



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search  
<http://ageconsearch.umn.edu>  
[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

# The Impact of Crop Insurance on Farm Credit and Investment Decisions

Elizabeth Berger <sup>1</sup>   Jennifer Ifft <sup>2</sup>   Margaret Jodlowski <sup>3</sup>   Todd  
Kuethe <sup>4</sup>

<sup>1</sup>Johnson Graduate School of Management, Cornell Univ.

<sup>2</sup>Department of Agricultural Economics, Kansas State Univ.

<sup>3</sup>Department of AEDE, Ohio State Univ.

<sup>4</sup>Department of Agricultural Economics, Purdue Univ.

NC-1177 2020 Virtual Annual Meeting  
October 21, 2020

This research was supported through a cooperative agreement with the USDA Office of the Chief Economist and Risk Management Agency.

# Introduction

Risk management increases firm value:

# Introduction

Risk management increases firm value:

- Strong correlation between operating credit levels and federal crop insurance (FCI)

# Introduction

Risk management increases firm value:

- Strong correlation between operating credit levels and federal crop insurance (FCI)
- Improves ability to invest

# Introduction

Risk management increases firm value:

- Strong correlation between operating credit levels and federal crop insurance (FCI)
- Improves ability to invest
- Productivity gains

# Introduction

Risk management increases firm value:

- Strong correlation between operating credit levels and federal crop insurance (FCI)
- Improves ability to invest
- Productivity gains

# Research Questions

One

How does FCI change the amount and type of credit used?



# Research Questions

One

How does FCI change the amount and type of credit used?

Two

What sort of investment does increased risk management promote on-farm?

# Research Questions

## One

How does FCI change the amount and type of credit used?

## Two

What sort of investment does increased risk management promote on-farm?

## Three

To what extent is capital-labor substitution another channel by which risk management augments firm value?

# Mechanisms

# Mechanisms

- Theoretical models of risk balancing (Gabriel and Baker, 1980)

# Mechanisms

- Theoretical models of risk balancing (Gabriel and Baker, 1980)
- Overcoming credit constraints (Liang, 2014)

# Mechanisms

- Theoretical models of risk balancing (Gabriel and Baker, 1980)
- Overcoming credit constraints (Liang, 2014)
- FCI as collateral: lenders driving relationship

# Mechanisms

- Theoretical models of risk balancing (Gabriel and Baker, 1980)
- Overcoming credit constraints (Liang, 2014)
- FCI as collateral: lenders driving relationship
- Lower variability of income increase demand for investment

# Mechanisms

- Theoretical models of risk balancing (Gabriel and Baker, 1980)
- Overcoming credit constraints (Liang, 2014)
- FCI as collateral: lenders driving relationship
- Lower variability of income increase demand for investment
- Estimation strategy can identify only direct relationships with crop insurance; use theory to form connections between them



# Summary

# Summary

## Data

91,000 farm-year observations from ARMS cross section; 30,000 farm-year observations from the ARMS unbalanced panel

# Summary

## Data

91,000 farm-year observations from ARMS cross section; 30,000 farm-year observations from the ARMS unbalanced panel

## Empirical Strategy

Unbalanced panel and FCI program coverage limits as an instrumental variable for insurance coverage (premiums paid per acre)

# Summary

## Data

91,000 farm-year observations from ARMS cross section; 30,000 farm-year observations from the ARMS unbalanced panel

## Empirical Strategy

Unbalanced panel and FCI program coverage limits as an instrumental variable for insurance coverage (premiums paid per acre)

## Results

Increased FCI:

- 1) Increases in the quantity and intensity of short term debt use;
- 2) Increased equipment value and more labor-saving equipment used;
- 3) Increases farm household specialization: increased operator on-farm hours with decreased spouse on-farm hours

# USDA Agricultural Resource Management Survey (ARMS)

# USDA Agricultural Resource Management Survey (ARMS)

- Unbalanced panel Panel summary statistics

# USDA Agricultural Resource Management Survey (ARMS)

- Unbalanced panel Panel summary statistics
  - ARMS observations can be linked over time (Weber et al., 2016)
  - Use data from 2000-2014
  - Farms must have had at least \$10,000 in sales from the primary insurable crops
  - Must have participated in FCI in at least one year

