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 and explain what has changed from last year's analysis.

In Part 2 of our paper, we publish our 30-year forecasts for cash, bonds, credit, equities, and real estate, incorporating the impact of climate change.

In this update of the 30-year asset return assumptions we have worked with Cambridge Econometrics to apply their E3ME energy-economy model to our productivity 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. Last year alongside temperature changes, our focus was on the impact of higher carbon taxes on future growth and inflation. Using the model we are now able to fully capture the transition impacts of economy-wide decarbonisation and a shift in investment towards renewables.

Irene Lauro
Economist

The three step approach

As in last year's analysis, we have adopted 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 asset returns in the long run. 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.

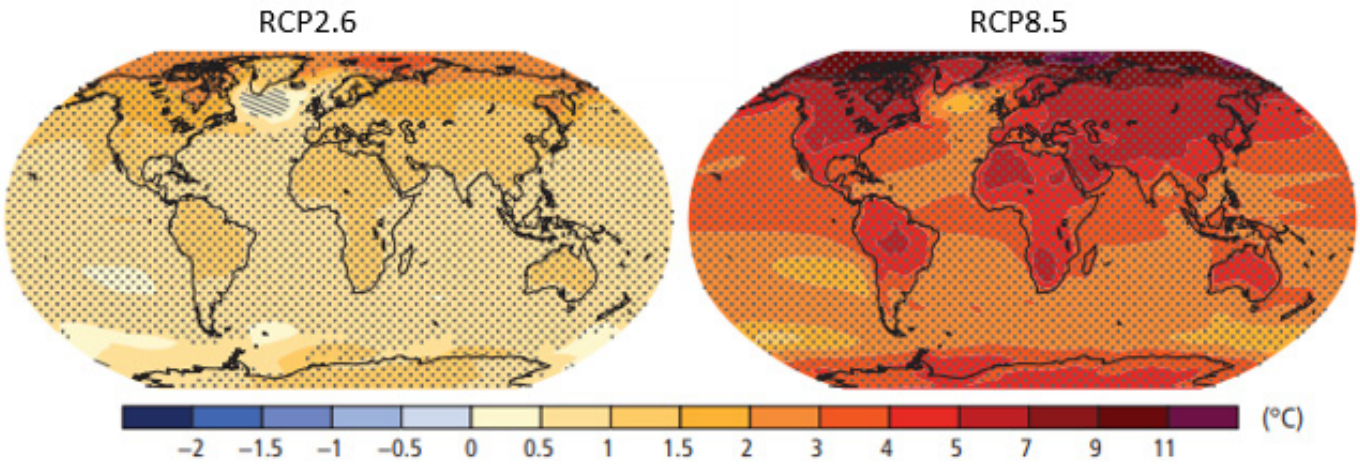
What has changed from last year's analysis?

Physical costs

This year, we have introduced a new assumption regarding temperature increases. Last year we assumed a uniform rise in temperature across the globe, with global warming increasing at a constant rate of 0.04 degrees Celsius per annum. With E3ME, temperature now becomes endogenous. From E3ME, we have an emissions trajectory associated with each scenario which is used to estimate the total change in global temperature above preindustrial levels, using methods from earth science and earth systems modelling.

We scale the country level temperature anomaly based on our global temperature expectation using data for average temperatures for different countries and the temperature anomaly under the different RCP (Representative Concentration Pathways) scenarios. 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) 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. 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 4 degrees compared to the pre-industrial average by 2100. As shown in chart 1 below, countries' temperature will rise at different speeds within each scenario.

