Distributional Costs of Net-Zero: A HANK Perspective

Ghassane Benmir

London School of Economics and Political Science

Full Paper Here

Abstract

This paper investigates the distributional impacts of implementing the 2050 net-zero emissions target in the U.S.

1. First, we empirically show:
   - i) How carbon pricing shocks propagate in the economy using an IV-SVAR for the case of the California cap-and-trade market,
   - ii) How bottom and top income households' consumption is asymmetrically impacted following carbon price shocks.
2. Second, we model a heterogeneous household economy and investigate:
   - i) How implementing a carbon price impacts consumption depending on different income and wealth levels,
   - ii) The distributional impacts of gradually tightening fiscal policy consistent with the net-zero emissions target,
   - iii) How distributing revenue from the carbon policy could partially offset consumption losses,
   - iv) Both the cases of abatement learning and sticky prices.

Introduction

- Oneofthe major concerns with the net-zero emissions target is its feasibility by 2050. The political economy aspect of net-zero warrants considerable attention. France's example of the Yellow Vests crisis (*Les Gilets Jaunes*) highlights the importance of accounting for distributional impacts when setting a carbon price, impacts of which may otherwise impede its implementation.
- In this paper, we provide a framework: i) to understand how carbon pricing impacts macroeconomic aggregates and the distribution of households in the case of California and the U.S.; and ii) under which, climate dynamics are cast within the standard incomplete market model of Aiyagari (1994) in continuous time following Achdou et al. (2022).

Contribution

Our main contributions are twofold:

- First—intermsof our empirical contribution—we propose a new empirical approach to identify the aggregate and distributional impacts of carbon pricing, by focusing on the California cap-and-trade market.
- Second—regarding our theoretical contribution—we develop a novel and flexible heterogeneous climate macroe conomic framework, where we show how accounting for climate dynamics is critical for understanding the distributional impacts along the transition to the net-zero emissions target, as well as paramount to the intertemporal inequality trade-off that arises from

Empirical analysis

The carbon policy instrument

To construct the carbon surprise price shock series, we use: i) front contract on carbon allowance futures τ_t^C; ii) the climate Sentometric index (SI) by Ardia et al. (2020) listing daily U.S. climate news sentiment between 2003-2018:

$$\tau_t^C = \begin{cases} \tau_t^C - \tau_{t-1}^C & \text{If } \text{day}_t(\text{SI}) \geq \frac{1}{T}\sum_{i=1}^T \text{SI}_i, \\ 0 & \text{otherwise.} \end{cases}$$

The IV-SVAR

We assume that the dynamics of the observables (energy prices, net energy generation, wages, equity index returns) are described by a system of linear simultaneous equations:

