Exploring the Impacts of Changing Energy Costs on New Zealand Agriculture to 2030: A GTAP-E-RD Application

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INTRODUCTION

• Considerable uncertainty exists about future fuel prices and carbon costs
  – Different trajectories may have significant potential impacts on New Zealand agriculture
  – We explore the impact of a range of possible changes in fuel and carbon prices on New Zealand’s key agro-food sectors, particularly dairy, beef and sheep

• We use the new GTAP-E-RD (GTAPv7) model to project the global economy to 2030
  – Assuming relatively conservative increases in NZ carbon emission prices with moderate changes in world oil & gas prices
  – We then consider the impact of a range of alternative scenarios
OUTLINE OF PRESENTATION

• Modelling Framework and Data
• Baseline Simulation
• Policy Simulations
• Results
• Concluding Comments
• We use the new GTAP-E-RD (Corong et al., 2019)
• And GTAP version 10A database
  – Base year of 2014, aggregated to 16 regions and 34 sectors
  – Including carbon dioxide emission data distinguished by fuel type and user
  – Supplemented with the GTAP non-carbon dioxide emissions data on other greenhouse gas emissions
• Beef and sheep are important sectors of focus here
  – We split the GTAP beef and sheep meat (cmt)
  – As well as the associated cattle and sheep (ctl)
## Regions and sectors modelled

### Regions Modelled

- New Zealand
- Australia
- United Kingdom
- Rest EU
- China
- Japan
- Hong Kong
- Taiwan
- South Korea
- ASEAN
- South Asia
- United States
- Canada
- Mexico
- Central and Latin America
- Rest of the World

### Sectors Modelled

- Rice
- Coal
- Fruit_Veg
- Oil
- Sugar
- Gas
- OtherCrops
- OthMinerals
- RawMilk
- TextilesWAP
- Cattle
- MotorVehicle
- Sheep
- Electronics
- OtherAnimal
- OthMachinery
- Wool
- OthManuf
- Beef
- ChemRubPl
- Sheepmeat
- PetroCoal
- OtherMeats
- MineralProds
- Dairy
- MetalProds
- ProcFoods
- AirOthTrn
- Bev_Tob
- ElecWatGas
- ForWoodPaper
- Construction
- Fisheries
- OtherServices
New Zealand beef and sheep meat export shares by market, 2014 (%)
**Global GHG emission shares, 2014 (%)**

- **China, 24.0%**
- **USA, 14.9%**
- **Rest of the World, 21.1%**
- **South Asia, 8.5%**
- **ASEAN, 5.2%**
- **Rest of EU, 8.9%**
- **UK, 1.3%**
- **Canada, 1.8%**
- **Mexico, 1.7%**
- **Central and Latin America, 5.9%**
- **Hong Kong, 0.2%**
- **Taiwan, 0.6%**
- **New Zealand, 0.2%**
- **Australia, 1.6%**
- **Japan, 2.7%**
- **Korea, 1.3%**
- **Rest of EU, 8.9%**

**Global GHG emissions (% share)**
Shares of CO2 and non-CO2 in total emissions by country/region, 2014 (%)
Shares of total GHG emissions by activity, New Zealand, 2014 (%)

- Cattle, 34.4%
- Sheep, 12.8%
- Transport, 16.7%
- Other industries, 10.7%
- Petroleum and Chemicals, 4.9%
- Electricity, 5.3%
- Mining, 1.7%
- Other Livestock, 0.4%
- Other food, 0.7%
- Dairy, 1.9%
- Beef Meat, 0.2%
- Sheep Meat, 0.3%
- Other food, 0.7%
- Houses, 7.0%
- Crops, 3.1%

GHG (CO₂ and Non-CO₂) emissions (% share, New Zealand)
Emission shares by industry and type of GHG, New Zealand, 2014 (%): CO₂

- Transport, 39.3%
- Households, 16.5%
- Electricity, 12.5%
- Petroleum and Chemicals, 9.3%
- Other industries, 10.1%
- National CO₂ emissions (% share)
Emission shares by industry and type of GHG, New Zealand 2014 (%): Non-CO₂
Cost shares by industry, New Zealand, 2014 (percent)
We project NZ and other economies to 2030
- Drawing on Shared Socio-economic Pathways (SSPs) (O’Neill et al., 2014)
- Middle of the road: ‘business as usual’ trends, SSP2

We include projections for
- GDP per capita
- Population
- Labour supply
- Labour productivity adjusts to hit GDP target
- Upward sloping supply for fixed and sluggish factors
Baseline emission and fuel price assumptions

• In the baseline, we include projections of New Zealand carbon emission prices, as well as and oil and gas prices
  – For NZ carbon prices, we draw on low scenario carbon price projection from Concept Economics et al. (2018)
    • Baseline assumption of US$17.5 in 2018 per tonne of CO₂ emissions, rising to US$26.6 by 2030
  – For baseline oil and gas prices, we draw on EIA’s (2019) moderate reference case projections
    • Oil prices projected to be US$89.67 per barrel and natural gas prices at US$4.27 per BTU by 2030
We model five scenarios:

1. New Zealand carbon emission prices rising to a moderate level in 2030
2. New Zealand carbon emission prices rising to a relatively high level in 2030
3. Global carbon emission prices rising to a moderate level in 2030
4. Oil and gas prices rising by a lower than baseline amount
5. Oil and gas prices rising by a higher than baseline amount
Carbon emission price under baseline, medium and high price scenarios, 2018 to 2030 (US dollars)
Oil and gas price projections, alternative scenarios, 2018-2030 (US$ per barrel of oil and US$ per million BTU gas)
RESULTS

• We present some selected summary results:
  – NZ’s real GDP
    • And decomposition of contributions
  – NZ’s real exports
  – Total world CO₂ emissions
  – NZ’s total CO₂ and non-CO₂ emissions
    • Impact on NZ’s CO2 emissions
  – Real output, selected NZ agricultural sectors
Impact on NZ’s real GDP, 2020-2030 relative to baseline (%, cumulative)
Decomposition of contributions to NZ real GDP change, 2030 (%)
Impact on NZ’s real exports, 2020-2030 relative to baseline (%, cumulative)
Impact on total world CO$_2$ emissions, relative to 2030 baseline (% cumulative)
Impact on NZ’s total $\text{CO}_2$ and non-$\text{CO}_2$ emissions, 2020-2030 (% cumulative)
Impact on real output, selected NZ agricultural sectors, 2020-2030 (%)
CONCLUDING COMMENTS

• We find increases in NZ carbon emission prices cause
  – Some reductions in real GDP
  – Substantial reductions in carbon emissions in NZ (though small global impact when NZ alone increases carbon prices)

• In the scenarios where increases in global carbon prices or global fuel prices impact all countries
  – We find a smaller negative impact on New Zealand’s real GDP, suggesting the costs are shared amongst countries
  – The impact on global emissions is much more substantive

• For key NZ agricultural sectors
  – Exports and output tend to decline with increases in carbon and fuel prices
  – But significant reductions in emissions
Thank you!