Western Cape Government

Agriculture

BETTER TOGETHER.

THE REAL COST OF A CARBON TAX

Estimating the Impact of South Africa's 2015 Carbon Tax with an Application to the Agricultural Sector of the Western Cape

Presentation prepared for National Treasury Carbon Tax Modelling Workshop

Andrew Partridge
Leann Cloete-Beets
Vanessa Barends

October 2016

Presentation Overview

- Background
- Methodology
- Impacts I – South African Economy
- Impacts II – South African Agriculture
- Impacts III - Other (Extensions)
- Conclusions

Western Cape Government
Agriculture

Background

Project Objectives

The NDP: "Chapter 5 - Transition to a Low-Carbon Economy"

- Page 182: "While the Long Term Mitigation Scenarios provided a useful starting point, more detailed analysis is needed to determine the optimal mix of mitigation actions to achieve the desired emission reduction outcomes for each sector and sub-sector of the economy. This work is needed to ensure that actions support job creation and take account of other relevant conditions related to the specific sector, sub-sector or organization concerned"
- Page 187: "Planning for the transition requires a foundation of trustworthy data and analysis, neither of which is reliably and transparently available in South Africa"

Project Objectives:

- Assess the economic impact of South Africa's 2015 Carbon Tax
- Analyse how the impact will affect the Western Cape's Agricultural Sector
- Identify the key potential sources of strain coming as a result of the carbon tax

Western Cape Government
Agriculture

Project Outputs

Partridge, A., Cloete-Beets, L. & Barends, V. 2014. *The Effect of a Carbon Tax an Agriculture: An Impact Assessment of South Africa's Proposed Carbon Tax with an Application to the South African Agricultural Sector.* Paper presented at the 5th World Congress of Environmental and Resource Economists, Istanbul, 28 June – 2 July 2014.

Partridge, A., Cloete-Beets, L. & Barends, V. 2014. *The Real Cost of a Carbon Tax: Estimating the Impact of South Africa's 2015 Carbon Tax with an Application to the Agricultural Sector of the Western Cape.* Paper presented at the 2014 Annual Conference of the Agricultural Economics Association of South Africa (AEASA), Mpekweni Beach Resort, 8 September to 01 October 2014.

Partridge, A., Cloete-Beets, L. & Barends, V. 2014. *The Real Cost of Going Clean: The Impact of a Carbon Tax on the Agricultural Sector of the Western Cape.* Paper presented at the 9th Africa Farm Management Association (AFMA) Congress, Cape Town, 16 - 20 November 2014.

Partridge, A., Cloete-Beets, L. & Barends, V. 2014. The Real Cost of Going Clean: The Potential Impact of South Africa's 2016 Carbon Tax on Agricultural Production. *Professional Agricultural Workers Journal*. 3 (1) : 11

Partridge, A. 2015. *The Impact of South Africa's Carbon Tax on Agri Processing*. Elsenburg: Western Cape Department of Agriculture

Western Cape Government
Agriculture

Methodology

The Project Model

Model Details

Static Computable General Equilibrium (CGE) Model

Model: International Food Policy Research Institute (IFPRI)

- Lofgren, Robinson & Harris (2001) "*A Standard Computable General Equilibrium (CGE) Model in GAMS*"
- Thurlow & van Seventer (2002) "*A Standard Computable General Equilibrium Model for South Africa*"

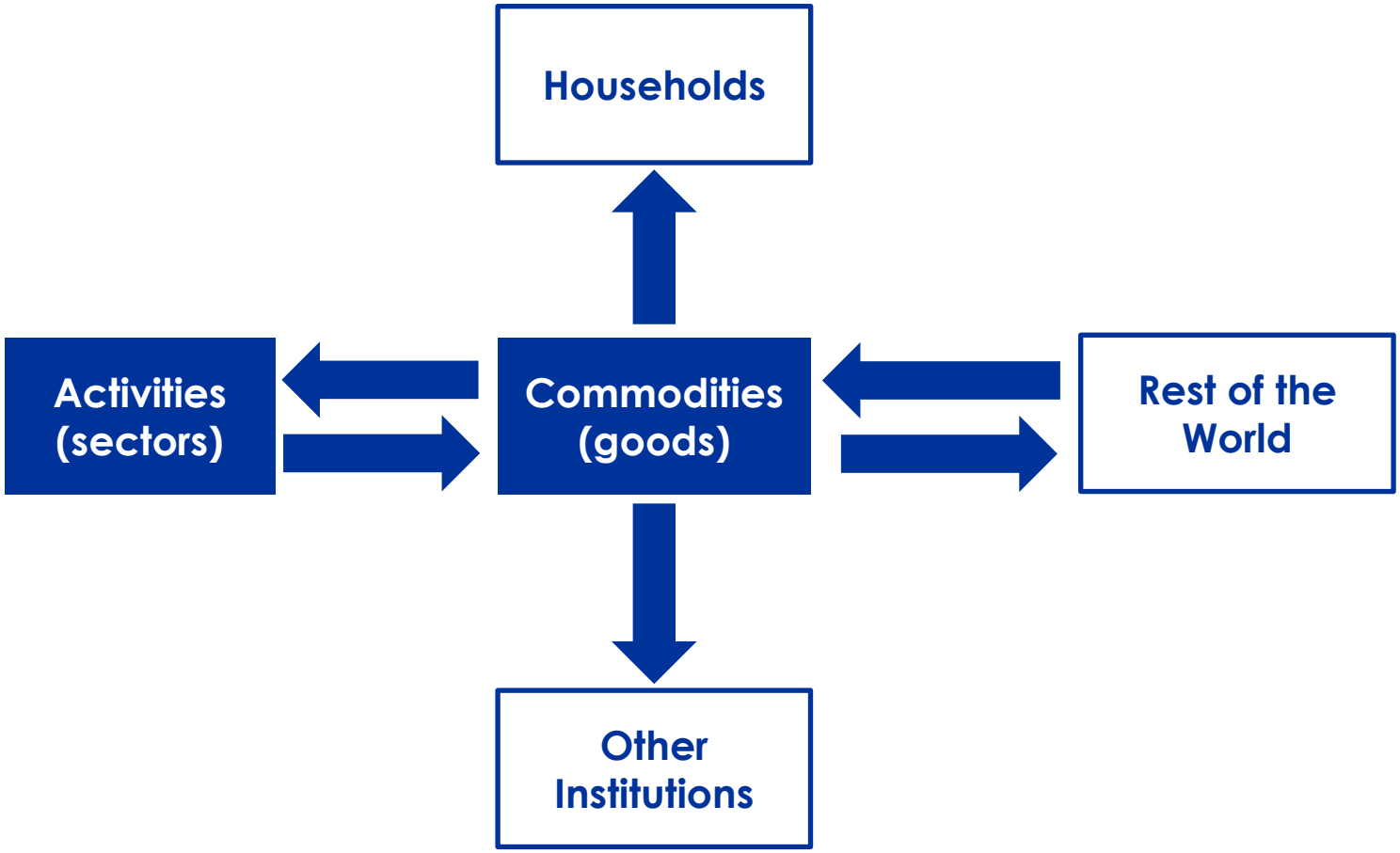
Social Accounting Matrix (SAM): United Nations University

