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 thirty-year return forecasts on an annual basis, which incorporates the impact of climate change.

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, and real estate, incorporating the impact of climate change and explain what has changed from our previous analysis.

Over the last two years, our climate change assumptions were based on the E3ME global macro-econometric model run by Cambridge Econometrics (CE). When we started using Cambridge Econometrics back then, the Network for Greening the Financial System (NFGS) scenarios were not fully established. The NGFS is a group of 116 central banks and supervisors, working together to enhance the role of the financial system to manage risks and to mobilize capital for green and low-carbon investments.

The NGFS scenarios provide a common starting point for analysing climate risks to the economy and financial system.

In an effort to bring our climate assumptions and scenarios more in-line with those used by central banks in their climate stress test analysis, for this update of the 30-year return forecasts, we have worked with Oxford Economics (OE) to apply their climate-macro model to our productivity, GDP and inflation forecasts. These are the key inputs in our return forecasts through their influence on interest rates and profits growth.

In particular, the carbon price used by OE closely matches those from the corresponding scenarios produced by the NGFS. They have used integrated assessment models to derive optimal carbon prices for a given degree of climate mitigation, while maximising welfare of the economy.

This means that our analysis continues to capture the diverse interactions between economies, energy systems and emissions and the impacts of economy-wide decarbonisation. Meanwhile, our assumptions on carbon pricing and temperature projections are consistent with those used by the NGFS under the corresponding scenarios.

Irene Lauro
Environmental 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 summarise the scenarios we take into consideration when thinking about the impacts of the changes to our climate on our long-term asset return assumptions.

It is important to highlight a key change of moving to using OE's scenarios. Previously, our starting pointing was a climate-uninformed scenario known as 'No Climate Change'. This has been replaced with 'Current Policies' which incorporates physical risks due to climate change. This is to reflect the fact that we are already seeing the impacts of global warming on economic activity and makes our baseline estimates more realistic.

Summary of our new scenarios

Current Policies (reference scenario)

- No further mitigation measures taken such as carbon pricing
- Reflects policy commitments that are supported by credible measures
- Global warming set to reach 2°C by 2050

Delayed Transition (central scenario)

- Policymakers only start to take action and increase carbon taxes in 2030
- Disorderly transition, with higher transitional impact
- Global temperature to rise by 1.7 °C by 2050

Net Zero with Innovation

- Prompt action is taken and carbon taxes start rising from 2023
- Orderly transition, with additional innovation benefits from R&D investment
- Global warming is limited to around 1.5°C by 2050

Source: Schroders Economics Group, January 2023.

Moreover, the new Current Policies scenario is in line with the IEA's Stated Policies Scenario (STEPS), which does not assume that governments will reach all announced goals. Instead, it takes a more granular approach to what has actually been put in place to reach these targets, taking account not just of existing policies and measures but also of those that are under development. So it reflects commitments that are backed up by credible measures and believed to be sufficiently detailed.

Despite falling oil and coal demand, the global energy mix in 2050 is still heavily reliant on dirtier fuels such as coal, oil, and gas. The corresponding emissions under the Current Policies scenario are estimated to lead to 2°C of global warming by 2050, as countries' current climate pledges are not ambitious enough to meet the legally binding threshold of 1.5°C established by the Paris Agreement.

Our transition scenarios

We then take into consideration two scenarios that incorporate the process of transition to a low-carbon economy, induced by the increase in the price of carbon, and where temperature increases are more limited than our Current Policies scenario. The transition will potentially transform the energy, transportation, industrial and natural resource-based supply chains, which means a significant reallocation of financial flows towards specific sectors. This will translate to both risks and opportunities for the financial industry.

- 'Delayed Transition' is a disorderly transition scenario that assumes policy makers only start to take more ambitious action and increase carbon prices from 2030. Stronger climate policies are needed to limit global warming to below 2°C. We think this is a more realistic profile than Net Zero.
- The 'Net Zero with Innovation' scenario represents an orderly transition as it assumes that climate policies are introduced early and become gradually more stringent. It also assumes there are wider economic benefits associated with innovation and factors in a greater amount of green investment from the private sector.

Of the transition scenarios available, we see the Delayed Transition scenario as the most likely of the three. Political headwinds remain around the world to recognise and act to reduce carbon emissions, and so we do not believe that immediate action, as assumed by the Net Zero with Innovation scenario, is likely.

