

Social Impact Assessment: ***Predicting the social impacts of environmental taxes, fees and charges***

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Why is it important to consider social effects of environmental taxes?

- Political economy and justice

Predicting the impact

- What channels to consider
- Use vs sources of income

Different approaches

- Models

Evidence

- Main results from the literature

Way forward

- Improve non monetary impacts

Why is it important to consider social effects of environmental taxes?

(using carbon tax as example)

Carbon taxes as climate policies

Carbon pricing is regarded as an efficient way to decrease emissions (but no silver bullet)

Can create fis

■ Increasing n
putting a price

But until n

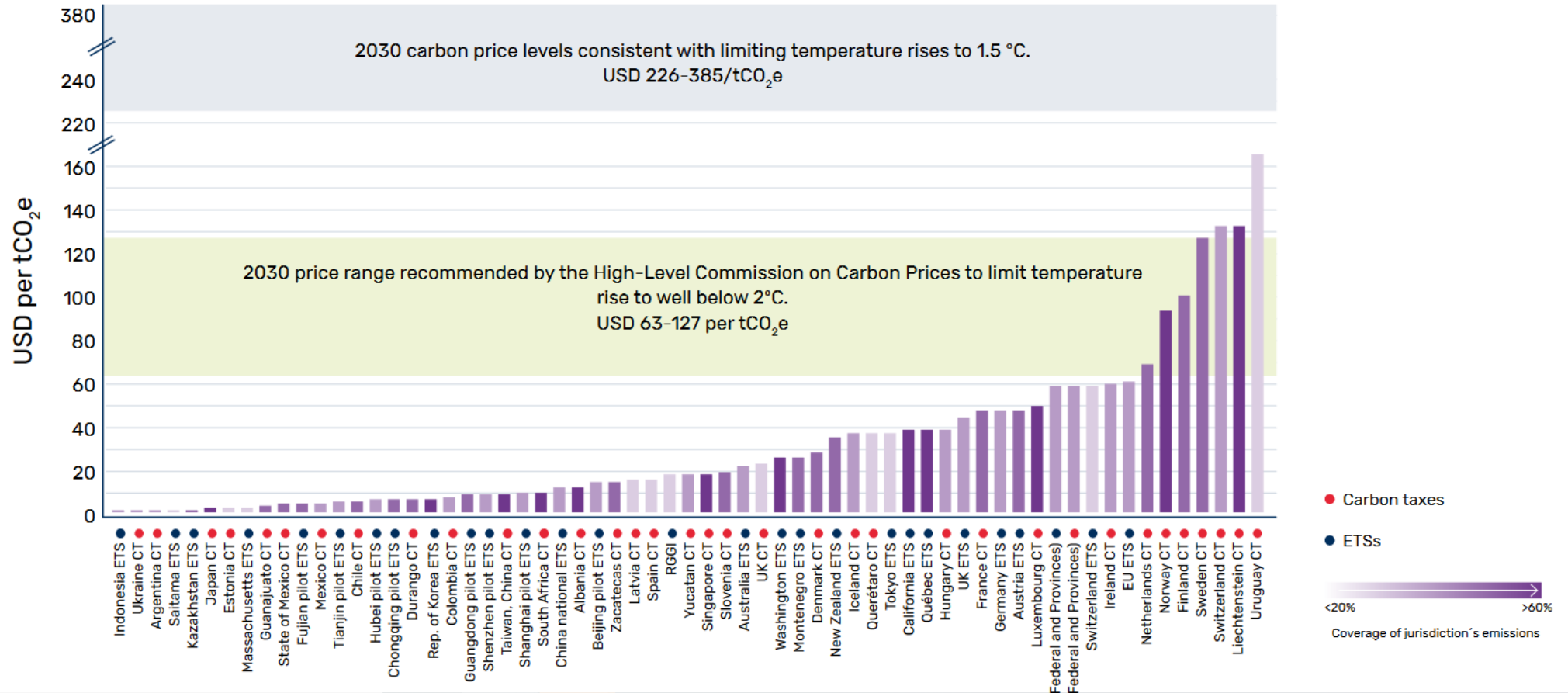
- Majority (
- 75 in
emis

- Levels ar

Why?

FIGURE 5

Global GHG emissions covered by ETSs and carbon taxes



Several reasons, among the most prominent

- Various interest groups and hesitating policymakers;
- Public acceptability

In terms of **public acceptability**, it depends on:

1. Beliefs

- Individual altruism and environmental concern;
- Partisanship/political affiliation

2. (Mis)trust in government

3. Effect of the policy

- **(Perceived) Personal effects;**
- **(Perceived) Effects on others (distributional effects); see yellow vests etc...**
- **Environmental effects**



Just transitions and fairness of climate policies

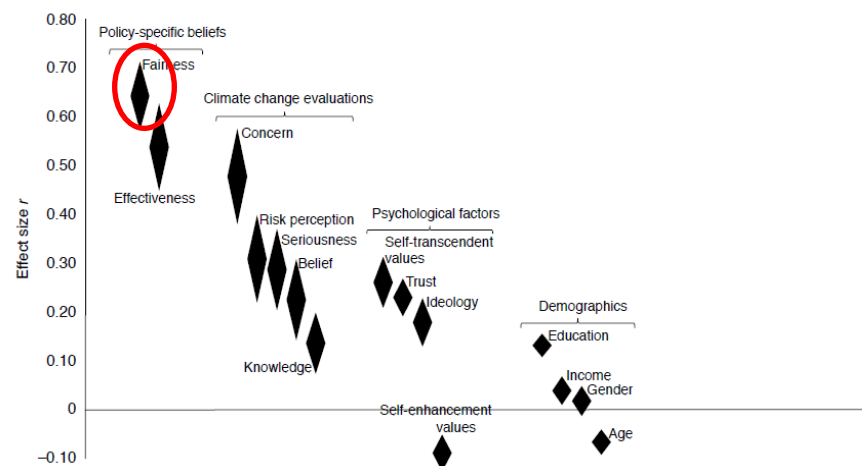


Fig. 1 | Visual summary of the relationship between determinants and public opinion about climate change taxes and laws. Higher levels of ideology represent identifying as left or liberal. Gender is coded 0, male; 1, female. Geometrical centres of the diamond shapes represent mean values and end-points represent $\pm 95\%$ CI.

Bergquist et al, 2022

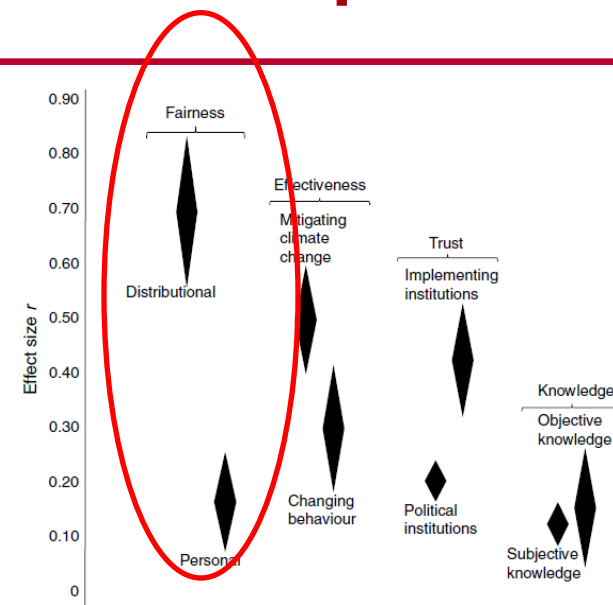


Fig. 2 | Visual summary of the relationship between subtypes of determinants and public opinion about climate change taxes and laws. Geometrical centres of the diamond shapes represent mean values and end-points represent $\pm 95\%$ CI.

Among all determinants, fairness showed the strongest relationship with public opinion.

- strong effect for **distributional fairness** measuring participants **perceived fairness** of policy distributions, for example how subsidies or taxes are distributed between or within specific groups.
- A weaker effect was found for **personal fairness** (“how fair a policy is perceived “for me””).
- But most evidence/research in HICs!

