



Modelling response measures: A global application for 1.5°C

Assessment with the E3ME-FTT model

Hector Pollitt, Cambridge Econometrics

Co-authors



Hector Pollitt, Unnada Chewpreecha
Macro-econometric modelling using E3ME

Radboud University



JF Mercure, Aileen Lam, Pablo Salas
Energy supply/demand modelling using FTT



Phil Holden, Neil Edwards
Climate modelling using GENIE-1



Contents

- Introduction
- Method and modelling approach
- Results from the analysis
- Key conclusions

e3me

Introduction

- Much of the analysis assessing climate targets focuses on carbon pricing in the energy system
- Here we put real-world policies into a model based on real-world data and test different groups of policies

Macroeconomic Modelling

- It is not usually possible to carry out real-world macroeconomic experiments
- Computer modelling provides the next best alternative – but it is a simplification of reality
- There are many types of model, each with its own strengths and weaknesses – it is important to use an appropriate tool for assessment

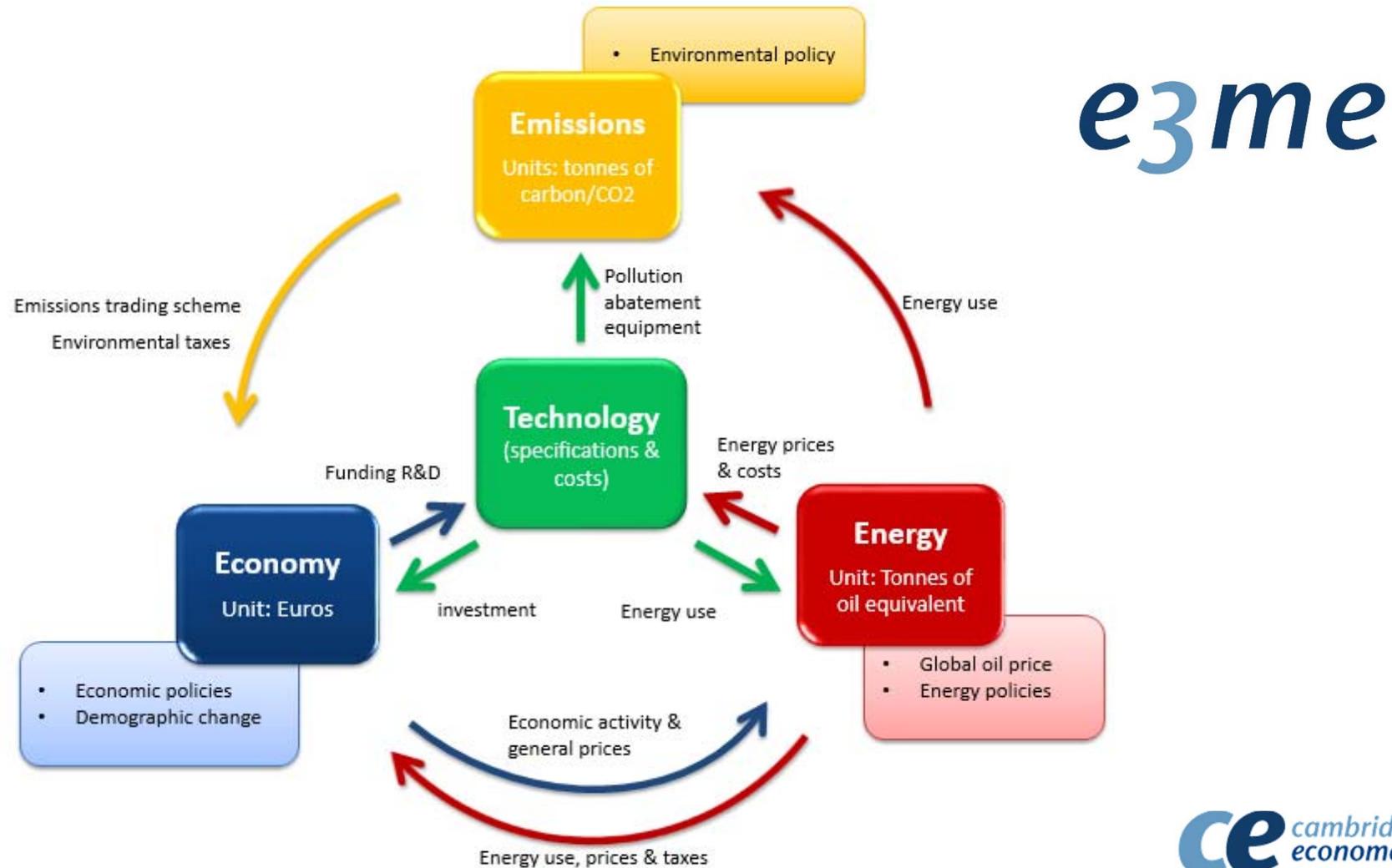


Optimisation and Simulation

- Optimisation models are used to estimate 'least-cost' pathways – they are used extensively by the IPCC
- Simulation models are used to test individual policies
- The distinction is important – using the wrong approach can give misleading results!



Approach: The E3ME Simulation Model

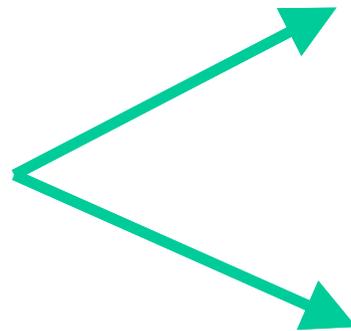


E3ME: Not a CGE Model!

- Macro-econometric model based on a post-Keynesian framework
- Optimisation not assumed
- Demand = Supply... but
- Demand \leq Potential Supply
- Under the right conditions it is therefore possible for regulation to increase output and employment