- Davies & Thurlow (2011) "*A 2009 Social Accounting Matrix for South Africa*"
  - 49 Activities (sectors)
  - 85 Commodities (goods and services)
  - 31 Other Accounts

Western Cape Government
Agriculture

CGE Models

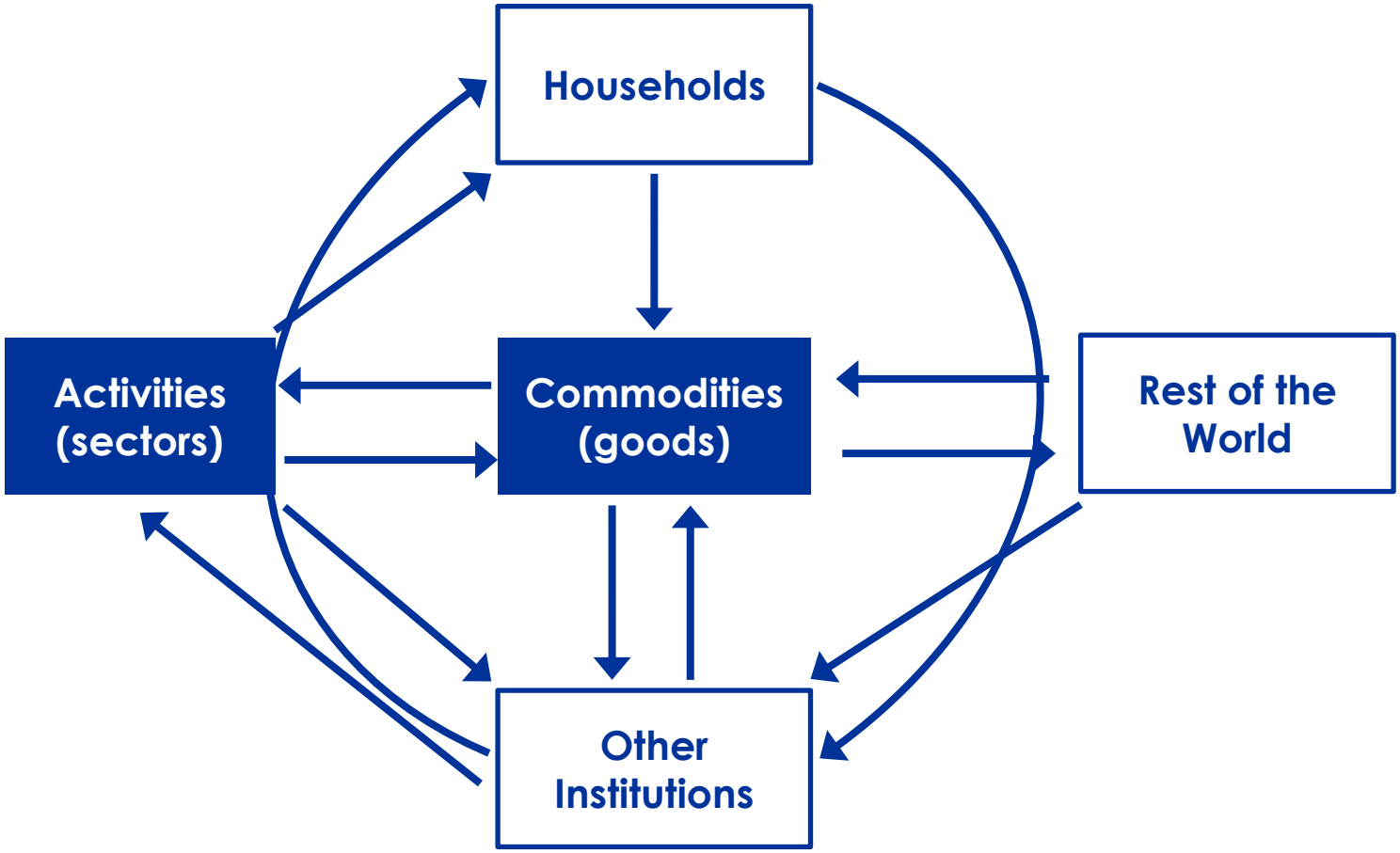
Flow of Goods



Western Cape Government
Agriculture

CGE Models

Flow of Income



Western Cape Government
Agriculture

The Project Model

Model Details

Static Computable General Equilibrium Model

- Behavioural changes need to be factored in exogenously
- Allows for analysis of direct and indirect impacts

Tax modelled as an activity tax

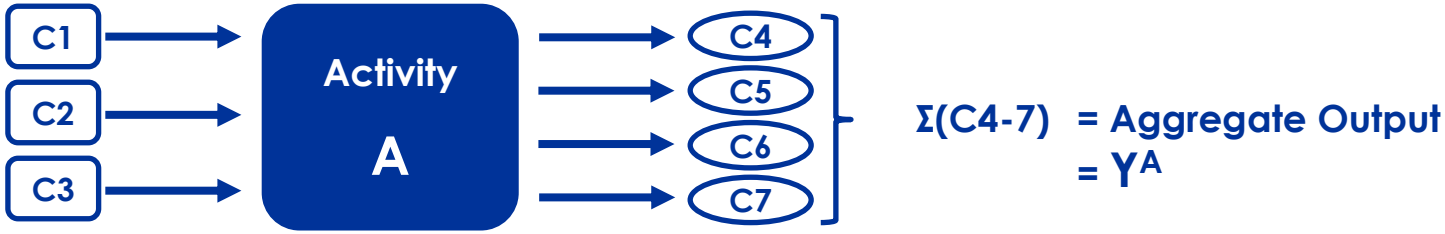
- Tax on activity output
- Tax calculated to be equivalent to a R200 tax per ton CO_2-eq emissions
- Tax rate for each activity determined by:
  - Fossil fuel use intensity
    - *Taken from Model SAM*
  - Emissions attributable to each fuel
    - *Taken from South Africa's 2009 Energy Balances provided by the Department of Energy*

