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Climate, Insurance, and Innovation: the Case of the U.S. Agriculture

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(Preliminary Results. Please do not quote without the author's permission.)

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Motivation

- Innovation and insurance:
 - ▣ two options for agricultural adaptation
 - ▣ Substitutes or complements?
- Research purposes:
 - ▣ effects of climate and insurance on innovation
 - ▣ interaction between climate and insurance

Relevant literature

- Crop insurance's effect on agricultural input use and technology adoption:
 - ▣ Weber, Key, and O'Donoghue (*JAERE*, 2016)
 - ▣ Deryugina and Konar (*Advances Water Resources*, 2017)
- Climatic shocks' effect on innovation:
 - ▣ Miao and Popp (2014, *JEEM*)
- Health insurance's effect on medical innovation:
 - ▣ Clemens (2013, NBER working paper): 'innovating-by-doing'

Theoretical Framework

- A farmer faces two technologies:
 - ▣ a conventional technology and a new technology
- Two states of nature:
 - ▣ bad weather with prob. p ;
 - ▣ good weather with prob. $1-p$.
- Let R_j^i denote returns of technology i in state j .
- Assume $R_{\text{good_st}}^{\text{conv_tech}} > R_{\text{good_st}}^{\text{new_tech}} > R_{\text{bad_st}}^{\text{new_tech}} > R_{\text{bad_st}}^{\text{conv_tech}}$.
- Study how climate variation and insurance affect

$$\Delta \equiv U(R^{\text{conv_tech}}) - U(R^{\text{new_tech}}).$$

Theoretical Framework: projections

- **Hypothesis 1:** Climate variation increases innovation.
- **Hypothesis 2 :** Crop insurance, subsidized or not, decreases innovation.
- **Hypothesis 3 :** Under certain conditions, crop insurance (subsidized or not) weakens the incentivizing effect of climate change on innovation.

Data

- Ten major crops in the United States.
- Drought trait patent counts as measure of innovation for each crop.
- Drought index in production area of each crop.
- Insured acreage as a measure of crop insurance prevalence for each crop.

Econometric model

drought tolerant crop patent counts =

- average drought index in previous 3 years +
- average insured acreage in previous 3 years +
- interaction b/t the above two variables +
- knowledge stock +
- time trend

Regression results (dependent var.: patent count)

	Model (1)		Model (2)	
	Fixed effects	Random effects	Fixed effects	Random effects
Average drought index in previous three years	0.022** (0.009)	0.022** (0.009)	0.017* (0.010)	0.015* (0.010)
Average insured acreage in previous three years	-	-	0.004 (0.003)	0.005 (0.003)
Drought index × Insured acreage	-0.0009*** (0.0002)	-0.0009*** (0.0002)	-0.0008*** (0.0002)	-0.0008*** (0.0002)
One-year lagged knowledge stock	-0.0006*** (0.0001)	-0.0006*** (0.0001)	-0.0006*** (0.0001)	-0.0006*** (0.0001)
Time trend	0.154*** (0.0060)	0.153*** (0.0060)	0.152*** (0.0060)	0.150*** (0.0060)
Constant	-	-303.76*** (11.2200)	-	-296.82*** (12.0300)
Observations	190	190	190	190

Preliminary Conclusions

- droughts in lagged years incentivize innovative activities for drought tolerant crops;
 - ▣ elasticity: about 0.25 in the absence of crop insurance.
- crop insurance weakens droughts' effect on innovation;
 - ▣ reduce the above elasticity by 60%: from 0.25 to 0.1;
- innovation on drought tolerant crops may have diminishing returns.