Environmental policy and tax-benefit microsimulation models

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Environmental models

$\Rightarrow$ Overview in Hynes & O'Donoghue (2015)

Uses and applications:

- Distributional incidence analysis of environmental policy
- Spatial incidence environmental models
- Agriculture and the environment
- Resource demand
- Transport and land use
- Non-market valuation studies

Distributional incidence analysis of environmental policy:

- Environmental taxes
- Tradable emission permits
- Taxes on methane emissions from cattle
- Taxes on nitrogen emissions

- Behaviour: e.g. impact of action on emissions if consumption patterns change

Here: global warming & climate change, perspective from household & demand-side policies

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Distribution and determinants of household greenhouse gas emissions in Belgium

SUSPENS-project

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b: Institute for New Economic Thinking, Department of Social Policy and Intervention – University of Oxford

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1. Context

IPCC (2018): “Rapid and far-reaching” transitions

Climate & social inequality

- **unequal contribution to emissions**
- unequal exposure to consequences & unequal capacity to protect against climate risks
- unequal incidence of costs and benefits of (intensifying) climate policy

→ call for “just transition”

1) How are GHG emissions distributed across households?

2) What determines the level of GHG emissions of households?

3) Next steps: policy analysis with EUROMOD

Case: Belgium

Data

Household consumption

- Belgian Household Budget Survey (2014)

+ direct link with IPCAL (tax declarations)

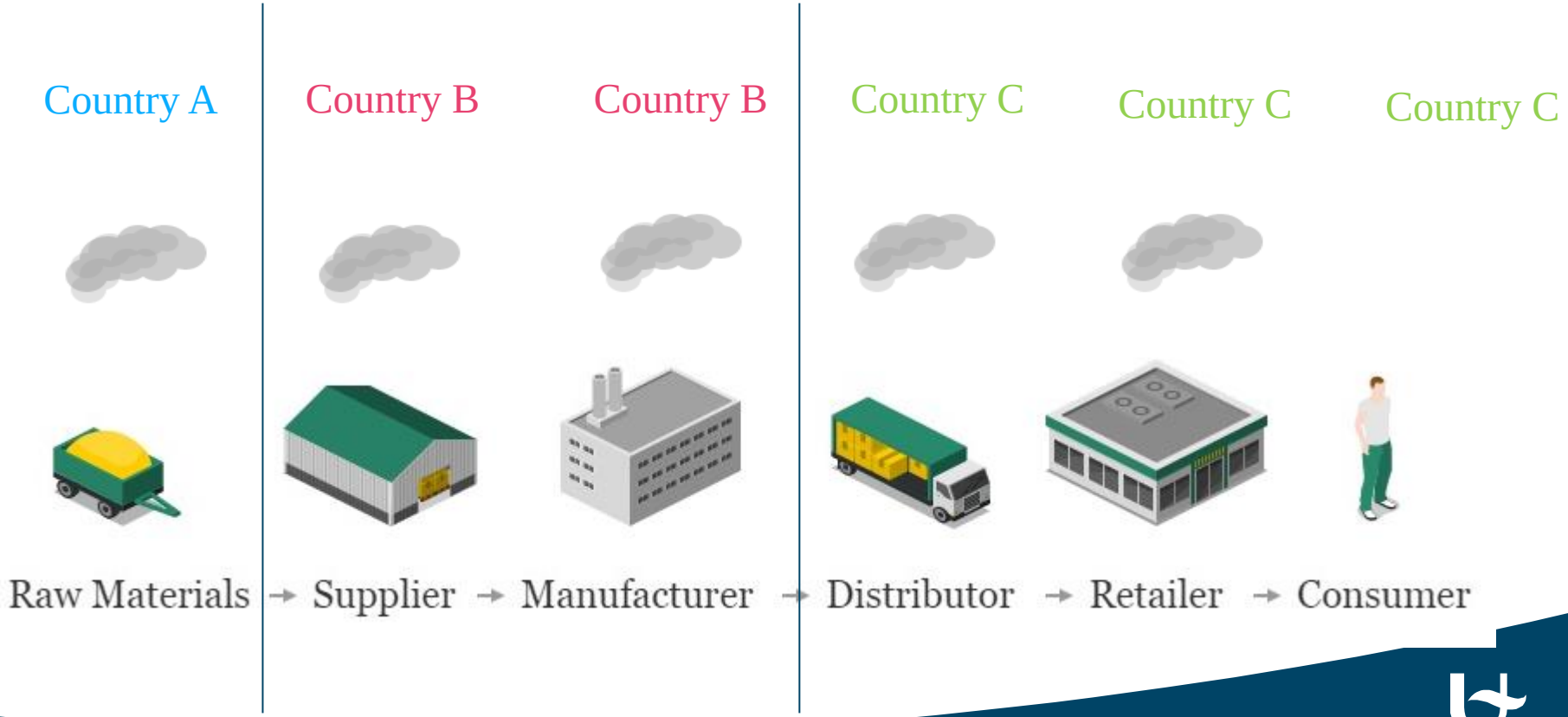
- Representative sample of Belgian households
- Expenditure logbook
- Questionnaire