Predicting the impact

Here we focus on the economic effects of environmental taxes (with a focus on carbon taxes)

- Other impacts will be discussed at the end (important also when doing cost-benefit analysis)
- Not considering here effects on displacements etc due to renewable energy projects and similar

Until recent the focus was on the double dividend hypothesis:

“can an environmental/carbon tax improve environmental outcomes while also allowing for economic growth”

Now the social/distributional effects of environmental taxes are gaining prominence

There are different channels for the impact of environmental taxes:

- Short vs long term effects
- **Price vs income effect**
 - ✓ Price effects can be decomposed into direct and indirect
 - ✓ Income effects include labour and capital

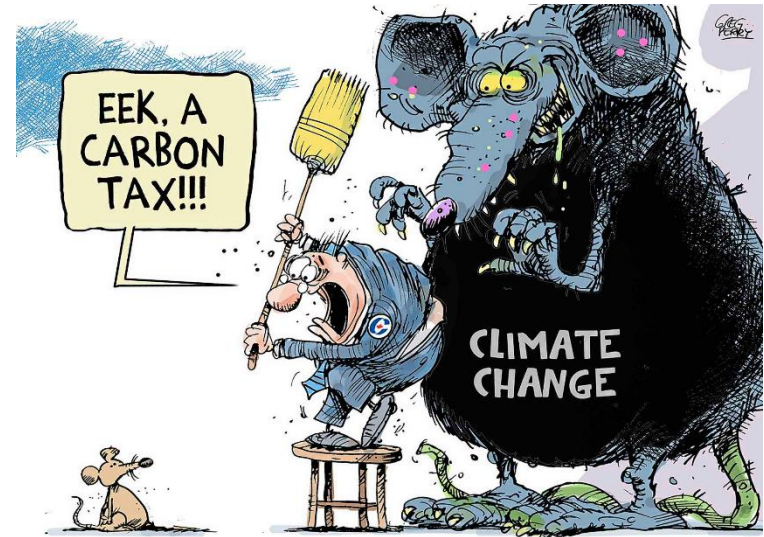
They also matter for the complementary policies

On the short term, effects of an carbon/environmental tax are mainly given by the increase in prices for consumers (assuming that there is a pass through of the carbon price/tax).

Such effects are defined as the “**uses of income**” effect;

- they depend on the carbon intensities of consumption baskets;
- the higher the carbon embedded in the consumption of goods, the higher a household or a consumer will pay in a carbon tax.
- Uses of income effect usually estimated with incidence:
Incidence = $\text{tax} / \text{total income (expenditure)}$

Increases in prices in the short term can fuel opposition to carbon taxes (see JJ in France)



The “uses of income” effect (incidence) depends on direct and indirect environmental impact of ones consumption (if the tax is “economy wide”)

Direct emissions are associated with the direct use of fossil fuels, i.e. the gasoline that you use to run your car

Indirect emissions are embodied in the consumed goods and services, i.e. The emissions that the company Y produces to produce the car that you buy

- Indirect emissions are more difficult to estimate

With pass-through of the tax (from producers to consumers), indirect effects matter



The “sources of income” effects are more medium to long term, as well as more indirect.

Environmental taxes, such as carbon pricing, can change macroeconomic conditions including the overall economic output, returns to capital and jobs; therefore they affect the income sources of households (rather than the price of goods and what can be done with a specific income amount income, such as the uses of income effect).

The “sources of income” effects on equality and social outcomes depend on:

- how changes in jobs are distributed, and
- how capital is affected as well as its ownership.

Uses of income effect still apply in the long term as well....but adjustments can take place

In addition, the sources of income effects also include the transfers that the government can make to citizens (revenue recycling)

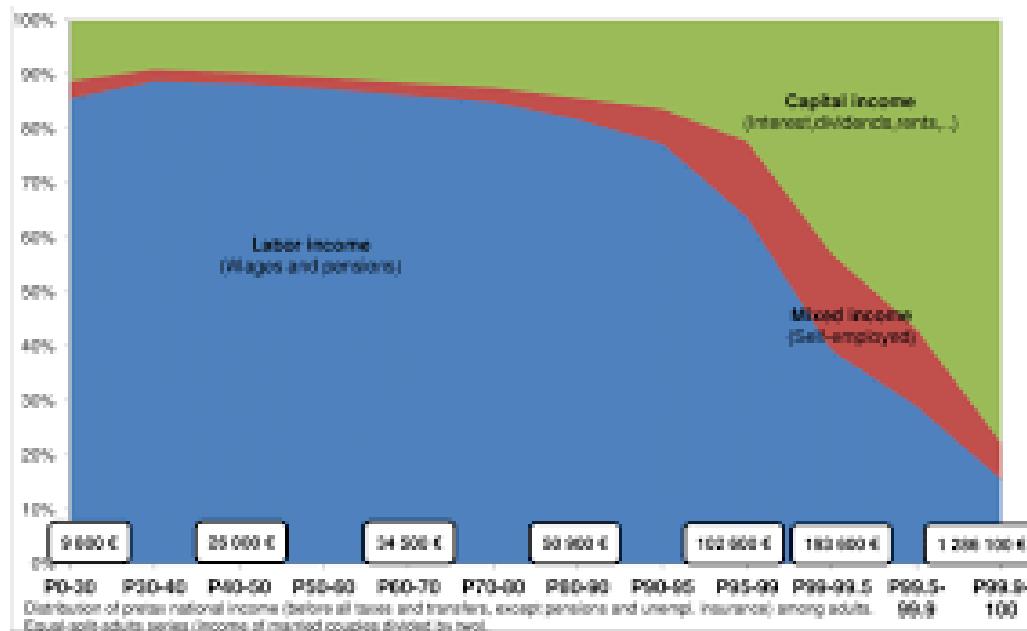
- You will see this more in the session on how to address social impact of environmental taxes

Why it is important to consider the different income sources?

Capital is owned mainly by the richest.

- Therefore if an environmental tax hits capital more than labour we will have good distributive effects

Income composition by income level, France 2012



Income composition by income level, South Africa

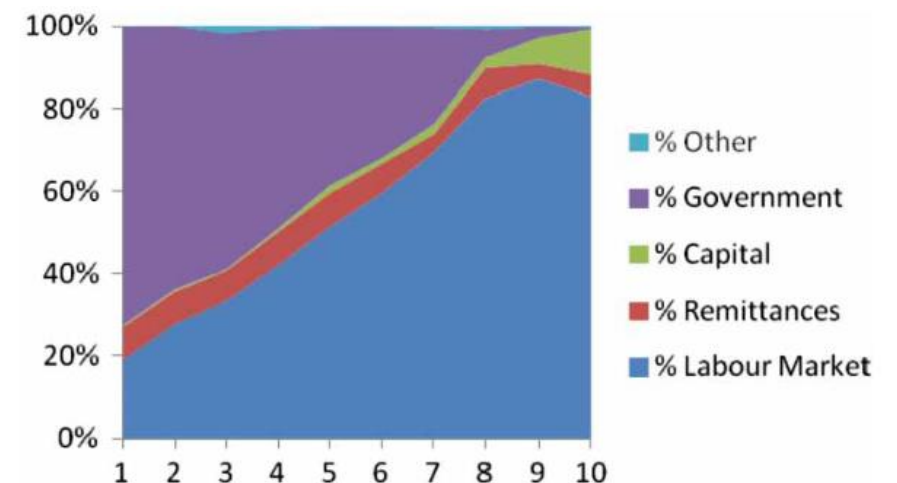
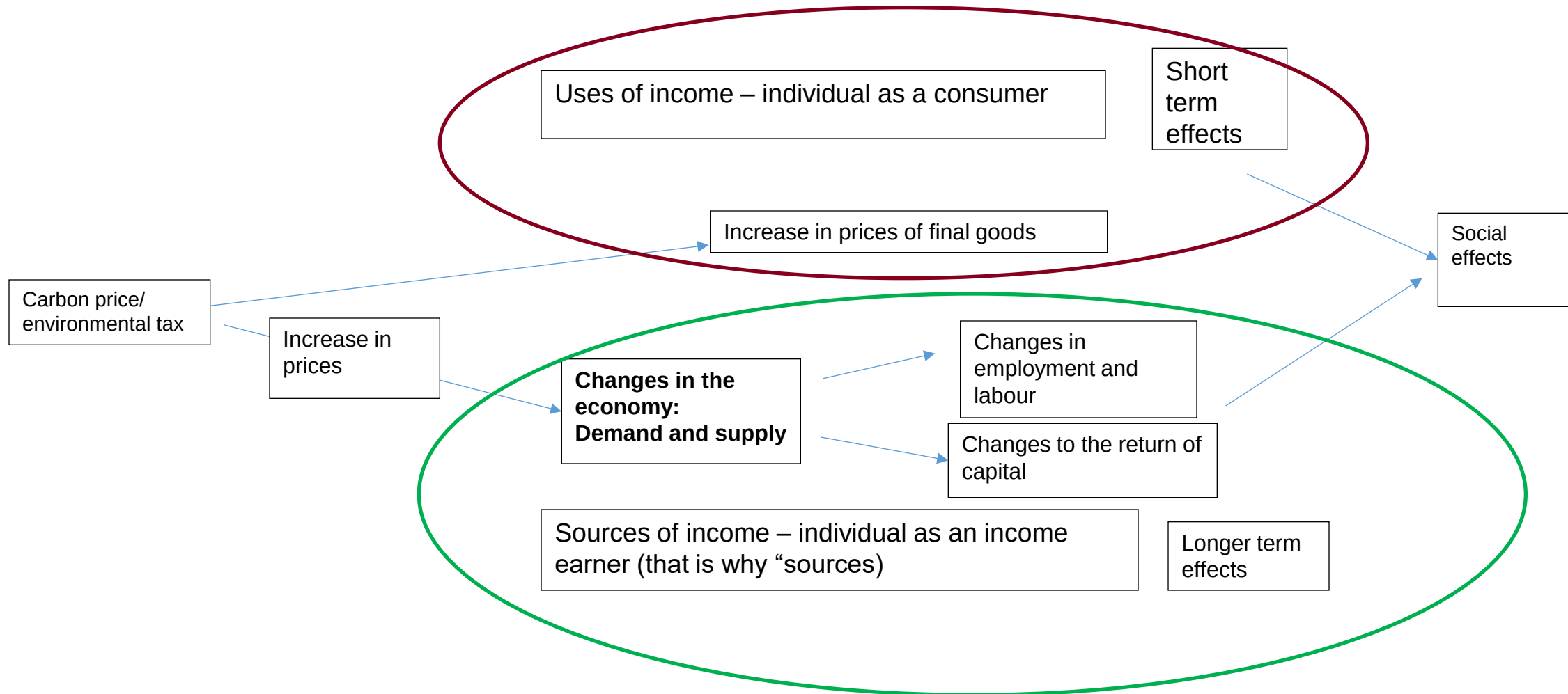


