
ENVIRONMENTAL SUBSIDIES TO MITIGATE NET-ZERO TRANSITION COSTS

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EEA

MOTIVATIONS

- ▶ Commitment of **zero emission by 2060** to maintain temperatures below 2°C ;
- ▶ Benchmark models suggest **gradual rise in carbon tax** sufficient to reach this target;
- ▶ However carbon tax is **permanent negative shock** to firms cost structure: harmful for the economy (**transition risk**);

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- ▶ If carbon tax implemented, how firms reduce their emissions?
- ▶ **Firms purchase abatement goods** (or green goods) to lower their carbon footprint;
- ▶ Abatement are goods and services that **prevent, limit, minimize or correct environmental damage** to water, air, soil (etc).
- ▶ Crucial sector to reach net zero: cumulated abatement spending represents ~50% of GDP between 2020-2050.

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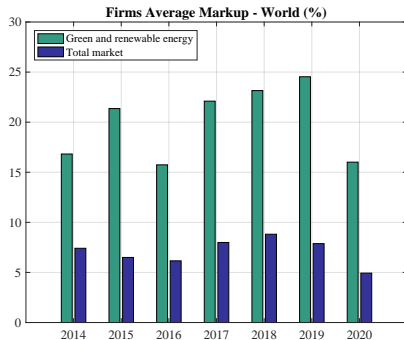
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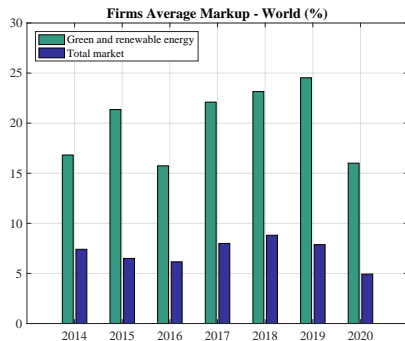
- ▶ **How competitive** is the abatement sector?
- ▶ Data suggest greater **rent opportunities** for abatement goods;
- ▶ Abatement concentrated on a few worldwide firms: **10% among them account for almost 80%** of the operating revenue (Eurostat, 2009).



Markup rate by sector
(financial data)

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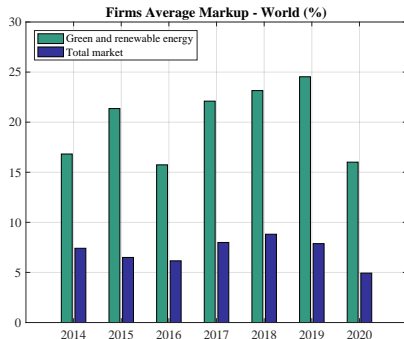
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- ▶ Standard interpretation: Greater markups = **weak competition + high barrier to entry**;
- ▶ Implications? **Higher selling price for abatement goods** increasing transition risk;
- ▶ So far, imperfect competition is **absent** in benchmark models of climate change, such as DICE;
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THIS PAPER:

► Objective:

Investigating how public subsidies can play a role in mitigating transition risk.

► How?

- We develop and estimate an Environmental DSGE model for the world economy;
- The model features endogenous green product variety;
- We provide projections up to horizon 2100, conditional on CO2 reduction efforts as in last IPCC report;
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- 2 Model**
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MODEL OVERVIEW

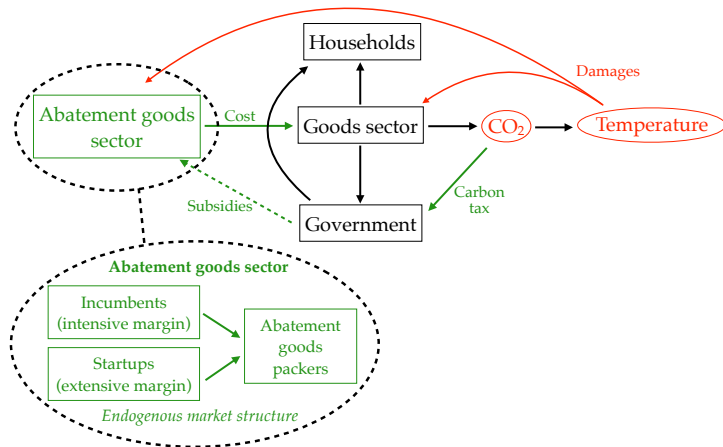


FIGURE 1: A presentation of the model

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ESTIMATION

- ▶ We estimate 15 parameters using **Bayesian techniques**;
- ▶ Inference based on World annual data 1961-2019;
- ▶ Fully-nonlinear method that **takes into account trends** (no balanced growth) and nonlinear climate change effects (but assumes certainty equivalence).

