Building climate-aware stress tests

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INTRODUCTION

Climate change is perhaps the biggest challenge of the age. Tackling man-made global warming and preventing catastrophic temperature increases will touch every sector of the economy. As investors, we all need to be prepared to adapt and make changes to our portfolios to ensure we're positioned as economies are progressively de-carbonised. Insurance companies are no different, with climate change creating three main risks for insurance balance sheets:

- Underwriting risk
- Market risk
- Credit risk

Many insurers now include climate risks in their investment process, and there is a move across the industry to commit to "net zero" carbon emissions in the coming years. Furthermore, insurers are also facing increasing pressures from regulators to include environmental, social and governance (ESG) issues as part of their balance sheet management.

The UK's Prudential Regulation Authority (PRA) and the Dutch central bank were the first in Europe to request a formal assessment of risks from climate change in 2019 and 2018 respectively. In 2021, the European Insurance and Occupational Pensions Authority (EIOPA) set out its own expectations on the integration of climate change risk scenarios as part of insurers' own risk solvency assessments (ORSAs).

There are several areas where insurers can incorporate ESG factors and account for climate risk on the asset side of their balance sheets. ESG criteria could be filtered in the strategic asset allocation stage of the asset liability management function. Insurers could integrate ESG analysis into their portfolio management by excluding certain sectors, implementing positive tilts towards sustainable companies and by monitoring investments for carbon emissions. Finally, insurers can also look to regularly stress test their portfolios based on a range of climate risk scenarios.

In this paper we focus on the last of these areas: stress testing portfolios for climate risk. First, we consider a methodology that insurers can use to measure the sensitivity of their balance sheets to climate change based on the Bank of England's stress testing framework. We then look at the limitations of the stress test framework and how it could be applied to insurance balance sheets. Finally, we apply the Bank of England climate risk scenarios to estimate the potential impact on asset class valuations and insurance solvency ratios by country.

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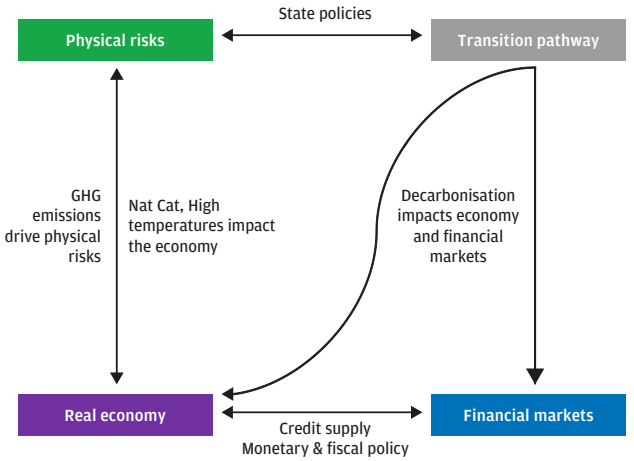
STRESS TESTING FOR CLIMATE RISK

To stress test for climate risk, insurers first need to build a coherent picture around the transition away from a reliance on fossil fuels. This top-down analysis needs to include all major potential macroeconomic scenarios and incorporate all the main physical climate risks. Insurers can then analyse their portfolios from the bottom up, assessing the impact of each macroeconomic scenario on every individual portfolio component to understand the present value impact on security pricing.

We are still in the early days of stress testing for climate risk using this two-pronged approach. In April 2021, European Insurance and Occupational Pensions Authority (EIOPA) published a set of expectations on the integration of climate change risk scenarios, recommending insurers test portfolios for climate scenarios based on global temperatures rising no more than 2-degrees Celsius higher than pre-industrial levels[1], and temperatures rising more than two degrees over multiple time periods (five to 10 years, 30 years and 80 years).

Indeed, no more than 13% of insurers currently make any reference to climate scenarios in their solvency assessments[2]. One of the reasons for the low take-up is that defining effective stress test scenarios is proving extremely difficult, as there are so many variables to consider when it comes to climate change (**EXHIBIT 1**).

