Green **EUROMOD**: Climate goals, carbon taxes and inequality in the EU

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European Commission

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1. Research questions and contribution
2. Background and motivation
3. Data and methodology
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Green **EUROMOD** project

Model	Data	Analysis / simulations
EUROMOD (EU tax- benefit microsimulation model)	EU/National SILC	Direct taxes, social insurance contributions, cash benefits
EUROMOD-ITTv4 *(Indirect Tax Tool)*	… + consumption expenditures from EU-HBS	Indirect (consumption) taxes: VAT + excises at detailed product level
Green EUROMOD *(Ongoing research project)*	… … + GHG footprints from EXIOBASE input-output tables	Carbon taxes and other GHG-related fiscal policies

Inspired by G. Verbist’s presentation at a Fiscal Policy Workshop in 2019 (Lévay et al, 2021)

2022-2024 AMEDI and AMEDI+ (Administrative Agreements JRC - EMPL)

Green **EUROMOD** project

Ongoing research work:

1) Data description (bridging, cleaning, imputations, definitions, etc. → open access)

2) Climate goals, carbon taxes and inequality in the EU:
new insights from microsimulations

Today's presentation

1. Research questions & contribution

Our questions…

- How much are **GHG emissions implicitly taxed** by **consumption tax systems** in the EU-27 countries?
- How "*green*" (tax per emission) and how "fair" (redistributive effect) are current consumption taxes?
- Are **carbon taxes** necessarily **inequality-increasing?**

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1. Research questions & contribution

Our contribution…

1. New (detailed) picture of the distribution of **household consumption footprints** in the EU-27, at very disaggregated product level

→ Most studies rely on **domestic-technology assumption**, and/or li**nk GHG to expenditures and not income** (e.g. those based on HBS)…We overcome these limitations

2. **Implicit carbon price and redistributive effects** of consumption taxes

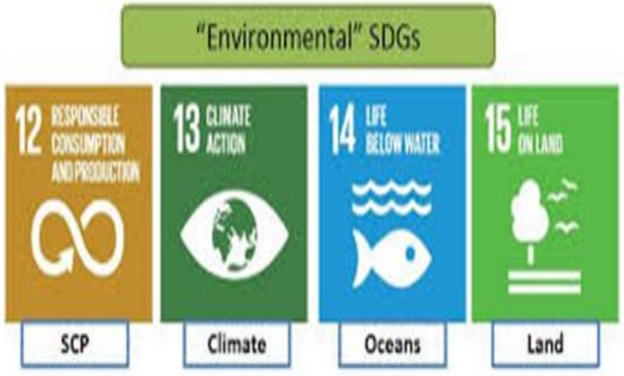
3. Assessment of "**green vs equity**" ***trade offs*** **through microsimulations**

→ We are not aware of papers doing 2-3 for the whole of the EU-27, with data on footprints, income and expenditures and based on current consumption taxes

2. Background and motivation: *goals*

The increase in the global average temperature to well below **2°C** *above pre-industrial levels* and pursue efforts *to* **1.5°C**

Reduction of 45% GHG emissions



4 environmental UN's Sustainable Development Goals towards 2030 (out of 17)

2030 55% reduction of GHG emissions w.r.t 1990

2050 carbon neutral

2. Background and motivation: *challenges*

COORDINATION EFFORTS

WAR, INFLATION AND ENERGY POVERTY

DISCONTENT: PUBLIC SUPPORT e.g. increasing taxes on fuels

DISCONTENT: NOT ENOUGH

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2. Background and motivation: *what we know*

Consensus

- We need to reduce GHG emissions to meet the new climate targets and prevent dangerous global warming → change demand (not only production/technology)
- One (among others) policy tools to achieve these goals: carbon pricing
- Sustainable price level, according to Stiglitz-Stern 2017 report: US$40–80/tCO2e by 2020, and US$50–100 by 2030 (social cost even larger, Tol, 2023)
- Carbon taxes are one type of carbon pricing (other: cap-and-trade, e.g. ETS)
- Popular for many decades, e.g. “Polluter pays principle" (OECD, EU)

2. Background and motivation: *carbon pricing*

Positive features of carbon pricing

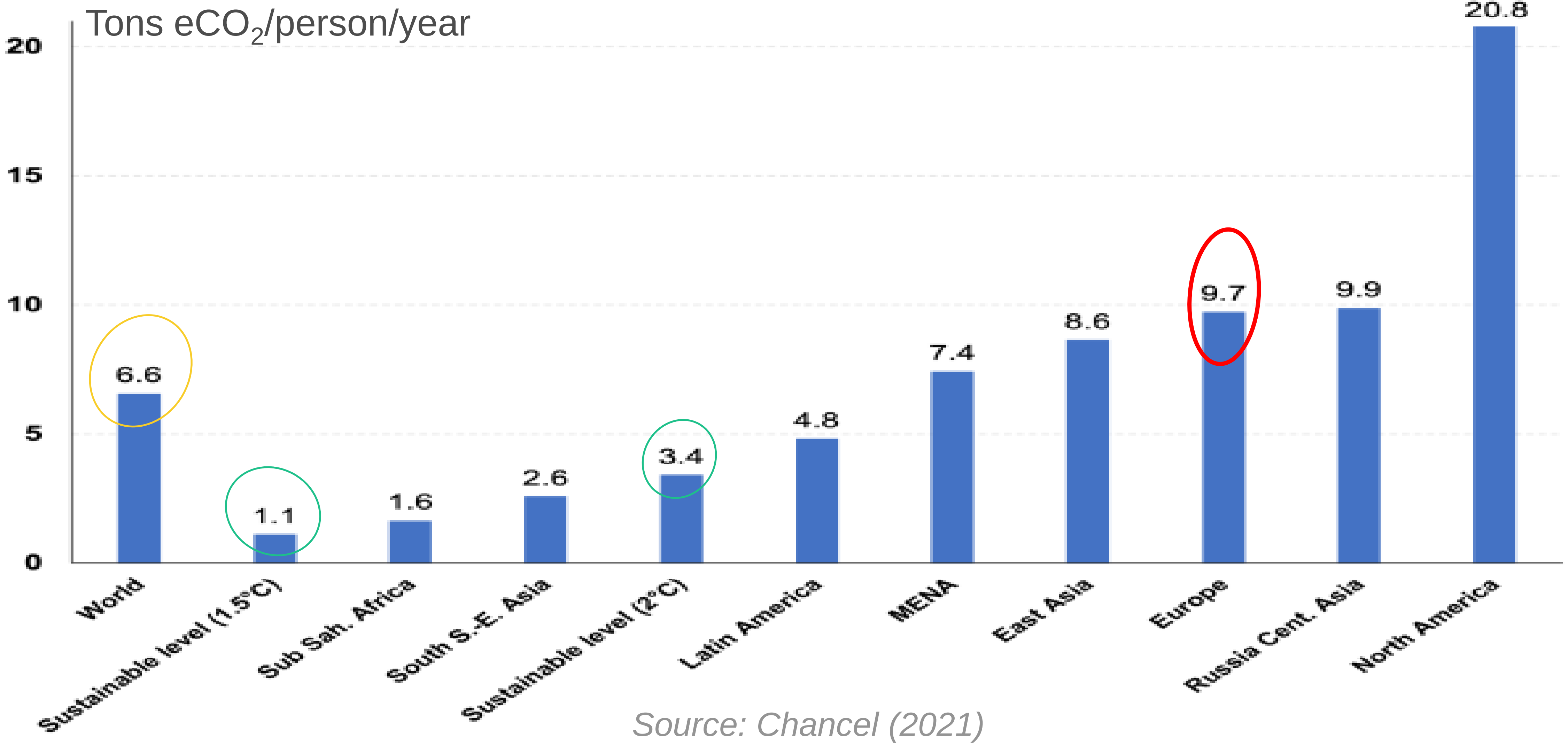
✓ Corrects **market signals** (externalities, Pigou 1922)

