



# Farmers' Climate Change Risk Perceptions: an Application of the Exchangeability Method

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# Research Questions

- 1. Do farmers perceive risk related to climate change?**
- 2. Do beliefs about climate change affect risk perceptions?**
- 3. Are there any other factors influencing risk perceptions?**



# Research Motivations

- Quantifying individuals' risk perceptions and investigating affecting factors is critical
  - Explaining farmers' willingness to implement adaptation and mitigation
  - Developing and improving outreach programs
- In previous literature:
  - reliance on qualitative methods (e.g., Likert type scales)
  - focus on magnitude of perceived risk and not on probability of events



## Our contribution to literature

- Quantification of short run (2011) and long run (2013) risk perception
  - using the Exchangeability method that allows to take both magnitude and probability into account
- Identification of beliefs, direct experience and probabilistic numeracy as explaining factors of risk perceptions



# Considered Hazards (I)

Focus on key crop loss hazards whose gravity is predicted to increase with climate change

## Hail precipitations:

- Main cause of revenue losses
- An increase in gravity and frequency is directly linked to more extreme weather conditions



## Considered Hazards (II)

### Powdery mildew:

- fungal disease that affects grapes
- a growing threat as temperatures increase and rain becomes scarcer



### Apple dieback:

- condition where apple trees die prematurely
- a growing threat as extreme winter conditions become more frequent







## Collected Data

- Computer-assisted-personal-interviews to collect data on
  - **risk perceptions elicited via the exchangeability method**
  - beliefs regarding climate change
  - farm and farmer characteristics
  - historical farm crop losses
- Data collected in spring 2011
- 195 farmers in Trentino
  - 120 operating apple orchards
  - 75 operating grape vineyards

# Exchangeability Method

(Baillon A., *Decision Analysis* 2008)

- Subjects choose between prospects that consist of two disjoint intervals of the event space.

Select (by clicking on it) the alternative (A or B) that you believe is more likely

In my opinion, the percentage of apple value losses due to hail at the province level in the upcoming season (2031) is going to be:

Alternative A

Less than or  
equal to  
50%

Alternative B

More than  
50%

- Choices are iterative, disjoint intervals are adjusted based on prior answer, until indifference.
- **Indifference identifies the median damage (our measure of risk perceptions).**



# Risk Perceptions

- Short-run perceptions:  
upcoming growing season, 2011
- **Long-run perceptions**  
future growing season, **2031**
  - We use long-run perceptions to investigate whether farmers have quantitatively detectable perceptions of climate change related risks
  - We were constrained in the choice of the long-run timeframe by practical reasons as emerged in the focus groups
- Each farmer went through the EM 4 times

# Elicited Values

*Median damage (Average values across farmers)*

<b>Risk type</b>	<b>Unit of measure</b>	<b>Short Run 2011</b>	<b>Long Run 2031</b>
Hail	% apple value loss	21.17	<b>26.24</b>
Hail	% grape value loss	12.68	<b>18.65</b>
Dieback	% apple trees affected	10.47	<b>11.74</b>
Powdery Mildew	% grape bunches affected	10.12	<b>13.27</b>



## General Beliefs on Climate Change

***Do you believe that climate is changing?***

**83% Yes**

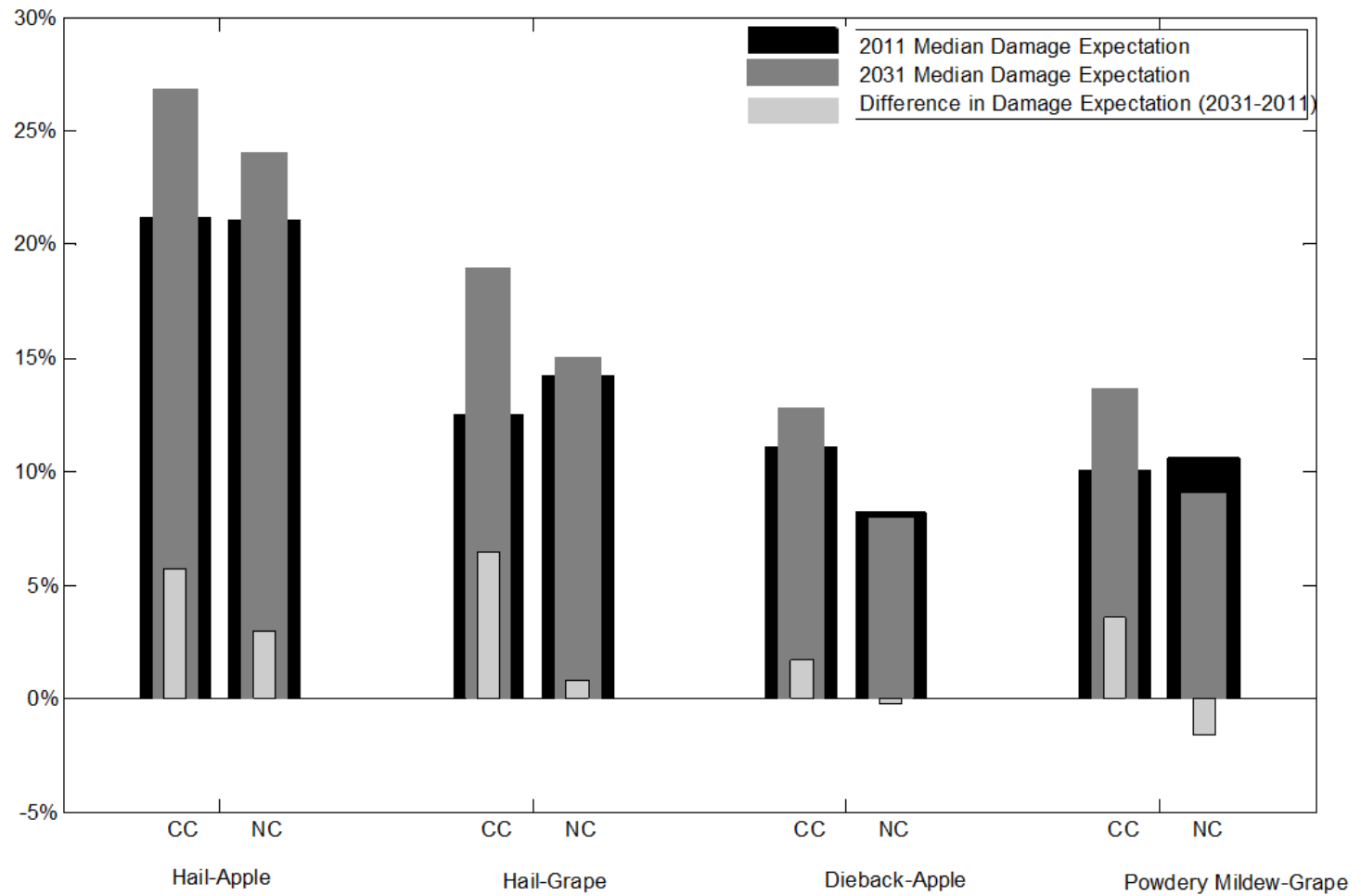
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	%
Due to natural factors exclusively	5.6
Due predominantly to natural factors	14.2
Due to a similar extent to natural and human activity factors	58.0
Due predominantly to human activity factors	19.1
Due to human activity factors exclusively	3.1

