Carbon Price Modeling: Assessing Impact of South Africa's Carbon Tax

PMR Expert Meeting: Modelling for Carbon Pricing Instruments

Peter Janoska, National Treasury South Africa
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Background

- SA is faced with challenges of relatively low economic growth, high unemployment, poverty and income inequality;
- It is also a relatively significant contributor to global climate change with significant GHG emission levels from energy-intensive, fossil-fuel powered economy. Government intervention is therefore important, e.g. through regulations, taxes, incentives, etc.;
- A carbon tax is a means by which government can intervene by way of a market based instrument to appropriately take into account the social costs resulting from carbon emissions;
- However, two main concerns of environmental taxes are their impacts on income distribution and international industrial competitiveness. Modelling shows that effective revenue recycling has a potential to neutralise the possible negative economic impact of the carbon tax;
- A number of studies have been done on the economic impacts of a carbon tax in South Africa since 2005;
## Carbon Price Modelling Studies in SA

<table>
<thead>
<tr>
<th>Type &amp; scope of modelling</th>
<th>University of Pretoria, 2006</th>
<th>University of Cape Town for Long Term Mitigation Scenarios, 2007</th>
<th>World Bank, 2009</th>
<th>University of Cape Town, 2008</th>
<th>National Treasury, 2010</th>
</tr>
</thead>
</table>

### Carbon pricing modelled

- **Tax rate of R35 ($3.8) per tCO₂ emissions as:**
  - Carbon tax
  - Fuel tax
  - Electricity tax
  - Energy tax

- **Tax rate simulations of R25 ($2.73) to R1000 ($109) per tCO₂.**
  - Energy input tax imposed on coal, crude oil and gas

- **Tax rate of R96 ($10) to R165 ($18) per tCO₂:**
  - Pure carbon tax (based on carbon content)
  - Excise tax on energy inputs (coal, gas and crude oil)
  - Sales tax on energy-intensive sectors

- **Tax simulations as of 2007 study, but imposed as a sales tax on used of commodities producing high levels of emissions to impact economic behaviour**

- **Tax rate of R100 ($11), R150 ($16.5) & R200 ($22) per tCO₂:**
  - Tax imposed upstream on fossil fuel inputs
  - Tax is introduced gradually over a 10-year period (from 2012).
Environmental impact of carbon tax – Summary

University of Pretoria, 2006 - Different levels of abatement:
• Carbon tax reduces emissions by 1.115 GgCO₂ per R million increase in tax revenue
• Revenue recycling increases emissions per R million of tax recycled
• A combination of tax and revenue recycling reduces emissions per R million tax recycled

University of Cape Town, 2007 (for Long Term Mitigation Scenarios)
• 17 500 MtCO₂-eq from 2003–50
• 2050 emissions of 620 MtCO₂-eq

World Bank, 2009
• All taxes have a comparable effect on emissions. The targeted abatement is a 15 per cent reduction in CO₂ emissions.

National Treasury, 2010
• The largest reduction in emissions is achieved when a tax of R200 per tCO₂ is introduced in 2012.
• Emissions decline by 34 per cent by 2020 and over 42 per cent by 2025, relative to the baseline.
Economic Impact of carbon tax – Summary

University of Pretoria, 2006
• R35/tCO2 ($3.8) carbon tax leads to a decrease in GDP without revenue recycling
• With revenue recycling (through reduction in food tax) GDP increases

University of Cape Town, 2007
• Carbon tax of up to R75/tCO2 ($8) - revenue recycling can undo negative impact on GDP growth
• Above R75/tCO2 - negative impact on economic growth (negative impact increases with increase in carbon tax rate)

University of Cape Town, 2008 (based on the 2007 model, but DCGE model)
• Net positive impact on GDP over entire period (up to 2050) is 0.73% due to increased investment
• Result holds with and without revenue recycling

World Bank, 2009
• Carbon tax on emissions leads to 0.2% reduction in GDP rate
Social impact of carbon tax – Summary (2)

University of Pretoria, 2006
With suitable recycling mechanism (food tax break) CT has net positive impact on the economy & delivers a „Triple-dividend“
- Reduction in emissions
- Reduction in poverty
- Increase in GDP

