Incidence Analysis of National Climate Policies: Estimates and Implications for Austrian Households

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Relevance of climate policy incidence

General wisdom, that carbon or fuel taxes are regressive as low income households spend a larger portion of their income on energy and fuels

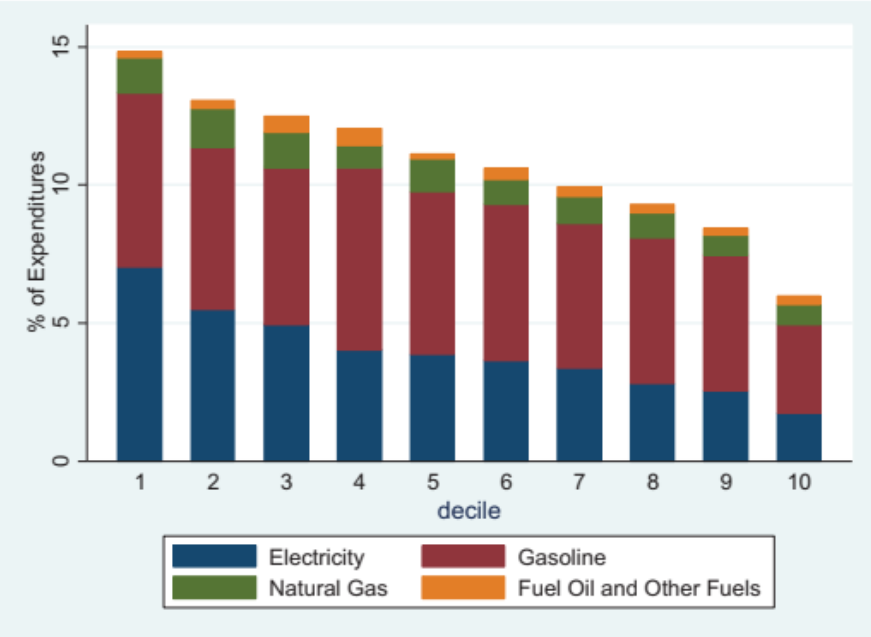


Figure 1 Average U.S. household energy expenditure as a percentage of total expenditure by expenditure decile.
Notes: Decile 1 is poorest, 10 is richest.
Source: Bureau of Labor Statistics (2014).

Channels of incidence and modelling approaches

- Different **channels** trough which incidence is affected:
  - Income use: direct effect from fuel and energy use
  - Income use: indirect effect
  - Income source: factor income in general equilibrium

- Correspondingly, different **approaches** (that imply increasing complexity) are able to cover these incidence channels to different extends:
  - Household budget survey analysis
  - Input-Output analysis (e.g. carbon footprints)
  - Macroeconomic modelling (CGE modelling)

Short literature overview

Approach	Incidence channel	Study	Policy	Region	Incidence (w./o. redistirubutive revenue recycling)
HBS	• Income use: direct	Callan et al. (2009)	Carbon pricing	Ireland	Regressive
		Sterner (2012)	Fuel tax	Seven European countries	Country-dependent (regressive, proportional to progressive)
		Farell (2017)	Carbon tax	Ireland	Regressive
IO	• Income use: direct and indirect	Grainger and Kolstad (2010)	Carbon pricing	US	Regressive
		Hassett et al. (2009)	Carbon tax	US	Regressive
CGE	• Income use: direct and indirect • Income source	Rausch et al. (2011)	Carbon pricing	US	proportional
		Dissou (2014)	Carbon tax	Canada	U-shape

- All of the incidence approaches are used in earlier and recent studies to estimate climate policy incidence
  - All of them acknowledge incidence channels covered and excluded
- Main body of the literature investigates carbon pricing instruments in developed countries
  - Revenue recycling may compensate regressivity
  - Effectiveness of recycling may be limited by within group variation (horizontal equity)

