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An Important Problem

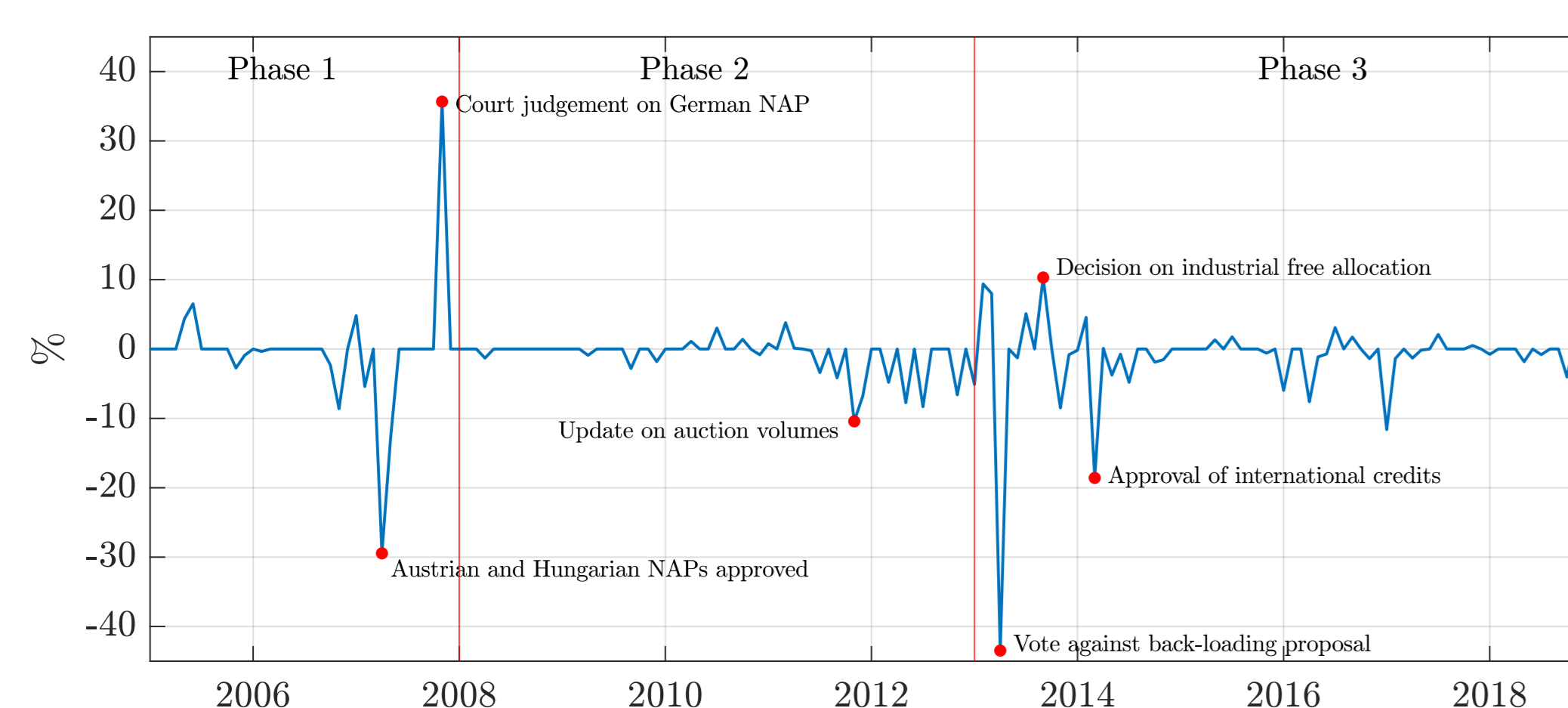
- Climate change is the defining problem of our time; broad consensus that carbon pricing is the way to address it
- Still little known about the effects of carbon pricing on emissions and economic activity in practice
- Distributional effects** of particular interest, as a sustainable transition to a low-carbon economy has to be just and equitable
 - Discussion about energy poverty and inequality around European Commission's proposal to expand the European carbon market
 - Particularly relevant given recent surge in carbon prices
- Research question:** How successful is carbon pricing in reducing emissions, and how does it affect **economic activity** and **inequality**?

