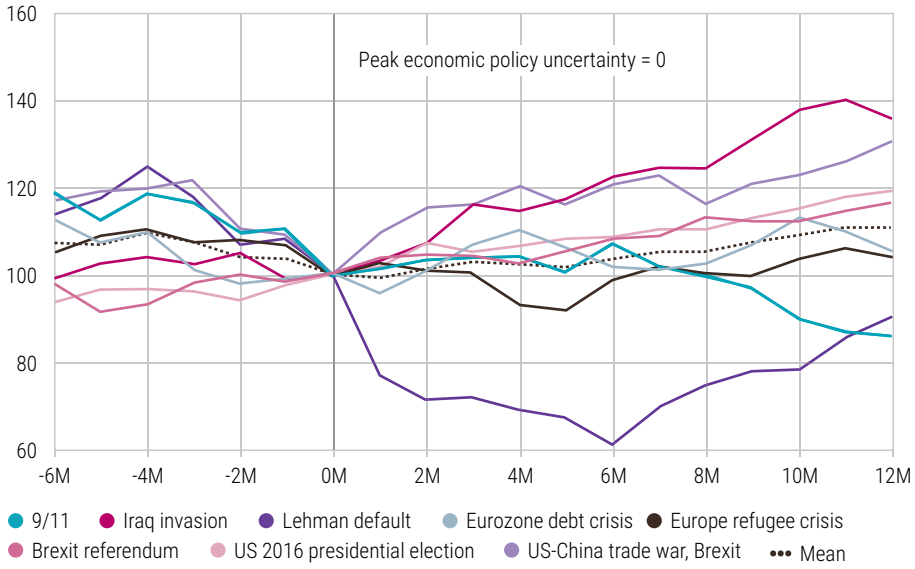
Figure 4.6: Higher relative policy uncertainty tends to coincide with lower relative CAPE



Source: Refinitiv Datastream, Robeco

It also explains why global equities have historically generally fallen prior to a peak in economic policy uncertainty but tended to rally afterwards (see Figure 4.7). As such, there is still some credibility to the contrarian investment maxim attributed to Baron Rothschild in the 19th Century that people should "buy when there is blood in the streets". While the literature on geopolitical risk in financial markets is still in its infancy (albeit rapidly growing), several papers, like that of Bedowska, Demir and Zaremba (2022) show that asset classes have unequal sensitivity to geopolitical risk, both in terms of magnitude and duration. In their study, green bonds, precious metals, the Swiss franc and real estate proved to be the best hedges against geopolitical risk.

Figure 4.7: Peak policy uncertainty often represents a buying opportunity



Source: Refinitiv Datastream, Robeco

The main causes of the ongoing erosion of trust are clear, with the struggle for dominance between China and the US likely to be the main source over the coming decade. The war in Ukraine, territorial disputes surrounding Taiwan and the Senkaku islands and the nuclear armament of Iran are likely to remain or become issues over the coming years.

Trying to predict how the geopolitical stars will align over the next five years is probably unnecessary for asset allocators, and could even be hazardous. Markets are much less worried about particular political outcomes than the level of uncertainty surrounding them. What's more, the degree of policy uncertainty is predominantly a function of policy constraints instead of stated policy preferences. In the tug of war between constraints and preferences, the former gain the upper hand in the long run. An example of this would be that despite China's policy preference for reunification with Taiwan, it might run into constraints such as Chinese people opposing a non-peaceful reunification, or Chinese military leaders assessing that its military is not yet ready for battle with the US.

If we are to gauge the levels of policy uncertainty that might prevail in various scenarios, we need to consider the policy constraints that could hinder geopolitical ambitions. The ability to successfully push out the technological frontier looms large in this respect: hegemons won't win the race in AI, cloud computing and robotics without improvements in their technological know-how. While previously a multiplicative force on the global stage, technology has now become a divisor. The Australian Strategic Policy Institute maintains a critical technology tracker that shows that China is leading the US in AI and robotics, in part because the US is suffering from a brain-drain of AI post-grads to China.

Yet in cloud computing, the US still leads the way. Given this close technology race, it is unsurprising that we are seeing a barrage of new regulation from both sides aiming to prevent the other from getting their hands on critical new technology that could help them gain a decisive edge.

When security were to take precedence over the economy

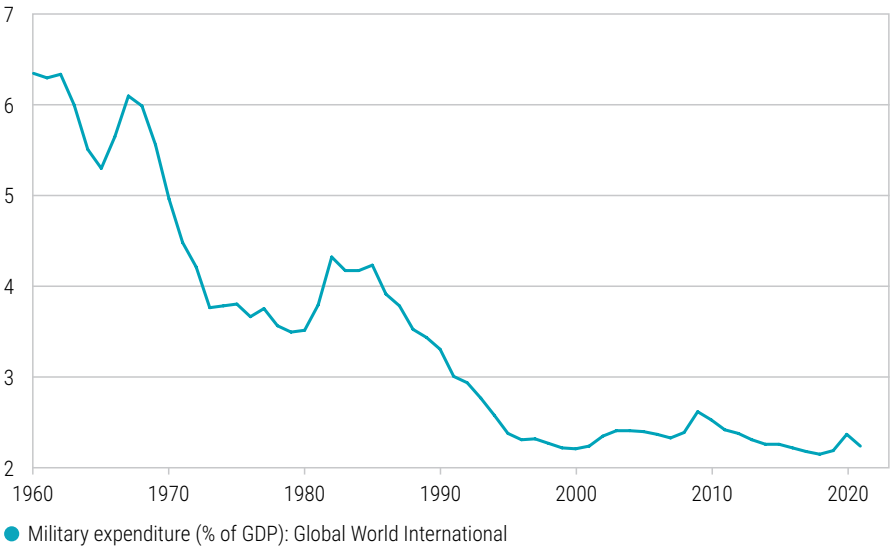
A closing gap between the world's great powers will probably create more turbulence. Some analysis has been carried out on what would happen if there were an economic clash between the West and China. An ECB study (2023) finds that if trade intensity were to fall to its mid-1990s level, the initial hit to the global economy would amount to about 5% of global GDP.[7] Self-reliant countries like the US would be better off in relative terms, but even in the long run trade losses would not be fully compensated for by trade diversion – in other words, friendshoring. Inflation would probably rise to 2-5 percentage points above steady-state levels as countries would be forced to substitute cheap imports. This would push up low-skilled wages in developed economies, whereas the wages of low-skilled workers in emerging economies would drop.

7. Friend-shoring global value chains: a model-based assessment (europa.eu)

However, not everyone agrees with the view of an emerging multipolar world. In 'The myth of multipolarity', Brooks and Wohlforth (2023) propose that we are not moving towards a bipolar or multipolar world, but at most a partially unipolar world in which the US (and implicitly the Washington consensus) still rules the day. They don't see a meaningful resemblance today with the age of multipolarity between 1500-1945, when alliances continuously shifted and war broke out with "'frightening regularity". Instead, they expect the already robust US alliance system to remain the key dynamic in the global balance of power, and for it actually to strengthen further.

Whatever one's view on the future balance of power, the peace dividend seems to be gone. Western governments' overriding concern with ensuring the status quo could have profound consequences in terms of more regulation, increased military spending and less *laissez-faire* economics.

Figure 4.8: End of the peace dividend – more military spending ahead



Source: Refinitiv Datastream, Robeco

4.3 Power play two: Capital versus labor

The hallmarks of a capitalist society are the drive to accumulate capital and maximize profit, an internally disciplined free market and a clear division of power between the public and private sectors.

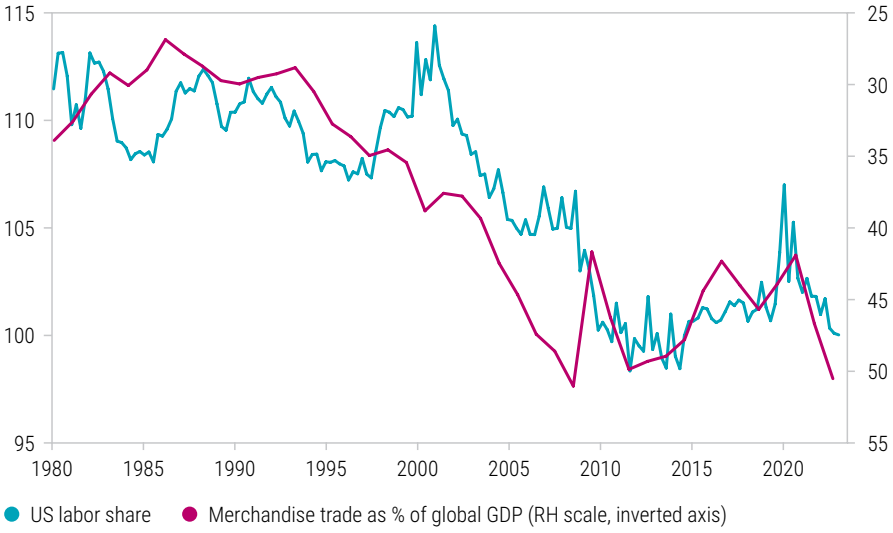
But capitalist systems are also marked by constant change. For instance, the boundaries between the state and the corporate sectors are becoming fuzzier, with technological progress a key catalyst for this development. The May 2023 congressional hearing of Sam Altman, CEO of OpenAI, showed that concerns about AI meddling in future elections are real. Meanwhile, Lowry (2023) points to the increasing overlap of private enterprise with public firms when it comes to sources of financing.[8] The fact that business is deemed by the general public to be the only really trustworthy institution left, according to the 2023 Edelman Trust barometer, also plays into the hands of the corporate sector.

8. See Lowry (2023).

Record-high corporate profit shares

When it comes to the pursuit of profit, things have run rather smoothly for shareholders in recent decades. Companies have managed to grab an increasing share of the economic pie, judging by the corporate profit share of the total economy. In fact, corporate profit shares hit record highs in both the US and the Eurozone by the end of 2022. The flipside of this has been a fall in labor's share of the economy. Interestingly, in the US this fall has largely coincided with the increase in globalization, as measured by trade intensity, over the past three decades (see Figure 4.9). The outsourcing of labor-intensive production to overseas countries with an abundance of cheap labor has steadily eroded the bargaining power of domestic labor, denting the overall labor share in developed economies.

Figure 4.9: Globalization and the share of labor in the US economy



Source: Refinitiv Datastream

Reshoring a huge boost for domestic labor bargaining power? Not so fast

If the backlash against globalization spurs reshoring, it ought to increase domestic labor's bargaining power again, as long as reshoring relies on labor-intensive import substitution. However, there are some caveats that are likely to prevent the coming decades from being a mirror image of the past 30 years.

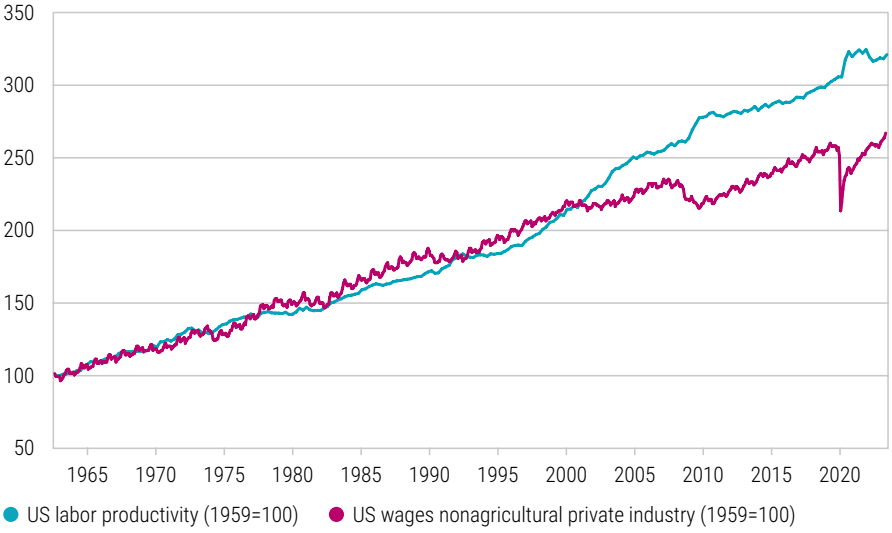
First, although the incentives for regionalization may have increased, Altman and Bastian (2023) warn against an exaggeration of the shift from globalization to regionalization, judging by the increase in average distance travelled by goods to 5,079 km by the end of 2021.[9]

9. Don't overestimate shifts from globalization to regionalization | Industrial Analytics Platform (unido.org)

Meanwhile, Kowalski and van Tongeren (2021) show that the growth in long-distance trade has outpaced the growth in short-distance trade.[10] The steep drop in freight costs in 2022 has probably only given new impetus for manufacturers to move production to cheaper countries. Second, import substitution – producing goods domestically rather than importing them – will probably have a higher capital intensity to maintain cost efficiency given the tightness of developed labor markets, high unit labor costs and promises of new technological capabilities like AI. Third, even if employment receives a boost from reshoring, it remains to be seen whether workers will get their fair share of the production reshuffle. US labor productivity and wage growth moved almost in tandem between the early 1960s and the late 1990s, but from there US labor productivity outpaced the growth in private sector wages, such that there was a cumulative gap of almost 50% by 2023. This suggests that the fruits of the IT revolution have fallen disproportionately into the lap of the corporate sector. This trend could persist if manufacturing becomes more tech-intensive.

10. See Kowalski and Van Tongeren (2021).

Figure 4.10: Marginal wage = marginal productivity? Not anymore for the average US worker



Source: Refinitiv Datastream, Robeco

It's important to note that productivity growth, and its rewards, vary widely both within and between industries. Technology has so far been a divisive force at the industry level. There has been polarized adoption of technology within manufacturing and services, creating a winner-takes-all environment in both. Andrews et al. (2016) find that the small minority of firms that were able to operate at the technology frontier saw an average increase in labor productivity of 2.8% per year, whereas technological laggards experienced annual productivity growth of just 0.6%. Slow diffusion of technology due to a lack of tech capabilities and low incentives to innovate (many firms are being kept alive by ultra-cheap financing rather than growth due to innovation) are the culprit. What's more, intra-industry divergence in productivity has been higher in industries that have experienced the slowest pro-competition market reforms. It seems tech billionaire Peter Thiel was onto something when he remarked in 2014 that "Competition is for losers. If you want to create and capture lasting value, look to build a monopoly".

Polarized adoption of new technology is confirmed by more recent studies about companies' integration of AI. Calvino and Fontanelli (2023) find that there is a positive relationship between firm size and AI adoption. Interestingly, they also find AI has an insignificant impact on productivity on its own – only firms that already possessed the required technological skills experienced productivity gains from adopting AI. This

confirms earlier findings by Andrews that a lack of IT-related skills represents a significant obstacle for technology diffusion and the ability of companies to catch up with the technology frontier, which would otherwise boost aggregate labor productivity.

Looking ahead, the aftermath of the recent central bank tightening cycle could partly undo the process of zombification and direct resources towards companies with a higher incentive to innovate, making them more profitable. And yet this process might just strengthen existing industry leaders and maintain the lopsided profitability distribution within and between industries. Without stringent pro-competition reforms and a more even dispersion of the IT skills needed to enable AI adoption, any general boost to productivity linked to AI is likely to be modest. In the absence of strong productivity growth, the profitability of the median firm over the next five years will come under pressure from rising interest costs and higher costs from investing to catch up with industry leaders. What's more, the bargaining power of labor is likely to rise against a backdrop of cyclically tight labor markets and greater unionization.

Challenges for profitability from climate change

There are other factors inhibiting a continued expansion of the corporate profit share in developed economies. The single-minded pursuit of maximizing profitability is increasingly being challenged by stakeholders pointing to the consequences. Increased internalization of companies' ecological footprints through, for example, higher carbon taxes and spending on expensive green innovation to prevent or capture carbon emissions will also dent profitability. Governments are responding to a looming ecological crisis by eliminating the negative externalities of carbon emissions. As we discuss in the Climate chapter, the Kaya identity shows much more needs to be done to enhance energy efficiency per unit of output and reduce emissions per unit of energy.

Huge upfront investments will be needed in carbon-intensive industries to ensure the world has a sustainable future and safeguard future profitability. As we discuss in the Climate chapter, physical risk and transition risk will probably shave 30-50 bps off companies' annual earnings growth over the long term, with the more immediate impact likely to be even larger. Firms that refrain from embracing sustainability will be faced with a higher cost of capital. This provides a strong incentive to make the necessary upfront investments to facilitate the green transition. McKinsey (2022) estimates companies around the world need to spend USD 9.2 trillion per year – equivalent to around 9% of global GDP – between 2026 and 2030 to achieve net-zero emissions by 2050. Expenditure on low-emission assets would be equivalent to 15% of gross fixed capital formation.[11]

11. A net-zero economy: The impact of decarbonization | McKinsey

Challenges for profitability from taxation

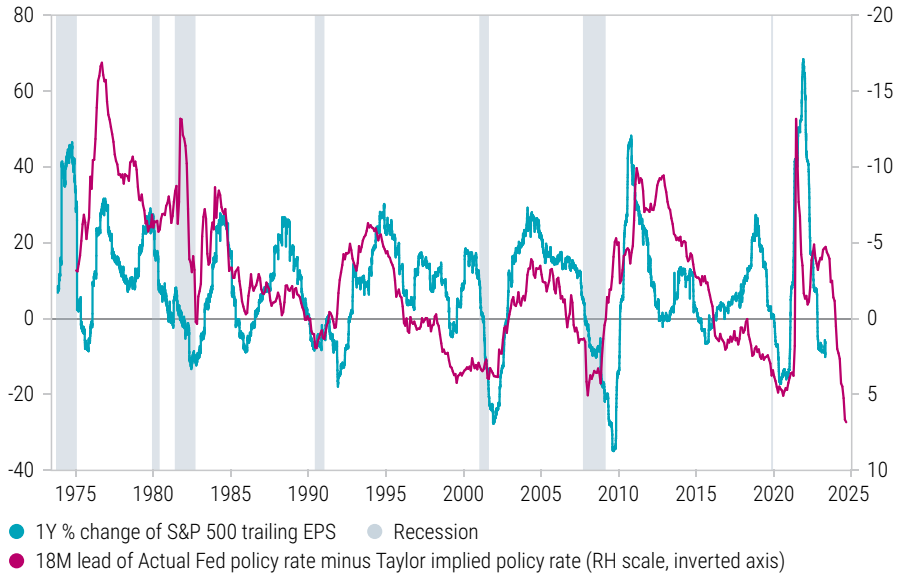
The average corporate tax rate of an OECD country back in the 1980s was rarely less than 45%. In the following decades, however, global tax competition to attract foreign capital led to a race to the bottom. By 2020, the average OECD member's corporate tax rate had fallen to 23%. In the US and other developed economies, these tax cuts took place without a corresponding increase in the tax base. This meant that whereas the factor capital profited from tax cuts, labor was taxed more or received a lower level of government services, such as healthcare and education. A landmark deal in 2021 saw the imposition of a global minimum corporate tax rate of 15%, effectively ending this race to the bottom. The focus on increasing revenues from corporate tax also suggests the tide may be shifting in favor of labor once again.

