The New Keynesian Climate Model

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Introduction

- Climate change will shake the macroeconomic landscape in the next decades and the central bank will have to face 2 phenomena [Schnabel 2022]:
  - On the one hand, a warming planet causes damages that will make resources scarcer & prices higher → climateflation.
  - On the other hand, the fight against climate change through increasing carbon taxes will increase production costs → greenflation.
- How should the central bank conduct monetary policy in this new landscape?
- Answering this question requires a new class of IAM with New Keynesian ingredients to capture inflation dynamics.
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This paper

- The canonical New Keynesian model (e.g. Woodford, 2003) not designed for climate analysis.
- This paper develops The New Keynesian Climate (NKC) model by:
  - extending with a carbon accumulation constraint and a mitigation policy from the Integrated Assessment Model (IAM) [Barrage and Nordhaus 2023];
  - estimating NKC for the world economy with techniques that take into account nonlinearities resulting from climate change;
  - providing projections up to horizon 2100 under mitigation versus *laissez-faire* policy by changing an exogenous carbon tax rate.
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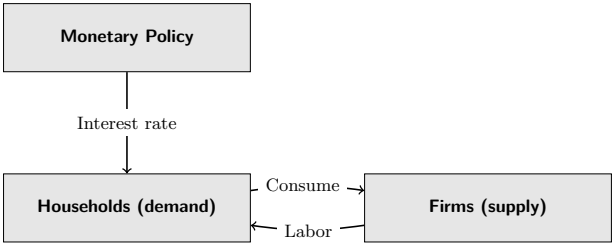
Outline

Plan

Main ingredients



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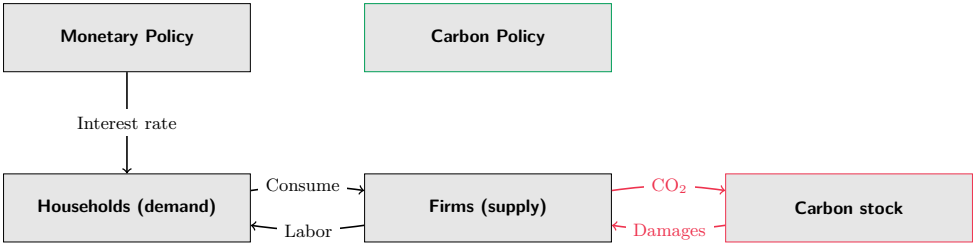

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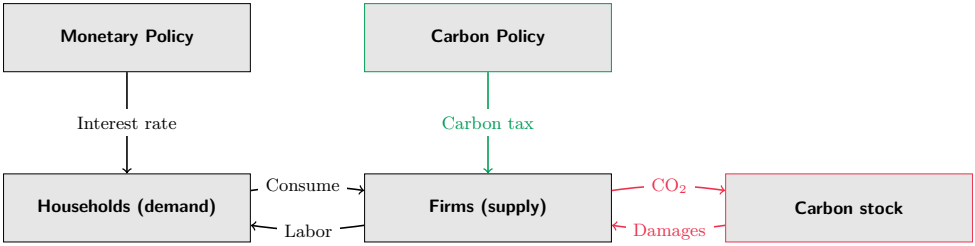

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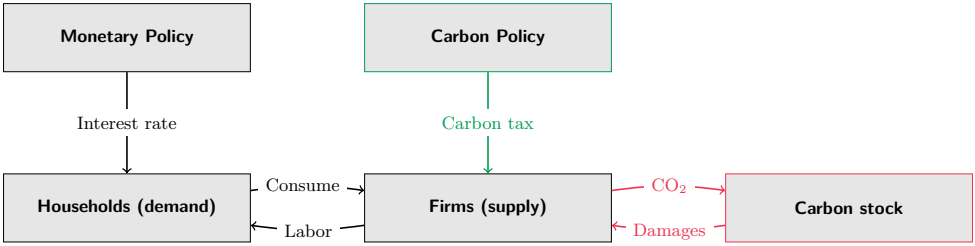

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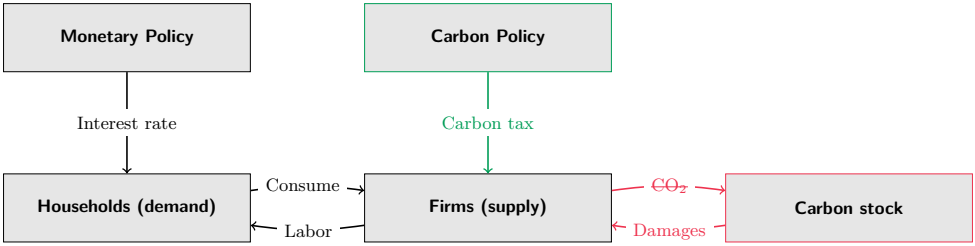


Estimation

- Estimation on world data from 1985Q1 to 2023Q3 (sources: World Bank, OECD and OurWorldInData).