$$\begin{bmatrix} \text{Real output growth rate} \\ \text{Real consumption growth rate} \\ \text{CO}_2 \text{ Emissions growth rate} \\ \text{Temperature anomaly change} \\ \text{Patents growth rate} \end{bmatrix} = \begin{bmatrix} \Delta \log(Y_t) \\ \Delta \log(C_t) \\ \Delta \log(E_t) \\ \Delta T_t \\ \log(N_t^E / N_{t-1}^E) \end{bmatrix}$$

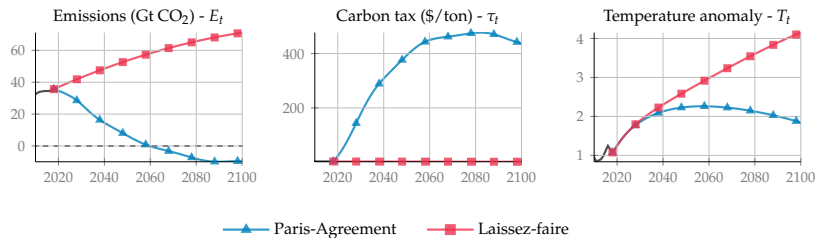
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A (UNCERTAIN) FUTURE PATH OF EMISSIONS

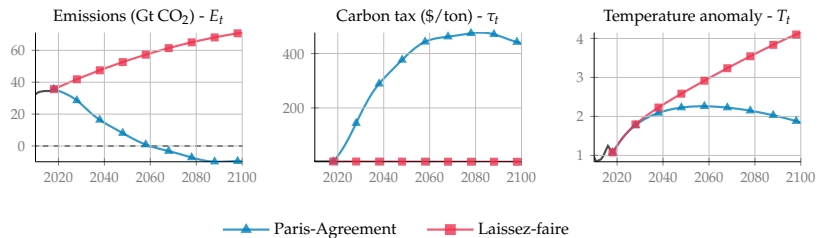
- ▶ Large uncertainty about future path of CO₂ emissions;
- ▶ We consider 2 alternative scenarios for CO₂ emission cuts, consistent with IPCC:
 1. **Carbon neutrality in 2060** (stringent policy, Paris agreement);
 2. **Business as usual** (no CO₂ reduction).

TRANSITION SCENARIOS



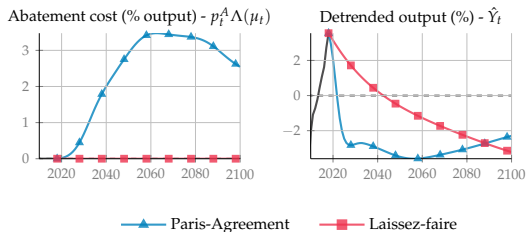
- ▶ Each path for emission cuts (μ_t) is matched by adjusting carbon tax (τ_t);
- ▶ More emissions translate into more temperature anomalies.

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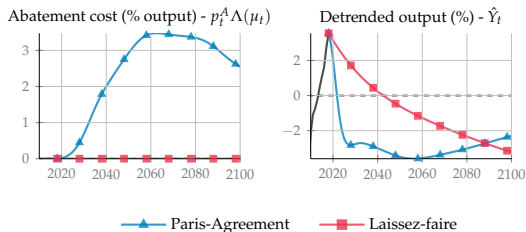
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TRANSITION SCENARIOS: MACROECONOMIC PROJECTIONS



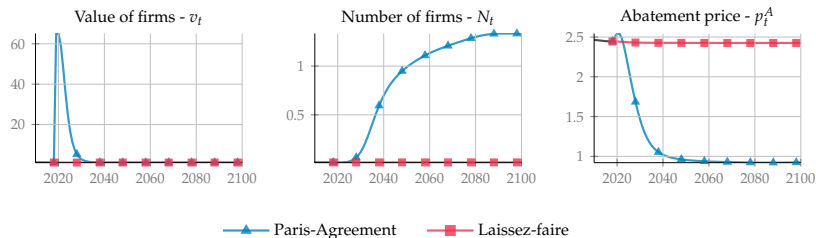
- ▶ More emission cuts (μ_t) imply a rise in abatement cost ($p_t^A \Lambda(\mu_t)$);
- ▶ Implication: GDP persistently below its trend.