Western Cape Government
Agriculture

Modelling a Carbon Tax

A Simplified Hypothetical Example

Assume a tax rate of R200 per ton CO2-eq emissions…

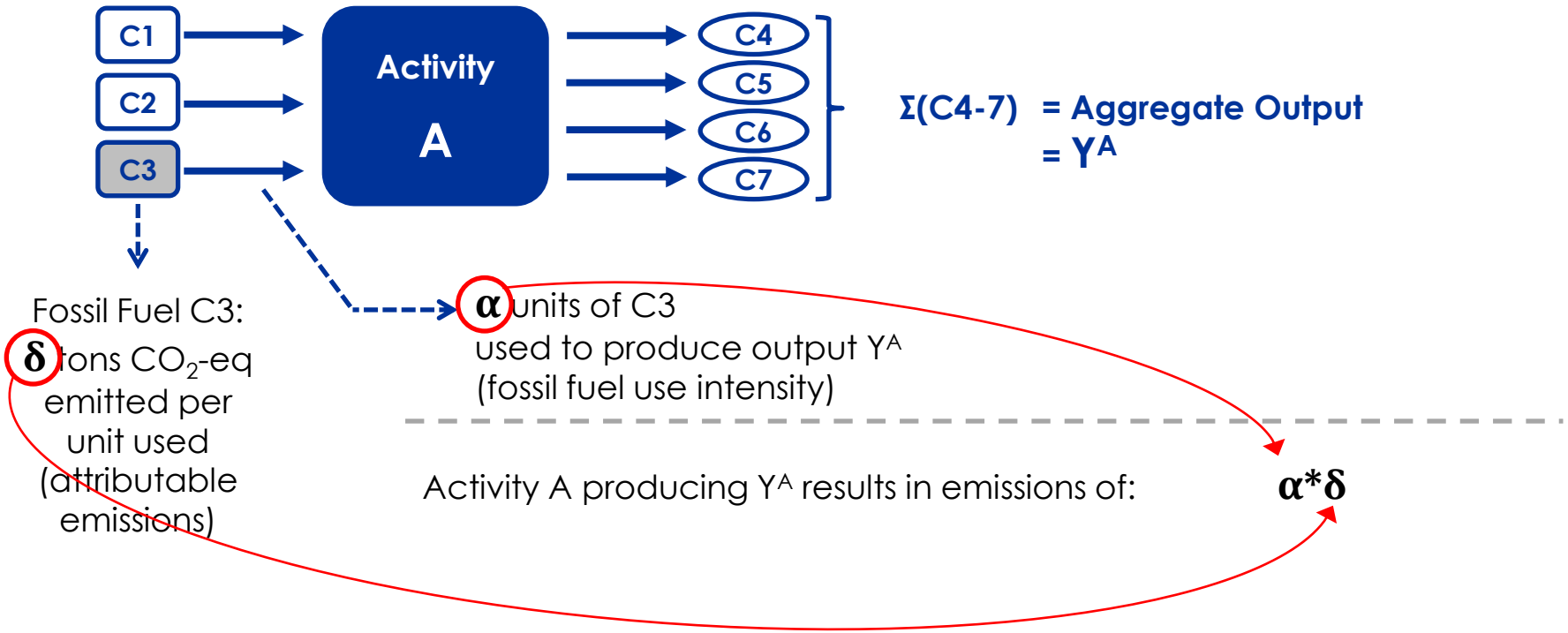


Western Cape Government
Agriculture

Modelling a Carbon Tax

A Simplified Hypothetical Example

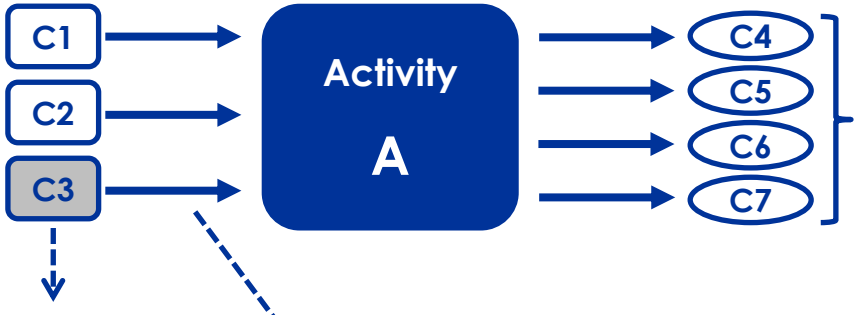
Assume a tax rate of R200 per ton CO2-eq emissions…



Modelling a Carbon Tax

A Simplified Hypothetical Example

Assume a tax rate of R200 per ton CO2-eq emissions…



Σ(C4-7) = Aggregate Output
= Y^A

Fossil Fuel C3:
δ tons CO_2-eq emitted per unit used (attributable emissions)

α units of C3 used to produce output Y^A (fossil fuel use intensity)

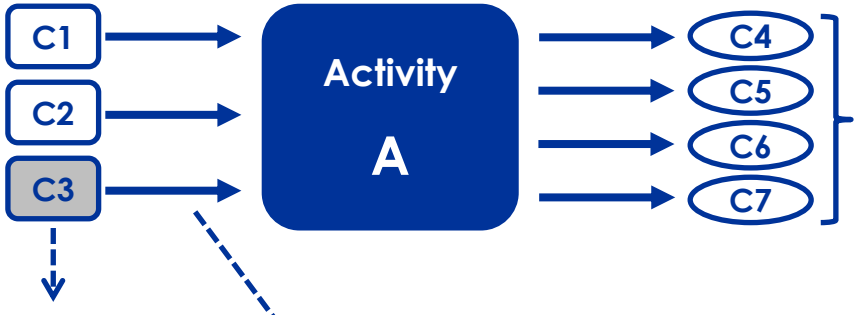
Activity A producing Y^A results in emissions of: **α*δ**

Therefore the total tax on Activity A will equal: 200***α*δ**

Modelling a Carbon Tax

A Simplified Hypothetical Example

Assume a tax rate of R200 per ton CO2-eq emissions…



Σ(C4-7) = Aggregate Output = Y^A

Fossil Fuel C3:
δ tons CO_2-eq emitted per unit used (attributable emissions)

α units of C3 used to produce output Y^A (fossil fuel use intensity)

Activity A producing Y^A results in emissions of: $\alpha*\delta$

Therefore the total tax on Activity A will equal: $200*\alpha*\delta$

➢ **Therefore the tax per unit activity:** $(200*\alpha*\delta) / Y^A$

Western Cape Government
Agriculture

Project Scenarios

Elementary Tax

- R200 per tCO_2-eq emissions

Carbon Efficiency

- R200 per tCO_2-eq emissions
- 20% decline in fossil fuel usage (across the board)

Alternative Electricity

- R200 per tCO_2-eq emissions
- 50% decline in coal use for electricity production

