Progressive Carbon taxation as an EU tax – Socio-Economic Impacts

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- Taxation of CO_2 emissions should be
  - Non-distorting (rising inequality)
  - Sustainable (global change)

- Large part of literature shows "regressive impact" of environmental taxation

- We design a "progressive" CO_2 tax
  - On household consumption at national level
  - Rates according to implicit CO_2 prices, i.e. based on CO_2e intensity

- CATs: Modelling of carbon tax scenarios with focus on Austria (work in progress)

- We here show results for

  - EU27 as one economy

  - Taxation of CO_2e footprint in consumption

  - Taxation rates in accordance to implicit CO_2e content of commodities

  - Threshold CO_2e footprint is excepted from tax

Methodology

- Macroeconomic model

  - Hybrid (Input-Output, CGE)

  - Production (62 industries)

  - Consumption (Private, Public, Exports, Investment)

  - Private Households

    - 5 income groups

    - Behaviour integrated via econometric model

  - Link to physical energy/emission flows

- DYNK (Dynamic New Keynesian)

Consumption parameters (I)
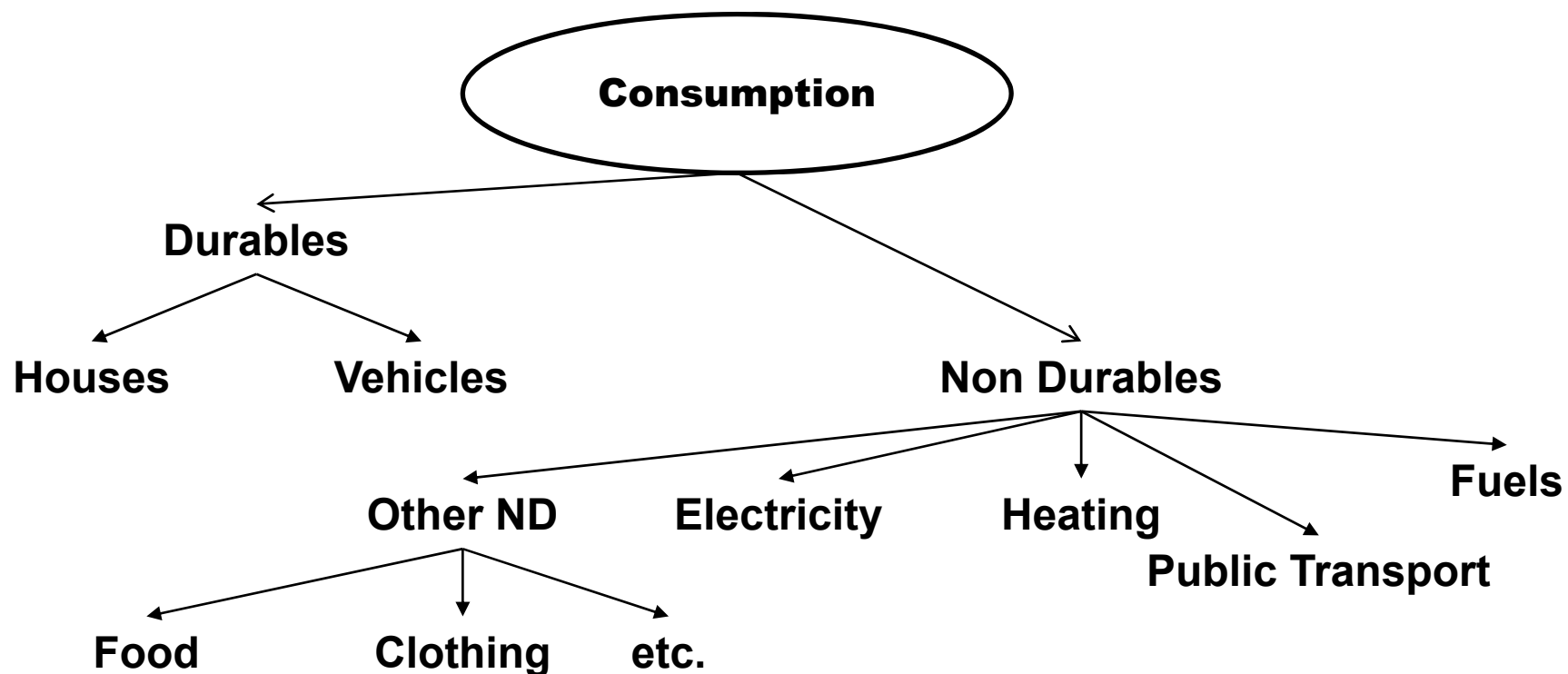
- Price and expenditure elasticity* of energy and non-energy demand of EU households

