



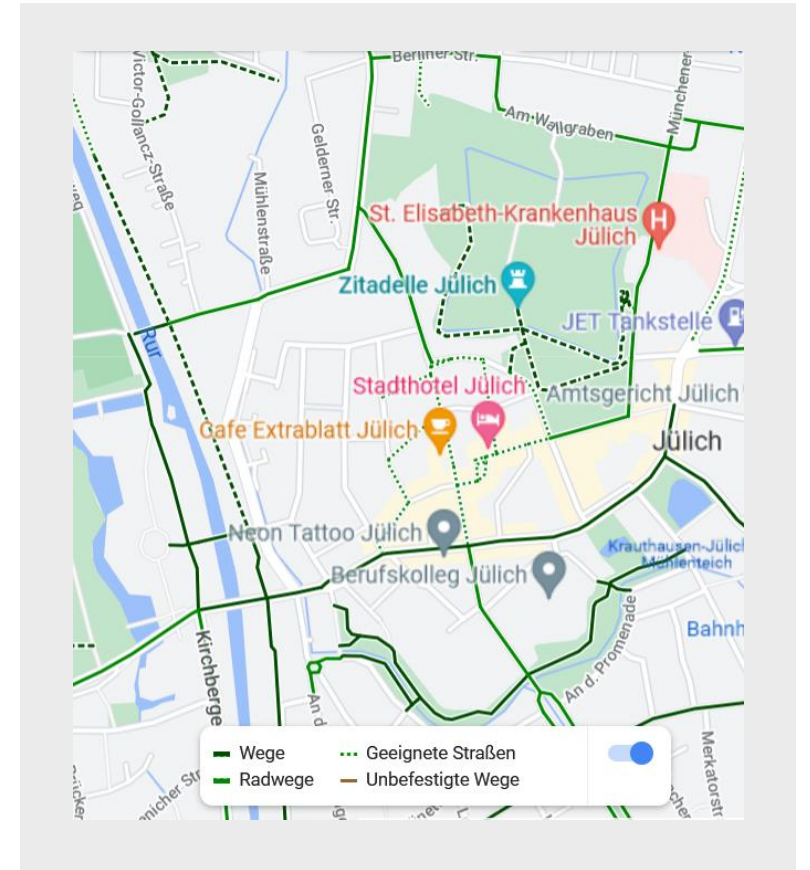
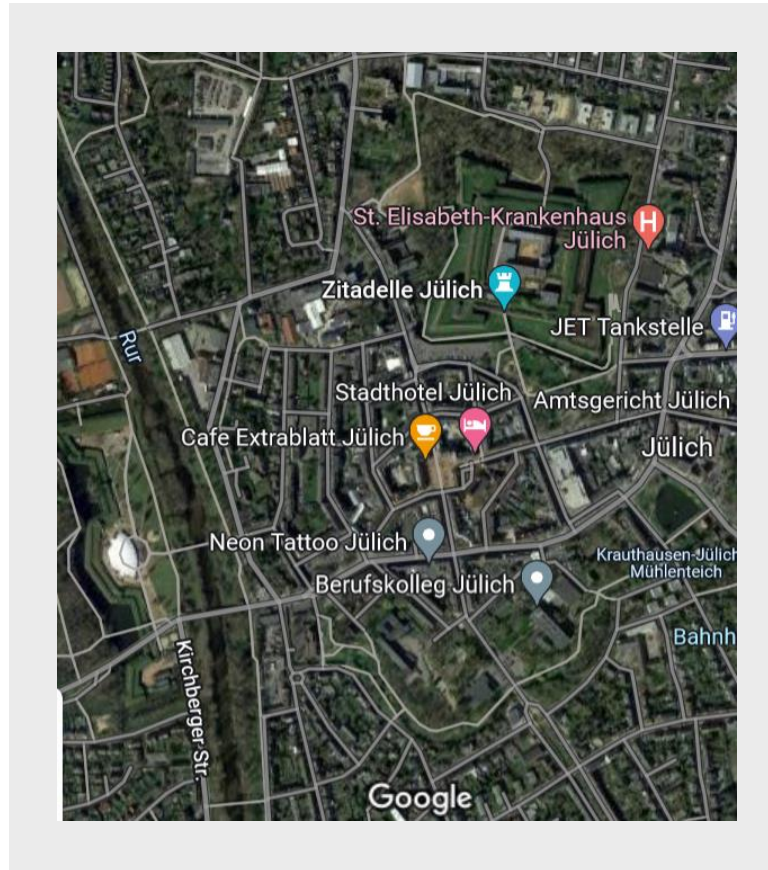
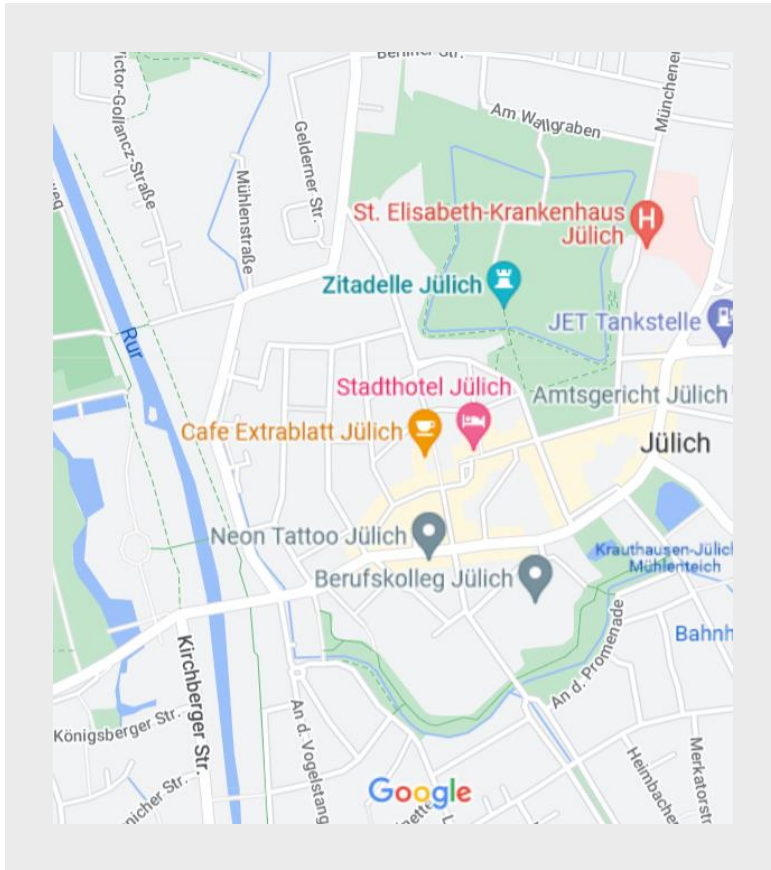
ENERGY SCENARIOS AND EMPLOYMENT IMPACT ANALYSIS (A NON-TECHNICAL OVERVIEW)