Agriculture Tax Free

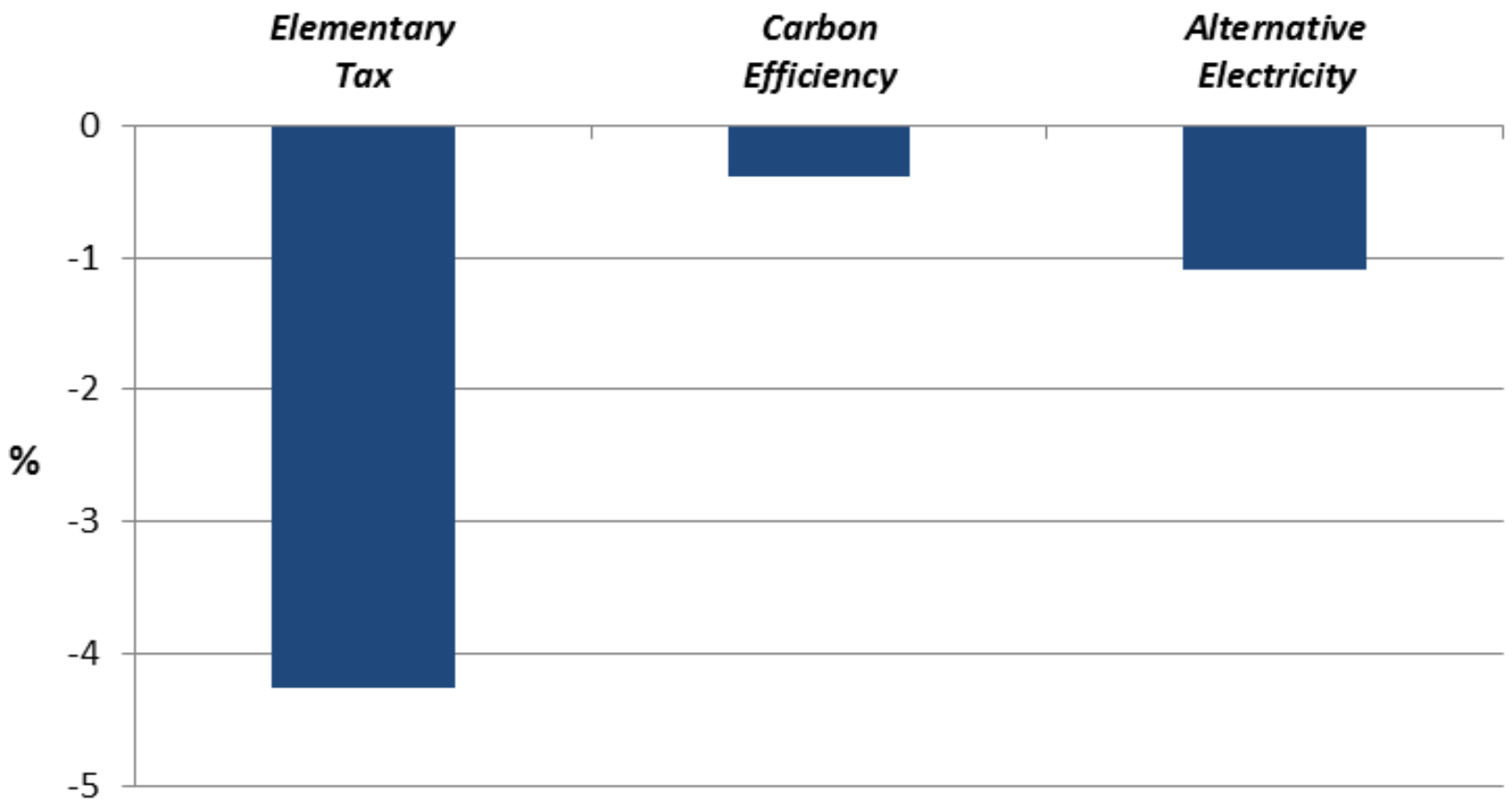
- R200 per tCO_2-eq emissions
- Agriculture excluded from tax base

Western Cape Government
Agriculture

Impacts I – South African Economy

Economy Impacts

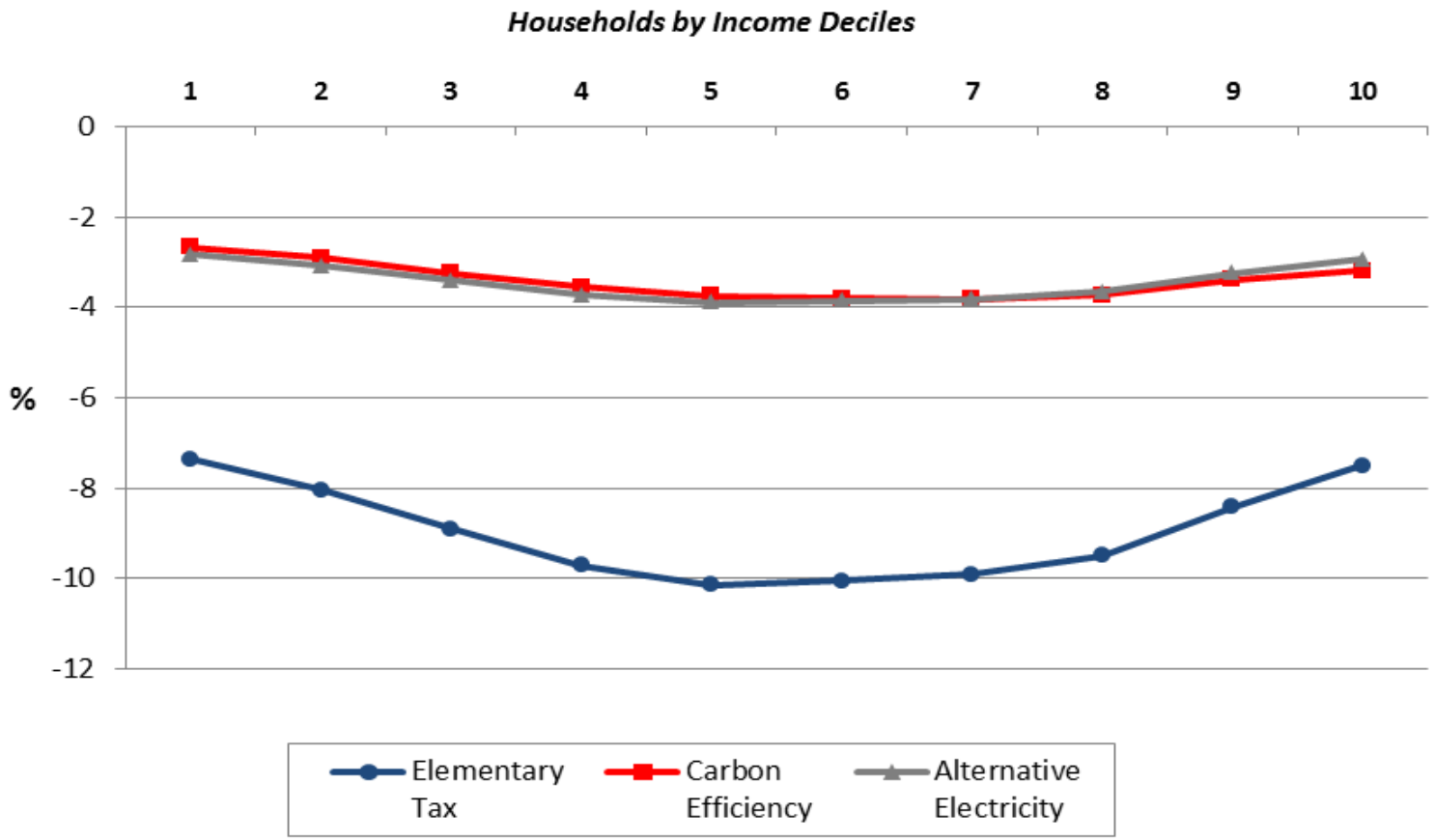
Percentage Change in GDP (Market Prices) Resulting from Carbon Tax