EXHIBIT 1: THE INTERACTION OF PHYSICAL AND ECONOMIC VARIABLES IN CLIMATE MODELLING



Source: J.P. Morgan Asset Management. For illustrative purposes only.

[1] The Paris Agreement reached at the COP21 Conference of the Parties in Paris in 2015 aims to keep global temperatures well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

[2] EIOPA, Opinion on the use of climate change risk scenarios in ORSA, April 2021

THE BANK OF ENGLAND STRESS TESTING FRAMEWORK

One of the most comprehensive attempts to define scenarios and risks for climate stress tests has come from the Bank of England. In 2021, the UK central bank conducted its Climate Biennial Exploratory Scenario (CBES), which is designed to help participants estimate their financial exposures to broad climate risks, covering both assets and liabilities.

The Bank of England's analysis is mainly aimed at the largest banks and insurers in the UK, which are obligated to participate in the study (covering over 60% of the market by asset size and gross written premiums). However, the CBES can also serve as a basis for all insurers looking to stress test their balance sheets for climate risks.

ASSESSING CLIMATE RISK

Assessing climate risk is a tricky endeavour, as the physical and transition components of the risk are somewhat interlinked and past observations will not accurately reflect future climate conditions. Notwithstanding these challenges, the Bank of England's CBES attempts to provide a first glimpse at the impact of climate change on balance sheets by mapping physical and transition risks over the next 30 years.

Physical risks have an acute component associated to the impact of climate change on the frequency and severity of extreme weather events (such as floods and fires), as well as a chronic component associated to longer-term shifts in climate patterns (such as rising sea levels).

The CBES assesses physical climate risks from a synthesis of the latest research and using the output of a range of tools, providing high-level benchmark hazard indicators covering the following chronic/acute risk parameters:

- Temperature increase (mean and max)
- Precipitation
- Sea-level rise
- Windstorm frequency/severity
- Agricultural yield levels
- Heatwave frequency/severity
- Soil moisture levels

Optional, open-source climate data is also provided to encourage more granular analyses.

The severity of physical climate risks will be impacted by the speed, intensity and characteristics of the shift to low-carbon technologies. These transition risks, resulting from the implementation of government policy and regulatory action to limit the rise in global temperatures, as well as market changes induced by the shift to a low-carbon economy, will also impact the profitability of businesses and the functioning of the broader economy.

STRESS TEST SCENARIOS

The CBES stress testing framework assesses the interplay between the physical and transition risks of climate change by leveraging a subset of the climate scenarios produced by the Network for Greening the Financial System (NGFS). The NGFS models are produced in partnership with leading climate scientists and leverage climate-economy models that are widely used by policymakers around the world.

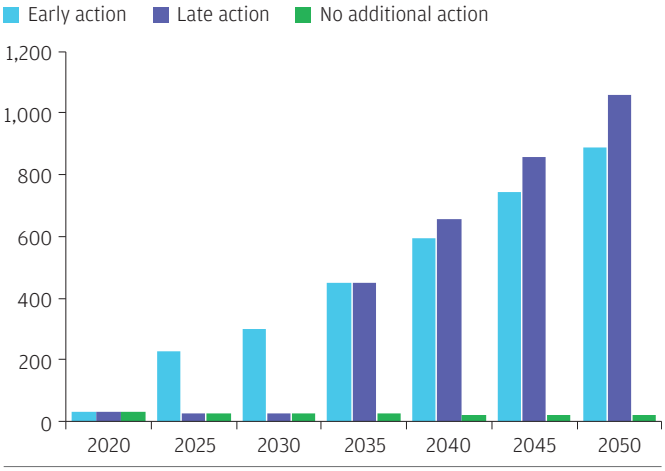
For the CBES, the Bank of England has focused on three plausible future pathways for carbon transition:

1. **EARLY ACTION** The transition to net-zero starts in 2021, with global carbon dioxide emissions reaching net-zero by 2050.
2. **LATE ACTION** The start of the transition is delayed to 2030, with global net-zero still achieved by 2050, but in a disorderly fashion.
3. **NO ACTION** Physical climate risks are explored if no new climate policies are introduced by 2050 (calibrated for the 2050-2080 period).