09 JUNE 2022 | ANDREW ROSS

OVERVIEW

- High-level introduction to some challenges of macroeconomic impact analysis.
 - No equations, no detailed model descriptions, and limited technical jargon.
 - Two key messages:
 1. What happens outside of the 'energy system' is also important.
 2. Identifying (all) impacts is necessary - but difficult.
- * Useful for all disciplines but not too exciting if you are an economist.

MODELS AS ABSTRACTS OF REALITY



SOME MACRO MODELS USED IN 'IMPACT' ANALYSIS

- **Input-Output (IO)**

- Allan, G., Comerford, D., Connolly, K., McGregor, P., & Ross, A. G. (2020). The economic and environmental impacts of UK offshore wind development: The importance of local content. *Energy*, 199, 117436.

- **Social Accounting (SAM)**

- Emonts-Holley, T., Ross, A. G., & Swales, K. (2021). Estimating induced effects in IO impact analysis: variation in the methods for calculating the Type II Leontief multipliers. *Economic Systems Research*, 33(4), 429-445.

- **Computable General Equilibrium (CGE)**

- McGregor, P. G., Ross, A. G., & Swales, J. K. (2021). How fiscal policies affect energy systems: the importance of an 'environmental social wage'. *Regional Studies*, 55(8), 1354-1364.

.... (Spatial) econometric models, DSGE, agent-based, and many more!