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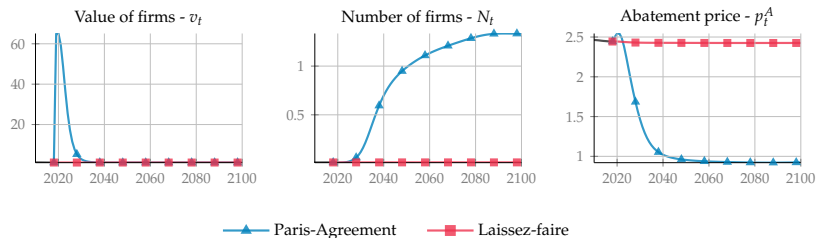
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DISSECTING THE FIRM ENTRY MECHANISM



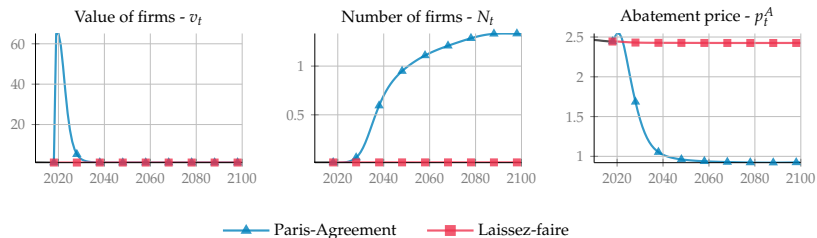
- ▶ The prospect of future profits in abatement goods boosts the value of firms;
- ▶ Startup creation occurs as long as future profits are high;
- ▶ Strong competition effect making abatement goods cheaper by 2050;

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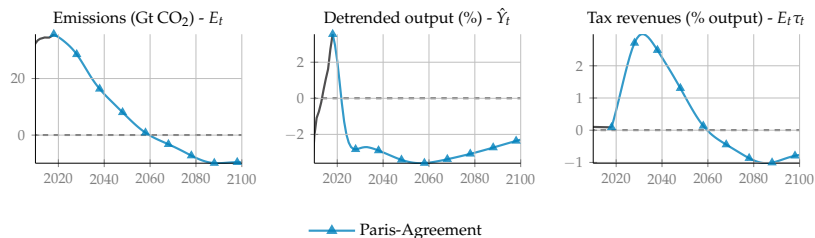
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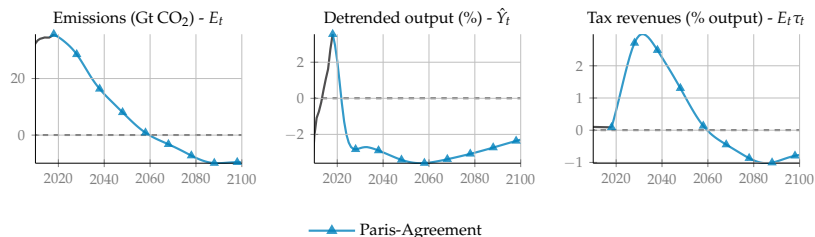
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- ▶ Quick but costly cuts in CO₂ emissions;
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ENVIRONMENTAL SUBSIDIES

- ▶ Let s_t^A & s_t^E denote resp. subsidy rates to existing firms and startups;
- ▶ How should be split the carbon tax revenues across firms?
- ▶ Let ς and $1-\varsigma$ the share of the carbon tax revenues going to startups and existing firms:

$$s_t^E H_t^E w_t = \varsigma \tau_t E_t$$

$$s_t^A H_t^A w_t = (1 - \varsigma) \tau_t E_t$$

AN OPTIMAL SHARING RULE ACROSS FIRMS

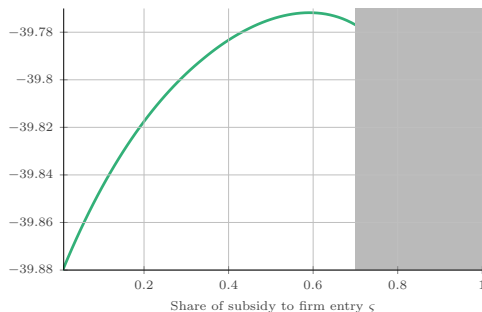
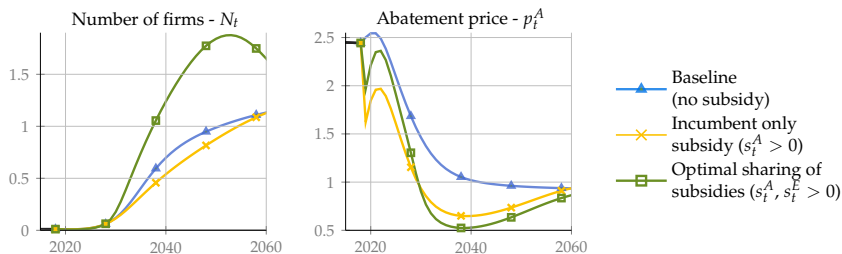