Cyclical factors influencing profit share

In addition to secular factors like deglobalization and the climate transition, other developments could represent a challenge to corporate profit share. The first is that the era of ultra-low interest rates is over. While the refinancing wall is still some time off as

many corporates have locked in low rates for a long time, the inverted yield curve tells us the aftermath of the recent aggressive tightening cycle in developed economies will probably have repercussions for profitability in the first half of our projection period. Our measure of excess tightening by the Fed also suggests earnings growth is more likely to fall than rise in 2024-25.

Figure 4.11: The degree of policy tightening has a leading and inverse relation to trailing EPS growth



Source: Refinitiv Datastream, Robeco

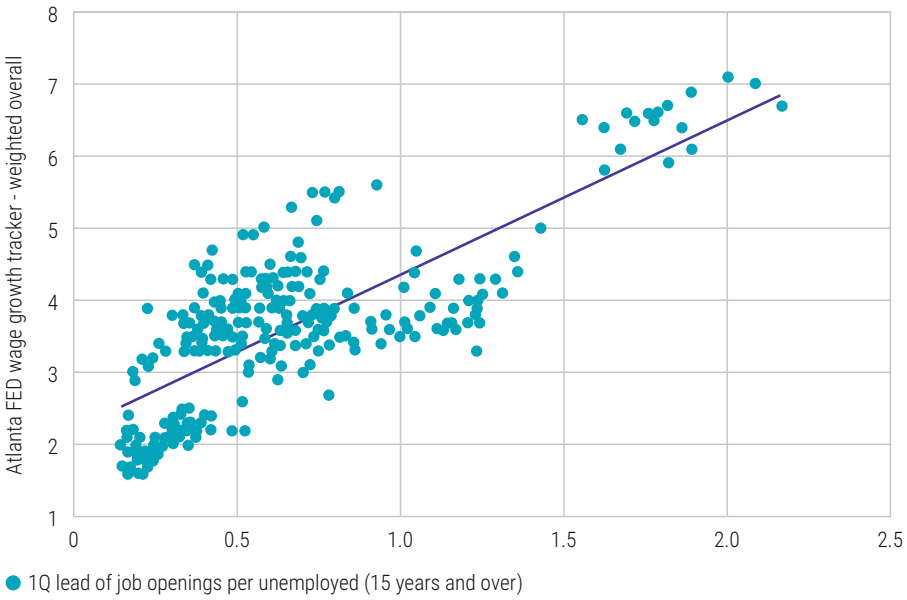
The outcome of the tussle

The outcome of the tussle between capital and labor over the next five years will probably be determined by wage dynamics in a sticky inflation environment. There are two important considerations here. First, will such an environment lead to persistent pressure to increase wages? Second, will companies be able to pass on a potentially higher wage bill to their customers in such a way that they expand their profit margins (in other words, can they increase prices more than costs are rising)?

Workers that enjoy a more centralized wage setting have greater bargaining power, and are therefore more responsive to sticky inflation pressures by demanding larger wage increases. Given that collective bargaining coverage is on average 20-40% lower than in the 1970s, the risk of a classic wage-price spiral developing looks relatively modest from this perspective.

However, labor shortages could still spur wage inflation in a high-inflation environment. At the time of writing the overall unemployment rate for the OECD stood at 4.8% – a record low. Measures that are even better at gauging the tightness of the labor market, such as the quits rate and the number of job openings per unemployed, suggest inflation, and therefore wage pressures, may only fade slowly over the next five years. A study by Bernanke and Blanchard (2023) shows that if the job openings per unemployed rate reverts back to its equilibrium rate of 1.2, US inflation will probably converge towards 2.5% by 2027, which is still above its current 25-year moving average. A cooling vacancy rate per unemployed towards its natural rate of 1.2 in the coming years would probably still mean annual growth in pay of 3.0-4.5% for US workers (see Figure 4.12).

Figure 4.12: Normalization of job openings per unemployed would still coincide with solid wage growth



Source: Refinitiv Datastream

The Phillips curve, which depicts the trade-off between unemployment and inflation/wages, is typically steeper when trend inflation is rising (see, for instance, Hajdini 2023).[12] The Phillips curve has steepened since the pandemic not only in the US, but also in the UK and Eurozone. Ari *et al*. (2023) find that the Phillips curve also tends to be steeper when trade intensity is lower and digitalization is higher – factors we discussed as future pivot points in the previous section.[13] In essence, a steeper Phillips curve makes central bankers' jobs a bit easier: disinflation costs less in terms of employment losses. The flipside of a steeper Phillips curve is that in the absence of a significant deterioration in employment, wage pressures may linger, creating an unstable post-tightening macroeconomic equilibrium. In addition, there is a large body of literature pointing to the existence of downwards nominal wage rigidity. This might prove to be especially strong after the current episode of exceptional labor market tightness, which has boosted wage growth. Branten et al. (2018) show that wages do not adjust downwards easily, even in the face of economic slowdown. Only in severe recessions does wage rigidity weaken.[14]

12. Trend Inflation and Implications for the Phillips Curve (clevelandfed.org).

13. Ari et al. (2023).

14. Nominal wage rigidity in the EU countries before and after the Great Recession: evidence from the WDN surveys (europa.eu).

Profitability in an environment of sticky wages

What does an environment of steeper wage Phillips curves and sticky wages mean for corporate pricing power? The answer is not straightforward and may depend on whether these conditions coincide with negative supply shocks that put pressure on other input costs or with a more benign demand-pull situation (or even better, demand pull in conjunction with a positive supply-side boost).

Companies' record-high profit share has not gone unnoticed. Greedflation has become a derogatory term, with corporates blamed for raising prices excessively on the back of the surge in input costs. But Conlon et al. (2023) show that there is no relationship between rising input costs and rising profit margins.[15] This view is corroborated by Suthaharan and Bleakly (2023), who note that in the presence of a negative supply shock, firms try to preserve margins rather than expand them.[16]

15. markups_pnp.pdf (chrisconlon.github.io).

16. Wage-price Dynamics in a High-inflation Environment: The International Evidence | Bulletin – September 2022 | RBA.

This stands in sharp contrast to a demand-pull environment, in which strong aggregate demand pulls wages and other non-wage input costs higher. In this type of environment, profit margins do expand. A demand-pull environment probably explains the increase in

profitability in recent years. While there is evidence that profit margin expansion has been responsible for almost half of actual inflation,[17] greedflation has more to do with too much money chasing too few goods. The huge pandemic fiscal stimulus resulted in historically low demand elasticity as a non-wage component in the form of fiscally sponsored pay checks (which was sometimes even higher than previous wage-related income) was added to consumers' income after Covid. It was resilient consumer demand that enabled profit margins to rise, not a sudden shift in market power or opportunism on the part of corporates. As documented by De Loecker (2020), the increase in profits during the pandemic-linked bout of inflation occurred against a backdrop of a decades-long run-up in profits, mark-ups and corporate market power concentration under conditions of remarkable price stability. A key question for investors in the coming years will therefore be whether demand-pull forces will still take precedence in a sticky-wage environment.

17. See, for instance Glover, del Rio and von Ende-Becker (2023).

4.4 Power play three: Fiscal versus monetary dominance

Since the start of 2022, G7 central banks have on average raised policy rates by 425 basis points. Governments have also tightened policy. For example, they have reined in expenditure from its pandemic peaks (when spending amounted to 25% of GDP), although they are still running sizable budget deficits. How have we arrived at the current policy mix and how will it evolve over the next five years?

Before the pandemic, developed economies suffered from a liquidity trap, a situation in which increases in the supply of money fail to translate into higher prices due to a slowdown in the velocity of money. A strong preference for saving rather than spending (excess savings in the US were above trend levels well before the pandemic) lowered the natural rate of interest. As a result, nominal policy rates had fallen to the zero lower bound, rendering monetary policy less effective. In this kind of situation it is up to fiscal policy to push the economy towards a better growth and inflation outcome. But, as an ECB study shows, this is not what happened between 2015-19.[18] Fiscal policy was too restrictive, delivering a net deflationary impulse to the Eurozone economy around 2016. Some experts, like French economist Olivier Blanchard, started to argue well before the pandemic that governments could start to lift the economy towards a better equilibrium.[19] He showed that with interest rates below the growth rate of the economy, debt is highly serviceable, enabling governments to run larger deficits without incurring a fiscal cost by running into debt sustainability issues. During the pandemic, the view that governments should provide strong countercyclical policy, with central banks acting as a fiscal financier (with unconventional monetary policy like the pandemic emergency purchase programme circumventing the binding zero lower bound), quickly became mainstream policy. The combination of accommodative monetary policy and strong fiscal expansion proved successful as the economy moved towards a better economic equilibrium, exactly as textbook investment-saving and liquidity-preference money supply models would have predicted.

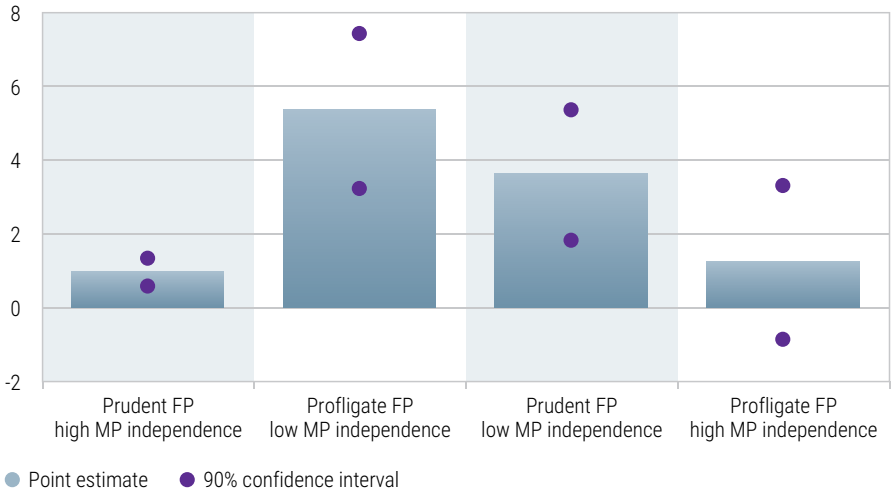
18. Monetary-fiscal interactions on the way out of the crisis (europa.eu).

19. See Blanchard (2019).

However, as the inflationary aftermath of the pandemic stimulus shows, too much of a good policy mix can be a bad thing. BIS (2022) provides evidence that the pandemic has resulted in a shift from a monetary-led to a fiscally-led regime. Whether this shift towards more profligate governments will leave inflation structurally higher depends on the fiscal-monetary policy regime. BIS finds that the combination of a profligate government and a weak central bank with limited independence creates the highest inflationary impulse. By contrast, a strong independent central bank is able to act as a counterbalance to even a profligate fiscal authority, with the result that there should only be marginal upwards pressure on prices.[20] As such, the power play between fiscal and monetary authorities in an above-target inflation environment is important for asset allocators to consider.

20. Fiscal deficits and inflation risks: the role of fiscal and monetary policy regimes (bis.org).

Figure 4.13: Fiscal-monetary interactions determine inflationary impulse



The inflationary impact of fiscal stimulus across fiscal and monetary regimes
The figure shows the estimated average impact of a one percentage point increase in the fiscal deficit on inflation over the next two years across different combinations of fiscal and monetary regimes. Fiscal regimes are classified as prudent or profligate based on Mauro et al. (2015). Monetary regimes are defined as being high or low independence based on legal limitations on central bank lending to the public sector in Romelli (2022).
Source: BIS

How will this dynamic evolve? First, governments will have to make a lot of difficult trade-offs between maintaining debt sustainability and fulfilling spending needs in the coming decade. Dealing with climate change and national security have become top priorities, with landmark bills passed in 2022 including the Inflation Reduction Act and the CHIPS and Science Act in the US. The IMF expects budget deficits to shrink towards 2028 but to remain sizable, especially for the US. In fact, the IMF's estimates could be an underestimation given the effects of the diffusion of generative AI technologies over this period. New, expensive government bodies may be needed to regulate AI.

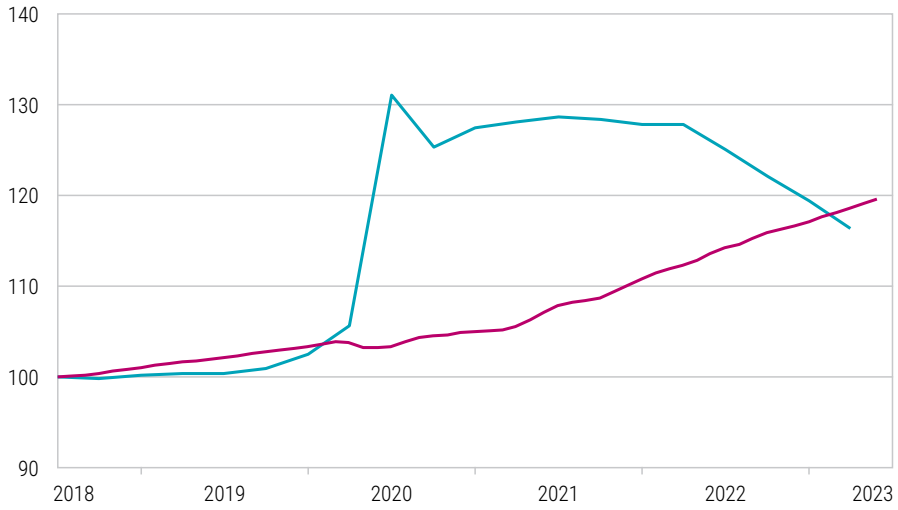
Economic growth, either directly from government fiscal multipliers or indirectly from other sources of growth, might not be of much help in easing the trade-off. As Cochrane (2020) shows, the historical contribution of GDP growth in easing government debt is "essentially none". Half of the variance of debt results from changes to budgets, with the other half stemming from changes in discount rates. In essence, in terms of debt service the focus should overwhelmingly be on interest rates rather than growth.

If a government were to prioritize security and climate change over a return to fiscal prudence it would be signaling to consumers that Ricardian equivalence (consumers postponing spending now in anticipation of tax hikes in the future) does not hold, and sticky inflation would be the natural outcome. A government that runs deficits for a prolonged period will not be able to avoid inflation. This is also picked up by the BIS study we referred to above, which notes that fiscal deficits are positively correlated with upside inflation risks, especially if the government is profligate. As Milton Friedman once remarked: "Inflation is made in Washington because only Washington can create money". The question is whether the Fed will allow this to happen.

The importance of low interest rates for a profligate fiscal authority reveals the tension that might emerge between fiscal and monetary authorities in the coming years. To constrain inflation, central banks need to keep policy rates at a restrictive or at most neutral level, although such a policy stance would not support fiscal expansion. The figures below illustrate these points. Figure 4.14 shows how the flow of easy money

(which is notable in that broad money growth exceeded underlying GDP growth by up to 30% at its peak during the pandemic) has been followed by US inflation increasing by 20% from pre-pandemic levels. Figure 4.15 and 4.16 show the strong correlation between the rapid monetary expansion and the huge fiscal stimulus. A reduction in base money relative to GDP will probably hamper fiscal expansion in the absence of a corresponding increase in government revenues.

Figure 4.14: Tight monetary policy required to tame inflation



Source: Refinitiv Datastream, Robeco

Figure 4.15: Fiscal expansion needs easy monetary policy (US)

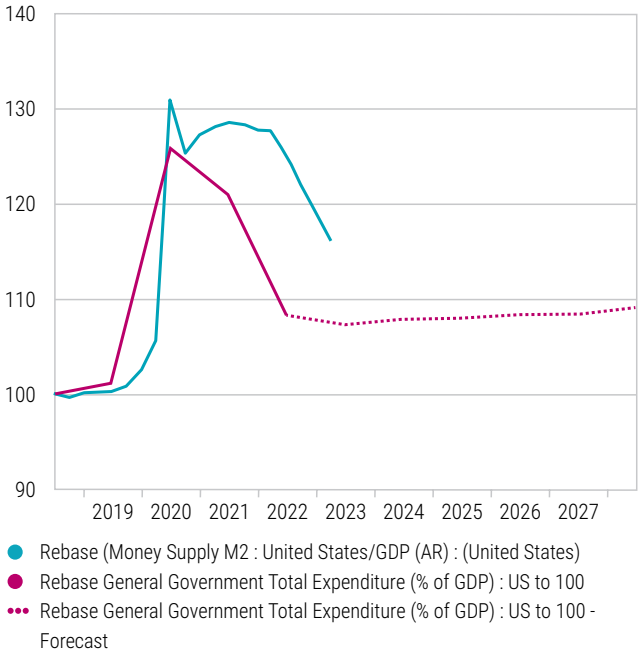
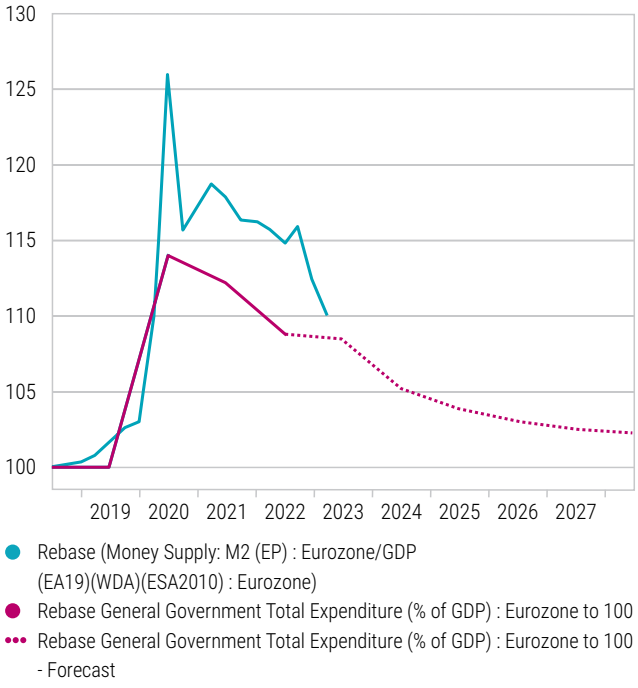


Figure 4.16: A similar picture in Europe to the US



Source: Refinitiv Datastream, Robeco

Scenarios

In our scenario section we distill the power play dynamics discussed earlier into three specific economic states. Given the current context, we consider these scenarios as the most plausible outcomes over a five-year period. In order to facilitate discussion about these scenarios, we introduce Table 4.1 containing the key pivot points that determine the nature of each scenario.

