Lecture XXV: An Introduction to Crop Insurance

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Risk Management as Agricultural Policy

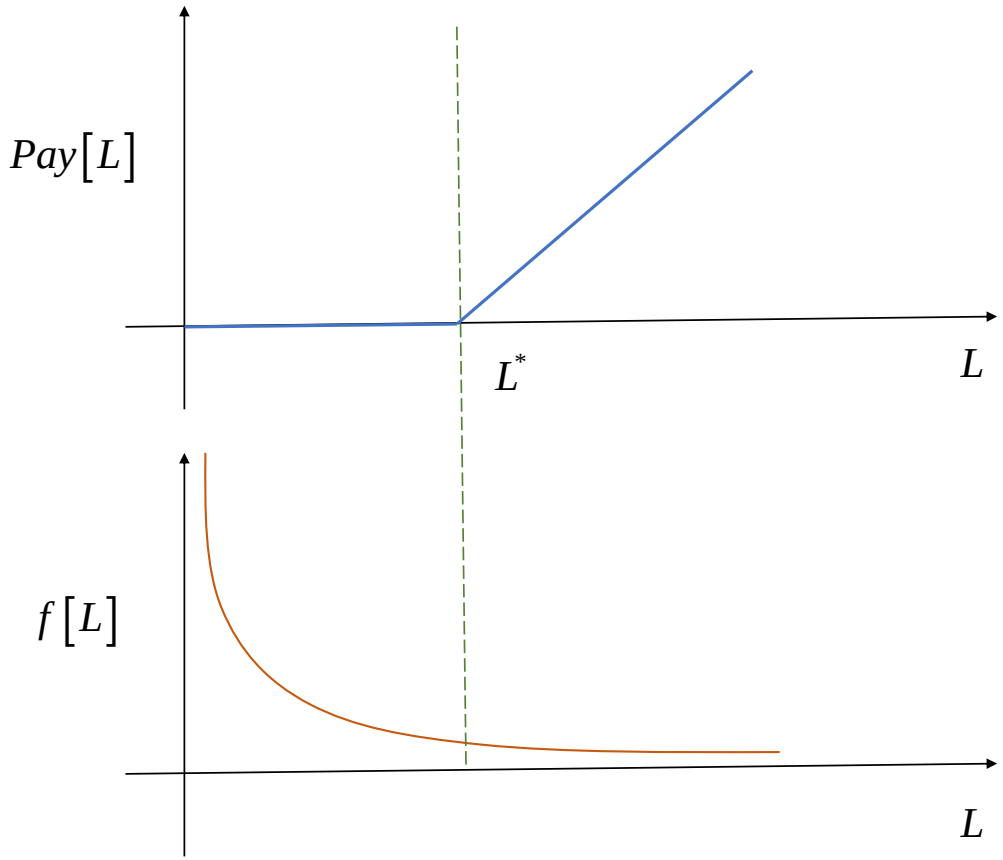
- As we started to develop in the lecture on Agricultural Risk Coverage payments, agricultural policies have shown some movement toward risk reduction or risk management.
- Several justifications may be possible for this move.
- The most convincing is that farmers should face market pressures, but they should also be protected from significant downside risk inherent in agriculture.
- Crop insurance programs represent a significant movement in this direction.

Valuing Insurance

- The components of the insurance contract involves the definition of some insurable event and the payoff to you (as the insured) or some other designated party.
- For automotive liability insurance, I buy a insurance policy that will cover a stated amount of my liability if I have an accident and injure another person.
  - Let L be my liability and $f[L]$ be the probability distribution that an insurable event will occur.
  - The expected value of this contract is

$$\text{Pay} = \sum_{i=1}^{n} f[L_i] L_i \tag{1}$$

Payoff and Deductible



Valuation with Deductible

- In the preceding figure, we consider the effect of a deductible of L^* – you pay the first \$ 1,000 of damages.

$$\text{Pay} = \sum_{i=1}^{n} f\left[L_i\right] \max\left[L_i - L^*, 0\right] \tag{2}$$

- The other concept is that there is a large probability that I will not have an insured event in any given year.
- Two concepts
  1. The price of insurance is a decreasing function of the level of the deductibility.
  2. Different groups may have different probability functions. Younger drivers (males under 25 years of age) are more likely to have insurable events. This leads to $f\left[L|\, a\right]$ and $\text{Pay}\left[L^*, a\right]$.

