Climate-Aware Investing and Fixed Income

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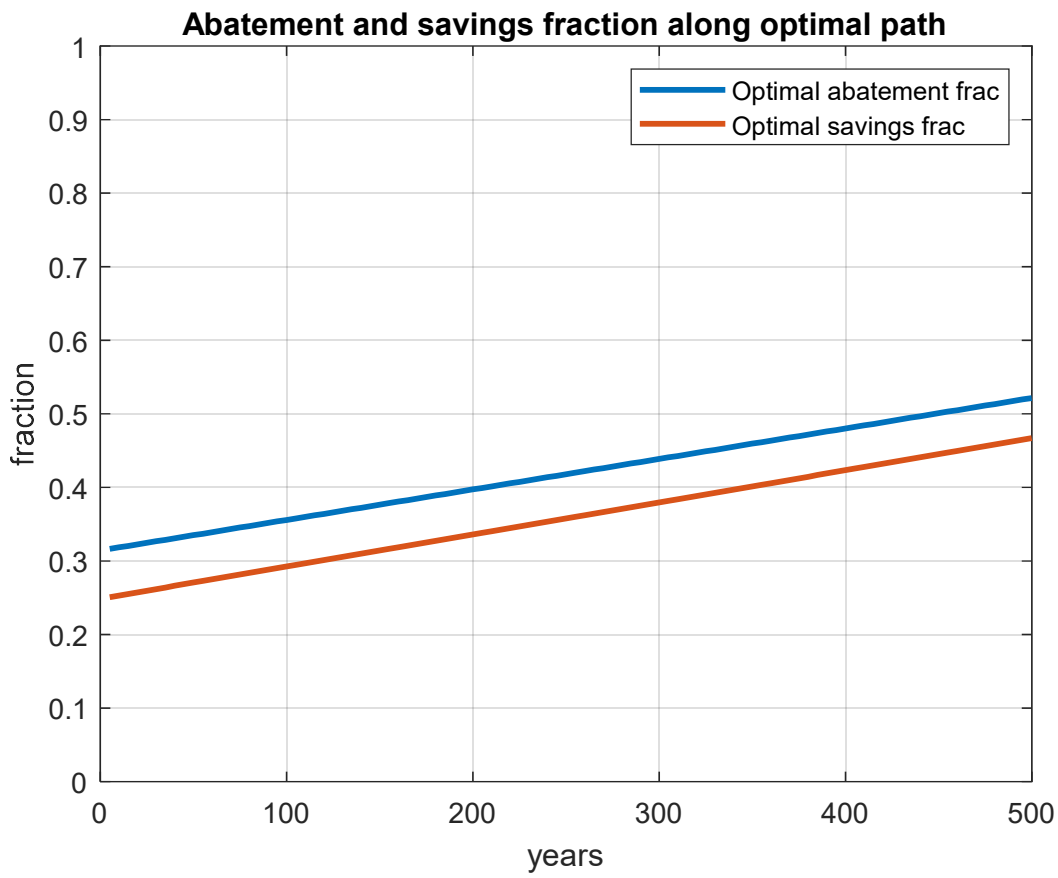
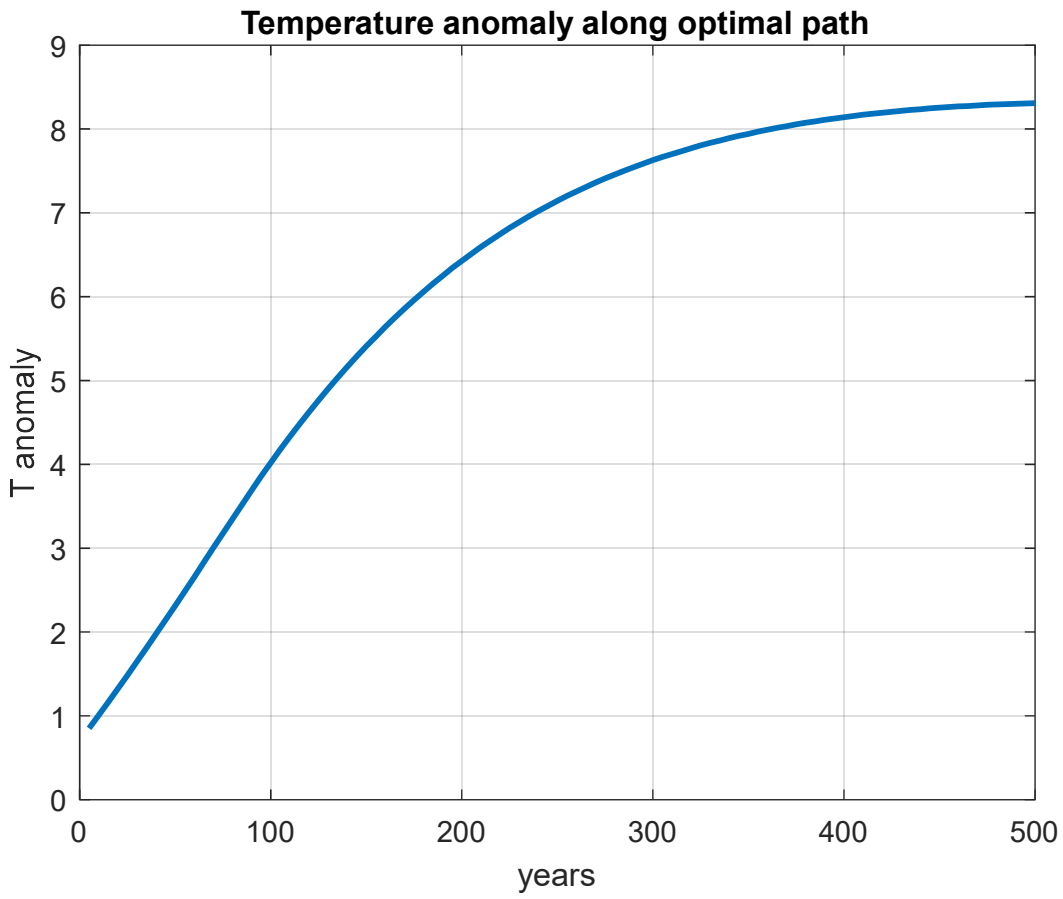
Integrated Assessment Models (IAMS) and Asset Pricing

