Carbon Tax Proposals in the US

- 14+ proposals over the last 3 years
- Similar tax: $25-$50
- Most call for some revenue to be recycled back to households
- Differ in the way the revenue is recycled
  - Efficiency instruments: tax swaps
  - Equity instruments: lump-sum payments, income-dependent payments
This Paper: Solve For Welfare-Maximizing Rebate

Quantitative OLG model with three pieces of heterogeneity

1. Age: model full lifecycle
2. Income: idiosyncratic labor productivity shocks
3. Energy: non-homothetic preferences over energy
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Quantitative OLG model with three pieces of heterogeneity

1. Age: model full lifecycle
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$40$ carbon tax, broad set of rebate instruments

- Efficiency instruments: uniform reduction in capital and labor taxes
- Equity instruments: lump-sum payment, income-dependent payment, increase in the labor-tax progressivity
- Any combination of instruments
The Welfare-Maximizing Rebate of $40 Carbon Tax

• Return $\approx \frac{2}{3}$ of revenue through decrease in capital tax
  • Unwind pre-existing distortions

• Return $\approx \frac{1}{3}$ of revenue through increase in labor-tax progressivity
  • Increase equity
  • Labor-tax progressivity is better than other progressive rebates
Previous Literature: Efficiency or Equity

Efficiency: double dividend

- Focus on economic surplus, reduce pre-existing distortionary taxes
- Like double dividend lit, optimal policy includes reduction in capital tax

Equity: distributional effects of carbon taxes

- e.g., Parry (2004); Fullerton and Heutal (2007); Metcalf (2007); Chiroleu-Assoline and Fodha (2014); Parry and Williams (2010); Williams et. al (2015); Fried, Novan, and Peterman (2018); Jacobs and van der ploeg (2019)
- Can use lump-sum rebate to offset regressive effects of carbon tax
- Like equity lit, optimal rebate increases equity, but not through lump-sum rebates
Overview

Heterogeneous agents
- Consume a generic consumption good and energy
- Non-homothetic preferences over energy
- Save in physical capital

Perfectly competitive firms
- Produce final good from capital, labor, and energy
- Produce energy from capital and labor

Government
- Taxes HH income to finance unproductive govt consumption
- Runs Social Security system

Environment
- Abstract from environmental benefits
Agents: Non-Homothetic Preferences Over Energy

Utility

\[
U(\tilde{c}_{i,j,t}, h_{i,j,t}) = \tilde{c}_{i,j,t}^{1-\theta_1} - \chi \frac{h_{i,j,t}^{1+\frac{1}{\theta_2}}}{1 + \frac{1}{\theta_2}}
\]

- \(\tilde{c}_{i,j,t} = c_{i,j,t}^{\gamma}(e_{i,j,t}^{c} - \bar{e})^{1-\gamma}\)

Calibration

- \(\gamma\): match residential energy consumption share relative to total
- \(\bar{e}\): match energy share differences across income distribution
Government Taxes

• Carbon tax, $\tau^c$

• Flat capital tax, $\tau^k$

• Progressive labor tax function
  • Benabou (2002); Heathcote, Storesletten, Violante (2017); Guner, Kaygusuz, Ventura (2014)

\[
\text{average labor-tax rate} = 1 - \lambda_1 \left( \frac{\tilde{y}^h_{i,j,t}}{\tilde{y}^h_{t}} \right)^{-\lambda_2}
\]

• Calibrate tax parameters to matching existing US tax system
Quantitative Experiment

- Carbon tax: $40 per ton CO$_2$ (CLC, 2019)
  - Carbon tax revenue $\approx$ 1.6 percent of GDP

- Return all revenue back to households
  - Policies differ in how revenue is returned to households

- Focus on long-run welfare outcomes
  - Compare stationary equilibria
Rebate Instruments

Efficiency instruments
- Uniform decrease in the labor tax
- Uniform decrease in the capital tax

Equity instruments
- Uniform lump-sum rebate
- Income-dependent rebate
- Increase the progressivity of the labor-tax function

Policymaker can use any combination of rebate instruments
Reduction in Labor Tax Rate

average labor-tax rate = 1 − \( \lambda_1 \left( \frac{\tilde{y}_{i,j,t}^h}{\tilde{y}_t^h} \right)^{-\lambda_2} \)
Reduction in Labor Tax Rate

\[
\text{average labor-tax rate} = 1 - \lambda_1 \left( \frac{\tilde{y}_{i,j,t}^h}{\bar{y}_t^h} \right)^{-\lambda_2}
\]
Increase in Labor Tax Progressivity

average labor-tax rate \( = 1 - \lambda_1 \left( \frac{\tilde{y}_{i,j,t}^h}{\bar{y}_t^h} \right)^{-\lambda_2} \)
Increase in Labor Tax Progressivity

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Increase in Labor Tax Progressivity

average labor-tax rate = 1 − \( \lambda_1 \left( \frac{\tilde{y}_{i,j,t}^h}{\bar{y}^h_t} \right)^{-\lambda_2} \)
Welfare Measure

- Measure using CEV between baseline and policy equilibria
- Ex-ante, expected lifetime utility of a newborn in stationary equilibrium
- Incorporates inequality impacts through the veil of ignorance

\[
\mathbb{E} \left\{ \sum_{k=1}^{J} \beta^{k-j} \prod_{q=j}^{k-1} \psi_q \left( \frac{\left[ ((1 + \Omega) \hat{c}_{i,j,t})^\gamma (\hat{e}_{i,j,t}^c - \bar{e})^{1-\gamma} \right]^{1-\theta_1} \hat{h}_{i,j,t} \times \left( \frac{1 + \frac{1}{\theta_2}}{1 + \frac{1}{\theta_2}} \right) }{1 - \theta_1} \right) \right\} \\
= \mathbb{E} \left\{ \sum_{k=1}^{J} \beta^{k-j} \prod_{q=j}^{k-1} \psi_q \left( \frac{\left[ \hat{c}_{i,j,t}^\gamma (\hat{e}_{i,j,t}^c - \bar{e})^{1-\gamma} \right]^{1-\theta_1} \hat{h}_{i,j,t} \times \left( \frac{1 + \frac{1}{\theta_2}}{1 + \frac{1}{\theta_2}} \right) }{1 - \theta_1} \right) \right\},
\]
Welfare-Maximizing Rebate (1)

