The unequal economic consequences of carbon pricing

Känzig (2023), WP

Environmental Reading Group session 27

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Research Question

- How does carbon pricing shock affect the economic outcomes?
- How are the costs distributed across society?

Phases of EUA

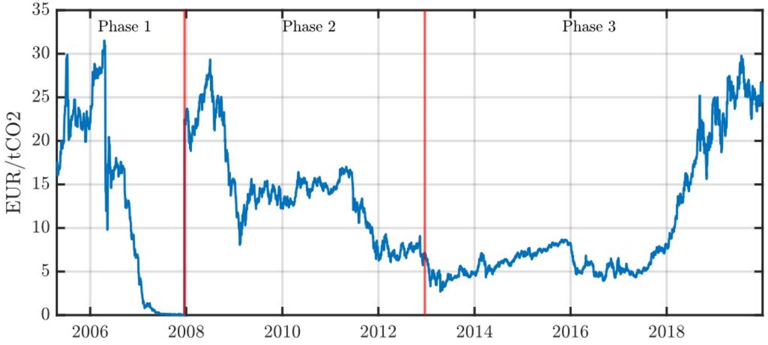


Figure 1: The EU Carbon Price

Instrument of Shock

- Shocks: regulatory news regarding the supply of emission allowances. 126 events during 2005-2019.
- Carbon Price: the future price of emission allowances.
- High-frequency identification: daily data on carbon price.
- Construct a series of carbon policy surprises: how carbon prices change around regulatory events in the carbon market.

Surprise series I

$$CPSurprise_{t,d} = \frac{F_{t,d}^{carbon} - F_{t,d-1}^{carbon}}{P_{t,d-1}^{elec}} \tag{1}$$

$$CPSurprise_t = \sum_d CPSurprise_{t,d} \tag{2}$$

$CPSurprise_t = 0$ if no event on month t. Not a precise measure of the surprise, but a good proxy and used as an intrument. $z_t = CPSurprise_t$.

Surprise series II

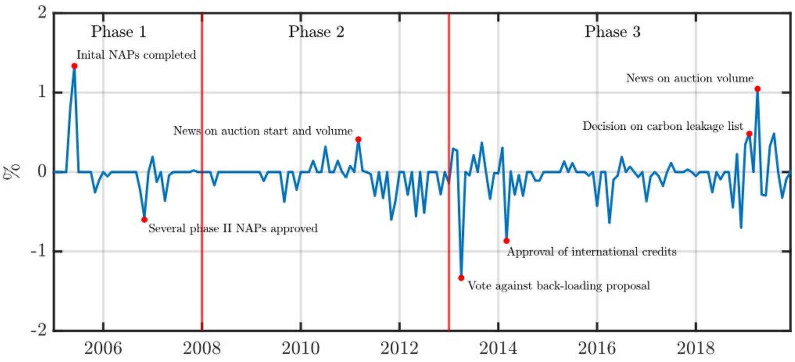


Figure 2: The Carbon Policy Surprise Series

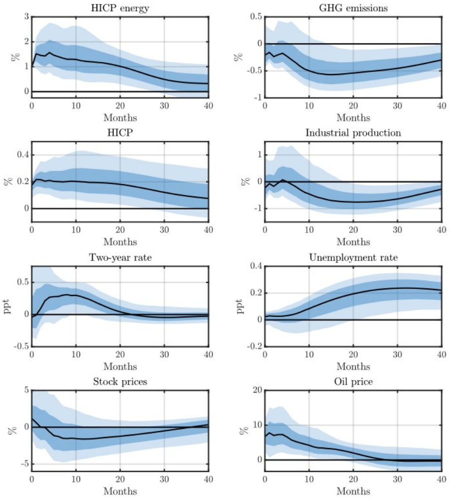
Econometric model 1 I

VAR model:

$$y_t = b + B1y_{t-1} + B2y_{t-2} + \ldots + Bpy_{t-p} + u_t \tag{3}$$

where the structural shocks $u_t = S\varepsilon_t$, and $Var(\varepsilon_t) = \Omega$, so that $Var(u_t) = S\Omega S'$. Main assumption: $E[z_t\varepsilon_{1,t}] \neq 0$ and $E[z_t\varepsilon_{2:n,t}] = 0$. First stage F: 17.43.

