Climate scenarios, climate risk and developed-market sovereign bonds: an evolving science

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Executive summary

- Until now, abrdn's climate scenario analysis has largely focused on asset classes in which valuations are largely derived from future corporate earnings streams: listed equities and corporate bonds.
- But there is growing demand to extend these insights to sovereign bonds. This is because of the large share of total assets under management that these bonds account for, as well as the growing requirements for asset owners to account for the climate risks embedded in their sovereign-bond portfolios.
- Our main takeaway from the climate scenario exercises undertaken so far is that a lot more development is required before frameworks are ready to be integrated into mainstream developed-market investment processes. This is for four main reasons:

01	The potential effects of only a limited number of stylised long-term 'tail' scenarios have been analysed, rather than the most likely pathways for climate policy;
02	These tail scenarios are largely not benchmarked against counterfactuals based on the climate-policy pathways we think are being priced into the market;
03	The reaction functions of central banks to climate-related shocks baked into modelling exercises are simplistic; and
04	The modelling does not adequately capture some of the important cross-market differences in growth and inflation pathways, and hence the outlook for policy and market interest rates.

- In future exercises, we intend to work with our modelling partner, Planetrics, to overcome some of these deficiencies. Nevertheless, when making a qualitative assessment of how more plausible assumptions about probable future climate policies would be likely to interact with growth, inflation and central-bank policy settings, we think that, for most of the major sovereign developed bond markets, climate effects are likely to have a relatively modest effect on average yields over the longer term.
- Of course, for some highly fossil-fuel-dependent or transition-metal-exporting emerging markets for which, this may not be true. For example, the effects of the intersection between macroeconomic outcomes and the nature of the global energy transition are likely to be especially strong for Middle Eastern oil and gas exporters. On the flip side, the critical role of copper in the electrification of the vehicle sector has the potential to generate large, long-term macroeconomic benefits in Chile. We will explore these effects in more depth in follow-up work.
- In the meantime, from a developed-market bond perspective, our rates team believe that asset managers can play a more effective role in encouraging efficient and effective climate-risk mitigation by developing new ESG and climate-related products. This offers asset owners the opportunity to invest in a more impactful way by considering not just the climate risks but the understanding and appreciation of these risks by policy-makers, and the policy environments and frameworks that are implemented to address such risks.

Subjecting sovereign bonds to highly stylised stresses

Climate scenario analysis is being extended to the sovereign-bond universe primarily through the Bank of England's (BoE's) **Climate Biennial Exploratory Scenario (CBES)** process. Under CBES, the Bank specifies a counterfactual (or baseline) scenario for the path of policy rates and hence the term structure of interest rates, and then analyses the effect of three additional scenarios relative to that baseline. This baseline is defined as the pathway for the key variables that would occur in the absence of climate-transition or physical risks.

The BoE believes that an Early Action scenario – in which an orderly global policy transition towards net-zero emissions by 2050 begins immediately – is likely to be the least disruptive to the global economy, though transition risks facing individual firms and economic sectors would still be immediate and large. This is why, in the BoE's analysis, the pathway of central-bank policy rates under this scenario are identical to the baseline (Figure 1).

The first alternative scenario generating a different pathway for policy rates is a Late Action scenario. Here the policy transition does not begin until 2031, and temperature increases are limited to 1.8 degrees above pre-industrial levels by the end of the scenario. Again, physical risks are limited while transition risks are initially delayed but ultimately much larger, with more stranded assets and a recession beginning soon after policy begins ramping up.

Finally, the second alternative scenario is one in which Current Policies are sustained over the very long term. This, along with the assumption in the scenario that warming impacts occur at the 90th percentile of the probability distribution, means that physical risks are very high while transition risks are very low. Under this scenario, global temperatures rise by 3.3 degrees by the middle of the century and 4.1 degrees by the end of the century.

The Bank translates these scenarios into changes in sovereign-bond valuations in four steps:

01	The scenarios are converted into specific transition and physical risks, like changes in carbon prices, energy intensity, damages from extreme weather and agricultural productivity;
02	These are then translated into macro shocks, primarily through the supply side of the economy;
03	These macro shocks generate changes in policy and market interest rates through their effects on economic activity, inflation, neutral real interest rates and the assumed reaction function of central banks to those effects; and
04	Finally, changes in bond yields are used to calculate changes in bond prices in each scenario.