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# Risk perceptions according to beliefs



# Regression models

Variable	Farmers' 2031-2011 Median Province Damage Expectations			
	Apple Hail	Grape Hail	Apple Dieback	Grape Powdery Mildew
Age	-0.046 (0.100)	-0.036 (0.074)	0.042 (0.088)	-0.077 (0.095)
Climate Change Belief	3.161* (1.648)	3.802** (1.716)	2.478* (1.377)	5.902 (4.268)
Cultivated/Owned	0.012 (0.029)	-0.003 (0.028)	0.020 (0.035)	0.045 (0.038)
Education	0.002 (0.357)	1.236*** (0.405)	-0.130 (0.384)	0.518 (0.405)
Farm Size	-0.492 (0.341)	-0.168 (0.316)	0.375 (0.250)	-0.464 (0.311)
Farming Experience	-0.069 (0.094)	0.149* (0.085)	0.024 (0.084)	0.086 (0.081)
Full Time	0.236 (2.067)	-1.213 (1.767)	0.314 (2.398)	-0.403 (2.266)
Household Size	-0.408 (0.777)	-0.180 (0.552)	0.328 (0.776)	-0.621 (0.845)
Income	0.941 (0.737)	0.089 (0.759)	0.532 (0.684)	1.782 (1.237)
Liquidity	0.571 (2.238)	-0.146 (1.638)	-3.957 (2.411)	-3.443* (1.964)



# Regression models (ctd)

Variable	Farmers' 2031-2011 Median Province Damage Expectations			
	Apple Hail	Grape Hail	Apple Dieback	Grape Powdery Mildew
Damage Experience <sup>a</sup>	3.480*	2.561*	3.364*	4.085**
	(1.841)	(1.435)	(1.805)	(1.619)
Probability Test Score	1.111*	0.826**	1.039*	1.511***
	(0.655)	(0.373)	(0.620)	(0.504)
Coop Member	-0.685	0.624	-2.248	3.482
	(2.404)	(3.400)	(2.471)	(4.361)
Coop Representative	1.326	-1.952	1.697	1.998
	(1.759)	(1.806)	(1.459)	(2.808)
Co.Di.Pr.A	2.904*	1.645	2.010	0.092
	(1.652)	(1.555)	(1.633)	(2.130)
Sessions & Articles	-0.279	0.581	-0.573*	0.442
	(0.407)	(0.378)	(0.291)	(0.393)
Constant	-0.191	-17.573**	-7.508	-20.695*
	(7.926)	(7.337)	(7.389)	(10.580)
R-Squared	0.159	0.490	0.164	0.348

Note: \* , \*\* , \*\*\* denote 10%, 5%, and 1% significance levels, respectively. Stdev in parenthesis.

<sup>a</sup> For the Apple Hail and Grape Hail regression this explanatory variable is past experience with hail damage.

For Apple Dieback and Grape Powdery Mildew this variable is past experience with damage from that peril.



# Qualitative measures

"On a scale from -5 (strong decline) to +5 (strong increase) in damage, how will climate change affect the average damage due to hail change in the future (2031)?"

Qualitative changes in expected average damage at the province level in the long-run (2031),

<b>Risk Type</b>	<b>Obs.</b>	<b>Mean</b>	<b>StdDev</b>
Hail-Apples	120	1.28	1.86
Hail-Grapes	75	1.49	1.36
Dieback-Apples	120	1.34	1.85
Powdery Mildew-Grapes	75	1.48	1.84

<b>Risk Type</b>	<b>CC Believers</b>	<b>CC Non-Believers</b>	<b>Difference</b>
Hail-Apples	1.43 (0.20)	0.77 (1.43)	0.65*
Hail-Grapes	1.55 (0.17)	0.83 (0.31)	0.72*
Dieback-Apples	1.59 (0.20)	0.48 (0.25)	1.10***
Powdery Mildew-Grapes	1.55 (0.23)	0.67 (0.49)	0.88

# Conclusions

- Farmers who believe in climate change have higher quantitative perceptions of future hazards to their farming operations that are directly (hail) or indirectly (crop disease susceptibility) related to climate change
- Direct experience .....



Thank you

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