Research question

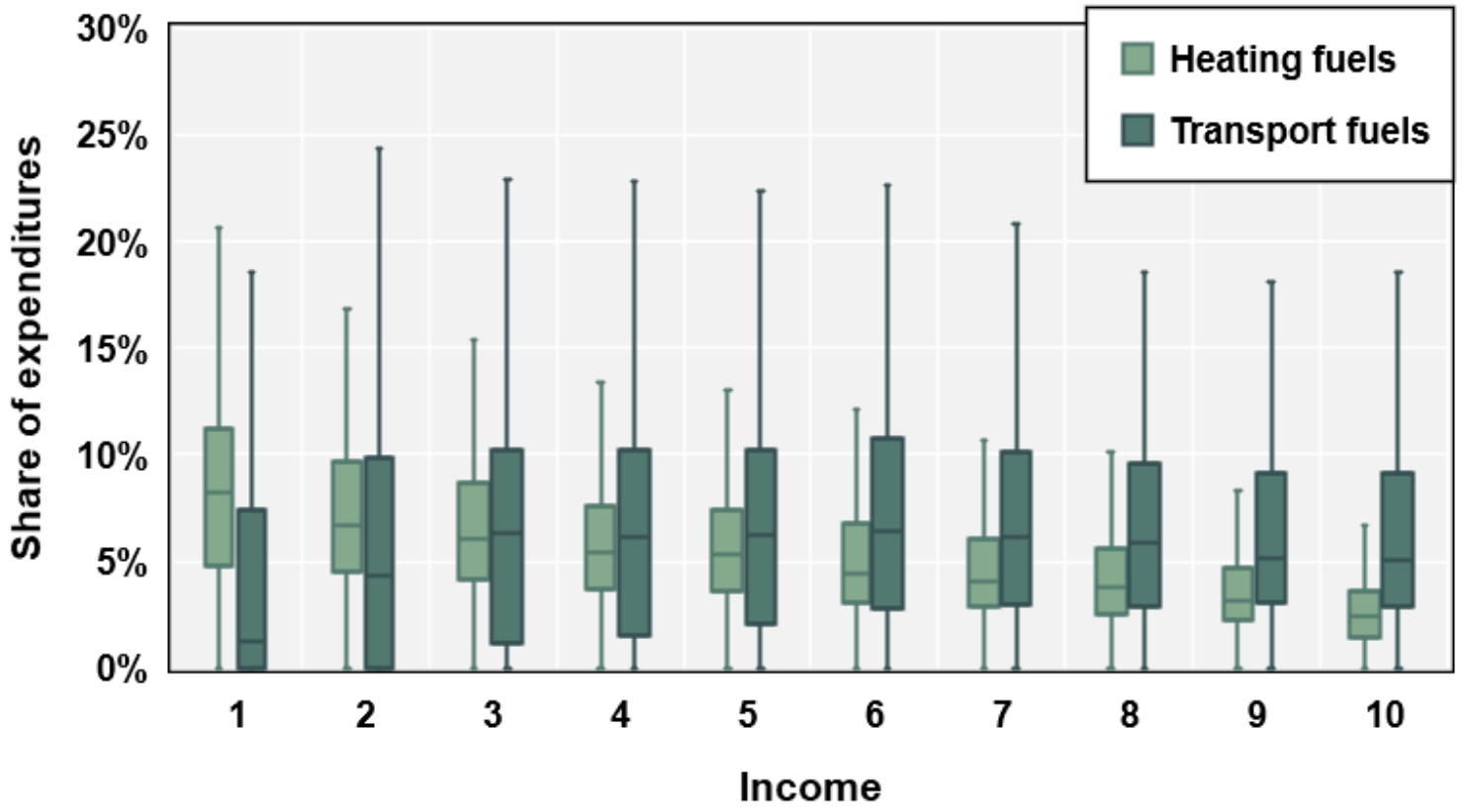
1. Different approaches
   - What is the climate policy incidence from each channel of direct and indirect income use as well as income source effect for Austria?
   - I.e. what is the „error“ when neglecting a channel by using different approaches?
2. Horizontal equity
   - How relevant is horizontal equity for revenue recycling when considering direct and indirect income use channels?
3. Different policy instruments
   - How does the incidence transmitted through each channel look for different national policy instruments?

Approaches and data used

- Household budget survey (HBS) analysis
  - Austrian HBS 2014/15 (Statistik Austria 2016a)
  - Representative sample of 7,162 households
  - Income deciles (1=lowest income, 10=highest income)
    - Lifetime income (expenditure proxy) (Poterba 1991)
    - Household equivalents (i.e. per capita)

Approaches and data used

- Household budget survey (HBS) analysis



➢On average higher budget share for fuels in low income households than for high incomes

➢Within-group variation is larger for low income groups (cf. also Pizer and Sexton 2019)

Approaches and data used

- Input-Output (IO) approach for embodied emission calculation
  - EE-MRIO based on GTAP database

$$\boldsymbol{e}^{*} = \boldsymbol{e}\,\hat{\boldsymbol{x}}^{-1}\,(\boldsymbol{I} - \boldsymbol{Z}\hat{\boldsymbol{x}}^{-1})^{-1}\hat{\boldsymbol{y}}$$

  - Regional and sectoral sources by using diagonalized vector of region-specific sectoral emission intensities $\boldsymbol{e}_{\boldsymbol{r}}\widehat{\widehat{\boldsymbol{x}_{\boldsymbol{r}}}}^{-1}$
  - Total Austrian emissions in the supply chain of Austrian final household demand
  - HBS 2014/15 (Statistik Austria 2016a)