- What can Integrated Assessment Models tell us about asset prices in the presence of climate change?
- An ***absolute*** dimension
  - Holders of financial assets (providers of capital) will reap what the economy produces after labour has been paid.
  - If climate change affects future production, then the fraction distributed as dividends and interest will change
- A ***relative*** perspective
  - Depending on the climate outcome *and on the abatement efforts* some sectors will do better than others.



No uncertainty

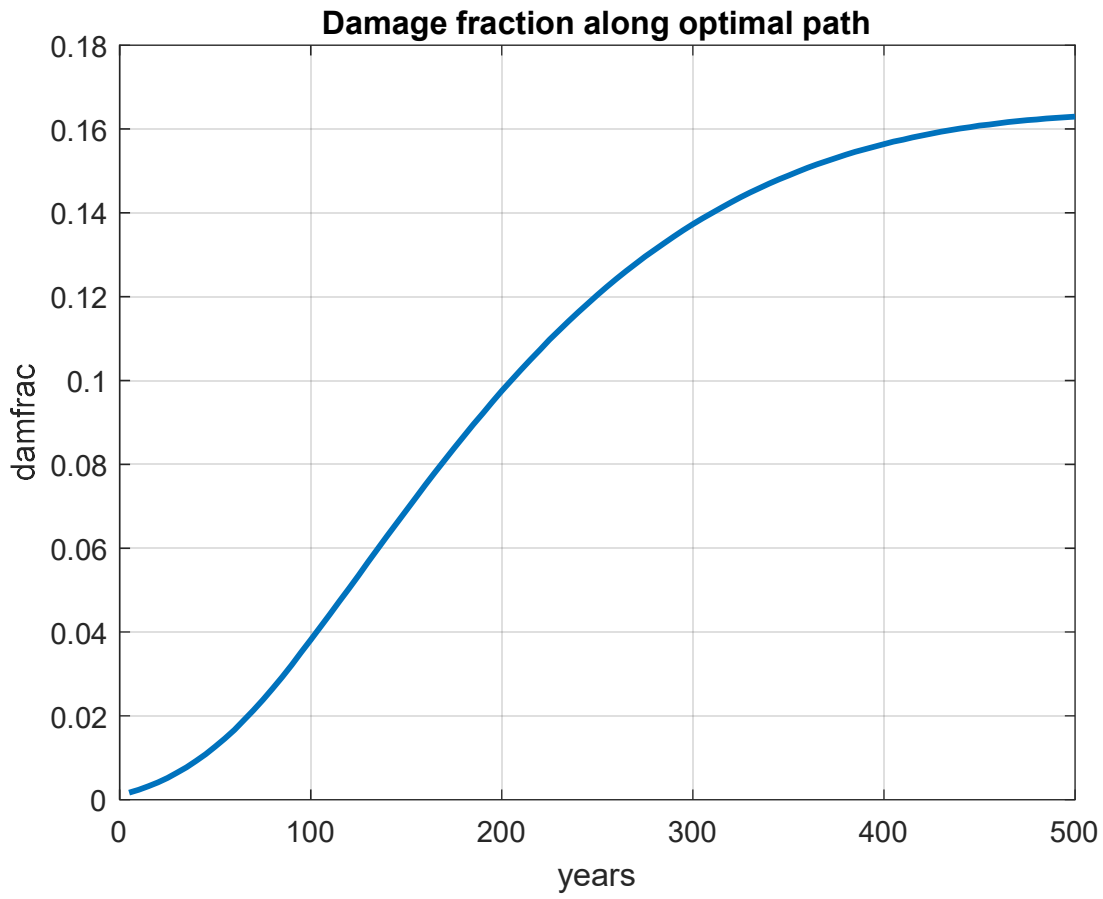
- Without uncertainty investment is backloaded:
  - we will be richer
  - we will have better technologies