Delayed policy action leads to the greatest variation in government bond yields

In the Bank's work, the assumption that the policy rate in the Early Action scenario follows that of the baseline is critical to interpreting the results (Figure 1). This is because yields in the other two scenarios are expressed relative to that baseline. And while the baseline is not referred to as the scenario that is being priced by the market or the Bank's view of the most likely long-run pathway for the economy, it does de facto play that role because the Bank provides no other reference scenarios as part of the exercise.

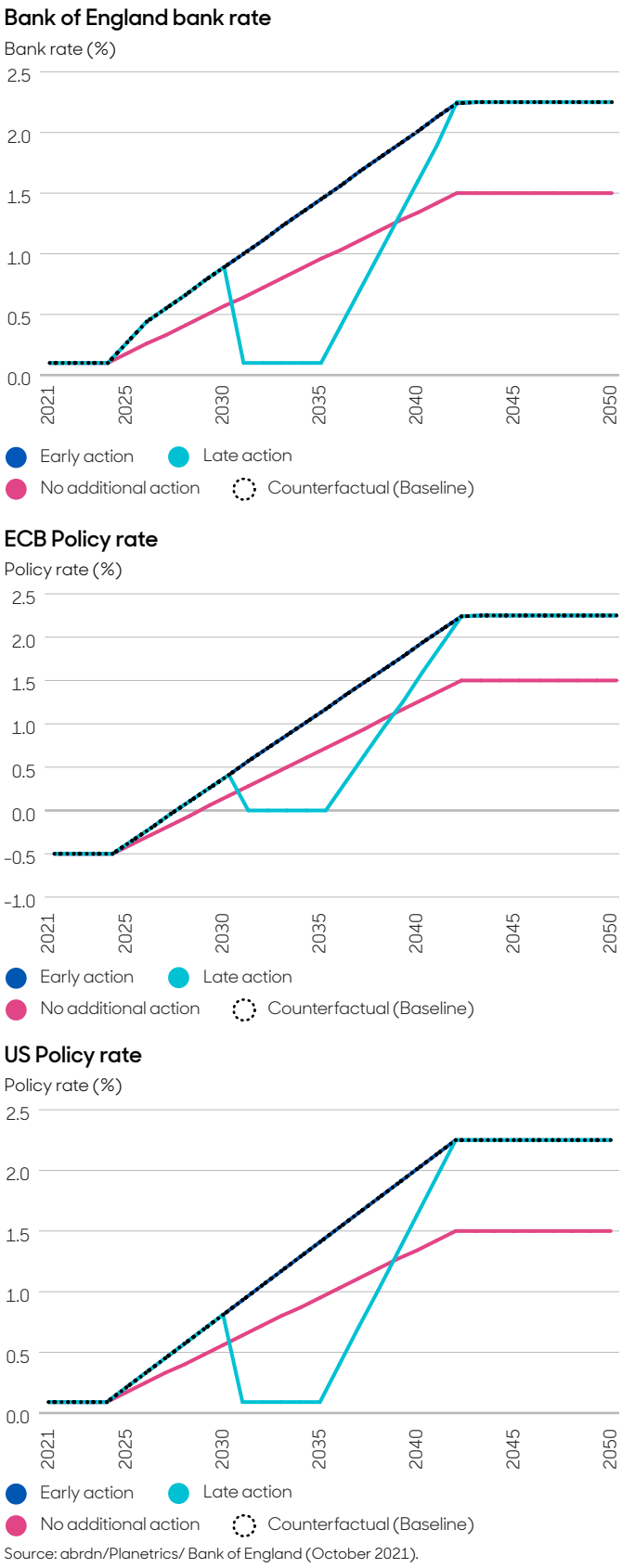
With respect to UK policy rates and gilt yields, the Bank's modelling implies that Bank rate only starts to rise in 2024, rises gradually towards 1% just after 2030 and then reaches a peak of 2.25% in the early 2040s. Very similar pathways are implied for the European Central Bank (ECB) and the US Federal Reserve (Fed), though the starting point for the ECB is lower because yields are currently negative (Figure 1). Moreover, this exercise assumes an identical terminal yield in all three markets.

The path for Bank rate is lowest in the Current Policy scenario. Though rates 'lift off' at the same time as under Early Action, they climb more slowly, only reaching and terminating at 1.5% by the early 2040s.

Conversely, the path for Bank rate is much more variable under the Late Action scenario. Bank rate follows the same path as Early Action until 2030, and then drops back towards zero for five years, before climbing back to the same rate as under Early Action by the early 2040s.