Approaches and data used

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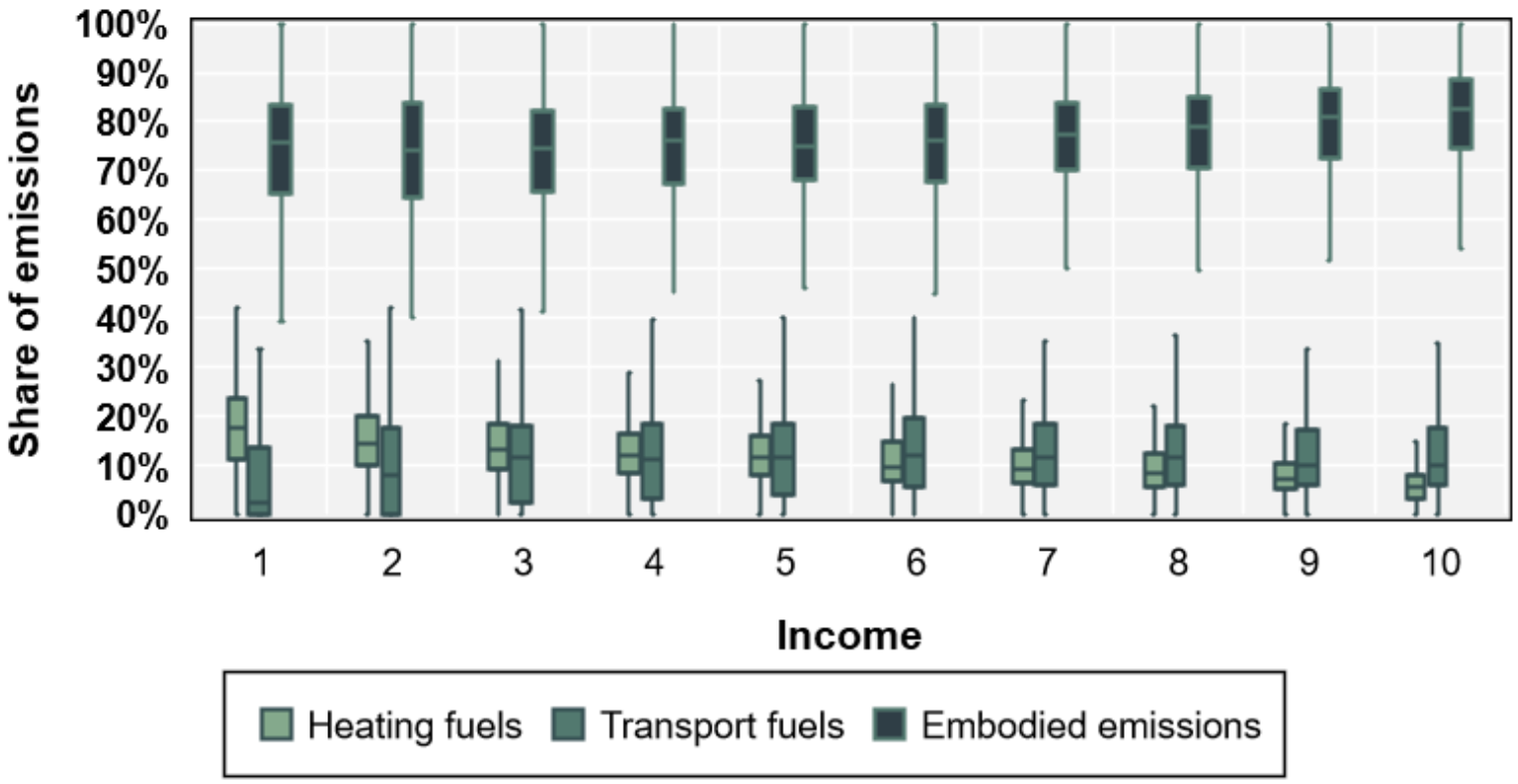
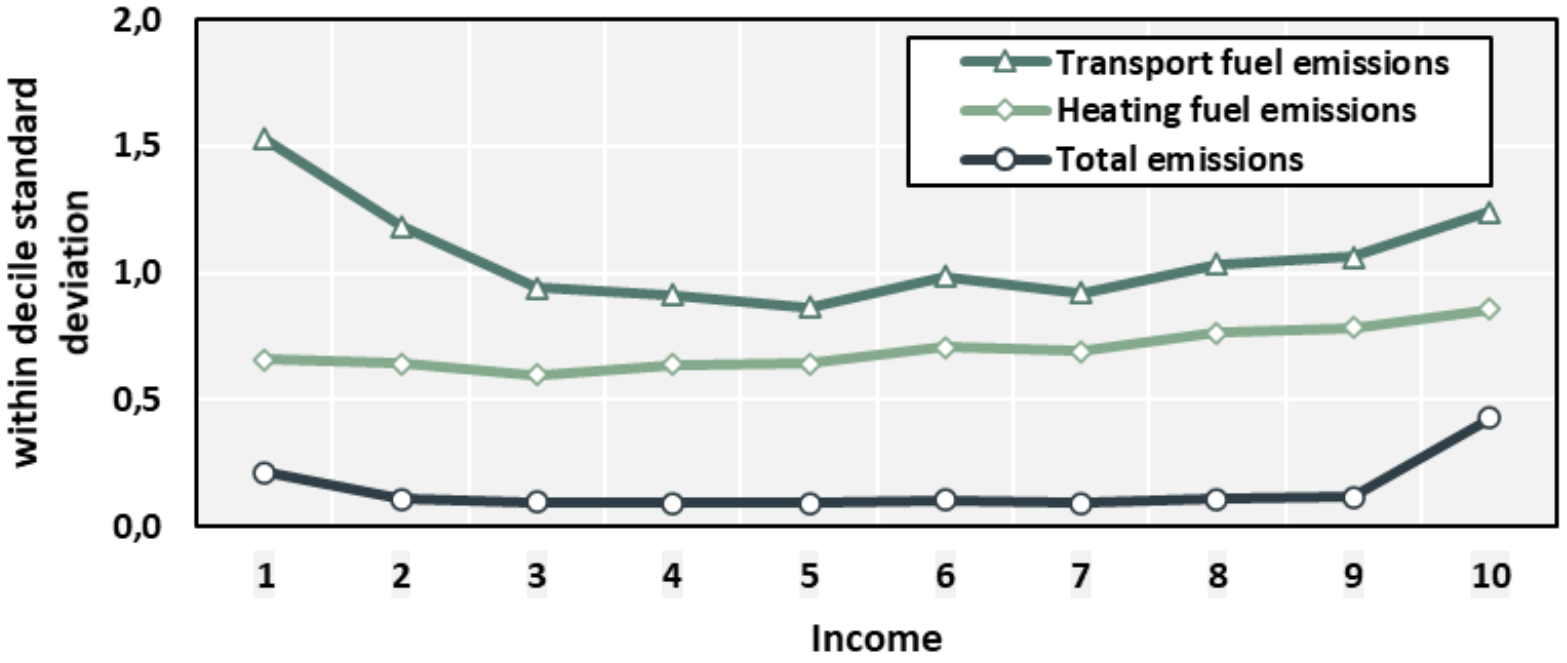


Emission embodied in consumption:

- Account for 70%-80% of total household emissions
- Are more equally distributed than direct fuel emissions

Approaches and data used

- Input-Output (IO) approach for embodied emission calculation



Emission embodied in consumption:

- Account for 70%-80% of total household emissions
- Are more equally distributed than direct fuel emissions
- Within-group variation of total emissions is lower than for fuels and more equal across income groups