Temperature anomaly - deterministic

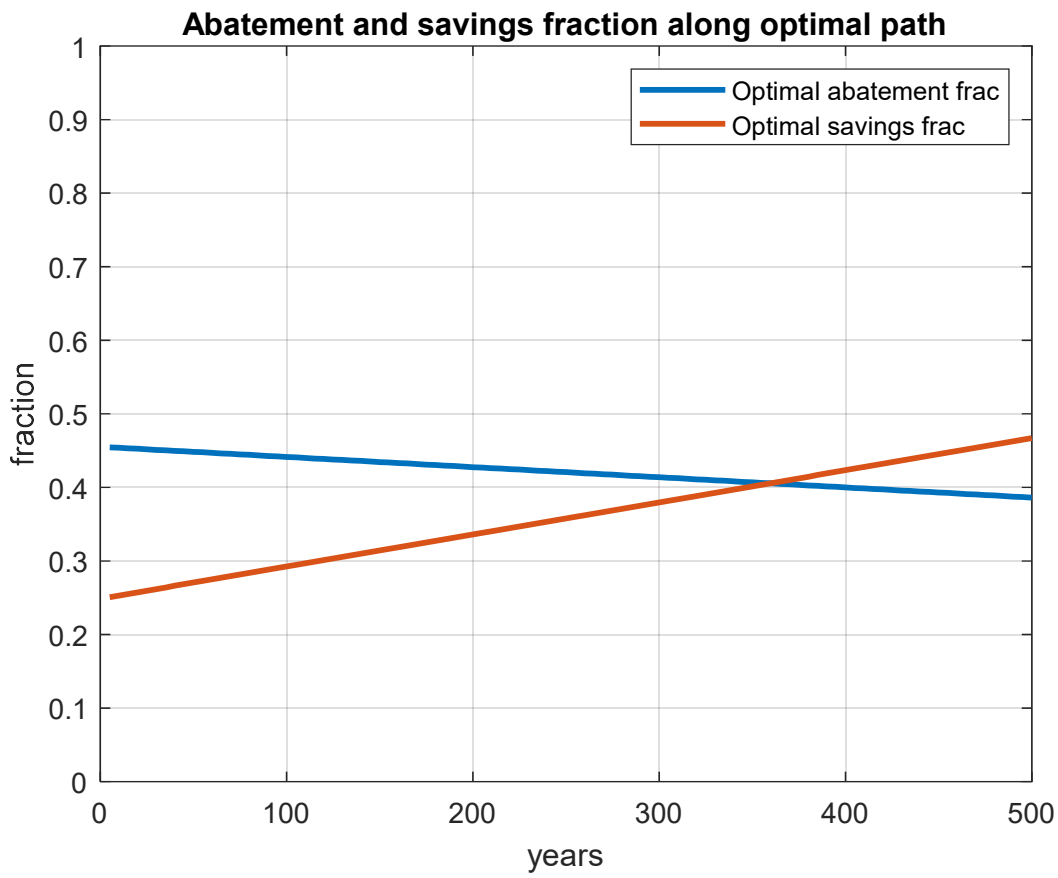
Temperature anomaly along optimal (deterministic) path is