Econometric model 1 II



Econometric model 2 I

LP-IV model:

$$y_{i,t+h} = \beta^i_{h,0} + \phi^i_h CPShock_t + \sum_{j=1}^{p} \beta^i_{h,p} y_{i,t-p} + \xi_{i,t,h} \tag{4}$$

Econometric model 2 II

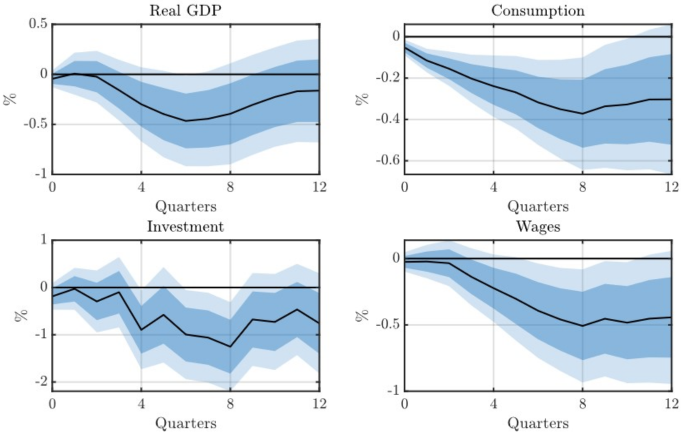


Figure 5: Effect on GDP, Consumption, Investment and Wages

Household Survey Data

- 1999-2019, 20 waves.
- 6000 households each wave. 120,000 observations in total.

This is not panel-data, but a repeated cross-section. Hence, the paper constructs a pseudo-panel, and group the households into three pseudo-cohorts: low ($< 25\%$), medium ($25\% - 75\%$), and high income ($> 75\%$).

Household Response

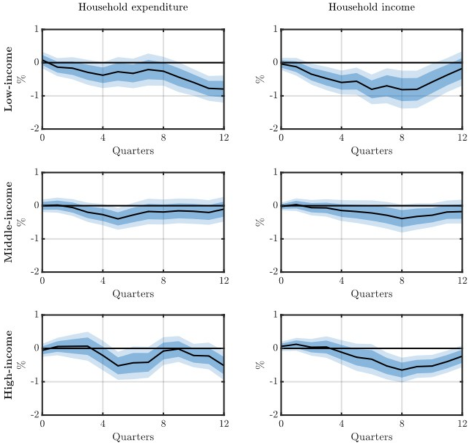


Figure 6: Household Expenditure and Income Responses by Income Group

Household Response

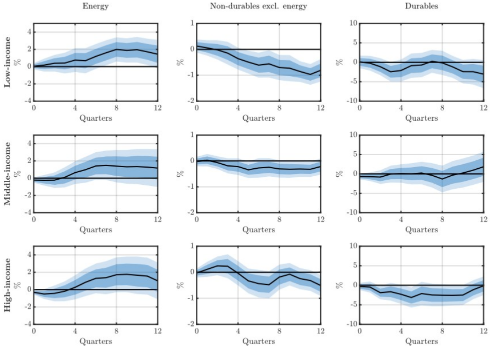


Figure 7: Energy, Non-durables and Durables Expenditure Responses by Income Group

Mechanism: Heterogeneity in Labor Income I

Table 3: Sectoral Distribution of Employment

Sectors	Overall	By income group		
		Low-income	Middle-income	High-income
Energy-intensity				
High	21.6	9.8	25.6	25.8
Lower	78.4	90.2	74.4	74.2
Demand-sensitivity				
High	30.5	49.0	27.2	18.1
Lower	69.5	51.0	72.8	81.9