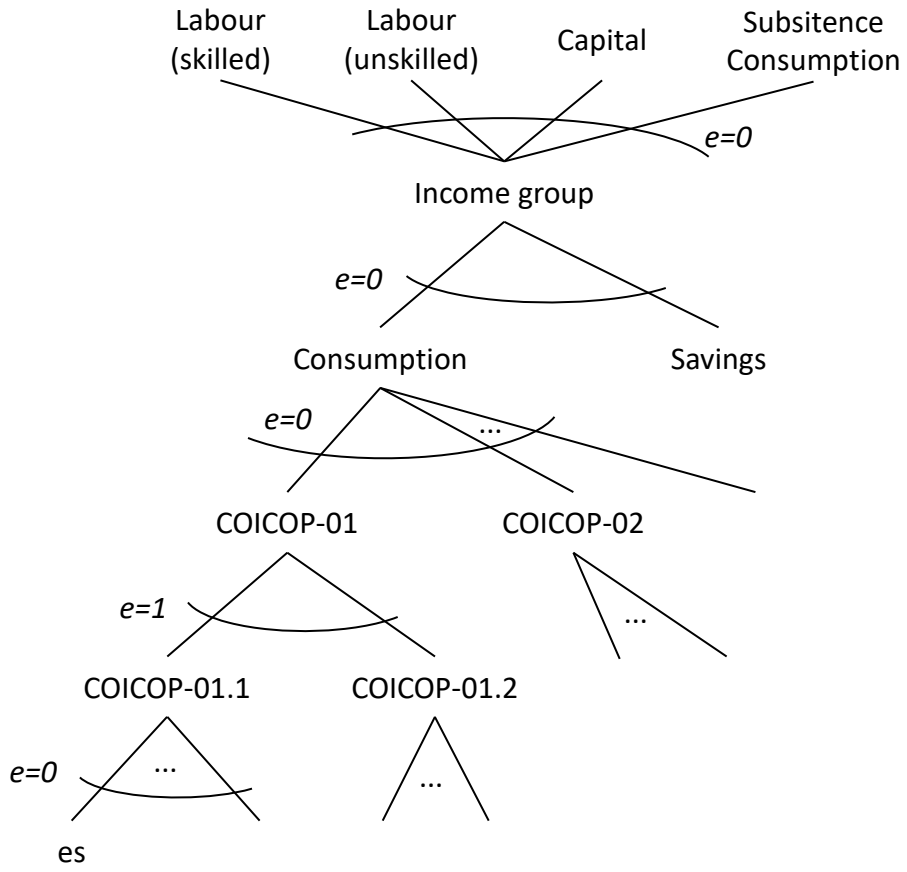
Approaches and data used

- Computable General Equilibrium (CGE) modelling
  - Multi-sector multi-regional CGE model of explicit global trade
    - Based on GTAP data
  - Simulation of...
    - Consumption responses of households
    - Production responses of firms

    ... via constant elasticity of substitution (CES) functions
  - Household representation in income quartiles
    - Income use: HBS 2014/15 (Statistik Austria 2016a)
    - Income source: EU-Silc (Statistik Austira 2016b)
      - Capital, high- and low-skilled labour, transfers
    - Subsistence consumption by Stone-Geary utility functions

Approaches and data used

- Computable General Equilibrium (CGE) modelling
  - Household representation in income quartiles



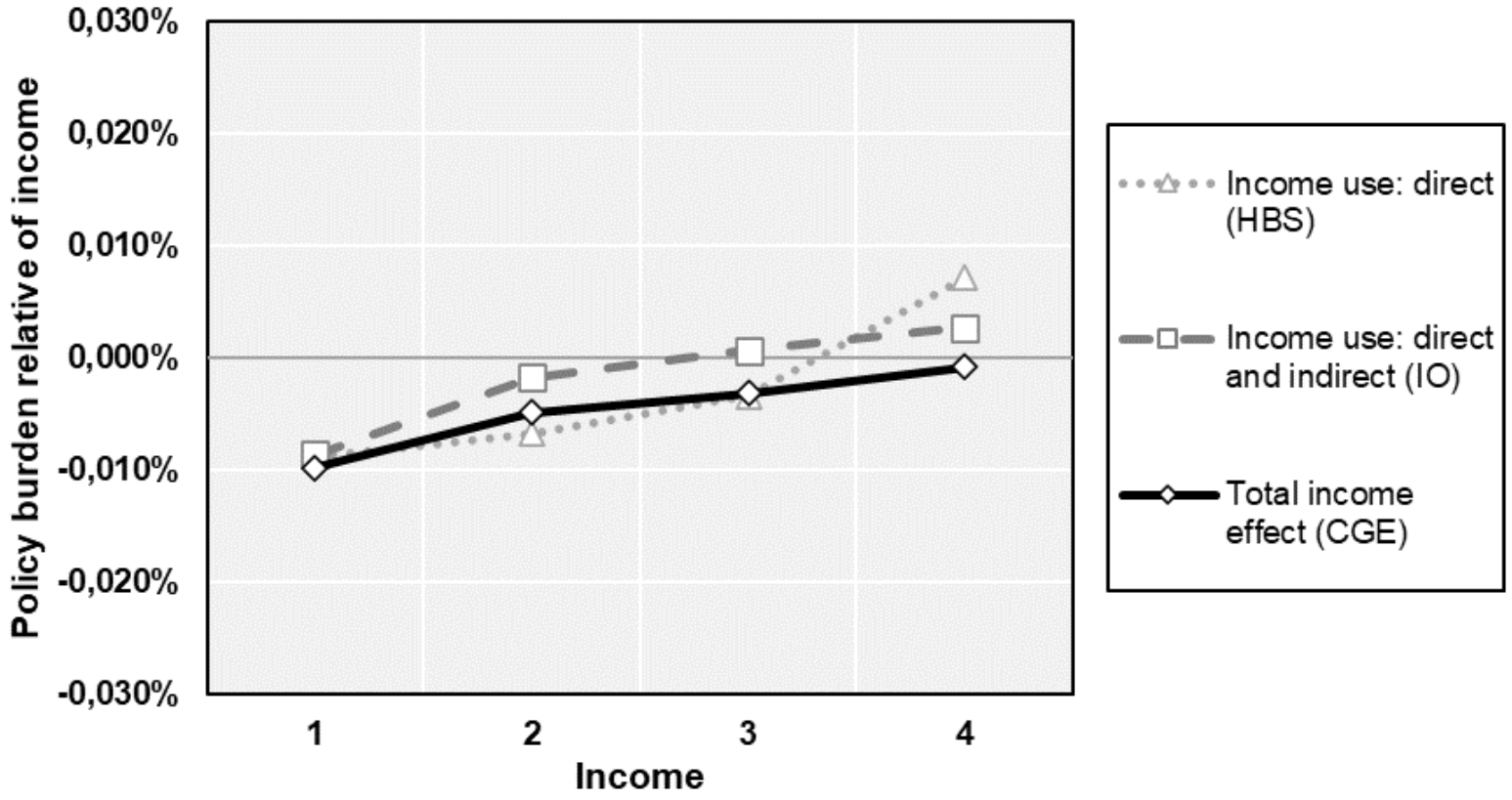
Investigated climate policies - overview