Figure 3: Composition of income by decile – 2008

Source: SALDRU (2008). Own calculations.

Summary of effects



Different approaches/models to estimate the effects

Here we focus on quantitative models; qualitative models can also be used.

For incidence (**short term effects**) the model used is mainly a

Combination of household surveys and Environmentally Extended MultiRegional Input-Output tables (EEMRI-O)

EEMRI-O tell us the environmental impact of the total and sectoral production and consumption

- They can look at different environmental variables
- You can look at production based impacts
- And consumption based impacts (that take into account exports and imports)
- Give direct and indirect impacts

Household surveys tell us the consumption baskets of different households

Merging EEMRI-O and household we can estimate the environmental footprint of a specific household

Then by multiplying the tax level by the environmental impact we get the tax to be paid by the individual

Input-Output (I-O) tables

Chart 1 Structure of Input-Output Tables

		Endogenous sectors					Exogenous sectors							
Demand sector (buyer)		Intermediate demand					Final demand			(Less)	National production (gross outputs)			
		1 Agriculture, forestry and fisher	2 Mining	3 Manufacturing	(Goods and services produced)	Total	Consumption expenditure outside households	Consumption	Fixed capital formation	Stock / Inventory		Exports	Total	Imports
Supply sector (seller)		A									B			
		Intermediate input	1 Agriculture, forestry and fishery	↓ Columns										
2 Mining						Composition of product sale destinations (outputs)								
3 Manufacturing														
	(Supplied goods and services)	→ Rows												
	Total	D												
Gross value added	Consumption expenditure outside households													
	Compensation of employees													
	Operating surplus													
	Depreciation of fixed capital													
	Indirect taxes													
	(Less) Current Subsidies													
	Total	E												
National production (gross inputs)		D+E												

Endogenous sectors

Exogenous sectors

Composition of raw materials and gross value added expenses (inputs)

Composition of product sale destinations (outputs)

• Row production (A + B - C) and Column production (D + E) agree.
• Totals for gross value added and final demand minus imports/ inflows agree.

The traditional Leontief Input-Output (IO) model is an economic model that represents the **interdependencies between different sectors of an economy**,

Environmentally-Extended Input-Output (EEIO) model integrates environmental data into this framework using satellite account, allowing for the analysis of environmental impacts across economic sectors (Peters & Hertwich, 2008).

- in environmentally extended input-output (EEIO) analysis, the embodied environmental pressures in the final consumption could be estimated.

For incidence (short term effects) the model used is mainly a

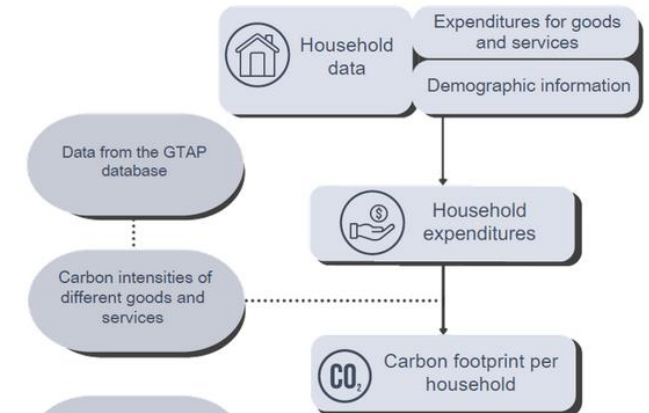
Combination of household surveys and EEMRI-O

Multi-regional input-output data

Country r	Sector s	Sectoral carbon intensity $e_{s,r}$
r_1	s_1	$e_{1,1}$
r_1	s_2	$e_{1,2}$
...	...	...
r_{160}	s_{65}	$e_{160,65}$

Household budget survey data

Household i	Characteristics X_i	Sectoral expenditure shares $w_{i,r,s}$
1	X_1	$w_{1,r,1}$
2	X_2	$w_{2,r,1}$
...	...	...
n	X_n	$w_{n,r,65}$



i	X_i	$w_{i,r,s}$	$e_{s,r}$
1	X_1	$w_{1,r,1}$	$e_{r,1}$
1	X_1	$w_{1,r,2}$	$e_{r,2}$
...	...	...	...
2	X_2	$w_{2,r,1}$	$e_{r,1}$
...	...	...	...
n	X_n	$w_{n,r,65}$	$e_{r,65}$

$$e_i = \sum_s e_{s,r} * w_{i,r,s}$$

Household i	Characteristics X_i	Carbon intensity of consumption e_i
1	X_1	e_1
2	X_2	e_2
...	...	...
n	X_n	e_n

For longer term effects, different options are available

For ex ante appraisal analysis we can use the following:

- **Partial equilibrium analyses** quantify direct, first-order effects on well-being such as monetizable co-benefits like improvements in health due to reduced local pollution. However, second-order effects will be large and mostly missed by partial equilibrium analyses.
- **General equilibrium (GE) analyses** (computable general equilibrium [CGE] and dynamic stochastic general equilibrium [DSGE]) analyze and quantify potential economy-wide effects of a tax on economic activity (output, employment, unemployment, and consumption). They permit analysis of sectoral adjustments, but are sensitive to inputs such as demand and supply elasticities of labor and relative elasticities of substitution between energy, labor, and capital
- **Macro-econometric analyses** use statistical correlations to predict future pathways for economic variables. This analytical technique includes consideration of short-run adjustments (which are less important in CGE models). However, they are not based on theory, and relationships may change over time, rendering predictions unreliable.
- **Endogenous growth models** can capture induced innovation and positive externalities/spillovers compared with CGE and DSGE models to analyze ex ante potential effects on long-run economic activity. But these models are less aggregated and may not capture important sectoral shifts from ET.

Integrated Assessment Models (IAMs) are mathematical representations of the world, with modules representing the climate, biosphere, energy, and economy (Barrage & Nordhaus, 2024).