e3me

The FTT:Power Model



t



$t + \Delta t$

mbridge
onometrics

The FTT:Transport Model



t



$t + \Delta t$

mbridge
onometrics

Cross-Sectoral Policies

- Energy efficiency – assumed to be the same as in the IEA 450PPM scenario and scaled up by 25%
- Carbon prices that increase up to 2050 to \$500/tCO₂
 - govt balances are balanced by adjusting a combination of incomes taxes, sales taxes and labour taxes

Year	Rate (2008\$/tCO ₂)
2020	50
2030	180
2040	300
2050	500

Power Sector Policies

- **Feed-In-Tariffs**
 - 100% of the difference between renewables cost and the spot price, plus 10-20% additional incentive to promote uptake
- **Direct subsidies on investment**
 - Up to 60% of the investment cost for renewables, decreasing over time
- **Increased storage capacity and interconnection**
- **Lifetimes of fossil plants reduced to 20 years**
- **Limitations on BECCS to avoid over dependence on biofuels**

Road Transport

- More efficient ICEs from 2017
- Regulation to stop sales of the most polluting vehicles from 2018
- Taxes on vehicle registration in relation to their emissions
- Fuel tax, \$0.50 per litre
- Biofuel mandate, increasing to 97% by 2050
- Initial public investment in EVs to kick-start production across the world

Other Policies

- Forced phase-out of coal in Chinese industry and district heating systems
- Gradual electrification of household heating through regulation (3% pa)
- Aviation is moved to biofuels from 2020 at 10pp pa, so largely decarbonised by 2030
- Emissions from industrial processes are assumed to fall at 3% pa in relation to production, although the technologies are not yet clear
- Similar reductions assumed in non-energy GHGs

