

Energy and climate policy in a DSGE model of the United Kingdom

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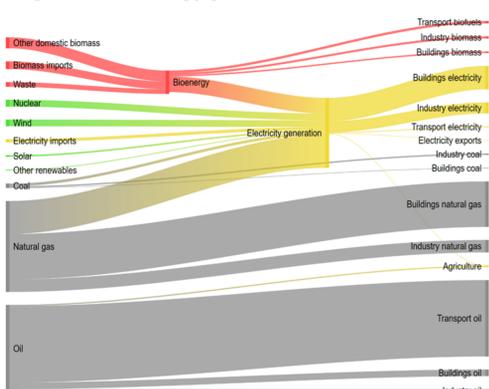
Abstract

We build an open economy Dynamic Stochastic General Equilibrium model with energy and use it to simulate the impact of different climate policies – specifically the introduction of a carbon tax and bans on petrol or gas usage – on macroeconomic variables. We show how the different policies lead to falls in both households' consumption of energy and firms' use of energy in production, while also having the effect of shifting the production of electricity from fossil fuels to renewable sources. GDP and the gross output of non-energy fall in response to the various policies. Electricity production rises in response to the carbon tax but falls in response to bans on the consumption of petrol and gas. Finally, the policies result in a temporary increase in inflation and a tightening in monetary policy.

Introduction and Motivation

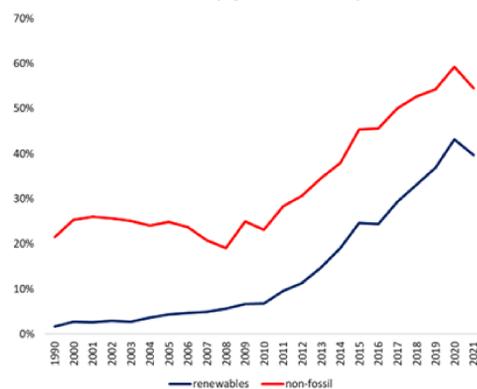
- Climate change is the most important trend affecting our economy
- Physical risks
 - Rising temperatures
 - More extreme weather events: floods, drought, etc
- Transition risks
 - Moving to new 'green' technologies is costly
 - Stranded assets
- We concentrate on transition risks and what policies to bring about the transition may mean for the economy
- UK government issued 'Net Zero Strategy' in October 2021, which includes:
 - Commitment to expand current UK ETS
 - 'By 2035 the UK will be powered entirely by clean electricity'
 - '2030 commitment to end the sale of new petrol and diesel cars' and 2035 commitment that all cars must be fully zero emissions capable
 - 'An ambition that by 2035, no new gas boilers will be sold'

Figure 3. UK energy generation and end uses



Source: HMG (2021) 'Net Zero Strategy: Build Back Greener' Figure 5: 2019 energy generation and uses

Chart 1. UK electricity generation by source



Source: BEIS: UK energy in brief 2022

Results

- Kick-start the transition by imposing a permanent carbon tax
- Energy and non-energy are complements
- Higher energy prices imply lower demand for energy
- Firms employ less energy and less of other factors of production
- And labour is less productive.

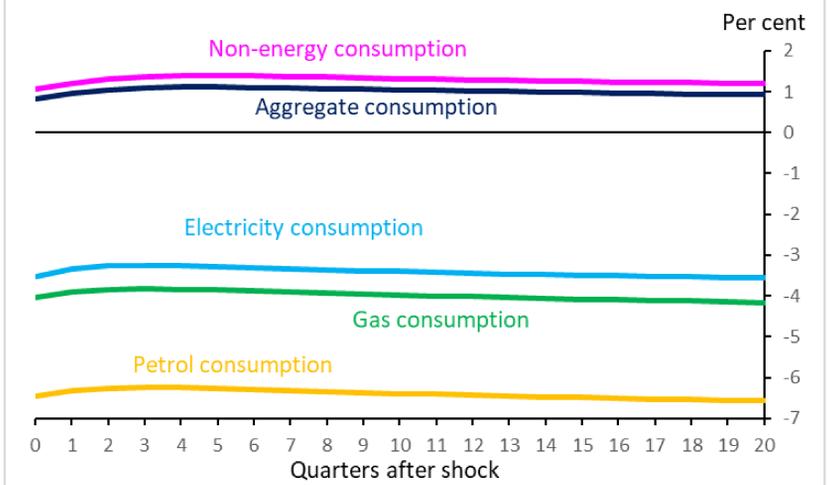


Chart 2. Effects of a carbon tax on consumption.