Pollution

- Direct
- Indirect

Basic concepts

- Emissions accounting
- Consumption-based vs production-based



Emissions embedded in the supply chain

Single-region environmentally extended input-output model

Input-output model

- Maps interdependencies between economic sectors
- Intermediate vs final output
- Monetary flows

Environmentally extended

- Emissions inventory data of economic sectors

Single-region

- Domestic production technology assumption

Data

Household consumption

- Belgian Household Budget Survey (2014) + IPCAL
- Representative sample of Belgian households
- Expenditure logbook
- Questionnaire

Pollution

- Direct: Direct pollution coefficients (FPB*)
- Indirect: single-region environmentally extended input-output model (FPB*)

grams of GHG emissions

* Federal Planning Bureau

Data limitations

Domestic technology assumption

- Same pollution per unit of imports

Homogeneity of price assumption

- No basic/luxury versions of products

Mixed invoices for electricity and gas

- Natural Gas is the residual after a prediction of electricity using regression with Adj. R^2 of 0.1493

No pollution caused by construction of houses

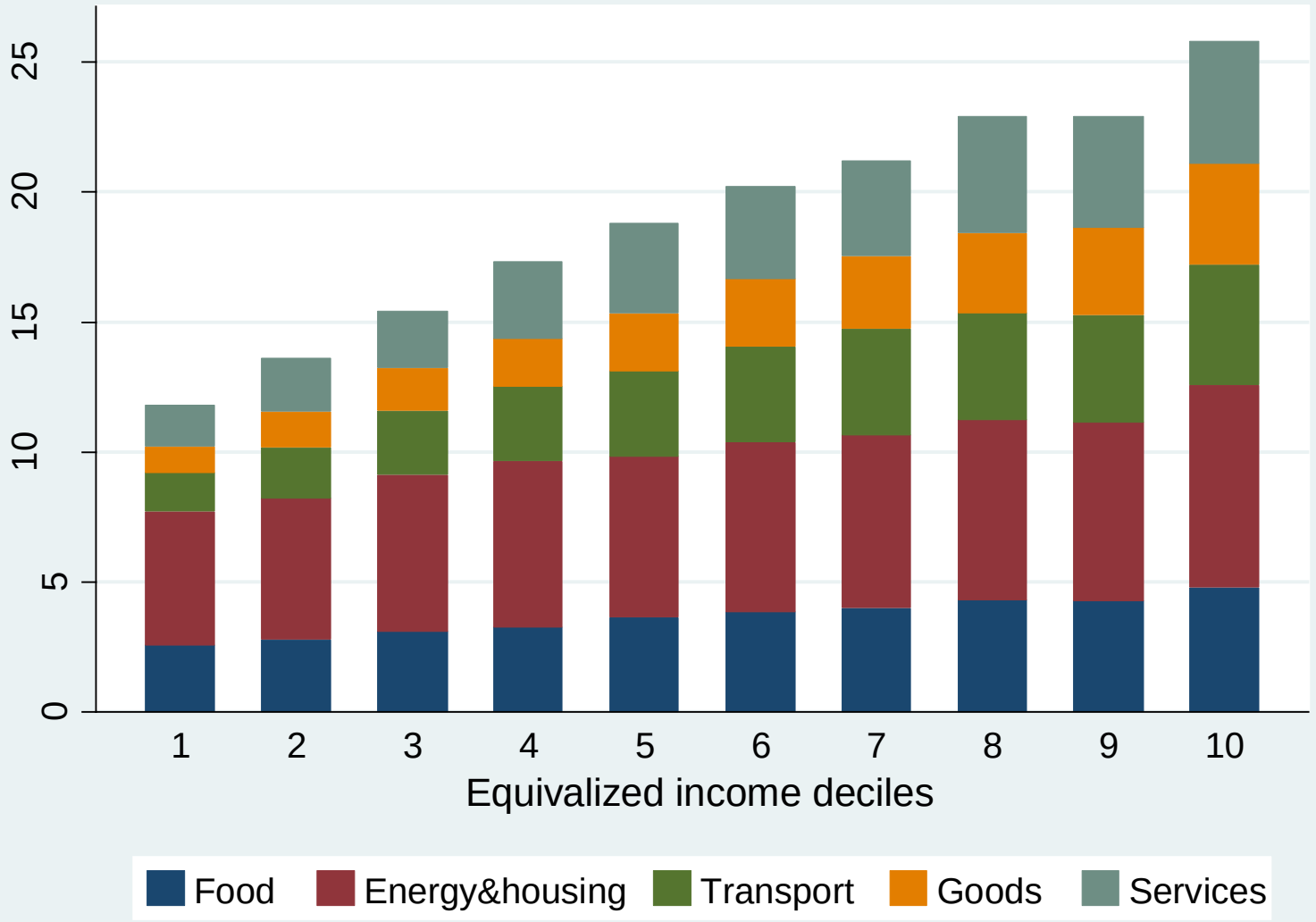
- Too infrequent to appear in HBS expenditures
- Data on stock of houses in HBS not detailed enough.