Approach

- Novel identification strategy**, exploiting institutional features of the EU ETS and high-frequency data
- EU ETS is the largest carbon market in the world
- Cap-and-trade system: **Market price** for carbon, liquid futures markets



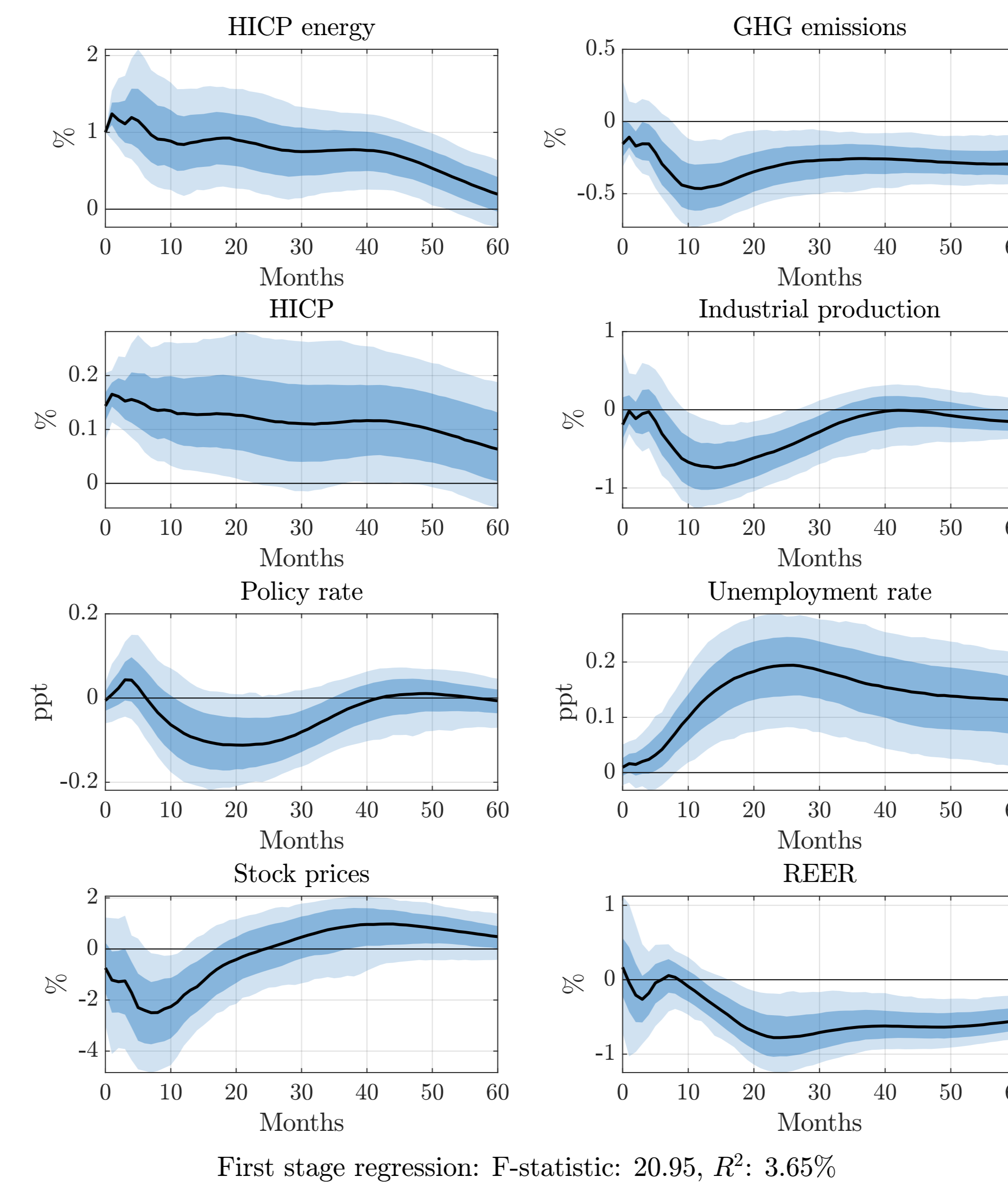
- Regulations in the market have changed considerably over time
- Isolate **exogenous** variation in carbon price by measuring price change in tight window around policy events concerning **supply of emission allowances**



