Risk Balancing, Credit Constraints, and Input Use: A Natural Experiment from Hog Farmers in China

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SCC-76 Annual Meeting, March 2016

Outline

Overview

- This paper examines whether purchasing agricultural insurance will result in higher demand for credit among farmers.
- We use a natural experiment to test the theory of Risk Balancing Hypothesis (RBH).
- Our data come from a pilot hog insurance program in China.
- Our identification strategy comes from a geographic regression discontinuity (RD) design.

For those farmers who are enrolled in the hog insurance program:

(1) they **do not** significantly have higher probability of taking debt,

(2) are **20% more** likely to be willing to take debt,

Possible explanation:

- Farmers face credit constraint.

Risk Balancing Hypothesis

The Risk Balancing Hypothesis (RBH) (Gabriel and Baker, 1980):

Farm Total Risk=Business Risk $\downarrow$+Financial Risk $\uparrow$

- Business risk–the risk inherent in the firm.

  e.g. yield or production variability; price variability for both outputs and inputs.

- Financial risk–the added variability of the net cash flows of the owners of equity.

  e.g. the risk of cash insolvency which associated with debt financing and cash leasing.

Literature Review: Theoretical Articles

Unconstraint model — Business Risk $\downarrow$ Financial Risk $\uparrow$

- Barry et al.(1981):
  —maximize the expected utility of return to equity
  —the farmer chooses the optimal debt level
- Collins (1985):
  —maximize the expected utility of rate of return to assets
  —the farmer chooses the optimal debt to asset ratio

Constraint model — RBH may not hold

- Wu et al. (2014):
  —extend Collins model by incorporating tax, cost of capital, and credit risk into the risk balancing framework

Literature Review: Empirical Articles

- Ifft et al. (2013): U.S. farms with crop insurance tend to take more debt.
- Uzea et al. (2014): Canadian business risk management program does not increase farmers' debt use.
- de Mey et al. (2014): In the EU, whether the RBH would be rejected depends on farmers' production sector and country of residence.
- Karlan et al. (2014): In northern Ghana, farmers with weather index insurance tend to increase their demand for larger size of investment and riskier production choices.
- Cai (2013): In China, tobacco farmers with crop insurance,on average, take 25 percent more debt.

Motivation

- Current studies on livestock insurance are relatively scarce.
- Findings in crop insurance may not be directly applicable for livestock insurances.
- We try to identify a **causal effect** rather than a correlation between participating insurance and debt use.

Research Question

- (1) whether purchasing hog insurance increases the farmers' probability of taking debt;
- (2) whether the farmers with hog insurance are more willing to take debt.

Contributions

- Using the **RD design**, this paper identify a **causal effect** between participating insurance and debt use.
- The **natural experimental data** allows for possible explanation for why RBH fails in certain cases
  —the presence of **credit constraint**.
- This is the first empirical paper on the impact of livestock insurance program on farmers' debt use decisions and demand of credit in developing countries.

In this study, we utilize a natrual experiment from Jiyuan City in Henan Province, China.

- In 2013, the pork production was 54.93 million tons in China, which is more than 50% of the total production of the world.
- Jiyuan is a top county of hog production in China. There are about 10,000 hog farmers, slaughtering about 1 million hogs per year.
- Hog insurance is mainly used to protect the hog production and stabilize farmers' income through compensating farmers for dead pigs.

- 2 from 13 towns of Jiyuan city were selected and implemented the compulsory hog insurance on farmers in 2013.
- The survey is conducted in early July 2014. The questionnaire includes:
  - farmers' basic demographic variables,
  - production risk and risk attitude,
  - financial information,
  - hog raising technology and behavioral information,
  - food safety information.

Data

- If selection into treatment is random, then an OLS is sufficient. However, it is not.
- The towns were chosen because they are closer to city center.
- Big, industrialized farms lie in the mountains, far away from city center (must be in control group).
- Thus, treatment group and control group are fundamentally different.

