How Does Crop Insurance Purchase Affect Marketing Contracts Participation: The Case of Peanut

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Background

- Marketing Contracts: specify the quantity and quality of the designated crop, and set a predetermined price for the crop. Integrators share price risks with farmers.
- Yield insurance, e.g., Actual Production History (APH) insurance. Aim to help farmers managing their financial risk.
- From farmer's perspective, contract farming and crop insurance can be substitutes as they are both risk management tools.
- Just et al. (1999) showed that farmers are mostly interested in getting the subsidy effect of the insurance program.

Model

Our theoretical model combines the contract design framework of Ligon (2003) and the crop insurance model of Babcock and Hennessy (1996). Integrator's problem is to maximize the expected profit:

$$\max_{a,b,\{w(q)\}} \int_0^{q_M} [pq - w(q)]f(q|a)dq. \quad (1)$$

where the participation constraint is that the expected utility of the contracted farmer must be greater than or equal to some reserved utility level $\underline{U}$. The expected utility of the farmer can be written as:

$$EU = \int_0^{b\bar{q}} U(\pi_1)f(q|a)dq + \int_{b\bar{q}}^{q_M} U(\pi_2)f(q|a)dq, \quad (2)$$

The participation constraint can be written as:

$$EU(a,b) \geq \underline{U}. \quad (3)$$

We assume that the contractor gives recommendation to the farmers on a, b that are incentive compatible. Then the IC constraints are:

$$a, b \in argmax EU(a,b), \quad (4)$$

Propositions

Proposition 1 *Let $w^*(q)$ denote the payment schedule without crop insurance. Then under crop insurance, the new payment schedule $w^{**}(q)$ pays more than $w^*(q)$ for realized q that are higher than insured level $b\bar{q}$; and pays less than $w^*(q)$ for realized q that are less than insured level, i.e.,*

$$[w^{**}(q) - w^*(q)](q - b\bar{q}) > 0, \forall q \in [0, q_M]. \quad (5)$$

Proposition 2 *Under the assumption that farmers' utility functions are Constant Absolute Risk Aversion (CARA), then as crop insurance becomes more expensive, the payment schedule $w(q)$ is lower for all $q \in [0, q_M]$.*

Empirical Strategy

We use a 2SLS model:

$$MP_{cst} = \beta \hat{I}_{cst} + X'_{cst}\gamma + u_{st} + \epsilon_{cst} \quad (6)$$
$$I_{cst} = IV_{cst}\delta + X'_{cst}\eta + v_{st} + e_{cst} \quad (7)$$

- MP is the value of peanut production under marketing contract.
- I is the expenditure on crop insurance, which is generated by calculating the difference of total premium and subsidy.
- IV denotes the instrumental variables.
- X is a set of control variables.
- cst denotes the county c, state s, and time t.
- u_{st} and v_{st} are state by year fixed effects.

- We want to test whether β is significantly positive or negative.

Data

Source	Data	Obs. Level	Time Period
Agricultural Resource Management Survey (ARMS)	Marketing contract related data	Farm	2000-2011
Risk Management Agency (RMA)	Crop insurance purchase & administration information data	County	
National Climatic Data Center (NCDC)	Historical weather data	Weather Station	

- We merge the data by $county \times year$ id.
- We use PEANUT as the target crop, because marketing contract is widely used and yield insurance (APH) is available for peanut.

Identification

- We consider two instrumenting strategies: using the weather variables as IVs and using lagged crop insurance subsidy as IV.
- We control the state by year fixed effects and cluster the standard error by state.
- The local average treatment effect (LATE) can be identified if the variation in the instrumental variables within a state and a given year is as good as random.

Results

Table 3: Effect of Crop Insurance on Marketing Contract Production Value

	First Stage Insurance Expenditure		Second Stage MC Production Value	
	IV: Weather	IV:L.Subsidy	IV: Weather	IV:L.Subsidy
Insurance Expenditure			0.76***	0.43*
			(0.217)	(0.240)
Lagged Subsidy		0.36		
		(0.408)		
Min Temp.	-1218.93	-1618.11		3652.26
	(689.688)	(1126.129)		(3160.875)
Max Temp.	1289.08	1435.17		-6477.44*
	(873.120)	(1171.391)		(3641.118)
Precipitation	-4.19	17.47**	-44.30	20.36
	(16.798)	(5.962)	(59.152)	(63.209)
Gross Income	0.01***	0.01**	0.01**	0.01
	(0.002)	(0.003)	(0.005)	(0.005)
Acres Operated	-0.04	2.17	0.89	-11.42***
	(0.464)	(2.208)	(0.852)	(2.479)
Harvested Acres	17.38***	24.93**	5.30	360.22***
	(2.541)	(10.515)	(6.990)	(20.164)
Constant	-189584.3	-251924.2	782745***	3358174**
	(313481.8)	(394591.2)	(281457.3)	(1684636)
N	961	587	961	587
R^2	0.571	0.423	0.104	0.514
F	133.40	16.33		
Farm Size Control	Y	Y	Y	Y
(State × Year) FE	Y	Y	Y	Y

Standard errors in parentheses are clustered at state level
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Conclusion

- Considering both weather IV and lagged insurance subsidy IV, results consistently report a positive impact of insurance purchase on value of production under marketing contracts.
- The results are consistent with our theoretic predictions.
- The significant causal effect for peanut is robust under falsification test and can be extended to corn growers.
- Both our theoretic and empirical results suggest that crop insurance and contracting could be complementary tools for farmers.

References

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