MACROECONOMIC IMPACTS (E.G. OFFSHORE WIND) I

- Direct: The offshore wind sector installs new capacity. This requires the inputs from several sectors, such as manufacturing, transport, and services. Jobs supported by such activities are considered direct. Could also be interpreted as 'first-round effects'.
- Indirect: Indirect employment occurs in association with the production of good and services in the direct supply chain of the offshore wind sector. The manufacturing sector, for example, that experiences an increase in demand via the direct effects, in turn requires inputs from other sectors such as services and other raw materials. This can also be described as the 'second-round effect'.

MACROECONOMIC IMPACTS (E.G. OFFSHORE WIND) II

- Induced: The employment income generated due to the direct and indirect activities could be spent by households on consumer goods. This in turn has additional first and second-round effects and so on.
- Gross: The sum of direct, indirect, and induced.
- Net: The positive macroeconomic effects from the increase in offshore wind capacity could be offset, for example, by the direct, indirect, and induced effects of the fall in demand for other electricity generation technologies (as consumers substitute away from conventional to wind energy).

DIRECT, INDIRECT, AND INDUCED ... LET'S PRACTICE

 The Canberra Times


Around 750 NSW coal miners could lose jobs

More than 700 coal mining jobs could be impacted by the closure of the Eraring power station in NSW. Around 750 NSW coal min...
vor 1 Monat



- Direct ?
- Indirect ?
- Induced ?
- Gross ?
- Net ?

(not about value judgements)

 GOV.UK

Type 45 Ballistic Missile Defence upgrade to support more ...

Type 45 Destroyers to receive significant upgrade as the UK to become ... supporting more than 100 jobs, including highly skill...
vor 2 Wochen



BRIEF SUMMARY

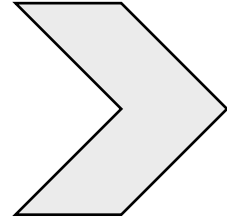
- Models as abstract from reality.
- Different types of models for macroeconomic impacts assessments.
- Direct, indirect, and induced effects (gross/net).
 - > How might direct, indirect, and induced effects impact your project?

IMPACT OF WHAT ON WHAT?

IMPACTS OF WHAT?

Economy:

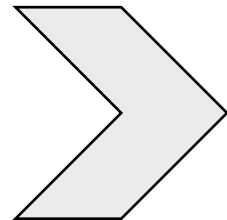
External trade (exports)
Minimum wages
Fiscal policy
Labour productivity
Migration
Education and training
...



Energy system / energy demand

Energy system:

Carbon capture
Hydrogen vehicles
Wind energy
Carbon tax
Household energy efficiency
Electricity market liberalisation
...



(Macro) economy

'NON-ENERGY' (AND ENERGY)