Western Cape Government
Agriculture

Economy Impacts

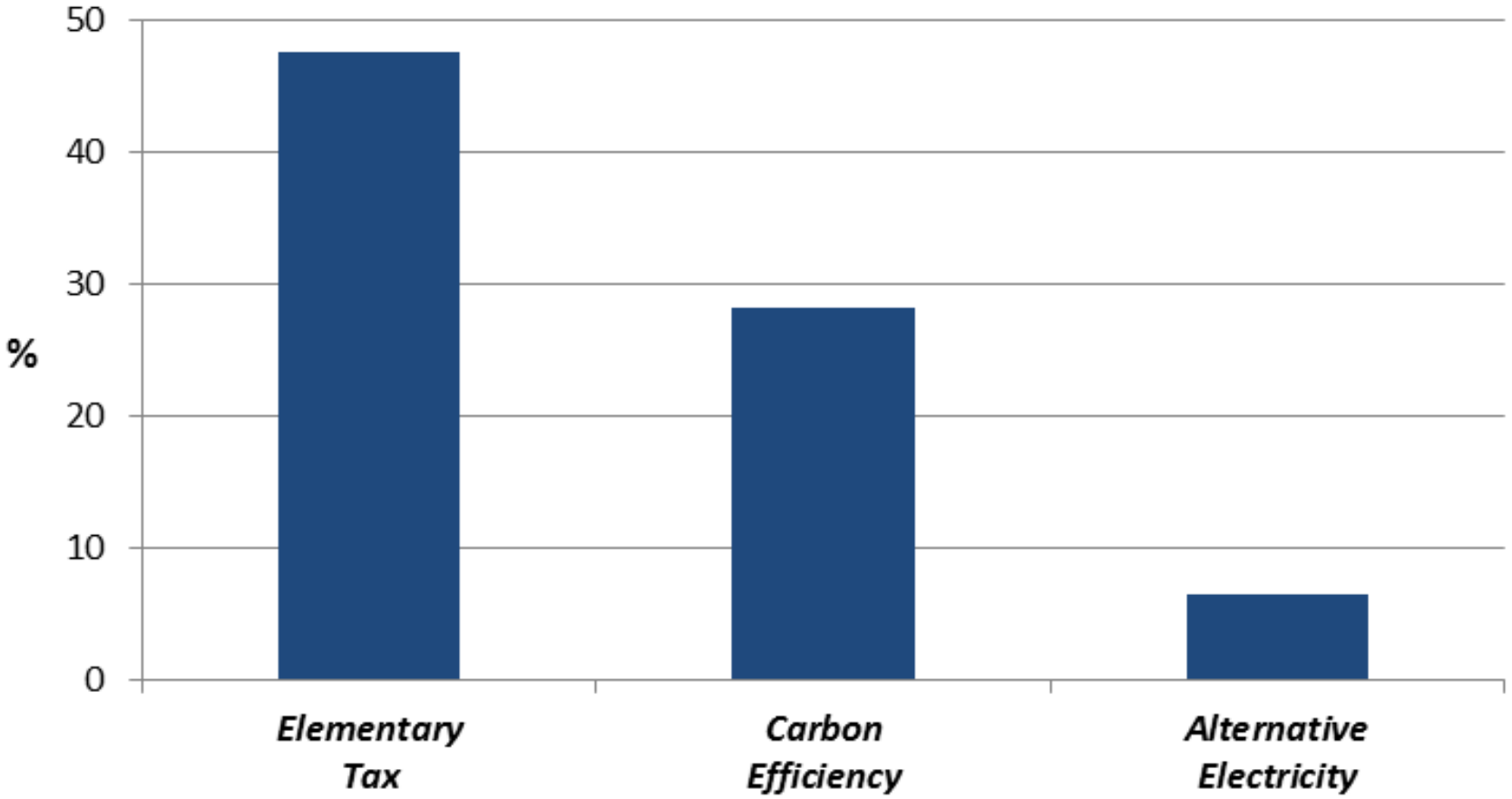
Percentage Change in Household Income by Income Decile