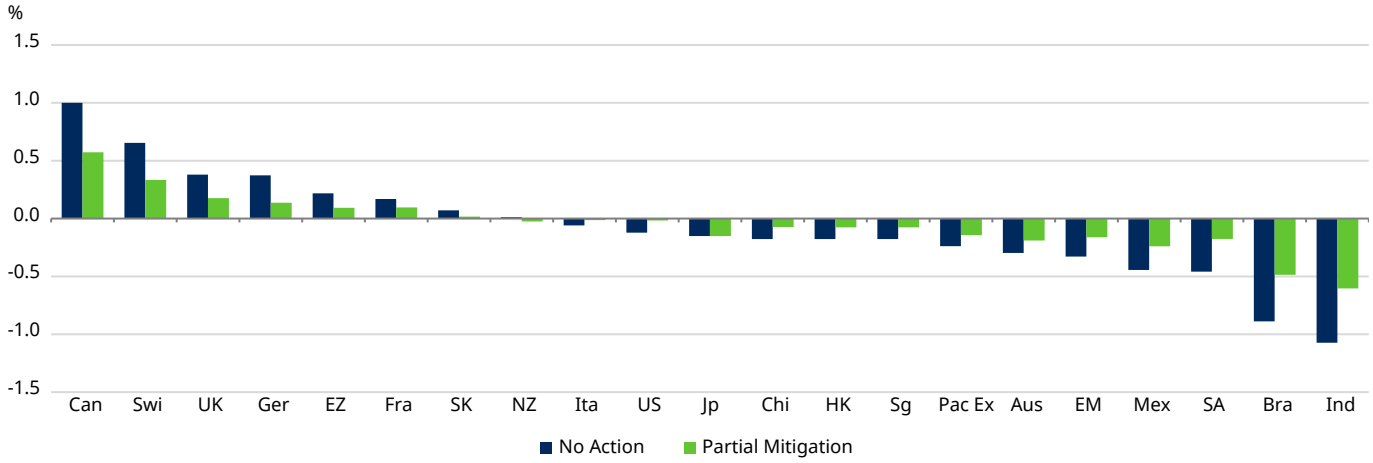
Chart 1: Change in average surface temperature (1986–2005 to 2081–2100)



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. 2021-2050)*



* 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 2021.

In this year's analysis we have added a new scenario, called the No Action scenario, where temperatures are set to rise more than 3°C above pre-industrial levels by the end of the century. We have kept the partial mitigation scenario as our base case, but broadened policy action such that temperature increases are more limited thanks to the introduction of carbon emission mitigation policies starting from 2025. 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 chart 2 we compare the physical costs of higher temperatures for the No Action scenario and the partial mitigation scenario. These are expressed relative to the no climate change case where there are no temperature effects.

It is important to note that projected warming by 2050 is already set. Whatever mitigation we undertake, temperature projections will only be 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. This suggests 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, 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 this is the more realistic profile. The No Action scenario is here 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.

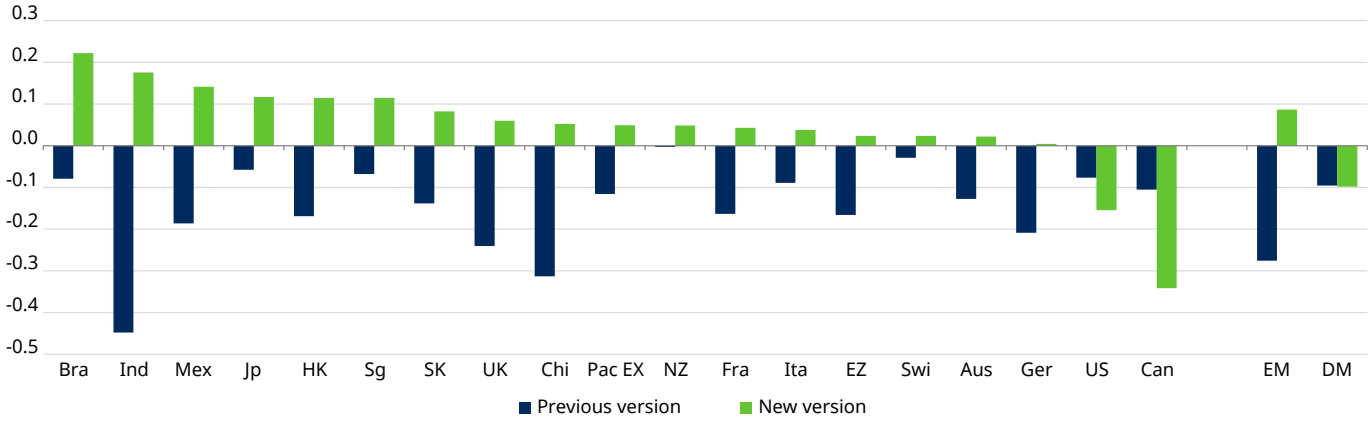
Last year we used the IMF modelling estimates to assess the impact of a uniform carbon tax on productivity. This year we have gone one step further, as E3ME enables us to address the economic impact of many more types of policy changes, fully capturing the transition impacts of economy wide decarbonisation and a shift in investment towards renewables.

