Foresight

Climate change and financial markets – Part 1

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Schroders

Long-run asset class performance: How climate change will impact asset returns – an update

Schroders Economics Group produces 30-year return forecasts, on an annual basis, for a range of asset classes.

This is Part 1 of our paper where we outline the methodology used to incorporate climate change into our return assumptions.

In Part 2 of our paper, we discuss our 30-year forecasts for cash, bonds, credit, equities, real estate and private equity, incorporating the impact of climate change. As in last year's analysis, we have worked with Cambridge Econometrics to apply their E3ME energy-economy model to our productivity, GDP and inflation forecasts. These are the key inputs into our return forecasts through their influence on interest rates and profits growth.

The E3ME is a global macro-econometric model with regional and sectoral resolution that captures the diverse interactions between economies, energy systems, emissions and material demands. Our focus remains on temperature changes, the impact of higher carbon taxes on future growth and inflation and the shift in investment towards renewables, fully capturing the physical impacts of climate change and the transition impacts of economy wide decarbonisation.

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Economist

Introduction

Given the high degree of uncertainty around policy intervention to tackle global warming, scenario analysis is a key framework to assess the implications of climate-related risks and opportunities for financial institutions.

The boxes below summarize the scenarios we take into consideration when thinking about the impacts of the changes to our climate on our long-term asset return assumptions.

As in last year's analysis, the No Action scenario is one in which temperatures are set to rise more than 3°C above pre-industrial levels by the end of the century. We have also kept the Partial Mitigation scenario, where temperature increases are more limited thanks to the introduction of carbon emission mitigation policies starting from 2025. Finally, this year we have added a Net Zero scenario, in which, thanks to more aggressive mitigation policies, temperatures projections are in line with the Paris Agreement.

Summary of our scenarios

No climate change	No Action	Partial Mitigation	Net Zero
– Current policies	– Global temperature to rise by 1.9 °C by 2050	– Global temperature to rise by 1.6 °C by 2050	– Global temperature to rise by 1.5 °C by 2050
– Physical risks are not taken into account	– No carbon taxes and no other mitigation policies implemented	– Carbon taxes start from 2030	– Carbon taxes start from 2021
– No transition		– Other mitigation policies introduced from 2025	– Other mitigation policies introduced from 2021

Source: Schroders Economics Group, January 2022.

The three step approach

We have continued to adopt a three step approach to incorporate climate change in our macroeconomic assumptions. The first step is a focus on what happens to output and productivity as temperatures rise, which we refer to as the 'physical cost' of climate change. The second considers the economic impact of steps taken to mitigate those temperature increases, or the 'transition cost'. Finally, we adjust for the effects of stranded assets. This is where we take account of the losses incurred where oil and other carbon based forms of energy have to be written off, as it is no longer possible to make use of them and they are left in the ground.

Productivity is a key driver of our asset returns. In particular, our equity return assumptions use a Gordon's growth model approach, in which returns are generated through the initial dividend yield and the growth rate of dividends (via earnings growth). Earnings are assumed to grow in line with productivity, because we believe that over the long term productivity is a good measure of how well capital is invested.

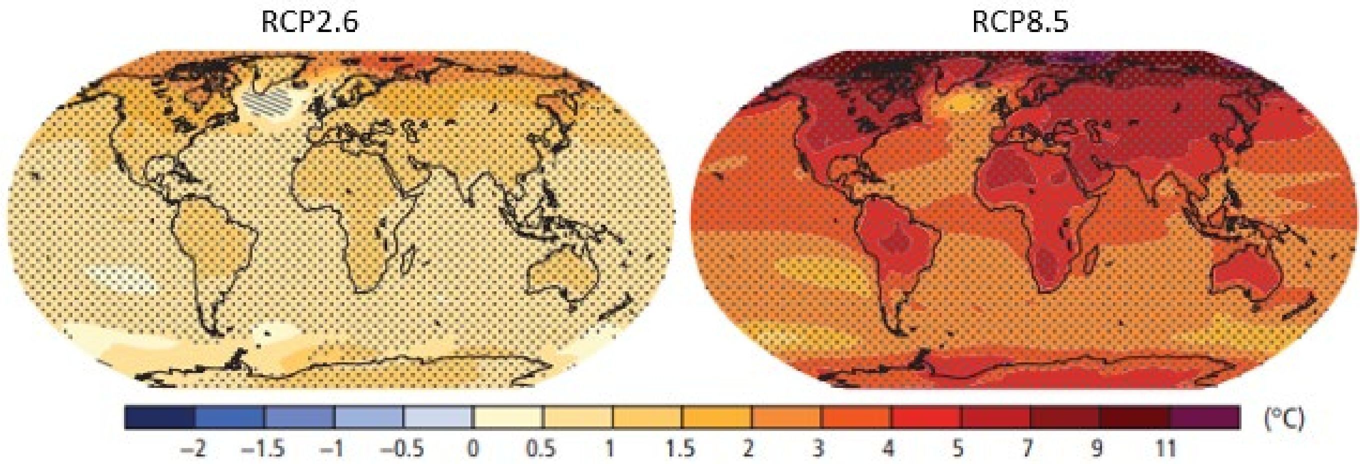
We can also assess the consequences for fixed income assets by making use of the productivity figures to modify our interest rate and bond returns. Following the framework developed by Laubach and Williams[1], long run equilibrium interest rates move in line with changes in trend growth in the economy. Assuming that the supply of labour is not affected by climate change then changes in productivity feed directly into changes in trend growth. In turn this directly affects the long run or equilibrium interest rate for the economy.