Western Cape Government
Agriculture

Economy Impacts

Percentage Change in the Price of Electricity as a Result of the Carbon Tax

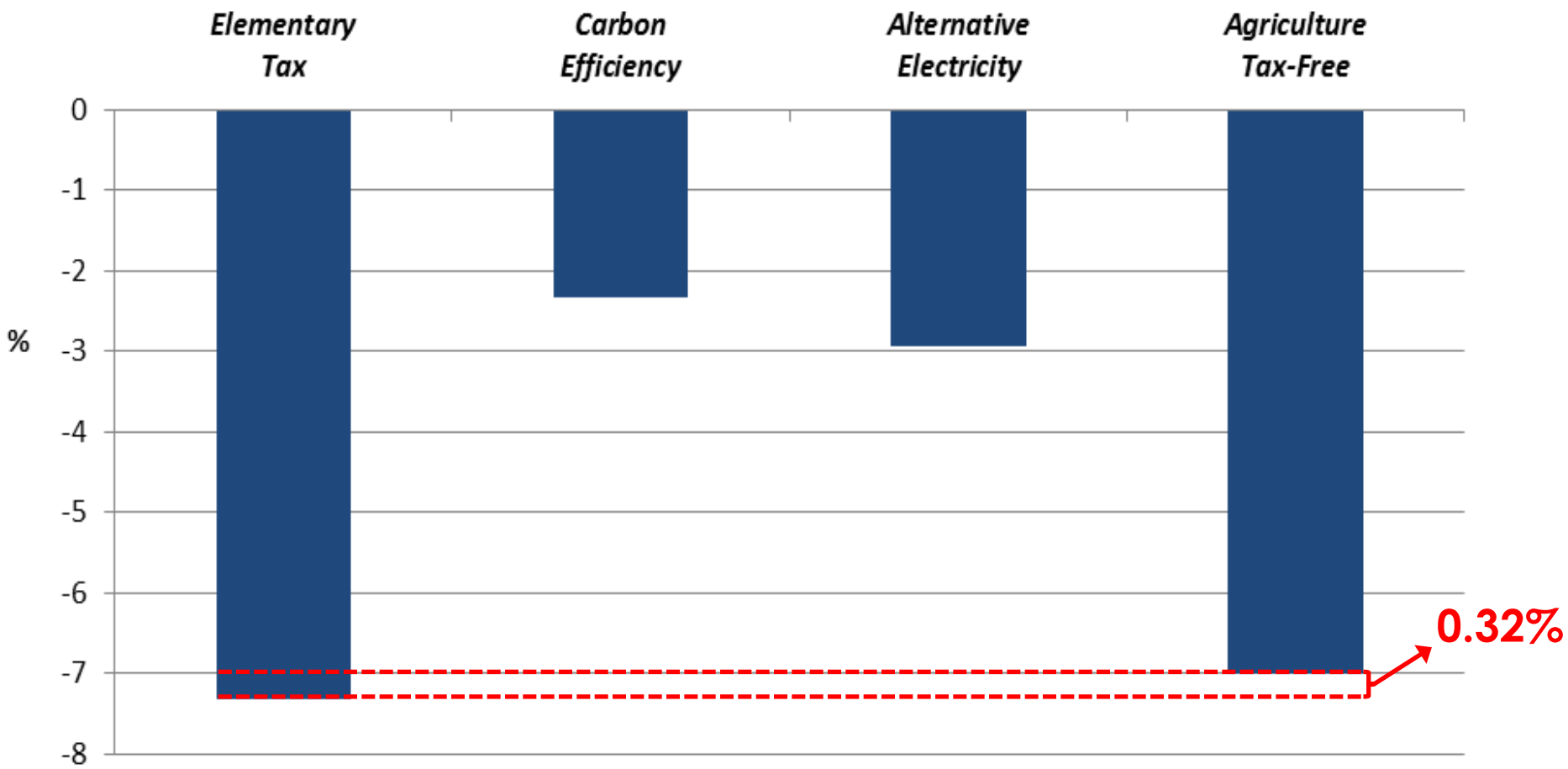


Western Cape Government
Agriculture

Impacts II – South African Agriculture

Agricultural Production

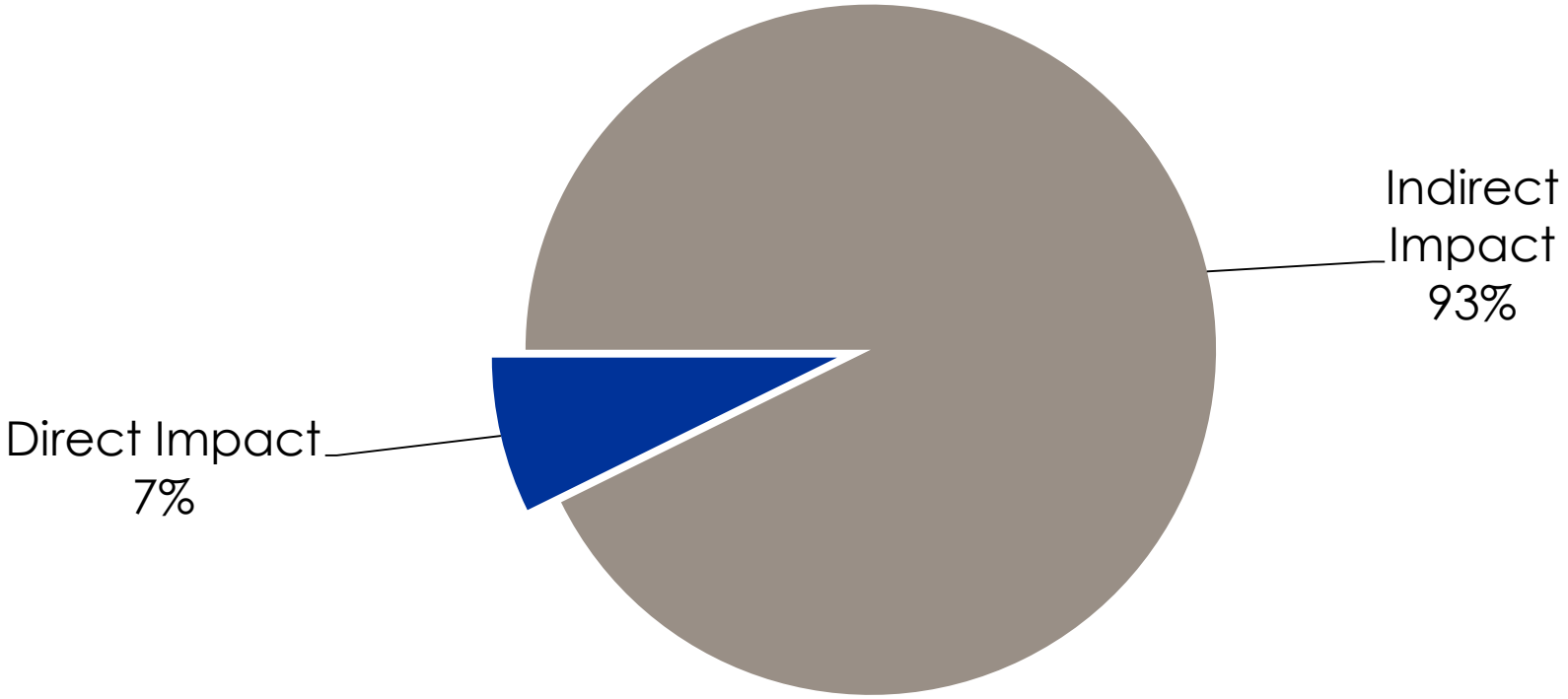
Percentage Change in Domestic Agricultural Activity Output



Western Cape Government
Agriculture

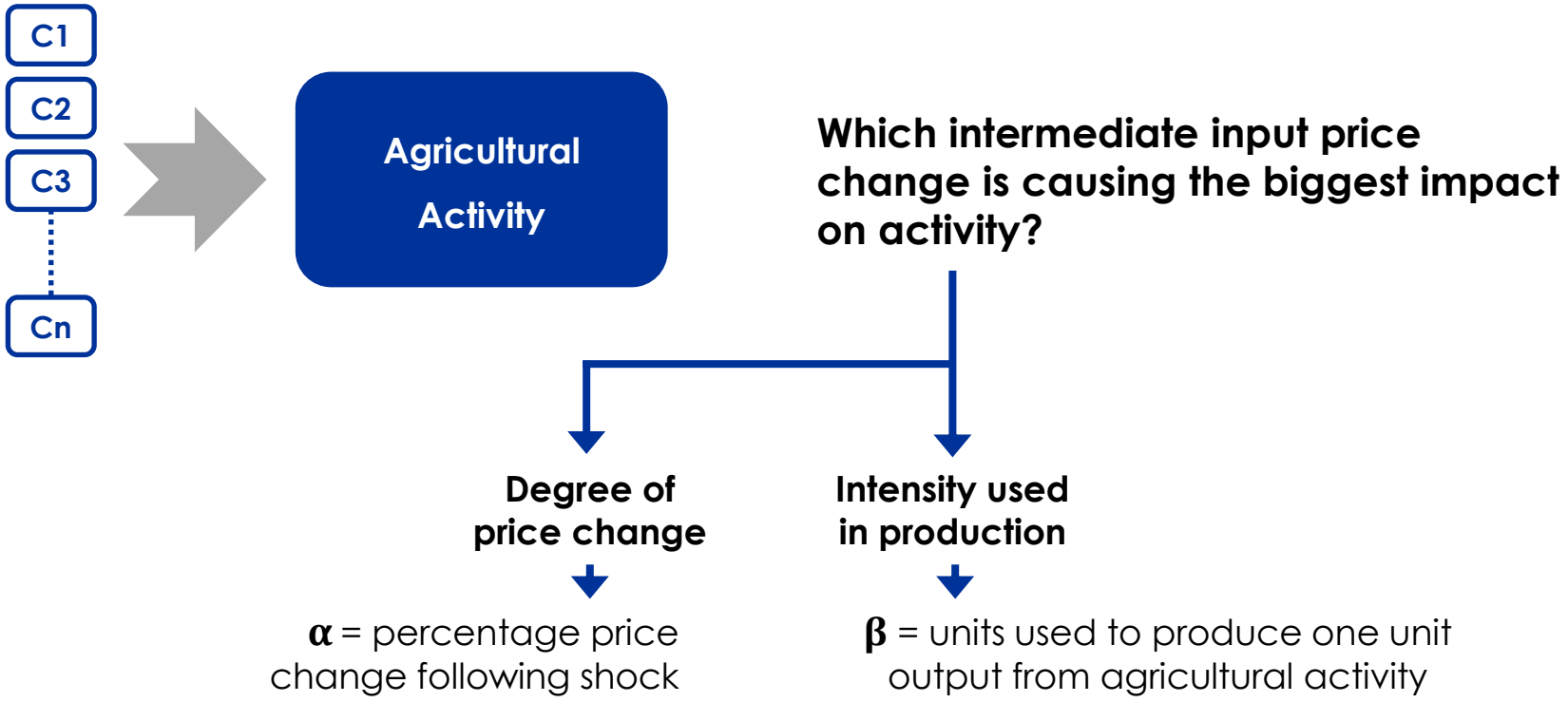
Agricultural Production

Indirect vs Direct Impacts of Carbon Tax on Agricultural Production



Western Cape Government
Agriculture

Shocks and Inputs



AC = (α * β)