EXPORTS

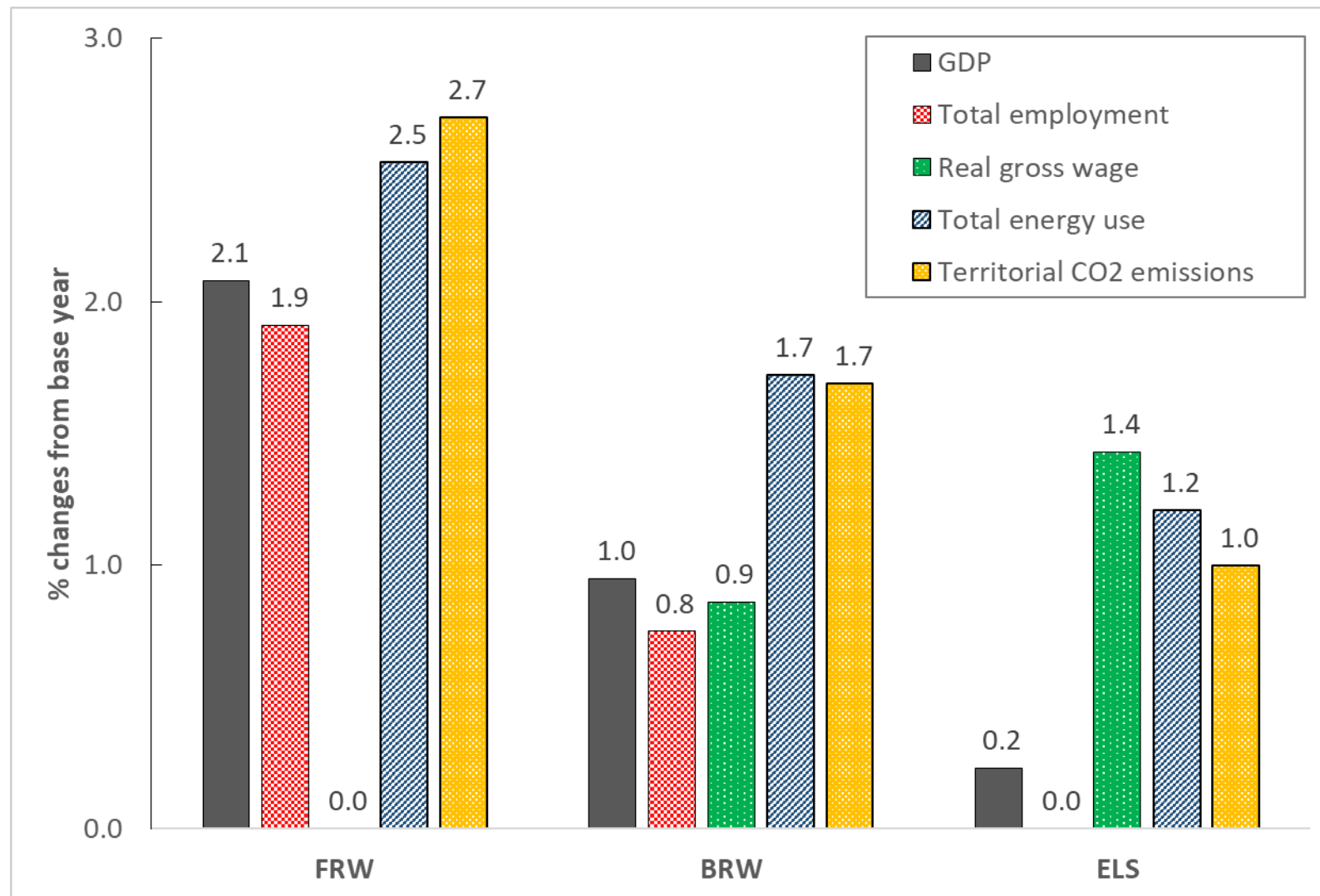
1. What do you think will happen to the following variables if a 'nation' increases its exports?

- Gross Domestic Product (GDP)
- Employment
- Real wages
- Energy use
- Territorial CO2 emissions

Hint: there is an increase in demands for goods and services...

2. Is this supportive of both economic- and energy-policy goals?

EXPORTS: SUMMARY OF RESULTS



Long-run effects of a 5% increase in international exports. % changes from base year.

Using a CGE model for the UK with different 'agent' responses, with non-optimal "equilibria".

Source: Allan, G., Barrett, J., ... & Turner, K. (2019). The economic and energy impacts of a UK export shock: comparing alternative modelling approaches. UK Energy Research Centre.