Projections are offered as opinion and are not reflective of potential performance. Projections are not guaranteed and actual events or results may differ materially.

Figure 1: Policy rates under the CBES scenarios.



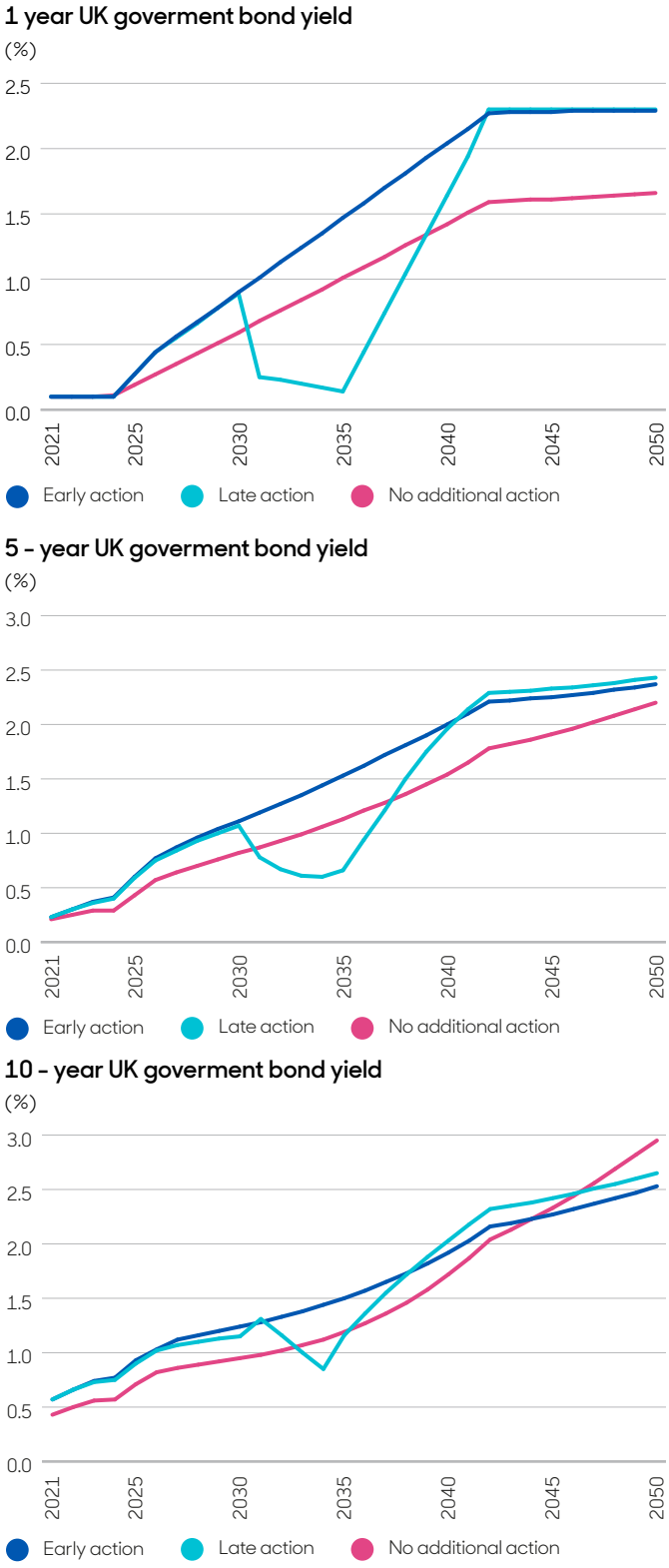
Source: abrdn/Planetrics/ Bank of England (October 2021).

This pathway is derived from the assumption that, under Late Action, governments impose a heavily restricting carbon price that forces the economy into a recession through the early 2030s. And though consumer-price inflation rises precipitously during that same period, the reaction function is assumed to respond to the growth shock rather than the inflation shock, with subsequent policy tightening bringing inflation back down to the Bank's target by 2040.

The reason why the path of Bank rate is lowest under the Current Policy scenario is because it is associated with the weakest GDP growth and hence the lowest neutral real interest rate. Physical climate change is assumed to have no meaningful effect on inflation in this scenario.

As one would expect, the 10-year yield evolves in a much smoother pattern through this modelling as it is effectively assumed to evolve in line with the 10-year moving average of Bank rate (Figure 2).