In each of these pathways, the reduction in emissions is expressed through carbon pricing, given that carbon trading schemes and carbon taxes are the main tools available to governments to reduce emissions, and are a central discussion point for COP 26 in November 2021 (**EXHIBIT 2**).

The *Early Action* and *Late Action* scenarios reflect the estimated rise in carbon prices required to transition to net zero emissions and limit global warming to 1.8 degrees Celsius by 2050 relative to pre-industrial levels. Both scenarios reduce the severity of long-term physical climate risks, but carbon prices would be expected to rise further and more sharply in the *Late Action* scenario, particularly as 2050 approaches, as delaying transition would require emissions to be reduced from a higher starting point and a much faster pace.

EXHIBIT 2: CARBON PRICE IMPACT BY SCENARIO (USD2010/T CO2)



Source: Bank of England; data as of June 2021.

In the *No Action* scenario, there is no increase carbon pricing and the concentration of greenhouse gases in the atmosphere continues to increase, leading to global warming of 3.3 degrees Celsius compared to pre-industrial levels. In this scenario, the physical effects of climate change on the economy are expected to be much more severe than when action is taken, with many changes irreversible and lasting well beyond the end of the scenario review period (2050).

CLIMATE MODELLING

According to the Intergovernmental Panel on Climate Change (IPCC), every degree of global warming leads to a 1.2 % annual reduction in global real GDP[3]. Keeping the temperature rise above pre-industrial levels below 1.5 degrees Celsius reduces the economic impact by 90% compared to a rise of 3.5 degrees[4] .

However, most IPCC models aimed at limiting the global temperature rise to 1.5 degrees deploy negative emissions technologies to varying degrees. While these technologies may end up playing a crucial role in tackling climate change, they are highly speculative at this stage.

Concerns over the use of negative emission technologies in climate modelling have been addressed to some extent by the International Energy Agency (IEA), which has released comprehensive analysis[5] setting out how the temperature rise can be kept to 1.5 degrees while reducing the need for highly uncertain negative emissions technologies by more than half compared to the assumptions made in the NGFS scenarios.

[3] IPCC: Chapter 3 - Impacts of 1.5°C of Global Warming on Natural and Human Systems
[4] Warren, R. et al., 2018c: Risks associated with global warming of 1.5°C or 2°C
[5] IEA World Energy Outlook 2021: World Energy Model – Scenario Analysis of Future Energy Trends

According to the IEA's Sustainable Development Scenario, to limit the rise in temperatures, governments around the world need to agree to stop new investments in oil and gas immediately, only exploit fossil fuels that have already been discovered, phase out combustion engine technologies by 2035, and implement a global carbon pricing regime.

The IEA analysis suggests that the Early Action scenario provides much greater certainty over the climate outcomes modelled in the CBES, with any delays to carbon transition making the chances of limiting the temperature increase much more uncertain in the Late Action scenario.

BALANCE SHEET PROJECTIONS

Climate risk will have an impact on both assets and liabilities. The impact on liabilities depends on climate signals, geography and exposures, with any change in risk profile based on average annual loss (AAL) and the annual exceedance probability (AEP) calculations.

While the impact on insurers' balance sheets is likely to manifest over time, the CBES framework demands that insurers apply these shocks instantaneously (similar to Solvency II). This means that the stress tests bring forward the future climatic environment to today's balance sheet, with no allowance for changes in future premiums, asset allocation, expenses, reinsurance programmes and other business model changes.