LABOUR PRODUCTIVITY

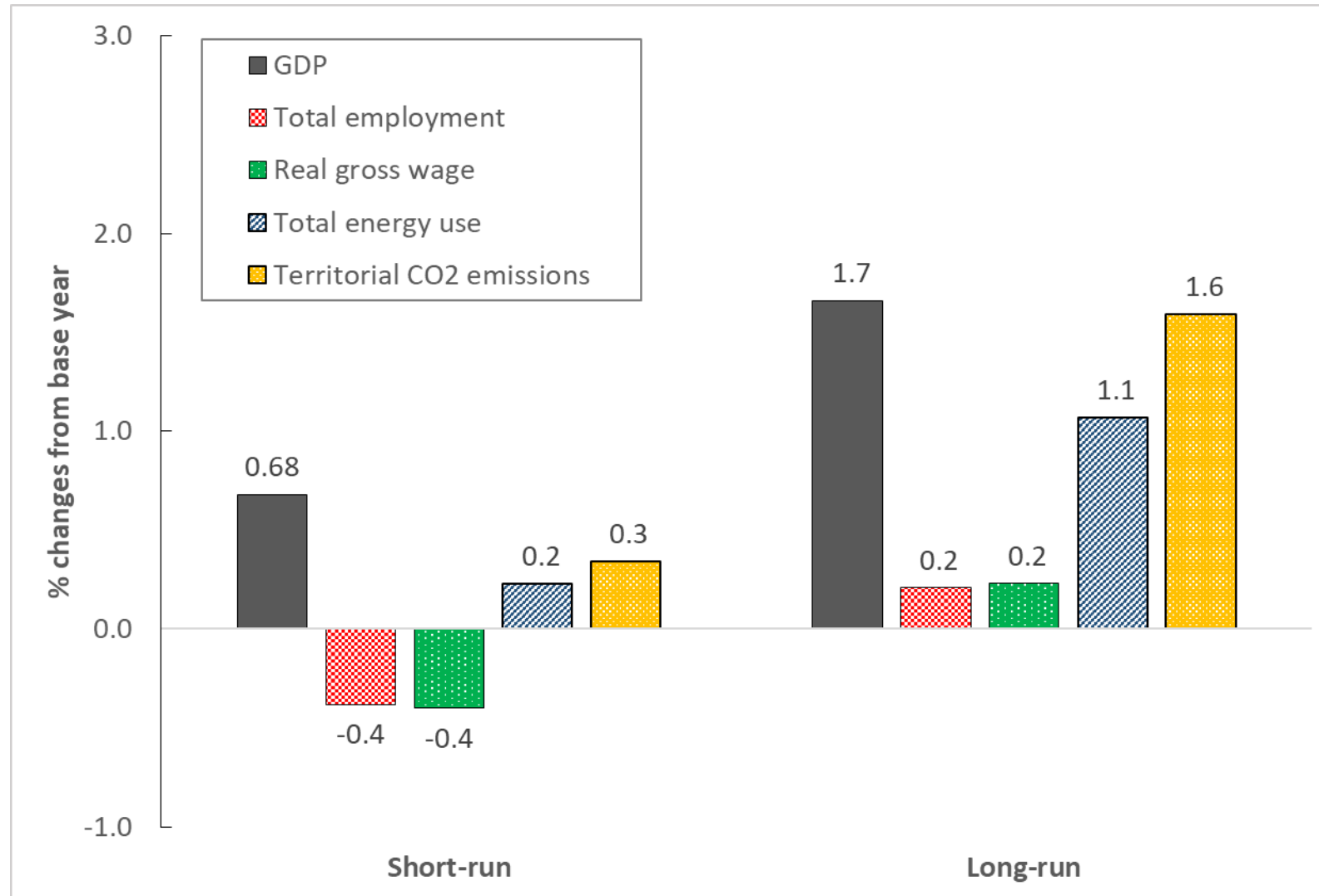
1. What do you think will happen to the following variables if labour productivity in a 'nation' is increased?

- Gross Domestic Product (GDP)
- Employment
- Real wages
- Energy use
- Territorial CO2 emissions

Hint: the direct effect of an increase in labour productivity is that the same level of labour services (measured in efficiency units) is supplied by fewer workers.

2. Is this supportive of both economic- and energy-policy goals?

LABOUR PRODUCTIVITY: SUMMARY OF RESULTS



Short and Long-run effects of a 1.5% increase in labour productivity. In % changes from base year.

Using a CGE model for the UK (paper also gives different 'agent' responses not shown here, with non-optimal equilibria.)

Source: Ross, A. G., McGregor, P. G., Swales, J. K., & Roy, G. Labour productivity-enhancing industrial policies and their impacts on environmental policy goals. Forthcoming.