In particular, we have been able to incorporate the impact of investment subsidies, fuel taxes and mandates for the phase-out of the carbon-intensive power generation sector. They make continued investment in some technologies less attractive as they are progressively banned from the market. More importantly, with E3ME 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 scenario we assume ambitious policy action focused on rapidly decarbonising the economy. Primarily this is 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 programmes to support the take-up and proliferation of low-carbon and electric heating technologies.

We also assume a carbon tax starting from 2030 in order to further reduce carbon emissions, as in our previous analysis. The IEA argues that the optimal carbon tax to meet the Paris target is a tax starting at $100 per ton for developed market economies and $75 per tonne for emerging, increasing after a decade. 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.

Chart 3: Transition costs - impact on productivity (% p.a. 2021-2050)*



*The chart compares the current version to last year's, showing 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.

Source: Cambridge Econometrics, Schroders Economics Group, January 2021.

In chart 3 we show the impact of decarbonisation on productivity, comparing the results with the estimates we produced in last year's analysis for our partial mitigation scenario. It is clear that in our current 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 temperature.

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. 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.

Additionally, some countries like the UK, the eurozone and Japan will also experience a major economic boost due to higher carbon taxes that will lead to a significant increase in government revenues. These revenues are 'recycled' and government budgets are balanced by reducing taxes elsewhere in the economy, supporting consumer spending.

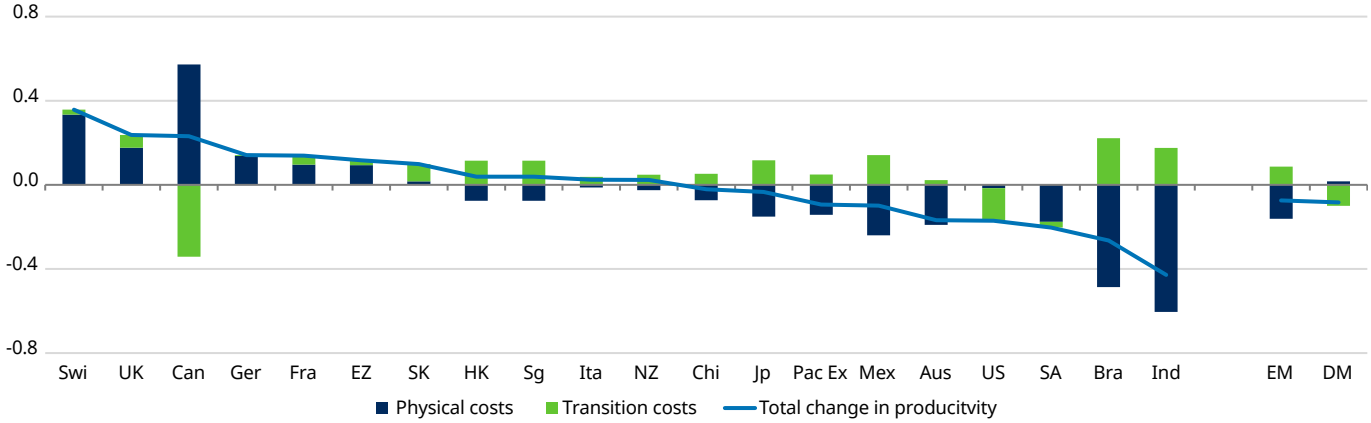
Finally, China, Australia, New Zealand, South Korea, India and the eurozone will require large investments in low-carbon electricity generation and energy efficiency improvements in order to reduce carbon emissions. Therefore, investment in nuclear power, offshore wind, and hydro-power installations 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 as it was the case in last year's analysis. Additionally, in this year's analysis 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.