4 C in a century.



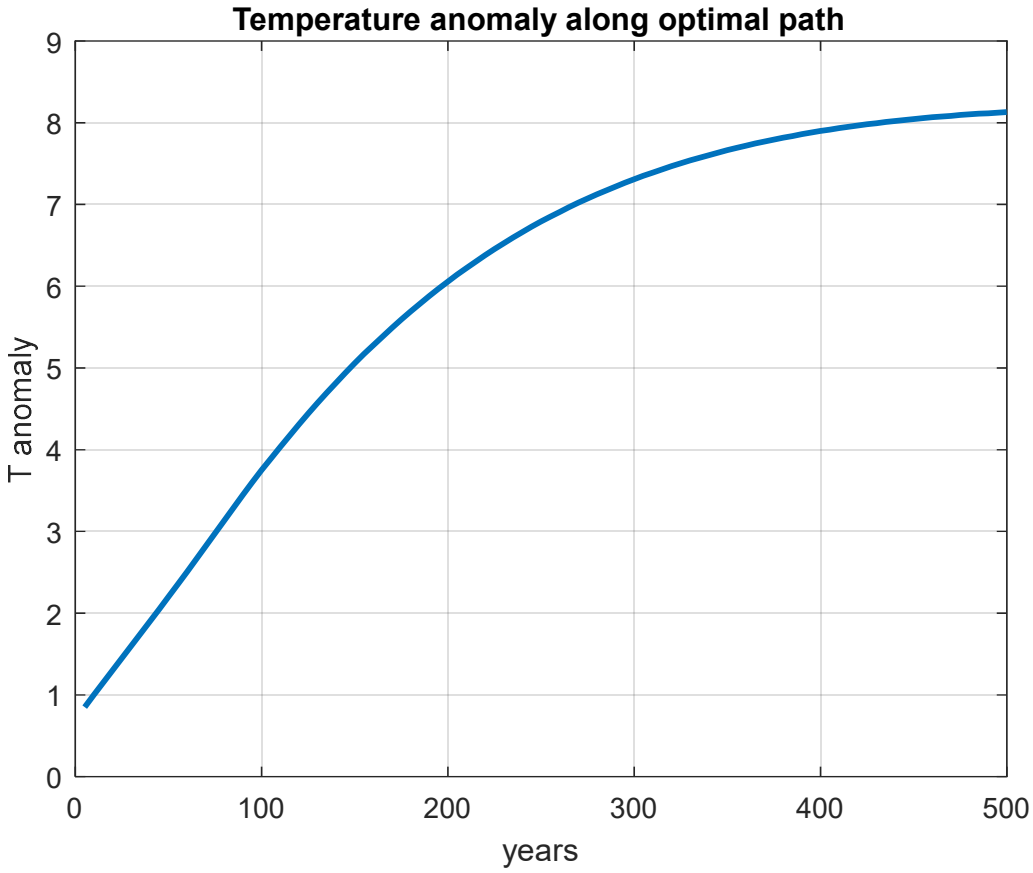
Along deterministic path

Damage fraction around 4% by the end of the century.