To see how the Bank of England scenarios will impact an insurer's balance sheets, we've adapted the approach taken in the CBES to focus on the most appropriate time periods from each stress test scenario, and have applied those conditions to the balance sheet:

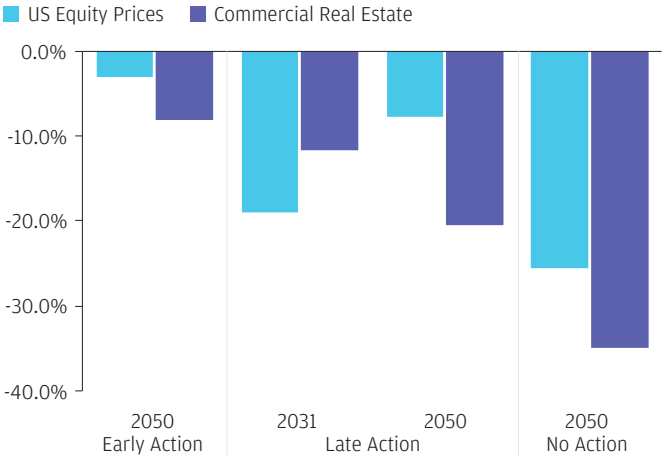
- **EARLY ACTION**: We compare the state of the world in 2050 vs. today's environment.
- **LATE ACTION**: We focus on the 2031 global economic crisis that results from the implementation of carbon pricing. We look at the change in economic variables over that year and also look at the recovery of the economy in 2050 vs today's environment.
- **NO ACTION**: We compare the state of the world in 2050 vs. today's environment.

THE IMPACT ON ASSET VALUATIONS

To see how the different macro scenarios could play out in terms of asset valuations, we've considered the 2030 *Late Action* economic crisis alongside the 2050 projections for all three scenarios and applied our analysis to equity and real estate valuations, and credit spreads.

Equity valuations and commercial real estate valuations are lower under all scenarios when viewed from 2050 (**EXHIBIT 3**). However, significantly greater drawdowns could be expected in the No Action scenario. Equity and real estate valuations also suffer a material hit in the late action scenario as carbon policy is tightened globally after 2030. Although equity prices recover somewhat by 2050, real estate continues to fall.

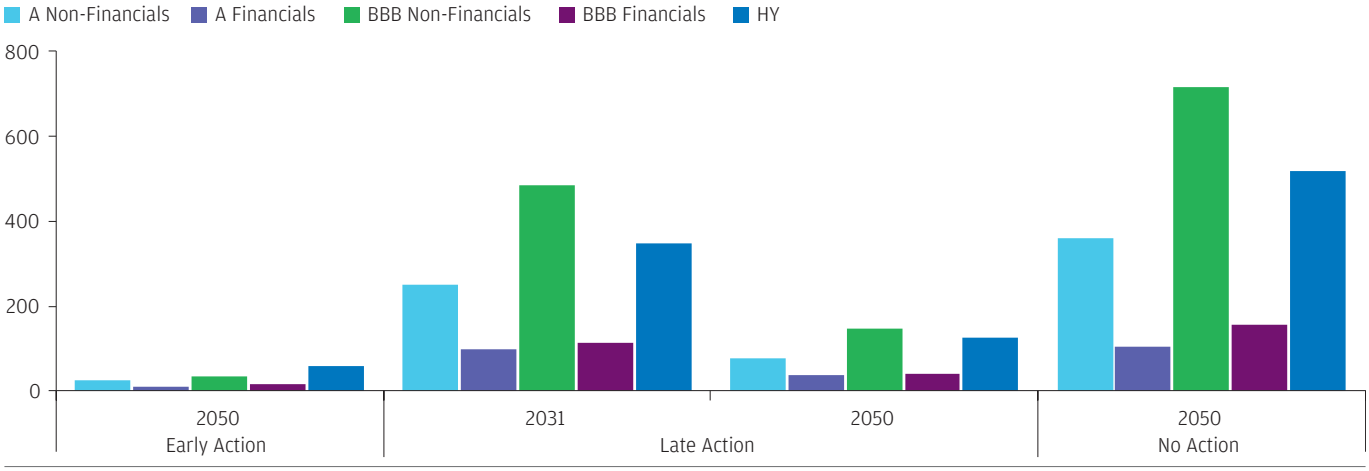
EXHIBIT 3: EQUITY AND REAL ESTATE SHOCKS