Mechanism: Heterogenity in Labor Income II

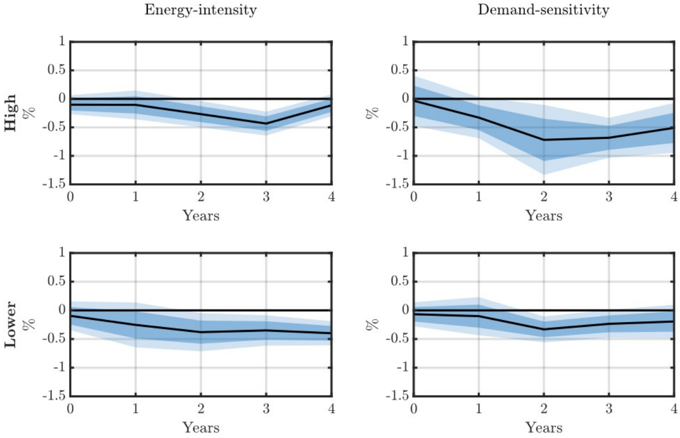


Figure 8: Income Response by Sector of Employment

Redisributing Effects I

A heterogenou-agent climate-economy model with a carbon tax. The Euler Equation with intertemporal consumption for savers (S type) is:

$$\frac{U_x(x_{S,t}, h_{S,t})}{p_{S,t}} = \beta E_t \left[s \frac{U_x(x_{S,t+1}, h_{S,t+1})}{p_{S,t+1}} + (1-s) \frac{U_x(x_{H,t+1}, h_{H,t+1})}{p_{H,t+1}} \right] \tag{5}$$

H: hand-to-mouth households, S: savers households. x: consumption, h: labor supply, p: price level, $1-s$: transition probability. $y_{S,t} = w_{S,t} + r_{S,t} + \omega_{S,t}$
H type consumes all of their income,

$$p_{H,t} x_{H,t} = y_{H,t} = w_{H,t} + \omega_{H,t} \tag{6}$$

Redisributing Effects II

Government runs a balanced budget every period and the transfer policy is:

$$\lambda \omega_{H,t} = \mu \tau_t p_{e,t} e_t$$
$$(1-\lambda)\omega_{S,t} = (1-\mu)\tau_t p_{e,t} e_t$$

baseline: $\mu = 0$, all revenue accrue to savers.
counterfactual: $\mu = \lambda$, equal distribution between savers and hand-to-mouth households.

Redisributing Effects III

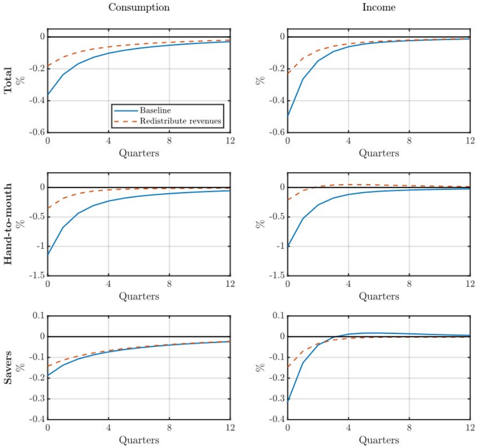


Figure 9: Model Responses for Consumption and Income

Attitude Towards Climate Change

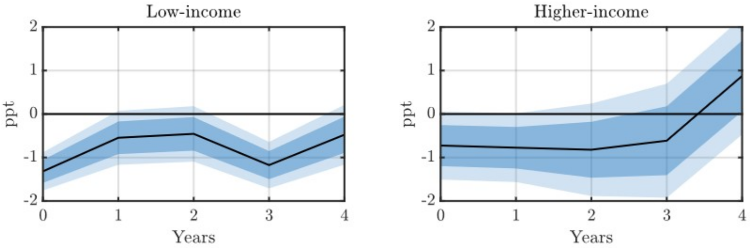


Figure 10: Effect on Attitude Towards Climate Policy

Conclusion

- Carbon pricing has unequal economic consequences. Poor households suffer more.
- The heterogeneity in labor income is the main mechanism. Poor households earn less and are more financially constrained.
- To accrue the revenue to the poor households can mitigate the inequality.

Reference

Känzig, D. R. (2023). The unequal economic consequences of carbon pricing (No. w31221). National Bureau of Economic Research.