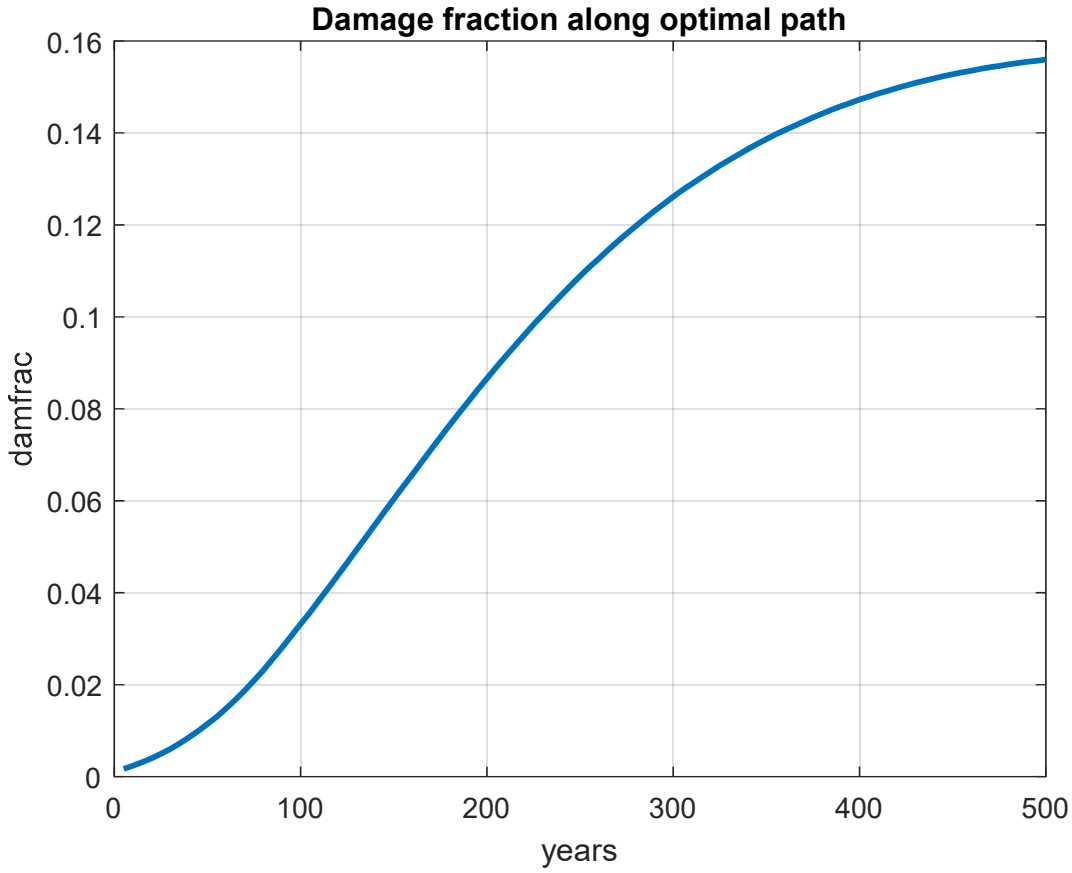
After uncertainty

- After inserting uncertainty, optimal abatement fraction becomes front-loaded.
- Major investment should start now.



After uncertainty

- Optimal temperature anomaly by the end of the century is about 4 C also after uncertainty

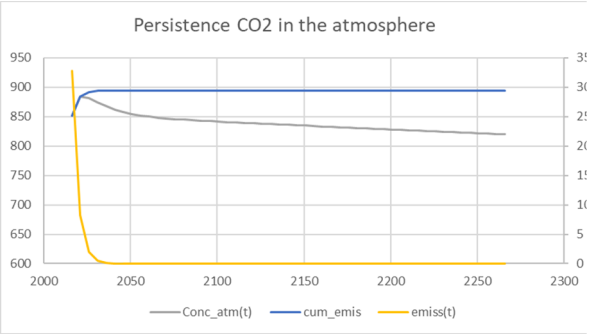


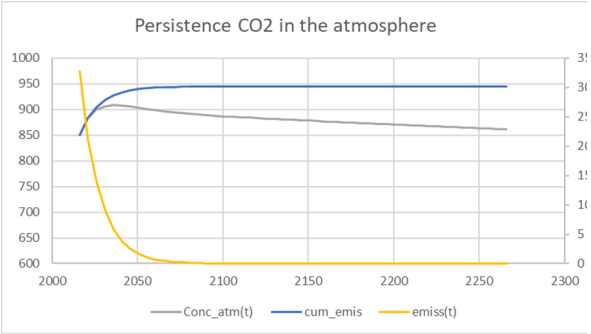
After uncertainty

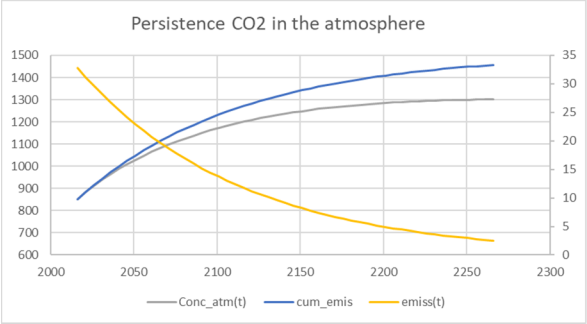
- The *optimal* damage fraction predicted by DICE is small by the end if the century.
- DICE does not consider tail events.

