# Farm Risk Managment Policies under Climate Change

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# Outline

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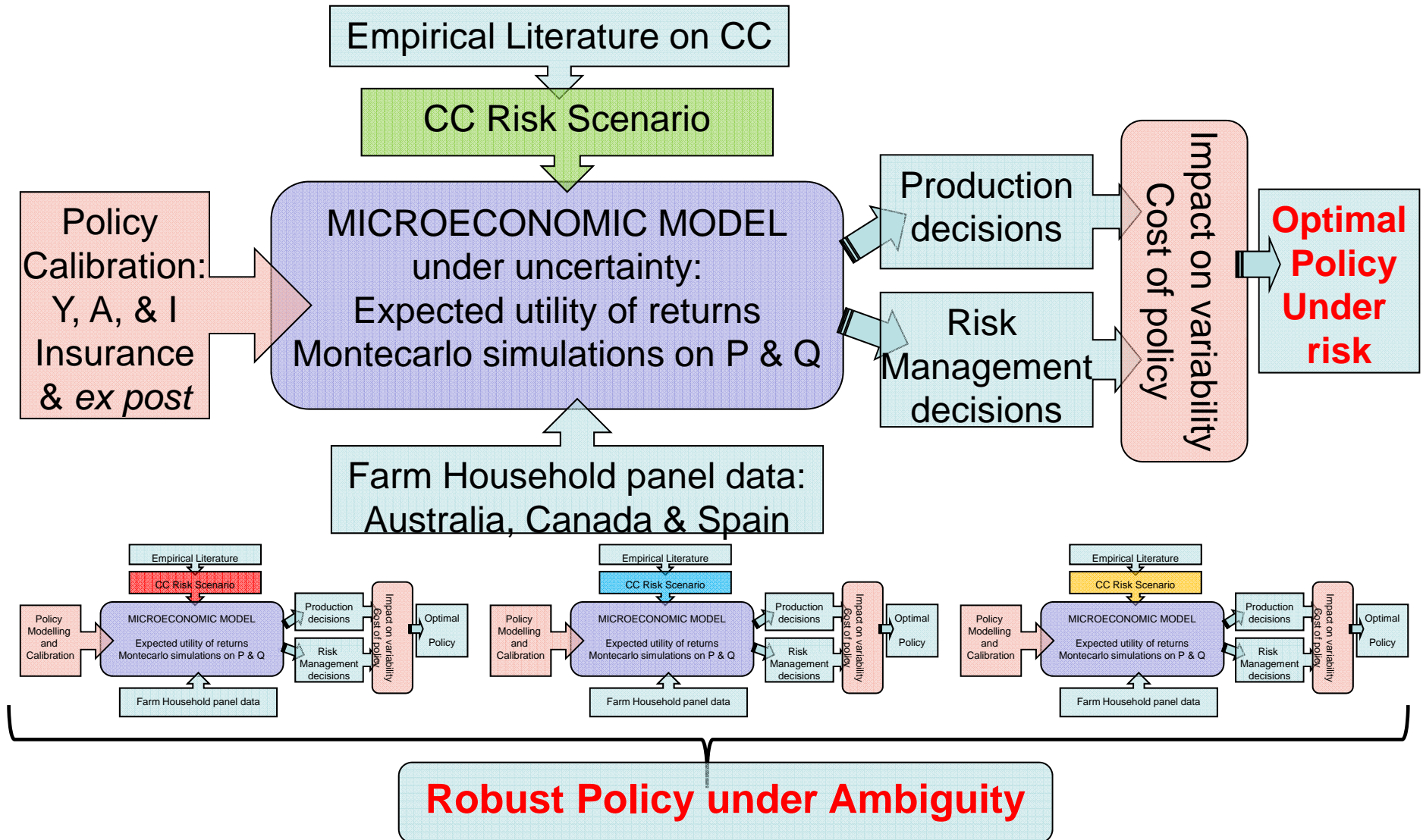6. Conclusions

# The issue

## From CC fears...

- More extreme weather events

- Farmers not aware, or without tools

- Production disrupted in some areas

- Government's role on management of new risk

## ... to adaptation policy issues

- CC modifies the farming **risk environment**, but how?

- High uncertainty about the impact and adaptation response (**ambiguity**)

- Policies often can hinder the needed **adaptation** to climate change
- Different needs/impacts by **farm type**

- What is **policy objective**? Market failure, stabilization, low incomes?