Figure 2: Indicative paths for UK government bond yields under the CBES scenarios



Source: abrdn/Planetrics/ Bank of England (October 2021).

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Mind the methodological gaps

We recommend that these CBES results be interpreted with extreme care for the following reasons:

- The modelling assumptions were finalised before the recent spurt of inflation, so the implied pathway of Bank rate is no longer consistent with the guidance of the Bank's Monetary Policy Committee and our own projections.
- We do not think that it is reasonable to assume that the long-term neutral nominal and real interest rate is identical in the UK, Euro Area and US economies.
- The pathway of Bank rate in the Late Action scenario is hard to square with a typical central-bank reaction function. Though the increase in carbon prices is specified as a negative supply shock that pushes output down and inflation up, the Bank is assumed to cut real interest rates aggressively and then take a decade to return the policy rate to its previous path.
- Most importantly, we think that these scenarios are quite limiting in terms of how they allow us to think about Bank rate and gilt yields under more plausible scenarios and emissions pathways, including the short-run dynamics that influence market pricing.

As outlined earlier, the path for policy rates is identical in the baseline and Early Action scenarios. But in our own bespoke analysis, we regard this scenario as extremely unlikely given the current outlook for global climate policies. Indeed, the three scenarios included in the CBES exercise collectively hold a weight of less than 5% in our analysis (Figure 3). In other words, we regard these as tail risks rather than likely pathways.

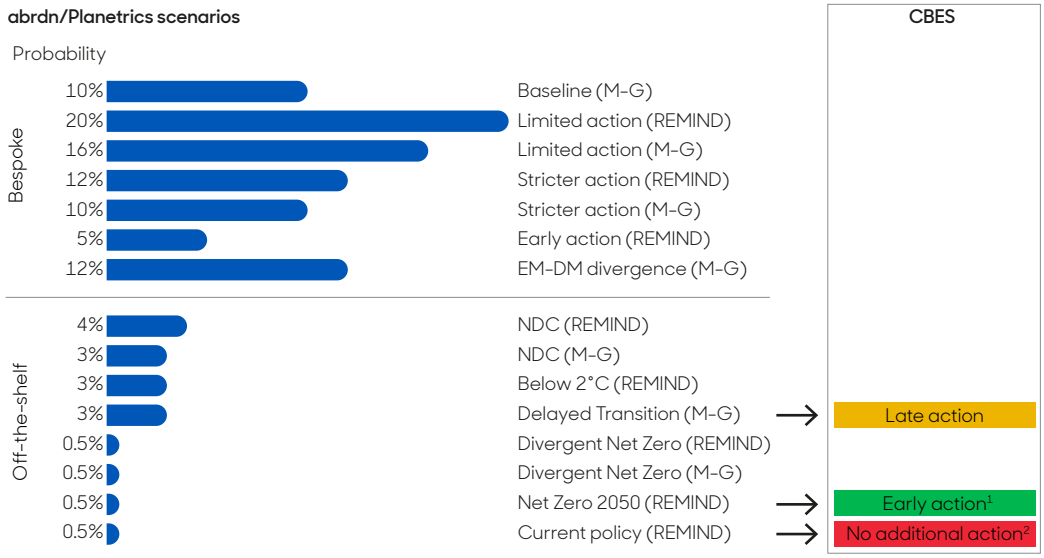
Critically, if bond investors' primary challenge is to consider their outlook for rates relative to what is in the price, it would be much better to specify a climate scenario that better reflects what investors are assuming about future climate policies and emissions pathways.

And on that front, we think that the scenarios closest to what is in the price are those assuming some further climate-policy action but not enough to hold warming to below 2 degrees. Our 'mean' bespoke scenario represents a moderately faster rate of emissions reduction than the market-implied baseline.

At this point, it is worth acknowledging the very different purposes of the CBES exercise and abrdn's exercises. CBES is primarily focused on stress tests, so it makes sense for it to focus on those scenarios that generate the most stress. We, on the other hand, are more focused on investment integration and thus scenarios that map most closely to what the future is likely to be, compared with what is being priced in.

In our listed-equity and corporate-credit scenario results, we have been able to overcome these deficiencies by specifying a more accurate baseline and then more plausible alternative pathways for global climate policies. Unfortunately, it is not yet possible to remodel the sovereign-bond results within this framework.

