

Carbon tax and revenue recycling: Impacts on households in British Columbia

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Resource and Energy Economics 41 (2015), 40-69

Benchmark taxes and tax reform

- without benchmark taxes: first-best illusion
- with benchmark taxes:
 - excess burden of benchmark taxation
 - => excess burden can be reduced by recycling revenues from simulated policy measures

Tax reform and the double dividend hypothesis

- 1st dividend: environmental improvement
- 2nd dividend: reduced excess burden of the tax system (at least with smart choice of recycling option)
- Bovenberg/de Mooij 1994: environmental taxes have a small and flexible tax base relative to income or value added taxes
- But: excess burden depends a lot on
 - tax rates
 - factor mobility
- Many CGE applications find chances on a (small) double dividend

Tax incidence

- incidence: who pays eventually?
 - incidence $\neq$ changes in sectoral outputs
- functional distribution: capital vs. labor income
- welfare loss (HEV) of different household types
 - income groups
 - families vs. singles
 - retired vs. working population
 - rural vs. urban population
 - ...

Distributional impacts of CO₂ taxes (some literature)

- a carbon tax is regressive (USA, Metcalf 1999)
- lump-sum recycling helps (it's progressive)
(10 EU Member States, Barker and Köhler 1998; USA, Rausch et al. 2011
Switzerland, Imhof 2012 and Ecoplan 2012)
-> Trade-off between equity and efficiency
- a carbon tax is mildly progressive after revenue recycling, even with recycling through income taxes (USA regional, Oladosu and Rose 2006)
- a carbon tax can be progressive even before recycling
(Canada regional, Beck et al. 2015)
- fuel taxation is highly progressive in developing and emerging economies (anthology, Sterner 2011)

Distributional impacts of CO₂ taxes ...

... largely depend on national/regional circumstances:

- tax system and choice of recycling option
- design of the tax reform (tax bases, tax rates, exemptions, ...)
- income composition for household groups
- economic structure and factor mobility
- (terms of) trade effects
- spending patterns of household groups
- energy system

Carbon tax reform in British Columbia

- tax of 30\$/t CO₂e (2012) mostly on fossil fuel combustion
- revenue recycling, e.g.
 - corporate income tax reductions
 - personal income tax reductions
 - transfers targeted at low income households
 - rural homeowner benefits
 - increased public deficit
- political contested, especially in rural areas

Study

■ backcasting

- comparing the implemented reform with a simulated reference situation without
- assessment of welfare distribution effects among different household income groups after the first 5 years (2012)
- comparative statics
- general equilibrium

■ decomposition (3 dimensions for thorough analysis)

- carbon tax and recycling
- income and expenditure pattern heterogeneity
- functional distribution

■ sensitivity analyses

Scenarios

- reference
- tax only
- full reform

- unusual setup due to backcasting and decomposition:
 - there is really only one scenario,
 - which is, technically speaking, the reference scenario

The computable general equilibrium model

- static
- multi-regional: 12 Canadian Provinces + ROW
- 17 sectors, including 5 energy sectors
- 10 representative households per Province (income deciles)
- 3 factors of production: labor, capital, natural resources
 - 50% of capital mobile across sectors and regions
 - labor mobile across sectors, immobile between regions
 - labor-leisure choice
 - fixed resource -> diminishing returns to scale in extraction
- Armington trade
- benchmark taxes