$$Y_t = \sum_{j=1}^{p} A_j Y_{t-j} + \eta_t,$$

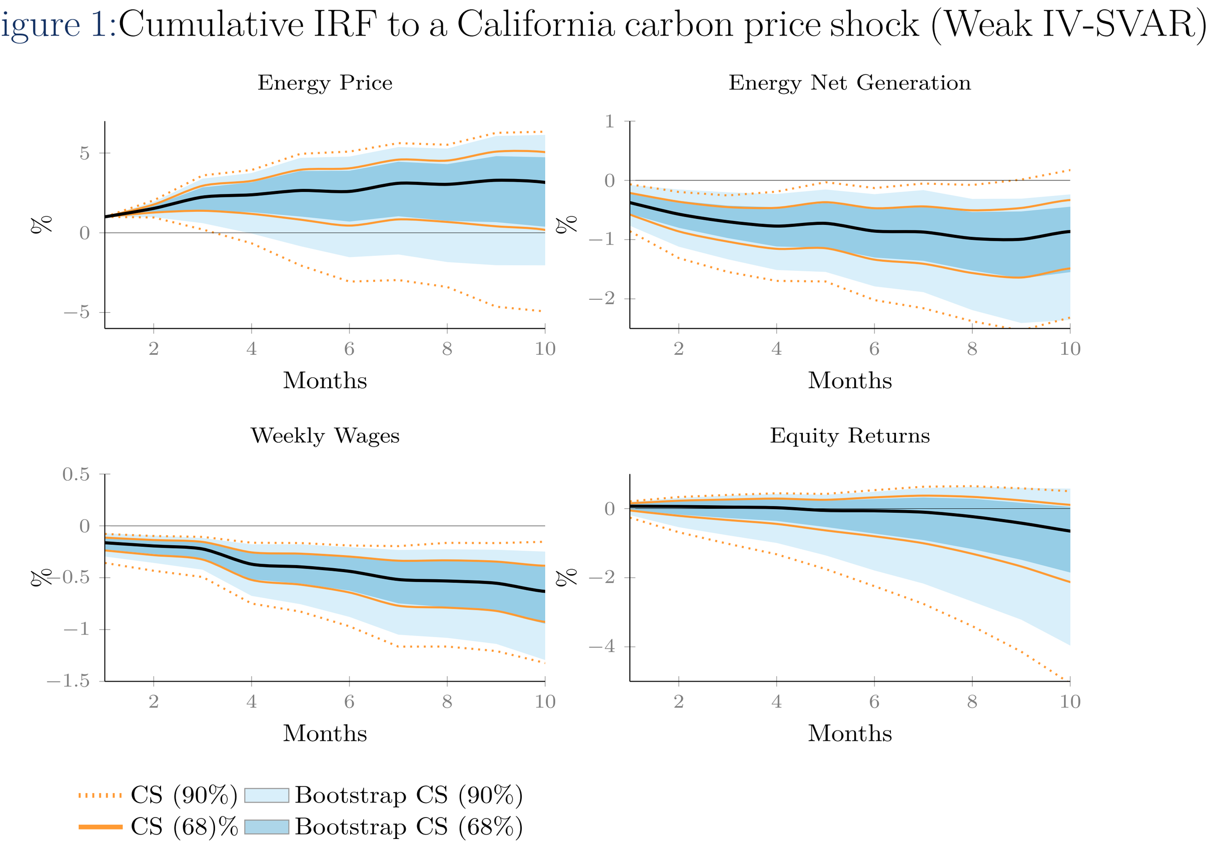
where our vector of observables is Y_t, and η_t is a vector of reduced-form VAR innovations.

Main empirical results

Result 1

Carbon policy shock (CPS) leads to:
⇒ **a persistent increase in energy prices**, triggering a **persistent decrease in net energy**.
⇒ This induces a cost to firms/consumers, contributing to a **persistent decrease in wages**, while for equity returns, the **fall does not manifest immediately**.

Figure 1:Cumulative IRF to a California carbon price shock (Weak IV-SVAR)



Result 2

CPS leads to an **asymmetric consumption reaction** in top and bottom 50 percent income distribution.

Climate HANK

The model

1. Environmental block: à la Dietz and Venmans (2019)
2. Energy block: à la Golosov et al. (2014)
3. Production: à la Kaplan et al. (2018)
4. Households: à la Achdou et la. (2021)
5. Gov't sets environmental policy following emission cap
6. Central Bank conducts conventional monetary policy