Impact on Emission Levels

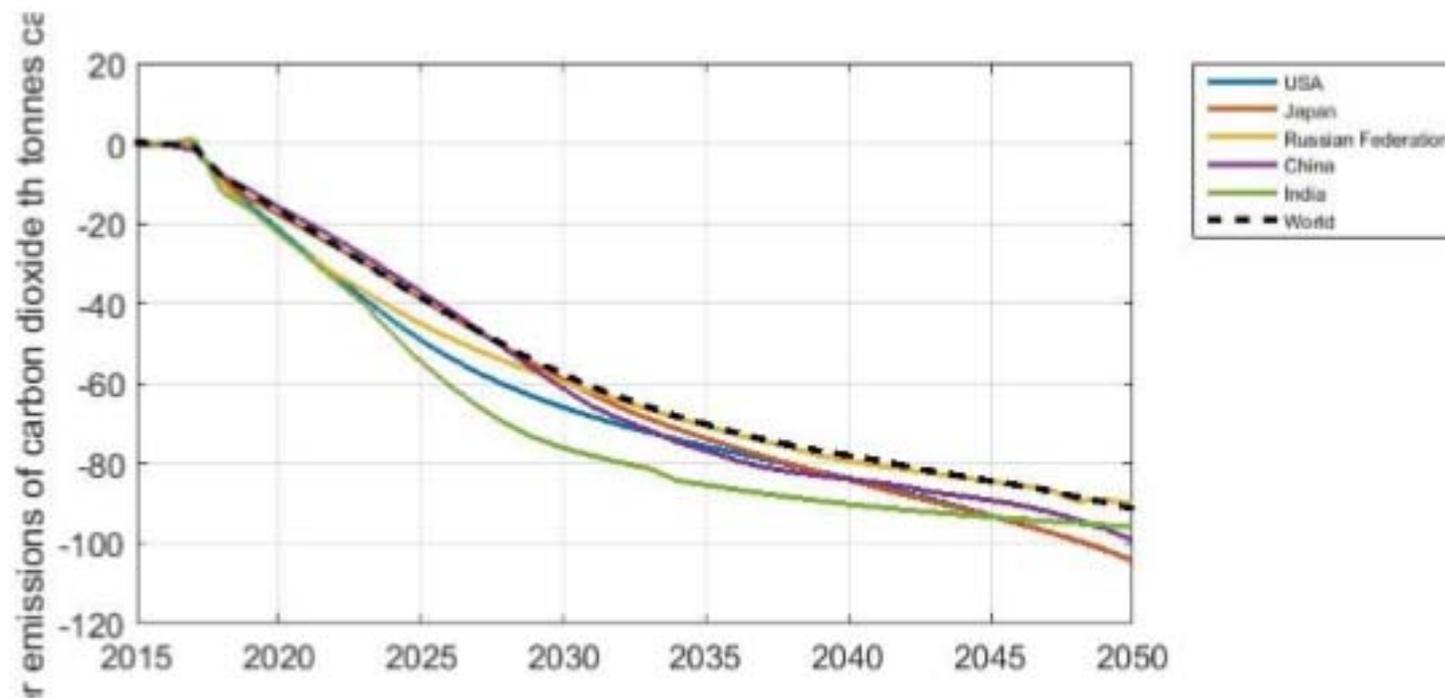


Figure 4: Reductions in CO₂, selected countries

Figure shows change in emissions levels compared to baseline.