Greenhouse gases in the model

■ 6 GHGs

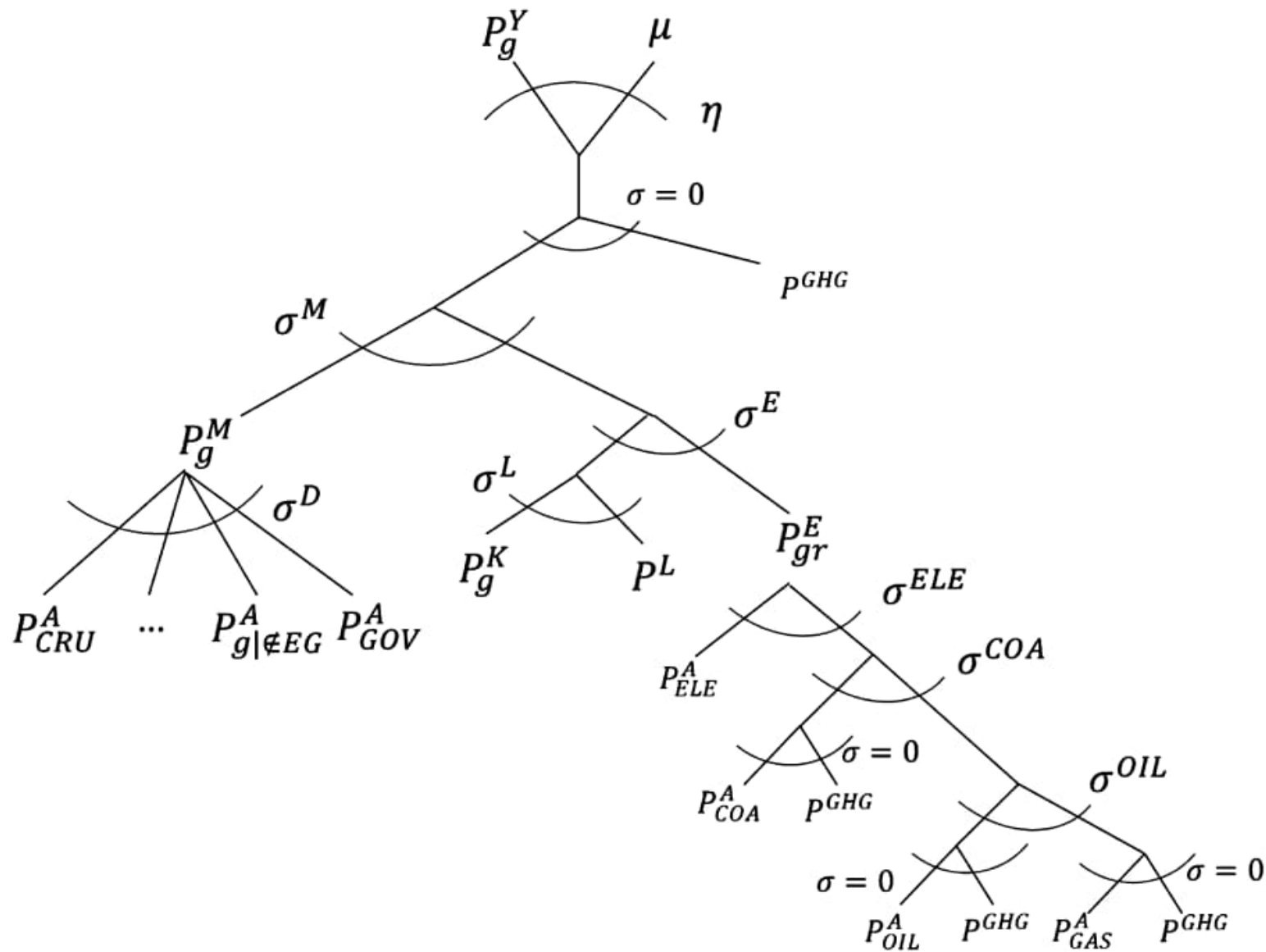
- Kyoto basket, weighted by Global Warming Potential (GWP100)
- emissions from combustion and process-related emissions
- carbon tax applies to fossil fuel combustion only

■ mitigation

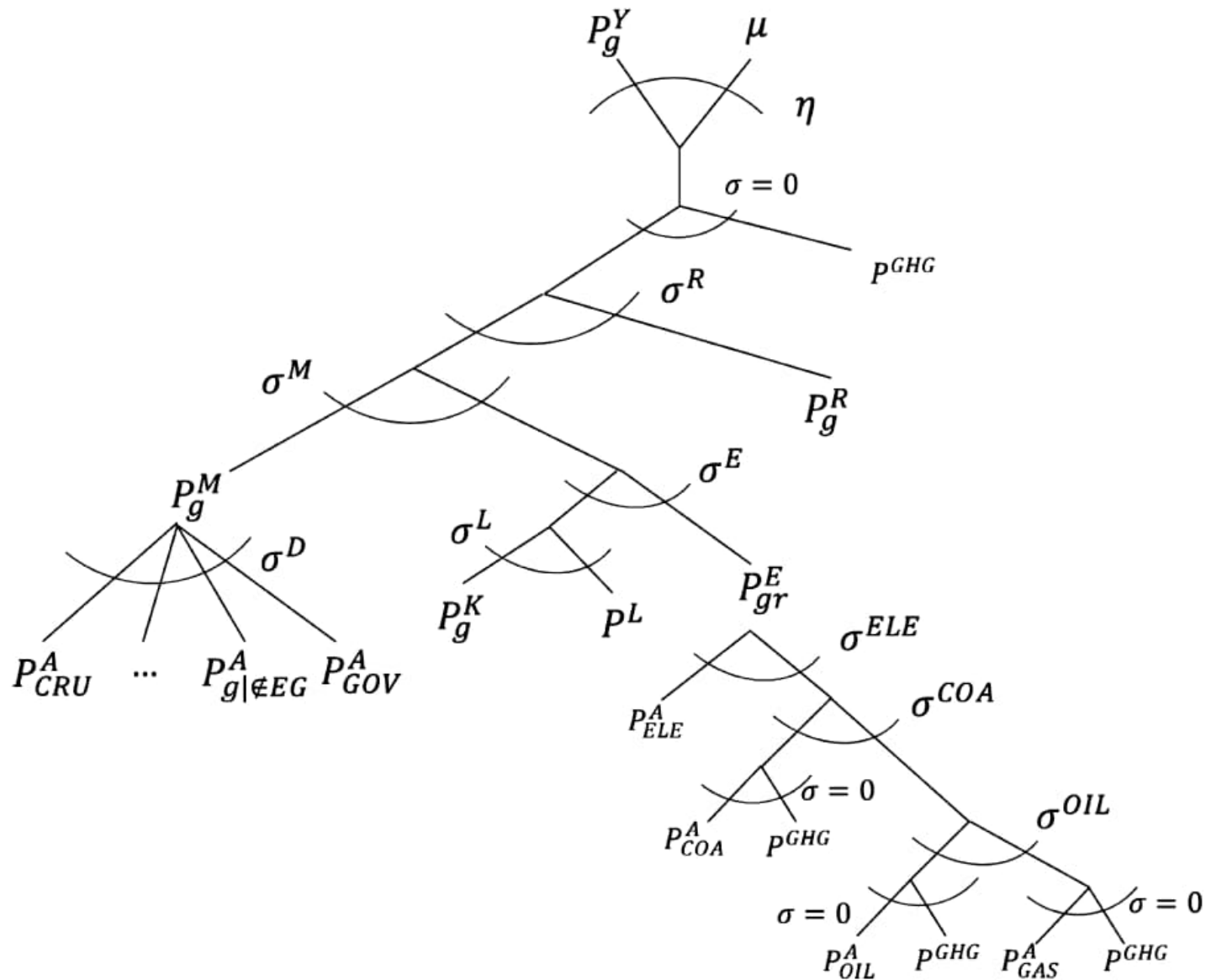
- fuel switch
- energy savings (substitution to non-energy inputs / factors)
- output reduction / altered consumption and trade patterns