Physical costs

Temperature is endogenous with E3ME as the amount of global warming is determined within the model by the amount of emissions produced in each scenario we analyse. We use this emissions trajectory associated with each scenario to estimate the total change in global temperature above pre-industrial levels using a method based on research from earth science and earth systems modelling.

It is important to note that the rise in temperature that each country is likely to experience strictly depends on its latitude. In order to scale a given level of global warming into country specific rises, we use the results of RCP (Representative Concentration Pathways) scenario analysis. These scenarios have been modelled by the Intergovernmental Panel on Climate Change (IPCC) to understand the risk of climate change determined by the amount of greenhouse gas (GHG) emissions

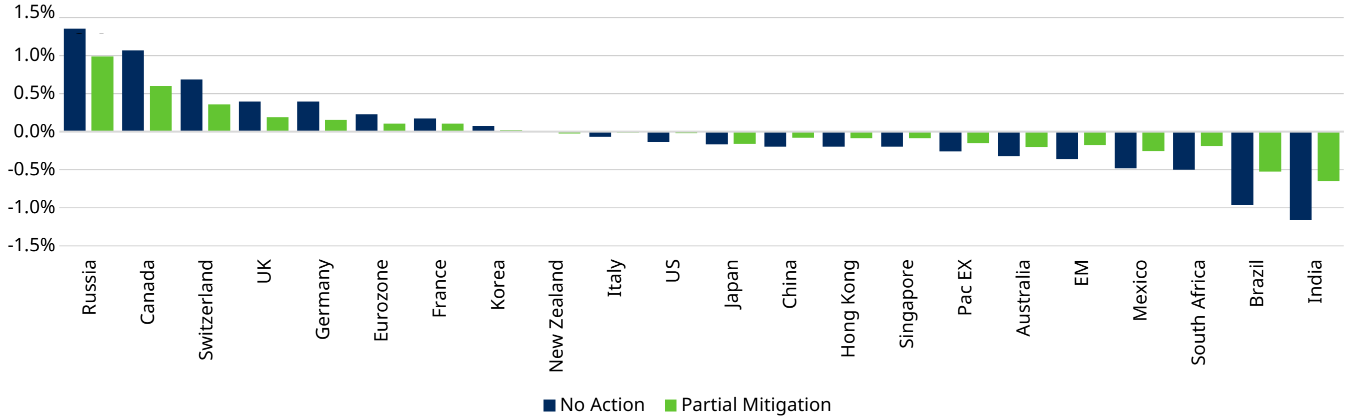
Chart 1: Change in average surface temperature (1986–2005 to 2081–2100)



Source: IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

[1]Laubach and Williams, Measuring the natural rate of interest, Review of Economics and Statistics (2003).

Chart 2: Physical costs – impact of climate change on productivity (% p.a. 2022–2051)*



* The chart shows the impact of higher temperatures measured as the difference in productivity of the Partial Mitigation and no Action scenarios relative to the no climate change scenario, in which there are no transition and physical costs.

Source: Cambridge Econometrics, Schroders Economics Group, January 2022.

we produce. Each scenario corresponds to a different level of warming. RCP2.6 is a 'best case' scenario, in which GHG emissions are cut back sufficiently such that global warming is capped at around 1.5 to 2 degrees above the pre-industrial average and corresponds to the Paris Agreement. At the other end of the scale, RCP8.5 is a worst case, 'business as usual' scenario in which no effort is made to rein in emissions and as a result global temperatures increase by four degrees compared to the pre-industrial average by 2100. As shown in chart 1 above, countries' temperature will rise at different speeds within each scenario.

In our analysis, the lower-warming pathway (RCP 4.5) is used to scale our Partial Mitigation temperature data and the highest warming pathway RCP 8.5 is used to scale our No Action scenario.