- Economy-wide fossil fuel tax increase
  - With proportional-to-income revenue recycling
- Building code adaptation
  - to allow for an increased use of wood-based building structures
- Company mobility plans
  - to increase environmental friendly commuting
  - implemented as obligation for large companies (>50 employees)

➢ Calibrated to equal emission reductions across policies

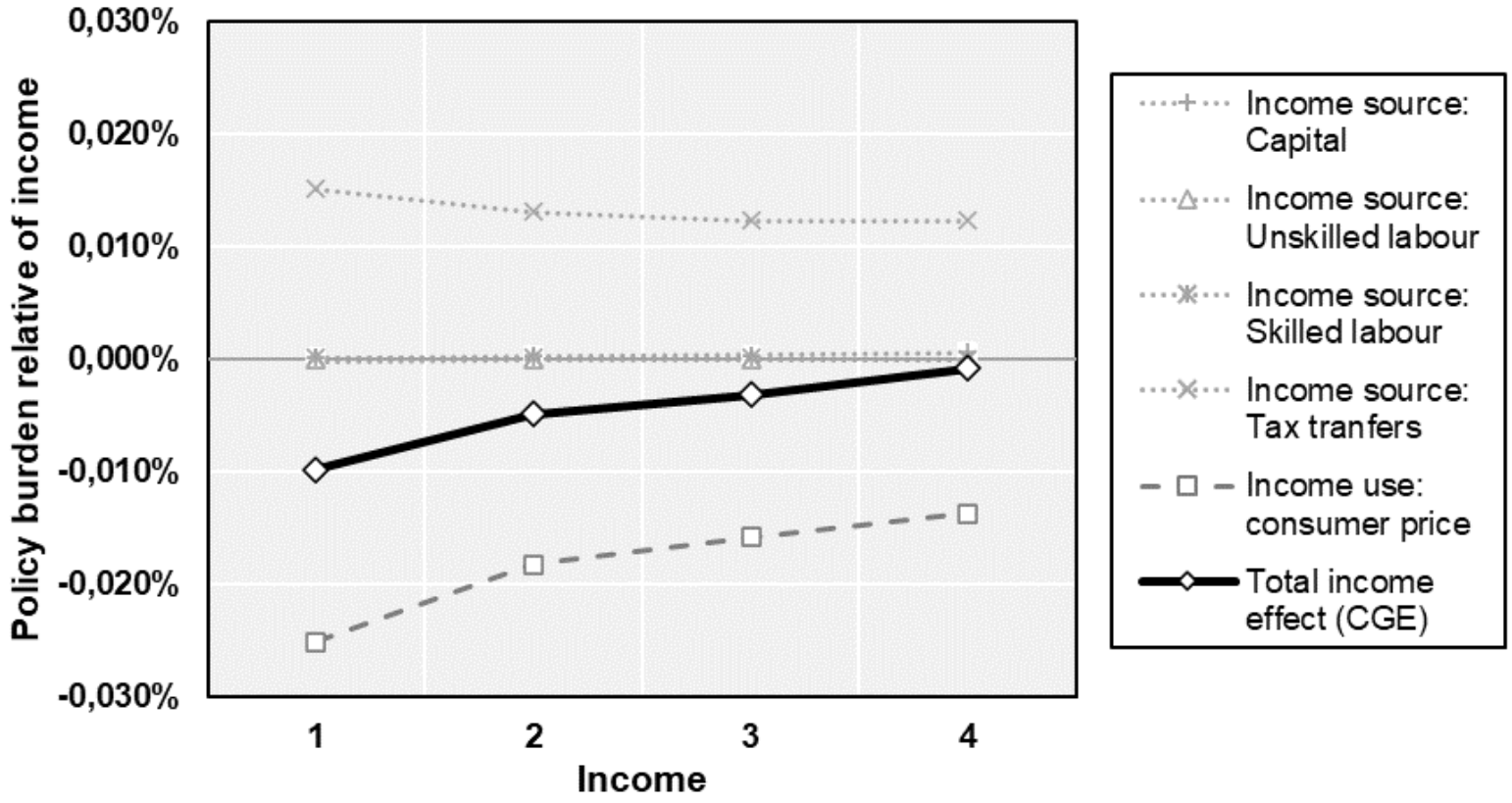
Incidence estimates of a fuel tax increase

- *HBS*: direct burden of transport and heating fuel price increase including proportional-to-income revenue recycling
- *IO*: direct and indirect burden of fuel price increase including proportional-to-income revenue recycling
- *CGE*: direct and indirect income use and income source effects