It is also important to highlight that in the Current Policies scenario temperatures keep rising after 2050, with global warming hitting 3.2°C by the end of the century. Meanwhile, in our Delayed Transition and Net Zero with Innovation scenarios, transition policies help stabilise global temperatures, that are see to be constant after 2050.

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 our equity returns for the effects of stranded assets. This is where we take account of the losses incurred where reserves of coal, oil and gas 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.

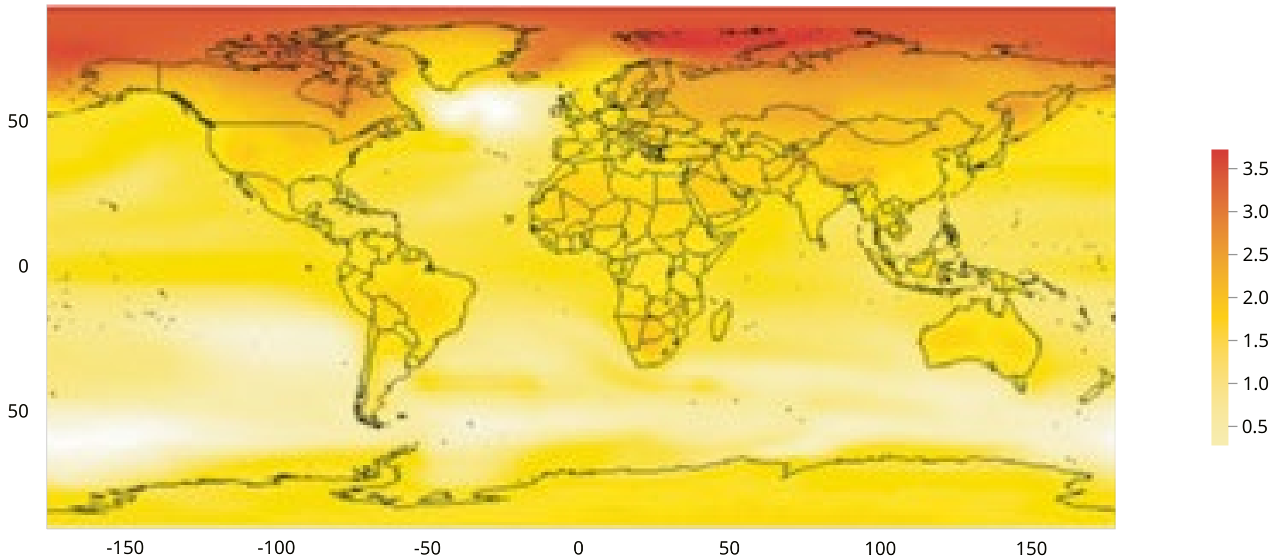
Assuming that the supply of labour is not affected by climate change, then changes in productivity feed directly into changes in trend growth. In turn this directly affects the long run or equilibrium interest rate for the economy.

Physical costs

Global carbon emissions have a direct effect on temperature. Emission estimates are determined within the model by annualised forecasts for coal, oil and gas demand. The flow of carbon dioxide emissions is then translated into a global temperature increase using a linear climate response function. Temperature is therefore endogenous as the amount of global warming is determined within the model by the amount of emissions produced in each scenario we analyse.

It is important to note that the rise in temperature that each country is likely to experience depends on its latitude. As illustrated in chart 1, more northerly latitudes warm the most. 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) people produce.