Selected Data Summary Statistics

	Full sample	Treatment	Control
Debt use dummy	0.643	0.586	0.669
(=1 if using debt)	(0.479)	(0.494)	(0.471)
WTD dummy	0.761	0.752	0.765
(=1 if willing to take debt)	(0.427)	(0.433)	(0.424)
Use input on credit dummy	0.813	0.845	0.799
(=1 if using inputs on credit)	(0.390)	(0.363)	(0.401)
Percentage of input use on credit	70.921	83.37	64.98
	(30.36)	(26.02)	(30.53)
Age of the Primary Owner	50.80	52.61	50.06
	(8.99)	(8.89)	(8.94)
Years of education	3.168	3.2	3.16
	(0.643)	(0.635)	(0.646)
Income from hog production (yuan)	16335.53	10244.4	19062.91
	(49776.87)	(36258.11)	(54588.4)
Distance to border (m)	-6430.82	1861.84	-9782.713
	(7442.45)	(1360.20)	(6161.054)
Observations	535	154	381

Identification Strategy –the Geographic Regression Discontinuity Design

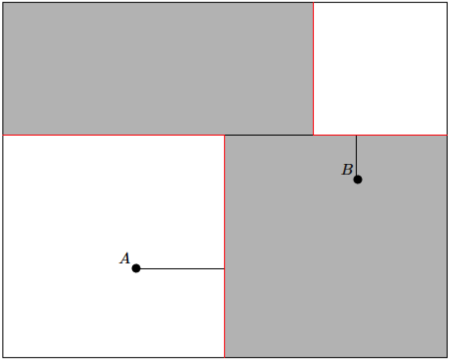
- We use geographic RD design to deal with this problem.
- Used in policy impact analysis where policies were implemented based on geographic area.
- Such as school district, construction of public facility, etc.
- In our case, we look at farms that are close enough to the border of policy implementation.
- The key identifying assumption:
  when farmers are close enough to the border between treatment and control group, the selection into treatment is as good as random.

Illustration of Distance Variable Construction

Following *Lalive* (2008), we construct a distance measure, denoted by d as follows.

$$d(c) = -|c, \mathcal{T}|, \forall c \in C.$$
$$d(t) = |t, \mathcal{C}|, \forall t \in T.$$

T, C—the set of **observations** in treatment and control group
$\mathcal{T}$, $\mathcal{C}$—the set of **borders** of treatment and control group



Estimation: Farmers' Demand of Credits

$$Debt\ Use_i = \beta_0 + \beta_1 I_i + \beta_2 d_i + \beta_3 d_i \cdot I_i, \quad |d| < \bar{d}.$$

$$WTD_i = \beta_0 + \beta_1 I_i + \beta_2 d_i + \beta_3 d_i \cdot I_i, \quad |d| < \bar{d}.$$

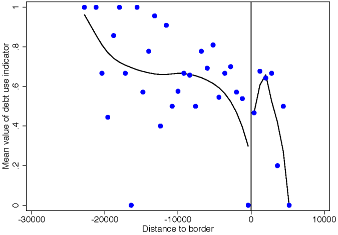
–***I*** is the indicator for insurance treatment;

–***d*** is the distance measure;

–***Debt Use*** is a dummy variable, i.e. $=1$ if the farmer uses debt;

–***WTD*** is a dummy variable, i.e. $=1$ if the farmer is willing to take debt.