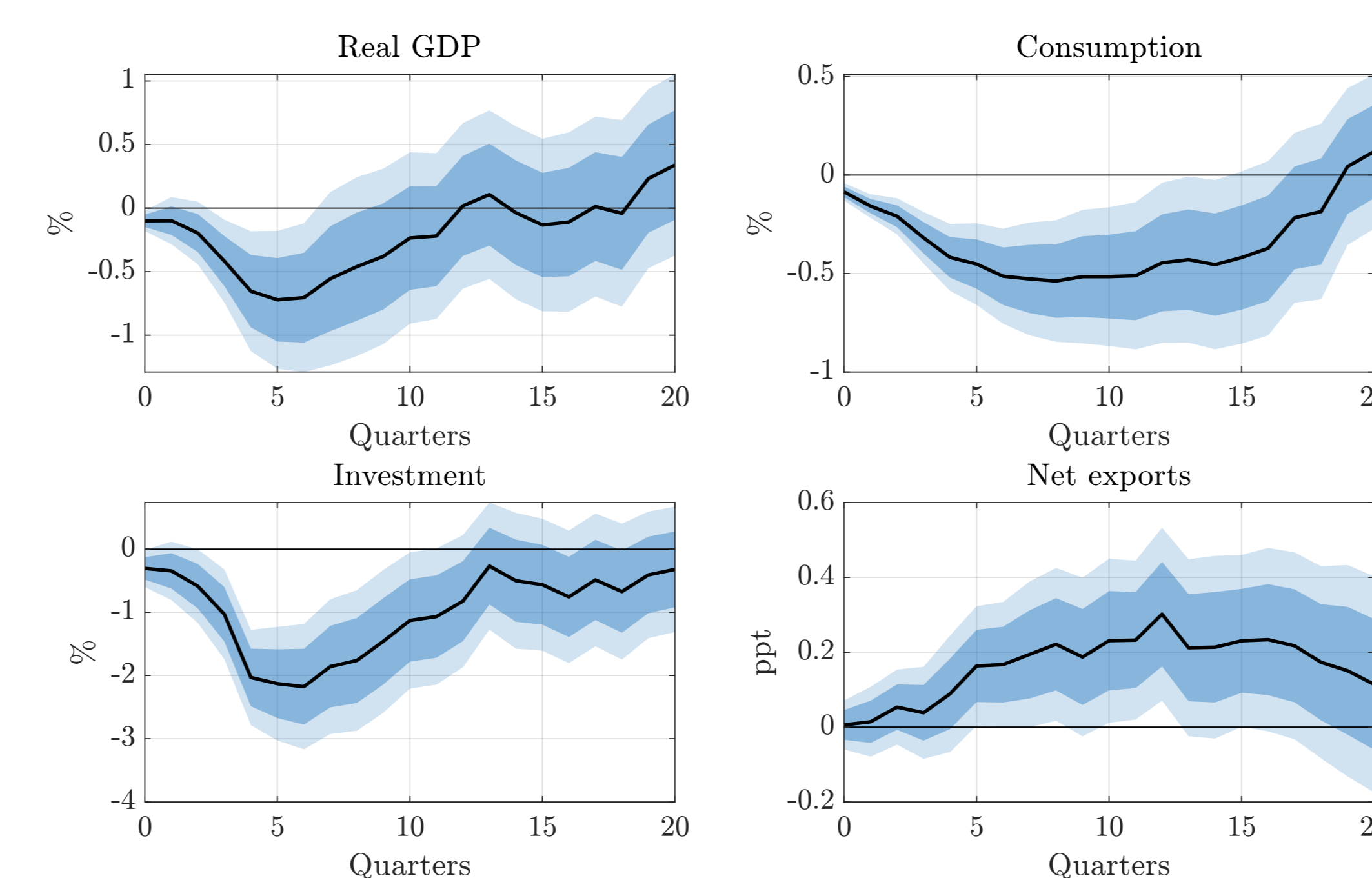
- Use as **instrument** to estimate dynamic causal effects of a carbon policy shock
 - External instrument approach (Stock and Watson, 2012; Mertens and Ravn, 2013), robust to using as internal instrument (Ramey, 2011; Plagborg-Møller and Wolf, 2019)
 - VAR model with carbon and macro block, 6 lags, spanning 1999M1-2018M12