Impact on Global Temperatures

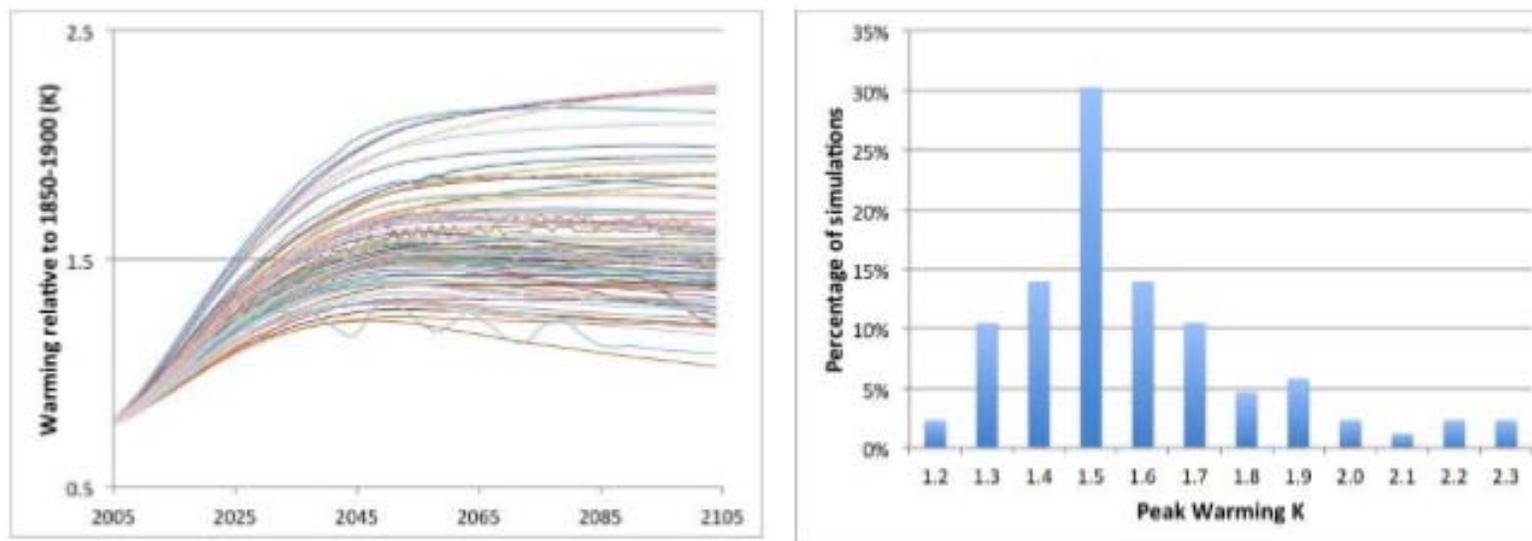


Figure 5: (Left) Simulation ensemble on the climate modelling platform using GENIE-1. (Right) Number of runs yielding stabilisation temperatures in ranges of 0.1°C between 1.2°C and 2.3°C.

Figure shows change in global temperature compared to baseline.

Impact on GDP

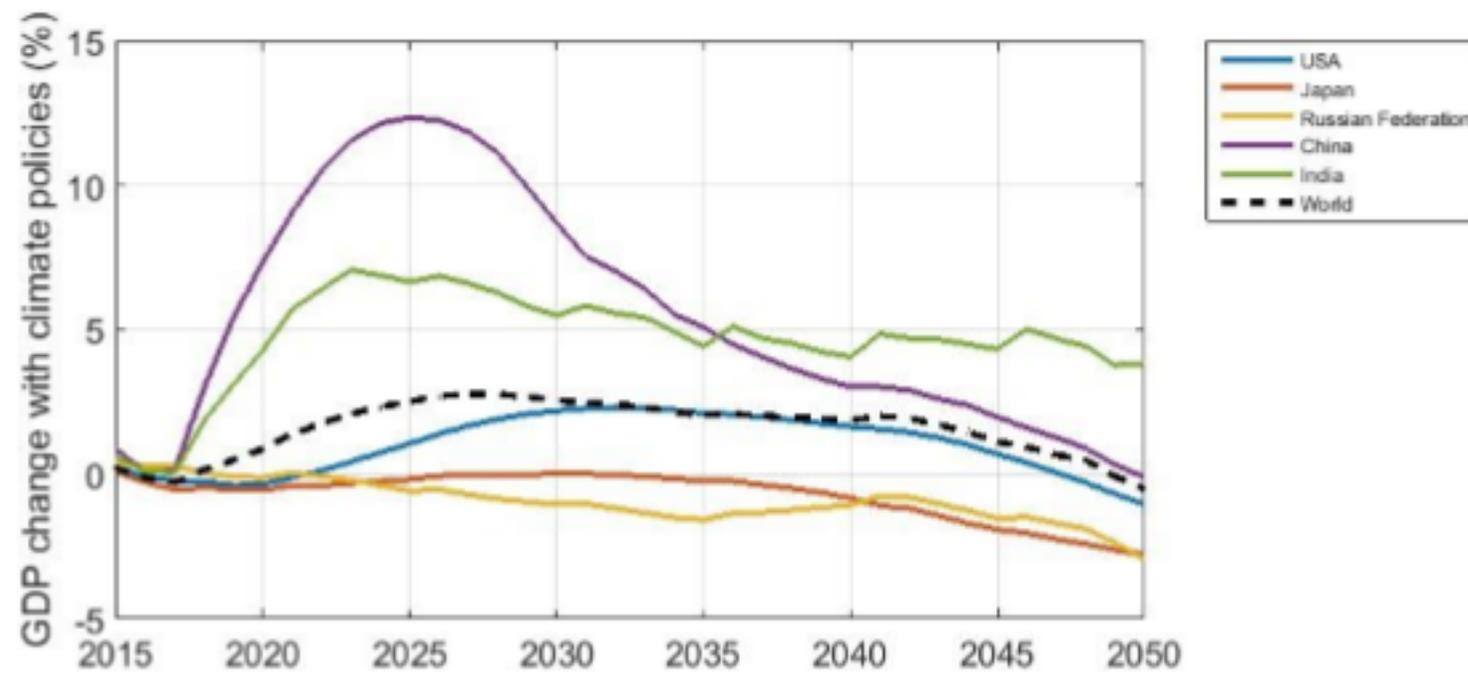


Figure 6: Impact on global GDP and that of selected countries

Figure shows change in GDP compared to baseline.