Chart 1: Average temperature increase in 2050 under RCP 6.0



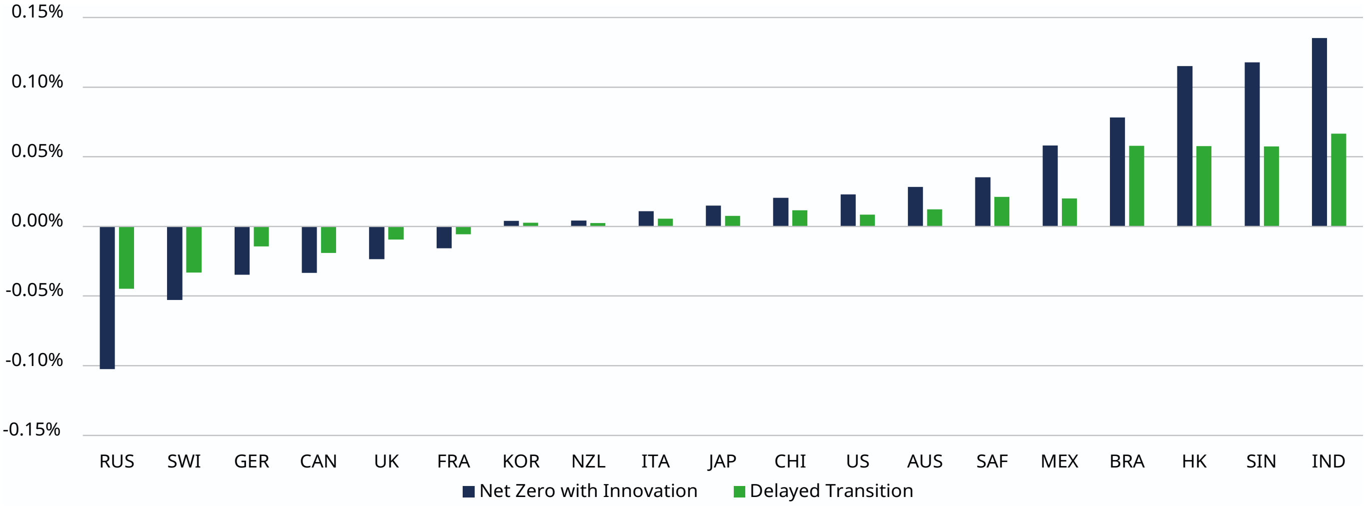
Source: IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

The impact of global warming on productivity is calculated using country-specific climate change damage functions that are drawn from the research done by Burke, Hsiang and Miguel (2015). In particular, they find 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.

In chart 2 we compare the physical costs of global warming in the Delayed Transition and Net Zero with Innovation scenarios against the Current Policies scenario, where global warming reaches 2°C by 2050. For the hotter regions, a less pronounced increase in temperatures means higher productivity. On a 30-year horizon, India, Singapore, Hong Kong, Brazil and Mexico will all be better off in a scenario where global warming rises less than 2°C above pre-industrial levels. On the other hand, colder regions, such as Russia, Switzerland and Canada will see lower productivity as a result of more limited temperature increases relative to the Current Policies scenario.

[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. 2023–2052)*



*The chart shows the impact of higher temperatures measured as the difference in productivity of the Delayed Transition and Net Zero with Innovation scenarios relative to the Current Policies scenario, in which global warming reaches 2°C by 2050.

Source: Oxford Economics, Schroders Economics Group, January 2023.

Finally, it is important to note that our methodology only considers the macroeconomic impact of change in average temperature. It does not include impacts related to extreme weather, rising sea levels or wider societal impacts from migration or conflict. For certain countries the losses due to extreme weather events are quite significant, increasing the physical risk. Additionally, these estimates do not fully capture adaptation, which would reduce impacts but require significant investment.

Transition costs

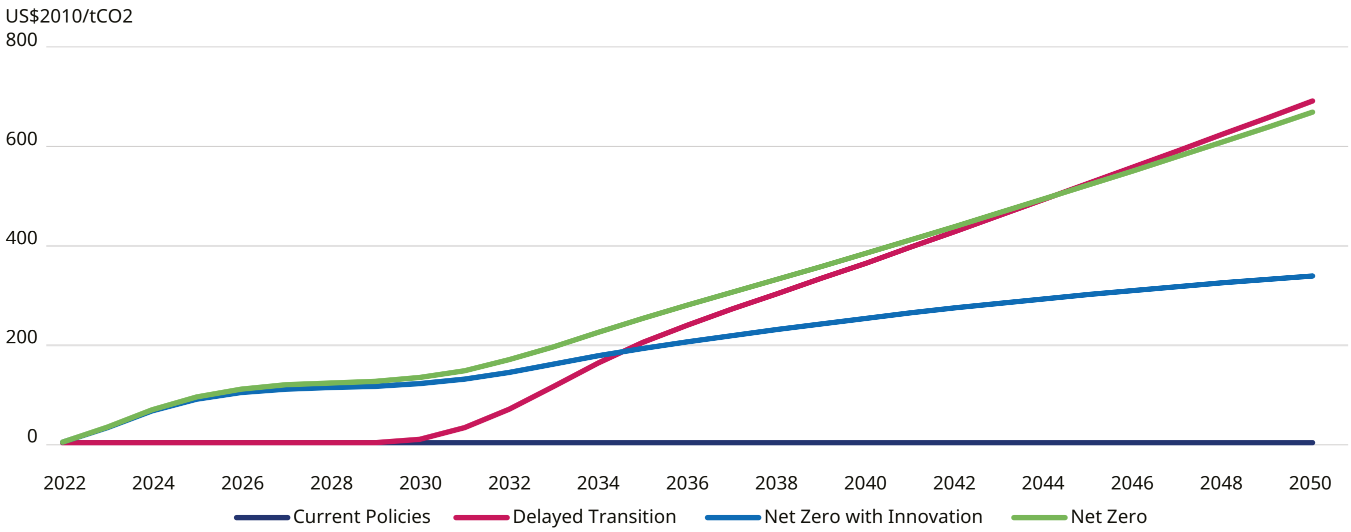
In the second step of our analysis, we take into account the impact on productivity of mitigation policies that will limit carbon emissions and, as a consequence, global warming.