✓ More efficient than other tools (e.g. controlling quantities, or increasing more “distortionary” taxes...) – At least since Weitzman (1974), Pizer (2002),Cremer et al (2003).

Challenges / limitations

- Regressivity (mixed evidence, see e.g. Feindt et al, 2021; Amores et al 2023)
- Public support (e.g. see Carattini et al 2017; Klenert et al, 2018; Douenne and Fabre 2022)
- Low coverage (1/4 GHG emissions covered by carbon pricing according to World Bank)

2. Background and motivation: *from 8 to 2-3*



Source: Chancel (2021)

3. Data and methodology

***GHG Multiplier** (final demand approach)*

$m_p = \frac{GHG_p}{X_p}$: *tons of CO2eq of GHG emissions per EUR spent on product p*

$$m_p = m_{p,direct} + m_{p,indirect}$$

Imputing EXIOBASE data into HBS-SILC EUROMOD files

→ Emission intensities by final demand (input-output tables)
→ Estimation of trade margins
→ Bridging matrices

$m_{p,direct}$ → Car use, heating..

$m_{p,indirect}$ → Emissions embedded from production and trade

$$m_{ind} = m_{dom} + m_{eu} + m_{row}$$

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3. Data and methodology

Household carbon footprint (total)

$$HCF_j = \sum_{p=1}^{P} X_{jp} m_p = \sum_{p=1}^{P} s_{jp} Y_j m_p$$

X_{jp}: consumption expenditures (EUR)

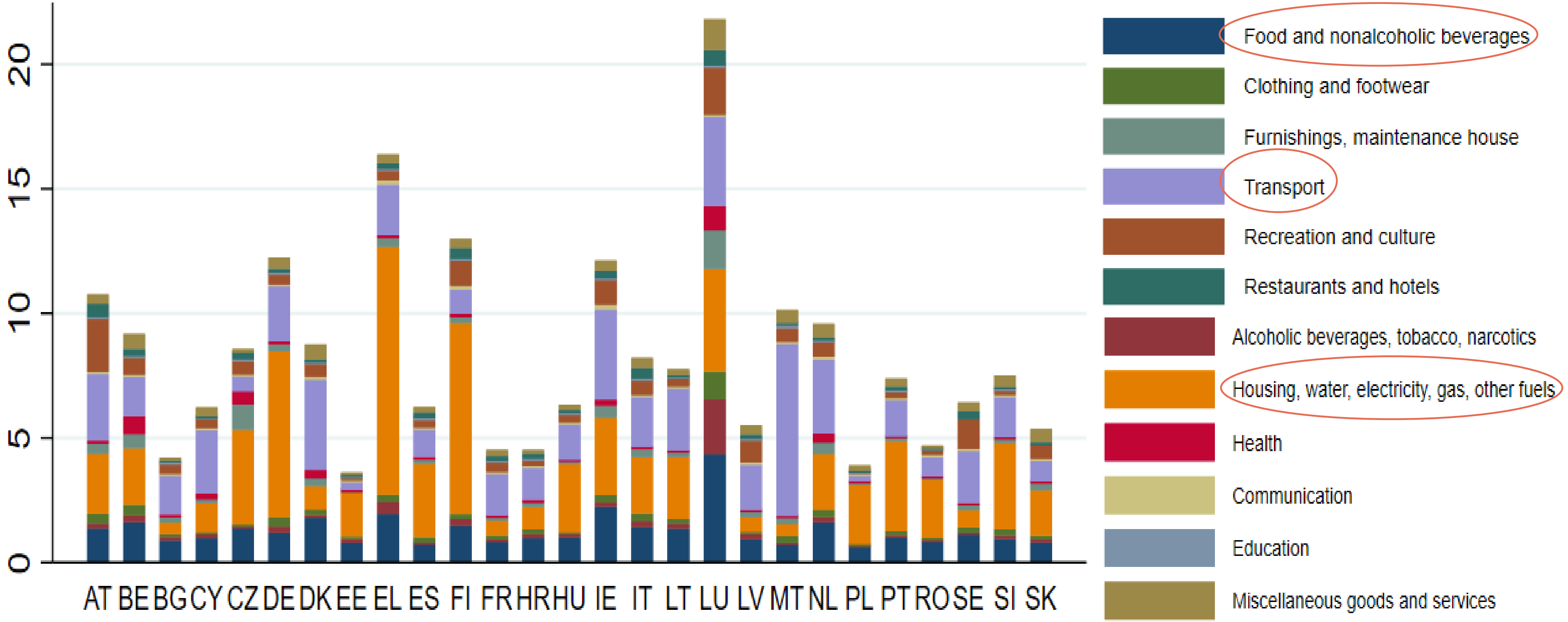
$\boldsymbol{m_p}$: multiplier (CO2eq/EUR) from [EXIOBASE]

$\boldsymbol{Y_j}$: disposable income (EUR) [EU−SILC + EUROMOD]

s_{jp} : income shares of expenditure (%) [EU−HBS]