- The IAMs extend neoclassical growth models (which maximize intertemporal welfare and represent the economy through a single aggregate sector) with certain geophysical relationships between climate change and the economy but only identify more detailed sectoral impacts with a top-down approach (Doukas et al., 2019).
- Two of the most troublesome parameters are the long-term cost of climate change and the discount rate that translates these future costs into present ones.
- **Social outcome are estimated through “soft link” modules**

For ex post evaluation of ET, tools include the following:

- Econometric analyses—methods such as regression analyses, complemented with instrumental variable approaches - can help isolate the effects of ET on the environment, economic activity, and other metrics. However, because ET has economy-wide, second-order diffused effects that emerge over time, isolating causation can be difficult.
- Not so many countries have environmental taxes adequate to the challenge, that can be studied in an ex-post framework

	Uses of income (price)	Source of income
Main focus	Purchasing power	Labour and capital returns
time	Short • Ex-ante	Medium-long • Also ex-post
Main issues	equity	Double dividend (efficiency)
methods	Incidence analysis • MRI-O and household surveys	(partial) equilibrium models, IAM • MRI-O can also be used for analysis on jobs creation
Economics	Price, consumption, supply	Equilibrium/optimization

Evidence

(just part of the picture, does not include revenue redistribution/complementary policies)

In terms of incidence/short term, an environmental/carbon tax is

- more or less neutral;
- more progressive in poorer countries,
- but more regressive in richer countries
 - ❑ The reason is that rich individuals in low and middle-income countries and poor individuals in high-income countries tend to consume proportionally more carbon-intensive goods.
 - ❑ Even if neutral, increase in prices can significantly affect households
- A lot depends also on the design of the tax (i.e. sectoral taxes or taxes with progressive elements such as luxury taxes).

Long terms effects:

- Negligible impact on total GDP/labour outcomes
- More progressive given the distribution of capital and labour

Uses of Income (Incidence)

The effects of a tax are around 3-5% of total expenditure

Inequality would remain unchanged (slightly progressive or regressive)

But absolute impacts need to be considered

I.I. Dorband et al./World Development 115 (2019) 246–257

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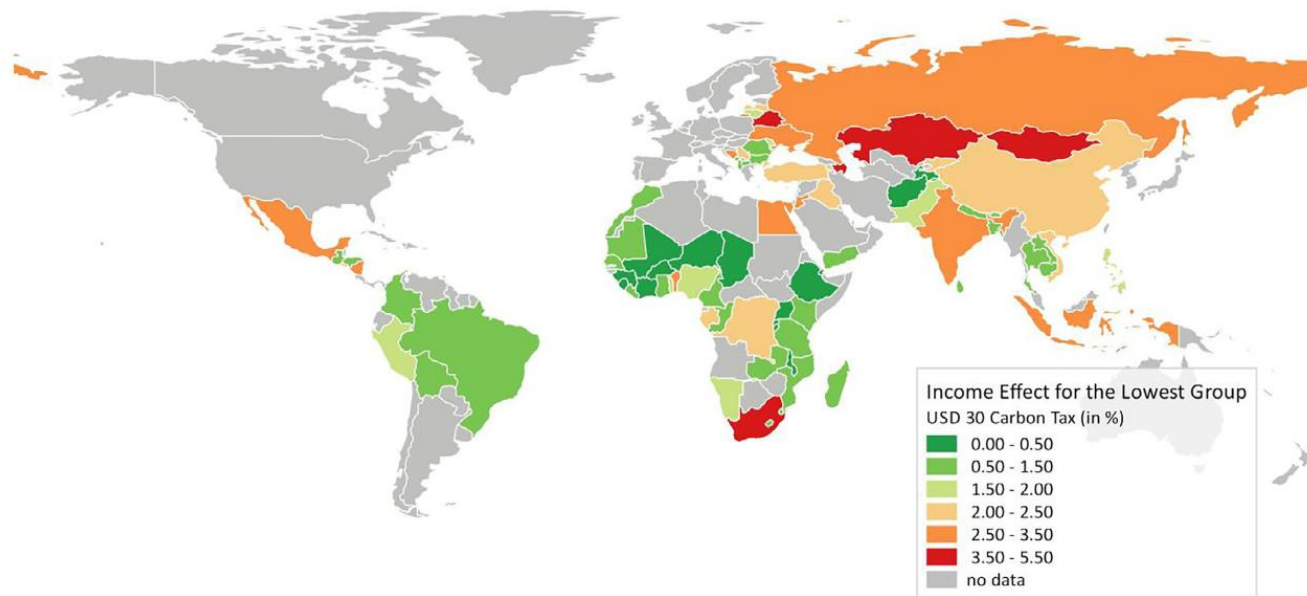
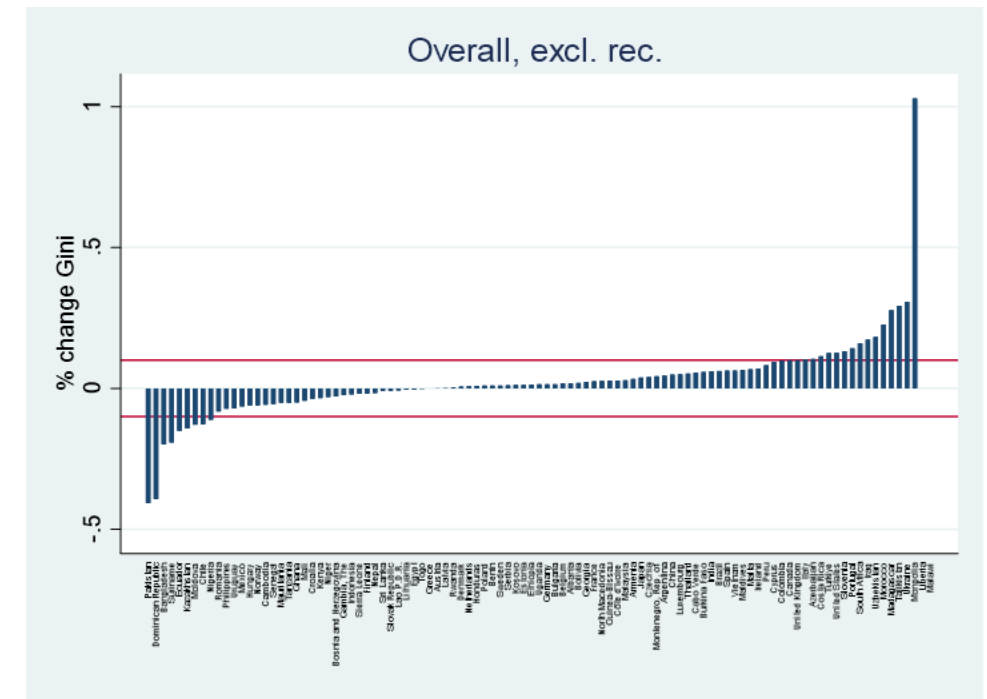