Policymakers induce a transition to low-carbon economy by raising carbon prices, internalising the costs of emissions. Our carbon prices closely match those from the corresponding NGFS scenarios and are determined at the country level. The NGFS use integrated assessment models which derive optimal prices for a given degree of mitigation while maximising welfare of each economy. Carbon pricing will increase fuel prices and disincentivise consumption of carbon intensive fuels, shifting consumption towards low-carbon sources which will help limit global warming.

The NGFS model suggests that a global carbon price of around $200 per tonne of carbon dioxide (tCO2) is needed in the next decade to incentivise a transition towards net zero by 2050 (chart 3). In Delayed Transition, the world ends up with more stringent policies from 2040 as a stronger incentive is needed to limit global warming to below 2°C, highlighting the risks associated with governments failing to act swiftly.

As in last year's analysis, we also incorporate the impact of higher investment in electrification and expansion of renewable capacity. However, the Oxford Economics model assumes this does not pass through to the supply side to produce innovation benefits. In other words, the positive impact of investment on the capital stock is initially muted due to a high depreciation rate, as carbon pricing encourages the scrappage of carbon intensive capital. Only our Net Zero with Innovation scenario factors in wider economic benefits associated with greater innovation. This means that carbon taxes do not need to rise as high in this scenario to achieve the same degree of preference switching. As shown in chart 3, carbon prices increase to just over $300/tCO2 by 2050, less than half of the prices required in a net zero transition without innovation.