# Tools & Research Strategy



Empirical Literature on CC

CC Risk Scenario

Policy Calibration: Y, A, & I Insurance & *ex post*

MICROECONOMIC MODEL under uncertainty: Expected utility of returns Montecarlo simulations on P & Q

Production decisions

Risk Management decisions

Impact on variability Cost of policy

**Optimal Policy Under risk**

Farm Household panel data: Australia, Canada & Spain

**Robust Policy under Ambiguity**

# Policy cost effectiveness

- **Two different objectives /risk reducing impacts:**
  - Reduce variability of farm income, measured by the welfare gain for the farmer from less risk
  - Increase lowest farm income occurrence, measured by the lowest 10 percentile of outcomes
- **Expected budgetary costs**
- **Two indicators of cost effectiveness:**
  - Impact / budgetary costs

# Ambiguity about CC impacts on Yield Risk

- **Increased temperatures, $CO_2$ fertilization, change in rainfall, "new" pest and diseases, climatic extremes**

- **Impacts: GCM + Econometric/Agronomic**
  - Australia: winter time decrease rainfall
  - Canada (Sask.): increase and changed precipitation
  - Spain: decrease rainfall

| | Australia[1] | | Canada[2] | | Spain[3] | |
|---|---|---|---|---|---|---|
| | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation |
| Wheat | -7.2 | 10.3 | -3.0 | -2.0 | -1.8 | 110.5 |
| Barley | -20.0 | 0.0 | -10.0 | -17.0 | 7.3 | 89.3 |
| Oilseeds | -19.9 | -6.1 | -13.0 | 2.0 | | |

*Sources*: 1. Luo *et al.* (2010), Van Gool and Vernon (2006), 2. Zhang *et al.* (2011), and 3. Guereña *et al.* (2001).

# Ambiguity about Behavioural response

- ## Adaptation

  - Structural / anticipatory: new technologies/type of farming

  - Reactive /autonomous: timing, diversification

    Change in diversification index in response to marginal climate change (percentage change)

    |                  | Australia | Canada | Spain |
    |------------------|-----------|--------|-------|
    | Low risk farm    | 17.6      | -3.6   | 19.8  |
    | Medium risk farm | 16.3      | -2.7   | n.a.  |
    | High risk farm   | 13.7      | 3.1    | 22.4  |

- ## Misalignment

  - What if nobody is responsive to CC new risk environment?

# CC Scenarios

| | | Description | Climate Scenarios | | |
|---|---|---|---|---|---|
| | | | Baseline (No climate change) | Marginal climate change | Extreme events |
| **Behavioural Sub-scenarios** | Business-as-usual | Expresses how policy instruments would function without climate change | Baseline | | |
| | Diversification (No adaptation) | Based on expected impact on yields assuming farmers can only adapt by diversifying among existing varietals | | Marginal | Extreme |
| | Structural adaptation | Expected impact on yields based on the literature, assuming farmers can switch to crop varietals that reduce impact of climate change | | Marginal with adaptation | Extreme with adaptation |
| | Misalignment | Farmers make production decisions based on their historical experience and therefore do not take into account the increase in systemic risk (no adaptation) | | Marginal with mis-alignment | Extreme with mis-alignment |

# Marginal Climate Change results (1)

- ## E.g.: Australia, High Risk Farms

| | Baseline | | | | | Marginal climate change | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % of land insured | Diversification index (percentage change) | Budgetary cost (AUD/ha) | Cost effectiveness — Welfare gain per AUD | Cost effectiveness — Impact on low incomes per AUD | % of land insured | Diversification index (percentage change) | Budgetary cost (aud/ha) | Cost effectiveness — Welfare gain per AUD | Cost effectiveness — Impact on low incomes per AUD |
| **High risk farm** | | | | | | | | | | |
| Individual yield | 77.1 | -4.7 | 10.90 | 0.12 | 1.73 | 100.0 | -18.22 | 14.47 | -0.30 | 0.33 |
| Area yield | 19.0 | 4.5 | 1.10 | 2.00 | 15.03 | 31.3 | -1.26 | 1.81 | 0.45 | 2.16 |
| Weather index | 48.7 | -7.3 | 2.30 | -0.57 | -2.30 | 63.0 | -11.59 | 2.42 | -0.58 | 0.57 |
| Ex-post payment | 0.0 | -0.4 | 1.30 | -0.05 | 0.99 | 0.0 | -0.98 | 2.76 | -0.05 | -0.39 |

# Marginal Climate Change results (2)

## Australia:

- Highest demand for Yield Ins., high cost
- Strong specialization (crowding out)
- Best performance: Area ins. and *ex post*
- CC does not dramatically modify results

## Canada:

- Low effectiveness of policies
- Even smaller consequences of CC
- Area Ins. Performs well, Index improved with CC (more correlation)

## Spain:

- Large increase in demand for insurance
- Non-irrigated farms more affected by CC, but no improvement on cost-effectiveness
- Area Ins. performs relatively well

## General:

- Cost effectiveness can be negative (e.g. Australia)
- Best policy can differ by farm type
- Individual Ins. is well demanded and reduces risk, but it is expensive
- *Ex post* payments are cheaper, but more effective for low income objectives
- Costs increase with CC (e.g. Spain)