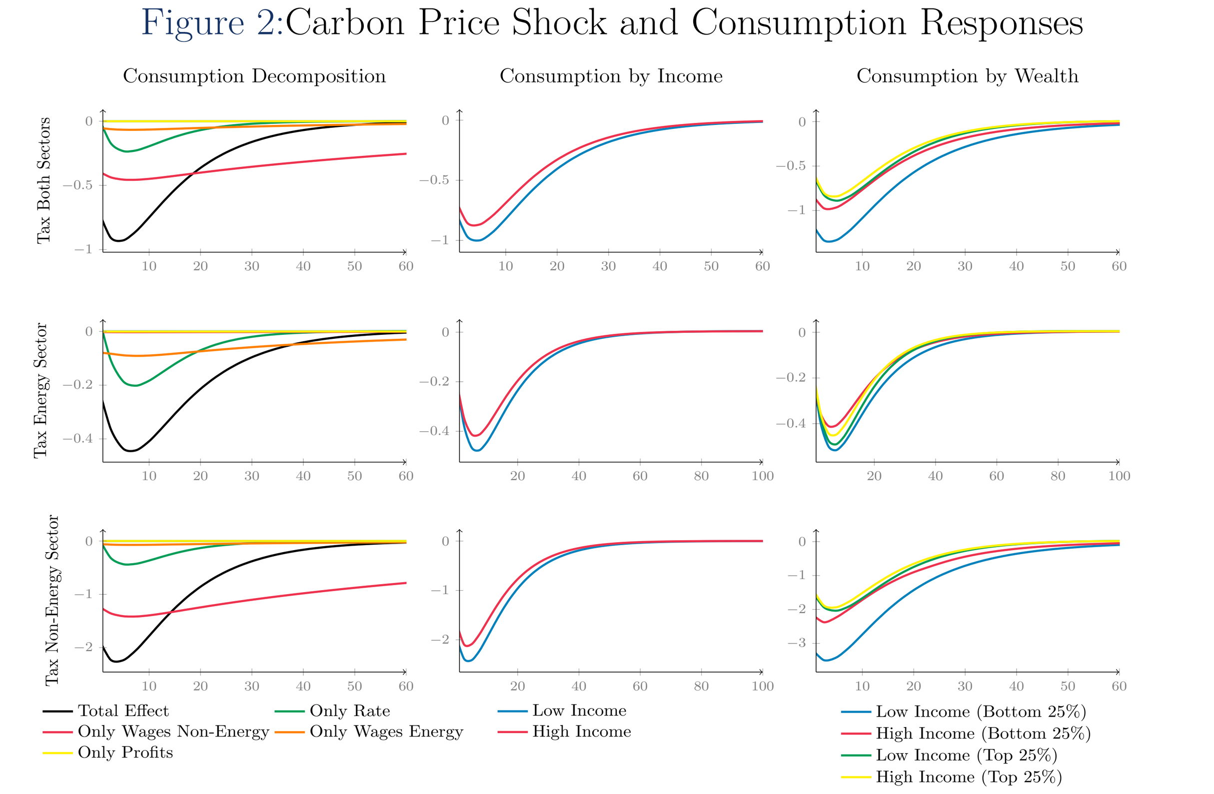
The solution algorithm

- To solve our heterogeneous-agent model, we find a **stationary equilibrium**, before turning to the **transition dynamics**, where we use finite differences à la Achdou et al. (2022) for the HJB.
- Contrary to standard models with idiosyncratic income risk, **climate dynamics** in our model imply adjustments to the Achdou et al. (2022) method for finding the initial and final steady states.
- Thus,**we first compute a synthetic path for emissions consistent with each RCP scenario**, to find the terminal value of emission stock and temperature. Thereafter, we retrieve the remaining values within the inner loop used to find the level of capital in each sector.

Result 1

Solely taxing the energy sector generates **less inequality** than other policies.
Taxing the non-energy sector generates a **consumption loss twice as high** for bottom wealth/income households than for top wealth/income households.

Figure 2:Carbon Price Shock and Consumption Responses

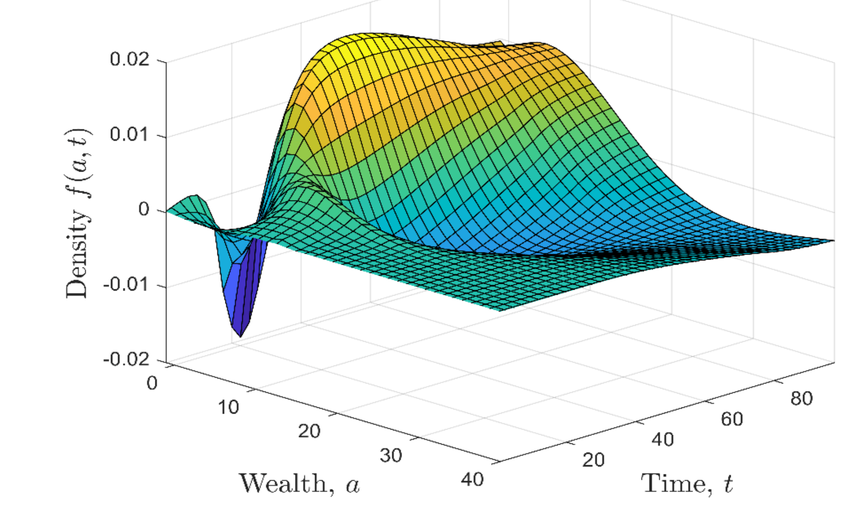


Note: The figure plots the reaction to an initial 25% reduction in emissions.