Chart 3: Carbon price under different scenarios

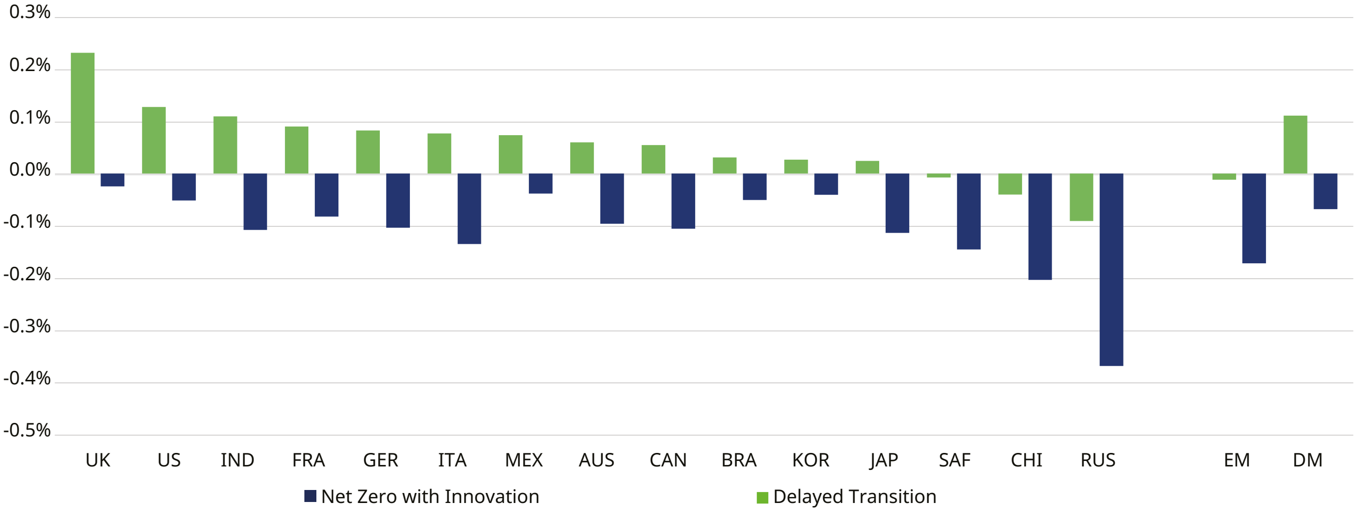


Source: Oxford Economics, Schroders Economics Group, January 2023.

It is important to note that the Delayed Transition scenario, in which more ambitious climate action only starts from 2030, is our central case for the purpose of calculating the 30-year returns. The Delayed Transition scenario highlights the risks associated with governments failing to act swiftly. The world ends up with more stringent policies from 2040 as a stronger incentive is needed to limit global warming.

In chart 4 we show the productivity impact of decarbonisation for our transition scenarios. It is clear that a carbon tax is a negative for all countries as the internalisation of the cost of greenhouse gas emissions leads to lower production, and a loss in output. The degree of the fall in productivity varies across countries. The impact of carbon pricing across the globe will depend on a number of country-specific factors.

Chart 4: Transition costs - impact on productivity (% p.a. 2023–2052)*



*The chart shows the climate change impact measured as the difference in productivity of our transition scenarios relative to the Current Policies scenario, in which there are no mitigation costs.

Source: Oxford Economics, Schroders Economics Group, January 2023.

First of all, the magnitude of carbon prices plays a key role in determining the impact to the economy. The NGFS analysis models carbon prices that are more severe for developed than developing economies. Among the emerging markets (EM), this model sees India, Brazil and Mexico having the smallest increase in carbon prices over the next three decades.

Another key factor behind the cross-country differences in the transition impacts is the energy mix. Countries that are currently more reliant on fossil fuels for their energy generation, like Russia, will be more exposed to carbon taxes, as a higher share of fossil fuels strengthens the pass-through to prices.

Finally, countries highly dependent on coal such as China and South Africa will also see a large hit to activity. This is due to the fact that coal is the most intensive fossil fuel, implying a larger increase to inflation that will weigh on economic growth.

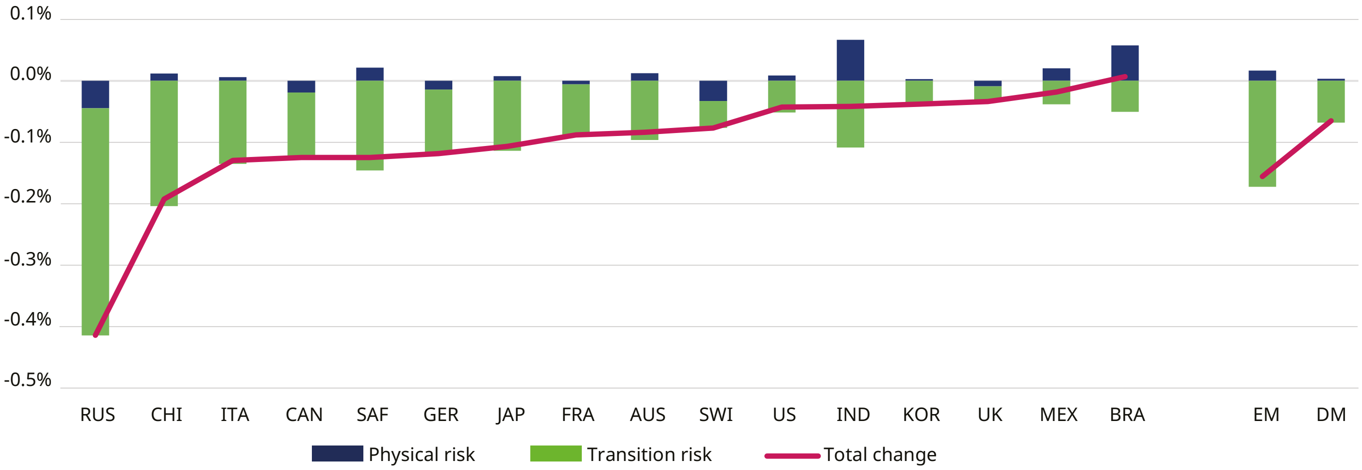
When taking into consideration the greater economic benefits associated with innovation, some countries will see a positive impact on productivity, with the transition creating winners and losers. Fossil fuel exporters, such as Russia, will continue to see a negative impact on productivity. In comparison, fossil fuel importers like the UK, European countries and India will see positive effects on economic growth by investing in low-carbon electricity generation and energy efficiency in order to reduce their imported fuel demand.