■ tracking of physical energy flows

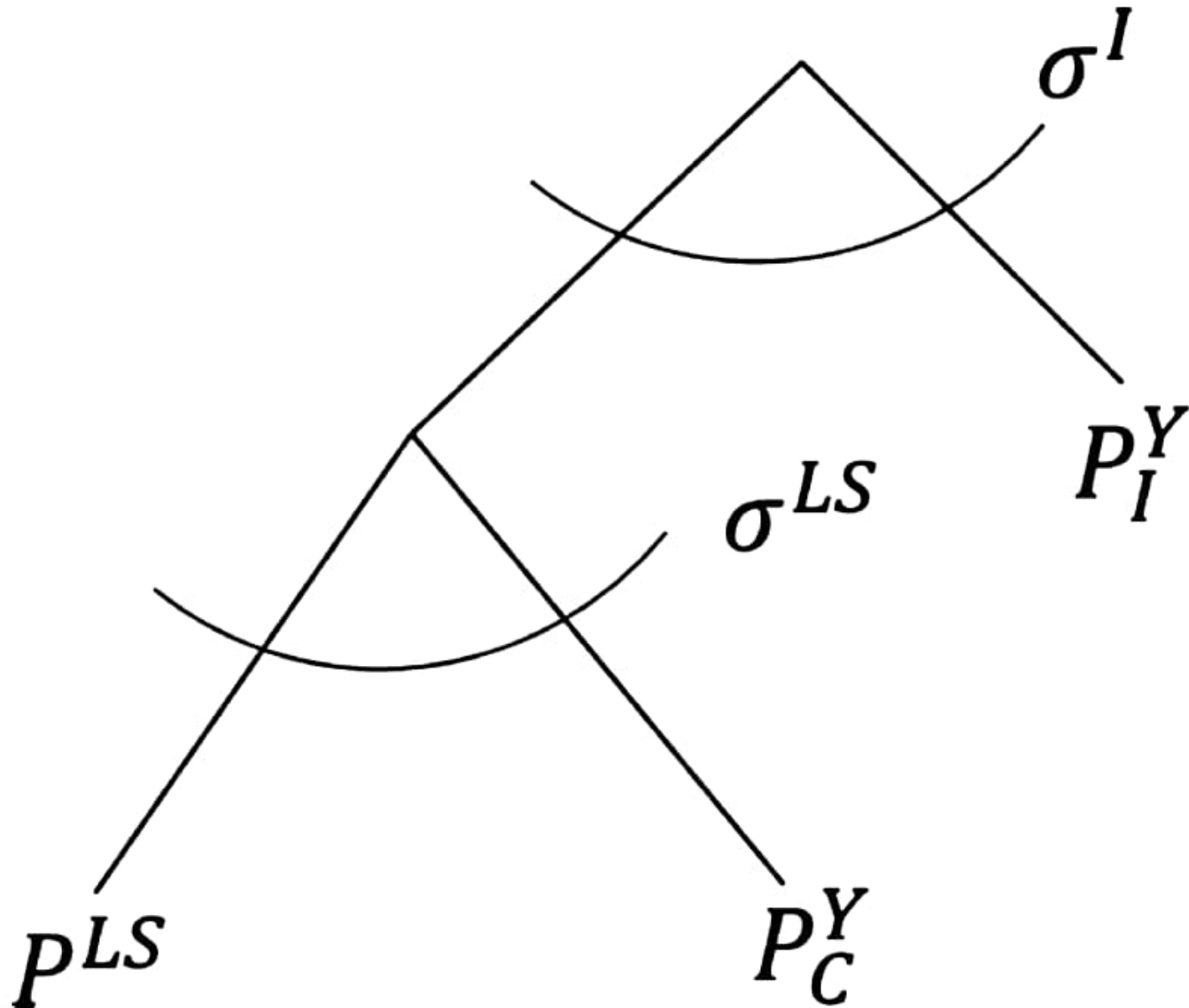
CES nesting in production