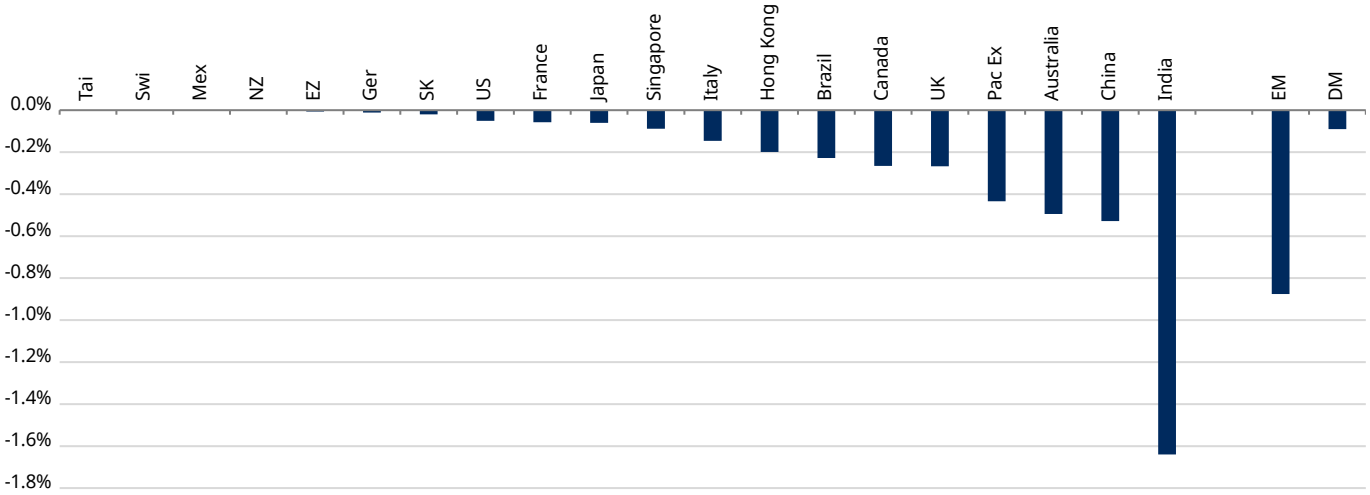
Chart 4: Changes in productivity compared to No climate change scenario (% p.a. 2021-2050)



Source: Cambridge Econometrics, Schroders Economics Group, January 2021.

Chart 5: Reduction in equity returns from stranded assets

Equity cost from stranded assets in the partial mitigation scenario (% p.a. 2021–50)



Source: Refinitiv Datastream, MSCI, Schroders Economics Group. December 2020. We use the Nifty Index for India and the Shanghai Stock Exchange Composite Index for China since we have data for companies listed on their domestic stock exchange.

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 reduce the quantity of fossil fuels we burn.

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 if we are to meet the Paris target.

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.

We did this by using MSCI data that reports potential CO2 emissions from coal, oil and natural gas reserves owned by public companies.

The results are shown in chart 5, highlighting the sizeable impact to EM returns, particularly in India and China. 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, we move onto the investment implications. In Part 2, we outline how we use the productivity estimates for our asset return forecasts cash, bonds, credit, equities, and real estate, along with a look at the historic evolution of most of these forecasts.

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