Table 4.1: Our macro views in a nutshell

Advanced economies	Base case: Stalemate (55%)	Bear case: De-risking (15%)	Bull case: AI gets wings (30%)
GDP growth 2024-2028	Around trend (1.8%)	Significantly below trend (0.5%)	Above trend (2.5%)
Headline CPI inflation 2024-2028	Above central bank target but < 3%	Above central bank target >3%	At central bank target
Peak CPI inflation 2024-2028	3.75%	4.5%	2.6%
Peak GDP growth 2024-2028	2.4%	1.25%	3.25%
Macro volatility	Consumption volatility 2-4%	Consumption volatility > 4%	Consumption volatility drops to pre-Covid levels = 1%
Recession	Yes, mild at the start of projection period	Moderate to deep recession midway projection period	No
Policy assumptions			
Power play 1: Geopolitics	Stalemate, rising tensions but nothing boiling over between US/China	Face-off. Rising/escalating tensions, elevated macro uncertainty	Strategic competition. Easing tensions, reapproachment
Power play 2: Fiscal/monetary policy mix	Independent CB, profligate fiscal policy. Fiscal expansion, initial monetary easing, later policy tightening	Low CB independence, profligate fiscal policy. Selective fiscal expansion (military, climate) initial CB dominance later capitulation/classic rate cutting into recession by 300-400 bps	Independent CB, prudent fiscal policy
Power play 3: Capital vs labor	Largely stalemate, marginal decline in profit share, gains in labor share	Melee. Strong gains in labor share (wage rigidity, resilient domestic labor markets, partly as result of reshoring/deglobalization)	Fading labor bargaining power. Further gains in profit share driven by positive technology driven supply shock
Zero lower bound binding?	No	No, but close call	No
Curvature	Initial bull steepening of curve, post 2024, bear steepening	Initial prolonged inversion/post-recession bear steepening	Initial bull steepening followed by stable term premium around 30-40 bps
Real short rates	Positive, close to neutral real rate	Negative, below neutral real rate	Positive, close to but below neutral rate
Nominal term premium	Rebuild of term premium in coming years, on average close to or above steady state premium of 50 bps	Negative term premium persisting in first half	On average steady state premium of 50 bps, slightly higher vs base case (mainly due to real term premium being higher vs base case)

4.5 Base case: Stalemate

Monetary policy works with long, but varying, lags. In the end, the recession signal that the deep inversion of the US yield curve has been flashing since spring 2022 is unlikely to prove false. After a mild recession in 2024, which sees headline inflation even dip below 2%, we expect developed economies to transition towards trend growth and above-target inflation again, with consumer price inflation remaining on average around 2.5% towards 2029. For the US, we expect real GDP growth to average 2.3%, 20 bps below what the current S&P 500 stock market valuation entails. While the growth outlook is rather benign, it is unlikely to be a smooth ride, with macroeconomic volatility remaining well above pre-pandemic levels as the dislocations in labor markets resulting from the pandemic have not been fully resolved.

Although the mild recession will be disinflationary and should take the sting out of inflation, this would not represent a victory for central bankers in developed economies. Unemployment increases by a couple of percentage points in this scenario, while non-cyclical core inflation pressures linger and cyclical inflation forces re-emerge quickly in the aftermath of the recession. Inflation is already back above 3% by 2025. Hence, a Pyrrhic victory for central bankers.

Modest annual increases in US unemployment of 30 bps per year on average towards 2028 and in precautionary savings result in US annual consumption growth of just above 2%. In the Eurozone, unemployment rises are more modest, coinciding with 1% consumption growth per year. Corporate investment activity as a share of GDP increases and contributes to trend-like growth. Adoption of AI technology remains limited mainly to industry leaders able to operate at the technological frontier such that there is no rapid, broad-based diffusion of this technology.

The aftermath of the 2022-23 tightening cycle has reduced debt serviceability for governments as the cost of debt has exceeded the rate of economic growth. Still running sizable deficits, low policy rates are needed to ensure debt is sustainable. Further fiscal expansion is needed for spending on defense (countries need to meet NATO's 2% of GDP defense spending requirements), health care, AI regulation and the climate transition. However, central bankers, mindful of the post-pandemic surge in inflation, are reluctant to act as fiscal financiers once again. Another central bank tightening cycle starts in the early expansion phase around 2025, but the tug of war between fiscal and monetary dominance means there is not enough monetary policy tightening to remove demand-pull inflation. Given this ongoing power play between fiscal and monetary authorities, yield curves bear-steepen as bond investors demand increased compensation for inflation risk in the medium term. Over the projection period the actual policy rate remains slightly below the neutral policy rate for developed-market central banks.

Stronger demand for labor from domestic manufacturing as a result of subsidized reshoring, nominal wage rigidity and a further decline in non-cyclical unemployment result in a landmark shift in the labor share of GDP in developed economies. In emerging markets, wage growth slows somewhat as elevated geopolitical tensions inhibit Chinese export growth, with an indirect hit on countries in the region that are dependent on exporting to China. However, tensions between China and the US do not boil over. The US maintains its longstanding, deliberately ambiguous policy towards Taiwan – aiding Taiwan's defense efforts while opposing unilateral Taiwanese independence. Meanwhile, China remains mindful of the costs of war and needs more time to convince itself of its military capabilities and that it would not experience a domestic backlash in the event of a non-peaceful reunification with Taiwan. The Chinese economy manages to escape prolonged outright deflation because its move towards a more self-sufficient growth model results in expensive import substitution, which pushes up input costs. What's more,

Chinese companies ultimately do not shift from the goal of profit maximization towards debt minimization, which characterizes a balance-sheet recession. However, key elements of Japanification – low growth, low inflation and low interest rates – surface on the back of partially forced deleveraging, falling trend growth and an aging population.

4.6 Bull case: AI gets wings

What if the current hype about artificial intelligence does not prove to be misplaced? At face value, the speed of adoption is breathtaking. Whereas it took other online services like Facebook and X (formerly Twitter) 4-5 years to gain 100 million users, ChatGPT, a large language model, hit the 100 million user mark in just two months. In our bull case we see above-trend growth and at-target inflation emerging on the back of early adoption of AI and its rapid diffusion across sectors and industries. But an AI-led productivity growth boost probably only appears in the official statistics after 2024 due to underreporting and measurement problems. In this scenario, AI technologies become cheaper due to increased competition and accessibility thanks to government regulation and targeted technology education efforts. As such, small- and medium-sized companies also adopt them. Facing the existential threat of AI, high-income workers tone down their wage demands in exchange for job security and non-wage compensation like tech education. Companies, especially those at the technological frontier, therefore enjoy an increase in profitability as unit labor cost growth remains in check. The power play between capital and labor is convincingly won by capital in this scenario.

The result is an almost Goldilocks scenario in which things are running neither too hot nor too cold. Consumption volatility drops and returns to its pre-pandemic level of 1%. Central banks can take a break from tightening policy as benign disinflation emerges around 2025 due to the supply-side boost that the rapid diffusion of technology results in. This balances the increasing demand-pull inflation stemming from consumers remaining in strong shape due to a positive wealth effect (from rising house and stock prices), higher disposable income and solid real income growth. The power play between fiscal and monetary authorities is the least intense in this scenario. First, governments feel less pressure to spend on military capabilities as geopolitical tensions ease, so government budget deficits shrink faster than expected on the back of increased revenues. Second, emerging productivity gains reduce the threat of a wage-price spiral and keep long-run inflation expectations well anchored. As such, central banks have more leeway to support fiscal expansion where it is needed. Actual policy rates increase as the cycle progresses, reflecting higher neutral real rates, but overall policy remains fairly accommodative. Job displacement as a result of the diffusion of AI does not yet surge as knowledge workers initially adopt and benefit from the new technology. Only closer to 2030 does generative AI's ability outright threaten white-collar workers' job security.

As in our base case, this scenario also sees a rebuilding of the term premium in sovereign debt markets. After a bull-steepening of yield curves in the early phase, term premiums in developed economies end up slightly higher than in our base case. Unlike the base case, the rebuilding of the term premium is predominantly driven by the inflation-adjusted real term premium as the global economy moves towards a better equilibrium in terms of growth and inflation.

4.7 Bear case: De-risking

Our bear case sees a vigorous display of the triple power play. Governments are in the crosshairs of their central banks as they fuel goods inflation with massive military spending. Mutual trust between superpowers hits rock bottom, accelerating friendshoring and reshoring, thereby fueling demand for domestic labor. Expensive import substitution of formerly outsourced inputs and AI-linked cyberwar threats compel companies to increase investments, denting profitability. Labor gains bargaining power in the goods

sector, but loses ground in the services sector. Ultimately, a turbulent environment results in growth of just 0.5% per year for developed economies, while inflation remains stubbornly high at 3.5% on average. A stagflationary environment emerges, intensifying the policy dilemma for central bankers.

At first, things do not seem that dire. In 2024, a mild global recession emerges on the back of the aggressive tightening of 2022-23. However, unlike the mild recession in our base case, this recession is different: it is not as disinflationary. Core inflation stays high as the prices of non-cyclical components in the inflation basket prove sticky. At the same time, rising geopolitical tensions mean concerns about energy security remain elevated, preventing a prolonged bear market in commodities. As such, headline inflation does not drop as much as in our base case. Central banks make a few cuts but their overriding concern remains inflation expectations becoming unanchored, not a modest rise in unemployment. This means that policy remains excessively tight, inhibiting a strong recovery in 2025 as the compounding effect of several years of net tightening starts to weigh on real activity. The US yield curve remains inverted, signaling a deeper economic slowdown. The ensuing recession is fairly deep, with growth contracting by 1% in developed economies. Central bankers capitulate, prioritizing growth over containing inflation as it becomes apparent that this recession is strongly disinflationary. A traditional rate-cutting cycle of 300-400 bps follows, and inflation moderates towards 2028, resulting in deeply negative real yields. ●

EXPECTED RETURNS 2024-2028

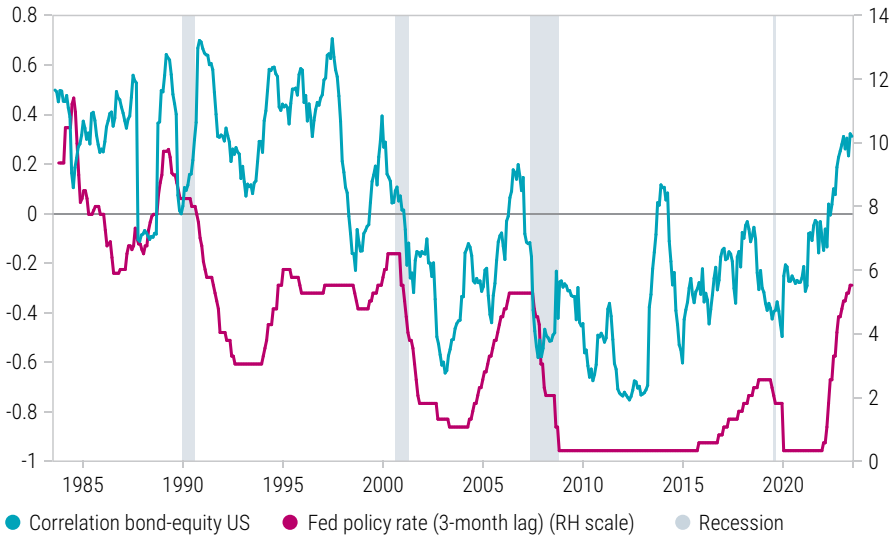
5. Expected returns

We calculate expected returns for the main asset classes using our steady-state capital market assumptions, taking into account our assessment of their valuations, the macroeconomic consequences of our three main scenarios, and the effect of climate change on our forecast. The continued increase of economic policy uncertainty makes determining our estimates more challenging and conviction is somewhat lower compared to previous years.

Strategic asset allocation predominantly seeks compensation for exposure to systemic risk factors, which also requires a deep understanding of business cycles. Therefore, anticipating how today's data-dependent central banks shape business cycles in their quest for price stability becomes an important piece of the asset allocation puzzle. With central banks tilting away from discretion to rule-based policies during the Great Moderation, their greater transparency increasingly helped shape market expectations. This is reflected in Figure 5.1 where the bond-equity correlation has led the actual Fed policy rate by three months over the past few decades. Molenaar, Senechal, Swinkels and Wang show that the sign and magnitude of the bond-equity correlation is influenced by the level and uncertainty surrounding inflation.[1] A declining bond-equity correlation as we observe YTD, signals that inflation has peaked. Yet, central banks realize they are not out of the woods as inflation is still well above target.

1. Molenaar, Senechal, Swinkels, and Zhang (2023).

Figure 5.1: Correlation of bond-equity signals Fed trajectory



Source: Refinitiv Datastream, Robeco.

Central banks determine the monetary base as well as part of the money multiplier in credit creation. Influential voices of past and present have stated that money is neutral and shouldn't matter for economic outcomes, let alone asset allocation. Money is a veil according to the classical economists, as John Stuart Mill wrote in 1871 "the relations of commodities to one another remain unaltered by money." Keynes however has shown the impact of monetary policy on relative prices is not neutral and as a modern money

manager it is simply impossible to ignore the behavior of central banks on asset volatility, correlations and ultimately asset returns. With the exception of our bear case, we expect inflation to average below 3% in the US which has historically coincided with a negative bond-equity correlation regime. Thus, for US-based investors, portfolio diversification benefits over the next five years could increase again after a tough spell for a traditional 60/40 portfolio during the heydays of the post-pandemic inflation surge.

Table 5.1: Five-year return forecast for the main asset classes

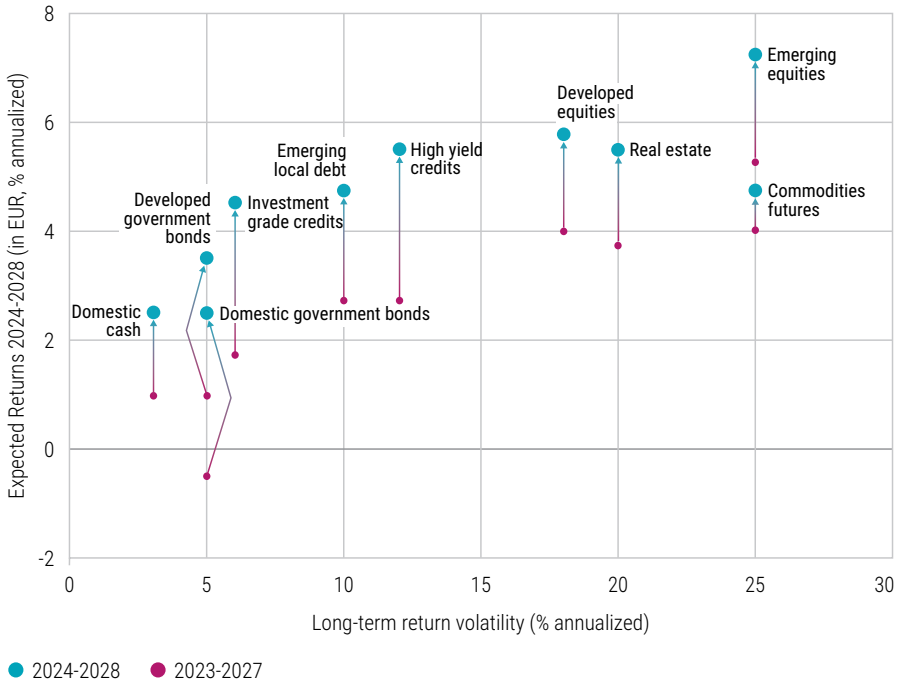
	Long-term	Medium-term influences				Forecast in EUR			USD	JPY	GBP
	Returns	Valuation	Macro	Climate		2024-28	2023-27		2024-28	2024-28	2024-28
Fixed income											
Domestic cash	3.50%		-1.00%		↑	2.50%	1.00%		3.25%	0.25%	3.00%
Domestic bonds	4.00%	-2.00%	0.50%	0.00%	↑	2.50%	-0.50%		5.25%	-1.00%	5.50%
Developed	4.25%	-1.25%	0.50%	0.00%	↑	3.50%	1.00%		4.25%	1.25%	4.00%
Emerging debt	5.75%	-0.50%	-0.25%	-0.25%	↑	4.75%	2.75%		5.75%	3.25%	5.25%
Corporate inv grade	5.00%	-0.25%	-0.25%	0.00%	↑	4.50%	1.75%		5.25%	2.25%	5.00%
Corporate high yield	6.00%	-0.25%	0.00%	-0.25%	↑	5.50%	2.75%		6.25%	3.25%	6.00%
Equity											
Developed	7.00%	-1.50%	0.50%	-0.25%	↑	5.75%	4.00%		6.75%	4.25%	6.25%
Emerging	7.50%	0.00%	0.25%	-0.50%	↑	7.25%	5.25%		8.25%	5.75%	7.75%
Real estate	6.00%	0.00%	-0.25%	-0.25%	↑	5.50%	3.75%		6.50%	4.00%	6.00%
Commodities	4.00%	-0.25%	0.50%	0.50%	↑	4.75%	4.00%		5.75%	3.25%	5.25%
CPI											
Inflation	3.00%				↑	2.50%	2.25%		2.75%	1.75%	3.00%

Source: Robeco. September 2023. The medium-term influences correspond with our qualitative assessment of the valuation, climate and macro influences described in Chapters 2, 3 and 4. For equity-like classes, our medium-term influences are assessed relative to developed equities. The expected returns are geometric and annualized. Bond returns are euro-hedged except for emerging market debt (local currency). The value of your investments may fluctuate, and estimated performance is no guarantee of future results.