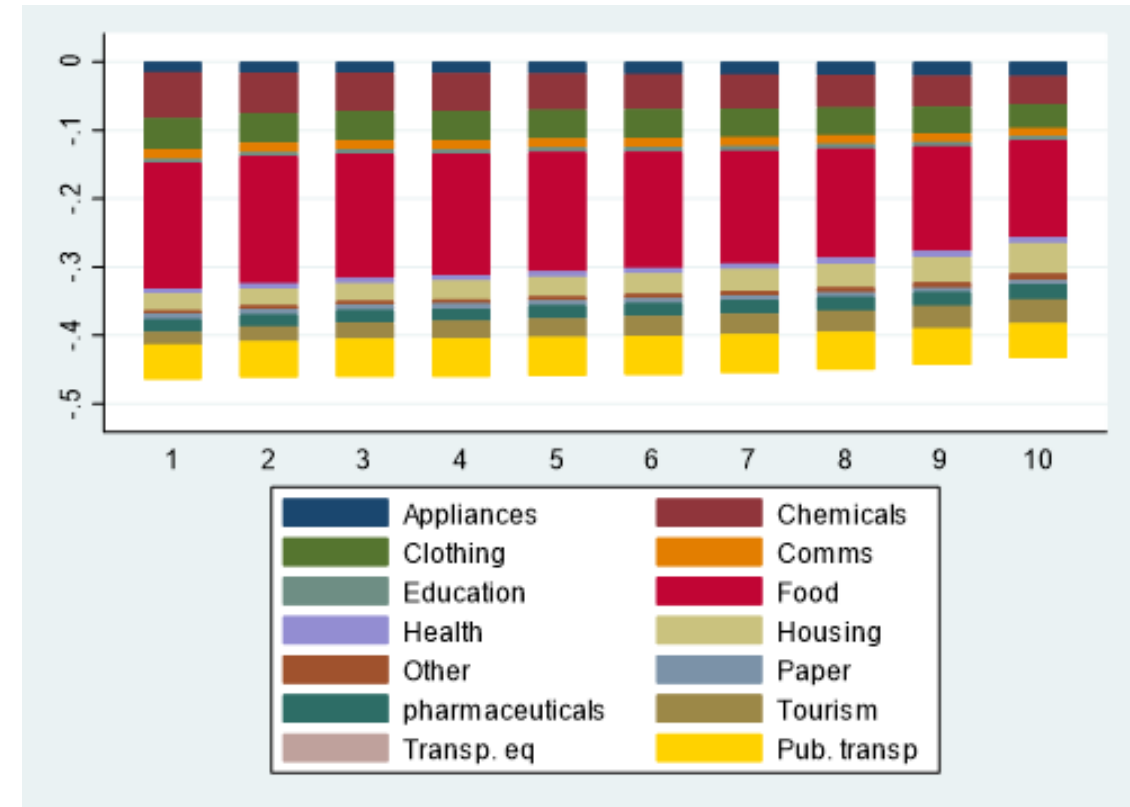
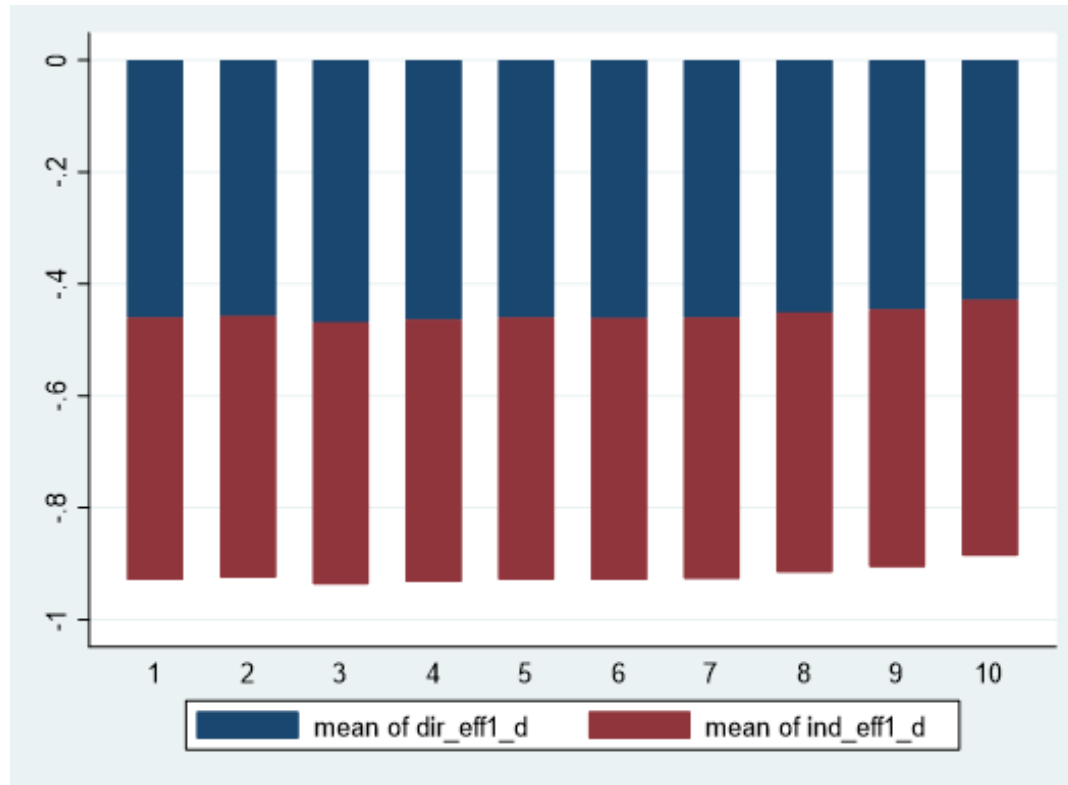
Fig. 2. Income losses (as percent of disposable income) for the lowest income group when applying a price of USD 30 per ton CO₂.



Uses of Income (Incidence)- direct and indirect effects

Direct and indirect effects are similar

- Food represents the largest share of indirect effects (Source CPAT, World Bank)



Carbon price incidence calculator (<https://www.cpic-global.net/>)..Example of Ghana

Configure your analysis

Population Carbon Price Compensation

Set how much of the revenues raised by carbon pricing should be distributed back to the population

50%

Select a compensation measure

Equal per capita transfer (lump sum)

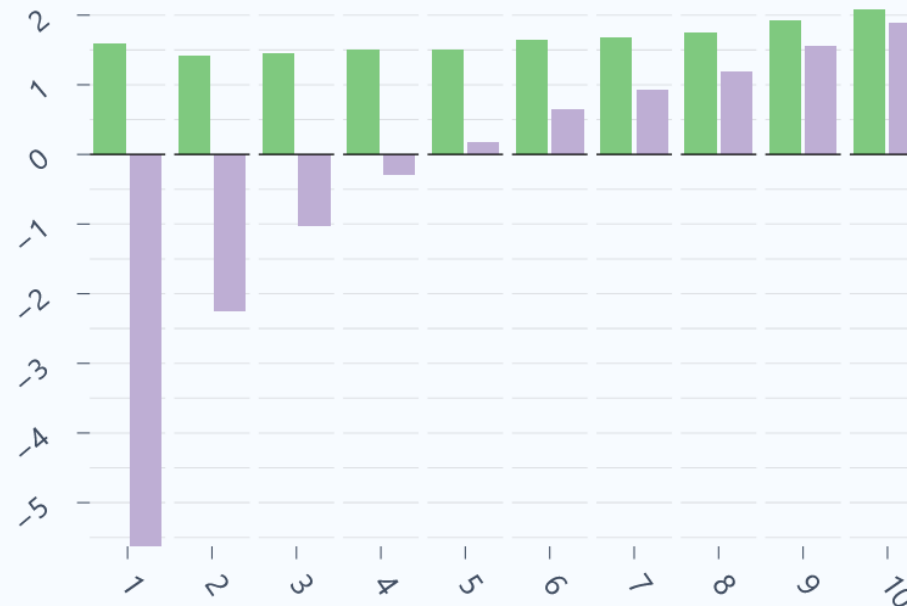
Equal per household transfer (lump sum)