FIGURE 2: Welfare index for various sharing rules between startups/existing firms

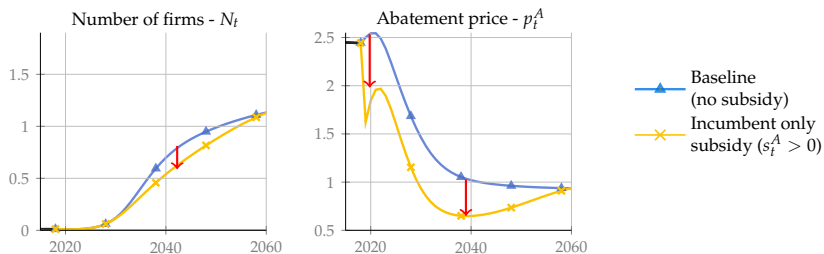
- ▶ **Optimal sharing rule across firms:** 60% of carbon tax revenues given to startups and 40% to existing firms;

WHAT DRIVES THE TRADE-OFF?



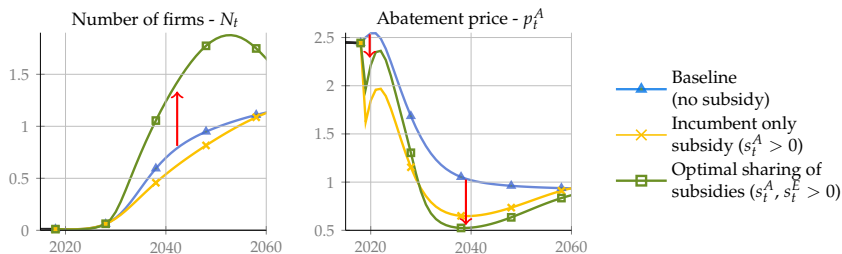
- ▶ Subsidizing installed firms only:
 - ▶ reduces the cost of abatement in short-term;
 - ▶ but impediment to entry, high rents in medium term.
- ▶ Subsidizing startups only:
 - ▶ firm entry is gradual process: no effect in short term!
 - ▶ boosts competition and reduces abatement price in medium-term;

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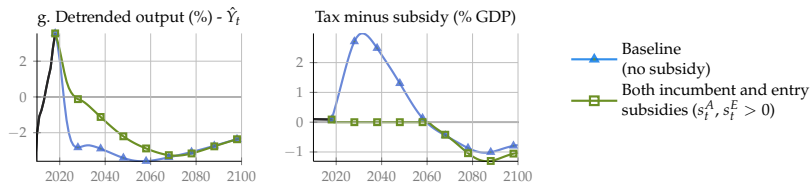
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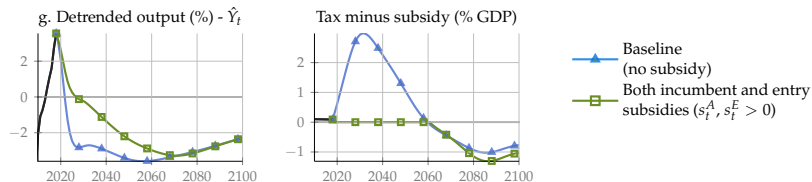
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UNDERSTANDING THE MECHANISM



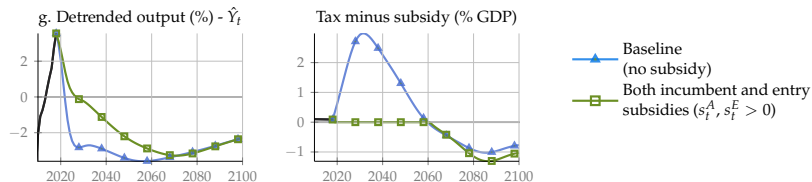
- ▶ Imperfect market competition distortion addressed by subsidy policy.
- ▶ Subsidy policy saves about \$2.5 trillion GDP per year.
- ▶ Fiscal multiplier high: 1\$ of subsidy leads to 2.27\$ of output.

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CONCLUDING REMARKS

- ▶ **Imperfect competition important matter** for transition risk;
- ▶ Welfare improving to **subsidize the creation** of new green products to address market distortion;
- ▶ We estimate that **this policy saves up to \$2.5 trillion** in GDP each year.

Eurostat (2009). Handbook on environmental goods and services sector. *Eurostat Methodologies*, European Commission.