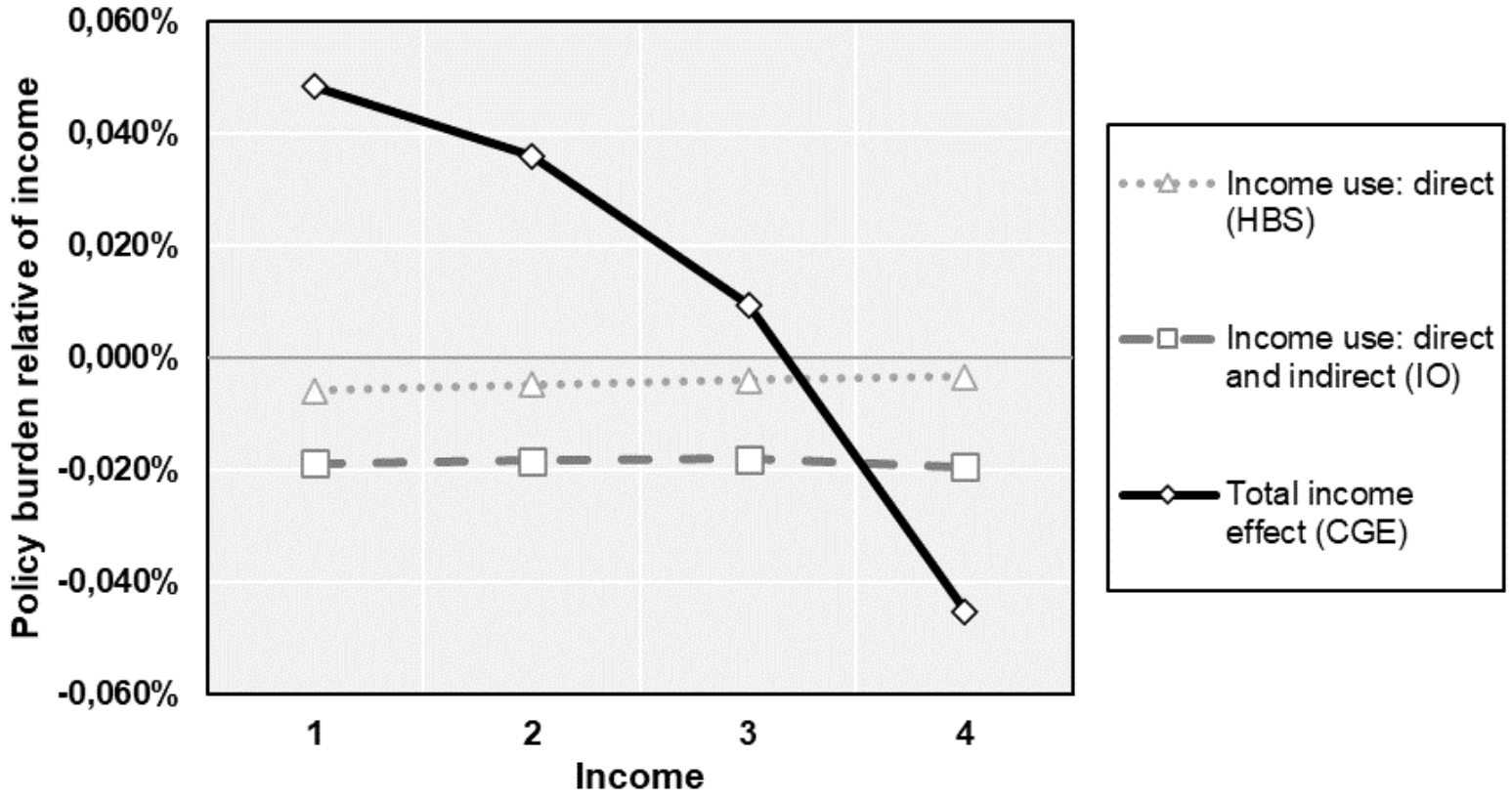
Incidence channels of a fuel tax increase

- CGE decomposition into income use and income source channels



Incidence estimates of a building code adaptation

- *HBS*: direct burden of price increase for real and imputed rents, induced by construction price change
- *IO*: direct and indirect burden of price changes induced by construction technology
- *CGE*: direct and indirect income use and income source effects from adapted construction technology