Source: Bank of England 2021 Biennial exploratory scenario

The credit spread data provided by the Bank of England is relatively high level, being split only by rating for financials and non-financials in USD and GBP (Exhibit 4). However, insurance companies' portfolios are varied and in particular in the non-financial sectors, insurers who have already positioned their portfolios to mitigate the risks of climate change and tilted away from sectors who are likely to be most impacted will not see the benefit based on the Bank of England high level spread data. To help insurers gain a more detailed view of how individual sectors would perform under the various scenarios, we developed an in-house model using the Bank of England's projections for gross value added by sector. The table in Exhibit 5 summarises the spread widening that would be observed for the years highlighted under each scenario for all credit sectors globally.

EXHIBIT 4: CREDIT SPREAD SHOCK



Source: Bank of England 2021 Biennial exploratory scenario

EXHIBIT 5: CREDIT SPREAD SHOCK BY SECTOR

	EARLY ACTION	LATE ACTION		NO ACTION
	2050	2031	2050	2050
Industrial	6	31	18	136
Basic Materials	20	86	55	225
Consumer, Cyclical	7	26	20	121
Consumer, Non-cyclical	5	20	15	150
Technology	1	-12	3	38
Communications	1	-17	3	76
Utilities	26	461	62	56
Energy	46	201	132	226
Financials	37	340	94	471

Source; J.P. Morgan Asset Management; data as of August 2021

The spread analysis, based on Bank of England data, shows that the financial sector would be badly hit across all scenarios, but the most impacted sectors may be expected to vary depending on the scenario. A 2031 recession, for example, would do particular harm to the utilities and energy sectors, while in the No Action scenario, basic materials and energy are the worse hit sectors, behind financials. The impact on financials in the Bank of England's scenario is interesting as it is not typically one of the sectors where environmental risks are thought to be as material (link to our ESG integration paper). The Bank of England's spread paths for financials point to the systemic risks that climate change could have on the whole of the financial market.