The aggregate impact on productivity in our central 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 5 shows the differences in productivity between the Delayed Transition scenario and a world in which only current policies are implemented.

Our modelling finds that all countries experience lower productivity in the Delayed Transition scenario, highlighting that mitigation costs will be more painful the longer we take to internalise the negative externalities associated with climate risks. The negative impacts of a delayed transition largely outweighs the positive boost from mitigating global warming. Hotter countries, like Brazil, Australia, India, Japan and the US, while benefitting from a more limited temperature increase relative to the warming under current policies, will be worse off on the back of larger transition costs. Economic growth in colder countries like Russia, Canada and Germany will see lower productivity in our central case as a result of a drag from both physical and transition costs.

Chart 5: Changes in productivity in Delayed Transition versus Current Policies (% p.a. 2023–2052)



Source: Oxford Economics, Schroders Economics Group, January 2023.

The impact on the inflation forecasts

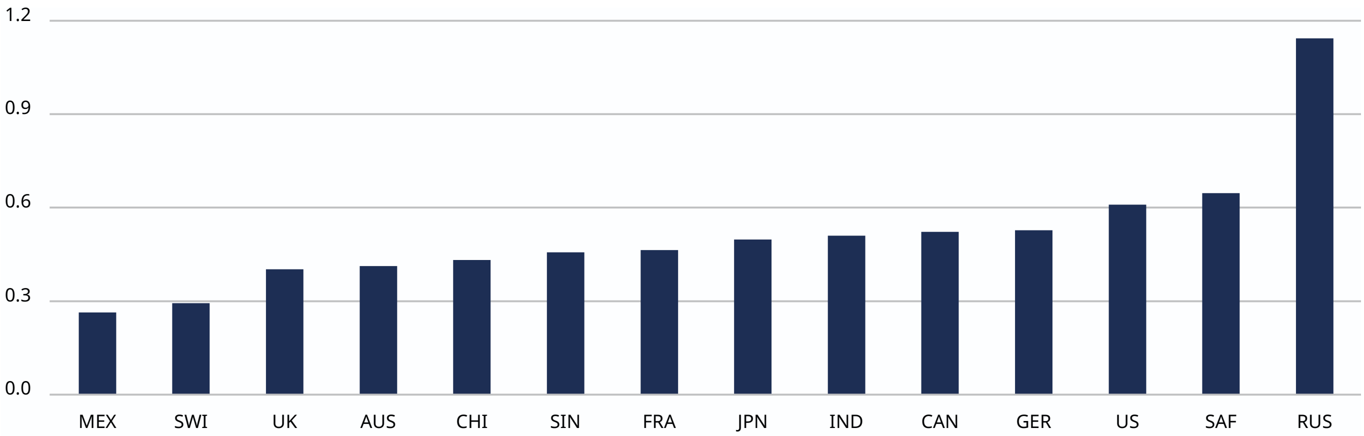
The green energy transition also impacts our forecasts for inflation. With more stringent climate action, inflation is mainly impacted by rising carbon prices via changes in energy prices. The Oxford Economics model assumes that fossil fuel supply is slow to adjust to the change in prices. In contrast, demand is more responsive and adapts more rapidly to changes in the price of energy.

Overall, aggressive carbon taxation policies result in substantial inflationary pressures globally. The energy transition is also set to boost demand for key industrial metals, such as aluminium, copper, cobalt and lithium, used to generate and store renewable energy. Given the supply challenges for these metals, this is likely to add further pressure on inflation. That said, the impact of carbon pricing on energy costs is the main inflationary driver.