3. Data and methodology: *statistics*

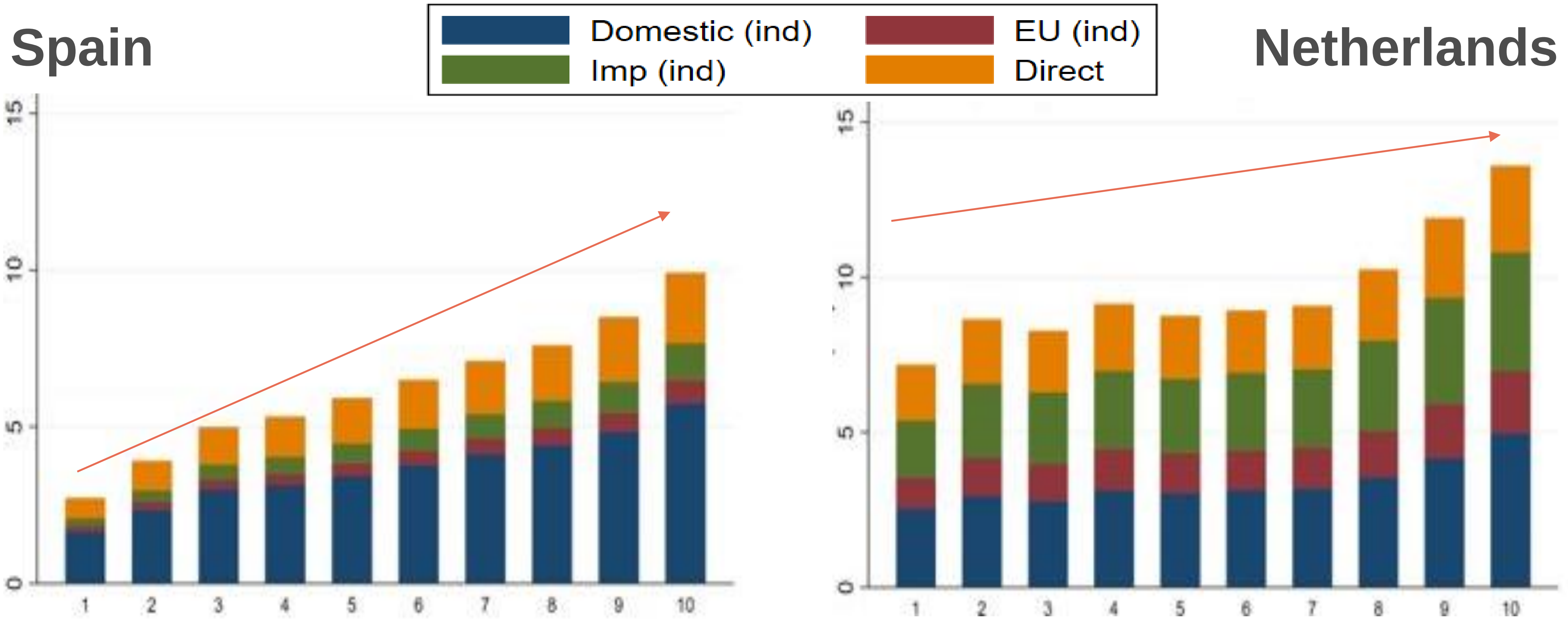
Figure 1. Per capita carbon footprints by aggregate product category (tons eqCO2 GHG per year)



Note: Based on Green EUROMOD (HBS-SILC + EXIOBASE). Expenditures scaled-up to NA.

3. Data and methodology: *statistics*

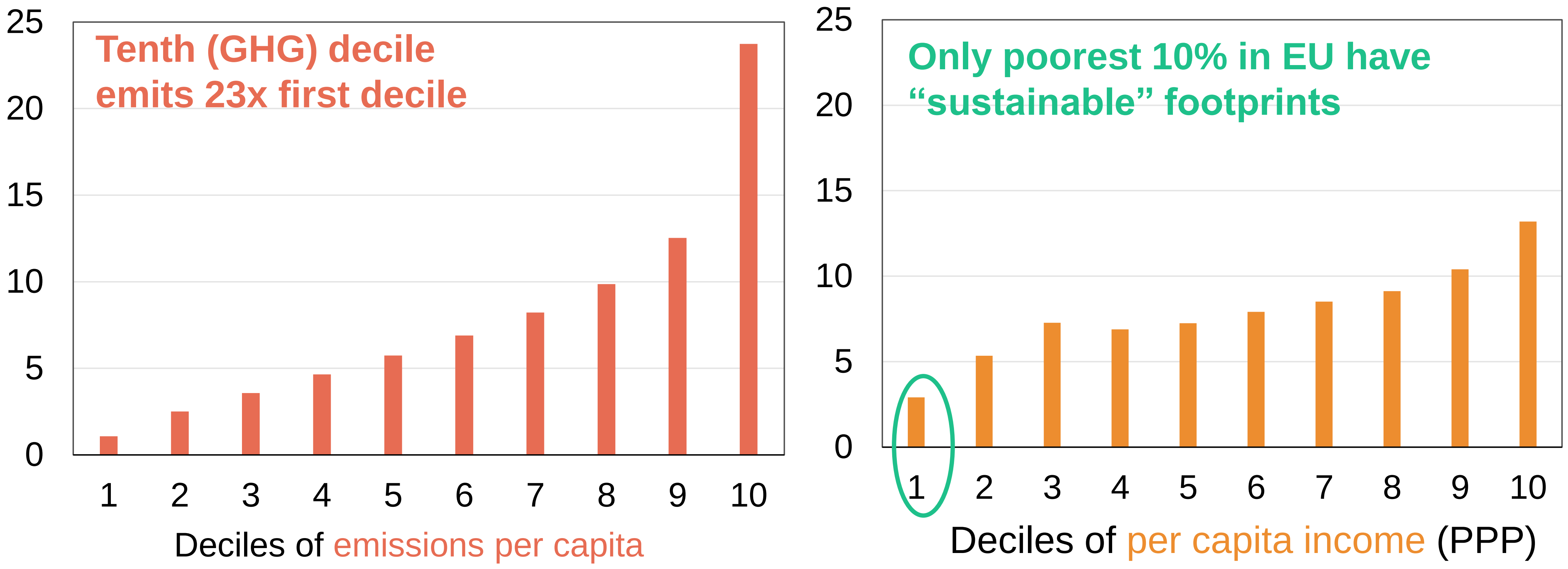
Figure 3. Per capita carbon footprints by income deciles (tons eqCO2 GHG per year)



Note: Based on Green EUROMOD (HBS-SILC + EXIOBASE). Expenditures scaled-up to National Accounts

3. Data and methodology: *statistics*

Figure 4. Per capita carbon footprints across **EU-level deciles** (tons eqCO2 GHG per year)



Note: Based on Green EUROMOD (HBS-SILC + EXIOBASE). Expenditures scaled-up to NA.