# Why robustness of policy?

- **Budgetary costs out of control (e.g. Canada)**

| | Baseline | Marginal Climate change | | | Extreme events | | |
|---|---|---|---|---|---|---|---|
| | | No Struct. Adapt. | Structural Adaptation | Misalignment | No Struct. Adapt. | Structural Adaptation | Misalignment |
| **No policy** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Individual yield** | 68 | 179 | 198 | 227 | 185 | 236 | 399 |
| **Area yield** | 82 | 80 | 90 | 630 | 87 | 134 | 1070 |
| **Weather index** | 36 | 32 | 31 | 95 | 41 | 49 | 88 |
| **Ex-post payment** | 56 | 41 | 42 | 199 | 35 | 48 | 308 |
| Percentage of triggering | 3.9 | 4.9 | 4.0 | 14.0 | 3.8 | 3.4 | 17.0 |
| Budgetary cost when triggered | 867 | 840 | 945 | 1419 | 917 | 1374 | 1925 |

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# Criteria for Robust Policies

– Bayesian: Best performance "on average"

– Satisficing: Best policy or within 35% of the best

– MaxiMin: Best performance in its worst outcome.

**Irrigated farm- change in 10 percentile income per dollar spending (e.g. Spain)**

| | Baseline | Marginal Climate change | | | Extreme events | | | Bayesian decision |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | No struct. adaptation | Adaptation | Misalignment | No struct. adaptation | Adaptation | Misalignment | |
| Individual yield | 2.96 | 3.28 | 4.04 | **2.65** | 3.81 | 2.79 | 2.72 | 3.35 |
| Area yield | 8.63 | 6.13 | 10.35 | 2.46 | 10.01 | 8.18 | 2.49 | **7.81** |
| Weather index | -0.09 | **-27.14** | -2.80 | 1.29 | -6.03 | -18.03 | 1.47 | -6.31 |
| Ex-post payment | 1.85 | **1.76** | 1.92 | 1.89 | 2.04 | 1.84 | 1.94 | 1.90 |

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# Optimal policy choice by scenario

| Country case | Baseline | Marginal Climate Change | | | Extreme Events | | |
|---|---|---|---|---|---|---|---|
| | | No structural adaptation | Adaptation | Misalign-ment | No structural adaptation | Adaptation | Misalign-ment |
| **Australia:** **Variability** **Low incomes gain** | Area yield  Area yield | Area yield  Ex-post payment | Area yield  Area yield | Area yield  Area yield | Area yield  Ex-post payment | Area yield  Ex-post payment | Weather index  Ex-post payment |
| **Canada:** **Variability** **Low incomes gain** | Area yield  Weather index | Area yield  Ex-post payment | Area yield  Weather index | Weather index  Individual yield | Weather index  Area yield | Weather index  Area yield | Weather index  Weather index |
| **Spain:** **Variability** **Low incomes gain** | Area yield  Weather index | Area yield  Weather index | Area yield  Weather index | Area yield  Weather index | Area yield  Weather index | Area yield  Weather index | Area yield  Weather index |

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# Robust Policy Choice

| Country case | Bayesian optimum | Satisficing | MaxiMin |
|---|---|---|---|
| Australia | | | |
| Variability | Area yield | Area yield | Area yield |
| Low incomes gain | Ex-post payment | - | Ex-post payment |
| Canada | | | |
| Variability | Weather index | Weather index | Weather index |
| Low incomes gain | Weather index | - | Ex-post payment |
| Spain | | | |
| Variability | Area yield | Area yield | Area yield |
| Low incomes gain | Weather index | Weather index | Weather index |

# Conclusions on Robustness

- **Extreme events and misalignment significantly change the decision environment**
  - Misalignment imply high cost and low adaptation
  - Information policies can be useful
- **Reduce variability focus on "normal" risk:**
  - Crowding adaptation is more likely
  - Area yield and weather insurance tend to be cheaper than individual risk and effective enough
- **Reduce incidence of low income more justified:**
  - Ex post payments are effective
  - Individual yield with deductible targeted, but costly

# Caveats and further insights

- **Other disadvantages of ex post payments:**
  - The costs of assessing occurrence of systemic losses
  - Governance and moral hazard
  - Other existing safety nets to be considered
- **Insurance Schemes as a continuum**
  - Area I. similar to Individual I. if few farmers in area
  - Area I. similar to Weather I. if the area is very large
  - Associated costs are a continuum (30%-10%-5%) as it is their effectiveness.
  - Subsidies do not solve the market failure, Information may do

# For more information

**Trade and Agriculture Directorate**

- Visit our website:
  **www.oecd.org/agriculture**

  **www.oecd.org/agriculture/policies/risk**

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