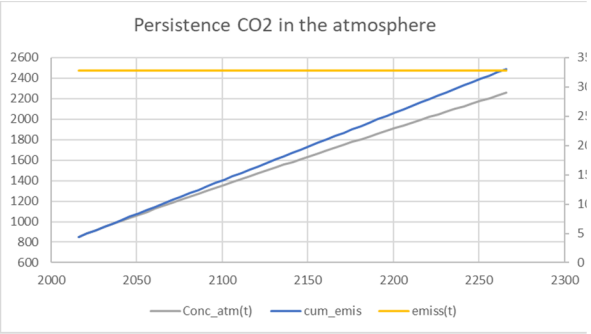
Growth – The size of the pie

- According the DICE *deterministic* path, after abatement costs and damages from climate change
  - in 100 years we will be approximately 9.5 times richer than today in real terms – the World will be on average about as rich as Luxembourg today;
  - the continuously compounded real growth rate for the next 100 years will be 2.25%
- After introducing a front-loaded abatement schedule, the growth remains very similar.
- The DICE damage fraction changes net production vey little.
- According to *all* these projections, providers of capital will do from extremely well to very well.
- *Another case of Ramsey's "weakness of imagination"?*





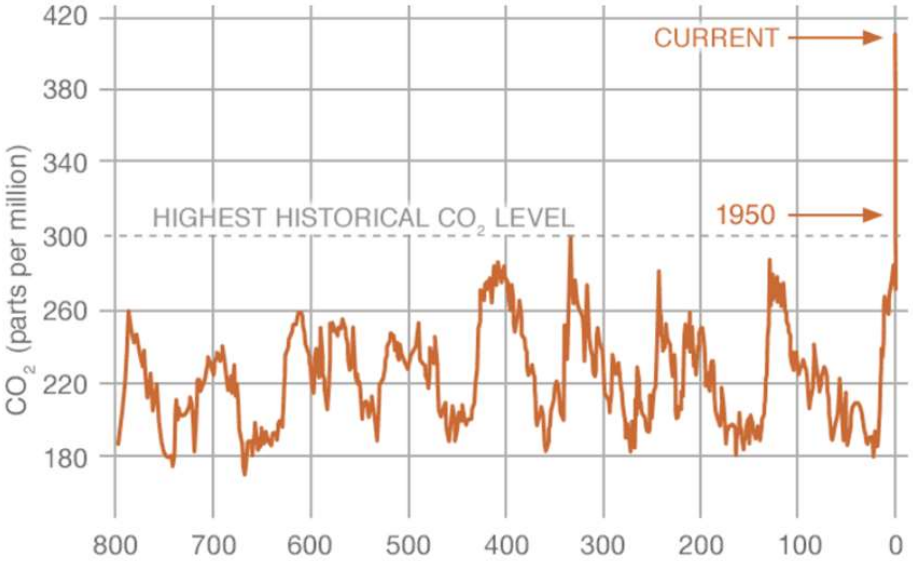




Sector Differences: Concentration paths for different emission paths

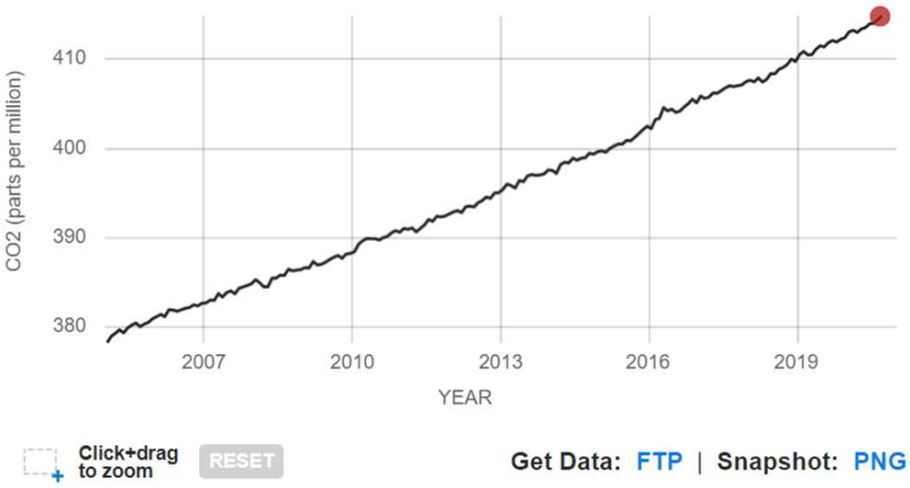
- The persistence of C02 is very high even if we stop emissions very abruptly.
- **Negative emission technologies must play a big role in effective climate control.**
- Established technologies are either
  - very land intensive (BEECS)
  - very energy intensive

Data source: Reconstruction from ice cores.
Credit: NOAA



DIRECT MEASUREMENTS: 2005-PRESENT

Data source: Monthly measurements (average seasonal cycle removed). Credit: NOAA



Actual path of CO2 concentration

Concentration of CO2 in the atmosphere

- The natural removal time of CO2 from the atmosphere (e-folding time) is *extremely long*.
- Early estimates (50-100 years) are currently thought to underestimate concentration in the atmosphere by *orders of mgnitude*.
- Serious climate management requires
  - sequestration and storage
  - negative emission technologies
- **Both require infrastructure investments on war-effort scale.**
- ‘Marginalist’ analyses are wholly inadequate.

Sectoral Differences: The Negative-Emission Effort

- Negative emission without enormous competition for land (BECCS, forestation) requires sequestration (at origin and from the atmosphere) and storage.
- Atmospheric sequestration is *very* energy intensive.