We expect asset returns in euro to remain below their long-term historical averages over the next five years with the exception of commodities. We are gradually moving away from a low risk-free rate, high realized risk premium world to a higher risk-free rate, lower risk premium world. Yet, despite the recent surge in risk-free rates by >400 bps in G7 economies, our below long-term historical average returns are primarily due to below steady-state risk-free rates and to some extent subdued risk premiums. We have upgraded return expectations for some risky fixed income asset classes, not only because of higher risk-free rates but also because we expect elevated risk premiums compared to the steady state. We have increased the expected return on equities, leading to a 5.75% geometric total nominal return on a developed equity market portfolio.

Yet, we believe this still delivers a marginally below steady-state equity risk premium in the coming years. The TINA (there is no alternative) for equities narrative has collapsed as the era of ultra-low interest rates has passed. We believe that taking equity market risk is somewhat less rewarded compared to fixed income risks, especially after a peak in policy rates has materialized, when equities tend to struggle to hold up against riskier fixed income. For a US dollar investor with an international portfolio, perspectives are rosier as we continue to expect other currencies to appreciate against the US dollar. It is worth noting that headwinds for the dollar have eased compared to last year's expectations. Table 5.1 summarizes our expected returns for the major asset classes.

Figure 5.2: Five-year return forecast versus long-term volatility



Source: Robeco. September 2023. Vertical axis contains the geometric annualized returns for a euro investor over the period 2023-2027 and 2024-2028. The horizontal axis is a proxy for the long-term return volatility of each asset class.

Figure 5.2 plots these expected returns against long-term volatility estimates for each asset class. Note that whereas the returns are projected for the next five years, the volatility figures are long-term estimates and are close to what has been observed historically over an extended period. Although it might be tempting to eyeball a mean-variance efficient frontier through the dots, this would be unwise because we have not considered correlations in our analysis. Assets with low correlations to other asset classes may still form part of a mean-variance efficient portfolio, even when their expected returns are low.

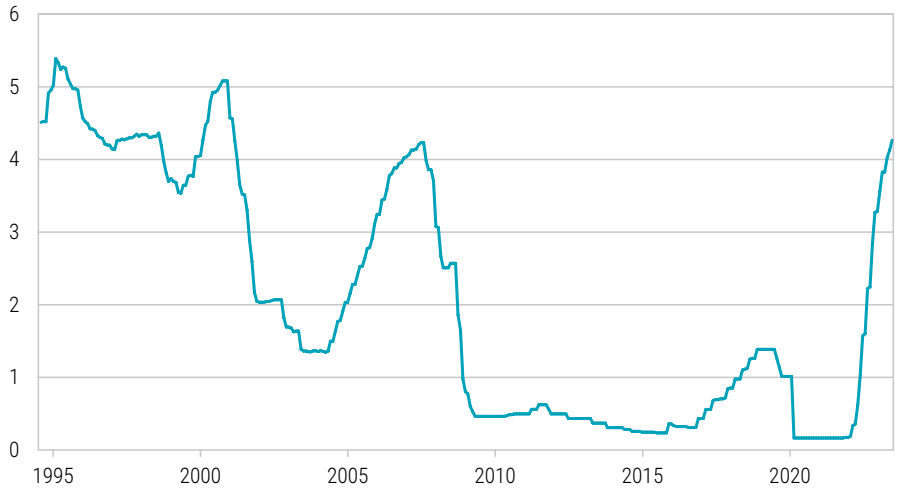
Figure 5.2 shows that returns have been upgraded across the board. Government bonds and investment grade bonds look especially attractive from a risk-return perspective. For most risky asset classes, the expected return for the volatility we believe they are likely to involve is substantial, resulting in attractive prospective Sharpe ratios. The biggest mover from last year are domestic government bonds, with a 2.5% return compared to -0.5% last year.

In the remainder of this chapter, we explain how we have calculated these expected returns.

5.1 Cash

Cash has beaten inflation by an average of 0.7% since 1900. While cash may not be king, it certainly is a prince and has several functions in a multi-asset portfolio. After it stood out as a safe haven in 2022, one of the steepest central bank hiking cycles in decades has further increased the appeal of cash for investors in search of risk-free yield. The GDP-weighted G7 policy rate stood at 4.3% at the end of July, the highest since August 2007.

Figure 5.3: GDP (PPP) weighted policy rate of G7 economies shows the steepest tightening cycle in decades



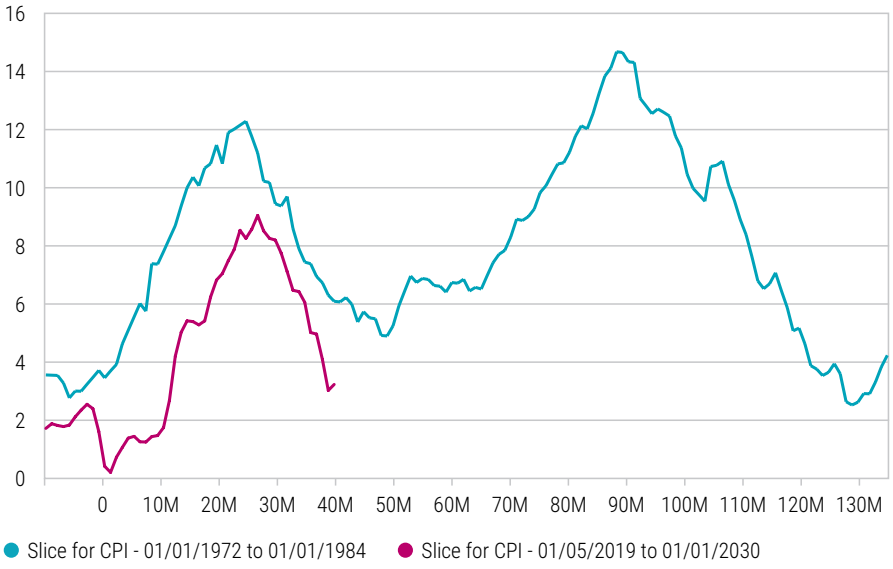
Source: Refinitiv Datastream, Robeco

In particular the steep nominal increase in the US Fed funds rate amounts to excess monetary tightening if one takes the 5Y OIS 5Y forward as a market-implied proxy for the nominal neutral policy rate. The 5Y OIS 5Y forward stands at 3.5% in early August 2023, implying the actual Fed funds rate is a full 200 bps above neutral.[2] In the Eurozone, the nominal policy rate is 75 bps above market-implied neutral policy rates. We expect this aggressive tightening will have taken the sting out of inflation as headline inflation drops somewhat below 2% inflation targets by 2024, in a year of economic slowdown. However, this episode could prove to be a short-lived victory for central banks as we expect inflationary pressures to resurface after 2024 on the back of economic recovery, a steeper Phillips curve, wage rigidity and a declining trend in structural unemployment in advanced economies. Yet, the degree to which inflation makes a comeback after 2024 differs across our scenarios.

2. For further details on neutral rates, see our central bank special.

As we outlined last year, we see a four-stage policy rate setting process unfolding. In the first stage, which has been the 2022-2023 experience, there is a laser-like focus by central banks on combating inflation and preventing second round effects to take hold in wage setting behavior. Ultimately their credibility is at stake. In the second stage, inflation has peaked and steady disinflation from very elevated inflation levels emerges. Relieved to see the path of inflation normalizing, central bankers start paying more attention to the business cycle. Smaller rate hikes are initiated as the prioritizing of inflation fighting over averting a hard landing becomes less outspoken. In the third stage, the pay-off function for central banks becomes more symmetric. Core inflation is still running considerably above target, but the growth slowdown becomes more pronounced and the employment situation starts to worsen. In the fourth stage, consistent evidence of ongoing disinflation leads to higher conviction among central bankers that medium-term core inflation will converge towards target while business cycle concerns become immediate. At this stage, the pay-off function becomes asymmetric again as in the first stage, though it is inverted; preventing a further slowdown is now prioritized over fighting inflation. We have now moved from the first phase to the second phase and are on the verge of entering the third phase. The year 2024 will likely see the sequence completed. The final stage of this sequence could also sow the seeds for a resurgence of inflation; the 1970s analogy could still be relevant.

Figure 5.4: Inflation comes in waves

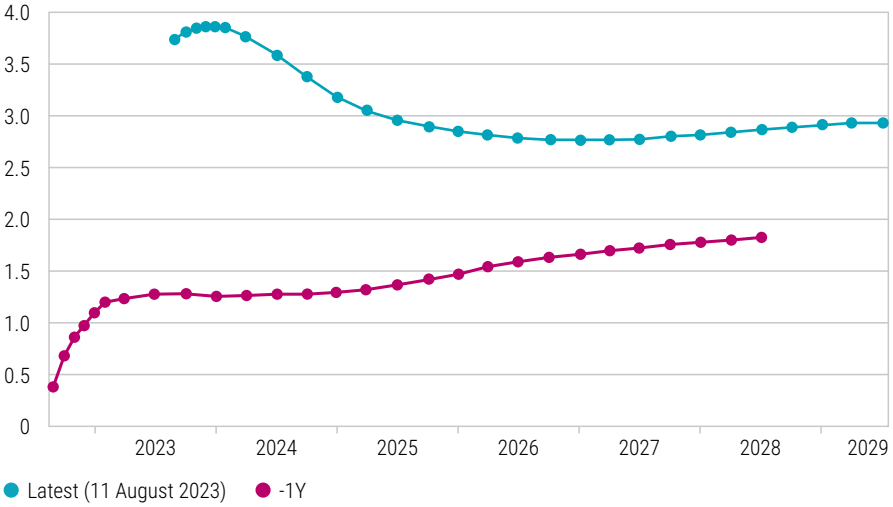


Source: Refinitiv Datastream, Robeco

In our base case, we expect the ECB only to deliver some hawkish cuts into 2024 as advanced economies experience a mild recession. The ECB will stick to a +3% policy rate throughout 2025 as inflation crawls back to 3% by year-end 2025. After 2026, contrary to market expectations we expect more cuts to a 2% policy rate as we deem the neutral policy rate to be lower than the 3% neutral ECB rate currently priced in by the market. The ECB policy rate from 2026 onwards thus ends up below the levels reflected in the current Euribor futures curve. The Fed will take the lead in the rate setting of developed economies as it typically leads the ECB by 10 months. During the cyclical slowdown we project there will be relatively modest cuts in 2024 by 200-300 bps, which still have a hawkish signature as core inflation pressures stemming from non-cyclical sources (i.e. lower trade intensity) linger. The Fed restarts hiking in 2025 as it is confronted by demand pull inflation on the back of strong consumption growth. Policy rates average around 3.25% in the US with the Eurozone investor able to earn 2.5% on cash.

Figure 5.5: Market expectations for future ECB rates saw a landmark reversal past 12 months

ECB interest rate expectations (LIFE 3-month Euribor futures)



Source: Refinitiv Datastream, Robeco

In our bull case, policy rate setting follows a fairly similar trajectory though terminal rate levels are generally 25-50 bps higher as advanced economies enjoy an AI-induced positive supply shock. A productivity growth spurt delivers a Goldilocks-like environment of above-trend growth and benign disinflation which allows real interest rates to be higher on average compared to the base case. Advanced economy central banks deliver some rate cuts in 2024 and 2025 but importantly, these are not recession-induced but rather a path correction to support employment growth in an environment where non-cyclical inflation forces are in retreat. Due to higher productivity, a lower global savings glut (resulting from higher degree of (green) capex and higher consumption growth), lower risk aversion and a lower degree of de-risking in financial institutions, the neutral rate of interest – the rate consistent with trend GDP growth and price stability – is higher compared to the base case and more in line with actual OIS implied market projections of 3.5%. While real policy rates are higher compared to the base case, the Fed has more leeway to support the expansion because inflation has been brought fully under control. Inflation in the US and Europe is expected to average 2% over the projection period. Even Japan manages to lift policy rates more decidedly away from the zero lower bound and sees an average cash return of 0.7%. In the Eurozone, the return on cash is projected to be 2.85%. US-based investors eye a cash return of 3.6%.

In our bear case, the power play between central banks and governments really moves to the forefront. Inflation remains high, especially because geopolitical turbulence sees accelerated reshoring, boosting expensive import substitution while reciprocal sanctions raise input costs. At the same time, advanced economies are badly in need of fiscal expansion as GDP growth decelerates to a meagre 0.5% annualized and militarization is prioritized. Yet, central banks initially refuse to act as a fiscal financier as inflation is well above 4% by 2026. In the deep recession that follows they finally capitulate and lower rates by almost 400 bps towards the zero lower bound even as inflation is not brought under control. A stagflationary environment prevails. In this scenario, Eurozone cash return will average 2.25% whereas US investors will see a 2.5% return. Note however that cash returns are deeply negative in real terms in this scenario as inflation averages around 3.5% in advanced economies.

5.2 Developed government bonds

Only two years ago more than a quarter of global developed government bonds exhibited negative yields. These days, nominal government bond yields are much closer to our expected long-term equilibrium level of 4%. Japan is the exception with long-dated yields still below 1%, but even in this situation only short-dated bonds have negative yields these days.

In theory, long-dated nominal government bonds are considered riskier than cash because of their exposure to real productivity growth risk and inflation risk. Over the past two years, investors in government bonds experienced how inflation risk can erode the real income from their nominal bonds and in addition, because of rising interest rates, also experience negative mark-to-market losses. Investors would therefore typically demand a term premium as a reward for holding these long-term assets instead of cash. We expect that over the long run, the premium for holding long-dated government bonds is 75 bps over cash, slightly below its historical global average of 100 bps since 1900.

However, as we saw in the Valuation chapter, the interest rate curves are inverted in the US, UK, and Germany, with the yields on long-term bonds lower than on cash. This suggests that bond investors are preparing for a recession in which the central banks will lower interest rates soon and/or are demanding lower liquidity premiums.

In our main scenario, we expect that bond yields will go down for these three markets when the mild recession strikes, such that most government bond yields will be at or below 3%. Afterwards interest rates will increase again but will likely remain below the current level at

the end of our five-year projection period. The exception is Japan, where we expect that bond yields will go up to 1.25% in 2028. This means that we expect that in the Eurozone, investments in cash or safe government bonds will give the same return of 2.50%. The excess return of government bonds in the US and UK will be substantial, because of the mark-to-market gains when interest rates decline. The opposite is true for Japan, where investors will experience mark-to-market losses because of the slight increase in rates, leading to a -1% expected return per year for the next five years.

For the developed government bonds asset class, we hedge the local return of each of these markets into the respective base currencies. The currency hedging cost is the difference in the predicted policy rates, as currency hedging is usually done by rolling short-term derivative contracts. For example, the 5.25% expected return for the US government bond market becomes a 4.50% return hedged to euro, because of the 0.75% difference in cash interest rates between the US and Germany. When we apply the same for other developed bond markets, the asset class has a 3.50% expected return for investors with the euro as their base currency. Japanese investors are expected to gain 1.50% when investing in a developed government bond portfolio. For investors with the US dollar as their base currency, the expected return is higher at 4.25%. However, this is substantially below the expected return on their domestic government bond market, so international diversification for them comes at a cost. This also holds true for the investor with the UK pound as base currency, where domestic government bond returns are expected to be higher than foreign government bond returns.

In the bull scenario, interest rates of most developed markets will be around the long-term equilibrium of 4% after five years, leading to lower expected returns on government bonds compared to the base case. Although Japanese government bond yields are expected to only rise to 1.50%, this also leads to lower expected returns.

In the bear scenario, interest rates are expected to decline to around 2% on average, leading to substantially higher expected bond returns for the next five years. For a euro investor, the expected bond return increases to as much as 4.25%. However, because inflation is expected to remain elevated in this scenario, the real inflation-adjusted return on developed government bonds is only 0.50%. In both of the other scenarios, the nominal developed market government bond return is lower, but because of lower expected inflation in these scenarios, they imply higher real returns of 1.00% in the base scenario and even 1.25% in the bull scenario.

5.3 Emerging local currency government bonds

Given the substantial upgrade to our expected returns for developed markets sovereign bonds in our base case, will EMD local currency issuers have to compete harder to lure capital inflows as the global search for real yield loses momentum?

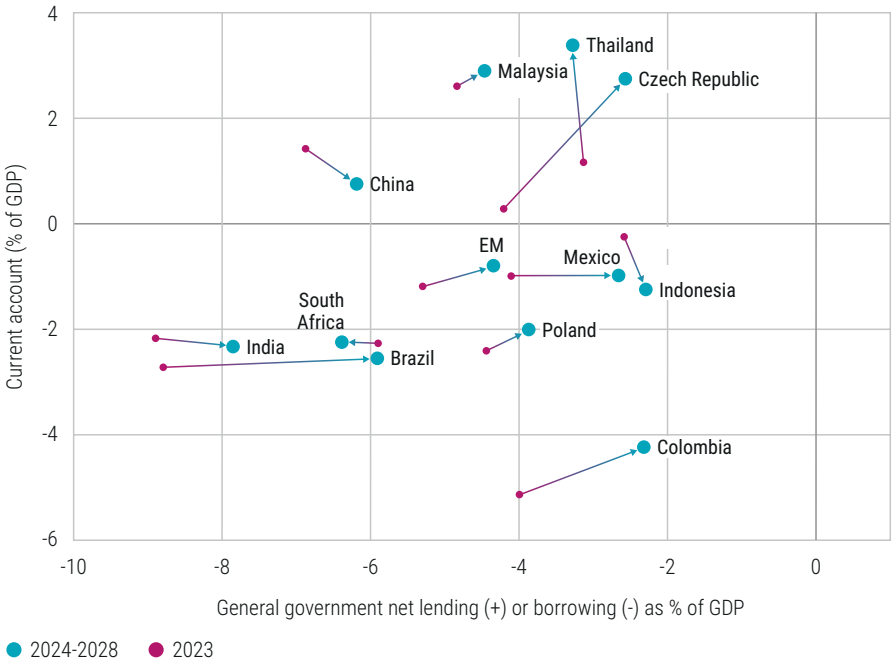
As we saw in the Valuation chapter, the difference in nominal yields between US Treasuries and the local-currency emerging government bond markets has declined considerably over the past year to only 2%. This may partially be because the IMF's expected inflation over the next five years for emerging markets is 3%, only 100 bps above the IMF's expectation for the US. Even though we think that inflation levels will be somewhat higher than predicted by the IMF, we agree that inflation differentials in developed and emerging markets will be low in the coming five years. This likely affects interest rate differentials, but also currency depreciation.

