

Climate scenario analysis: Questions from 1 June 2020 IFoA webinar

Has there been any modelling on how these scenarios may impact on life expectancy as well? I presume there may be some offset for pension schemes from financial impacts?

In the current case study, we did not take this into account. But this topic has been researched. In the Paris pathways, life expectancy is expected to increase in the UK as the expected decrease in cold-related mortality is larger than the expected increase in heat-related mortality. In a Failed Transition pathway, in the coming decades life expectancy will still increase, but this trend will probably stop by the end of this century as heat-related mortality will dominate cold-related mortality by that time. See for instance: *Vicedo-Cabrera, A., F. Sera, and A. Gasparrini (2019). Hands-on tutorial on a modelling framework for projections of climate change impacts on health. Epidemiology 30 (3), 321-329.*

An IFoA working party published a [paper](#) on environmental impacts on mortality in 2018. The paper focuses on air pollution and temperature-related deaths, since this has been the focus of most of the quantitative research into environmental impacts on mortality. However, other environmental impacts may be more significant. In particular, they could have macroeconomic effects such as lower economic growth and higher food prices, resulting in lower healthcare spending and poorer nutrition. These have the potential to far outweigh the impacts of better air quality and milder winters, and could work in the opposite direction.

Did the modelling produce any surprising results or broadly were they what you were intuitively thinking?

We answered this within the webinar. But to add a couple of further observations, the overall outcome is not surprising if you compare with some of the physical risk predictions for a 4 degree warmer world. It is broadly consistent with statements such as that of Thomas Buberl, the CEO of AXA, who commented that a "4 degree warmer world is uninsurable". Those interested may also be interested in the underlying climate science. Nick Spencer referenced these long term projections when opening the IFoA Sessional meeting in November 2018. His remarks are available as a summary in this post <https://www.linkedin.com/pulse/alligators-your-economic-models-nick-spencer/>. The work in the long-term impacts paper presented in this webinar provides a more quantitative basis to these high level remarks.

It would be most useful to see sensitivity analysis on these scenarios, especially if the outputs didn't actually tell us anything new. Like a different baseline scenario which isn't so rosy, different asset strategies, etc. What are the future plans of the working party?

In the working papers, we also discuss the results when the pension fund does not change its investment strategy. Alternative asset strategies can easily be analysed using Ortec's model, but this is not something that is currently scheduled by the working party. With respect to alternative baseline scenarios: of course the current COVID pandemic also impacts the baseline. Future expected returns will be negatively impacted for the coming years in all pathways. But we do not expect that the relative

differences between the baseline and the climate pathways will be impacted significantly. So the conclusions will be similar, but more negative overall.

**Have you explored the impact of error propagation in the models, considering the uncertainty (parameter, model, etc.) associated with each stage of the modelling?
Thanks.**

The stochastic scenario model used to model the baseline does take into account parameter uncertainty. So this is incorporated in the scenario set. We did not explicitly consider uncertainty in the climate impact modelling within our two papers. However, the model can be used to construct and analyse alternative bespoke climate pathways to analyse the impact of different climate modelling choices and assumptions. Ortec Finance can undertake this work with their clients.

The slide showing asset growth median and tails under each scenario seems to suggest that the variation arising from climate change is massively dominated by the variation arising from macroeconomic noise. Given this, are actuaries justified in incorporating climate change into their analysis?

It is true that the uncertainty / bandwidth in the return projections in the climate-uninformed baseline is already substantial. And that the median impacts under the climate pathways modelled are well within these probability bands. However, these climate pathway impacts can still substantially impact expected returns, and therefore the achievability of a scheme's funding plans. Moreover, as explained in the papers, the scenarios considered are not intended to be extreme and the modelling is likely to have a bias towards optimism. Therefore, in the authors' opinion, actuaries definitely should incorporate climate change into their analysis.

Was a General Insurance angle part of the scope of the research papers? Aside from the use of climate change models - in parametric trigger General Insurance products - are there other applications where this research is being used/can be used in the GI world?