- Reduce capital tax rate from 36 to 31 percent
- Increase labor-tax progressivity

Rebate from increase in labor-tax progressivity
Welfare-Maximizing Rebate (2)

<table>
<thead>
<tr>
<th>CEV</th>
<th>Percent change in Welfare</th>
<th>Gini</th>
<th>Output</th>
<th>Capital</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal</td>
<td>-0.11</td>
<td>-2.4</td>
<td>-0.4</td>
<td>-0.5</td>
<td>-31.2</td>
</tr>
</tbody>
</table>

- Increase in labor-tax progressivity dominates other equity instruments
- If increase in labor-tax progressivity is not available, return all revenue through reduction in capital tax
Comparison of Simple Equity Rebates

<table>
<thead>
<tr>
<th>CEV</th>
<th>Percent change in Welfare</th>
<th>Gini</th>
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<td>-0.4</td>
<td>-0.5</td>
<td>-31.2</td>
</tr>
<tr>
<td>Lump sum</td>
<td>-0.64</td>
<td>-1.1</td>
<td>-1.1</td>
<td>-3.4</td>
<td>-32.0</td>
</tr>
<tr>
<td>Labor progressivity</td>
<td>-0.13</td>
<td>-3.7</td>
<td>-1.6</td>
<td>-3.8</td>
<td>-32.4</td>
</tr>
<tr>
<td>Income dependent</td>
<td>-1.57</td>
<td>-2.8</td>
<td>-2.5</td>
<td>-7.7</td>
<td>-33.5</td>
</tr>
</tbody>
</table>
## Role of the Lifecycle

<table>
<thead>
<tr>
<th>Corr. with marginal utility</th>
<th>Lump sum payments</th>
<th>Income dependent payments</th>
<th>Labor progressivity payments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working agents</td>
<td>0</td>
<td>0.63</td>
<td>0.59</td>
</tr>
<tr>
<td>Retired agents</td>
<td>0</td>
<td>0.70</td>
<td>na</td>
</tr>
<tr>
<td>Full population</td>
<td>0</td>
<td>0.25</td>
<td>0.57</td>
</tr>
<tr>
<td>% of revenue to retired</td>
<td>18</td>
<td>40</td>
<td>0</td>
</tr>
</tbody>
</table>
Distributional Implications of Policies (1)

Inequality and Welfare Impacts of Carbon Tax Policies

Fried, Novan, Peterman (2022)
Inequality and Welfare Impacts of Carbon Tax Policies

Fried, Novan, Peterman (2022)
What’s Special About a Carbon Tax?

- Raising revenue from a given source could affect how you want to return it
- Suppose revenue instead comes from an exogenous source
- How does the welfare-maximizing rebate differ?
## Carbon Tax vs. Exogenous Revenue

### Fraction of revenue for each use

<table>
<thead>
<tr>
<th>Source of revenue</th>
<th>↓ Capital tax</th>
<th>↑ Labor progressivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon tax</td>
<td>0.64</td>
<td>0.36</td>
</tr>
<tr>
<td>Exogenous</td>
<td>0.37</td>
<td>0.63</td>
</tr>
</tbody>
</table>

### Intuition

- Carbon tax depresses the capital stock
- \(\Rightarrow\) use more revenue to decrease capital tax
# Sensitivity

<table>
<thead>
<tr>
<th>Subsistence energy: $\bar{e}$</th>
<th>Fraction of revenue used to reduce the capital tax</th>
<th>Percent change in the welfare Gini</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{e} = 0$</td>
<td>0.65</td>
<td>-2.36</td>
</tr>
<tr>
<td>$\bar{e} = 0.0013$</td>
<td>0.64</td>
<td>-2.35</td>
</tr>
<tr>
<td>$\bar{e} = 0.0026$</td>
<td>0.62</td>
<td>-2.33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Carbon tax: $\tau^c$</th>
<th>Fraction of revenue used to reduce the capital tax</th>
<th>Percent change in the welfare Gini</th>
</tr>
</thead>
<tbody>
<tr>
<td>$30/\text{ton CO}_2$</td>
<td>0.60</td>
<td>-2.21</td>
</tr>
<tr>
<td>$40/\text{ton CO}_2$</td>
<td>0.64</td>
<td>-2.35</td>
</tr>
<tr>
<td>$50/\text{ton CO}_2$</td>
<td>0.66</td>
<td>-2.38</td>
</tr>
</tbody>
</table>
What If the Economy Starts at the Optimal Tax System?

- Solve for optimal baseline policy without carbon tax
  - Baseline capital tax: 36%
  - Optimal tax on capital: 11.6%

- Optimal rebate beginning from the optimal tax system
  - Still reduce capital tax and increase progressivity of labor tax
  - Only use 40% of revenue to reduce capital tax instead of 64%
Conclusion

- Welfare-maximizing rebate uses revenue to reduce pre-existing distortions and increase equality.

- Increase in labor-tax progressivity is a much less costly way to increase equality than lump-sum or income dependent payments.

- Same combination of rebate instruments if start at the optimal tax system.
Conclusion

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Thank you!