We expect that interest rates for emerging government debt markets will also come down during the next mild recession, initially leading to positive mark-to-market gains. However, thereafter interest rates are set to increase again. The increases in emerging markets may

be spurred by climate risks. Governments in emerging markets are expected to need to borrow additionally to manage damages from climate disasters that will impact their countries. For example, Germanwatch estimates that Thailand, a country with a weight of 8% in our emerging markets bond index, suffered from 146 climate-related disasters over the past 20 years, with associated damages of 0.82% of GDP per year.[3] In addition, the energy transition in emerging markets requires additional investments that are unlikely to exclusively come from private capital. The additional borrowing demand from emerging markets due to climate change may contribute to higher bond yields towards the end of our five-year estimation period.

3. See Eckstein, Künzel, and Schäfer (2021).

Figure 5.6: Both current account and government net lending expected to improve



Source: International Monetary Fund, Robeco.

According to IMF projections for 2024-2028, the emerging markets government debt index continues to show twin deficits, with a negative current account and net government borrowing. However, the situation is forecast to improve, with a less negative current account and reduced net government lending. For most individual countries at least one of the two deficits improves. For example, China is expected to see its current account surplus decline to below 1% of GDP, but its net borrowing will improve with almost 1% of GDP over the next five years. But for countries like Colombia, Poland, Malaysia, and Czech Republic, both are likely to improve in the next five years. While the twin deficits indicate downside risks are present in emerging market debt investing, the expected improvement is comforting.

From a credit rating perspective, many governments in the index obtained an investment grade credit rating of the major rating agencies and the outlook for most countries is stable. Even though a country never has to default on local-currency debt, as its central bank can always print more money to repay the debt, such events would most likely trigger a currency crisis and hence a risk for unhedged investors with a hard base currency.

Therefore, in addition to country-specific duration and credit risk, local currency risk needs to be factored into the equation. Currency movements remain an important contributor to risk in emerging market investing and tend to be expensive to hedge, which leads most investors to keep an open currency position. Relative to the US dollar, emerging currency

markets are substantially undervalued, and hence part of the expected return of investing in emerging government bonds may come from currency appreciation over the next five years, when part of the undervaluation reverses. We expect 5.75% for a US dollar investor. Since the euro is fairly valued compared to emerging markets currencies, we do not expect returns to be 100 bps lower in euro than in US dollars.

In our bull scenario, we expect emerging market debt to do better than in our base scenario, because obtaining financing will remain relatively cheap during the five-year period, even if climate disasters strike. Moreover, current accounts will be more positive as global aggregate demand is higher, allowing emerging currencies to appreciate more relative to the US dollar, leading to lower undervaluation. Expected returns in euro are 75 bps higher than in the base scenario, and even 150 bps in US dollars. In our bear scenario, we consider that some countries in the index will find it challenging to maintain the strength of their currencies as a fragmenting global economy hurts smaller open economies the most. This leads to losses for unhedged investors with a hard base currency, especially the US dollar, which acts as a safe haven in this scenario in times of abundant geopolitical turbulence.

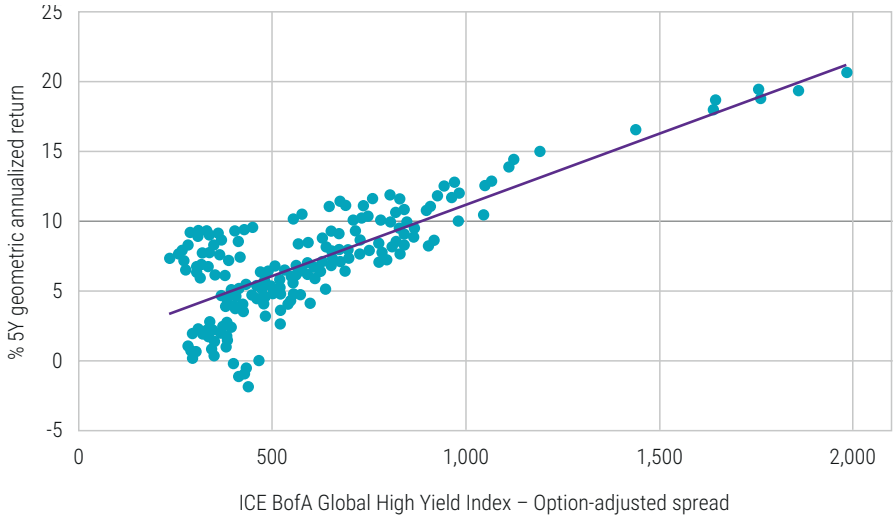
5.4 Corporate bonds

Corporate bonds pay investors a premium over government bonds to compensate for the credit and liquidity risk that the asset class involves. While they are procyclical assets like equities, their upside is capped whereas equities have in theory unlimited upside. The Commissie Parameters (2019) has mapped credit risk for each rating class.[4] For the lowest rated segment of investment grade (BBB), they find it has 80% bond-like exposure and 20% equity-like exposure. For high yield bonds they find that it has only a 60% bond-like exposure and a 40% equity-like exposure.

4. Commissie Parameters. (2019). Advies Commissie Parameters. Den Haag: Commissie Parameters

Where are we in the credit cycle? As we discussed in our Valuation chapter, valuations are in no-man's land. On the one hand, they are not overly expensive but on the other hand they don't discount a mild recession which we foresee at the very start of our projection period. Current US HY OAS spreads would be consistent with a 5.5% geometrically annualized return in the next five years, a bit below our steady-state return for the asset class. For investment grade actual credit spreads this would equate to a 5Y forward geometrically annualized return of 4.8%. Similar to high yield, this would result in a return that is close to but still below the steady-state level.

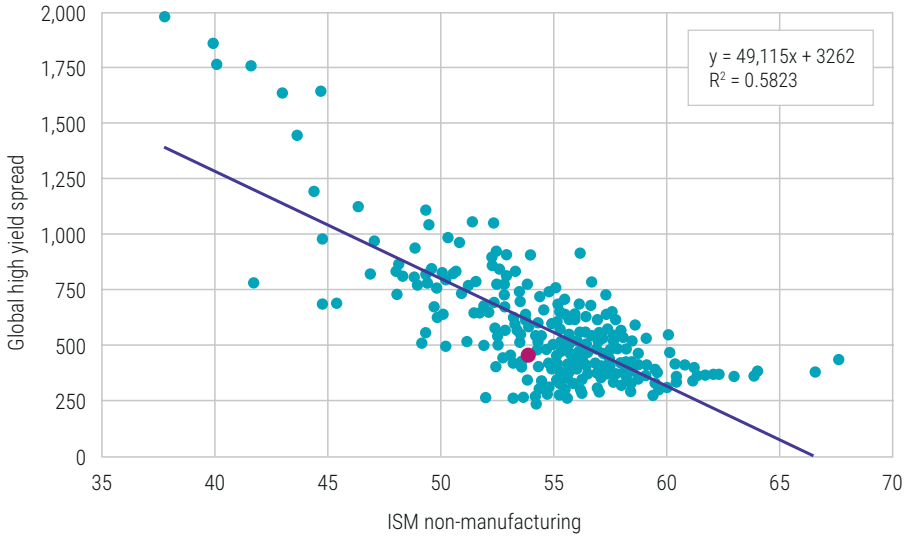
Figure 5.7: High correlation between starting OAS spread and subsequent 5Y geometrically annualized HY returns



Source: Refinitiv Datastream

Recessions do not have to be deep to cause a steep widening in credit spreads as Figure 5.8 shows.

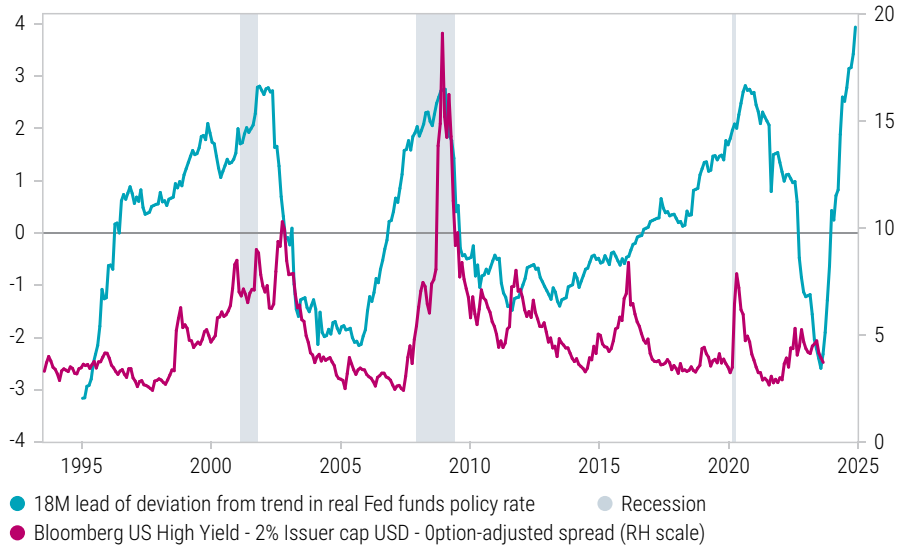
Figure 5.8: US services leading indicator versus high yield spreads; even a mild recession still may amount to spreads around 800 bps



Source: Refinitiv Datastream

If the non-manufacturing ISM (a leading indicator for the US services sector) were to dip its toes just below the 50 bps mark, as we expect during the mild base case recession, the global high yield spread could almost double and peak at 800 bps from the current low 400s levels in 2024. This phenomenon especially holds true against a backdrop of elevated real interest rates which typically spells trouble for speculative grade issuers when they are forced to roll over their debt. Elevated positive real yield episodes typically lead to somewhat higher defaults. Additionally, our monetary policy tightening metric, which is the deviation from long-term trend in the real Fed funds rate, suggests a peak in speculative grade debt 16 months after peak policy rates has been achieved (see Figure 5.9). Moreover, credit markets have the tendency to overshoot during downturns.

Figure 5.9: A metric that measures degree of policy tightening typically leads credit cycle

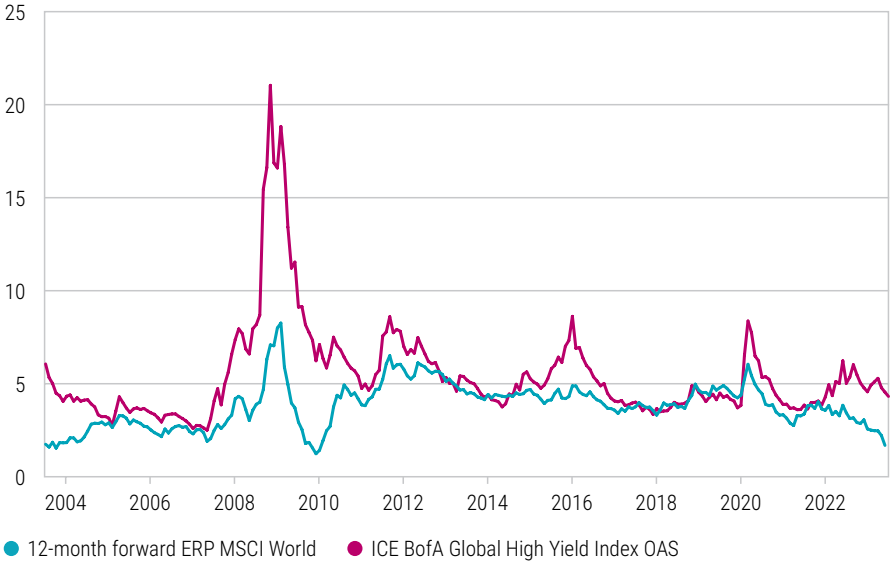


Source: Refinitiv Datastream, Robeco

However, after the sour of 2024 comes the sweet for corporate bonds as we expect modest above-trend growth in the US and lower real yields as the Fed delivers modest rate cuts. Thus, interest coverage improves. Yet, there will likely be another bump in the road around 2025-26 when a large chunk of outstanding debt matures and needs to be refinanced. Additionally, to the extent that AI-induced innovation causes creative destruction in our base case, industry laggards, mainly CCC-rated companies who have survived because of ultra-low interest rates, could see higher default rates compared to pre-Covid. The outlook for investment grade credit in our base case scenario from a macroeconomic perspective follows a fairly similar pattern, though here we expect spreads to widen to 200 bps in 2024 in reflection of substantially lower default risk, even as the investment grade universe is now more tilted towards the lower rated BBB segment.

Moreover, IG has a higher duration compared to high yield and thus benefits relatively more from the overall decline in long-dated bond yields we project towards 2028. For a Eurozone investor, both asset classes start to offer risk premiums that are 50 bps above their long-term risk premium as we expect a return of 5.5% for high yield and a 4.5% return for investment grade. This results in a neutral mutual attractiveness compared to the long-term steady state. We don't think investment grade can significantly close the 1% return gap with high yield as we do not expect a steep contraction in overall corporate profitability. As long as profit margins in the US stay above 10%, HY historically outperforms investment grade. However, for a Eurozone investor, more favorable starting valuations for global high yield against, in particular US equities (Figure 5.10), the forthcoming cutting phase of the monetary policy cycle, and more balance sheet friendly corporate actions (decline in debt-financed buybacks given higher cost of funding) makes corporate bonds a relative attractive risk-adjusted return proposition versus developed equities.

Figure 5.10: Global HY relatively more attractively valued versus developed equities



Source: Refinitiv Datastream, Robeco

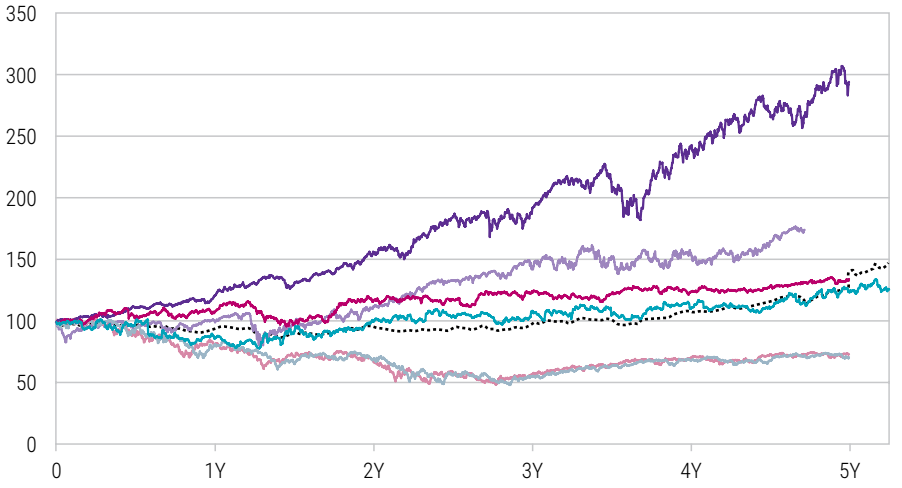
While we expect developed market equities to outperform high yield in absolute terms in our base case, we highlight that in the five years following a peak in the Fed policy rate equities typically struggle to outperform high yield. Thus, after years where TINA (there is no alternative) for equities ruled supreme, high yield could become a challenger.

Figure 5.11: US equity performance versus global HY after peak Fed policy rate

Slice for (S&P 500 COMPOSITE/ICE BofA Global High Yield Index) from:
01/05/2000 to 01/05/2005 01/06/2006 to 01/06/2011 01/12/2018 to 01/12/2023

Source: Refinitiv Datastream, Robeco

Figure 5.12: Weak performance of US equities versus US investment grade in years following peak policy rate



Slice for (S&P 500 COMPOSITE/ICE BofA US Corporate Index) from: Mean
01/05/1981 to 01/08/1986 01/05/1989 to 01/05/1994 01/02/1995 to 01/02/2000
01/05/2000 to 01/05/2005 01/06/2000 to 01/06/2005 01/12/2018 to 01/12/2023

Source: Refinitiv Datastream, Robeco

In our bull case scenario, we expect credit spreads to show a fairly similar pattern as in the base case. An initial spread blowout at the very start of our projection period is followed by spread compression, which is more sizeable compared to our base case, as growth establishes an even stronger footing. Yet, in our view what the market misjudges in this scenario is the degree of creative destruction due to AI-led innovation and its impact on the lowest rated credit issuers. Industry laggards among CCC issuers, who fail to adopt the latest technology and have only survived the last decade because of ultra-low interest rates, will bear the brunt. The combination of higher real yields, as well as a higher pace of

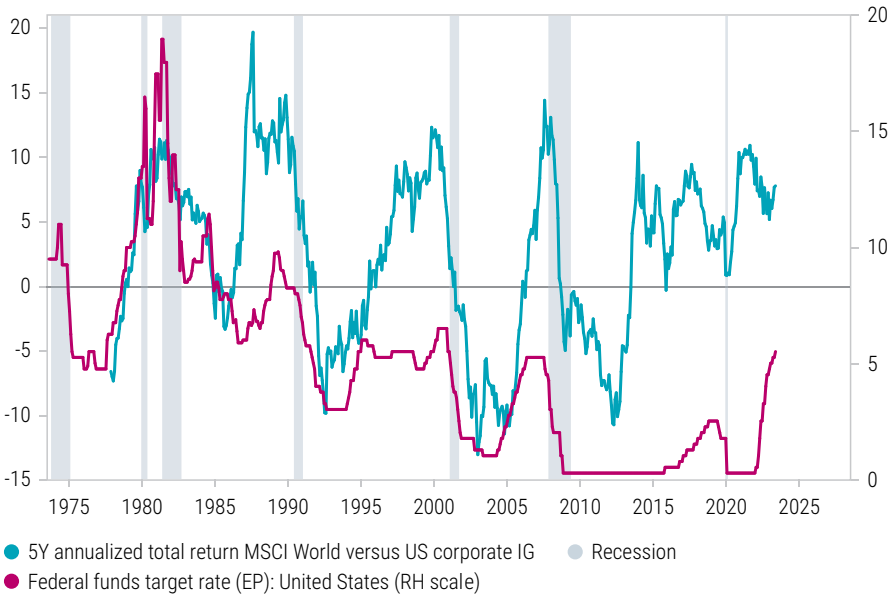
creative destruction compared to our base case, leads to somewhat higher terminal default rates in speculative grade debt. Given the relatively lower spread buffer, the result is a somewhat lower return compared to our base case results. We expect a 5.25% return for high yield and a 4.25% return for investment grade for a Eurozone-based investor.