Electricity price subsidy

Exempting electricity from carbon

no compensation with compensation

↑ Relative cost in %

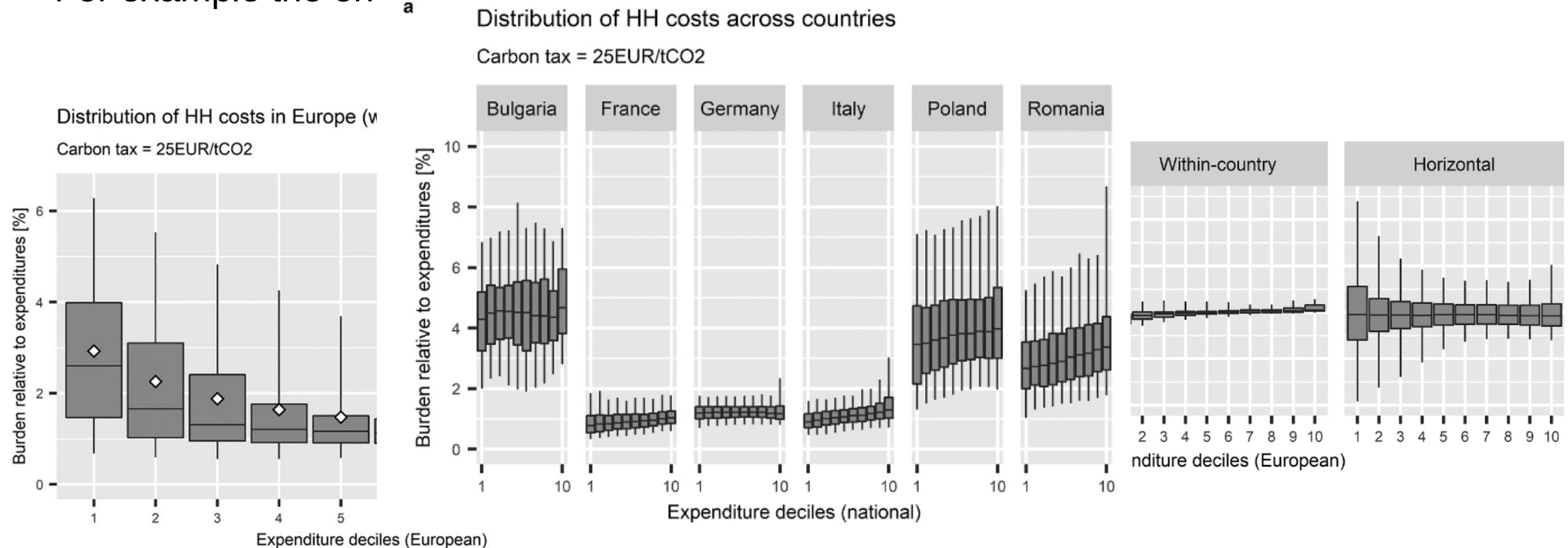


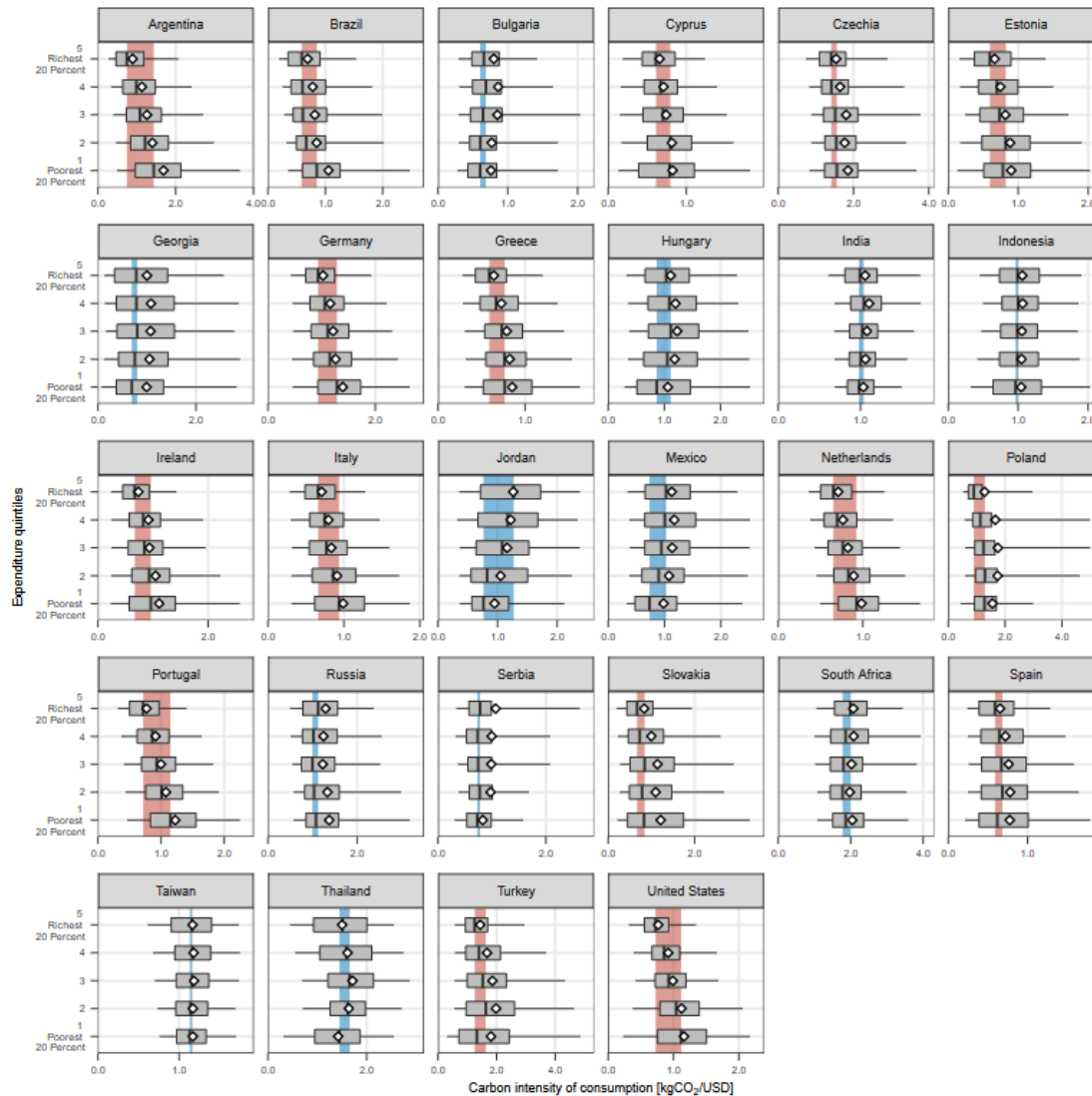
Visualisation & Download

For the relative impact, What matters is in which country you are and not in which decile

“.....the between-country effect is the essential driver of European regressivity and not the within-country or horizontal effect.....” (Feindt et al., 2021)

- For example the energy mix of the country is crucial

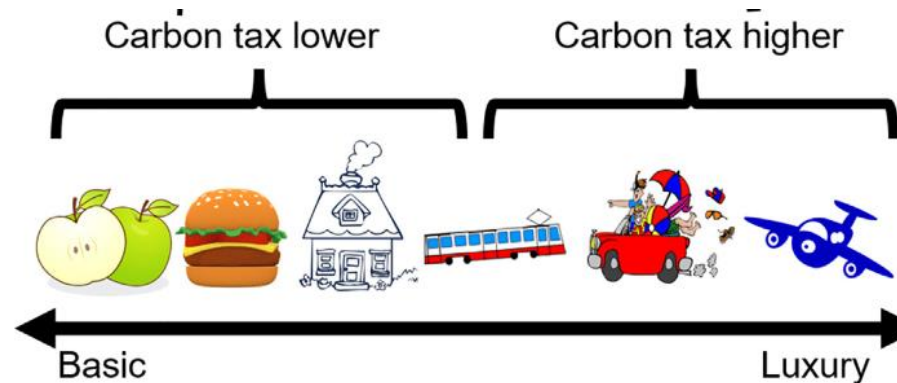
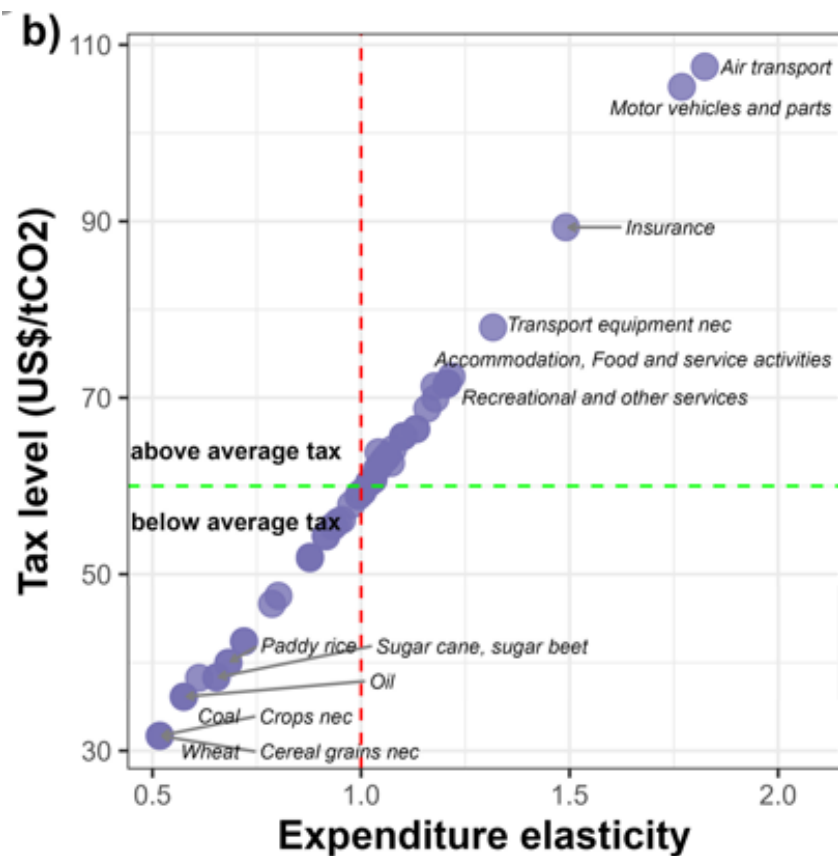




Why do we find this?