- There are four observable variables:

$$\begin{bmatrix} \text{Real output growth rate} \\ \text{Inflation rate} \\ \text{Short-term interest rate} \\ \text{CO}_2 \text{ emissions growth rate} \end{bmatrix} = 100 \times \begin{bmatrix} \Delta \log (y_t) \\ \pi_t - 1 \\ r_t - 1 \\ \Delta \log (e_t) \end{bmatrix}$$

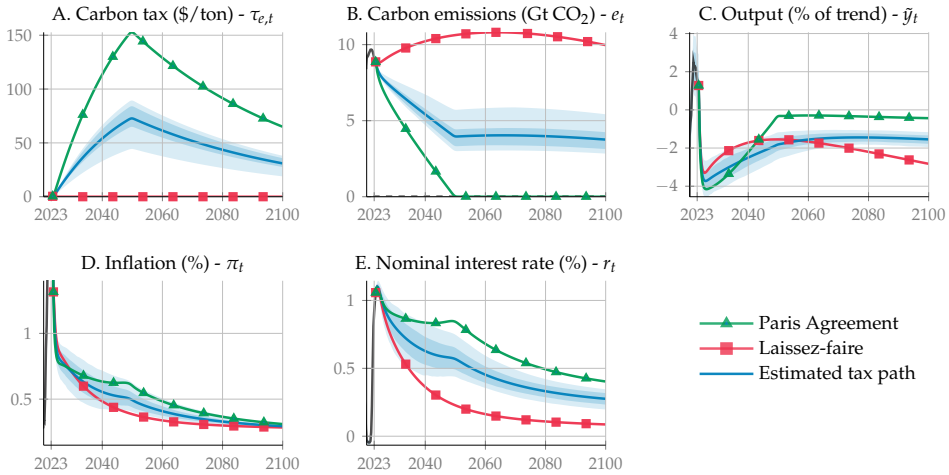
- Solution & filtering methods from Fair and Taylor (1983): fully nonlinear, MIT shocks and no aggregate uncertainty.

Plan

The Anatomy of Green/Climateflation

- What is the future macroeconomic landscape by the end of the century?
- We consider three alternative scenarios based on effective realization $\varphi\tilde{\tau}_t^*$ of Paris Agreement $\tilde{\tau}_t^*$
  - Paris-Agreement with $\varphi = 1$
  - Estimated carbon path with $\varphi = 0.53$
  - Laissez-faire with $\varphi = 0$

Figure 1: Model-implied projections based on alternative control rates of emissions



Dissecting the PC curve

- Stabilization objective of a central bank: important to understand how climate affects inflation.
- One can split the marginal cost into three term:

$$mc_t = \underbrace{\tilde{w}_t}_{\text{real wage}} \; / \; \underbrace{\Phi\left(m_t\right)}_{\text{climateflation}} + \underbrace{\theta_{1,t}\mu_t^{\theta_2} + \tau_{e,t}\sigma_t\left(1-\mu_t\right)\varepsilon_{e,t}}_{\text{greenflation}}, \tag{1}$$

which allows to break down inflation into 4 different forces:

$$\hat{\pi}_t \simeq \underbrace{\hat{\pi}_t^w}_{\text{wage term}} + \underbrace{\hat{\pi}_t^c}_{\text{climateflation}} + \underbrace{\hat{\pi}_t^g}_{\text{greenflation}} + \underbrace{\hat{\pi}_t^x}_{\text{cost-push shocks}} \tag{2}$$

with $\hat{\pi}_t = \pi_t - \pi_t^\star$

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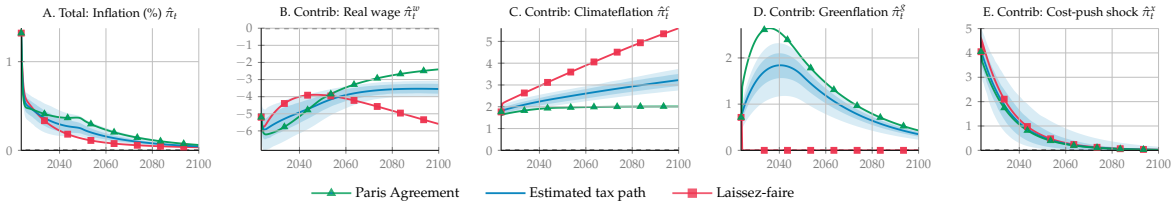

- Under Paris Agreement:
  - The immediate increase in carbon tax fuels inflation
  - General equilibrium effect: increasing abatement expenditures reduces both consumption and in turn the wealth effect on the labor supply
  - Net zero stabilizes damages, and hence climateflation

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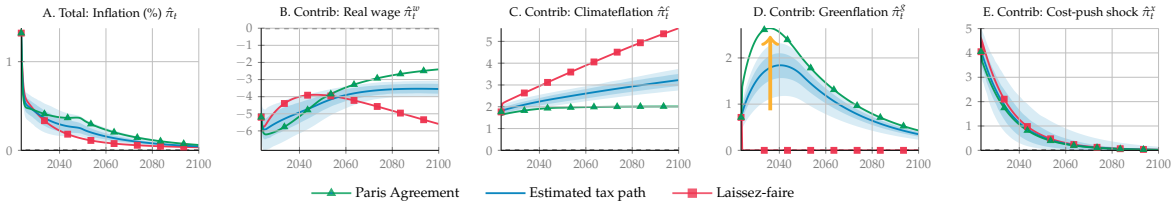