Our bear case scenario sees a much larger return differential between high yield and investment grade as the profit cycle takes a steep downturn. Real yields become negative in the second half of our projection period, which especially boosts the more duration-sensitive investment grade. At the same time a declining corporate profit share in the economy hurts the more procyclical asset classes and therefore high yield. We expect only a 2% return for high yield as default losses rise to high single digits while investment grade also suffers from higher defaults but benefits overall from a steep decline in long-term bond yields. Investment grade for a Eurozone investor eyes a 6% return.

5.5 Equities

The MSCI World in local currency rose 15.1% in the first half of 2023. This is about twice the long-run average annual equity calendar return investors have been enjoying over the past century. After a dismal 2022, where equity markets traded down driven by higher discount rates, markets so far have been able to ignore the further rise in interest rates. The promise of generative AI created a powerful cashflow positive narrative that skyrocketed index heavyweights, like Microsoft and Alphabet. Current equity market performance portrays a very narrow market breadth. Whereas large technology companies in the S&P 500 were up more than 50% year to date by the end of June, the S&P 500 index ex-big tech companies saw just 8% return year to date.

Figure 5.13: Realized 5y annualized excess equity return tends to trend lower whenever rate cuts are recession induced



Source: Refinitiv Datastream

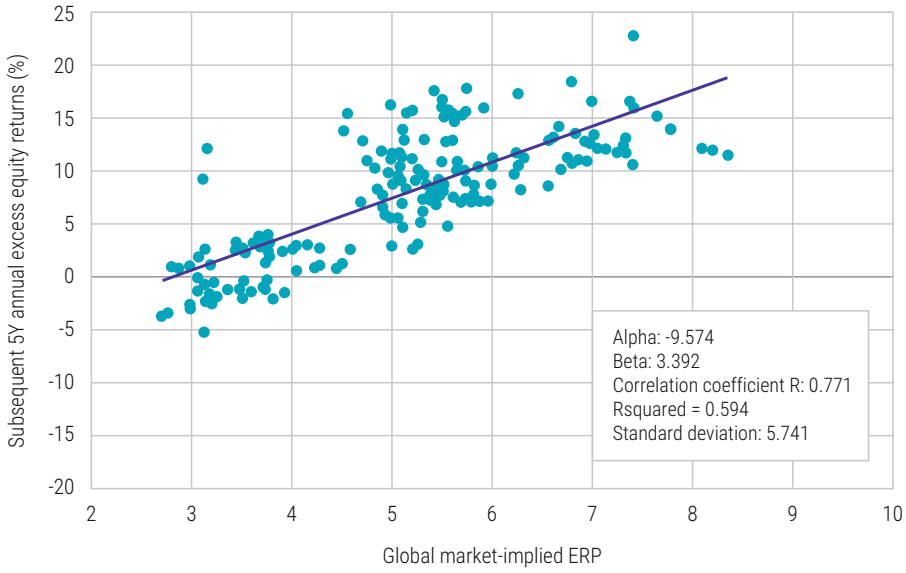
Looking ahead, a key question is: are we eyeing the start of a new bull market that will broaden and pave the way for another streak of above-historical excess equity return? With the exception of the Covid-recession, which saw a deep bear market, US equities have managed to outperform US Treasury bonds by a broad margin in the past decade on a 5Y annualized basis. Last year we projected for the first time in 12 years an expected

developed market equity risk premium for a Eurozone-based investor that was below its steady-state excess return. There are several reasons why we continue to hold that view despite the promises of generative AI for productivity. The TINA narrative that has ruled the last decade is collapsing. Firstly, the G7 GDP-weighted central bank policy rate has risen by 415 bps since early 2022. That is a gamechanger. It raises the appeal of risk-free alternatives. Rising discount rates lower net present values that equity investors are willing to pay, all else being equal.

Secondly, if inflation in the US is closer to 3% than 2% in the next five years, the odds of open-ended quantitative easing, which has boosted equity returns in the last decade, are dwindling. Instead, the pursuit of shrinking balance sheets by central banks could pressure equity multiples. Central banks will want to have ammunition to weather any future deflationary pressures on a secular horizon and the way to achieve this is to decidedly reverse course on balance sheet expansion in the medium term.

Thirdly, starting valuations for equities relative to the risk-free alternatives are not hinting at above steady-state excess equity returns for developed markets in the medium term. For instance the MSCI World market-implied equity risk premium (ERP) has halved since last year, now at 2.4%, suggesting lower excess equity returns ahead (Figure 5.14). The beta of excess realized equity return and the starting market-implied ERP has increased in the last 20 years compared to earlier decades.

Figure 5.14: Starting implied equity risk premium and 5Y annualized excess equity returns versus risk free bonds; a sub-3% starting ERP suggests lower relative upside for equities



Source: Refinitiv Datastream, Robeco

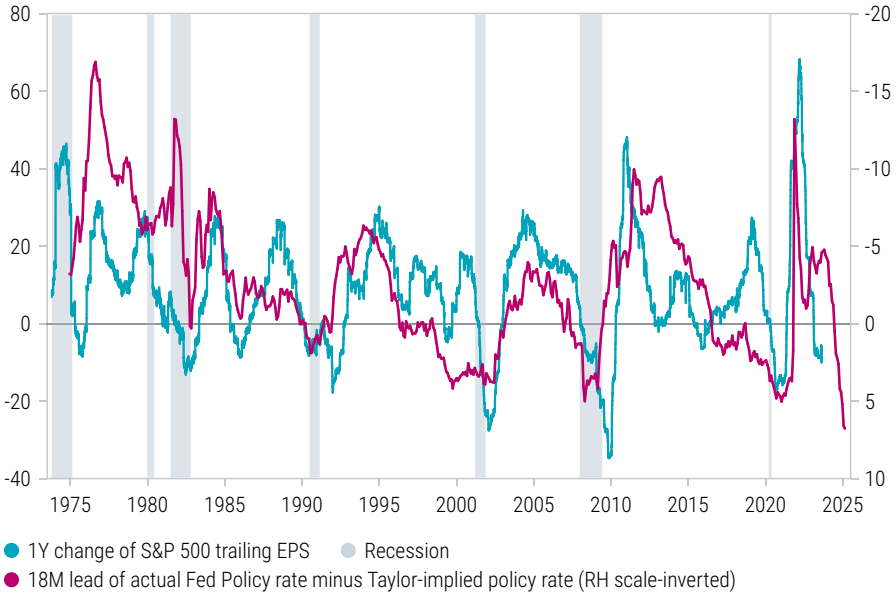
Additionally, the current market-implied equity risk premium does not accurately reflect higher future cashflow volatility due to elevated post-Covid consumption volatility and the rising trend in economic policy uncertainty. The fourth reason to expect a compression in the realized equity risk premium is the phase of the monetary policy cycle. After a peak in central bank policy rates, equities tend to see lower excess equity return compared to their steady-state excess equity return in the years following a recession-induced sequence of policy rate cuts. This is all the more so when starting valuations look stretched. In the five years following the bursting of the dotcom bubble, the developed markets equity risk premium became negative around peak policy rates in May 2000, leaving subsequent 5Y annualized excess equity returns outright negative. The prerequisite of a recession prior to

policy cuts is an important observation as without a NBER recession, as the 1995-2000 experience shows, equity markets may opt to neglect the growth signal from policy rate cuts and trend higher versus their risk-free counterparts. In our base case, we expect a mild recession by 2024.

In our base case, we expect developed markets earnings growth to end up below current 5Y forward consensus projections which are high single-digit or even still low double-digit for the US and Eurozone. At first glance, the consensus projections do look reasonable even incorporating our GDP and inflation estimates. We expect consumption growth in developed economies to remain close to their 120-year average of 2%, albeit against elevated volatility. Based on a simple regression, US GDP growth of 2.3% would likely deliver 8% earnings per share (EPS) growth. However, we opt for somewhat lower EPS growth as we expect the profit share will decrease on the back of declining corporate profitability. In other words, GDP growth will outpace earnings growth in the next five years as margins have peaked.

The reason we foresee a decline in profitability is linked to our overarching macro theme, the triple power play. Equities will likely bear the brunt of the power play in geopolitics. Further increases in capex towards friendshoring or nearshoring for global corporates will prove more costly and lower efficiency. Historically, the profit share has declined, and the labor share increased whenever the pace of globalization stalled thereby granting domestic labor more negotiating power versus capital. Further pressure from margins will come from a lagged response from past policy rate hikes. The degree of excess monetary policy tightening historically leads the twists and turns in the earnings cycle.

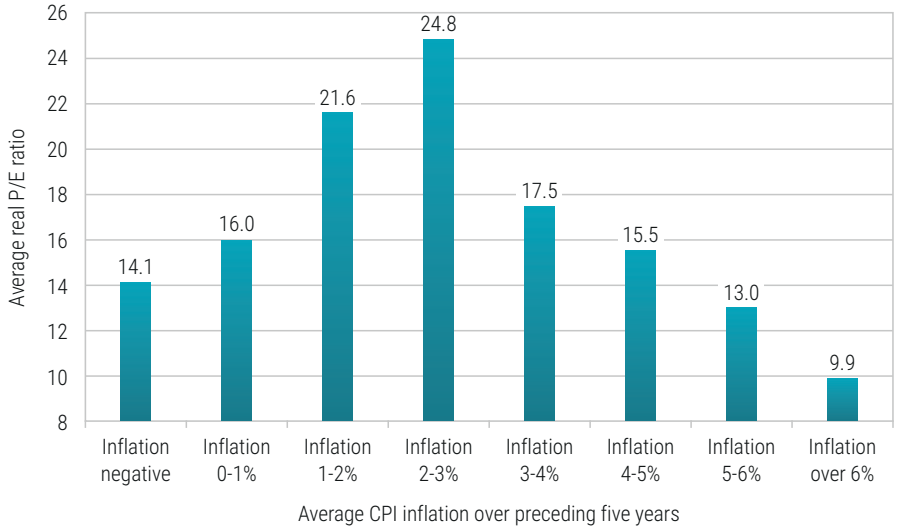
Figure 5.15: Our Fed tightening metric leads the earnings cycle by 18 months



Source: Refinitiv Datastream, Robeco

In recent years, we have been calling for multiple compressions from both a cyclical, as well as a secular nature. From a cyclical standpoint, we now expect less downside from multiple compression compared to last year as we are firmly moving into a more favorable inflation regime with inflation between 2-3% which has historically coincided with high equity multiples.

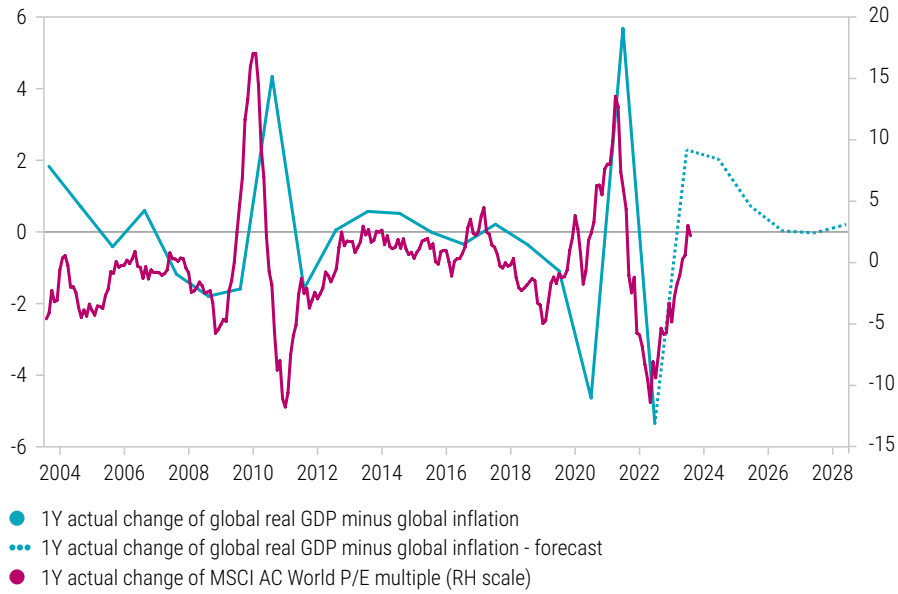
Figure 5.16: Inflation averaging below, but close to 3% benign for equity multiples



Source: Refinitiv Datastream, Robeco

Plugging our macroeconomic forecasts into the golden difference equation, which explains the change in prospective equity multiple by the difference between future real GDP and inflation, our base case foresees only a modest annual decline in developed market equity multiples. From a secular perspective we continue to see downside risks prevail for equity multiples as the era of ultra-low interest rates has clearly ended and consumption volatility post-Covid has more than doubled.

Figure 5.17: The golden difference (GDP minus inflation) leads the equity multiple

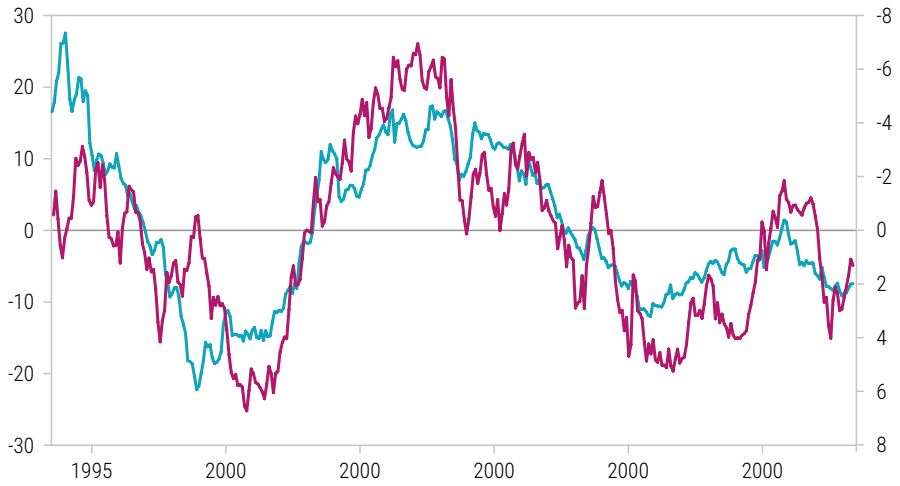


Source: Refinitiv Datastream

When it comes to emerging markets, we see less headwinds from higher domestic policy rates. As we wrote last year, deflationary pressures could come to the fore in China, and we foresee a further easing of policy rates in emerging markets that will sustain emerging equity multiples. From an earnings perspective a weakening US dollar, peaking emerging market bond yields, and stronger fiscal support for Chinese households in the next five

years bodes well for emerging market equity outperformance versus US equities, especially for US dollar investors. We expect an above-historical excess emerging market equity return versus developed markets of 1.5%. Whereas developed equity markets eye a return of 5.75%, we expect a total return of 7.25% for emerging markets in our base case.

Figure 5.18: A weaker US dollar supports relative outperformance EM versus DM



Source: Refinitiv Datastream, Robeco

In our bull case, the triple power play dynamics that especially caps upside risk for equities fade as the generative AI narrative that has recently skyrocketed technology majors proves to hold water and sees an early adoption across the broader economy, boosting productivity and profitability. Corporates enjoy lower unit labor costs, not only because higher productivity takes center stage, but also as white-collar workers foresee that ultimately generative AI could match their skills and threaten their job security, thereby toning down their wage demands. In this scenario, profit margins expand further from current levels and high beta and procyclical regions see outperformance.

In this scenario, we believe emerging markets that are very dependent on export-led growth could see a 15.25% return in euros as the trade-weighted dollar retraces further, cross-country technology dispersion regains momentum, China manages to maintain a +5% real GDP growth trajectory while a lower degree of protectionism around cutting edge western technologies takes hold. This return matches previous five-year peaks in the performance cycle for emerging markets. We expect 11% return for developed market equities for a euro investor. Returns for a US dollar investor who does not hedge foreign equity exposure will be higher as both the euro and emerging currencies appreciate more strongly versus the dollar compared to our base case.

In our bear case, the triple power play takes center stage. Turbulent geopolitics sees a higher market-implied equity risk premium and therefore a strong multiple compression. Central banks fail to eliminate the root of inflation, which ultimately proves to be non-cyclical in nature and sourced by the changing nature of globalization. An increasing fragmenting global economy only raises input costs and sees unit labor costs rise against a backdrop of subpar growth in real activity. Despite anemic GDP growth, domestic labor gains bargaining power on the back of a reshoring wave. In this scenario, corporates lack pricing power.

Higher producer prices are not easily passed on to consumers partly because stimulus checks for consumers are not as generous as in the aftermath of the Covid pandemic. Governments are given less leeway by central banks as the latter initially prioritize inflation above facilitating cheap government funding. A fairly deep global recession at the mid-point of our projection period around a 2026 recession sees a steep contraction in profit margins. Developed equity markets bear the brunt in these years, ending 2028 with a five-year annualized return of 2.5% for a euro investor. Emerging market equities see a marginally higher return of 2.75%.