3. Data and methodology

- Cross-country comparative assessment of the *greenness* and redistributive effect of current consumption taxes:
    - *How green?* – implicit carbon price (% GHG taxed)
    - *Redistributive effect* - concentration indices (Gini before vs after tax)
- Simulation of alternative hypothetical carbon taxes
    - *Welfare:* changes in adjusted disposable income
    - *Assumptions*: non-behavioural responses (morning-after effects)

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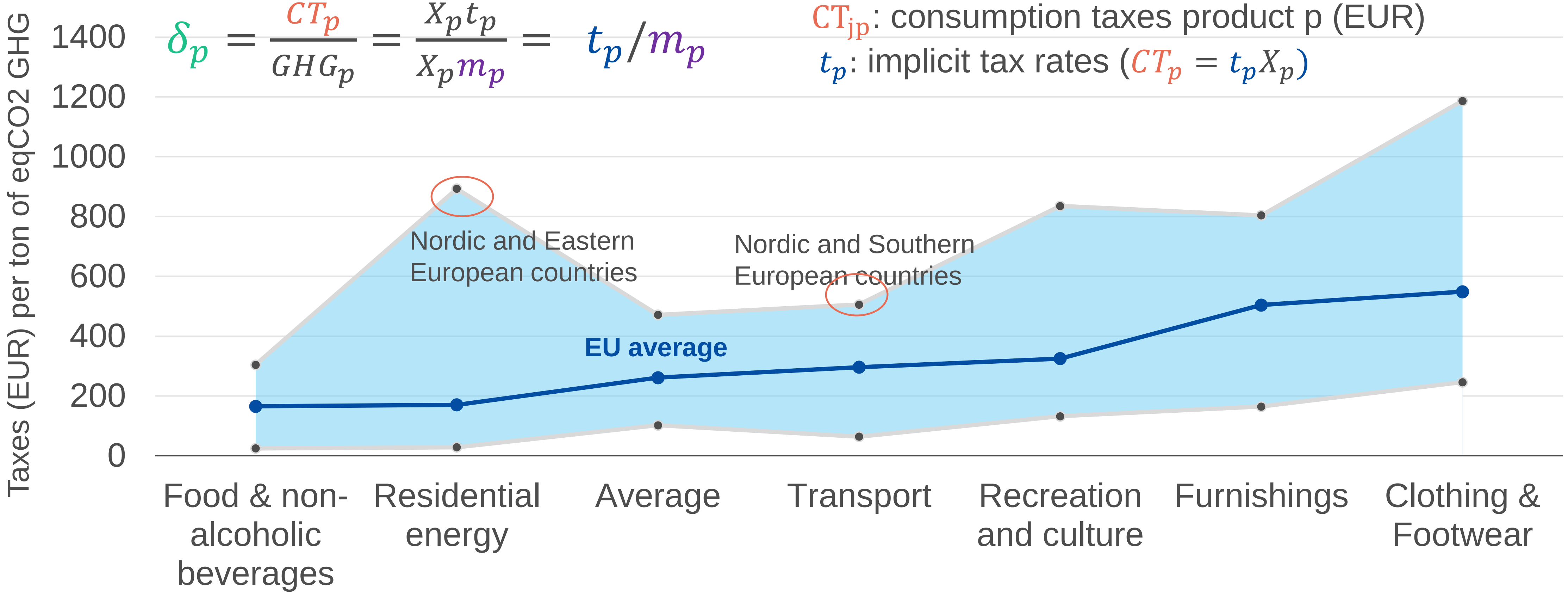
4. Results: how much are GHG *de-facto* taxed?

Figure 5. Implicit carbon price (δp) of consumption taxes (EUR per ton eqCO2 GHG)

$$\delta_p = \frac{CT_p}{GHG_p} = \frac{X_p t_p}{X_p m_p} = t_p/m_p$$

CT_{jp}: consumption taxes product p (EUR)

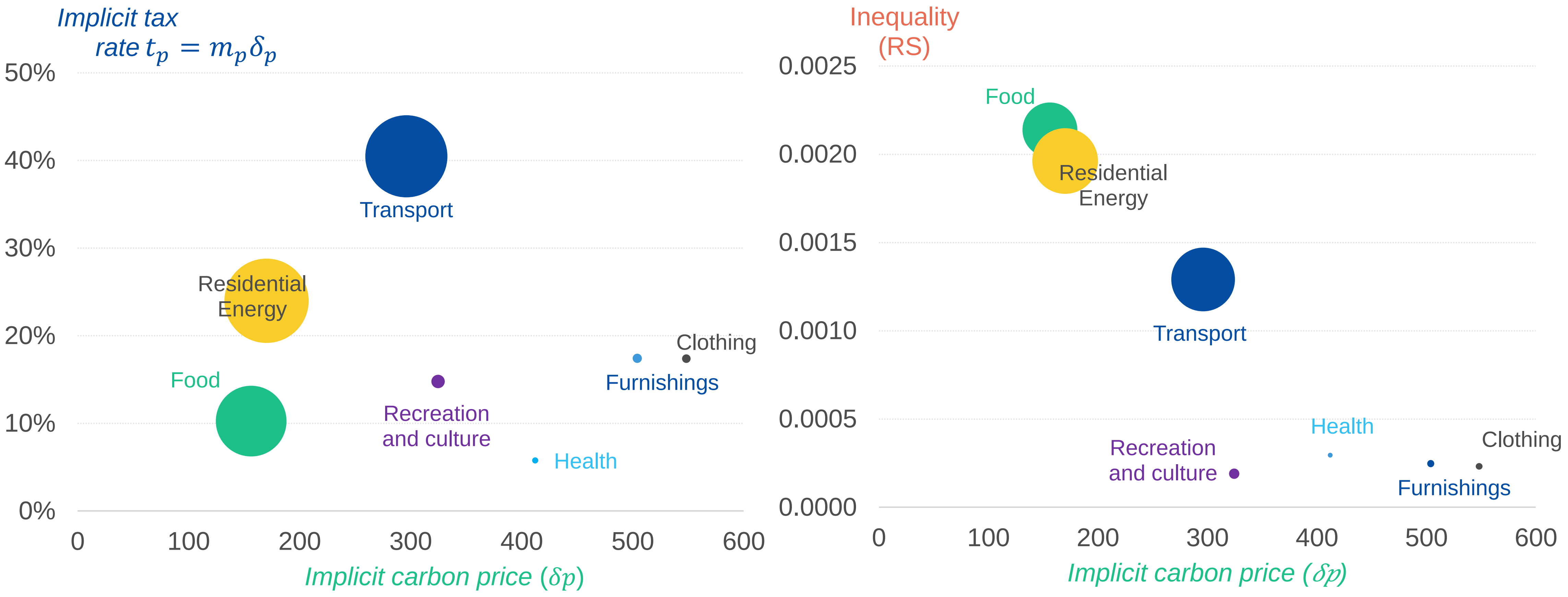
t_p: implicit tax rates ($CT_p = t_p X_p$)



Note: Based on Green EUROMOD (HBS-SILC 2015, policy system 2019 + EXIOBASE)

4. Results: the green-equity trade off

Figure 6. Implicit carbon price, tax rates, redistributive effect and footprints by product