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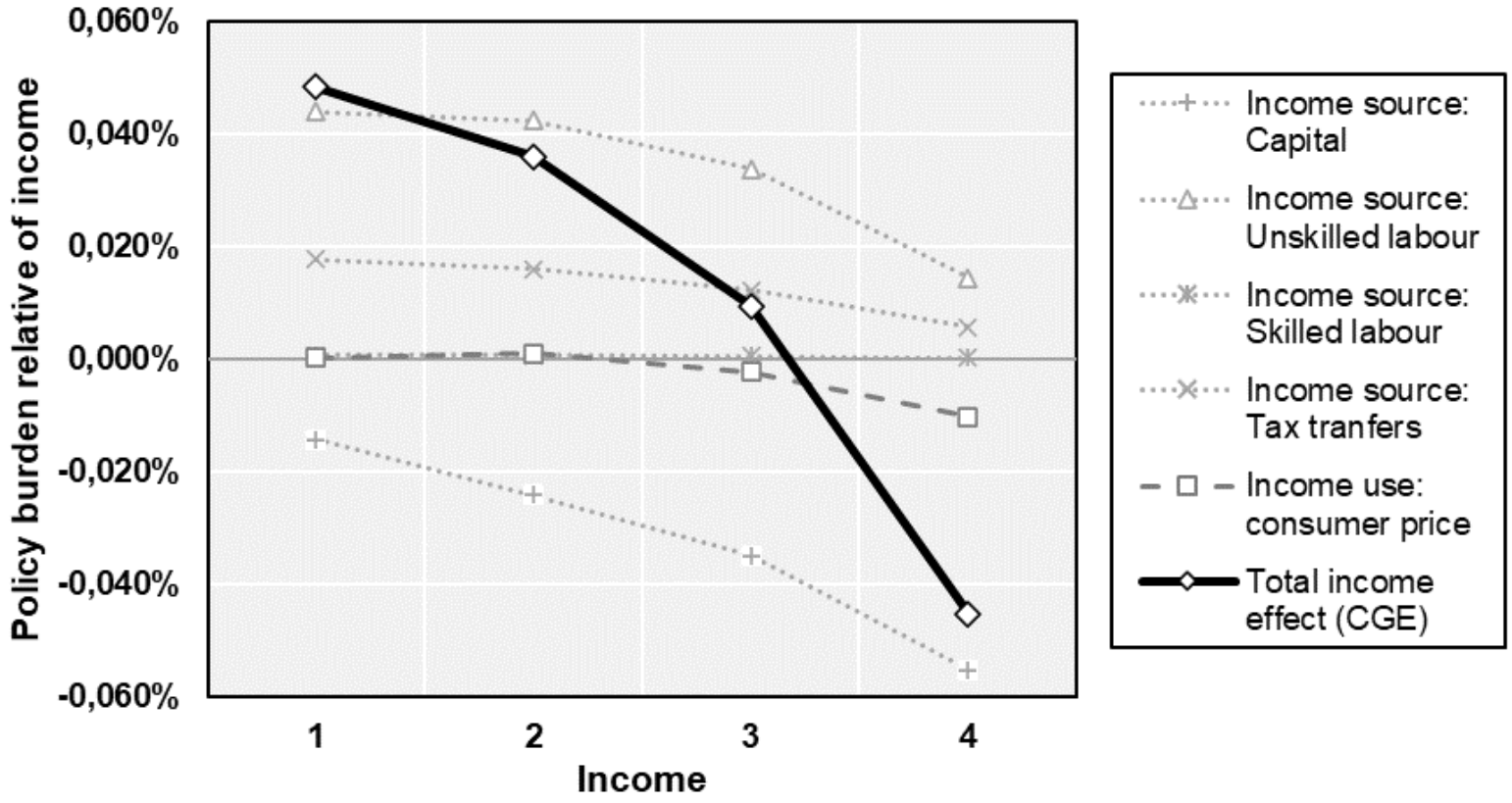
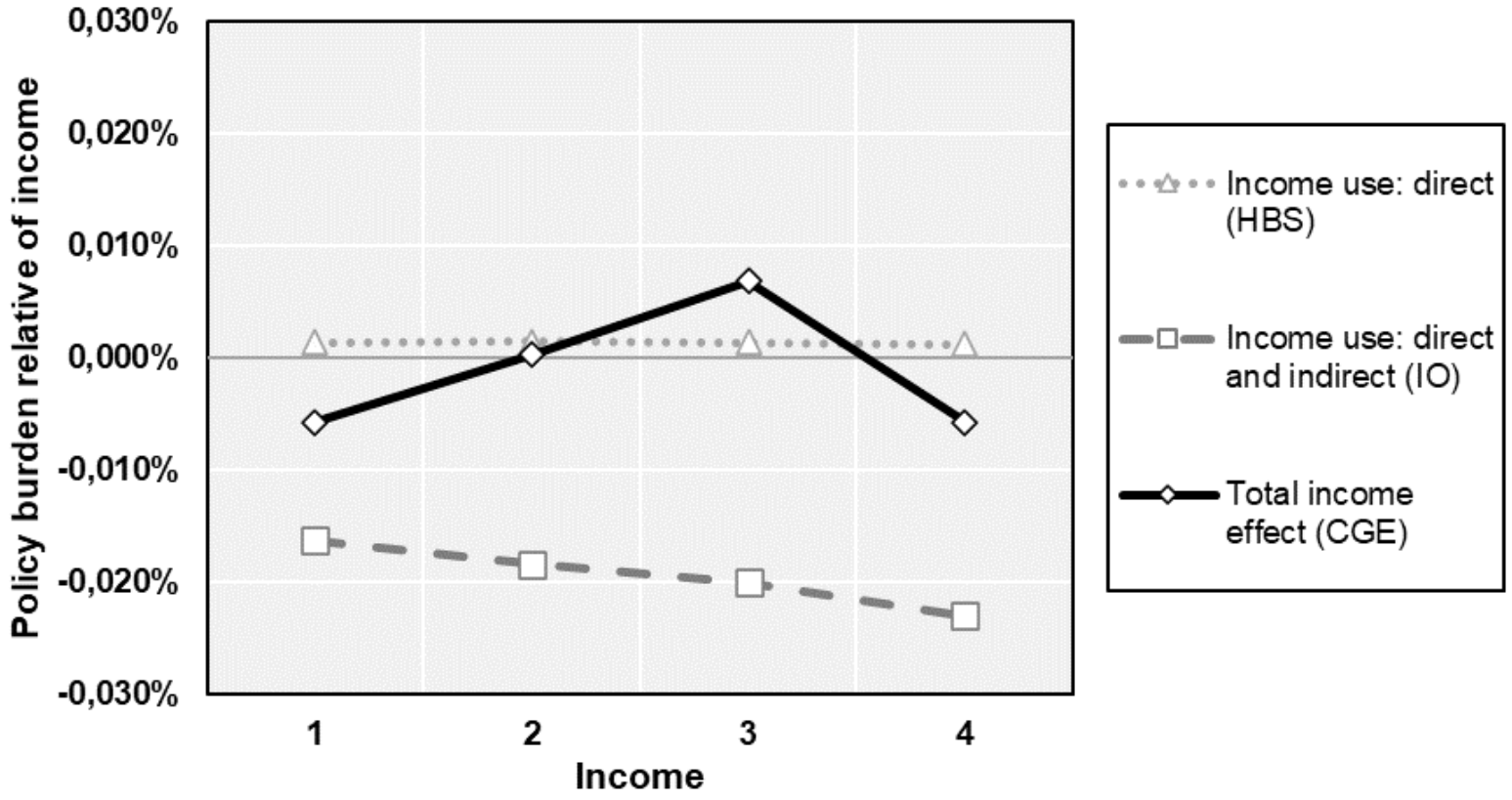