In the chart above, we compare the physical costs of higher temperatures for the No Action scenario and the Partial Mitigation scenario expressed a world in which no climate change occurs.

It is important to note that most of our projected warming by 2050 is already set. Whatever mitigation we undertake, temperature projections will only be largely affected in the second half of this century. The No Action scenario, in which the world economies fail to implement mitigation strategies to limit carbon emissions and global temperatures rise by more than 3 degrees Celsius by 2100 relative to the pre-industrial average, shows that some countries will still benefit over the next 30 years.

As highlighted by Burke and Tanutama's research, there is a quadratic relationship between productivity growth and temperature, suggesting that 'cold country' economic growth increases as annual temperatures increase, while at annual temperatures higher than 12–13°C economic growth begins to decline. For the colder countries, a more pronounced increase in temperatures means a higher productivity boost. On a 30 year horizon, Russia, Switzerland, Canada, Germany, France and the UK will all be better off in a scenario where global warming rises more than 3°C above pre-industrial levels.

Our base case is the Partial Mitigation scenario in which there is some action taken to reduce carbon emissions. Temperature increases are more limited than in the No Action case and therefore the physical costs are smaller. It is important to note, we will use the Partial Mitigation scenario in the rest of our analysis as our base case as this is the more realistic profile. The No Action scenario is only for illustrative purposes, as it highlights the impact of higher temperatures on economies.

Transition costs

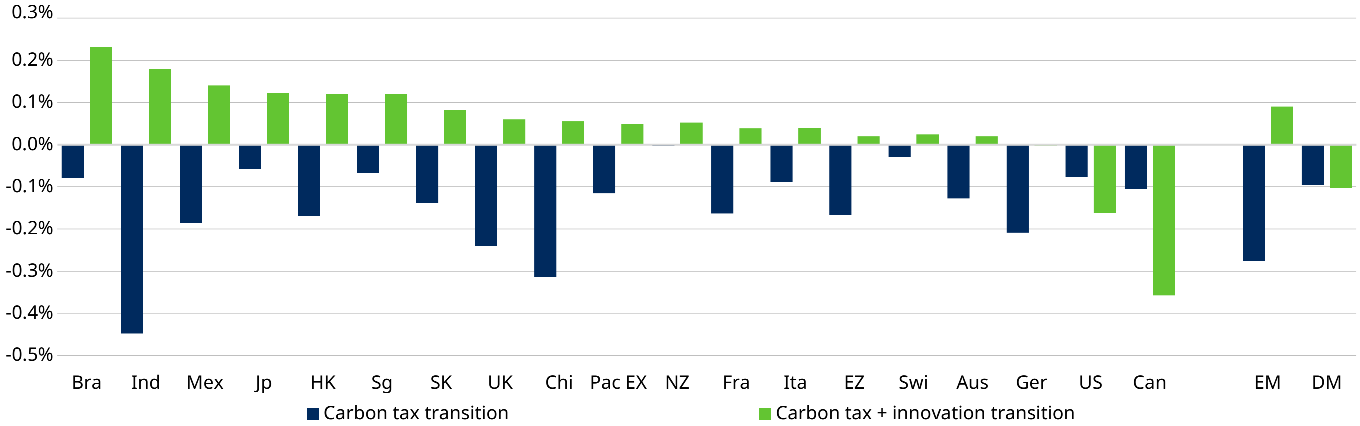
In the second step of our analysis, we take into account the impact on productivity of mitigation policies that will try to limit carbon emissions.

As in last year's analysis, we not only incorporate the impact of a global carbon tax on productivity, but we also address the economic impact of other policy changes, like investment subsidies, fuel taxes and mandates for the phase-out of the carbon-intensive power generation sector. These policies are essential to make continued investment in some technologies less attractive and to stimulate shift in investment towards renewables. More importantly, with E3ME model we are able to capture the technological change required to rapidly decarbonise some of the more emissions intensive sectors within the economy.

More specifically, in the Partial Mitigation and in the Net Zero scenarios we assume ambitious policy action focused on rapidly decarbonising the economy, primarily in the electricity sector with investment for low-carbon technologies and investment subsidies for technologies with nascent Carbon Capture Storage (CCS) capabilities. In the road transport sector, policies are put in place that incentivise the take-up of hybrid and electric vehicles and the phase-out of internal combustion engines. Modest biofuel blending mandates are pursued to gradually reduce the fossil fuel intensity of internal combustion engines that remain in the vehicle stock. There are ambitious investment programmes in energy efficiency to reduce household, industry, and commercial fuel demand. At the same time, there are programs to support the take-up and proliferation of low-carbon and electric heating technologies.