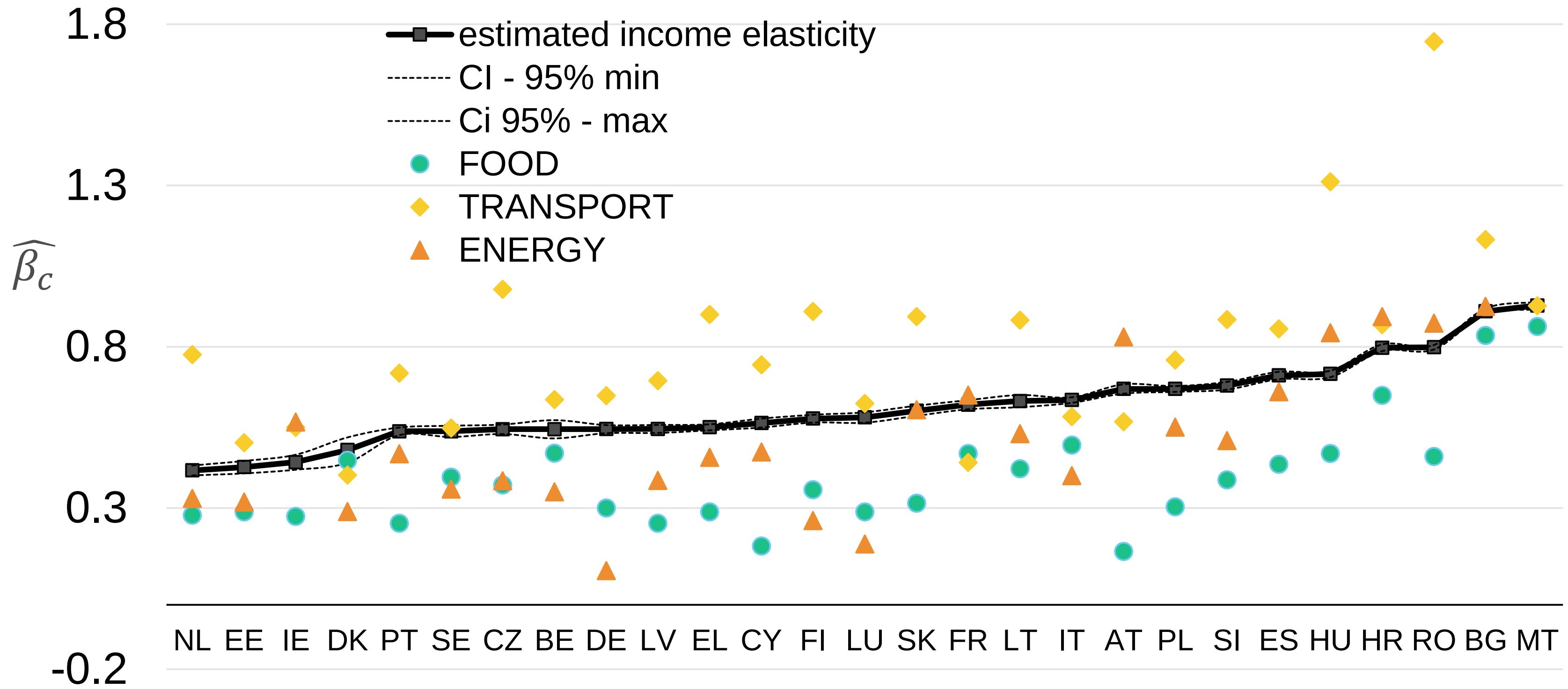


Note: EU average. Bubble size: GHG per capita eqCO2.

4. Results: income elasticity

$$\ln(HCF_{ic}) = \alpha_c + \beta_c \ln(DY_{ic}) + X\gamma + \mu_c \qquad c = country, i = individual\ (with\ equivalised\ income)$$

Figure 7. Income elasticities of carbon footprints (HCF)



Elasticities

- Higher for transport than for energy and food
- Higher for indirect emissions
- Higher in low-income countries

4. Results: simulated scenarios

Scenarios			Description	Budget
1) Green consumption tax shifts	1.1	CO_2 Tax	Country-specific flat carbon tax replacing current consumption taxes	neutral
	1.2	A **2.2**	… with allowances: up to 2.2 tons of GHG (compatible with Paris Agreement)	neutral
	1.3	A **5.17**	… with allowances: up to 5.17 tons of GHG (compatible with 2030 EU goals)	neutral
2) EU-level CO_2 tax	2.1	EU CO_2 Tax (**40 EUR**)	EU-level flat carbon tax	up
	2.2	EU CO_2 Tax + LS	… + revenue recycling lump sum cash transfer	neutral

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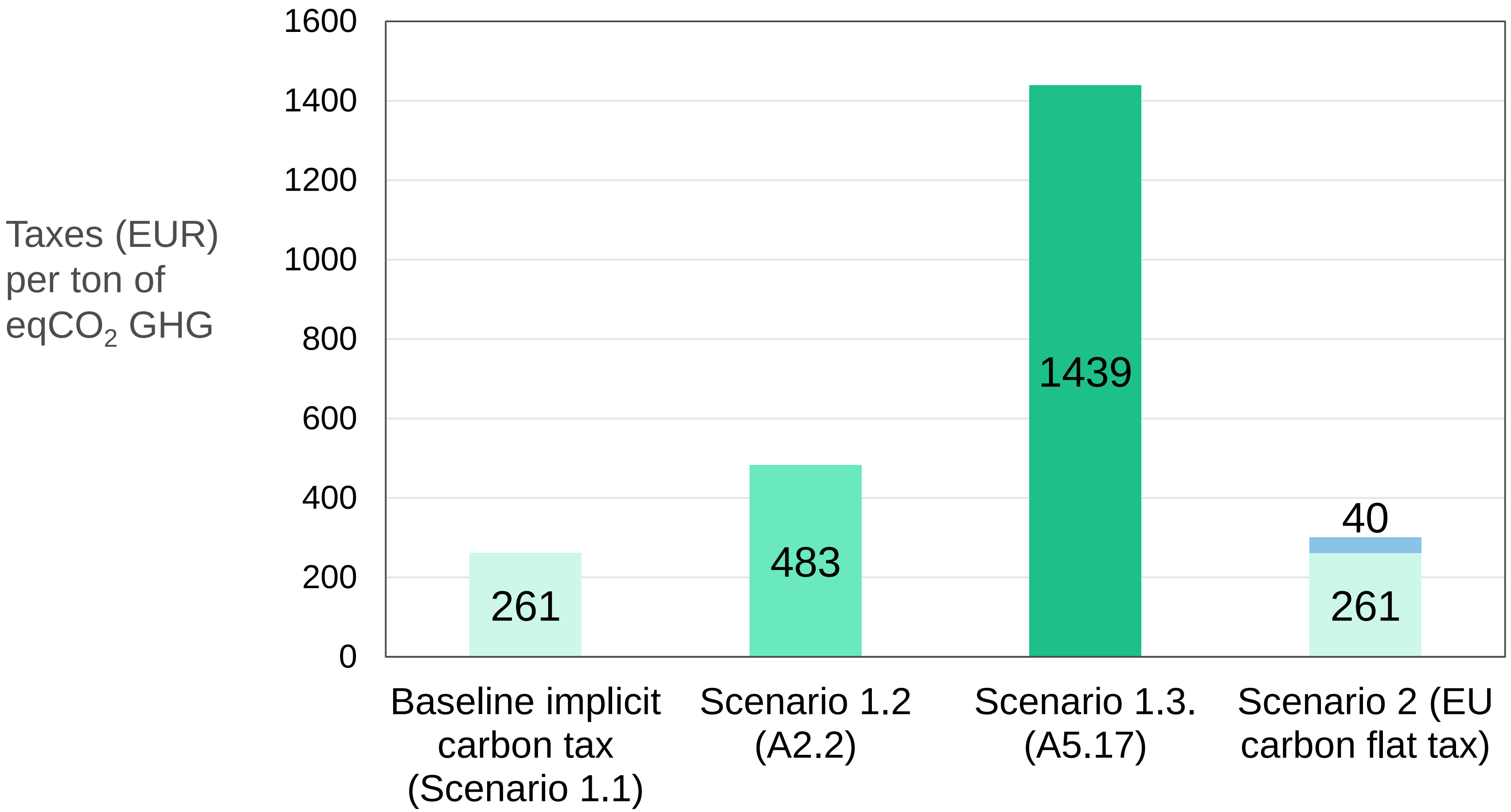
4. Results: carbon price across scenarios