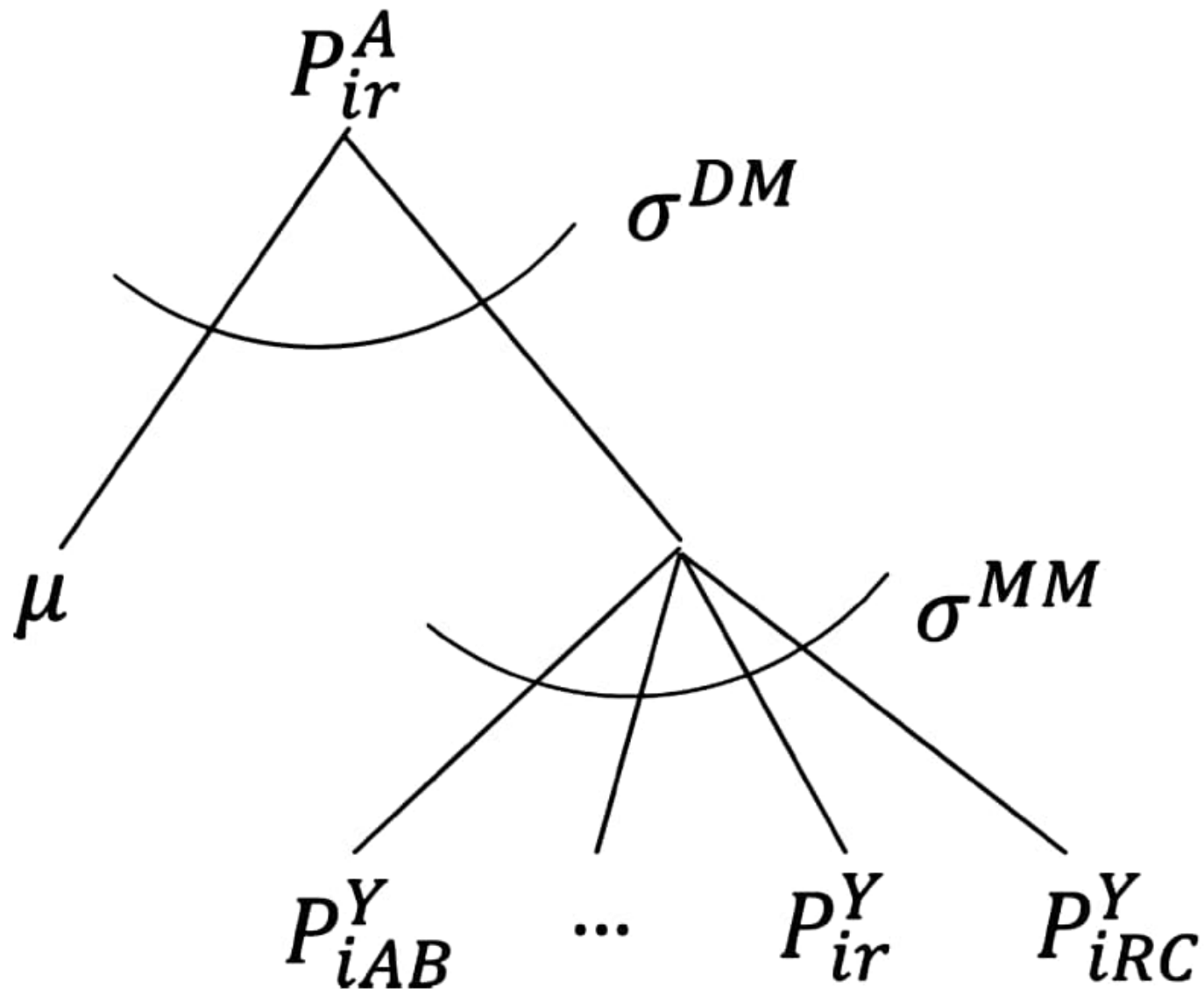
CES nesting in extraction



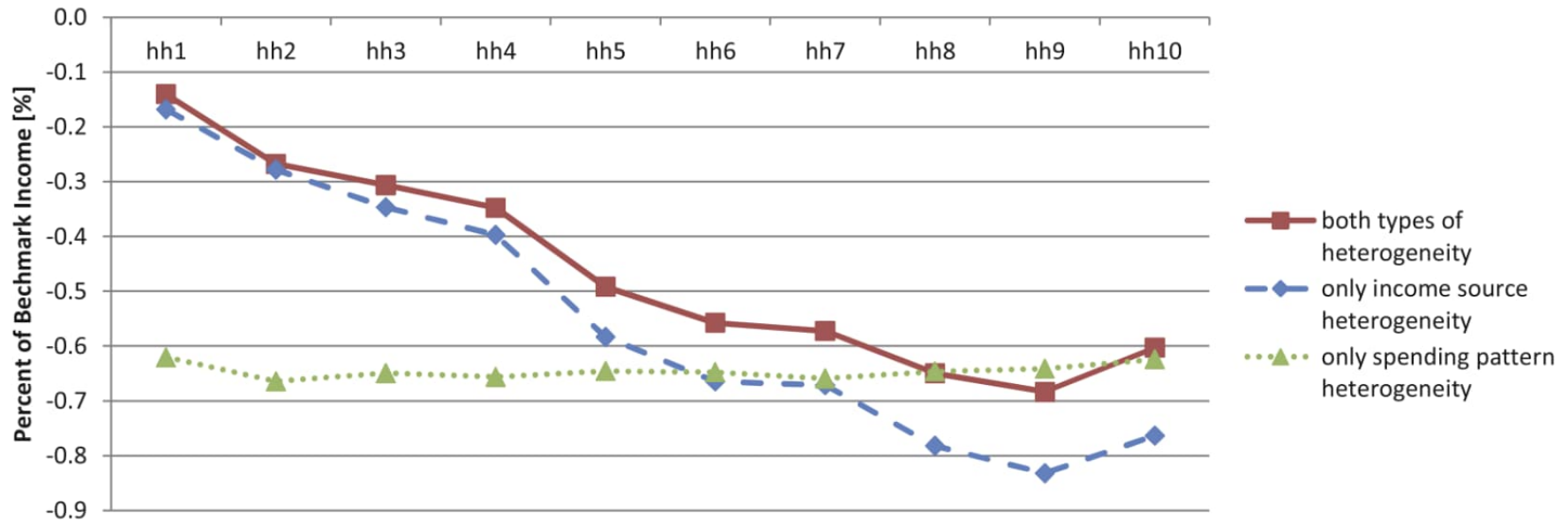
Welfare function (CES nesting)