Nondurable Consumption	own price elasticity	expenditure elasticity	
		Time series	Cross section
Food	-0.14	0.85	0.61
Clothing	-0.64	1.04	1.28
Furniture/equipment	-1.06	1.11	1.46
Health	-0.83	0.98	1.20
Communication	-0.89	0.96	0.68
Recreation/accomodation	-0.50	1.08	1.27
Financial Services	-0.94	1.33	1.00
Other	-0.68	1.09	1.00
Energy Consumption	own price elasticity	durable stock elasticity	
Transport fuel	-0.77	1.00	
Heating	-0.87	1.00	
Electricity	-0.81	1.00	

- Sensitivity of consumption to (lagged) income growth (marginal propensity of consumption*, 2007-2050)

Sensitivity, low θ									
	1st quintile		2nd quintile		3rd quintile		4th quintile		5th quintile
$dlog(C_{dur})$	0.45	***	0.38	***	0.30	**	0.21		0.14
	(0.15)		(0.16)		(0.16)		(0.16)		(0.16)
$dlog(C_{nondur})$	0.94	***	0.76	***	0.58	***	0.38	***	-0.03
	(0.41)		(0.20)		(0.15)		(0.12)		(0.13)
Sensitivity, high θ									
	1st quintile		2nd quintile		3rd quintile		4th quintile		5th quintile
$dlog(C_{dur})$	0.44	***	0.40	**	0.33	***	0.26	**	0.20
	(0.13)		(0.14)		(0.14)		(0.14)		(0.14)
$dlog(C_{nondur})$	1.02	***	0.86	***	0.69	***	0.49	***	0.09
	(0.37)		(0.18)		(0.14)		(0.12)		(0.09)

Direct household emissions

- Total consumption by quintile (q) & category

$$\mathbf{C}_C = \begin{bmatrix} c_{hous,1} & \cdot & \cdot & \cdot & c_{hous,5} \\ c_{veh,1} & \cdot & \cdot & \cdot & c_{veh,5} \\ c_{fuel,1} & \cdot & \cdot & \cdot & c_{fuel,5} \\ c_{heat,1} & \cdot & \cdot & \cdot & c_{heat,5} \\ c_{el,1} & \cdot & \cdot & \cdot & c_{el,5} \\ .. & .. & .. & .. & .. \\ c_{j,1} & \cdot & \cdot & \cdot & c_{j,5} \\ .. & .. & .. & .. & .. \end{bmatrix}$$

- Energy consumption: monetary → physical units

$$\mathbf{C}_e = \begin{bmatrix} c_{e1,1} & .. & .. & .. & c_{e1,5} \\ .. & .. & .. & .. & .. \\ .. & .. & .. & .. & .. \\ c_{e26,1} & .. & .. & .. & c_{e26,5} \end{bmatrix}$$

- Direct GHG emissions: $\mathbf{EM}_{GHG,q} = \mathbf{em}_{GHG,e}\begin{bmatrix} \mathbf{C}_e \end{bmatrix}$

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- The total CO$_2$e footprint of a quintile is the sum of direct (energy related), indirect domestic (production) and indirect imported CO$_2$e footprint:

$$\frac{d\mathbf{EM}_{\mathbf{GHG}}}{d\mathbf{c}_{\mathbf{q}}} = \mathbf{EM}_{\mathrm{GHG,q}} + \frac{d\sum_{j}\mathbf{EM}_{\mathbf{GHG,j}}}{d\mathbf{c}_{\mathbf{q}}} + \frac{d\mathbf{EM}_{\mathrm{GHG}}^{\mathrm{m}}}{d\mathbf{c}_{\mathbf{q}}}$$

- Calculation of the CO$_2$e footprint of quintile q = adding the consumption vector of quintile q exogenously

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Calculating the CO_2 footprint