Incidence estimates of a building code adaptation

- *HBS*: direct burden of public transport subsidy
- *IO*: direct and indirect burden consumer price changes induced by total investment costs of firms
- *CGE*: direct and indirect income use and income source effects from firm investment



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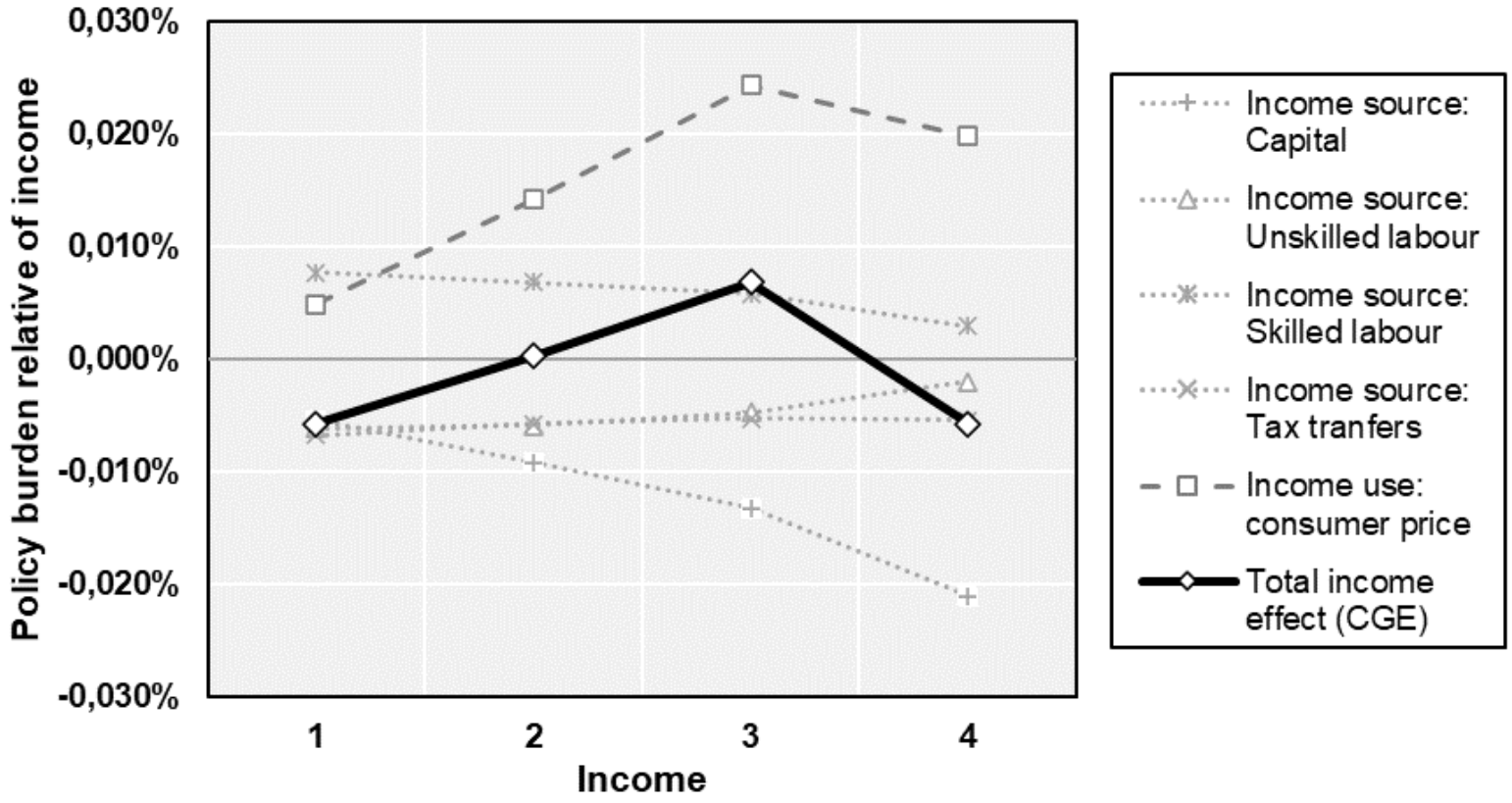

Conclusion

- Fuel tax policy
  - Incidence estimate from HBS is more regressive than from IO or CGE
  - IO and CGE estimate similar incidence, as factor incomes hardly change
- Building code adaptation
  - Dominating income source side effects from factor incomes
- Company mobility plan policy
  - Strong interaction of income use and income source side effects

➢ Household incidence strongly varies across policy instruments

Discussion

- Applicability of HBS estimates is rather limited
- IO estimates can be useful when income source effects are small or interpreted as short-term estimates
- Horizontal equity is less an issue for economy-wide taxes, when considering total embodied emissions instead of fuel consumption

Discussion

- In general, incidence of climate policies is determined by
  - the consumption patterns of households (income use)
  - the corresponding emission intensities of consumption
  - the existing distribution and composition of income (income source)
  - the specific policy and policy design

- Evaluation of policy incidence should cover all these aspects to give best information basis for decision makers and public.

Thank you!

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