Armington trade (CES nesting)

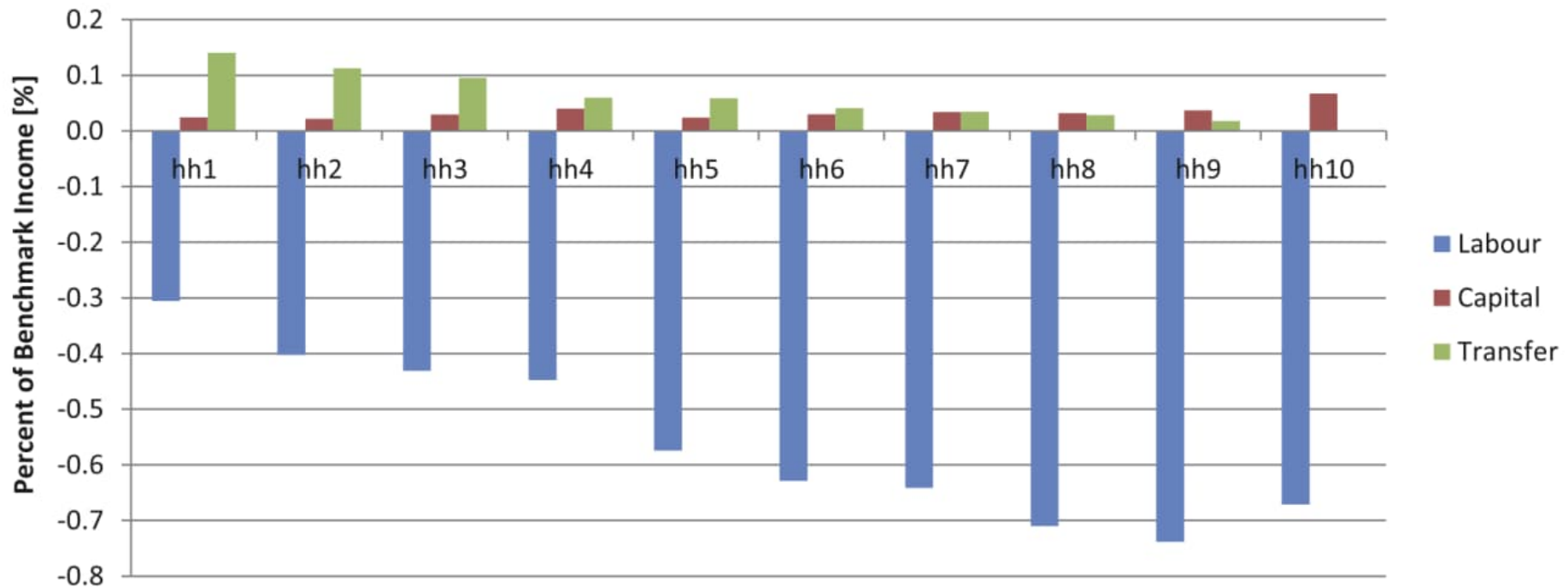


HEV without revenue recycling



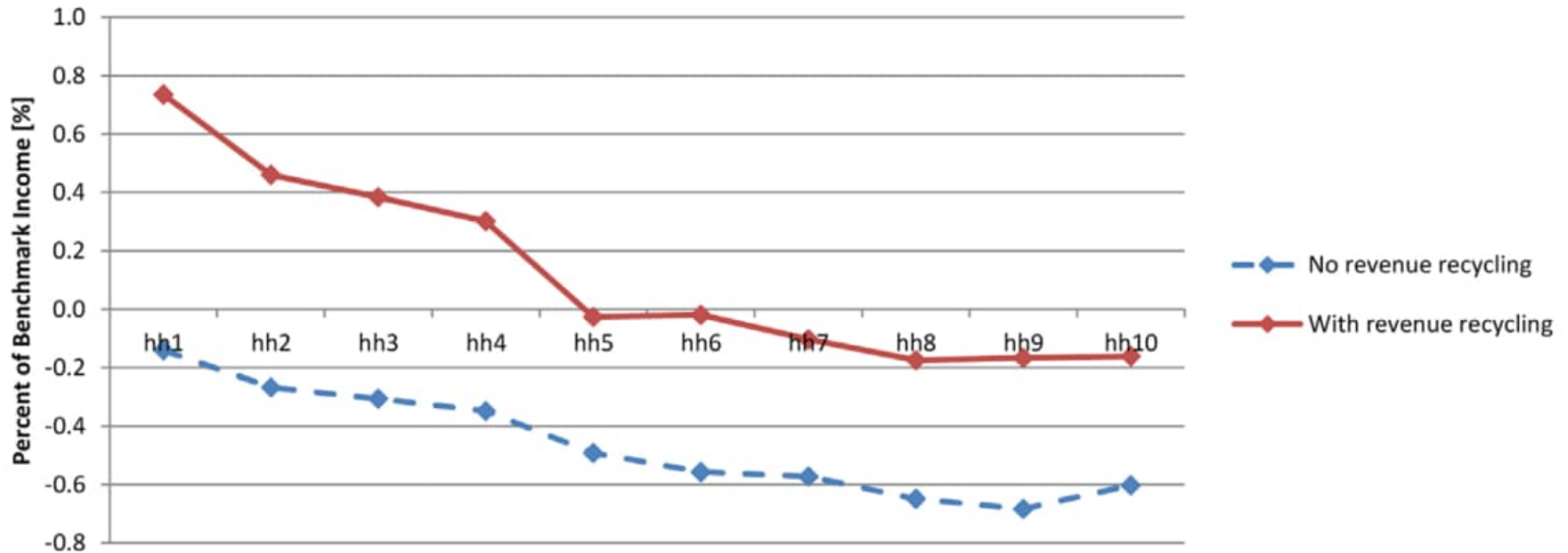
- The tax is progressive even without revenue recycling
 - surprising result
 - income source heterogeneity (e.g. rich households with labor income from fossil fuel industries)
 - unimportant spending pattern heterogeneity (e.g. hydropower)

Functional distribution without recycling