The general insurance angle was not explicitly part of the scope, although the results are relevant, particularly for longer-term modelling. This type of modelling is used by other institutional investors across the globe, like insurance companies, sovereign wealth funds and banks.

Is it, or will it be, the professional duty of IFoA-member advisers to present analysis like this to trustees?

[Draft guidance](#) from the Pensions Climate Risk Industry Group sets an expectation that all UK pension scheme trustees will conduct quantitative scenario analysis. The Pension Schemes Bill currently before Parliament is expected to make TCFD reporting, which includes climate scenario analysis, a legal requirement for large schemes. Hence we expect climate scenario analysis to become a standard part of trustee funding/investment advice within the next few years, although some trustees might focus on bottom-up analysis rather than top-down analysis like ours. Regardless of regulatory/legislative developments, we'd expect actuaries to be supporting trustees in meeting their fiduciary duty to understand and manage the risks to their pension scheme and believe that analysis like ours is a useful tool for doing that in relation to climate-related risks

Just a reiteration of the question on longevity: are we allowing for longevity decline?

See previous response: not in the current case study.

How reliable are the assumptions under the climate modelling?

The modelling results for impacts on economic and financial indicators clearly depend on a large body of analysis that links economic activity to global warming via GHG emissions, and global warming to economic activity via gradual and extreme physical impacts. The relationship between cumulative net GHG emissions and global warming has been extensively studied by the scientific community and summaries of the evidence are reported, for example, in the IPCC assessment reports. While predictions are always subject to uncertainty, the consensus is currently strong. The relationship between global warming and impacts on economic activity is much more uncertain as can be seen in the debate following the 2006 Stern Review which pioneered estimates of economic impact. Some economists, notably in the US, have produced modest estimates of GDP impact even from warming of 3°C or more, but these estimates are contested and make no allowance for the potential acceleration of change that could occur if tipping points are crossed. The uncertainty is compounded by the fact that historically-observed differences in economic prosperity across time and places are consistent with various functional forms, some of which imply much stronger GDP impacts than others. Also, the data on these existing differences do not reflect what could happen in a world in which there is much more energy stored in the global geophysical system.

I would be grateful if we could get a flavour of how we expect climate change to affect valuation of Direct Investments/Real Estate assets

Commercial real estate are driven by the same factors as equities: economic growth expectations, inflation and interest rates. Economic growth drives market rents and the probability of vacancies. If expected economic growth is lower, this decreases expected future rental income, just like it impacts expected earnings and dividends for listed equity. Therefore, when a pricing-in shock materializes on the stock market, this will also impact real estate markets. Furthermore, real estate markets are directly impacted by extreme weather events via direct damage to properties. See Appendix F of the long-term impacts paper for more details.

Have you been able to use any historical data to calibrate the responses of the macroeconomic variables to the climate change scenarios, or is it mainly judgement and trying to think through all the linked impacts of climate changes? Thanks for the helpful presentation.

For the response of macroeconomic variables to global warming, see the earlier answer to 'How reliable are the assumptions under the climate modelling?' In short, the estimates of physical impacts draw on literature which estimates the relationship of macroeconomic outcomes to temperature differences from historical data, but such estimates have a wide range of uncertainty. For the response of macroeconomic variables to transition policies, the modelling that drives these results depends on (1) estimates based on historical data for the response of energy use to changes in economic activity and prices, (2) models of take-up of new technologies which are fitted to early take-up data but which are necessarily subject to greater uncertainty (e.g. we do not have much data on take-up of electric vehicles beyond the 'innovators' and 'early adopters' groups), and (3) estimates of future reductions in the cost of clean technologies in response to larger market take-up, based on past experience and technology

expert opinion (also subject to great uncertainty, evidenced by the underestimation of the dramatic fall in solar PV costs over the past 15 years).

How does the Paris Disorderly transition compare to what we are currently experiencing under COVID19. Have we had the "disorderly transition" already.

Already answered during the webinar. But the short answer is No, we would expect a disorderly climate transition to be quite different.