Because the elasticity of carbon footprints to income is around 1: A 1% increase in income has the same increase of carbon footprints

The consumption of the rich is therefore not always more carbon intensive (within countries!)



But the design of a carbon tax matters!

Designing a luxury consumption tax can effectively reduce the burden on the poor.

Or based on (international) justice

Or consumption vs production taxes also matter

For the long-term effects, the focus was on the **double dividend hypothesis**:

“can an environmental/carbon tax improve environmental outcomes while also allowing for economic growth”

There is no definitive answer on that

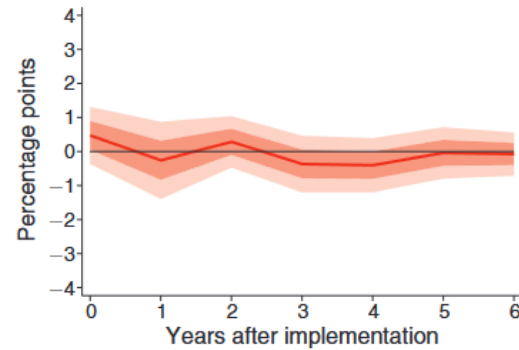
- Main findings is that there is no significant effect of taxes on overall economic output and total employment

For example, Goulder and Hafstead (2013) suggest that imposing a carbon tax with an initial rate of \$10/ton and rising at 5 percent/year would cause the level of *GDP 20 years later to be roughly 0.6 percent lower than it would have been in the absence of the tax*

In a study for the US, estimates that a carbon tax of \$40 per ton of carbon dioxide (rising over time at the rate of inflation) with the revenue returned to households via rebates would increase *long-run unemployment by 0.3 percentage points*

Longer term effects – double dividend

Panel A. Effect on GDP growth of a \$40 carbon tax covering 30 percent of emissions:
LP regression – unrestricted



Panel B. Effect on GDP growth of a \$40 carbon tax covering 30 percent of emissions:
LP regression – restricted

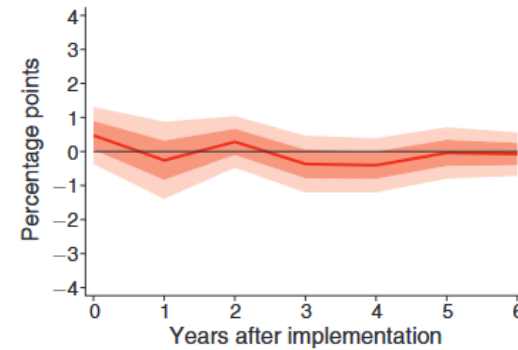


FIGURE 3. EFFECT ON GDP GROWTH OF A \$40 CARBON TAX COVERING 30 PERCENT OF EMISSIONS

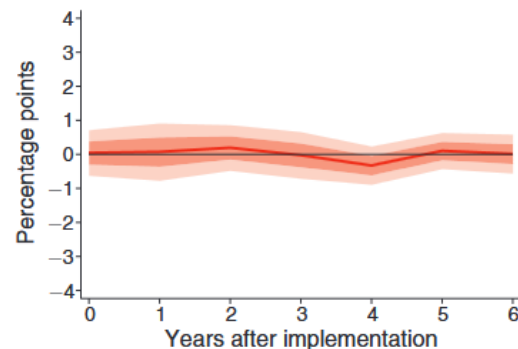
Notes: Sixty-seven percent and 95 percent confidence bands. Includes four lags of all regressors.

Using econometric ex-post analysis

Metcalf

- No effects on GDP and Jobs in the EU

Panel A. Effect on GDP growth: Bivariate LP regression – restricted



Panel B. Effect on GDP growth: Bivariate SVAR regression – restricted

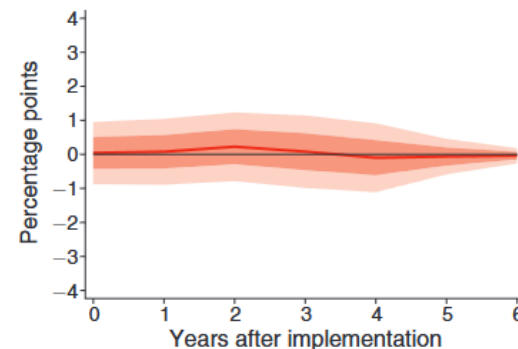


FIGURE 4. EFFECT ON GDP GROWTH

Longer term effects – double dividend

- Also using input output tables one can look at the potential increase in jobs
- Results are similar (around 0.3% increase)

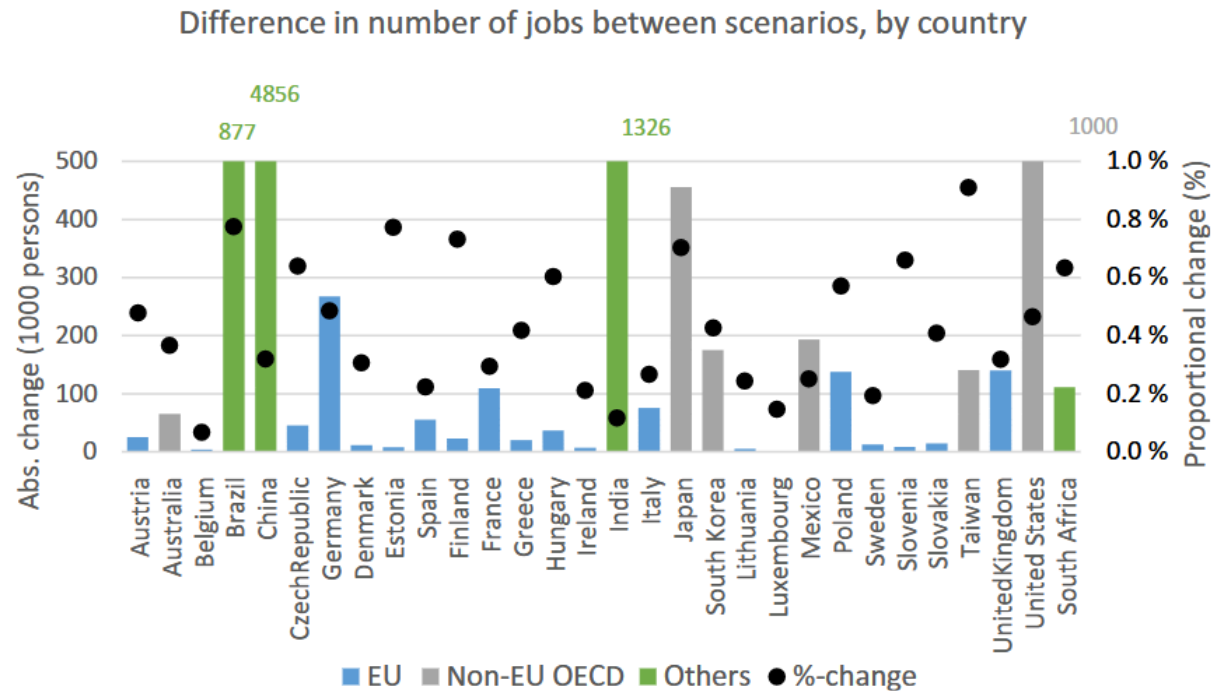


Figure 2. Absolute and proportional difference in number of jobs between scenarios, by country. Values above 500 were truncated for better visualization, with actual values on top of the bars.