- incidence mainly on labor income
 - transfers assumed constant in real terms
 - capital assumed very mobile (-> constant real return to capital)
 - share of labor income high for high income households

HEV with / without revenue recycling



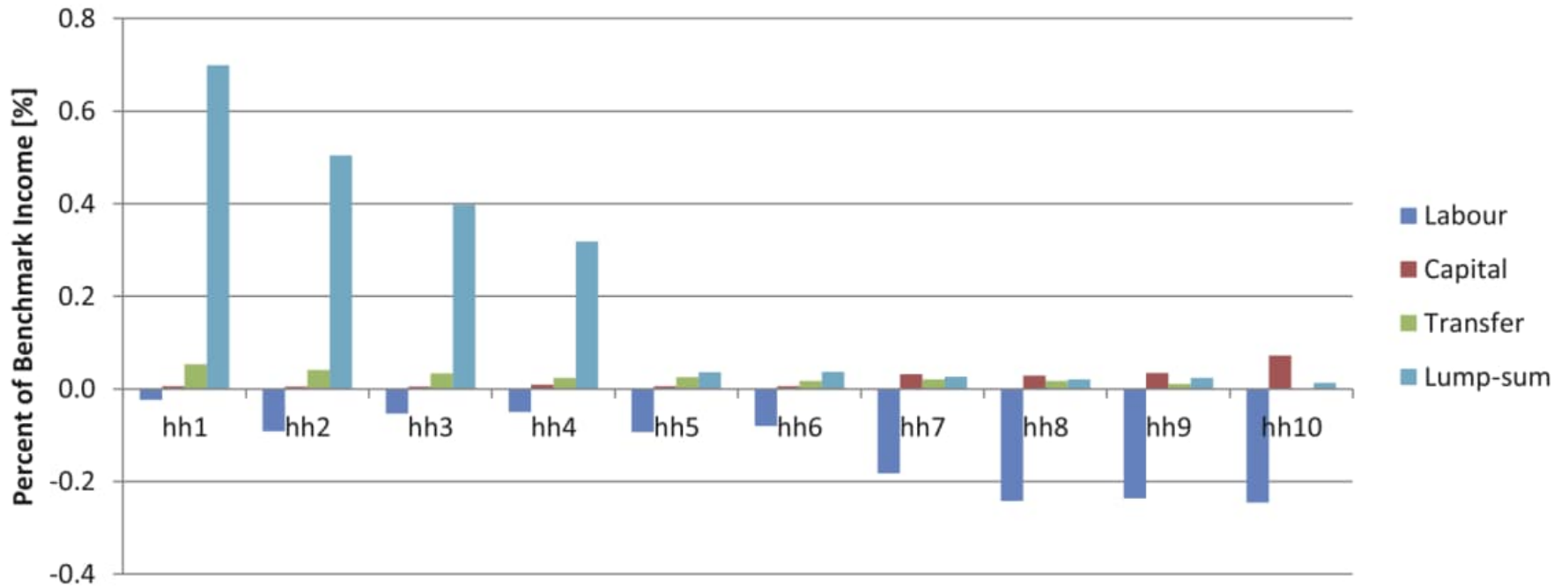
- Recycling enhances the progressiveness of the reform
 - unsurprising result
 - large revenues + increased gov. déficit -> impressive social program