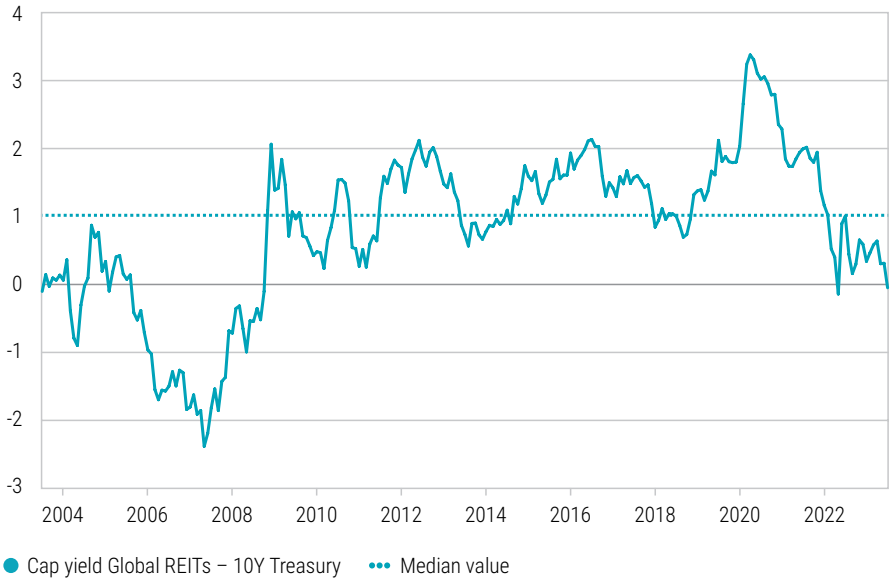
5.6 Real estate

Indirect real estate (REITs) can be seen as a real asset class as it has some inflation hedging capabilities. Yet, as the past 12 months have shown, it is far from a perfect inflation hedge, especially in times of economic slowdown. While the general perception is for REITs to be a defensive asset class, it really depends on where we are in the cycle. REITs' betas vary during the business cycle. In expansions REITs typically show a significant positive correlation with relative cyclicals/defensive performance and start to behave more like a cyclical asset. Glascock already observed that REITs' betas shift with regard to changing market conditions.[5] REITs' betas are typically higher during strong cyclical upswings but are lower during cyclical downswings. This suggests REITs have somewhat lower downside risk compared to equities during economic downturns.

5. See Glascock (1991).

Real estate entered a deep bear market in 2023 on the back of cumulative policy tightening by central banks. It is likely that the full impact of the aggressive tightening cycle by developed economies central banks is yet to be fully materialized for the asset class. In the recent years of ultra-low interest rates, the real estate sector has been playing a game by revaluating portfolios to allow more debt, leaving many companies with deteriorating loan-to-value ratios which necessitate balance sheet restructuring. In addition, for office REITs it has become clear that working from home is here to stay. Even in 2023, occupancy rates in top 10 US cities average between 40-60%, reflecting this behavioral shift. Another headwind is that REITs may not be the first choice for investors wanting an alternative for equities, with US Treasuries offering almost as much yield. Cap yields for global REITs were only 7 bps above 10Y US Treasury yields at the time of writing, below their median value of 100 bps.

Figure 5.19: Treasury yield now on par with cap yield

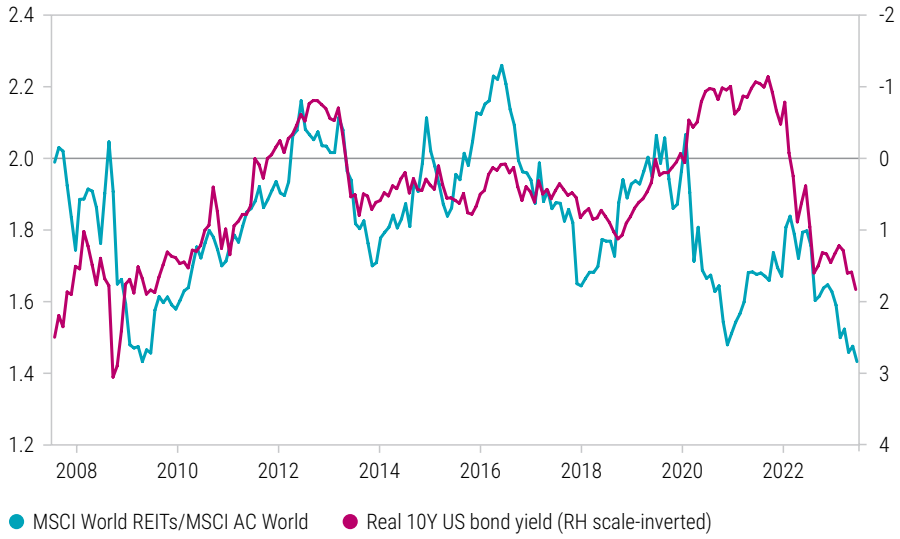


Source: Refinitiv Datastream, Robeco

As the average rating profile of renters is BBB, underperformance of REITs versus equities coincides, but are not limited to, blow-out in investment grade spreads. As we anticipate some turmoil for BBB-rated issuers is still lies ahead of us in 2024, driven by the lagged impact of past monetary policy tightening, there is also potential further downside risk for REITs.

From both a discount rate and a cashflow perspective some subsectors in REITs will face persisting headwinds. Overall, this highly levered asset class will likely lag equities in the next five years as it also does in our steady-state framework.

Figure 5.20: Real US 10Y and relative REITs performance versus global equities



Source: Refinitiv Datastream, Robeco

Yet, in our base case, there will be episodes in the next five years where REITs do outperform equities, especially when US real yields start to compress. Furthermore, investors will be on the look-out for assets that maintain pricing power. Even as the sting is taken out of the current inflation dynamics by central banks further down the road in our base case, inflation remains above 2% in the next five years. We expect 4.75% for the asset class in euro.

In our bull case, we expect REITs to underperform equities as well. With the global economy expanding at a healthy pace after the 2024 slowdown and inflation well behaved (around 2%), REITs see a return of 5.5% in euro. Elevated real yields remain a drag on performance versus equities, though data centers might benefit from a more rapid diffusion of AI technology across the economy.

Table 5.2: 1M Relative performance of MSCI Global REITs versus MSCI AC World Index

	ISM					
CPI	< 40	40-45	45-50	50-55	55-60	> 60
< 2%	0.07%	-0.76%	-0.09%	-0.68%	-0.12%	-1.95%
2-3%	-	0.22%	-0.95%	-0.16%	-0.22%	0.83%
> 3%	-7.45%	1.81%	-0.28%	0.05%	0.73%	1.78%

Source: Refinitiv Datastream, Robeco

In our bear case, a deep recession around 2026 will pose challenges for the performance of REITs given its higher degree of leverage and its high growth sensitivity compared to equities. Yet, we do expect a significant decline in real yields in this scenario due to higher inflation and central banks forced to move towards in the zero lower bound to counter a further rise in unemployment. This will mitigate downside for REITs versus equities. Also, as reshoring surges in this scenario and countries move towards relatively more autarkic economies, more domestic demand for real estate is to be expected. REITs eye an geometrically annualized return of -3.5% in this state of world.

5.7 Commodities

Commodities enjoyed an exceptionally strong 2020 and 2021, but summer 2022 saw the start of a commodity bear market that took many investors by surprise, especially those that heralded the earlier bull market years as the start of a commodity supercycle. We have remained more sceptical of such a supercycle in commodities and only pencilled in modest above steady-state returns in recent years. Commodities as an asset class have shown to exhibit high annual volatility of around 25%, so the decline by >20% y-o-y is nothing out of the ordinary. Even so, the bear market in commodities took us somewhat by surprise. Russia being more able than expected to circumvent oil sanctions, a mild winter in Europe and a grain deal between Russia and Ukraine were just a few factors that contributed to price dynamics.

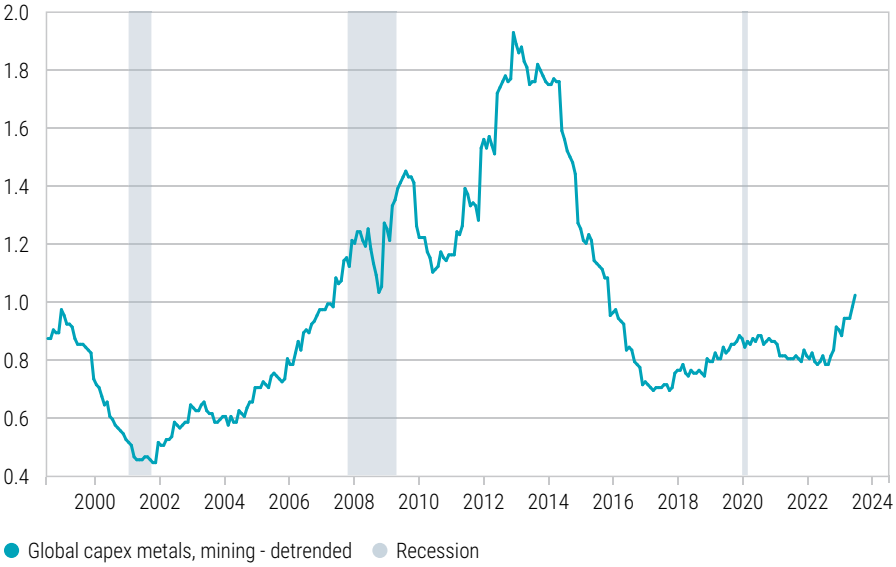
Commodity returns consist of roll return, spot return and cost of carry. There has been an academic debate whether commodity returns embed a risk premium as Keynes argues.[6] A study looking at data from 1871-2018 does find a commodity risk premium of 5.2% annually with a volatility of 28.9%.[7] Nonetheless, the nature of a risk premium in commodities remains controversial and is likely to be time-varying. Net hedging pressure theory states that the futures price of a commodity is equal to the expected spot price of the commodity minus a risk premium. This risk premium can be positive in the case where there is higher demand from producers for hedging, leading them to enter short positions in order to entice speculators to enter long positions. But in case of overwhelming consumer hedging activity, the risk premium can instead become negative.

6. See Keynes, J. (1923).

7. See Bhardwaj, G. , Janardanan, R. and Rouwenhorst, K.G. (2018)

Predicting long-term swings in net hedging pressure to discern the future magnitude of the roll return to be harvested is a tedious exercise. However, zooming in at the spot price component of returns, we do know that commodities are strongly procyclical and positively correlated to the business cycle as well as the inflation cycle. With DM real GDP growth close to trend in our base case, commodity prices have cyclical support. Also, inflation between the 2-3% bracket on average has often positively correlated with commodity prices showing single digit returns. As such, it remains one of the few asset classes where we continue to see above steady-state like returns adding to the diversification benefit that commodities typically offer. Yet, we stick to an overall modest expected return of 4.75% in our base case, generating a 2.25% risk premium versus euro cash.

Figure 5.21: Supply response; capex spending in commodities has surged back to trend



Source: Refinitiv Datastream, Robeco

We think the case for commodities is more compelling in our bull case because developed markets continue to grow above their long-term trend with aggregate demand able to weather higher prices for longer. A lower inelasticity of supply compared to the base case (also as costs of capital for miners and oil producers decline as a result of an accelerated green transition) contributes to a rebalancing in commodity markets. With the supply side contributing, price rises are less explosive and more sustainable as a result. We expect a policy driven push to speed up the green energy transition and in the wake of this demand for 'green metals', i.e. copper, iron ore and aluminium will increase. Steel is the biggest input for windmill producers as it consumes around 84% of each turbine's weight.

According to the IEA, an offshore wind plant requires nine times more mineral resources than a gas-fired plant, while the typical electrical car requires six times the mineral inputs of a conventional car. Electrification requires huge amounts of copper and aluminium. To facilitate the renewable energy transition, there will be a lot of roasting, i.e. smelting of iron ore, copper and alumina, in coming decades. To meet the net zero carbon emission target by 2050, six times more mineral and metal inputs are required compared to today's inputs into renewables. Our bull case sees a benign environment for this procyclical asset class, generating 5.5% in the next five years.

In our bear case, commodities suffer from a fallout in aggregate demand around a potential deep recession somewhere in 2026. Gold will benefit from safe haven flows in an environment of geopolitical turbulence as well as the steep drop in real yields we expect to materialize as inflation remains sticky. In an increasingly fragmented world in this scenario, supply remains relatively inelastic, with the rebalancing between supply and demand predominantly achieved by demand destruction, which fuels commodity prices and inflation even as real growth remains subdued. While growth is significantly below trend, the commodity intensity of economic growth could rise on the back of reshoring and a surge in military expenditures. Still, eyeing cheaper financing costs as real yields decline, commodity producers eventually catch-up with higher supply. Commodities see an overall return of 6% in euro in the next five years.

5.8 Summary

We provide a full overview of our expectations for the main asset classes in our base case scenario in the introduction to this chapter. Here, we show these returns and our expectations for asset class returns in the two other scenarios, both for euro and US dollar investors. We can see that in our bull case scenario we expect further high returns for risky asset classes, whereas our bear case scenario would see negative returns for most riskier asset classes, at least for a euro investor. ●

Table 5.3: Five-year return forecast for three macroeconomic scenarios

	Expected Returns 2024-2028 (EUR)				Expected Returns 2024-2028 (USD)		
	Bull	Base	Bear		Bull	Base	Bear
Bonds							
Domestic cash	2.75%	2.50%	2.25%		3.50%	3.25%	2.50%
Domestic bonds	1.25%	2.50%	4.25%		4.00%	5.25%	4.75%
Developed	3.25%	3.50%	4.25%		4.00%	4.25%	4.50%
Emerging debt	5.50%	4.75%	2.50%		7.25%	5.75%	2.00%
Corporate inv grade	4.25%	4.50%	6.00%		5.00%	5.25%	6.25%
Corporate high yield	5.25%	5.50%	2.00%		6.00%	6.25%	2.25%
Equity							
Developed	11.00%	5.75%	2.75%		12.75%	6.75%	2.25%
Emerging	15.25%	7.25%	5.00%		17.00%	8.25%	4.50%
Real estate	6.00%	5.50%	3.00%		7.75%	6.50%	2.50%
Commodities	5.50%	4.75%	2.50%		7.25%	5.75%	2.00%
CPI							
Inflation	2.00%	2.50%	3.75%		2.00%	2.75%	3.25%

Source: Robeco. September 2023. Returns are geometric and annualized.

The Sustainable Multi-Asset Solutions team

This Expected Returns publication is produced every year by the Robeco Sustainable Multi-Asset Solutions team, with contributions from colleagues from across the company. The 14-strong team's expertise includes strategists, portfolio managers and sustainability specialists, each with an average of 18 years investment experience.

A broad suite of assets globally is managed by the team. This includes multi-asset investment strategies, discretionary multi-asset solutions, and customized liability and buy-and-maintain fixed income solutions.

Strategic and tactical asset allocation

Robeco's approach to multi-asset investing can broadly be split into two approaches: strategic allocation (3-5 years) and tactical asset allocation (0-24 months). These tend not to be correlated to help support diversification and the consistency of returns. This mix helps to safely navigate the potentially tricky waters created by the ever-changing political and economic environment. Put simply, it avoids putting all your eggs in one basket.

The team can also rely on the expertise of Robeco's 50-strong Sustainable Investing Center of Expertise, which houses our sustainability thought leaders and investment researchers. Sustainability can be used to target specific impact metrics, for example in emphasizing exposures to companies scoring well on the Sustainable Development Goals, or those with a good climate alignment strategy.

The research that creates Expected Returns provides the baseplate from which a coherent and forward-looking multi-asset strategy can be developed. The predictions that it makes for the likely returns of all the major asset classes over the coming five years, including commodities, real estate and cash, forms the benchmark from which to proceed.

References

Note that many of the papers listed below are available at scholar.google.com of www.ssrn.com

Literature Chapter 2 – Valuation (p. 12-31)

Adrian, T., Crump, R., and Mönch, E. (2013) "Pricing the term structure with linear regressions", *Journal of Financial Economics* 110(1), pp. 110-138.

Adrian, T., Crump, R., Mills, B., and Mönch, E. (2014) "Treasury term premia: 1961-present", *Liberty Street Economics*.

Asness, C., Moskowitz, T., and Pedersen, L. (2013) "Value and momentum everywhere", Journal of Finance 68(3), pp. 929-985.

Balassa, B. (1964) "The purchasing power parity doctrine: a reappraisal", *Journal of Political Economy* 72 (6), pp. 584–596.

Bunn, O., and Shiller, R. (2014) "Changing times, changing values: a historical analysis of sectors within the US stock market 1872-2013", *NBER working paper* 20370.

Campbell, J. and Shiller, R. (1988) "Stock prices, earnings and expected dividends", *Journal of Finance* 43(3), pp. 661-676.

Campbell, J., Sunderam, A. and Viceira, L. (2017) "Inflation bets or deflation hedges? The changing risks of nominal bonds", *Critical Finance Review* 6 (2), pp. 263-301.

Catanho, R., and Saville, A. (2022) "A modified Shiller's cyclically adjusted price-to-earnings (CAPE) ratio for stock market index valuation in a zero-interest rate environment", *Investment Analysts Journal* 51(1), 49-66.

Chauvet, M. (1998) "An economic characterization of business cycle dynamics with factor structure and regime switching" *International Economic Review* 39, 969-996.

Chauvet, M. and Piger, J. (2008) "A comparison of the real-time performance of business cycle dating methods", *Journal of Business and Economic Statistics* 26, 42-49.

Damodaran, A. (2020) "Equity risk premiums: determinants, estimation and implications", SSRN working paper 3550293.
DeBondt, W., and Thaler, R. (1985) "Does the stock market overreact?", *Journal of Finance* 40, pp. 793–805.

Doeswijk, R., Lam, T., and Swinkels, L. (2014) "The global multi-asset market portfolio, 1959–2012", *Financial Analysts Journal* 70(2), pp. 26-41.

Frankel, J. and Rose, A. (1996) "A panel project on purchasing power parity: mean reversion within and between countries", *Journal of International Economics* 40(1-2), pp. 209-224.

Giannone, D., Reichlin, L., and Small, D. (2008) "Nowcasting: the real-time informational content of macroeconomic data", *Journal of Monetary Economics* 55(4), 665-676.

Harvey, C. (1988) "The real term structure and consumption growth", *Journal of Financial Economics* 22(2), 305-333.

Ilmanen, A., Israel, R., Moskowitz, T., Lee, R., and Thapar, A. (2021) "How do factor premia vary over time? A century of evidence", *Journal of Investment Management* 19(4), 15-57.

Jivraj, F., and Shiller, R. (2017) "The many colors of CAPE", *SSRN working paper* 3258404.

Kim, D., and Wright, J. (2005) "An arbitrage-free three-factor term structure model and the recent behavior of long-term yields and distant-horizon forward rates", *Washington: Board of Governors of the Federal Reserve System*.

Klement, J. (2012) "Does the Shiller-PE work in emerging markets?", *SSRN working paper* 2088140.

Lleo, S., and Ziemba, W. (2019) "Can Warren Buffett forecast equity market corrections?", *European Journal of Finance* 25(4), pp. 369-393.

Molenaar, R., Sénéchal, E., Swinkels, L., and Wang, Z. (2023) "Empirical evidence on the stock-bond correlation", *SSRN working paper* 4514947.