Figure 3: CBES scenarios mapped to abrdn/Planetrics scenarios



Source: abrdn/Planetrics (December 2021).

Projections are offered as opinion and are not reflective of potential performance. Projections are not guaranteed and actual events or results may differ materially.

[1] Physical risks assumed to be sane as Late action.

[2] Physical risks accelerated 30 years.

More plausible climate scenarios would be likely to have modest effects on yields

We have to be very careful about extrapolating the conclusions from our bespoke process to a counterfactual sovereign analysis.

But our working assumption is that there would be only a small difference between what is currently in the price of gilt yields and the path implied by our mean scenario. The differences in average economic growth would be a little higher in our mean scenario, with underlying inflation also a little higher on average as the rate of carbon-price increases relative to the baseline would be modest, and with a declining incidence as the carbon intensity of the economy declined moderately over time.

The upshot is that extreme assumptions about climate-policy change do have the potential to alter the implied fair value of gilts today and their path in the future. However, more reasonable assumptions about the future, based on what is likely rather than tail risks, yield the conclusion that climate transition and physical effects are likely to be very small contributors to the those pathways, and swamped by the other factors influencing the trajectories of economic growth and inflation.

There are some markets for which that might not be true – in particular, much more carbon-intensive economies and, especially, large fossil-fuel producers – but these will be the exception rather than the rule.

In our Year 3 exercise, we hope to be able to correct for the constraints imposed by the CBES framework and translate our bespoke analysis into the sovereign realm.

"The upshot is that extreme assumptions about climate-policy change do have the potential to alter the implied fair value of gilts today and their path in the future."

The developed-market-bond investor's perspective

The demand to take climate risks into account in sovereign-bond investing is growing rapidly, especially among asset owners for whom sovereigns account for a large share of their aggregate portfolios. These sovereign exposures are increasingly falling within the climate-regulation net.

However, this needs to be undertaken in a very nuanced way. Climate effect can affect asset values through two main channels – climate risk and climate-risk mitigation. For asset classes in which valuations are derived from market expectations of the discounted value of future earnings streams, these two channels work in the same direction.

For example, a firm exposed to significant costs or risks from the energy transition or physical climate change should be valued more punitively than an otherwise similar company that faces lower costs. Likewise, for two companies facing identical risks to their business, the company that is recognised as mitigating those risks better should be more richly valued.

But in sovereign bonds, these two channels will typically work in opposite directions. The major drivers of the yield on a sovereign bond denominated in that country's own currency are changes, or expected changes, in growth, inflation and central-bank policy rates, over the duration of the bond.

To illustrate why, consider a climate-related disaster severe enough to lower expected growth and inflation, and lead to an easing of monetary policy in a particular country. In this example, as long as the event doesn't alter investors' perception of default risk, the yield on the associated sovereign bond should decline and increase the immediate return to the investor.

However, the sign and magnitude of the effect of countries taking mitigating actions is more ambiguous. A country taking bold steps to invest in green infrastructure might see a near-term decline in its credit metrics while also ushering in a higher and more sustainable medium-term growth path for the economy. Both effects could lead to higher bond yields and lower mark-to market returns for the existing holder.

It is thus primarily through the lens of expected growth, inflation and policy changes that sovereign-bond holders must view climate-related risks. And though there are risk-modelling frameworks that can assess such risks on 2, 5 or 10-year timeframes, except in the most extreme circumstances, changes in sovereign yields will be largely driven by more easily understood, traditional macro factors affecting expectations.

The upshot is that abrdn's developed-market rates team strongly agrees with the conclusions of their colleagues in the abrdn Research Institute. The climate scenarios presented by the BoE stand at the periphery of the probability distribution. The interplay between these climate inputs and economic and policy setting is somewhat simplistic. And we would expect non-climate factors to primarily dictate the paths of growth, inflation and thus monetary policy in the future.

Where we think sovereign-bond asset managers can play a role in effecting efficient and effective climate-risk mitigation is through product development. In this way, we can offer our clients and investors the opportunity to invest in a more impactful way. We can do this by considering not only the climate risks themselves but also the understanding and appreciation of those risks by policy-makers, and the policy environments and frameworks that are implemented to address them. The resultant products can therefore be much more explicit about where and how these social-responsibility considerations may affect expected returns.

"The demand to take climate risks into account in sovereign bond investing is growing rapidly, especially among asset owners for whom sovereigns account for a large share of their aggregate portfolios."

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