- Macroeconomic impact and CO_2e footprint of consumption by quintile (in %)

|	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile
GDP, const. prices	2.7	3.6	4.0	4.2	4.5
Private Consumption, const. prices	0.6	0.6	0.5	0.2	-0.2
Capital formation, const. prices	0.0	0.0	0.1	0.1	0.1
Exports, const. prices	-4.6	-7.7	-10.4	-13.7	-21.1
Employment (persons)	4.9	7.2	8.7	10.3	13.7
Unemployment rate (% points)	-4.2	-6.3	-7.7	-9.0	-10.5
GHG emissions, direct	5.4	11.5	17.7	24.8	40.5
GHG emissions, indirect	18.6	31.1	41.3	53.6	83.6
GHG emissions, total	15.3	26.2	35.4	46.5	72.9

- The direct induced CO_2e footprint by quintiles sums up to 100%

- The indirect induced CO2e footprint contains imported footprint and sums to 228%, i.e. The imported CO2e is 2.3 times bigger.

- Cross quintile income impact of consumption by quintile (in %)

	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile
Total	5.2	8.1	10.4	12.9	19.6
1st quintile		5.7	7.5	9.7	15.4
2nd quintile	4.6		9.3	11.7	18.2
3rd quintile	4.9	7.7		12.3	19.1
4th quintile	5.2	8.1	10.3		19.8
5th quintile	5.7	8.8	11.2	13.9	

- Consumption of high income groups generates income in low income groups, used for consumption

- Consumption of low income groups generates income in high income groups, used for savings

Calculating the CO₂ footprint

- Income, consumption and CO2-e footprint by quintile (shares in %)