FISCAL POLICY

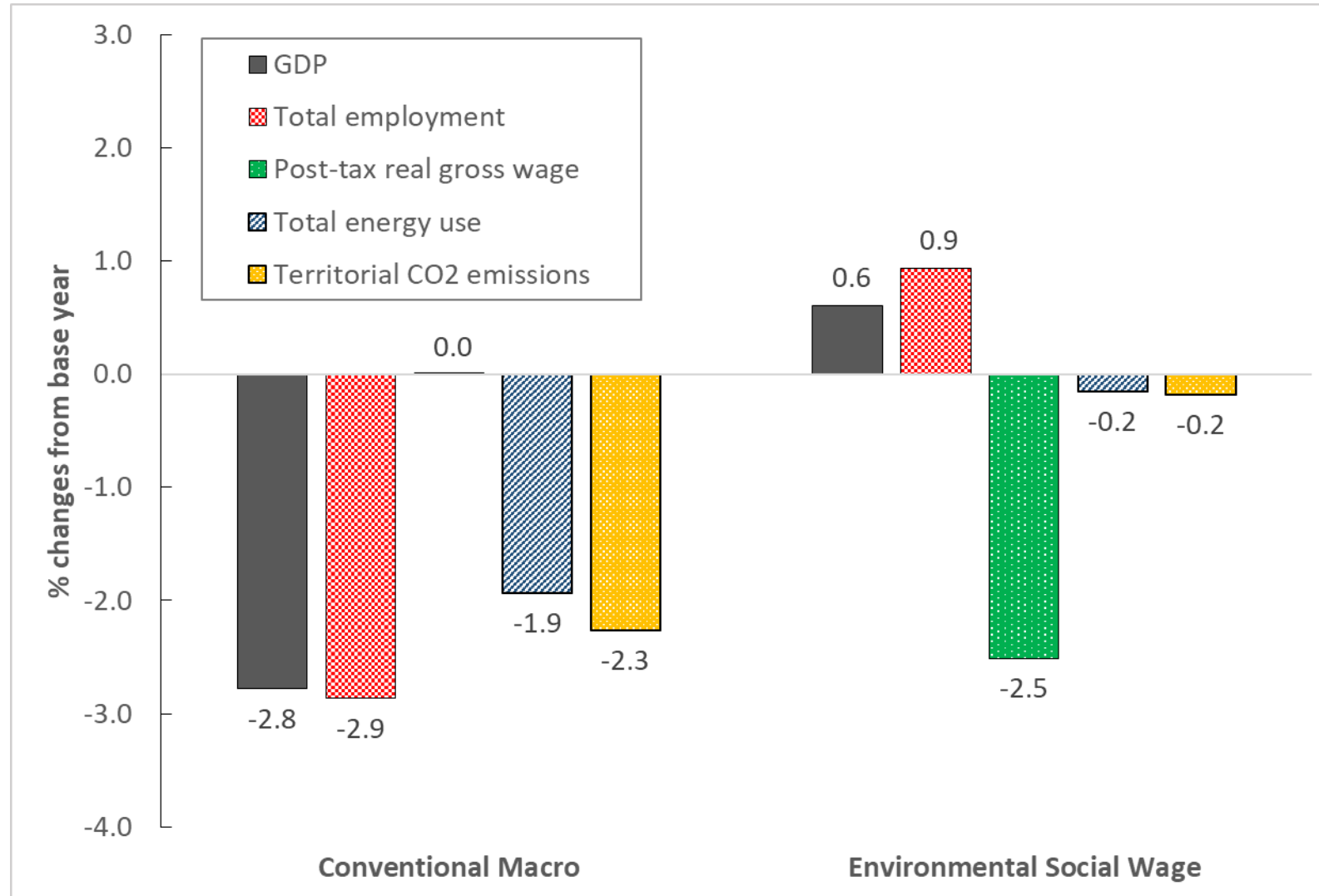
1. What do you think will happen to the following variables if a 'nation' increases its income tax rate and the tax revenues are recycled to finance current government expenditure.

- Gross Domestic Product (GDP)
- Employment
- Real wages
- Energy use
- Territorial CO2 emissions

Hint: contrary simultaneous direct effects of increase in taxation (good and services becoming more expensive and so demand falls) and increase in government expenditures (demand increases). Is there a net positive?

2. Is this supportive of both economic- and energy-policy goals?

FISCAL POLICY: SUMMARY OF RESULTS



Long-run effects of a 5% increase in the income tax rate under a balanced budget. % changes from base year.

Using a CGE model for Scotland with different 'agent' responses, with non-optimal equilibria.

Source: McGregor, P. G., Ross, A. G., & Swales, J. K. (2021). How fiscal policies affect energy systems: the importance of an 'environmental social wage'. *Regional Studies*, 55(8), 1354-1364.

BRIEF SUMMARY

- Exports
- Labour productivity
- Fiscal policy

Impacts of such ‘interventions’ might pose additional burden on meeting energy-policy goals.

> How might ‘non-energy’ impact your project?