Graphical Analysis and Estimation Results —Farmer's Debt Use

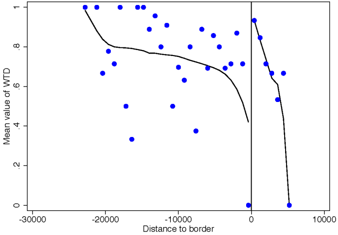


	(1) Full sample OLS	(2) 20 km OLS	(3) 20 km OLS	(4) 10km OLS	(5) 10km OLS	(6) 10km Probit
Treatment effect	0.033 (0.073)	0.096 (0.082)	0.185* (0.109)	0.185 (0.122)	-0.209 (0.379)	0.184 (.122)
Polynomial order	1	1	1	1	3	1
Boundary FE	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	No	No	Yes	Yes	Yes	Yes
R^2	0.037	0.042	0.080	0.065	0.094	
Observations	502	470	412	312	312	312

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Graphical Analysis and Estimation Results —Farmer's Willingness to Take Debt



	(1) Full sample OLS	(2) 20 km OLS	(3) 20 km OLS	(4) 10km OLS	(5) 10km OLS	(6) 10km Probit
Treatment effect	0.104 (0.071)	0.155** (0.078)	0.253*** (0.090)	0.195** (0.103)	0.229* (0.136)	0.203** (0.104)
Polynomial order	1	1	1	1	3	1
Boundary FE	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	No	No	Yes	Yes	Yes	Yes
R^2	0.037	0.035	0.073	0.083	0.126	
Observations	506	473	414	314	313	313

Standard errors in parentheses

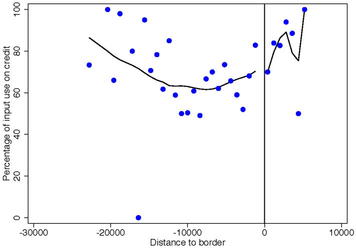
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Estimation: Evidance of Farmers' Informal Credit Use

$$Deferred\ \ Payment\ \ Percentage_i = \beta_0 + \beta_1 I_i + \beta_2 d_i + \beta_3 d_i \cdot I_i, \ \ |d| < \bar{d}.$$

–***Deferred Payment Percentage*** is the percentage of a farm's total feed cost on deferred payment option.

Graphical Analysis and Estimation Results
—the Percentage of Farmers' Deferred Payment Use



	(1) Full sample OLS	(2) 20 km OLS	(3) 20 km OLS	(4) 10km OLS	(5) 10km OLS
Treatment effect	19.596*** (6.309)	18.530*** (6.540)	21.526*** (6.899)	7.149 (7.523)	5.985 (8.660)
Polynomial order	1	1	1	1	3
Boundary FE	Yes	Yes	Yes	Yes	Yes
Covariates	No	No	Yes	Yes	Yes
R^2	0.097	0.100	0.149	0.203	0.207
Observations	418.00	397.00	358.00	271.00	271.00

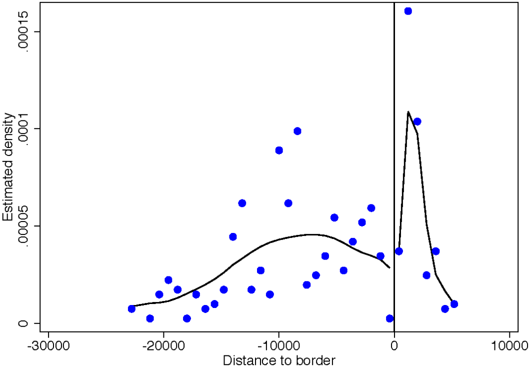
Standard errors in parentheses

It is **impossible** for farmers to choose to change their operation location.

- (1) most of the farms in our sample are smallholders;
- (2) the selection into the compulsory insurance is determined by the "Hukou" of the farmers, which is the residential registration status for a farm;
- (3) we use a McCrary (2008) method to empirical test if there is manipulation with the running variable (*d*) and the test result is negative.

Graphical Analysis
–Density of the Running Variable (d)

McCrary (2008) suggests that, if there is no manipulation of the running variable, we should not observe a discontinuous change of the running variable at the cutoff.



Conclusions

- The difference of probability of taking debt between the two groups is insignificant;
- Farmers that are selected into the compulsory hog insurance program are 20% more likely to be willing to take debt than those who are not.
- Big farms without hog insurance use more inputs on credit.
  - The existence of credit constraint prevents farmers with hog insurance from taking more debt.

Thank you!