Aggregate effects

- First stage:** F-statistic of 21, no evidence for weak instrument problems
- Carbon pricing has **significant** effects on emissions and the economy



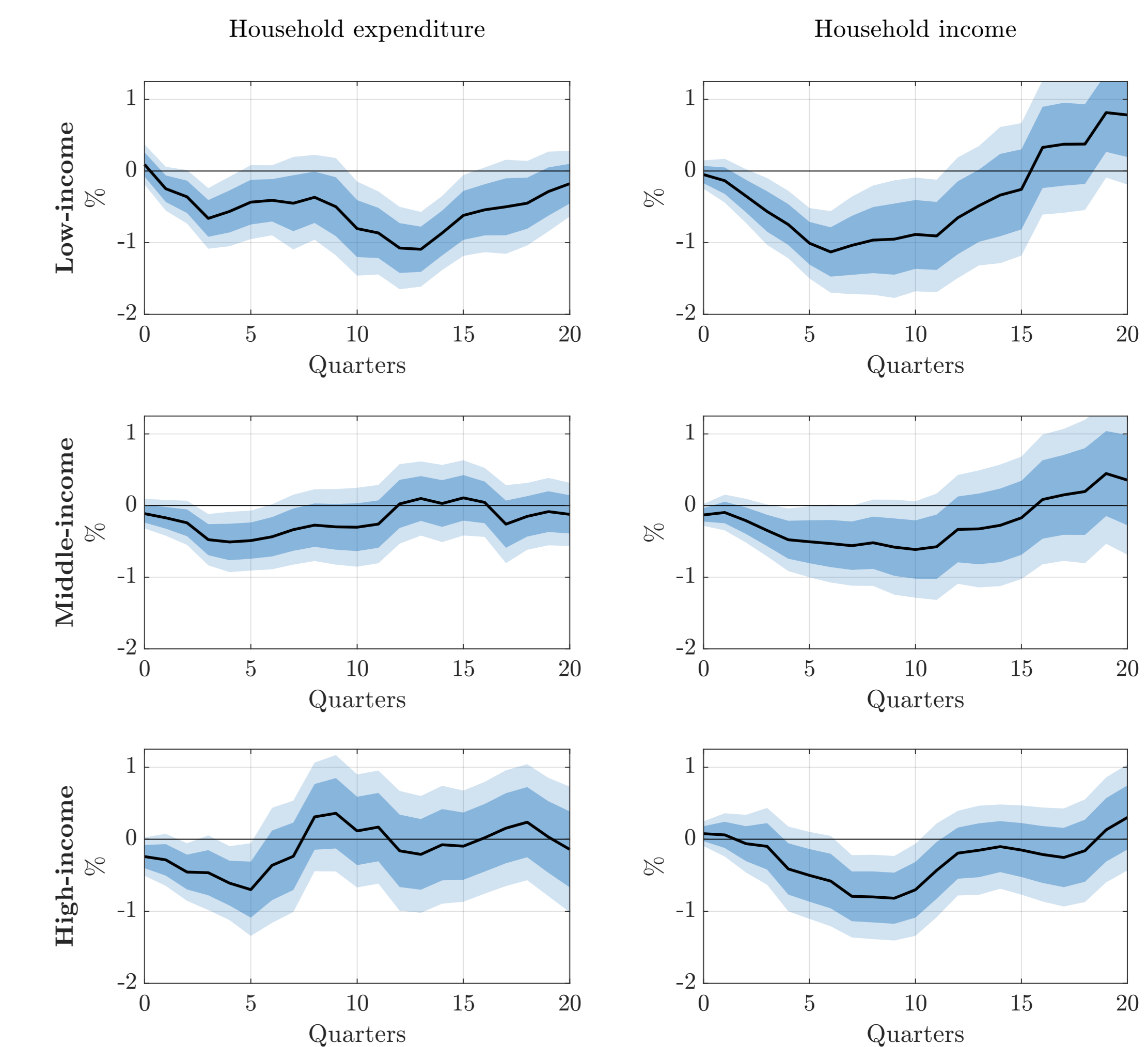
- A shock **tightening** the carbon pricing regime leads to
 - a significant **increase** in **energy prices** and a persistent **fall** in **emissions**
 - an increase in consumer prices and a temporary **fall** in **economic activity**, as measured by lower industrial production and higher unemployment
- Energy prices play a **crucial role** in the transmission, as power producers pass through the cost of emissions
- Higher energy prices in turn can have significant effects on the economy via
 - direct effect through **energy share**
 - indirect effects through **income** and **employment**
- Estimate effects on GDP and component using local projections