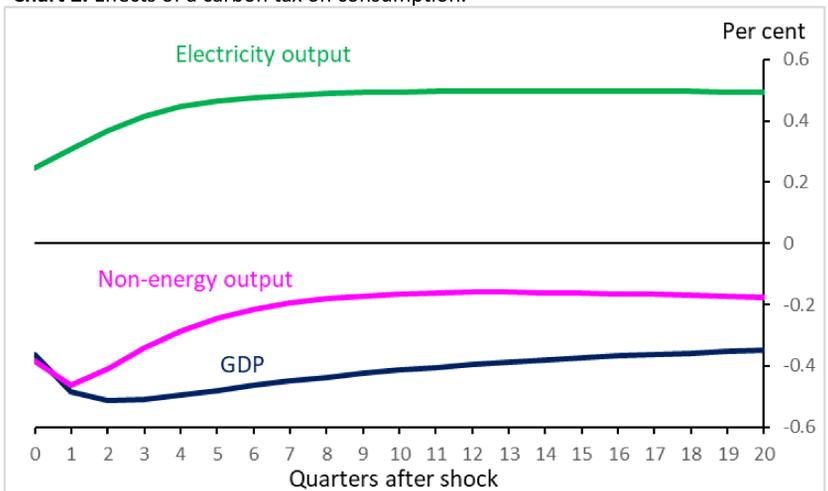


Chart 3. Effect of a carbon tax on output and GDP.

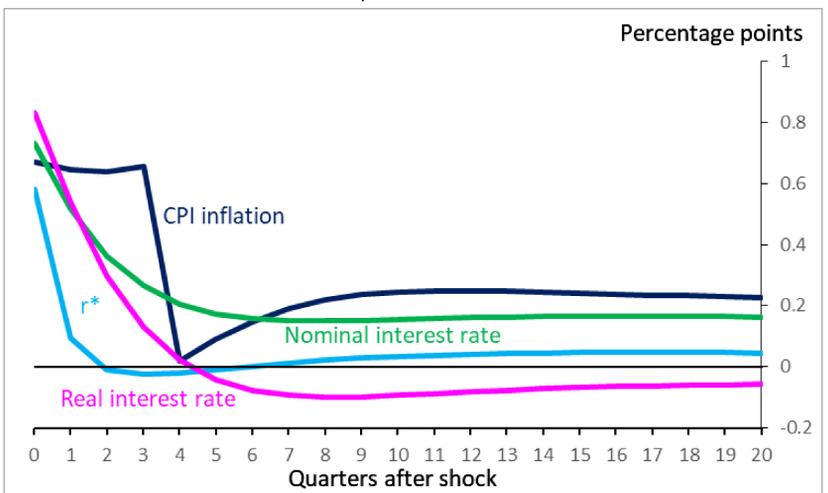


Chart 7. Effects of a carbon tax on inflation and interest rates.

Model

- Open economy DGE model with energy, calibrated to the UK
- Analysis reflects UK energy system, e.g. reduced role of coal in energy production
- Can incorporate UK climate policy as set out in HMG Net Zero Strategy
- Households consume petrol, gas, electricity and non-energy
- Non-energy producers use labour, capital, imported intermediates, petrol, gas and electricity and sell to households and foreigners (ie, exports)
- Electricity producers use labour, capital and gas to generate electricity, which they sell to households and non-energy producers
- Economy is endowed with petrol and gas; any surplus (deficit) is exported (imported)
- Government taxes carbon emissions and distributes the revenue lump sum to households

Conclusions

- Carbon tax shifts production from fossil fuels towards renewables
- Consumption shifts to 'non energy' and electricity
- In the short-run, the move towards net zero leads to a fall in GDP and a rise in inflation
- Monetary policy is tightened but r rises by more than r^*

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Selected References

- Angeli, M, Archer, C, Batten, S, Cesa-Bianchi, A, D'Aguanno, L, Haberis, A, Löber, T, Maxwell, S, Sajedi, R, van der Merwe, M, Wanengkirtyo, B and Young, C (2022) 'Climate change: possible macroeconomic implications,' *Bank of England Quarterly Bulletin*.
- Annicchiarico, B and Di Dio, F (2015) 'Environmental policy and macroeconomic dynamics in a new Keynesian model,' *Journal of Environmental Economics and Management*, 69:1–21.
- Batten, S (2018) 'Climate change and the macroeconomy: a critical review,' Bank of England Staff Working paper no. 706, London.
- Batten, S, Sowerbutts, R and Tanaka, M (2016) 'Let's talk about the weather: The impact of climate change on central banks,' Bank of England Staff Working Paper no. 603, London.
- Batten, S, Sowerbutts, R and Tanaka, M (2020) 'Climate change: macroeconomic impact and implications for monetary policy' in: (T. Walker, D. Gramlich, M. Bitá, P. Fardnia, eds.) *Ecological, Societal, and Technological Risks and the Financial Sector*, Springer.
- Dixon, H, Franklin, J and Millard, S (2023) 'Sectoral shocks and monetary policy in the United Kingdom,' *Oxford Bulletin of Economics and Statistics*, Vol. 85, pages 805–29.
- HMG (2021) 'Net Zero Strategy: Build Back Greener.'