# USDA Agricultural Resource Management Survey (ARMS)

- Unbalanced panel Panel summary statistics
  - ARMS observations can be linked over time (Weber et al., 2016)
  - Use data from 2000-2014
  - Farms must have had at least \$10,000 in sales from the primary insurable crops
  - Must have participated in FCI in at least one year
- Operations with and without crop insurance differ markedly panel



# USDA Agricultural Resource Management Survey (ARMS)

- Unbalanced panel Panel summary statistics
  - ARMS observations can be linked over time (Weber et al., 2016)
  - Use data from 2000-2014
  - Farms must have had at least \$10,000 in sales from the primary insurable crops
  - Must have participated in FCI in at least one year
- Operations with and without crop insurance differ markedly panel
- Measure crop insurance participation using premiums paid per acre

# Instrumental variable

- Simultaneity between financial decisions and the decision to enroll in crop insurance

## Instrumental variable

- Simultaneity between financial decisions and the decision to enroll in crop insurance
- Use the IV developed by Weber et al. (2016):

# Instrumental variable

- Simultaneity between financial decisions and the decision to enroll in crop insurance
- Use the IV developed by Weber et al. (2016):
  - Maximum coverage levels means that some farmers can increase coverage more than others

# Instrumental variable

- Simultaneity between financial decisions and the decision to enroll in crop insurance
- Use the IV developed by Weber et al. (2016):
  - Maximum coverage levels means that some farmers can increase coverage more than others
  - Program limits are plausibly exogenous to current decision making

## Instrumental variable

- Simultaneity between financial decisions and the decision to enroll in crop insurance
- Use the IV developed by Weber et al. (2016):
  - Maximum coverage levels means that some farmers can increase coverage more than others
  - Program limits are plausibly exogenous to current decision making
  - The ratio of the initial premium and the maximum premium therefore serves as an instrument for the difference in premiums between any two years:

$$\ln(PA_{i,t=2}) - \ln(PA_{i,t=1}) = \theta \ln\left(\frac{PA_{i,t=1}}{\text{Max}PA_{i,t=1}}\right) \quad (1)$$

## Estimating equation: Farm panel

$$y_{it} = \beta_0 + \tau_t + \gamma_c + \beta_1 \underbrace{P_{it}}_{=\theta \ln\left(\frac{PA_{i,t=1}}{\text{Max}PA_{i,t=1}}\right)} + \beta_2 \mathbf{F}_{it} + \epsilon_{ict} \quad (2)$$

where:

$y_{it}$  is the outcome of interest for farm  $i$  in year  $t$

$P_{it}$  is FCI coverage

$\theta \ln\left(\frac{PA_{i,t=1}}{\text{Max}PA_{i,t=1}}\right)$  is IV described previously

$F_{it}$  are controls for time-variant operator characteristics

$\tau_t$  are year fixed effects

$\gamma_c$  are county fixed effects

# Debt

Relationship between debt and insurance has been observed in the literature and confirmed here:

- Increase in premiums paid increases farm operation's short term debt



# Debt

Relationship between debt and insurance has been observed in the literature and confirmed here:

- Increase in premiums paid increases farm operation's short term debt
- Results driven by increase in outstanding (rather than repaid) debt

# Debt

Relationship between debt and insurance has been observed in the literature and confirmed here:

- Increase in premiums paid increases farm operation's short term debt
- Results driven by increase in outstanding (rather than repaid) debt
- Effect concentrated among operations that are:
  - Less leveraged than average
  - Have higher DRCU than average
  - Have operators that are older

## Where does the money go? Results on investment

No impact on long term debt (real estate) but investment in capital does increase:

## Where does the money go? Results on investment

No impact on long term debt (real estate) but investment in capital does increase:

- Increase in annual spending on:
  - Non-tractor farm machinery (\$2,700\*)
  - Attachments for farm machinery (\$1,700\*)

## Where does the money go? Results on investment

No impact on long term debt (real estate) but investment in capital does increase:

- Increase in annual spending on:
  - Non-tractor farm machinery (\$2,700\*)
  - Attachments for farm machinery (\$1,700\*)
- Increase in market value of farm machinery (\$40,000\*\*\*)

# Is this equipment labor-saving? Labor allocations

Farm households' response to risk management:

# Is this equipment labor-saving? Labor allocations

Farm households' response to risk management:

- Operators increase on-farm hours

## Is this equipment labor-saving? Labor allocations

Farm households' response to risk management:

- Operators increase on-farm hours
- Spouses and other (business) partners decrease on-farm hours



## Is this equipment labor-saving? Labor allocations

Farm households' response to risk management:

- Operators increase on-farm hours
- Spouses and other (business) partners decrease on-farm hours
- Net effect: fewer on-farm hours

# Discussion

We find:

# Discussion

We find:

- Strong relationship between the quantity of short term debt and crop insurance coverage and participation

# Discussion

We find:

- Strong relationship between the quantity of short term debt and crop insurance coverage and participation
- Simultaneous increase in investment in equipment, which is less labor-intensive
  - Robustness check using machinery characteristics from Phase2

# Discussion

We find:

- Strong relationship between the quantity of short term debt and crop insurance coverage and participation
- Simultaneous increase in investment in equipment, which is less labor-intensive
  - Robustness check using machinery characteristics from Phase2
- Managerial vs. “employee” labor: Advantages to freeing up employee labor

# Conclusion

# Conclusion

- Reduction in cash flow volatility as internal finance to increase investment in equipment

# Conclusion

- Reduction in cash flow volatility as internal finance to increase investment in equipment
- Crop insurance addressed financial frictions associated with operating credit and it freed up working capital for labor saving investments



# Conclusion

- Reduction in cash flow volatility as internal finance to increase investment in equipment
- Crop insurance addressed financial frictions associated with operating credit and it freed up working capital for labor saving investments
- Previous research (i.e. Weber et al. (2016)) finds minimal impact of crop insurance on the intensive margin of production, for example chemical expenditure.

# Conclusion

- Reduction in cash flow volatility as internal finance to increase investment in equipment
- Crop insurance addressed financial frictions associated with operating credit and it freed up working capital for labor saving investments
- Previous research (i.e. Weber et al. (2016)) finds minimal impact of crop insurance on the intensive margin of production, for example chemical expenditure.
  - Our research suggests alleviation of financial frictions leads to dynamic adjustments in capital/labor use by farm households

# Conclusion

- Reduction in cash flow volatility as internal finance to increase investment in equipment
- Crop insurance addressed financial frictions associated with operating credit and it freed up working capital for labor saving investments
- Previous research (i.e. Weber et al. (2016)) finds minimal impact of crop insurance on the intensive margin of production, for example chemical expenditure.
  - Our research suggests alleviation of financial frictions leads to dynamic adjustments in capital/labor use by farm households
  - Farm household behavior and decision making is relevant for analysis of commercial agriculture

# Thank you!

Any questions?

## References I

- Ahrendsen, B. L., Dixon, B. L., Dodson, C. B., Danforth, D., McMin, N., et al. (2016). Arms respondent errors: A case of farm service agency loans. In *2016 Annual Meeting, July 31-August 2, 2016, Boston, Massachusetts*. Agricultural and Applied Economics Association.
- Briggeman, B. C., Towe, C. A., and Morehart, M. J. (2009). Credit constraints: their existence, determinants, and implications for us farm and nonfarm sole proprietorships. *American Journal of Agricultural Economics*, 91(1):275–289.
- Coble, K., Barnett, B., Riley, J., et al. (2013). Challenging belief in the law of small numbers. In *Agricultural and Applied Economics Association 2013 Crop Insurance and the Farm Bill Symposium, Louisville Oct.*
- de Mey, Y., Van Winsen, F., Wauters, E., Vancauteran, M., Lauwers, L., and Van Passel, S. (2014). Farm-level evidence on risk balancing behavior in the eu-15. *Agricultural Finance Review*, 74(1):17–37.

## References II

- Economic Research Service (2016). Farm household income (historical). <https://www.ers.usda.gov/topics/farm-economy/farm-household-well-being/farm-household-income-historical/>.
- Erik, O. (2014). The effects of premium subsidies on demand for crop insurance. Technical report, United States Department of Agriculture, Economic Research Service.
- Featherstone, A. M., Moss, C. B., Baker, T. G., and Preckel, P. V. (1988). The theoretical effects of farm policies on optimal leverage and the probability of equity losses. *American Journal of Agricultural Economics*, 70(3):572–579.
- Gabriel, S. C. and Baker, C. B. (1980). Concepts of business and financial risk. *American Journal of Agricultural Economics*, 62(3):560–564.
- Glauber, J. W. (2004). Crop insurance reconsidered. *American Journal of Agricultural Economics*, 86(5):1179–1195.