# Calculating the CO$_2$ footprint
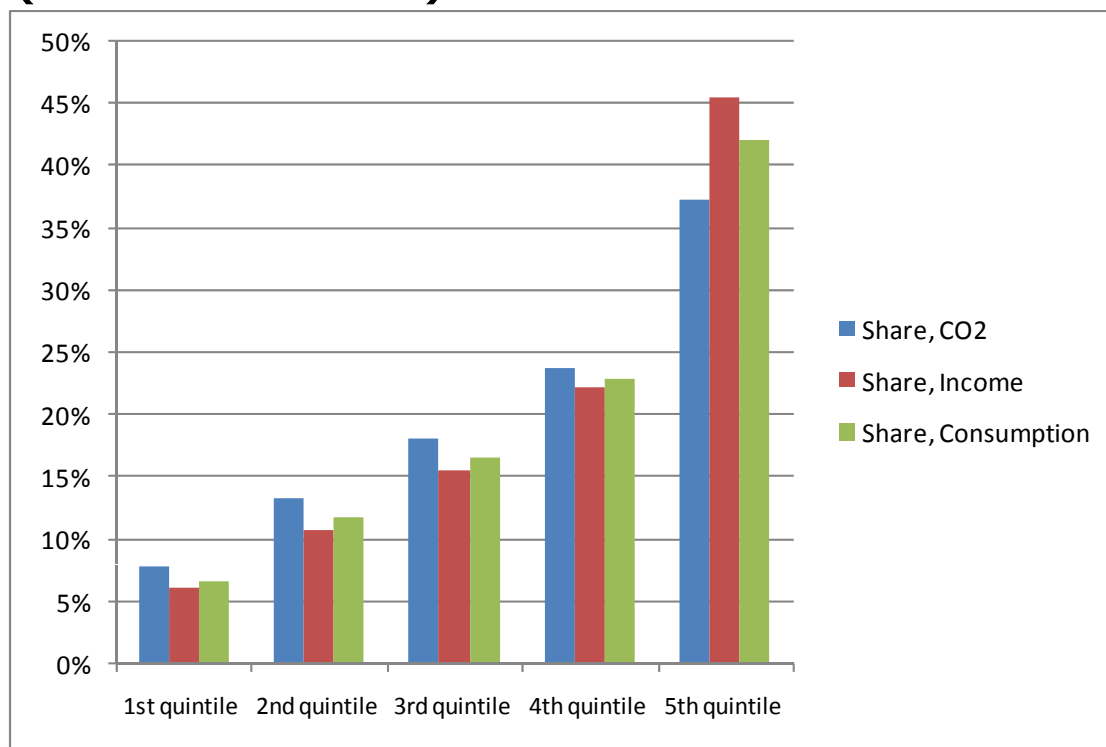
- Absolute CO$_2$e footprint by quintile (in t/capita)
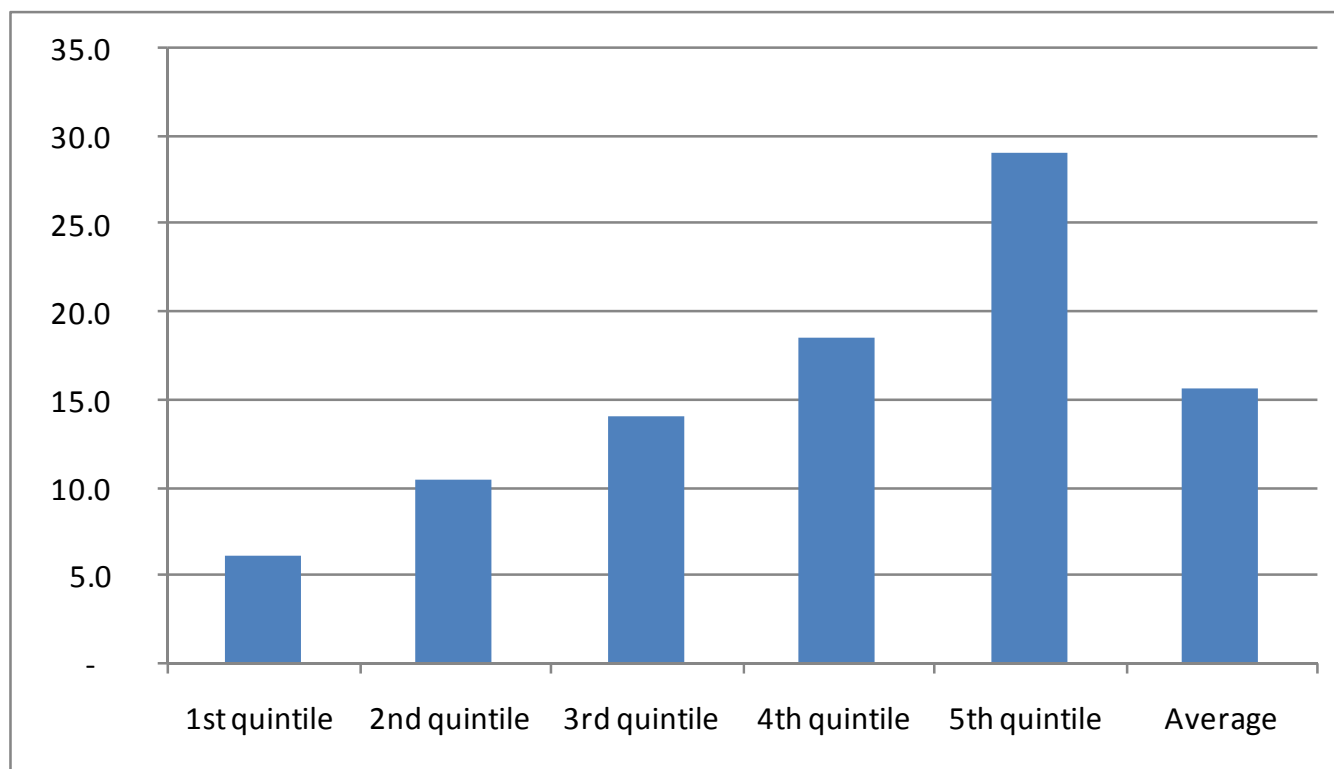
- The Chancel and Piketty (2015) proposal
  - Taxing the CO_2 footprint progressively, i.e. proportionally to its difference from a tax-free threshold (four different versions)

- This paper: the world average footprint (6.2 t CO2e/capita)

- Total tax revenue finances 100% of EU budget (150 bill €)
  - 30 €/t CO_2 and taxing quintile 2 to 5

- The tax burden on high incomes:

  39 bill € (quintile 4) and 73 bill € (quintile 5)