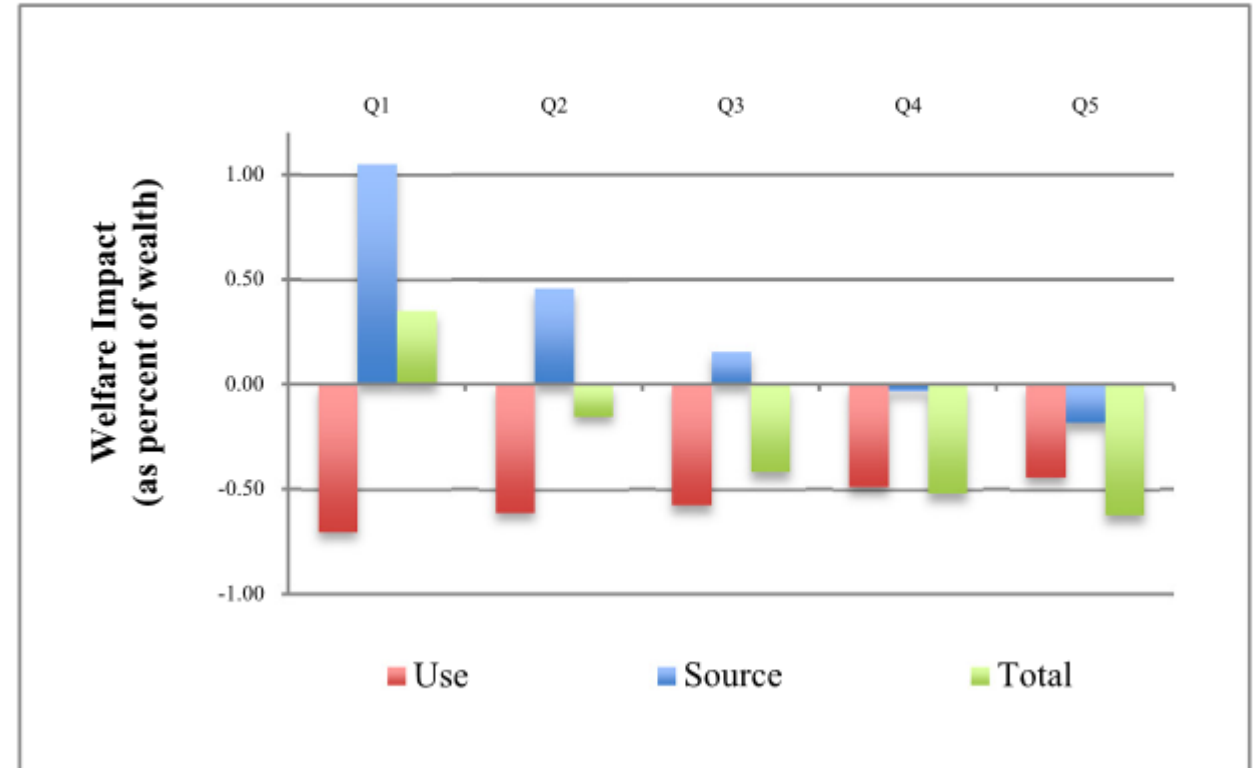
Longer term effects – distributional

(b) 2018–40

In terms of sources of income effects, if we go beyond the overall effects....

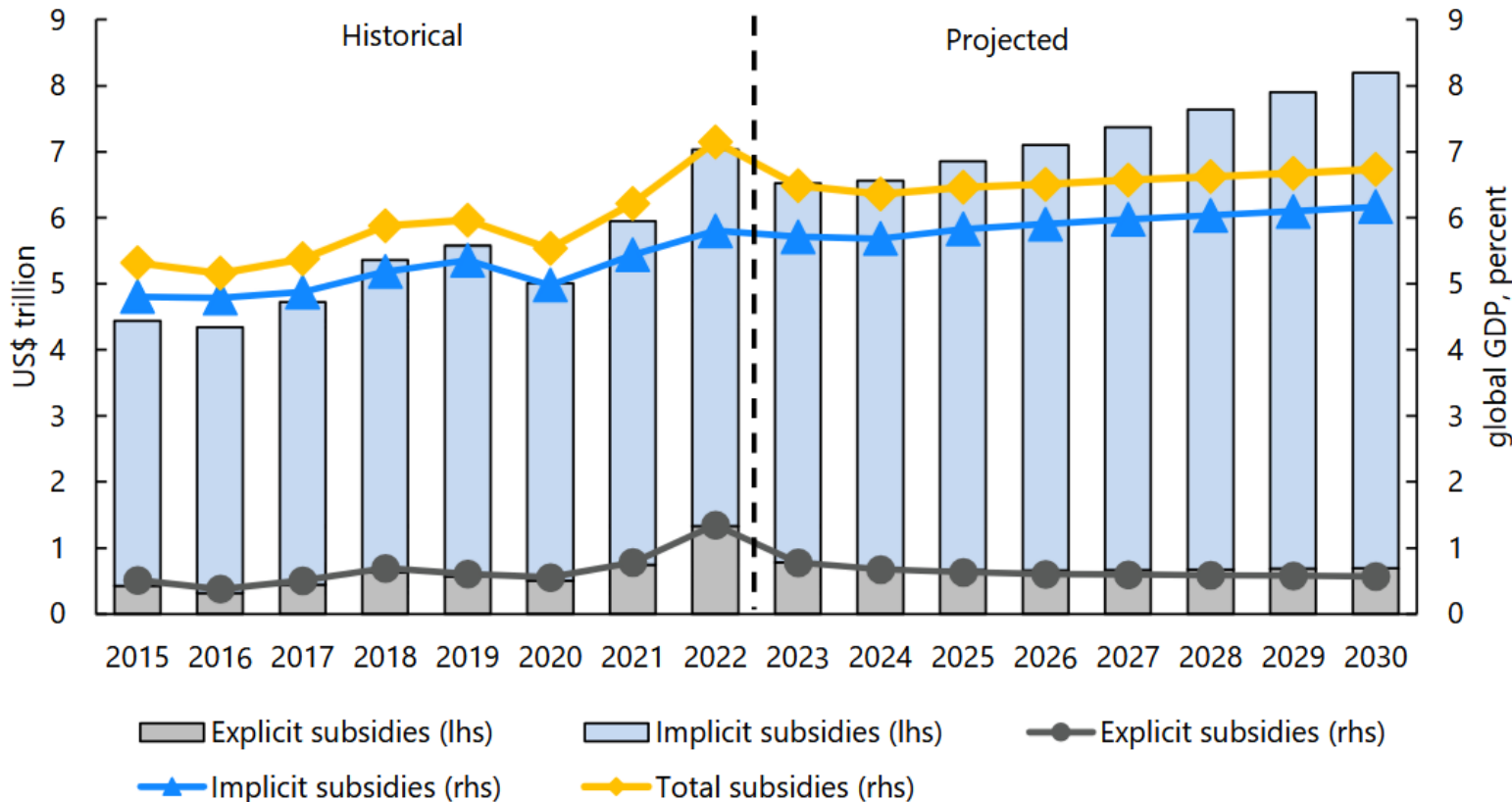
More progressive due to the effects

- On labour
- And capital



Because carbon-intensive industries tend to be highly capital-intensive and getting prices right will reduce demand for capital relative to labor, causing not only capital returns to fall relative to wages, but also increasing economy-wide labor demand.

Figure ES1. Global Fossil Fuel Subsidies



Source. IMF staff calculations. Note. 2019 and 2022 onwards use projections of fuel use and fuel prices, respectively.

One important point is how to account for non-strictly monetary effects, i.e. health etc and their distribution which can be hard to assess..

For example IMF considers implicit subsidies, that are the health effects from pollution etc of energy subsidies

- But is difficult to do a distributional analysis
- And many assumptions

Estimating the effects of environmental taxes can be a complex task

- Different channels need to be considered (long vs short; source vs use)
- Different models can be applied to consider these channels
 - Each model has advantages but also limitations
- Environmental taxes are usually neutral on relative terms when short term effects are considered
- With long-term effects, taxes may be progressive (due to unequal distribution of capital)

All these issues are relevant when considering complementary policies

- Most consider cash transfers to households also because they are easier to model

In terms of way forward

- There needs to be improvement on the modelling long term (especially on some hard to quantify aspects)
- And also in the communication of the results
- gender

<https://www.tandfonline.com/doi/full/10.1080/14693062.2020.1728208#d1e174>

<https://arxiv.org/html/2501.06251v1>

<https://pymrio.readthedocs.io/en/latest/>

Thank you!



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