Figure 8. Implicit carbon price (δp) of baseline and simulated scenarios



4. Results: redistributive effects

Figure 9. Redistributive effect of simulated carbon taxes

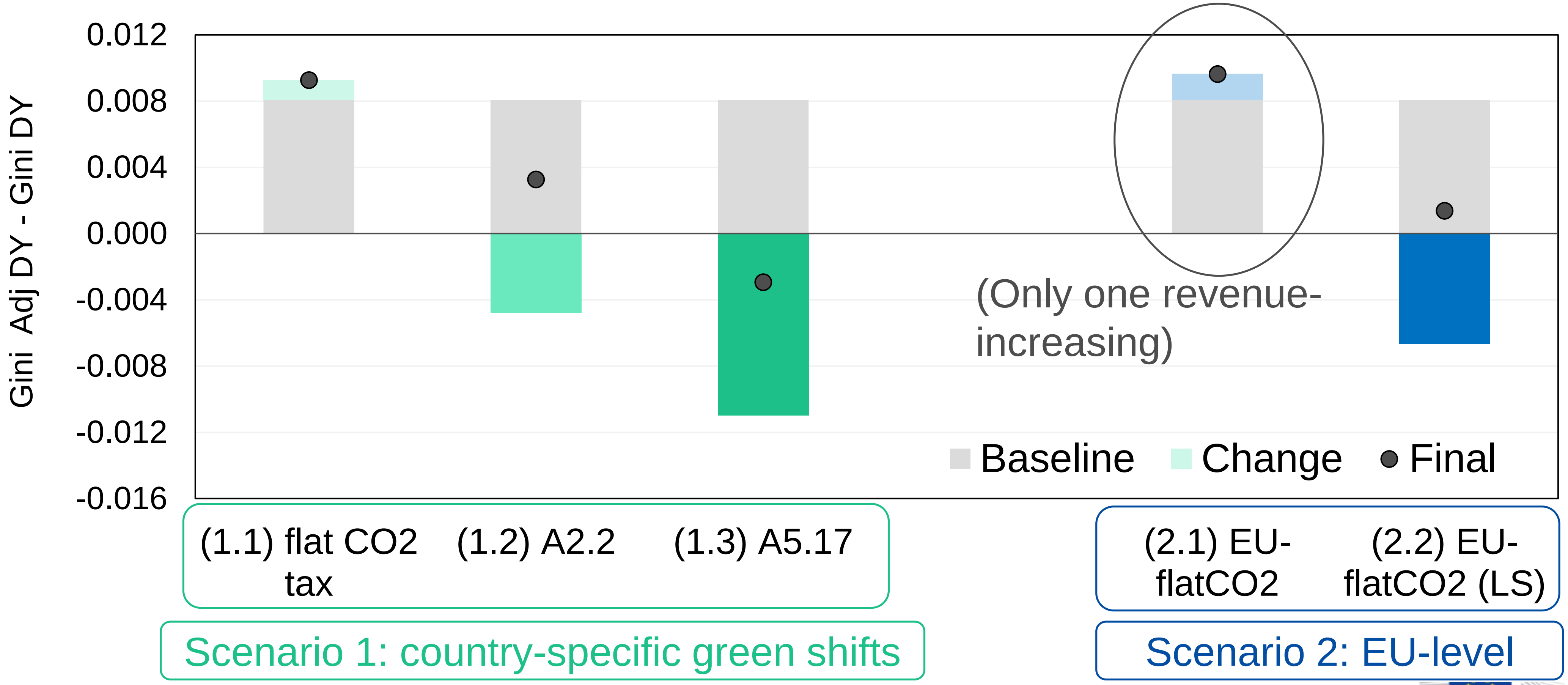
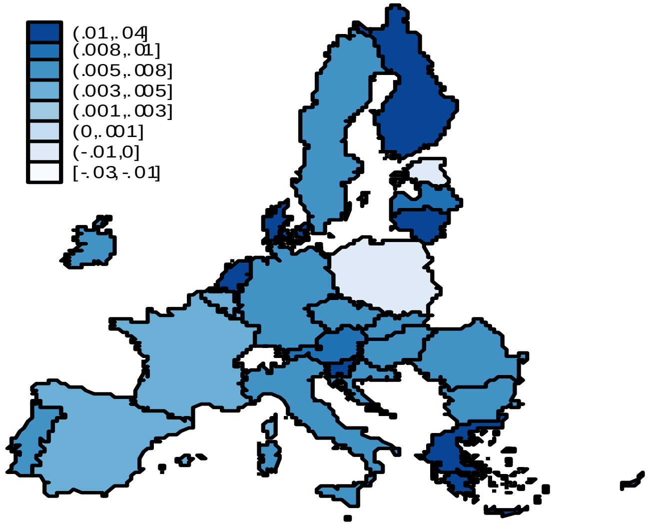


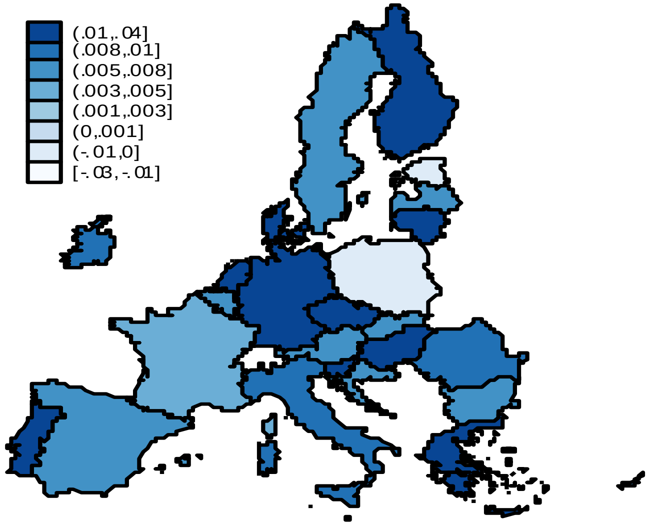
Figure 10. Redistributive effect of simulated carbon taxes