“Adjusted” welfare

	No revenue recycling	With revenue recycling
“Adjusted” welfare	−0.13	−0.08
Welfare	−0.53	−0.01
Gov. deficit increase	−0.40	0.07
GHG	−9.22	−9.14

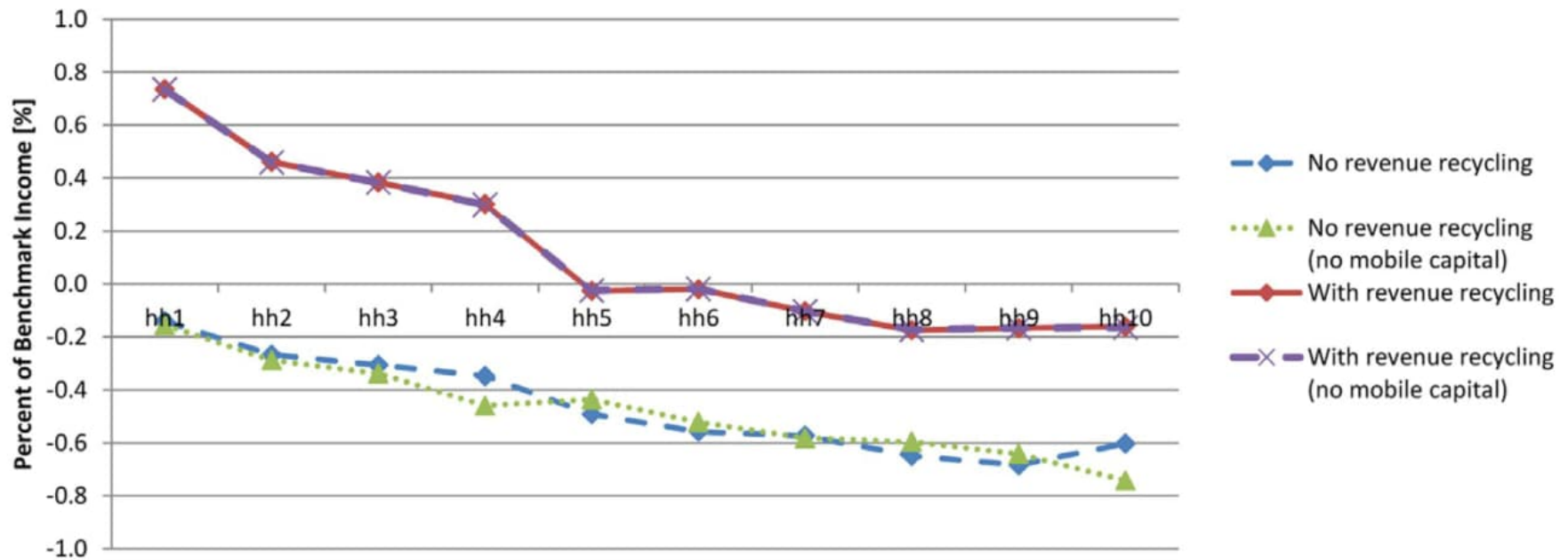
- HEV does not reflect
 - benefits due to the mitigation of climate change
 - secondary benefits (e.g. health benefits due to improved air quality)
 - changes in the public deficit
- Presumed method to “adjust” welfare:
 - assuming equal marginal utility of private and public expenditure
 - benchmark expenditure share used for weighting
 - (otherwise it wouldn’t make sense)
 - usually: equal yield = constant public goods provision (see SA)

Functional distribution with recycling



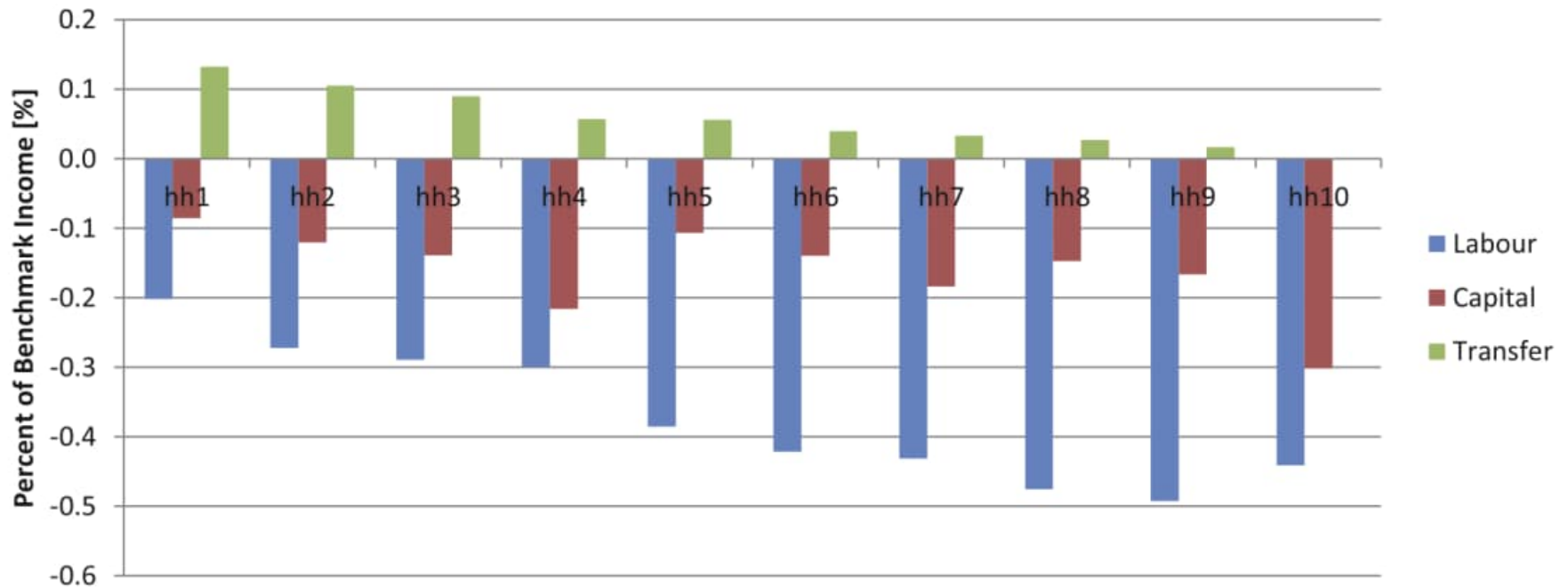
- Transfers added
- Note the general equilibrium effects!