- Large effects on consumption and investment suggest that **indirect effects** are important

Heterogeneous effects

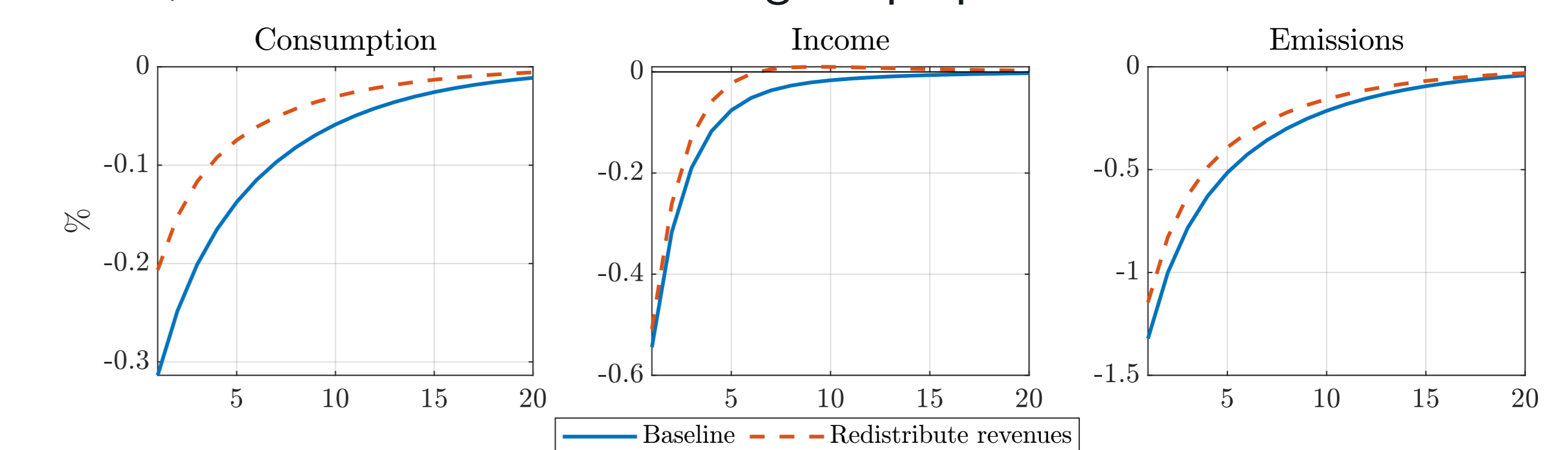
- Study **heterogeneous effects** on carbon pricing using detailed household micro data for the United Kingdom (confirm external validity using data for Denmark and Spain)
- Split households by **normal disposable income** into **low-income** (bottom 25%), **middle-income** (middle 50%) and **high-income** (top 25%)



- Low-income households** reduce their consumption **significantly** and **persistently**, response of higher-income barely significant
 - Not only are low-income households more exposed because of higher energy expenditure share, they also experience a stronger fall in their income
- Low-income households account for **~40%** of the aggregate effect on consumption even though they only represent 25% of the population

Policy implications

- Fiscal policies **targeted** at the most affected households can reduce the economic costs of carbon pricing
 - To the extent that energy demand is inelastic, this should not compromise emission reductions
 - Intuition confirmed in a **climate DSGE** model with heterogeneity in energy expenditure shares, income incidence and marginal propensities to consume



- Crucial for a **sustainable** transition, which should not come at the cost of the most vulnerable
- Suggestive evidence that making policy more equitable helps to increase **public support** for climate change mitigation