Scenario 1: country-specific green shifts

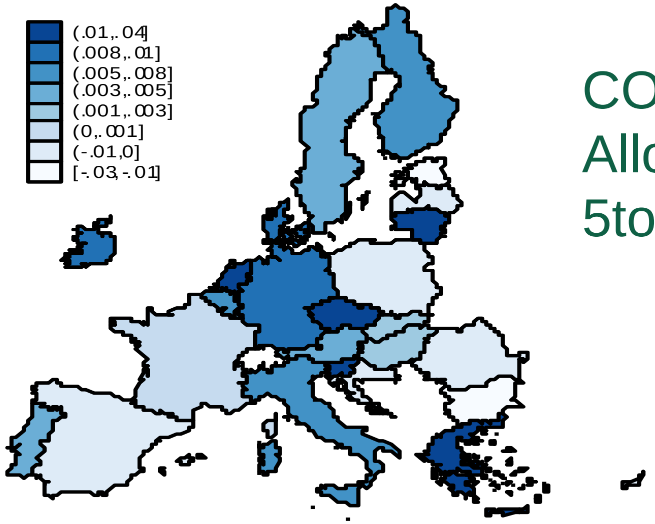
Baseline consumption taxes



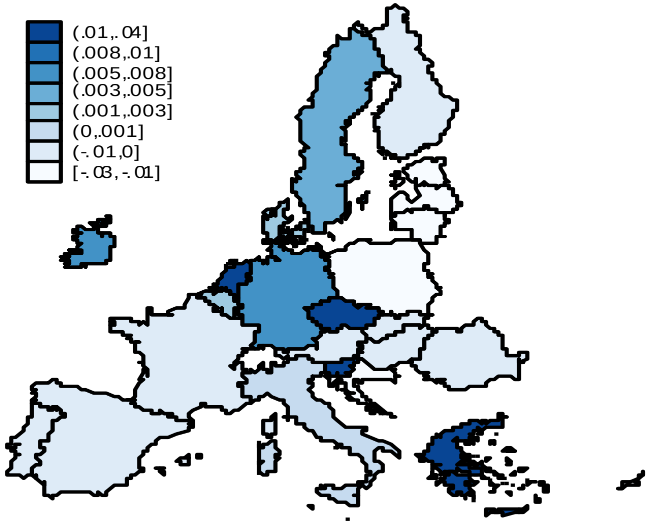
CO_2 tax (1.1)



CO_2 tax with Allowances 2.2tons (1.2)



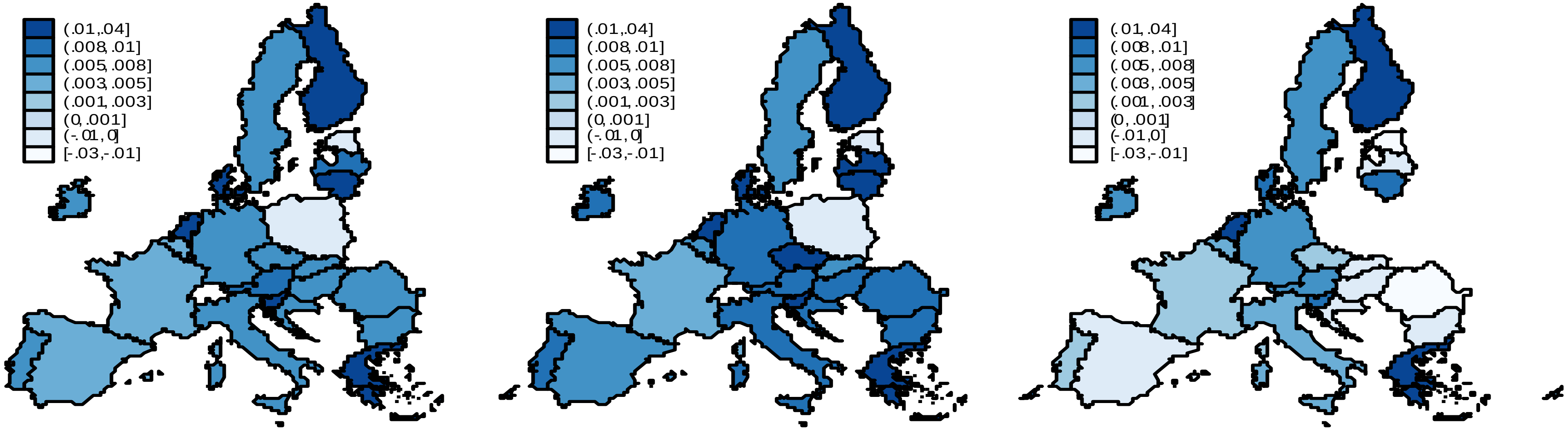
CO_2 tax with Allowances 5tons (1.3)



Note: Gini of adjusted disposable income – Gini of disposable income (without re-ranking).
Based on Green EUROMOD (HBS-SILC + EXIOBASE).