Does the concept of growth assets mean anything in a severe climate change scenario?

Already answered during the webinar. But the short answer is that in the long run, when the transition fails, there will be no growth assets.

Why does the graph on slide 27 not mirror the graph on side 26? 26 shows funding level currently of 75% trending upwards, but 27 shows all scenarios starting at 100% trending downwards?

Slide 26 shows funding ratio LEVELS, whereas slide 27 shows ratios (median funding ratio climate pathway / median funding ratio baseline). For all three climate-informed pathways, even though the median funding ratio increases, it does not keep up with the baseline median funding ratio development.

How were the financial shocks modelled?

See the papers. Short answer: Current equity valuations have not yet (fully) priced in the impact of a change in expected future economic growth caused by climate change. We apply a standard corporate finance pricing model to translate changes in expected future growth on country–sector level (from the E3ME model) into regional and global equity market shocks.

What can we as actuaries do to increase the credibility of the scenarios? This would naturally lead to the increased awareness of the decision makers.

The authors think the climate pathways are credible and consistent with IPCC projections. So the question is how do we raise awareness with decision-makers. We think this is very important. A first step for actuaries is to take the work of economists and long term climate projections and help translate them into economic and financial terms. This shows that we either find the transition investment now, or we won't be able to pay later (with ever greater impacts caused by passing through "one-way doors" of irreversible damage.) The second responsibility of actuaries is to bring these facts, these risks, to the attention of regulators and policy makers which is clearly acting in the public interest.

To what extent does the model allow for markets adapting to price in the future climate impacts in to assets?

It makes allowance for all listed assets and real estate. The papers provide details.

How does sponsor covenant interact with this modelling? i.e. are there points in the modelling where impact to GDP is so severe that many sponsor covenants fail and people don't receive their pensions at all

The implications of climate risk for sponsor covenant can be considered as an overlay to the modelling. Figure 9 in the second paper (“Climate scenario analysis: An illustration of potential long-term economic & financial market impacts”) shows how average equity returns might vary by sector under the three scenarios considered and this could provide a starting point for such analysis, combined with knowledge of how the sponsor’s climate risk exposure and climate risk management differs from the industry average.

The probability of sponsor insolvency may be higher under some scenarios than in the baseline case, particularly where GDP is significantly lower. We note that, for the scenarios modelled, the most severe economic impacts occur under the Failed Transition pathway over the longer-term. Over time, the proportion of DB benefits expected to be provided by insurers is expected to increase and so the solvency of insurers will become increasingly important to the question of members’ benefit security.

On the "so what" question - did you test the outcomes using e.g. different investment strategies and how much difference did it make? Can the trustees do anything that would actually make a difference?!

Our case study paper illustrates the impact of maintaining the same asset allocation throughout, ie not reducing investment risk from 2030 onwards. We did not test other investment strategies in detail, but in the paper we comment in high-level terms on the impact of differing high/low risk asset allocations and the sensitivity of the results of the timing of switches out of high risk assets relative to market pricing shocks. The modelling suggests that reducing the allocation to higher risk assets such as equities will, on average, reduce the scheme’s climate risk exposure. In practice, we would expect trustees to first look at the extent of their climate risk exposure within asset classes and seek to reduce it, for example by switching into a low carbon equity fund or amending segregated mandates to require decarbonisation over time.

With Covid we are contemplating entrenched negative interest rates and/or inflation. Given the major climate impacts, ageing populations and pressure on resources, how far do these factors come into the analysis?

The impact of ageing populations, climate change and pressure on resources on interest rates and inflation are explicitly taken into account. However, as the analysis is based on the December 2019 situation, the analysis does not reflect the COVID impact.

How would a larger holding in ESG assets change the results under the 3 scenarios in the case study?

In a Paris transition pathway, when your portfolio is tilted towards low-carbon electricity and underweighted in fossil fuel sectors, this will improve returns. As the modelling is top-down, it is not able to reflect granular differences in the ESG characteristics of assets. Instead, it can be complemented by bottom-up modelling that explores the extent of climate risk exposure within asset classes.