It is important to note that the inflation impact is estimated to differ across countries (chart 6). In particular, the degree to which energy prices rise depends on the country's carbon usage and energy efficiency. Coal is expected to experience the largest price rise as it is the most carbon-intensive fuel, while natural gas is likely to have a smaller price increase. So, countries with greater reliance on coal for their energy production should experience higher inflation than economies more dependent on cleaner sources of energy.

For this reason, over the next 30 years, Mexico, Switzerland the UK are expected to see the smallest inflation increases, as the share of coal in their current energy production mix is less than 4%. Russia and South Africa are set to experience the largest rise. For the US, the Delayed Transition scenario is estimated to add 0.6% p.a. to headline inflation over the next 30 years.

Chart 6: The impact on inflation from incorporating more ambitious climate action (Delayed Transition versus Current Policies) (% p.a. 2023–2052)



Source: Oxford Economics, Schroders Economics Group, January 2023.

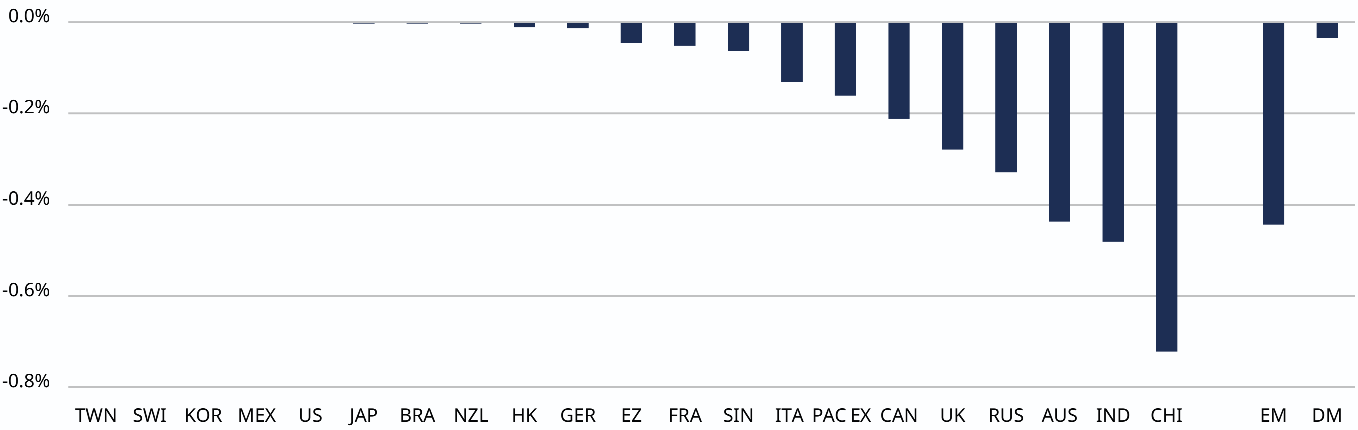
Having calculated the difference climate change makes to productivity and inflation, we then adjust for stranded assets to assess the full impact on our equity return forecasts. In particular, any attempt to limit global carbon emissions is going to mean we have to reduce the quantity of fossil fuels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

Stranded assets

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 meet the Paris target. We use MSCI data that reports potential CO2 emissions from coal, oil and natural gas reserves owned by public companies to calculated the loss that companies' balance sheets would register given the fraction of unburnable reserves of oil, coal and gas. We do this for each equity index in the scenario where mitigation policies lead to some moderation in global temperatures. The results are shown in chart 7, highlighting the sizeable impact to EM returns, particularly in China and India. In the US, there is only a small downward adjustment to returns; a reflection of the sheer size o f the equity market, even relative to its oil giants.

Chart 7: Reduction in equity returns from stranded assets

Equity cost from stranded assets in Delayed Transition (% p. a. 2023–2052)



Source: Refinitiv, MSCI, Schroders Economics Group. January 2023. 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 exchange.

Our analysis shows that the energy transition has important implications for our assumptions on productivity and inflation. In particular, we find that productivity growth is broadly lower in Delayed Transition compared to Current Policies as a disorderly move towards net zero requires rapidly increasing carbon pricing. We find that aggressive carbon taxation policies also result in substantial inflationary pressures globally. 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, and real estate, along with a look at the historic evolution of most of those forecasts.

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