Welfare Implications of the Renewable Fuel Standard with a Revenue Neutral Carbon Tax

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Objectives

• Model the imposition of a double-dividend environmental tax on crude oil use in a general equilibrium model in the presence of a Renewable Fuel Standard (RFS).
• Specify and calibrate measures of welfare and fuel production with a double-dividend tax for Washington, Oregon, and Idaho.
• Examine the effect of RFS policies on optimal tax rates.

Definitions

• Tax rates are chosen to optimize the social welfare function, defined as follows:
  Social Welfare = Consumer Surplus + Producer Surplus - Tax Revenue - Disutility from Pollution
where disutility of pollution is valued at $258 per ton of carbon emitted. The burning of one gallon of crude oil emits 0.01 metric tons of carbon dioxide equivalent into the atmosphere.
• Pigouvian Tax: An environmental tax that internalizes the negative externality from blended fuel production. Typically equal to marginal environmental damage ($0.26), but includes extra price effects in a closed general equilibrium model.
• Double-Dividend Tax: Similar to the Pigouvian tax, except that the generated tax revenue is used to offset an existing distortionary tax.
• RFS Policies: The RFS imposes a percentage requirement on cellulosic fuel use but allows the purchase of waivers to satisfy the requirement.

Results: Optimal Taxes and Welfare Implications

Modeling the double-dividend tax depends on preexisting distortionary taxes:
• For Washington State, it is a sales tax on the composite consumption good.
• For Oregon and Idaho, it is an ad valorem tax imposed on labor income.

Welfare Effects Associated with the Double-Dividend

• Pigouvian Effect: Positive effect from a reduction in environmental damage due to the crude oil tax.
• Residual Pigouvian Effect: Negative effect from the residual decrease in blended fuel production.
• Revenue-Recycling Effect: Positive effect from the increase in tax revenue resulting from the offsetting crude oil tax.
• Interaction Effect: Negative effect from the efficiency loss when substituting away from blended fuel consumption.

Discussion

(1) The double-dividend tax is 69% to 77% of the Pigouvian tax.
(2) Net welfare increases by 6c to 11c per gallon with a double-dividend tax.
(3) Cellulosic fuel increases by 0.7% to 3.4% with a double-dividend tax.

Table 1: Optimal Taxes, Welfare Effects, and Fuel Production

<table>
<thead>
<tr>
<th></th>
<th>WA</th>
<th>OR</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxes ($/gal. of crude oil)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Pigouvian</td>
<td>$0.26</td>
<td>$0.30</td>
<td>$0.34</td>
</tr>
<tr>
<td>Double-Dividend</td>
<td>$0.18</td>
<td>$0.22</td>
<td>$0.26</td>
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<tr>
<td>Double-Dividend Welfare Effects ($/gal. of crude oil)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Revenue-recycling</td>
<td>$0.15</td>
<td>$0.18</td>
<td>$0.20</td>
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<tr>
<td>Pigouvian</td>
<td>$0.11</td>
<td>$0.15</td>
<td>$0.18</td>
</tr>
<tr>
<td>Residual Pigouvian</td>
<td>$-0.02</td>
<td>$-0.01</td>
<td>$-0.03</td>
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<tr>
<td>Interaction</td>
<td>$-0.16</td>
<td>$-0.21</td>
<td>$-0.26</td>
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<tr>
<td>Total</td>
<td>$0.06</td>
<td>$0.11</td>
<td>$0.09</td>
</tr>
<tr>
<td>Fuel production (Millions of gallons)</td>
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<tr>
<td>2012 Baseline values</td>
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<tr>
<td>Blended fuel</td>
<td>2604.11</td>
<td>1171.85</td>
<td>520.82</td>
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<tr>
<td>Cellulosic fuel</td>
<td>0.0004</td>
<td>0.0002</td>
<td>0.0001</td>
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<tr>
<td>With Pigouvian Tax (% change from baseline)</td>
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<tr>
<td>Blended fuel</td>
<td>-8.62%</td>
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<td>-8.78%</td>
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<tr>
<td>Cellulosic fuel</td>
<td>3.32%</td>
<td>1.45%</td>
<td>6.27%</td>
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<tr>
<td>With Double-Dividend Tax (% change from baseline)</td>
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<tr>
<td>Blended fuel</td>
<td>-5.55%</td>
<td>-3.31%</td>
<td>-5.86%</td>
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<tr>
<td>Cellulosic fuel</td>
<td>1.79%</td>
<td>0.68%</td>
<td>3.37%</td>
</tr>
</tbody>
</table>

Conclusions

• The optimal double-dividend environmental tax on crude-oil is approximately 86% of marginal environmental damages.
• Net welfare and cellulosic fuel usage increases with the double-dividend tax.
• When the optimal tax is imposed, the RFS percentage requirement is non-binding due to the relative increase in crude-oil price.

Future Work

• Model the effects of an integrated tax-subsidy policy within the regional energy sector given the RFS.
• Incorporate economic input substitutability into life-cycle analysis (LCA) of biofuel carbon emissions and integrate LCA into the economic and policy modeling.

Acknowledgements

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