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

PMR Expert Meeting: Modelling for Carbon Pricing Instruments

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Contents

1. Background
2. Carbon tax modelling studies in South Africa
3. Environmental impact of carbon tax
4. Economic impact of carbon tax
5. Social impact of carbon tax
6. National Treasury Carbon Tax & Long Term Mitigation Scenarios Economic Modelling
7. Current South African carbon tax design – need to understand specific impact
8. Further modelling work required

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

	University of Pretoria, 2006	University of Cape Town for Long Term Mitigation Scenarios, 2007	World Bank, 2009	University of Cape Town, 2008	National Treasury, 2010
Type & scope of modelling	Static CGE model based on 2000 SAM	Static CGE Model based on 2000 SAM	Static CGE Model based on 2003 SAM	DCGE model based on 2000 SAM	Dynamic CGE model based on 2005 SAM
Carbon pricing modelled	Tax rate of R35 ($3.8) per tCO_2 emissions as: • Carbon tax • Fuel tax • Electricity tax • Energy tax	Tax rate simulations of R25 ($2.73) to R1000 ($109) per tCO_2. Energy input tax imposed on coal, crude oil and gas	Tax rate of R96 ($10) to R165 ($18) per tCO_2: - 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 tCO_2: - 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 $GgCO_2$ 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 $MtCO_2$-eq from 2003–50
- 2050 emissions of 620 $MtCO_2$-eq

World Bank, 2009

- All taxes have a comparable effect on emissions. The targeted abatement is a 15 per cent reduction in CO_2 emissions.

National Treasury, 2010

- The largest reduction in emissions is achieved when a tax of R200 per tCO_2 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 tCO_2 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 CO_2 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 ≈ 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)

	Deviation from baseline by 2035 (%) Gradual Implementation	
	R200 tax	R100 tax
VAT	**-0.18**	**-0.14**
Primary	-2.20	-1.55
Manufacturing	-0.73	-0.57
Services	0.35	0.25
CIT	**-0.48**	**-0.30**
Primary	-3.61	-2.25
Manufacturing	-2.93	-1.73
Services	0.91	0.53
PIT	**-0.41**	**-0.27**
Primary	-2.33	-1.67
Manufacturing	-1.51	-1.04
Services	0.20	0.16
TRANSFERS	**-0.38**	**-0.25**
Primary	-1.78	-1.31
Manufacturing	-1.16	-0.81
Services	0.12	0.12
INVESTMENT	**0.89**	**0.54**
Primary	0.19	-0.05
Manufacturing	0.37	0.16
Services	1.18	0.77

	Deviation from baseline by 2035 (%) Gradual Implementation	
	R200 tax	R100 tax
TOTAL GDP	**-0.18**	**-0.14**
Primary	**-2.20**	**-1.55**
Agriculture	1.17	0.93
Mining	-3.19	-2.28
Manufacturing	**-0.73**	**-0.57**
Food	1.07	0.73
Textiles	2.36	1.84
Wood, paper & plastic	0.12	0.32
Petroleum	-19.93	-15.99
Chemical	-1.27	-1.12
Non-metal	0.17	0.07
Metal	2.74	2.50
Machinery	1.06	0.81
Vehicles	4.06	3.25
Other	2.73	2.27
Electricity	0.00	0.00
Water	-1.24	-0.59
Construction	-0.49	-0.57
Services	**0.35**	**0.25**
Wholesale and retail trade	0.77	0.59
Transport and communication	0.07	0.01
Financial and insurance	0.38	0.29
Business	0.38	0.23
Government	0.18	0.14
Other	0.38	0.25

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_2e 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.

South African carbon tax design features (2)

- 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:
- $Z = Y / X$
  - 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?

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