Economic Implications of Carbon Taxes in South Africa

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• South Africa must produce more energy but also reduce emissions
  – Pledged to lower emissions by 42% by 2025 (relative to business-as-usual)
Energy-Economy Model

• South African General Equilibrium (SAGE) model

• 2005 social accounting matrix (SAM)
  – 54 industries, 7 factors of production, 14 household groups

• Resource constraints
  – Upward sloping labor supply curves for less-educated workers
  – “Putty clay” capital and endogenous capital accumulation

• Macroeconomic closures
  – Fixed current account with flexible real exchange rate
  – Savings-driven investment
Energy Use

Energy efficiency = \frac{\text{Energy input}}{\text{Industry output}}

- Energy efficiency determined by...
  - Existing technologies
  - Energy prices (provided there is new investment)
  - New investment (provided the price rises)
Simulations

1. Domestic carbon tax
   – Applied to all fossil fuels burned in South Africa
   – Starts at US$3 per ton CO₂ in 2012 and rises gradually to US$30 in 2022
   – Uniform reduction in indirect sales tax rates (distribution neutral)

2. Domestic border tax adjustment on embodied carbon
   – As above, but rebate exporters and tax imports at same carbon tax rate

3. Foreign border tax adjustment
   – South African exports are taxed at foreign border
   – Starts at US$1.5 per ton CO₂ in 2012 and rises gradually to US$15 in 2022

4. Recycling revenues
   – Instead of sales taxes, reduce corporate taxes or increase social transfers
Electricity Investments

Base Case (BAU)

Policy-Adjusted
Cost: ???
Emissions: -19% of BAU by 2025

Emissions 3
Cost: US$171 bil.
Emissions: -42% of BAU by 2030
Results: Emissions Reductions

- A US$30 per ton CO2 carbon tax achieves emissions targets
- Ring-fencing of electricity means large reduction in other sectors

Changes in GHG emissions, 2010-2025

<table>
<thead>
<tr>
<th></th>
<th>Business-as-usual, 2010</th>
<th>Deviation from “business-as-usual” scenario, 2025 (%)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Policy-Adjusted</td>
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<tr>
<td>CO₂ emissions (mil.mt) using the reference approach</td>
<td>447.5</td>
<td>-8.6</td>
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<tr>
<td>Electricity generation</td>
<td>237.0</td>
<td>-19.0</td>
</tr>
<tr>
<td>Other sectors/households</td>
<td>210.5</td>
<td>0.0</td>
</tr>
<tr>
<td>CO₂ emissions (mil.mt) using the sectoral approach</td>
<td>397.4</td>
<td>n.a.</td>
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</tbody>
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Results: GDP and Employment Losses

Economywide abatement costs

- Decline in GDP or employment, 2025 (%)
- Decline in GHG emissions, 2025 (%)
- Carbon tax (US$/mt)

Sectoral sources of losses

- Services
- Construction
- Manufacturing
- Mining
- Agriculture

Decline in GDP, 2025 (%)

Decline in Employment, 2025 (%)

Carbon tax (US$/mt)
Results: Income Distribution

Consumption growth incidence curves

- Deviation in consumption, 2025 (%)
- Ranked population per capita expenditure percentiles

Corporate tax
Sales tax
Retaliatory tax
Social transfers

1-10
11-20
21-30
31-40
41-50
51-60
61-70
71-80
81-90
91-96
97
98
99
100
Conclusions

• Carbon taxes reduce national welfare and employment
  – Absorption and employment fall by 1.2 and 0.6 percent, respectively, by 2025
  – These effects are small in annual growth rate terms (less than 0.1 %-points)

• Welfare and employment losses are larger if RSA’s trading partners unilaterally impose BTAs on South African exports

• Domestic BTAs reduce welfare and employment losses while maintaining the same emissions reductions

• Mode of revenue recycling strongly influences growth and distributional outcomes (i.e., trade-offs)