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Constructing Climate Pathway Scenarios to Assess the Financial Impact of Climate Risk

Climate risk is a rapidly moving space, where regulatory and business requirements are accelerating. To address these demands insurers and pensions funds need coherent, and transparent scenarios which allow them to quantify the financial impact from physical and transition risks.

The release of the phase 2 scenarios by the Network for Greening the Financial System (NGFS) in June 2021 represented a significant step forward in understanding the potential risks and uncertainties associated with different climate pathways, but there is still a long way to go.

To use a set of standard scenarios such as those produced by the NGFS to assess the impact on your asset and liability valuations, a series of additional modeling steps are required. Energy and climate variables must be converted into macroeconomic effects, and then into financial market variables such as interest rates, inflation, and asset class returns.

On climate, economic, and financial assessments, there are many significant unknowns. Basic facts such as the climate sensitivity (how much warming we will see for a doubling of greenhouse gases in the atmosphere), and economic sensitivity (how much damage we see given a level of warming) are both uncertain within a wide range. Technology costs and fiscal responses to climate shocks and carbon prices can further impact the overall results. While the NGFS scenarios may appear to have only a limited number of narratives, the total universe of possible outcomes is much larger when each of these assumptions is considered. Analyzing just one or two scenarios will not be enough to grasp the sensitivity to these underlying assumptions, and to assess the full range of plausible outcomes.

Setting Transparent Macroeconomic Assumptions

The first step in expanding a climate scenario is to consider the macroeconomic impacts. Macroeconomic modeling of climate change often concentrates principally on the impact on GDP, but this focus can obscure the real magnitude of the costs[1]. Acute physical risks like flooding or storm damage can produce significant damages, but reconstruction provides a rebound boost to GDP. Similarly, investments in new transport stock or retrofitting buildings will show as a contribution to overall output. In both cases, however, these are more correctly viewed as opportunity costs, reducing investment available elsewhere or consumption.

To reflect the climate risks in financial markets, we calculate the total impact of these opportunity costs on consumption within a given region. These costs can be classified as adaption costs/physical damages (caused by or in response to physical risks), abatement costs (spending on decarbonization), and allowance costs (carbon taxes, permits, or prices). This "three A" approach to accounting for climate costs aims to quantify the primary impact on economic activity of different climate pathways.

In the phase 2 release the NGFS have expanded the range of macroeconomic modeling they provide. Partnering with the National Institute of Economic and Social Research (NIESR) and using their econometric model NiGEM to produce a range of expanded macro and financial variables. A key assumption in the NiGEM results is the choice of fiscal response. As the NGFS phase two documentation attests, whether carbon tax revenues are used to pay down debt, to offset taxes elsewhere, or are directly reinvested by governments, can even change whether a given scenario is positive or negative for overall output. Given how important the choice of response, and the implicit assumptions about fiscal multipliers are, it is unfortunate that the NGFS scenarios do not offer a range of NiGEM outcomes, making it hard to disentangle the effects of the climate shocks from the fiscal response and to analyze the sensitivity to these assumptions.

In addition to the fiscal rules applied to a given scenario, the technology costs, and availability of different technologies are also critical inputs. The NGFS runs three different integrated assessment models (IAMs): REMIND-MAgPIE, GCAM, and MESSAGE-GLOBIOM. These models differ on a range of modeling inputs, from regional granularity, to land use policies, the potential for carbon capture and storage (CCS), energy system capital costs and their optimization methods. As a result, the energy mix can vary significantly between models, for the same narrative, as can the carbon price, and hence the abatement costs. For example, carbon prices in the Below 2C scenario reach a level of $420 per ton of CO2 to achieve net zero in the REMIND-MaGPIE model, but surpass $850 per ton in GCAM for the same target.

Comparing results across IAMs can help to examine the impact of these variations on overall transition costs and financial returns. In future releases, there will hopefully be a greater range of scenarios focused on different technology pathways: For example scenarios without any significant CCS, or with a more substantial role for hydrogen could produce different results than the current narratives.

The High-Level View

Given the range of uncertainties and layers of modeling used in climate risk analysis it is important to take time to understand the scenarios and the materiality of each assumption before diving too deeply into detailed modeling of the results.