Sensitivity analysis: capital mobility (1)



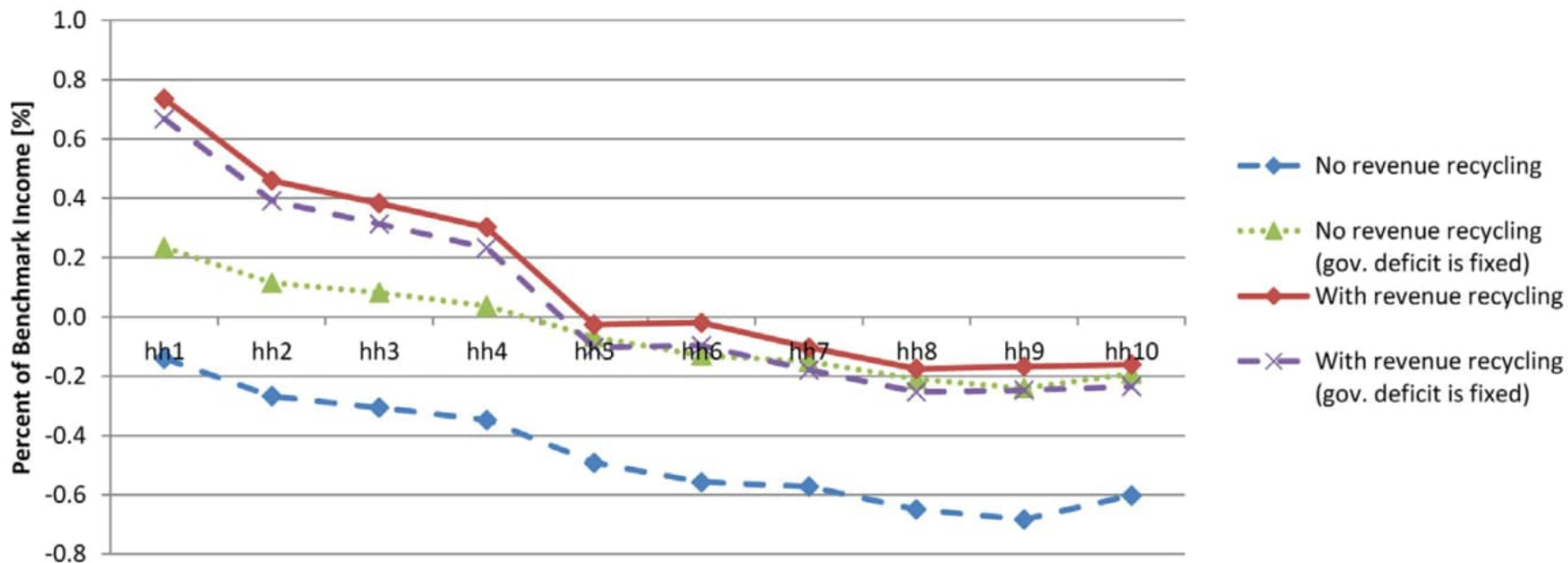
■ Surprisingly little influence

Sensitivity analysis: capital mobility (2)



- A part of the incidence shifts from labor to capital

Sensitivity analysis: equal yield



■ Parallel by construction

Conclusions

- Carbon tax in BC is progressive even before revenue recycling is taken into account
 - unusual result
 - due to particular income patterns and low carbon electricity supply
- Revenue recycling as a social program
 - well-known opportunity, due to large revenues
- General equilibrium effects matter
 - pure expenditure side calculations miss important effects
- Public debate dominated by perceived winners and losers
 - not in line with evidence from simulations

Appraisal of the paper

- Example of an outstanding applied paper
 - implemented policy
 - referring to and contributing to the policy debate
 - adequate choice of model and state of the art modeling
 - rather well documented
 - mechanisms decomposed and well-explained
 - sensitivity analyses enhance credibility
 - relevant conclusions
- Some unusual choices
 - “adjusted” welfare measure
 - high capital mobility assumption
 - “decomposition” which does not add up to the total effect