In our Partial Mitigation scenario, we also assume a carbon tax starting from 2030 in order to further reduce carbon emissions and these government revenues are used to reduce other taxes in the economy. The International Energy Agency (IEA) argues that the optimal carbon tax to meet the Paris target is a tax of 130$/tC02 for developed markets and 90$/tC02 for emerging markets in 2030. We think this profile is too ambitious and we instead model a tax starting at 75$/tCO2 for developed markets and 50$/tCO2 for emerging markets in our Partial Mitigation scenario.

Chart 3: Transition costs - impact on productivity (% p.a. 2022–2051)*



*The chart shows the climate change impact measured as the difference in productivity of the Partial Mitigation scenario relative to the no climate change scenario, in which there are no transition and physical costs, and compares it with the impact on productivity of the introduction of a carbon tax alone.

Source: Cambridge Econometrics, Schroders Economics Group, January 2022.

In chart 3 we show the impact of decarbonisation on productivity for our Partial Mitigation scenario. It is clear that a carbon tax is a negative for all countries. This is because a carbon tax causes an output loss for all countries as it internalizes the cost of greenhouse gas emissions in the production process. However, in our analysis, reducing carbon emissions will have positive transition impacts for some economies. This is because we are now taking into account the full impact of decarbonisation, where investment in clean technology and efforts to improve energy efficiency partially offset the economic drag due to the introduction of a carbon tax and to rising temperatures.

In particular, fossil fuel importers (i.e. Brazil, Germany, France, Japan, Hong Kong, Singapore and South Korea, the eurozone and the UK) will see positive effects on economic growth by investing in low-carbon electricity generation and energy efficiency has positive effects on GDP in order to reduce their imported fuel demand. Countries like the US and Canada will also see a positive investment effect associated with the shift to clean technology, but this positive effect is outweighed by falling export revenue in the oil and gas sector and a fall in government revenues from natural resource extraction as they are fossil fuel exporters.

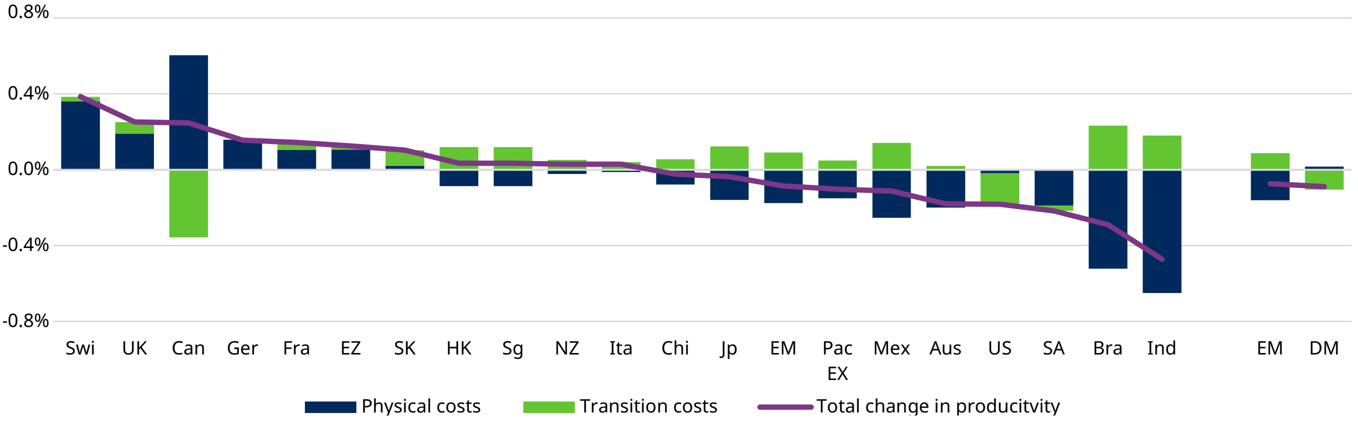
Finally, China, Australia, New Zealand, South Korea, India, the eurozone and the UK will also require large investments in low-carbon electricity generation and energy efficiency improvements in order to reduce carbon emissions. Therefore, investment in nuclear power, offshore wind, and hydro-power installations will provide a productivity boost to these economies.

The aggregate impact on productivity in our base case

We can now combine the physical and transition costs to get our final estimate for productivity that we will use to calculate our long-term asset returns.