Traditionally, investors have managed their exposure to risk through allocations at the asset class level, and it is a good place to start with climate risk as well. Shocks to consumption can be formally linked to interest rates and to risk premia through a combination of the Ramsey rule and the consumption capital asset pricing model. These shocks will cascade into individual asset classes, providing specific impacts to returns on each class; these impacts will vary across classes and geographic regions.

[1] Focusing on growth in economic output is often critiqued by environmentalists and economists on the basis that many of the economic costs associated with climate change are non-monetary. Further, they argue that focusing on output as a measure of welfare is overly narrow, and that perpetual growth in output cannot be sustainable given finite resources. Our critique is more narrowly applied to the monetary impacts, focusing just on growth in output misses important opportunity costs and investment requirements arising from climate change.

In addition to the impacts from changes to consumption, another channel which can provide a more immediate effect, is inflation. Energy prices increase significantly in transition scenarios, in some cases more than doubling, as carbon prices are passed through to consumers. Energy prices are a direct component of inflation, but also produce secondary effects as higher energy prices are themselves passed along the production chain. While impacts on consumption from abatement spending, or physical damages can take time to accumulate, inflationary effects are often immediate. The drag on consumption, lowering real returns, while energy inflation rises, can create a wedge between nominal and real returns, causing them to move in different directions.

Drilling Down to Individual Sectors

After we have understood the impact of our climate pathways at the asset class level, and determined which scenarios will be of most concern, the next step is to consider how to respond. At this stage, it's natural to drill down into individual sectors. Even in a transition scenario which looks relatively benign at the macro level, there will be winners and losers in different industries.

There are four principal channels through which sector costs are impacted in a climate transition scenario:

- **Demand:** Changes in the structure of the economy can alter demand across sectors. Cost pass-through can also impact overall demand depending on the level of elasticity in different markets. Input-output tables and national accounts of value added by sector can provide a starting point for demand.
- **Energy Costs:** Final energy demand and energy prices are a crucial output from Integrated Assessment Models. Energy costs can increase significantly in early years of a transition scenario.
- **Carbon Taxes:** Carbon taxes are the key driver of policy effects within climate models. Carbon taxes here represent the total direct costs of emitting carbon, and in practice could be implemented as tradeable permits, direct taxes, or regulations such as emissions standards which imply a shadow price. Tax rates can vary by sector and region, reflecting the degree of coordination and how orderly a transition is.
- **Investment:** Significant investment will be required to restructure the economy in a transition scenario. In some sectors investment may be needed just to maintain current demand. As at the whole economy level for each sector and firm there will be trade-offs between paying direct taxes, or higher energy costs and making investments to reduce emissions.

Understanding all of these channels, and their interactions, is essential to provide an accurate assessment of transition costs. Some sectors, such as electricity supply, may currently have high emissions, and hence expect to pay large direct taxes, but they may also be able to decarbonize more easily than other sectors. Renewables are likely to experience significant growth in demand, but this growth does not come for free: debt will have to be raised, or earnings retained, to provide investment in new capital stock.

To maximize value, management and investors need to consider both the expected growth (or fall) in earnings for a given sectors, alongside the costs of capital.

The rate of reinvestment should depend on expected growth, and whether the return on invested capital (ROIC) is higher or lower than the weighted cost of capital (WACC). Growth adds value for existing owners when ROIC > WACC, but when costs of capital are greater than returns it may make more sense to carefully run down a business and return cash to owners. In a scenario where firms attempt to continue investment beyond the point where they can generate sufficient returns, they could end up with stranded assets which ultimately have to be written off.

Making Sense of NGFS Scenarios

Incorporating climate risk into business planning, risk management, and investment decisions poses a significant challenge for insurers and pension firms, but one which is of increasing importance for both internal and regulatory purposes. Scenario analysis built on the NGFS projections can be an invaluable tool in this process, but care must be taken to understand the range of underlying risks and uncertainties.

This is part of a series of papers on climate risk topics for insurers. Read the others here:

» Climate change – The biggest risk multiplier for the insurance industry

» Incorporating ESG into P&C underwriting

» Climate aware Own Risk Solvency Assessment

» Incorporating Climate Risk into Strategic Asset Allocation

» Exploring the impact of IFRS Sustainability Disclosure Standards on Insurers