Is there an element of climate risk already factored into market assumptions?

In our modelling, we assume that only current climate policies and current levels of physical risks and extreme weather event impacts are already priced in. So we assume that equity markets are ignoring the increasing number of natural disasters. See also a recent article in The Guardian on this topic.

https://www.theguardian.com/business/2020/may/29/markets-not-paying-attention-to-climate-crisis-imf-warns?CMP=Share_iOSApp_Other

Much pension related work centres on DB plans. It was good to see some mention of DC in the UK consultation on TCFD but I'm interested in views on how actuaries in DC should be including climate scenario modelling in design of DC plans (investment, benefits etc), esp given longer time horizon for DC?

The modelling can be applied to DC assets in the same way as for DB. Given the longer time horizons and higher allocation to growth assets, DC schemes will typically have a higher exposure to climate risks than DB schemes. Top-down modelling like that in our paper can help DC trustees explore the impact of climate change on different investment pathways. Bottom-up modelling (which is currently mainly available for equity and corporate bond portfolios) can then help trustees to select less-exposed investment funds to use within those pathways.

Population impacts are going to be really important for pension schemes and life insurance companies so are a pretty key variable to be missing. Is there any plan to try to introduce these? Either by the working party or other groups?

This remains very much at the frontier of research, as robust estimates of the drivers of migration or climate change-related mortality have yet to be established. A large number of drivers are at work and the data are complicated by population movements in response to war or natural disaster that are followed to some extent by return some years later when conditions improve. While it would be possible to include formal migration equations based entirely on assumptions and thereby 'solve' the problem, we think it would be misleading to do so if such equations have little or no empirical support. In addition, while the IFOA and International Actuarial Association has done significant research on the potential impacts of climate change induced mortality changes, further research around the temperature-mortality relationship is necessary. Currently, therefore, the way to approach this would be to construct a small number of scenarios for population impacts, with alternative assumptions for scale of response. The working party does not currently have plans to carry out further research in this area.

When the Make My Money Matter campaign is shortly launched, how well prepared do the actuaries on the panel think their pension fund clients are prepared to answer questions from beneficiaries based on this work?

It will be helpful for those advising Pension Funds to look at the website, www.makemymoneymatter.co.uk. They can consider how they can help their clients with any questions that arise.

Do you have a view as to how we can work to integrate this into the everyday thinking of dB pensions - I.e to maximise the adoption and implementation ASAP - or do you think this will be a gradual adoption?

As outlined in answer to another question, we expect climate scenario analysis to become a standard part of DB pensions advice during the next few years due to legislative and regulatory requirements. This will entail a steep learning curve for actuaries, particularly if their firm is not already developing its climate scenario analysis capabilities, so they should start building their knowledge and skills in this area now. The IFoA is supporting this process through a number of webinars this summer.

Most integrated climate-economy models have their GDP growing over time which is counter-intuitive assuming climate will have negative impact on our economy. How Ortec managed to keep it as per our expectation?

There are a range of views on how sensitive macroeconomic variables are to global warming (see the earlier answer to 'How reliable are the assumptions under the climate modelling?'). Cambridge Econometrics thinks that the arguments against modest estimates carry weight and so adopts higher estimates from the literature. This approach is also consistent with the IPCC view on the urgency of the need to address climate change, which implies more severe impacts from global warming than many Integrated Assessment Models predict.

Are the standard FCA projection rates (2%, 5% 8%) still relevant? Is it realistic to expect returns as high as 5%?

We do not wish to comment in detail, but note that our projections illustrate why all analysis based purely on historic trends need to be reconsidered in light of climate impacts that will be different than those implied by historic data.

How do you quantitatively consider interaction (correlation/dependency) between asset classes moving over time due to climate change?

The stochastic scenario model used explicitly takes into account interactions between asset classes in the baseline. Furthermore, in translating the pricing-in shocks in the different pathways, we explicitly take into account interactions between equity, corporate bond, and real estate markets (for example, when stock markets go down, spreads tend to go up).