- Ordinal Measure of the degree to which a shock influences activity

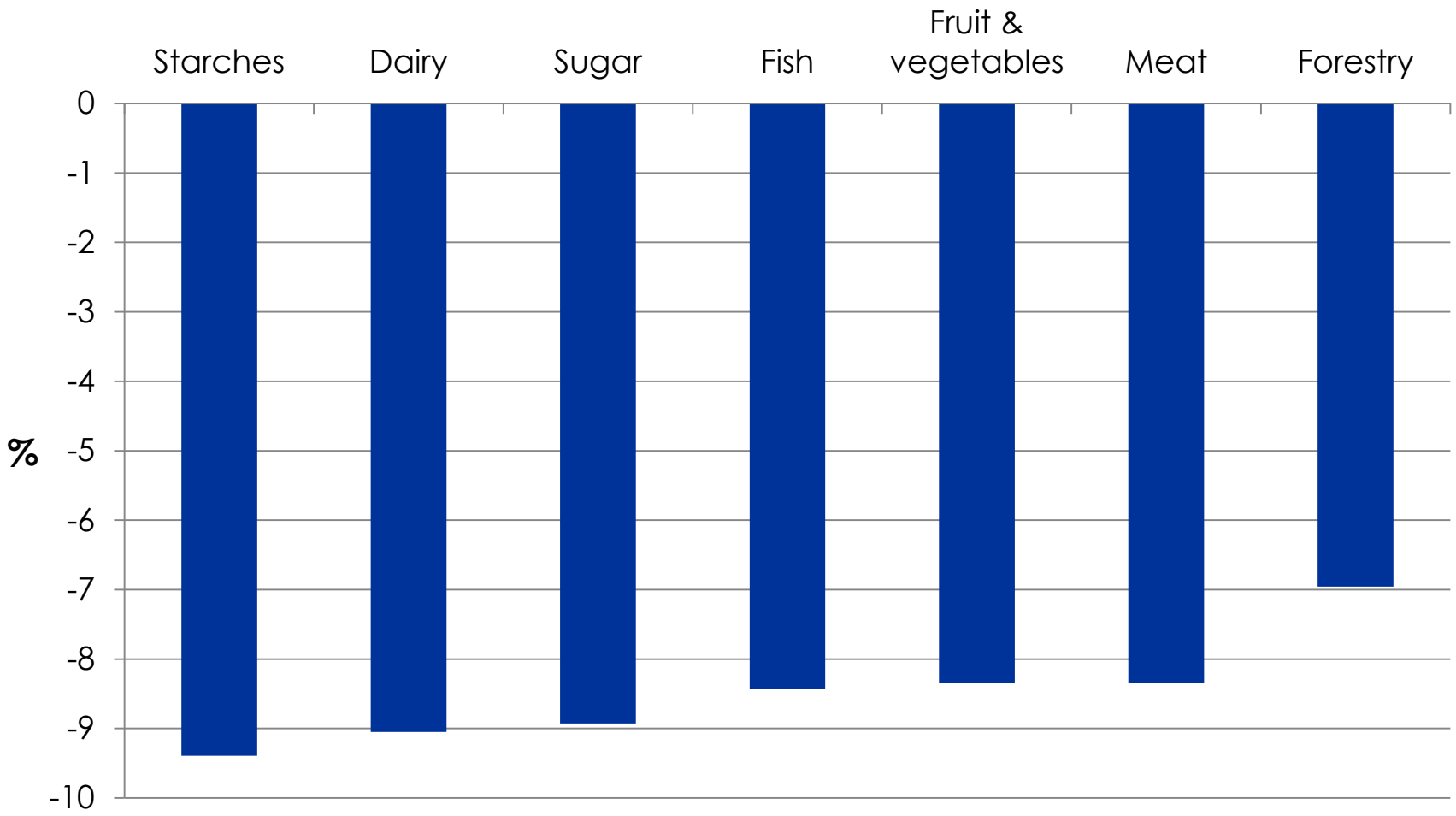
Inputs With Biggest Impact

Commodity Price Increases Most Influencing Agricultural Activity Decline

#	Commodity	% Price Change After Shock (α)	Intermediate Units Per Unit Activity Output (β)	AC (α.β)
1	**Electricity & gas distribution**	47.70	0.02	**0.99**
2	**Fertilizers & pesticides**	3.93	0.20	**0.78**
3	**Petroleum products**	6.14	0.06	**0.34**
4	**Metal products**	3.63	0.04	**0.13**
5	**Animal feeds**	0.80	0.15	**0.12**
6	**Water distribution**	11.63	0.01	**0.06**
7	**Pharmaceuticals**	1.36	0.03	**0.04**
8	**Made-up textiles**	1.62	0.02	**0.03**
9	**Special purpose machinery**	3.96	0.01	**0.03**
10	**Vehicles & parts**	1.92	0.01	**0.03**