Figure 11. Redistributive effect of simulated carbon taxes

Scenario 2: EU-level carbon tax



Baseline consumption taxes

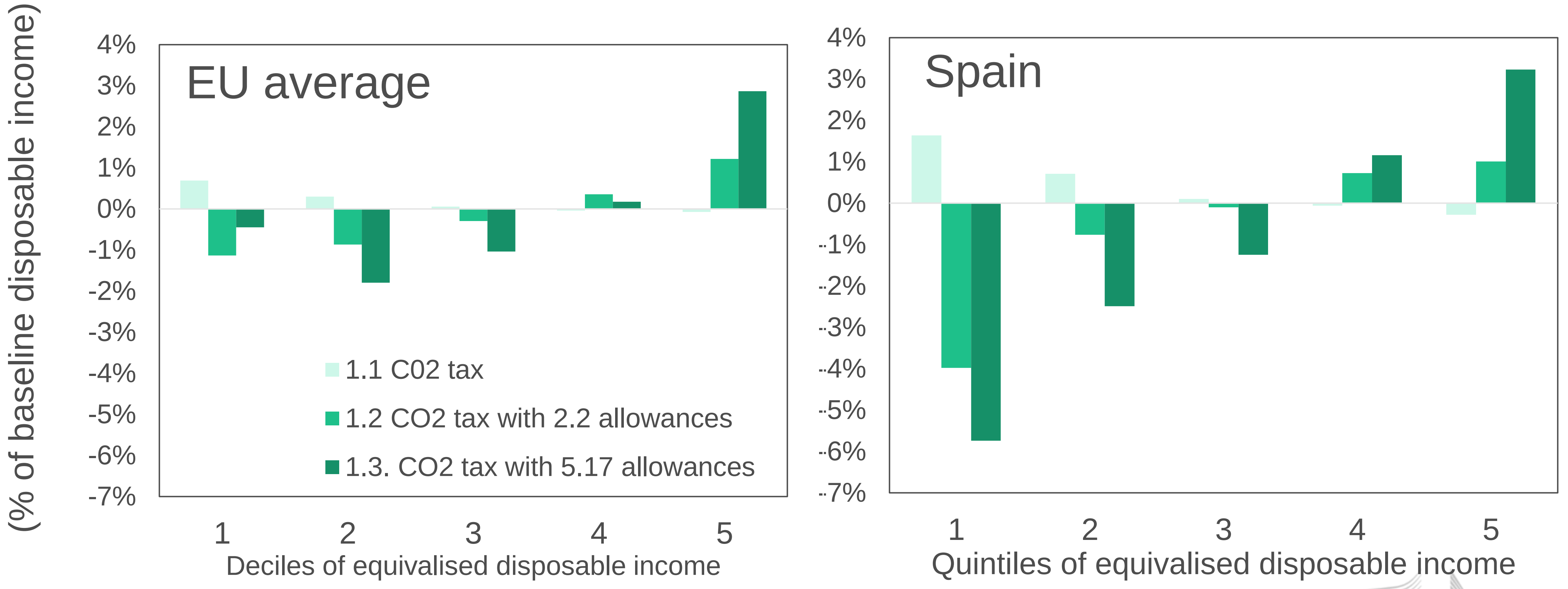
Flat CO2 tax (40 EUR) (2.1)

Flat CO2 tax (40 EUR) + lump sum (350 EUR pc - annual) (2.2)

4. Results: effect across income quintiles

Figure 12. Effect of reform across income quintiles

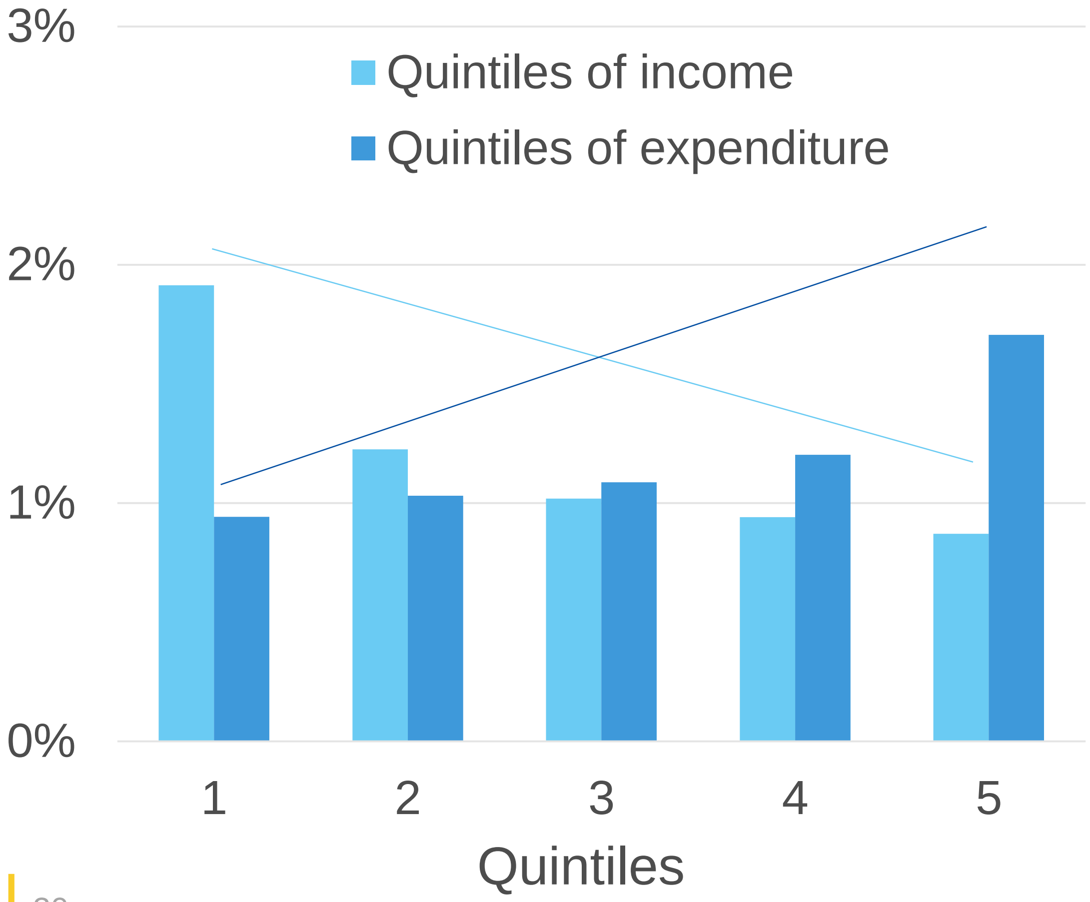
Scenario 1: country-specific green shifts



4. Results: expenditures vs income rankings

Figure 13. Impact across expenditure and income-based quintiles (EU average)

Scenario 2: EU-level carbon tax (2.1) – without lump-sum



- Feindt, et al 2021 in ***Understanding regressivity…Energy Economics:*** progressivity of a EU-C02 flat taxes at the country level...
- If we would use expenditures our results would be much more progressive too…
- Same discussions as in the literature of consumption taxes, see e.g. Thomas (2022)

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5. Conclusions (preliminary)

- Footprints in EU above world average and far from sustainable levels
- Only the poorest decile (EU-level) has footprints <3 tons of eqC02 a year
- Richest 10% EU citizens emit 5x more than poorest 10%
- Low and middle income countries (within the EU) have lower per capita emissions and also lower implicit carbon price despite their higher implicit tax rates → any EU-level flat CO2 tax will disproportionately affect them
- Income elasticity of GHG driven by income elasticity of consumption (multipliers actually tend to decrease across income).
- Key trade offs across different taxation by products: transport is the most taxed and higher implicit carbon pricing among highly polluting goods… but others (e.g. energy/food) are much more inequality-costly.

5. Conclusions (preliminary)

From the simulations:

- Greening consumption taxes [SC 1] (keeping constant government revenues) would be inequality-increasing in most countries (2/3)
    - However, reversed with "sustainable allowances" (2.2, 5.17): design matters
- EU-level CO_2 flat tax of 40 EUR [SC 2] is inequality-increasing in 26/27 EU MS
    - However, with budget-neutral lump sum inequality would even decrease
- Conclusions would change if we look into effects over expenditures as some papers do (choice or lack of income data?)

Thanks!

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