Underreporting in HBS

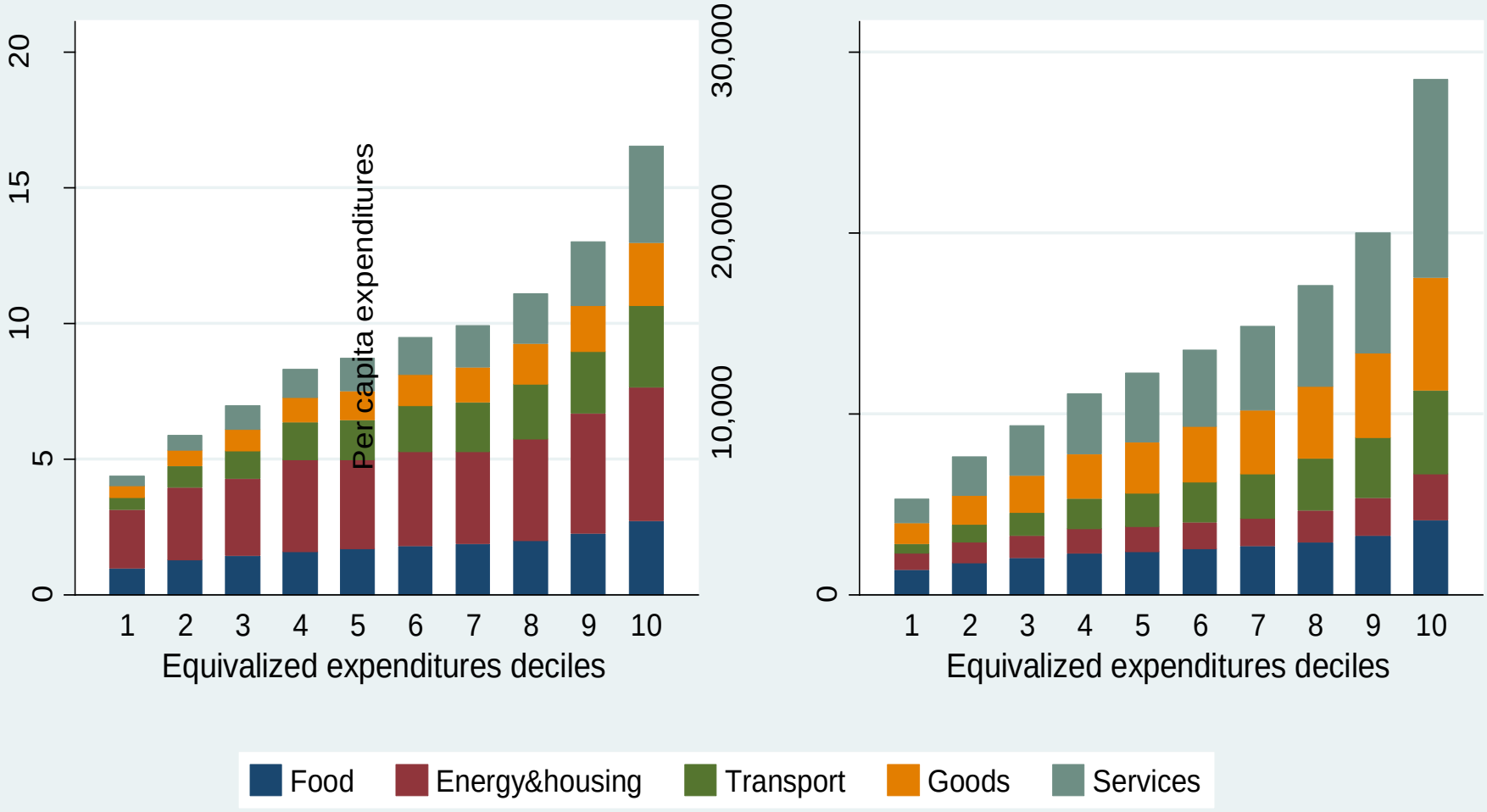
Durables: smoothing

How GHG emissions are distributed across households?

Living standard – income deciles



Living standard – expenditure deciles



What determines the level of GHG emissions of households?

Determinants

Multiple regression analysis:

$$\ln(GHG) = \alpha + \beta \ln(inc) + \boldsymbol{\delta x} + \boldsymbol{\gamma z} + u$$

Greenhouse gas emissions of households

Household income

Socio-economic variables:
- Number of adults
- Number of children
- Age
- Professional status
- Education
- Region

Housing-related variables:
- Number of rooms
- House type
- Tenure status

	(1) Ln(GHG_all)	(2) ln(GHG_Food)	(3) ln(GHG_Energy_housing)	(4) ln(GHG_Transport)	(5) ln(GHG_Goods)	(6) ln(GHG_Services)
Ln(Income)	0.323***	0.235***	0.114***	0.589***	0.693***	0.582***
	(0.019)	(0.019)	(0.025)	(0.040)	(0.030)	(0.046)

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Number of adults						
1	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
2	0.199***	0.437***	0.103***	0.360***	0.203***	0.175***
	(0.017)	(0.019)	(0.025)	(0.036)	(0.023)	(0.049)
3	0.264***	0.573***	0.149***	0.300***	0.126***	0.236***
	(0.023)	(0.027)	(0.032)	(0.065)	(0.030)	(0.062)
>=4	0.354***	0.738***	0.192***	0.284***	0.140***	0.387***
	(0.029)	(0.026)	(0.043)	(0.056)	(0.032)	(0.086)
Nr of children						
0	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
1	0.095***	0.123***	0.070**	-0.038	-0.018	0.269***
	(0.015)	(0.023)	(0.024)	(0.040)	(0.018)	(0.039)
2	0.122***	0.225***	-0.009	-0.088*	-0.066**	0.444***
	(0.015)	(0.022)	(0.025)	(0.039)	(0.020)	(0.050)
3	0.190***	0.316***	0.052	-0.105	-0.084*	0.636***
	(0.034)	(0.032)	(0.054)	(0.075)	(0.033)	(0.087)
>=4	0.292***	0.428***	0.122	0.093	0.051	0.730***
	(0.055)	(0.069)	(0.118)	(0.151)	(0.053)	(0.185)