## References III

- Glauber, J. W. (2013). The growth of the federal crop insurance program, 1990–2011. *American Journal of Agricultural Economics*, 95(2):482–488.
- Goodwin, B. K. and Smith, V. H. (2013). What harm is done by subsidizing crop insurance? *American Journal of Agricultural Economics*, 95(2):489–497.
- Hoppe, R. A., , and MacDonald, J. (2016). America's diverse family farms 2016 edition. *Economic Information Bulletin-USDA Economic Research Service*, (164).
- Ifft, J., Wu, S., and Kuethe, T. (2014). The impact of pasture insurance on farmland values. *Agricultural and Resource Economics Review*, 43(3):390–405.

## References IV

- Ifft, J. E., Kueth, T., and Morehart, M. (2015). Does federal crop insurance lead to higher farm debt use? evidence from the agricultural resource management survey (arms). *Agricultural Finance Review*, 75(3):349–367.
- Just, R. E., Calvin, L., and Quiggin, J. (1999). Adverse selection in crop insurance: Actuarial and asymmetric information incentives. *American Journal of Agricultural Economics*, 81(4):834–849.
- Liang, L. (2014). Federal crop insurance and credit constraints: Theory and evidence. Technical report.
- Miranda, M. J. and Glauber, J. W. (1997). Systemic risk, reinsurance, and the failure of crop insurance markets. *American Journal of Agricultural Economics*, 79(1):206–215.



## References V

- Uzea, N., Poon, K., Sparling, D., and Weersink, A. (2014). Farm support payments and risk balancing: implications for financial riskiness of canadian farms. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, 62(4):595–618.
- Weber, J. G., Key, N., and O'Donoghue, E. (2016). Does federal crop insurance make environmental externalities from agriculture worse? *Journal of the Association of Environmental and Resource Economists*, 3(3):707–742.
- Zhang, W. (2017). Four reasons why we aren't likely to see a replay of the 1980's farm crisis. *Agricultural Policy Review*, Spring 2017:7–10.

# Cross section summary statistics

	Restricted cross section (select variables)		
	Obs	Mean	Std. Dev.
Insurance acres dummy	91,171	0.6797337	0.4665814
FCI premium paid per acre (\$)	88,867	\$ 7.24	\$ 15.58
<b>Outcomes</b>			
totalshort	123,122	\$ 266,389.20	\$ 968,516.80
financed	122,860	0.556	15.68
dshort	123,122	\$ 95,246.66	500031.9
repaid	123,122	\$ 171,142.50	707988.9
dreale	123,122	\$ 206,759.30	\$ 895,115.90
dnreale	123,122	\$ 84,739.47	\$ 462,139.70
<b>Operator characteristics</b>			
Operator age	123,122	55.05	12.08
Total off-farm income	117,149	\$ 53,171.37	\$ 142,985.80
<b>Operation characteristics</b>			
Acres operated	123,122	1681.34	4262.38
Share of acres owned	123,122	0.551	1.738
<b>Sales class</b>			
\$500,000+	123,122	42.18%	49.39%
\$250,000-\$499,000	123,122	18.56%	38.88%
\$100,000-\$249,000	123,122	18.47%	38.81%
\$40,000-\$99,999	123,122	11.08%	31.39%
\$20,000-\$39,000	123,122	4.54%	20.81%
\$10,000-\$19,000	123,122	2.40%	15.32%
\$9,999 or less	123,122	2.76%	16.39%

## Panel summary statistics

	Obs	Restricted panel	
		Mean	Std. Dev.
Insurance acres dummy	22,371	0.702	0.457
FCI premium paid per acre (\$)	27,921	\$ 7.35	\$ 14.28
<b>Outcomes</b>			
totalshort	30,957	\$ 458,179.20	\$ 1,519,330.00
financed	30,930	0.514	0.866
dshort	30,957	\$ 157,107.20	\$ 770,473.90
repaid	30,957	\$ 301,072.00	\$ 1,137,942.00
dreale	30,957	\$ 329,667.50	\$ 1,333,795.00
dnreale	30,957	\$ 139,431.60	\$ 627,065.80
<b>Operator characteristics</b>			
Operator age	30,957	54.60	11.09
Acres operated	30,957	2512.49	6212.23
Soybeans share	30,957	20.66%	23.60%
Corn share	30,957	17.89%	21.60%
Wheat share	30,957	9.58%	16.85%