Rabe, C. and Waddle, A. (2020) "The evolution of purchasing power parity", *Journal of International Money and Finance* 109, 102237.

Rogoff, K. (1996) "The purchasing power parity puzzle", *Journal of Economic Literature* 34, pp. 647-668.

Samuelson, P. (1964) "Theoretical notes on trade problems", *Review of Economics and Statistics* 46 (2), pp. 145–154.

Seok, S., Cho, H., and Ryu, D. (2020) "The information content of funds from operations and net income in real estate investment trusts", *North American Journal of Economics and Finance* 51, 101063.

Swinkels, L., and Umlauft, T. (2022) "The Buffett valuation indicator: international evidence", *SSRN working paper* 4071039.

Swinkels, L., and Yang, J. (2023) "The value of emerging markets", Robeco Client Note.

Umlauft, T. (2020) "The market value of equity-to-gross domestic product ratio as a predictor of long-term equity returns: evidence from the U.S. market, 1951-2019", *SSRN working paper* 3551661.

Wright, S. (2004) "Measures of stock market value and returns for the U.S. nonfinancial corporate sector, 1900-2002", *Review of Income and Wealth* 50(4), pp. 561-584.

Literature Chapter 3 – Climate (p. 32-45)

Ardia, D., Bluteau, K., Boudt, K., and Inghelbrecht, K. (2023) "Climate change concerns and the performance of green vs. brown stocks", *Management Science* (forthcoming).

Aswani, J., Raghunandan, A., and Rajgopal, S. (2023) "Are carbon emissions associated with stock returns?", *Review of Finance*, forthcoming.

REFERENCES

Azlen, M., Gostlow, G., and Child, A. (2022) "The carbon risk premium", *Journal of Alternative Investments* 25(1), 33-64.

Balvers, R., Du, D., and Zhao, X., 2016, "Temperature shocks and the cost of equity capital: Implications for climate change perceptions", *Journal of Banking and Finance* 77, 18-34.

Bauer, M., Huber, D., Rudebusch, G., and Wilms, O. (2022) "Where is the carbon premium? Global performance of green and brown stocks", *Journal of Climate Finance* 1, 100006.

Beirne, J., Renzhi, N., and Volz, U. (2021) "Feeling the heat: Climate risks and the cost of sovereign borrowing", *International Review of Economics and Finance* 76, 920-936.

Boehm, S. (2022) "Physical climate change and the sovereign risk of emerging economies", *Journal of Economic Structures* 11, 31.

Boehm, S., Jeffery, L., Levin, K., Hecke, J., Schumer, C., Fyson, C., Majid, A., Jaeger, J., Nilsson, A., Naimoli, S., Thwaites, J., Cassidy, E., Lebling, K., Sims, M., Waite, R., Wilson, R., Castellanos, S., Singh, N., Lee, A., and Geiges, A. (2022). *State of Climate Action 2022*.

Cassidy, E., Lebling, K., Sims, M., Waite, R., Wilson, R., Castellanos, S., Singh, N., Lee, A., and Geiges, A. (2022). *State of Climate Action 2022*.

Bolton, P., and Kacperczyk, M. (2021) "Do investors care about carbon risk?", *Journal of Financial Economics* 142(2), 517-549.

Bolton, P., and Kacperczyk, M. (2023) "Global pricing of carbon-transition risk", Journal of Finance (forthcoming).

Clayton, J., Devaney, S., Sayce, S., and Van de Wetering, J. (2021) "Climate risk and real estate prices: What do we know?", *Journal of Portfolio Management* 47(10), 75-90.

Coqueret, G. and Giroux, T. (2023) "A closer look at the biodiversity premium", *SSRN Working Paper* 4489550.

Engel, R., Giglio, S., Kelly, B., Lee, H., and Stroebel, J. (2020) "Hedging climate change news", *Review of Financial Studies* 33(3), 1184-1216.

Flammer, C., Giroux, T., and Heal, G. (2023) "Biodiversity finance", *NBER Working Paper* 31022.

Garel, A., Romec, A., Sautner, Z., and Wagner, A. (2023) "Do investors care about biodiversity?", *SSRN Working Paper* 4398110.

Giglio, S., Kuchler, T., Stroebel, J., and Zeng, X. (2023)."Biodiversity risk", NBER Working Paper 31137.

Hain, L., Kölbel, J., and Leippold, M. (2023) "Let's get physical: Comparing metrics of physical climate risk", *Finance Research Letters* 46B, 102406.

Hoepner, A., Klausmann, J., Leippold, M., and Rillaerts, J. (2023) "Beyond Climate: The Impact of Biodiversity, Water, and Pollution on the CDS Term Structure", *SSRN Working Paper* 4351633.

Hsu, P., Li, K., and Tsuo, C. (2023) "The pollution premium", *Journal of Finance* 78(3), 1343-1392.

Huij, J., Laurs, D., Stork, P., and Zwinkels, R. (2023) "Carbon beta: A market-based measure of climate transition risk exposure", *SSRN Working Paper* 3957900.

Huynh, T., and Xia, Y. (2021) "Climate change news risk and corporate bond returns", *Journal of Financial and Quantitative Analysis* 56(6), 1985-2009.

Javadi, S. and Masum, A. (2021) "The impact of climate change on the cost of bank loans", *Journal of Corporate Finance* 69, 102019.

Kaya, Y. (1995) "The role of CO2 removal and disposal", *Energy Conversion and Management* 36(6-9), 375-380.

Koekkoek, R., and Swinkels, L. (2023) "Better decarbonization incentives with a shorter bond maturity profile", Robeco Client Note.

Markwat, T., and Swinkels, L. (2023) "Corporate carbon emissions data for equity and bond portfolios", *SSRN Working Paper* 4346300.

Mastouri, A., Mendiratta, R., and Giese, G. (2022) "Corporate bonds and climate change risk" *Journal of Portfolio Management* 48(10), 78-97.

Lomborg, B. (2020) "Welfare in the 21st century: Increasing development, reducing inequality, the impact of climate change, and the cost of climate policies", *Technological Forecasting and Social Change* 156, 119981.

Penn, M. (2022a) "Kaya and the climate trilemma", *Absolute Strategy Research*.

Penn, M. (2022b) "Assessing climate impacts on growth", *Absolute Strategy Research*.

Penn, M. (2023) "The underinvested energy transition", *Absolute Strategy Research*.

Rebonato, R., Kainth, D., and Melin, L. (2022) "Climate output at risk", *Journal of Portfolio Management* 48(10), 46-59.

Sautner, Z., Van Lent, L., Vilkov, G., and Zhang, R. (2023) "Pricing climate change exposure", *Management Science* (forthcoming).

Stroebel, J., and Wurgler, J. (2021) "What do you think about climate finance?", *Journal of Financial Economics* 142(2), 487-498.

Swinkels, L. and Yang, J. (2023) "Investing in carbon credits" Journal of Alternative Investing (forthcoming).

Literature Special topic – Emerging markets (p. 48-56)

Cakici, N., Fieberg, C., Metko, D., Zaremba, A. (2023) "Machine learning goes global: Cross-sectional return predictability in international stock markets", *SSRN Working Paper* 4141663.

De Groot, W., Pang, J., and Swinkels, L. (2012) "The cross-section of stock returns in frontier emerging markets", *Journal of Empirical Finance* 19(5), 796-818.

Fama, E., and French, K. (2018) "Choosing factors", *Journal of Financial Economics* 128(2), 234-252.

Hanauer, M., and Kalsbach, T. (2023) "Machine learning and the cross-section of emerging market stock returns", *Emerging Markets Review* 55, 101022.

Leippold, M., Wang, Q., and Zhou, W. (2022) "Machine learning in the Chinese stock market", *Journal of Financial Economics* 145(2), 64-82.

REFERENCES

Van der Hart, J., Slagter, E., and Van Dijk, D. (2003) "Stock selection strategies in emerging markets", *Journal of Empirical Finance* 10(1-2), 105-132.

Windmüller, S. (2022) "Firm characteristics and global stock returns: A conditional asset pricing model", *Review of Asset Pricing Studies* 12(2), 447-499.

Literature Special topic – R-star (p. 57-63)

Arena, M. et al. (2020) "It is only natural: Europe's low interest rates", *IMF Working Paper* 20/116.

Bailey, A. (2022) "The economic landscape: structural change, global R* and the missing-investment puzzle", speech OMFIF.

Brand, C. et. al. (2018) "The natural rate of interest: estimates, drivers, and challenges to monetary policy", *ECB occasional paper* No 217.

Cesa-Bianchi, A. et al. (2022) "Decomposing the drivers of Global R*", *BoE Staff Working Paper* No. 990.

Clarida, R. (2019) "The global factor in neutral policy rates: some implications for exchange rates, monetary policy, policy coordination", *Board of Governors of the Federal Reserve System* number 1244.

Del Negro et al. (2019) "Global trends in interest rates", *Journal of International Economics*, vol. 118, issue C.

Eggertsson, G. et al. (2019) "A model of secular stagnation: Theory and Quantitative evaluation", *American Economic Journal*: Macroeconomics 2019.

Ferreira, T. and C. Davin (2022) "Longer-run neutral rates in major advanced economies", *FEDS Notes*.

Gopinath, G. (2022) "How will the pandemic and the war shape future monetary policy?", Presentation by IMF.

Guofeng Sun and D. Rees (2021) "The natural interest rate in China", *BIS working paper* No. 949.

Rachel, L. and L Summers (2019) "On secular stagnation in the industrialized world", *NBER Working Paper* 26198.

Rafiq, S. (2021) "What's in the (R)-Stars for Korea", *IMF Working Paper* 21/93.

Ruch, F. (2021) "Neutral real interest rates in inflation targeting emerging and developing economies", *World Bank Policy Research Working Paper* 9711.

Literature Special topic – SDGs (p. 64-71)

Adler, M. (1983) "Global fixed-income portfolio management", *Financial Analysts Journal* 39(5), 41-48.

Gaspar, V., Amaglobeli, D., Garcia-Escribano, M., Prady, D., and Soto, M. (2019) "Fiscal policy and development: human, social, and physical investment for the SDGs", *IMF Staff Discussion Note* 3.

Gratcheva, E.M., Gurgy, B., Emery, T., Wang, D., Oganes, L., Linzie, J.K., Harvey, L., Marney, K., Murray, J., & Rink, R. (2021) *A New Dawn: rethinking Sovereign ESG*. Washington, DC: World Bank.

Piljak, V., and Swinkels, L. (2017) "Fundamental indexation for developed, emerging, and frontier government bond markets", *Journal of Asset Management* 18, 405-420.

Sachs, J., Lafortune, G., Kroll, C., Fuller, G., and Woelm, F. (2022) *Sustainable Development Report 2022. From Crisis to Sustainable Development: the SDGs as Roadmap to 2030 and Beyond*. Cambridge: Cambridge University Press.

Ten Bosch, E., Van Dijk, M., and Schoenmaker, D. (2022) "Do the SDGs affect sovereign bond spreads? First evidence", *SSRN Working Paper* 4006375.

Van Zanten, J., Sharma, B., and Christensen, M. (2021) "Sustainability integration for sovereign debt investors: engaging with countries on the SDGs", *Journal of Sustainable Finance and Investment,* forthcoming.

Van Zanten, J., Swinkels, L., Scholten, R., and Schieler, M. (2023) "Integrating the Sustainable Development Goals in government bond investment strategies ", *SSRN working paper* 4365013.

Literature Special topic – Thematic investing (p. 72-79)

Bergakker, S. (2017) "When paying a high multiple makes sense," Robeco.

Bessembinder, H. (2020) "Wealth Creation in the U.S. Public Stock Markets 1926 to 2019", Arizona State University.

Bessembinder, H. (2021) "Stock Market Winners: Conditional Probabilities, Elapsed Times, and Post-Event Returns", Arizona State University.

Bessembinder, H. (2023) "Long-term shareholder returns: Evidence from 64,000 global stocks", Arizona State University.

Blitz, D. (2021) "Betting against Quant: Examining the Factor Exposures of Thematic Indexes," *Journal of Index Investing.*

Mauboussin, M. (2015) "Managing the Man Overboard Moment", Credit Suisse.

Munger, C. (1995) "A lesson on elementary, worldly wisdom as it relates to investment management and business", Berkshire Hathaway.

Preston, H. (2023) "Contextualizing Style Shifts", S&P Global.

Literature Chapter 4 – Macro (p. 80-99)

Algan, Y. and Cahuc, P. (2014) "Trust, growth and well-being: New evidence and policy implications", in Aghion, P. and Durlauf, S. (eds.), *Handbook of Economic Growth*, Vol. 2, Elsevier, North Holland, Amsterdam, pp. 49-120.

Altman, S.A., and Bastian, C.R. (2023) " Don't overestimate shifts from globalization to regionalization", Industrial Analytics Platform (unido.org).

REFERENCES

Andrews, D., Nicoletti, G. and Timiliotis, C. (2018) "Digital technology diffusion: A matter of capabilities, incentives or both?", *OECD Economics Department Working Papers*, No. 1476, OECD Publishing, Paris.

Ari, A., Garcia-Macia, D., and Mishra, S. (2023) "Has the Phillips Curve Become Steeper?" *IMF Working Paper*, WP/23/100.

Arriola, C., Kowalski, P. and Van Tongeren, F. (2021) "The impact of COVID-19 on directions and structure of international trade", *OECD Trade Policy Papers*, No. 252, OECD Publishing, Paris.

Arrow, K.J. (1972) "Gifts and Exchanges", *Philosophy & Public Affairs*, Vol. 1(4), pp. 343-362.

Baker, S. R., Bloom, N., and Davis, S. J. (2016) "Measuring Economic Policy Uncertainty", *The Quarterly Journal of Economics*, 131, 1593-1636.

Bedowska-Sojka, B., Demir, E. and Zaremba, A. (2022) "Hedging Geopolitical Risks with Different Asset Classes: A Focus on the Russian Invasion of Ukraine". Available at SSRN: https://ssrn.com/abstract=4085689.

Bernanke, B. and Blanchard, O. (2023) "What Caused the U.S. Pandemic-Era Inflation?", conference draft, Bernanke-Blanchard-conference-draft_5.23.23.pdf (brookings.edu).

Blanchard, O. (2019) "Public Debt and Low Interest Rates", *American Economic Review*, 109 (4): 1197-1229.

Branten, E., Lamo, A. and Room, T. (2018) "Nominal Wage Rigidity in the EU Countries Before and after the Great Recession: Evidence from the WDN Surveys". ECB Working Paper No. 2159, Available at SSRN: https://ssrn.com/abstract=3199722.

Brooks, S., and Wohlforth, W. (2023) "The Myth of Multipolarity", Foreign Affairs, 102, 76-91.

Cacares, C. (2019) "Analyzing the Effects of Financial and Housing Wealth on Consumption using Micro Data", IMF working Paper 19/115.

Calvino, F. and Fontanelli, L. (2023) "A portrait of AI adopters across countries: Firm characteristics, assets' complementarities and productivity," OECD Science, Technology and Industry Working Papers 2023/02, OECD Publishing.

Cochrane, J.H. (2020) "The Value of Government Debt", Hoover Institutions, Economics Working Paper 20107.

Conlon, C., Miller, N.H. and Otgon, T., Yao, Y. (2023) markups_pnp.pdf (chrisconlon.github.io).

De Loecker, J., Eeckhout, J. and Unger, G. (2020) "The rise of market power and the macroeconomic implications", *Quarterly Journal of Economics*, Oxford University Press.

Edelman Trust barometer (2023) 2023 Edelman Trust Barometer Global Report FINAL.pdf

Hajdini, I. (2023) "Trend Inflation and Implications for the Phillips Curve", (clevelandfed.org).

Glover, A, Mustre-del-Rio, J. and Von Ende-Becker, A. (2023) "How Much Have Record Corporate Profits Contributed to Recent Inflation?," Economic Review, Federal Reserve Bank of Kansas City, vol. 0(no.1), pages 1-13, January.

Lowry, M. B. (2023) "The Blurring Lines between Private and Public Ownership", European Corporate Governance Institute – Finance Working Paper No. 844/2022, Available at SSRN: https://ssrn.com/abstract=4200794.

Suthaharan, N. and Bleakly, J. (2023) "Wage-price Dynamics in a High-inflation Environment: The International Evidence", Bulletin – September 2022, RBA.

Literature Chapter 5 – Asset classes (p. 100-122)

Ang, A., 2014. *Asset management: a systematic approach to factor investing*. Oxford: Oxford University Press.

Baltussen, G., Swinkels, L., and Van Vliet, P., 2022, "Investing in deflation, inflation, and stagflation regimes", *SSRN working paper* 4153468.

Banerjee, R., and Hofmann, B., 2018, "The Rise of Zombie Firms: Causes and Consequences", *BIS Quarterly Review*

Bansal, R., and Yaron, A., 2004, "Risks for the Long Run: A Potential Resolution of Asset Pricing Puzzles", *Journal of Finance* 59(4), 1481-1509.

Bhardwaj, G., Janardanan, R. and Rouwenhorst, K. G. (2019) "The Commodity Futures Risk Premium: 1871–2018", Available at SSRN: https://ssrn.com/abstract=3452255.

Bolt, J., and Van Zanten, J., 2020, "Maddison style estimates of the evolution of the world economy. A new 2020 update", *Maddison-Project working paper* 15.

Eckstein, D., Künzel, V., and Schäfer, L. (2021) "Global Climate Risk Index 2021", *GermanWatch Briefing Paper*.

Glascock, J.L. (1991) "Market Conditions, risk and real estate portfolio returns: some empirical evidence" *The Journal of Real Estate Finance and Economics* 4: 367-374.

Keynes, J. (1923) "Some aspects of commodity markets. Manchester Guardian Commercial", 13, 784– 786.

McGowan, M., Andrews, D., and Millot, V., 2018, "The walking dead? Zombie firms and productivity performance in OECD countries", *Economic Policy* 33(96), 685-736.

Molenaar, R., Senechal, E., Swinkels, L. and Wang, Z. (2023) "Empirical evidence on the stock-bond correlation". Available at SSRN: https://ssrn.com/abstract=4514947.

Smith, A. and Valcarcel, V., 2022, "The financial market effects of unwinding the Federal Reserve's balance sheet", *Federal Reserve Bank of Kansas City research working paper*.

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