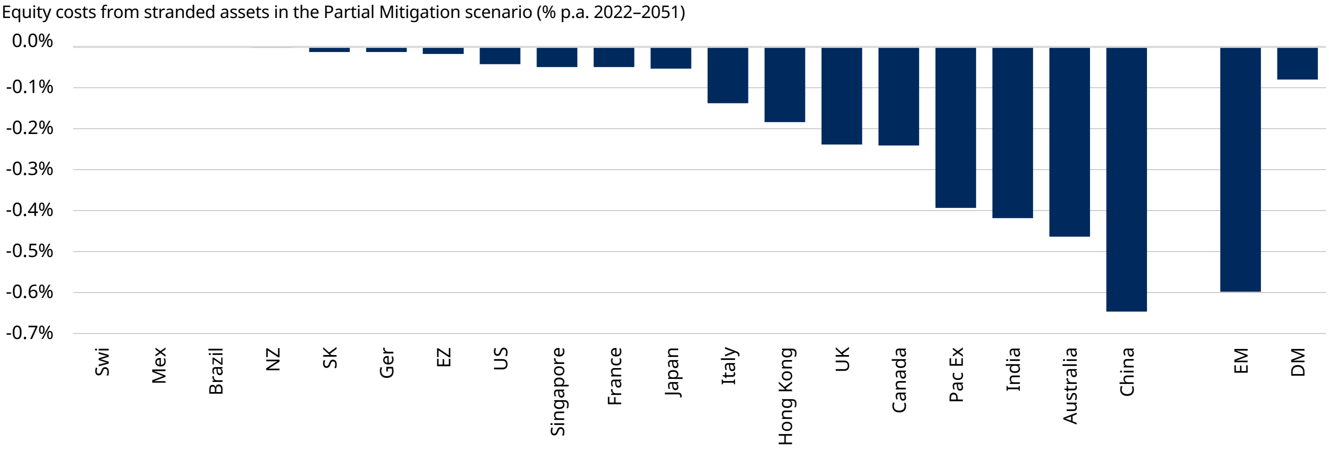
Chart 4 below shows the differences in productivity in our base case compared to a world in which no climate change occurs. Our modelling finds that some countries experience higher productivity in the Partial Mitigation scenario thanks to higher temperatures. This is true for colder countries such as Switzerland, Canada, the UK, Germany. Additionally, countries like South Korea, Hong Kong, Singapore and New Zealand France and the UK will also see higher productivity thanks to a shift in investment towards clean technology. China, Japan, India and Brazil will also see the benefits from shifting to cleaner technology, but this will only partially offset the drag coming from a higher temperatures. Emerging markets are worse off in a world with climate change. The same is true for the US as it will see lower productivity in our base case as a result of a drag from both physical and transition costs from higher temperatures.

Chart 4: Changes in productivity compared to no climate change scenario (% p.a. 2022–2051)



Source: Cambridge Econometrics, Schroders Economics Group, January 2022.

Chart 5: Reduction in equity returns from stranded assets



Source: Refinitiv Datastream, MSCI, Schroders Economics Group. January 2022. For Russia, we use the MICEX Index instead of the MSCI Russia, given the low number of listings on the latter. We also use the NSE for India and the Shanghai Stock Exchange Composite Index for China since we have data for companies listed on their domestic stock exchanges.

Having calculated the difference climate change makes to productivity, we then adjust for stranded assets to assess the full impact on our equity return forecasts. In particular, any attempt to limit global carbon emissions is going to mean we have to reduce the quantity of fossil fuels we burn.

Yet present valuations of energy companies, for example, implicitly assume that their energy reserves have future market value. If this changes, there will be consequences for equity markets.

Finally, it's important to highlight that, while the aggregate impact on productivity in Net Zero is similar to the one in Partial Mitigation, equity returns will differ thanks to a larger loss from stranded assets in order to be in line with the Paris Agreement.

Stranded assets

Recent analysis from the IEA finds that almost 60% of oil and gas reserves, and over 80% of current coal reserves should remain unused in order to limit global warming by 2 degrees. Using MSCI data that reports potential CO2 emissions from coal, oil and natural gas reserves owned by public companies we calculated the loss that companies' balance sheets would register given the fraction of unburnable reserves of oil, coal and gas for each equity index in the scenario where mitigation policies lead to some moderation in global temperatures. The results are shown in chart 5, highlighting the sizeable impact to EM returns, particularly in China and India. In the US, returns see only a small downward adjustment; a reflection of the sheer size of the equity market, even relative to its oil giants.

Now that we have aggregate estimates for the impact on productivity from climate change and the costs of stranded assets, in Part 2 of our paper we outline how we use the productivity estimates for our asset return forecasts explaining the methodology for cash, bonds, credit, equities, real estate and private equity, along with a look at the historic evolution of most of those forecasts.

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