- For it to make 'climate sense', the energy must come from renewables or nuclear.
- Massive subsidies are needed: **via taxation or by increasing debt**?

From climate facts to asset prices

- *If* serious action is taken to curb climate change, the allocation of resources in the economy will be *transformed*.
- If serious action is *not* taken there could be serious negative repercussion on economic growth.
- Both these factors will have implications
  - for the overall level of assets (size of the pie)
  - for cross-sectional variations in asset returns
- Net returns to capital providers and return to labour may change depending on
  - the level of taxation
  - the level of infrastructure commitment.

Cross-Sectional Variation in Asset Prices

- Asset prices can be expected to have a cross-sectional variation in temperature exposure.
- One source of this cross-sectional variation is the exposure of their payoffs to macroeconomic growth risks (i.e., consumption risks).
- Since climate change affects consumption dynamics, assets that are highly exposed to consumption growth risks are highly affected by climate-change risks.
- Bansal, Kichu and Ochoa (2019) show that "*cross-sectional differences in consumption risks in assets' dividends translate into cross-sectional differences in temperature risks in assets' returns*".

Cross-Sectional Variations: Market signals versus structural analysis

- **The prevailing market-signal approach**:
  - determine the sensitivity of different assets to climate (temperature);
  - read from changes in prices due to changes in temperature expectations the 'climate beta' of an asset;
  - build long-short portfolios to extract the 'climate factor'.
- Assumption: **strong version of informational efficiency of prices.**
- All of this in the midst of the price distortions brought about by Quantitative Easing

Structural Analysis: Three scenarios

1. **Business as usual – *not* the BAU of IPCC**
2. **Muddle along – "window dressing", partial solutions**
3. **Optimal Action – problem tackled in economically optimal way**