University of Cape Town, 2007
Similar results as University of Pretoria study at relatively low tax levels (below R200/tCO2 ($22))
With recycling of revenues through a subsidisation of basic food prices, employment levels increase up to the tax rate of
- R100/tCO2 ($11) for semi-skilled workers
- R200/tCO2 ($22) for unskilled workers
Social impact of carbon tax – Summary (2)

University of Cape Town, 2008 (based on the 2007 model, but DCGE model)
- Increase in household welfare under all scenarios
- Increase in employment across skill levels

World Bank, 2009
Carbon tax of R96.25/tCO2 ($10) (flexible economy)
- 0.33% reduction in welfare (no revenue recycling)
- 0.27% reduction in welfare (revenue recycling)
Carbon tax of R165.22/tCO2 ($18) (rigid economy)
- 0.35% reduction in welfare (no revenue recycling)
- 0.26% reduction in welfare (revenue recycling)
Loss in welfare due to rigidities in SA labour market
Long Term Mitigation Scenarios Modelling Results (University of Cape Town, 2007)

- Simulations of economy-wide impacts of the mitigation scenarios in the Long Term Mitigation Scenarios report (that charts Peak Plateau Decline).
- The effects on GDP under the different scenarios show a GDP decline by 0.5 per cent and 13.9 per cent for carbon taxes of R25 and R1000 respectively without revenue recycling.
- A tax of R75 per tCO₂ and increased to around R200 per ton seems appropriate.
- Under a variety of revenue recycling measures, food subsidy yields the most positive result, with increase in GDP at low levels of taxation.
- At the lower levels some of the revenue recycling schemes, in particular the biofuels subsidy, the food subsidy and the general VAT subsidy have a positive effect on employment.
- The food subsidy & welfare transfer scenario benefits low-income households most. In contrast, an income tax relief programme benefits mostly high income households.
NT Carbon Tax Modelling Results (1)

• The largest emission reduction achieved by a once off introduction (in 2012) of R200 ($22) per ton of CO₂ tax; Emissions decline by 34% by 2020 and over 45% by 2025 relative to the baseline;

• Recycling revenue by increasing government savings and investment has large positive gains;

• If revenue is recycled via VAT, GDP is about 0.2% lower relative to baseline by 2035 (annually \( \approx 0.006\% \)); CIT and PIT recycling sees GDP decrease by 0.4% by 2035

• Carbon-intensive industries’ costs > less carbon-intensive e.g. mining (primary sector) and the petroleum sector penalised while greener industries rewarded;

• Carbon tax shown to affect capital and energy-intensive sectors; rents of which accrue to the top deciles of income distribution, hence not necessarily regressive

• If social transfers chosen as recycling option, strongly progressive outcomes can be delivered

• Impact on employment is through sector output and composition – labour intensive sectors benefit;
## NT Carbon Tax Modelling Results (2)

### Gradual Implementation

<table>
<thead>
<tr>
<th>Deviation from baseline by 2035 (%)</th>
<th>R200 tax</th>
<th>R100 tax</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VAT</strong></td>
<td>-0.18</td>
<td>-0.14</td>
</tr>
<tr>
<td>Primary</td>
<td>-2.20</td>
<td>-1.55</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>-0.73</td>
<td>-0.57</td>
</tr>
<tr>
<td>Services</td>
<td>0.35</td>
<td>0.25</td>
</tr>
<tr>
<td><strong>CIT</strong></td>
<td>-0.48</td>
<td>-0.30</td>
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<tr>
<td>Primary</td>
<td>-3.61</td>
<td>-2.25</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>-2.93</td>
<td>-1.73</td>
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<tr>
<td>Services</td>
<td>0.91</td>
<td>0.53</td>
</tr>
<tr>
<td><strong>PIT</strong></td>
<td>-0.41</td>
<td>-0.27</td>
</tr>
<tr>
<td>Primary</td>
<td>-2.33</td>
<td>-1.67</td>
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<tr>
<td>Manufacturing</td>
<td>-1.51</td>
<td>-1.04</td>
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<tr>
<td>Services</td>
<td>0.20</td>
<td>0.16</td>
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<tr>
<td><strong>TRANSFERS</strong></td>
<td>-0.38</td>
<td>-0.25</td>
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<tr>
<td>Primary</td>
<td>-1.78</td>
<td>-1.31</td>
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<tr>
<td>Manufacturing</td>
<td>-1.16</td>
<td>-0.81</td>
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<tr>
<td>Services</td>
<td>0.12</td>
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<td><strong>INVESTMENT</strong></td>
<td>0.89</td>
<td>0.54</td>
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<td>Primary</td>
<td>0.19</td>
<td>-0.05</td>
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### TOTAL GDP