- Tax burden and income groups
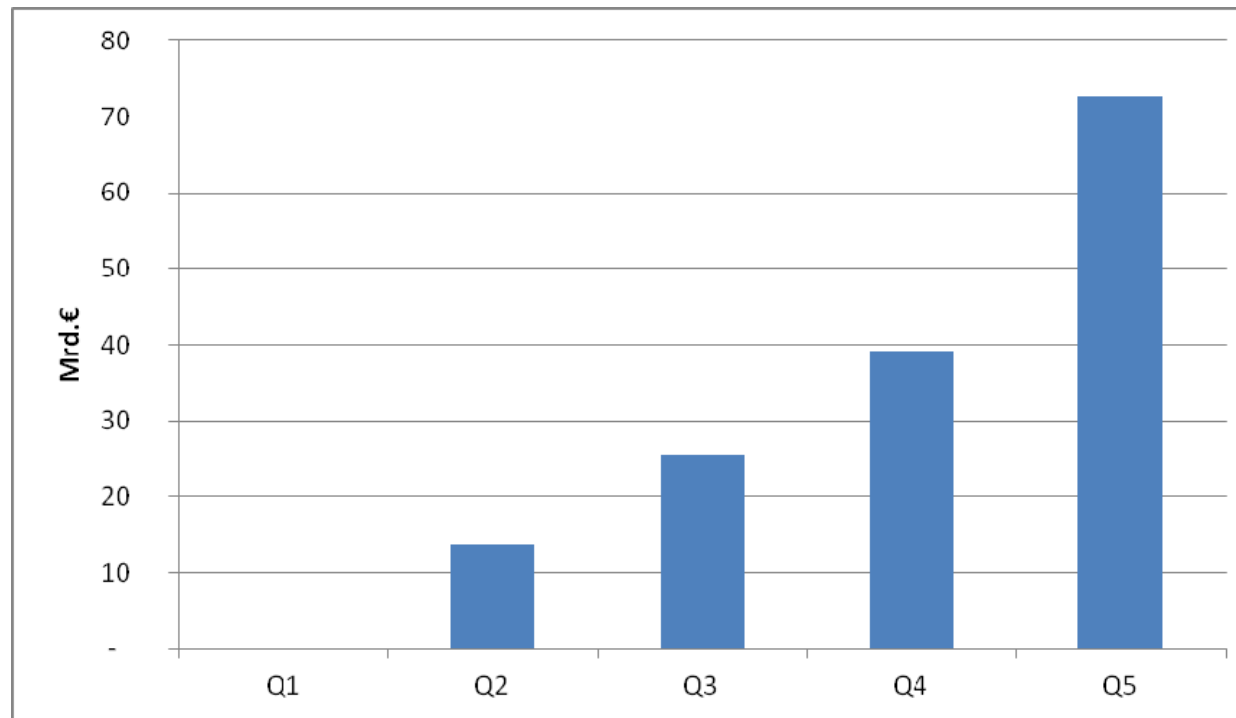
- Macroeconomic impact (%) of the implementation of a tax based on the threshold of the average CO_2e footprint

	2015	2020
GDP, const. prices	0.74	-0.76
Private Consumption, const. prices	-0.55	-1.17
Public Consumption, const. prices	6.81	4.52
Capital formation, const. prices	0.88	-0.69
Storage, const. prices	-0.67	-1.31
Exports, const. prices	-0.67	-1.32
Imports, const. prices	1.81	3.05
Employment (persons)	1.43	0.26
Unemployment rate (% points)	-1.26	-0.23

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- Impact (%) on households of World threshold

	2015	2020
Durable consumption, const. prices	-0.58	-1.15
Nondurable consumption, const. prices	-0.53	-1.12
Energy, const. prices	0.02	0.13
Real disposable income, const. Prices		
Total	-0.96	-1.71
1st quintile	0.58	0.28
2nd quintile	-0.52	-1.08
3rd quintile	-0.90	-1.54
4th quintile	-1.05	-1.77
5th quintile	-1.27	-2.16

Conclusions

- Employment double dividend due to substitution of EU member countries contribution to EU budget (higher public expenditure)

- Feedback from labour market: wage increase and loss in price competitiveness of EU

- Outlook for the CATs project
  - Modelling the impact of an energy/CO_2 tax on household durables (cars, appliances)
  - Modelling of CO_2 tax scenarios for Austria based on best practice examples from other EU Member States
  - Modelling tax scenarios with lump sum refunding vs. progressive energy/CO_2 tax on households