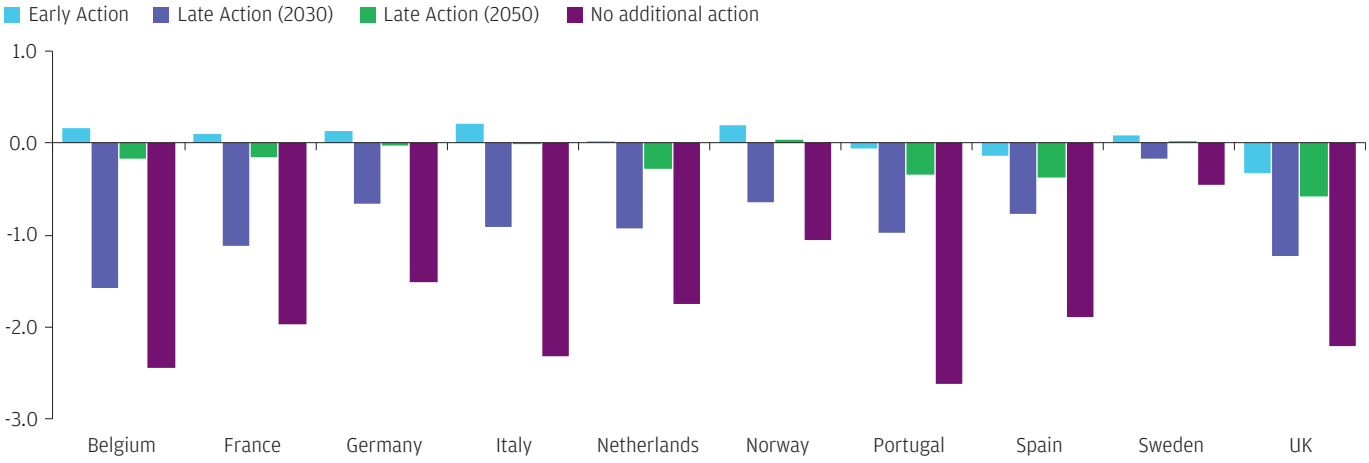
THE IMPACT ON INSURANCE SOLVENCY RATIOS

In this section, we tried to estimate the impact of these climate change scenarios on the insurance balance sheet and the solvency ratios in particular. To do so, we have applied the shock solely on the asset side of the balance sheet for life insurers across Europe, and have not accounted for underwriting risk (**EXHIBIT 6**). It is worth noting that the shocks are applied instantaneously as per the bank of England recommendation. However, for life insurers, progressively rising rates over the next 30 years would rather have a positive impact (limited policy lapses alongside higher fixed income yield to meet guarantees).

We project the change in own funds resulting from the impact to investment portfolios and also account for the loss absorption capacity of technical provisions. Our analysis suggests that the Early Action scenario will have by far the mildest impact on solvency. In many countries, this scenario would actually lead to a small increase in solvency ratios; mainly thanks to Solvency II discount rates are rising faster than Government and corporate spreads. By contrast, the UK is more heavily impacted because of the Bank of England's projected Solvency II discount curves.

As may be expected, the No Action scenario is by far the worst scenario for insurers' solvency. In the Late Action scenario, insurers would also suffer a big hit to their solvency ratios during the expected 2031 crisis – leading to an average loss in solvency of around 90%. However, the majority of insurers would be expected to recover by 2050, so that only a small loss in solvency ratios remains (around 20% on average).

EXHIBIT 6: PROJECTED CHANGE IN SOLVENCY RATIOS



Source: Bank of England 2021 Biennial exploratory scenario

CONCLUSION

Climate stress testing is a rapidly developing field, and a wide range of methods and tools are currently being developed to develop comprehensive views of risk and opportunities that integrate both transition and physical risks. Given the complex nature of the societal, political and physical responses to climate change, it is useful to consider a wide range of methodologies, while remaining aware of their strengths and limitations.

Having previously written about our proprietary approach to stress tests for Fixed Income assets in this blog (**https://am.jpmorgan.com/ca/en/asset-management/institutional/ insights/portfolio-insights/fixed-income/fixed-income-perspectives/Introduction-to-Climate-Change-Scenario- Analysis/**), we have taken here a closer look at the implications of the Climate Biennial Exploratory Scenario (CBES) from the Bank of England. Their framework aimed to highlight the sensitivities of the industry not just to the physical component of climate risks, but also to transition risks. Its approach is innovative, and we expect other regulators globally to follow suit in the coming years. Here, our analysis demonstrates that early action is preferable, even though carbon price levels would lead to immediate profitability losses.

Whilst we are seeing a pick-up in pledges to reduce emissions in the lead-up to COP26, current targets remain wholly insufficient to achieve the goals of the Paris Agreement and carbon prices remain well below where they need to be in order to drive significant emission reductions. Insurers should therefore pay close attention to the Late Action and No Action scenarios and discuss with their managers the steps that should be taken to mitigate those potential risks. Furthermore, as the interest for decarbonisation strategies continues to grow, building carbon transition portfolios will become more and more important. In an earlier publication (link to building carbon transition portfolios paper), our Fixed Income team outlined some of the steps that can be taken to achieve those goals in Buy and Maintain mandates.

NEXT STEPS

For more information, contact your J.P. Morgan representative.

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