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NT Carbon Tax Modelling Caveats

• The model only contains generic revenue recycling measures (PIT, CIT, VAT), the current proposal contains a number of measures to address specific issues
• The model employs 2005 SAM data, calibrated for the period 2006 to 2010, which compromise on the quality of data;
• The baseline is an extrapolation of the current economic environment and fails to factor in shocks and factor improvement in the model;
• The model is unable to quantify the concurrent benefits of emission reductions resulting from the introduction of the tax
South African carbon tax design features (1)

- A carbon tax proposed at R120 ($13 or €10) per ton of CO$_2$e above the suggested thresholds with annual increases of 10 per cent until 2019/20 is to be imposed as from 1 Jan 2015.
- A basic tax-free threshold of 60 per cent is proposed.
- Additional tax-free allowance for process emission (10%)
- Additional relief for trade-exposed sectors (max 10%)
- Carbon offsetting allowed to reduce carbon tax liability (max 5% or 10%)
- The overall tax-free allowance for an entity will be capped at 90 per cent of actual verified emissions. Tax-free thresholds will be reduced during the second phase (2020 to 2025) and may be replaced with absolute emission thresholds thereafter.
• A formula is proposed to adjust the basic (60%) percentage tax-free threshold to take into account efforts already made by firms to reduce their emissions and to encourage firms to invest in low-carbon alternatives. The basic percentage threshold below which the tax will not be payable may be adjusted using a carbon emissions intensity factor for output compared to an agreed sector benchmark. A formula is proposed to calculate a factor Z, which will then be used to adjust (increase or decrease) the basic percentage tax-free threshold as described below:

• \[ Z = \frac{Y}{X} \]
  – X is the average measured and verified carbon intensity of the output of a firm.
  – Y is the agreed benchmark carbon intensity for the sector.

• The adjustment to the tax-free threshold is then determined by multiplying the original percentage threshold by Z.
Revenue recycling measures

- Revenue recycling mechanisms for structural adjustment:
  - “soft” earmarking (on budget allocations): Electricity Demand Side Management programme, enhanced free basic energy / electricity programme, Independent Power Producers programme to incentivise renewable energy uptake, Energy Efficiency Savings Tax Incentive
  - tax shifting: reducing or not increasing other taxes (gradual phasing down of the electricity levy)
Further Modelling Needs

- Modelling which takes into account the current carbon tax design proposal, e.g. tax free thresholds & carbon offsetting
- A detailed analysis of the possible impacts on:
  - Emissions reduction that can be achieved
  - Economic growth
  - Employment impact (on different skills levels)
  - Welfare impact (on different income groups and social programmes)
  - Sectoral shifts (impact on specific sectors)
- An analysis to understand impact of revenue recycling measures (on a variety of socio-economic indicators) and identify further revenue recycling options to address gaps
- Create a tool to be used on a regular basis to evaluate the impact of the policy and produces detailed scenario analysis
Thank you

Any Questions?

Peter Janoska
Senior Economist, Economic Tax Analysis, National Treasury, South Africa

peter.janoska@treasury.gov.za
+27 12 315 5783
References


• University of Cape Town, 2008 (Kearney, M, 2008. Modeling the impact of CO2 taxes in combination with the Long-Term Mitigation Scenarios on emissions in South Africa using a dynamic computable general equilibrium model. University of Cape Town: Energy Research Centre (ERC).