	(1) Ln(GHG_all)	(2) ln(GHG_Food)	(3) ln(GHG_Energy_housing)	(4) ln(GHG_Transport)	(5) ln(GHG_Goods)	(6) ln(GHG_Services)
Prof.stat.refpers.						
Working	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Unemployed	-0.085**	-0.084	0.018	-0.404***	-0.198***	-0.246***
	(0.030)	(0.045)	(0.048)	(0.072)	(0.040)	(0.069)
Student	-0.067	-0.120	-0.034	-0.360**	-0.104	0.090
	(0.098)	(0.096)	(0.187)	(0.136)	(0.115)	(0.178)
Housewife	-0.046	-0.127*	0.051	-0.235	-0.096	-0.199
	(0.064)	(0.061)	(0.133)	(0.204)	(0.061)	(0.179)
Incapacitated	-0.046	0.009	0.047	-0.406***	-0.067	-0.062
	(0.034)	(0.037)	(0.059)	(0.074)	(0.039)	(0.075)
Pension	-0.049*	-0.030	-0.007	-0.149**	0.003	-0.053
	(0.025)	(0.024)	(0.037)	(0.056)	(0.033)	(0.060)
Education						
Primary or less	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Lower secondary	0.025	-0.023	0.060	0.055	0.017	0.083
	(0.031)	(0.044)	(0.065)	(0.091)	(0.045)	(0.074)
Upper secondary	0.092**	0.044	0.074	0.262**	0.110**	0.301***
	(0.030)	(0.040)	(0.051)	(0.081)	(0.040)	(0.077)
Tertiary	0.173***	0.147***	0.092	0.323***	0.236***	0.515***
	(0.032)	(0.040)	(0.055)	(0.077)	(0.040)	(0.078)

	(1) Ln(GHG_all)	(2) ln(GHG_Food)	(3) ln(GHG_Energy_housing)	(4) ln(GHG_Transport)	(5) ln(GHG_Goods)	(6) ln(GHG_Services)
Region						
BXL	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
VL	0.019	-0.034	-0.021	0.170*	0.035	0.080
	(0.028)	(0.025)	(0.038)	(0.073)	(0.022)	(0.061)
WA	0.100***	-0.016	0.200***	0.314***	0.017	-0.108
	(0.029)	(0.024)	(0.038)	(0.075)	(0.023)	(0.063)

	(1) Ln(GHG_all)	(2) ln(GHG_Food)	(3) ln(GHG_Energy_housing)	(4) ln(GHG_Transport)	(5) ln(GHG_Goods)	(6) ln(GHG_Services)
House type						
Detached	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Semi-detached	-0.083***	-0.008	-0.134***	-0.175***	-0.012	-0.010
	(0.012)	(0.016)	(0.021)	(0.030)	(0.020)	(0.030)
Apartment	-0.162***	-0.061*	-0.371***	-0.254***	-0.066*	0.137**
	(0.019)	(0.025)	(0.035)	(0.050)	(0.028)	(0.052)
Other	-0.015	-0.046	-0.118	-0.155	0.156	0.170
	(0.082)	(0.135)	(0.171)	(0.188)	(0.126)	(0.191)
Tenure status						
Owner	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Tenant	-0.109***	-0.050*	-0.060*	-0.242***	-0.113***	-0.315***
	(0.016)	(0.024)	(0.026)	(0.045)	(0.018)	(0.043)
Constant	-1.342***	-2.389***	-0.171	-6.080***	-7.021***	-6.931***
	(0.218)	(0.221)	(0.298)	(0.470)	(0.295)	(0.483)
Observations	6128	6128	6128	6128	6128	6128
R^2	0.803	0.584	0.305	0.528	0.731	0.580

4. Conclusions - I

- GHG emissions grow with increasing income

Because of different composition of expenditures

- 'Food', and 'Energy and housing'
  - Highest share at the bottom
  - Relatively stable over the income distribution
- 'Transport', 'Goods' and 'Services'
  - Highest share at the top
  - Strong growth over the income distribution

- Main determinants: income and household size
- Socio-demographic determinants: age, unemployment, education, house type, house size, region, tenure status

Conclusions - III

Policy implications

- Distributional effect of a policy measure will depend on
  - Type of policy measure
  - Way of revenue recycling
  - Domain of consumption which is targeted
- Results warn for regressive effects from price increases based on carbon content in domains of food and energy
- Further research attention for:
  - Socially-sensitive compensation/revenue recycling
  - Potential of eco-social policies

Next steps: policy analysis with EUROMOD

Extend database in EUROMOD with emissions

Incidence analysis of environmental tax expenditures

Implementation of a carbon tax => different types
+ compensation mechanisms (e.g. carbon dividend)

Eco-social policies: ecological policies that also reduce inequality and/or support vulnerable groups

MORE NEXT YEAR …
THANK YOU FOR
YOUR ATTENTION !

University of Antwerp