Commodity Impacts

Changes in Agricultural Commodity Outputs Resulting from Carbon Tax

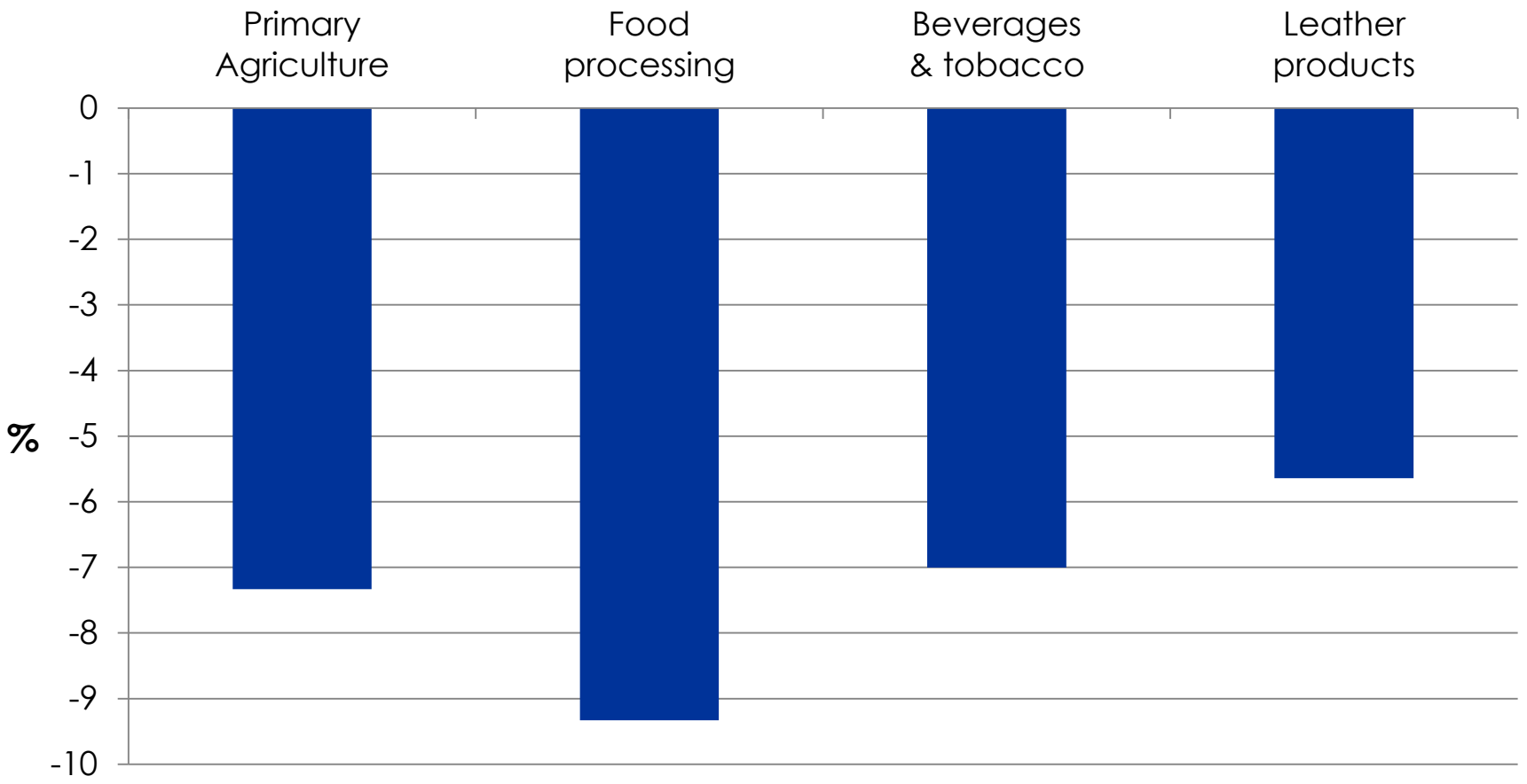


Western Cape Government
Agriculture

Impacts III - Other (Extensions)

Agri Processing

Changes in Agri Processing Output Resulting from Carbon Tax



Western Cape Government
Agriculture

Agri Processing Inputs

AC Index for Food Processing Activity

#	Commodity	% Price Change After Shock (a)	Intermediate Units Per Unit Activity Output (β)	AC (a.β)
1	Electricity & gas distribution	47.70	0.02	1.068
2	Paper products	14.54	0.02	0.281
3	Plastics	1.13	0.04	0.041
4	Basic chemicals	4.46	0.01	0.030
5	Water distribution	11.63	< 0.01	0.021
6	Construction	2.88	0.01	0.017
7	Miscellaneous business activities	0.26	0.06	0.017
8	Miscellaneous chemicals	2.31	0.01	0.012
9	Dairy	0.17	0.06	0.010
10	Grain milling	0.11	0.07	0.008

Agri Processing Inputs

AC Index for Beverages and Tobacco Activity

#	Commodity	% Price Change After Shock (a)	Intermediate Units Per Unit Activity Output (β)	AC (a.β)
1	Paper products	14.54	0.04	0.609
2	Electricity & gas distribution	47.70	0.01	0.406
3	Water distribution	11.63	0.02	0.275
4	Glass products	3.79	0.04	0.167
5	Basic chemicals	4.46	0.02	0.084
6	Plastics	1.13	0.05	0.061
7	Construction	2.88	0.01	0.029
8	Weaving & finishing of fabrics	4.72	0.01	0.025
9	Miscellaneous chemicals	2.31	0.01	0.015
10	Miscellaneous business activities	0.26	0.05	0.013

Agri Processing Inputs

AC Index for Leather Products Activity

#	Commodity	% Price Change After Shock (α)	Intermediate Units Per Unit Activity Output (β)	AC (α.β)
1	Electricity & gas distribution	47.70	0.01	0.491
2	Basic chemicals	4.46	0.03	0.144
3	Metal products	3.63	0.03	0.093
4	Paper products	14.54	< 0.01	0.049
5	Weaving & finishing of fabrics	4.72	< 0.01	0.017
6	Plastics	1.13	0.01	0.009
7	Miscellaneous textiles	6.49	< 0.01	0.007
8	Construction	2.88	< 0.01	0.006
9	Soap & related products	0.56	0.01	0.006
10	Water distribution	11.63	< 0.01	0.005

Conclusions

Conclusions… Difficulties / Short-comings

Modelling Difficulties

- Simplification of complex system
- Uncertain policy stances
  - Revenue recycling
  - Offsets
  - Reporting
- Changes in relative prices
  - Electricity: renewables vs fossil fuels
- Data relevance
  - Social Accounting Matrix (2009)

Western Cape Government
Agriculture

Conclusions… Presentation Summary

Economic impacts of carbon tax worrying

- Sharp drop in Gross Domestic Product
- Disproportionately felt by middle income households

The key factor in the carbon tax impact will be the behavioural reaction

- We have a good idea of how we want behaviour to react, uncertainty around how it will
- Key factor: recycling of tax revenues

Negative impact of carbon tax can be mostly offset through an across the board decline in fossil fuel use intensity

- Feasibility?

Negative impacts can also be set off by a targeted intervention at South Africa's Energy Sector

- Reduced dependency on coal for electricity production

Western Cape Government
Agriculture

Conclusions… Presentation Summary

Carbon tax IS a serious threat to South Africa's Agricultural Sector

Direct impact of tax negligible but it is still essential to look to reduce emissions in the sector

- Constitutional mandate
- What about post 2020?
  - Potential for a tax on agricultural emissions

Substantial indirect impacts

- Soaring electricity prices
  - Electricity infrastructure already under strain
- Strong impact also through rising prices of fertilizers and pesticides
- To a lesser extent, but still significant impact from rising prices of petroleum products

Impact on key Western Cape agricultural products greater than the sector's aggregate impact

Western Cape Government
Agriculture

Conclusions… The Way Forward

Produce more with less

- Less electricity
  - Small-scale on-farm electricity production
- Less fertilizers and pesticides
  - Or look to fertilizers and pesticides utilising different production methods

Agriculture could be a key player in transitioning to cleaner energy production

- Biofuels
- Solar, wind, hydro etc.

We don't have much time to plan and the phase-in period has been shortened

- Need to act NOW
- Need to ensure of efficient monitoring systems to collect data to be reviewed regularly

Western Cape Government
Agriculture

Thank you

Contact Us


Western Cape Government
Agriculture
BETTER TOGETHER.
Andrew Partridge
Macro & Resource Economic Services
Tel: (+27) 021 808 7633
Fax: (+27) 021 808 5210
andrewp@elsenburg.com
www.elsenburg.com