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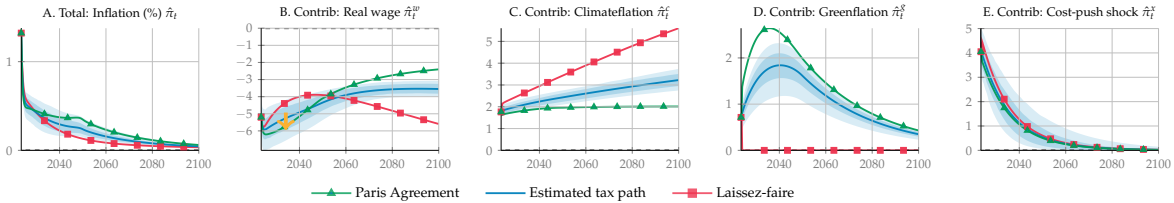

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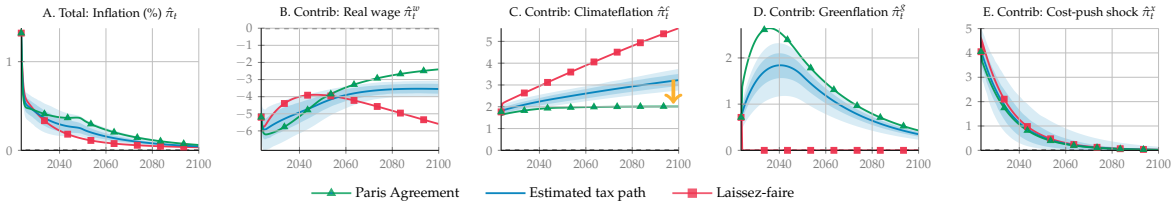

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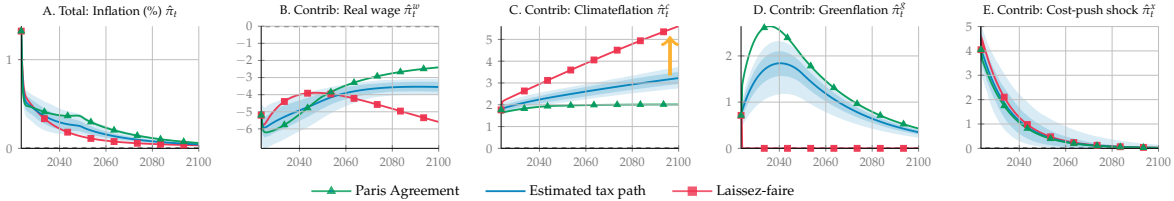

- Under Laissez-faire:
  - The rising damage makes resources scarcer: ever growing inflation as long as planet warms
  - Disengagement from carbon policy makes carbon price to be zero
  - General equilibrium effect: real wages fall as climate decreases productivity

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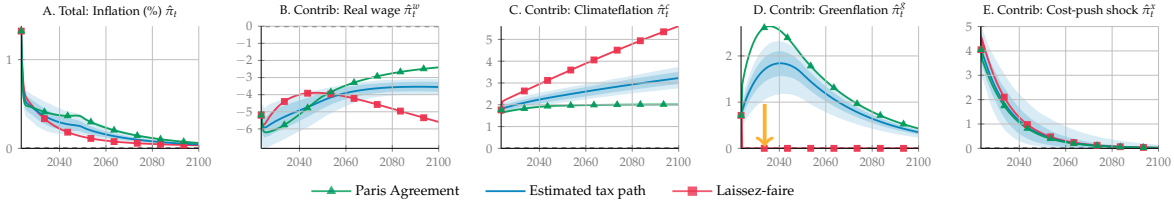

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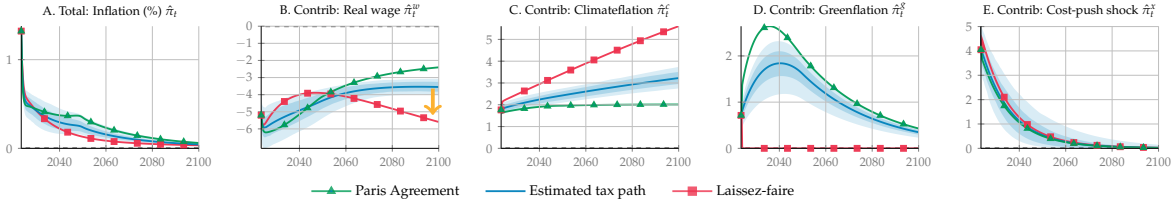

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Conclusion

- With conservative assumptions, climateflation and greenflation are sizable and depend on how real wages adjust
- Greenflation robustness: more greenflation with (i) capital, (ii) tax redistribution, (iii) optimal carbon taxing (iv) durable abatement goods
- Additional results in the paper:
  1. short vs. long run trade-offs affected by climate change
  2. structural change of r^* matters for inflation dynamics
  3. carbon mispricing risk: nominal rigidities shape the social cost of carbon

Thank you for your attention

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