Result 2

Growth expectations lead to increases in consumption, as households expect higher future income given low environmental costs. However, in the second phase of the cap policy (in 2037), **inequality rises**.

Figure 3:Net-Zero versus Laissez-faire with Moderate Abatement

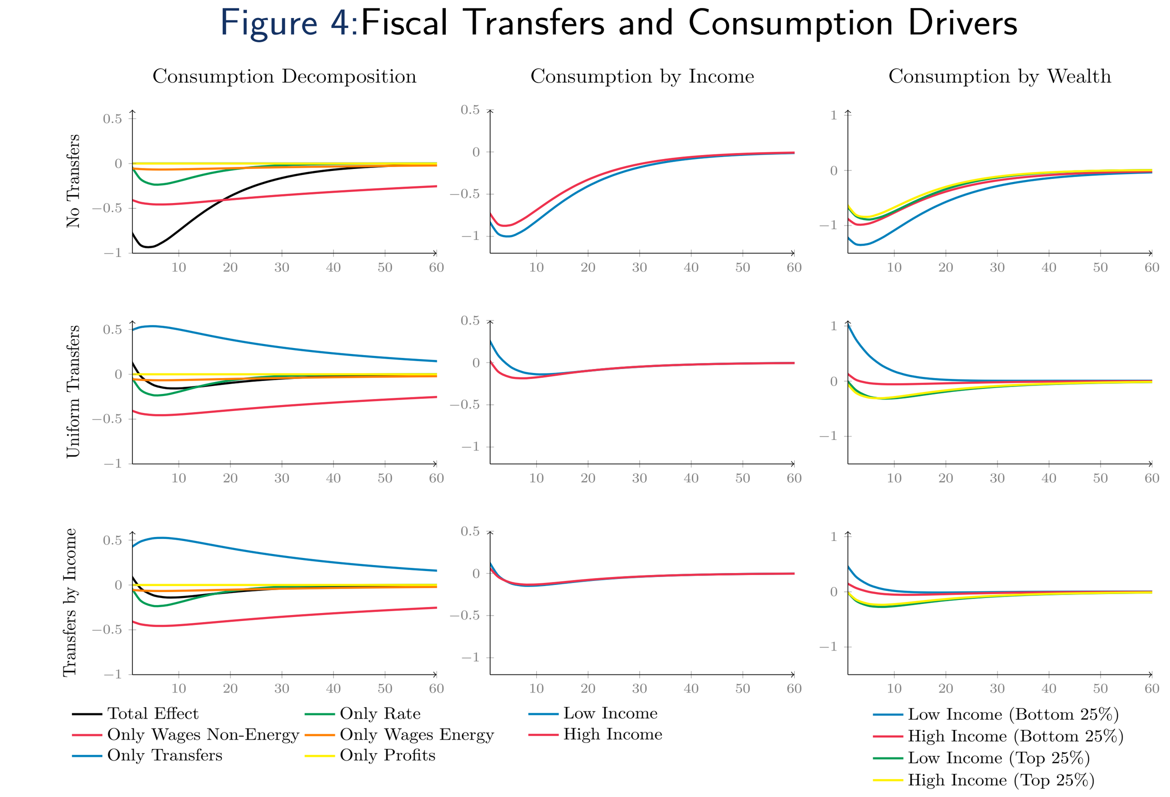


Note: This figure compares the net-zero and laissez-faire scenarios over the transition for the wealth distribution (period 2022 to 2100) for average income households. When a point is below zero the distribution of wealth across households has improved under the net-zero compared to laissez-faire and vice versa.

Result 3

Carbon revenue redistributions—following an **income-based approach**—allows for an offset of most negative impact on consumption, and thus on welfare, with no major distortion (seen in the case of uniform transfers).

Figure 4:Fiscal Transfers and Consumption Drivers



Result 4

Generalizing the market for carbon permits can create extra pressure on firm input costs, leading to **lower inflation** as carbon prices decrease wages and interest rates. These effects could be **dampened by decreasing carbon prices utilizing learning by doing**.