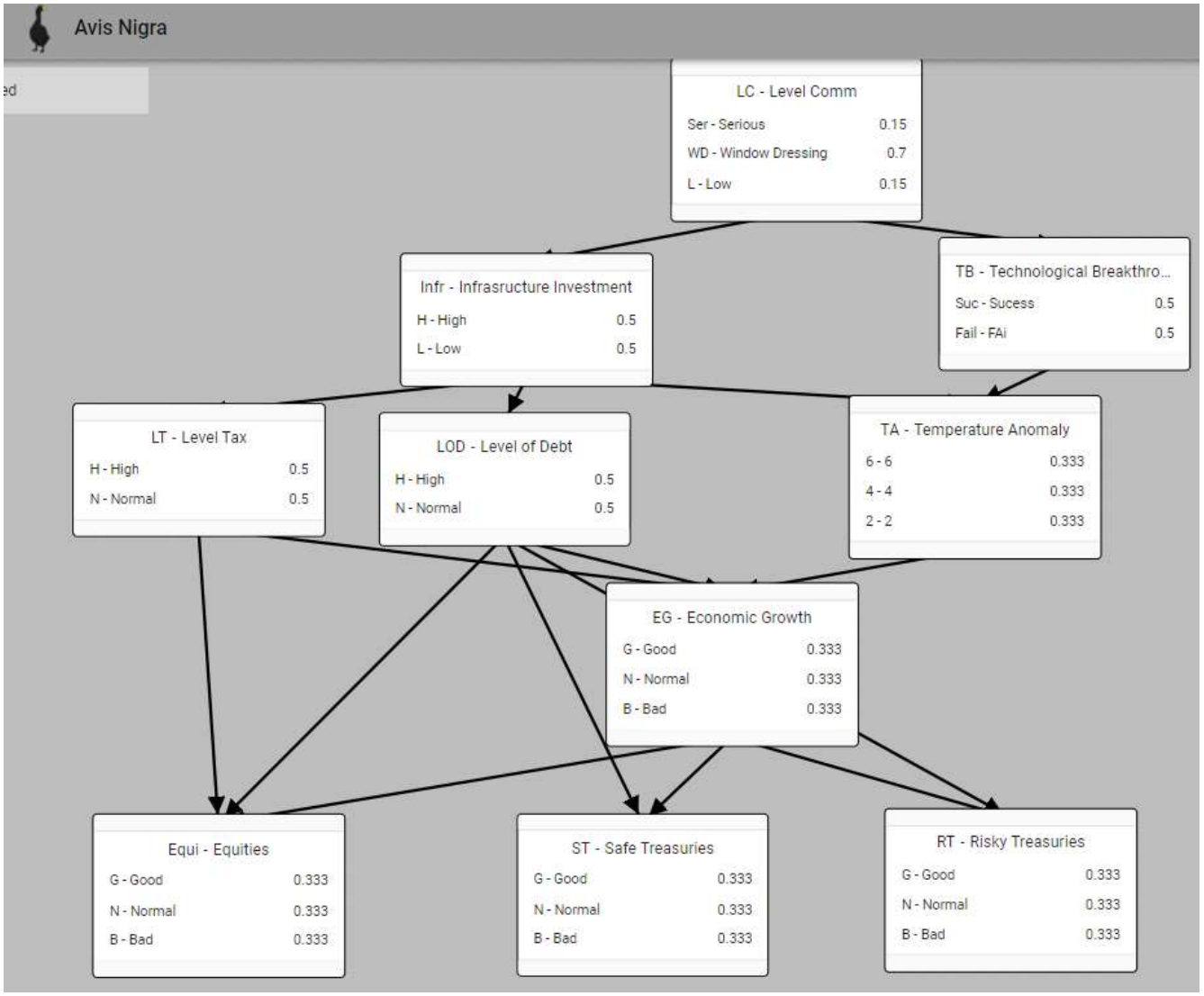
- The
  - redirection of resources
  - size of the pie
  - cross-sectional variation

  differ strongly in the three scenarios.

Structural analysis

- **The structural analysis approach**
  - Focus on a small number of key scenarios – as above
  - *For each scenario*, work out implications for
    - economic growth – the ‘size of the pie’
    - level of government debt and interest rates required to finance the abatement effort
    - cost of capital
    - the level of taxation
    - level of required infrastructure investment (employment, pricing power of labour)
    - inflation
  - Establish scenario-dependent sensitivity of different asset classes to these macrofinancial drivers.
  - Average over scenarios.

A Bayesian net application



Conclusions

- It is currently difficult to use IAMs to gauge the impact of climate change on asset prices.
- It is clear, however, that serious management of CC requires **major redirection of productive capacity**.
- On the other hand, failure to act could have economic consequences more severe than what many IAMs currently project.
- The outcome for prices
  - is strongly scenario-dependent;
  - has a cross-sectional and size-of-the pie dimensions
- Working out the sensitivity of asset prices to the macrofinancial variables affected by CC may be easier than estimating a 'climate beta'.