Change in Employment Levels

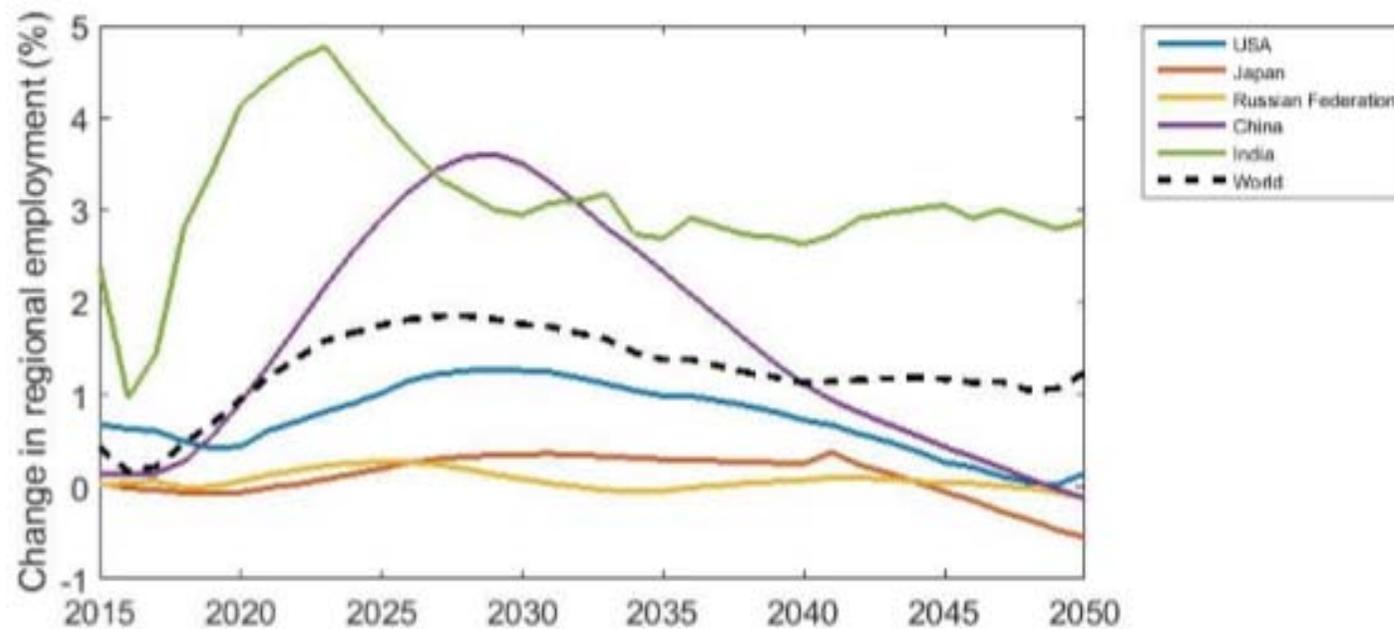


Figure 7: Impact on global employment and that of selected regions

Figure shows change in employment compared to baseline.

Conclusions

- The modelling does not rule out the possibility of meeting a 1.5°C target, but:
 - a broad range of policies across all sectors/countries is required
 - action must happen almost immediately
- The carbon price needs to be high, but not unrealistically high
 - sensitivity testing showed that once it reached a certain level further increases had little impact

Conclusions (cont.)

- There is a short-run potential benefit from a large investment programme aimed at reducing carbon dependency
- Employment could benefit from higher labour intensities
- Global energy prices fall and could have a dramatic impact on energy-exporters – this needs further research



Modelling response measures: A global application for 1.5°C

Assessment with the E3ME-FTT model

Hector Pollitt, Cambridge Econometrics