# Cross section: FCI participants vs. non-participants

	Any Insurance			No Insurance			Difference significant at:
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	
Insurance acres dummy	64,991	0.954	0.210	26,180	0	0	***
FCI premium paid per acre (\$)	64,145	10.03	17.56	24,722	0	0	***
<b>Outcomes</b>							
totalshort	86,989	\$ 301,813.20	\$ 936,834.50	36,133	\$ 181,107.20	\$ 1,035,899.00	***
financed	86,976	0.562	0.837	35,884	0.541	28.98	***
dshort	86,989	\$ 103,916.10	\$ 480,045.50	36,133	\$ 74,375.34	\$ 544,592.50	***
repaid	86,989	\$ 197,897.10	\$ 673,003.30	36,133	\$ 106,731.80	\$ 782,117.70	***
dreale	86,989	\$ 211,898.70	\$ 841,170.00	36,133	\$ 194,386.40	\$ 1,013,182.00	***
dnreale	86,989	\$ 87,799.53	\$ 376,065.30	36,133	\$ 77,372.48	\$ 622,253.00	***
<b>Operator characteristics</b>							
Operator age	86,989	54.34	11.85	36,133	56.75	12.46	***
Total off-farm income	83,094	\$ 51,218.25	\$ 144,638.60	34,055	\$ 57,936.95	\$ 138,757.00	***
<b>Operation characteristics</b>							
Acres operated	86,989	1906.01	3642.47	36,133	1140.45	5436.16	***
Share of acres owned	86,989	0.444	0.719	36,133	0.808	2.992	***
<b>Sales class</b>							
\$500,000+	86,989	45.21%	49.77%	3.61E+04	34.90%	47.67%	***
\$250,000-\$499,000	86,989	20.62%	40.45%	36,133	13.60%	34.28%	***
\$100,000-\$249,000	86,989	19.05%	39.27%	36,133	17.07%	37.63%	***
\$40,000-\$99,999	86,989	10.01%	30.01%	36,133	13.68%	34.36%	***
\$20,000-\$39,000	86,989	3.18%	17.54%	36,133	7.81%	26.84%	***
\$10,000-\$19,000	86,989	1.27%	11.21%	36,133	5.13%	22.05%	***
\$9,999 or less	86,989	0.67%	8.15%	36,133	7.80%	26.82%	***

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1; subset of control variables from cross section analysis

# Panel: FCI participants vs. non-participants

	FCI Panel: Insurance			FCI Panel: No Insurance			Difference significant at:
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	
Insurance acres dummy	16,780	0.9359356	0.2448749	5,591	0	0	***
FCI premium paid per acre (\$)	21,177	\$ 9.69	\$ 15.69	6,744	0	0	***
<b>Outcomes</b>							
totalshort	23,137	\$ 483,616.30	\$ 1,462,872.00	7,820	\$ 382,918.70	\$ 1,673,101.00	***
financed	23,135	0.570	0.791	7,795	0.346	1.040	***
dshort	23,137	\$ 157,104.40	\$ 763,784.40	7,820	\$ 157,115.70	\$ 789,984.00	***
repaid	23,137	\$ 326,511.90	\$ 1,063,437.00	7,820	\$ 225,803.00	\$ 1,331,468.00	***
dreale	23,137	\$ 313,314.50	\$ 1,152,952.00	7,820	\$ 378,051.10	\$ 1,762,606.00	***
dnreale	23,137	\$ 133,104.60	\$ 506,455.10	7,820	\$ 158,151.10	\$ 892,930.30	***
<b>Operator characteristics</b>							
Operator age	23,137	54.27	10.92	7,820	55.60	11.53	***
Acres operated	23,137	2772.20	5311.63	7,820	1744.10	8277.43	***
Soybeans share	23,137	23.61%	23.92%	7,820	11.95%	20.28%	***
Corn share	23,137	20.31%	22.11%	7,820	10.75%	18.22%	***
Wheat share	23,137	11.11%	17.81%	7,820	5.06%	12.60%	***

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1