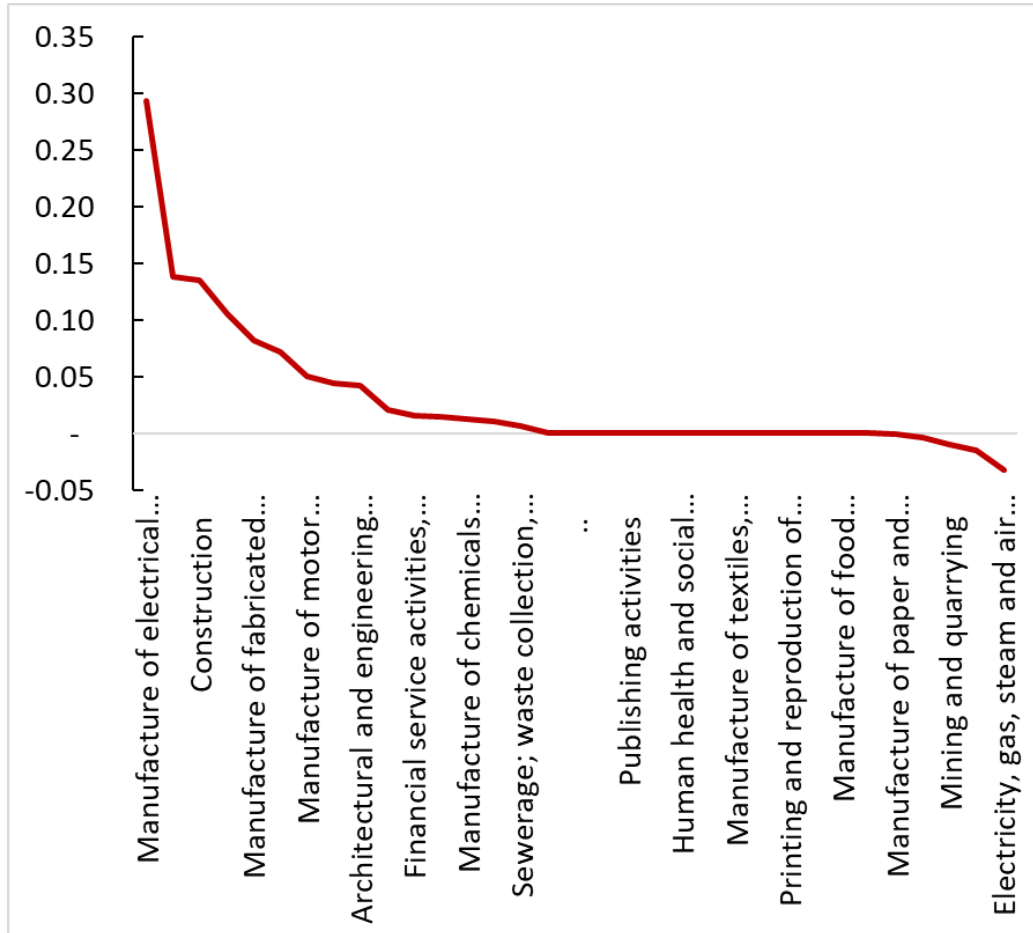
ENERGY (AND 'NON-ENERGY')

GREENHOUSE GAS NEUTRAL ENERGY SYSTEM

- Ongoing efforts to identify macroeconomic impacts of energy scenarios (IEK-STE and IEK3).
- Link between energy-systems model and macro Input-Output (IO) model.
- Energy systems model identifies the ‘costs’ (or output) of the energy system.
- Input-Output analysis identifies the macroeconomic impacts (e.g. employment).

DIRECT EMPLOYMENT (INDICATIVE RESULTS)

Direct employment (in % of total employment) by Industrial sector for 2045, sorted by size of effect.



Difference between two scenarios. One is a 60% reduction of greenhouse gas emissions, and the other scenarios is a 100% reduction (as compared to 1990 levels).

Some sectors with large positive direct employment effects in 2045. Particularly Manufacturing and Construction sectors.

Large number of sectors not directly affected.

Small number of sectors with negative direct employment impacts in 2045 e.g. Electricity supply sector.

... **but:** indirect, induced, net/gross ? Who bears these additional costs and what are the counterfactual budget effects? Feedbacks etc ?

OVERALL SUMMARY

- Direct, indirect, induced, gross/net (next time you read a study or similar, this should come to your mind).
- Highly specialised models – potentially blind to key issues outwith the modelled system.
- Very little attention paid to the impacts of ‘non-energy policies’ on ‘energy’.
- Need for hybrid (‘holistic’) approaches (but this has trade-offs).
- One ‘huge’ model versus employing different modelling approaches in parallel and treating them as complimentary rather than substitutes.

Q&A

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