Insurable Events

- Automobile liability and collision.
- Home owners insurance.
- Life insurance.

Pricing Insurance

- How is insurance priced?
- In general $\text{Pay}\left[L^*, a\right]$ is called the actuarial value or fair price of insurance.
- However, offering insurance implies other costs
  - Sales
  - Adjusting claims
  - Administering payments

$$\text{Price} = \text{Load}\left(\sum_{i=1}^{n} f\left[L_i, a\right] \max\left[L_i - L^*, 0\right]\right) \tag{3}$$

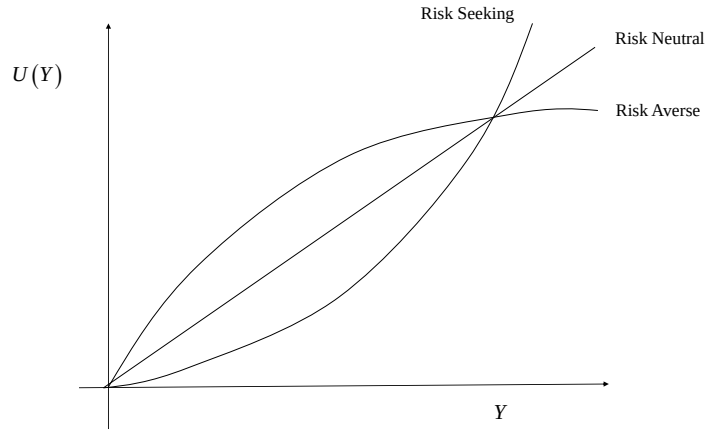
- Suppose the load is 1.05, then an additional 5 % is required to sell and administer insurance (including the cost of making claims).

Loading – Definition

- An amount that is built in to the insurance cost. This amount covers the operating cost of the insurer, as well as the chance that the insurer's losses for that period will be higher than anticipated, and the changes in the interest earned from the insurer's investments. This is added to the amount required to cover losses, known as the pure insurance cost.
- `http://www.businessdictionary.com/definition/loading.html`

Risk Attitudes

- Risk Neutral - Willing to pay the expected value of a risky alternative.
- Risk Averse - Willing to pay less than the expected value of a risky alternative
- Risk Seeking (or Taking) - Willing to pay more than the expected value of a risky alternative.



Who Buys Insurance?

- Because there is typically a load to offering insurance, we expect that only risk averse individuals will purchase insurance.
- Laws/Conventions requiring insurance.
  - Florida requires all drives to have liability insurance.
  - Lenders typically require insurance
    - Mortgage lenders require home-owners insurance
    - Farm lenders often require increased crop insurance
  - Health insurance was required under the Affordable Care Act.

Introduction to Crop Insurance

$$\text{Pay} = \sum_{i=1}^{n} f\left[Y_i\right] \max\left[Y^* - Y_i, 0\right] \tag{4}$$

- Where Y^* is a target yield.
- The target yield depends on the program.
- Note that this payoff expresses the insurance payoff in terms of output (i.e., bushels of corn).
- We convert this into dollars using a price

$$\text{Pay} = P^* \sum_{i=1}^{n} f\left[Y_i\right] \max\left[Y^* - Y_i, 0\right] \tag{5}$$

where P^* is some agreed upon price.

Coverage Level

- The Y^* is usually specified as coverage level of a historical (or expected) yield – $Y^* = c_R \bar{Y}$.
  - $c_R = 0.65$ Catastrophic Coverage.
  - $c_R = 0.80$ Additional (or buy-up) Coverage.

$$\text{Pay} = P^* \int_0^{c_R \bar{Y}} \left[c_R \bar{Y} - Y \right] f\left[Y\right] dY \tag{6}$$

Cotton in Florida

- https://www.rma.usda.gov/Fact-Sheets/Valdosta-Regional-Office-Fact-Sheets/Cotton-2018-AL-FL-GA-SC
- **Area Risk Protection** - Available only in certain Georgia counties. Provides protection against widespread loss of either revenue or yield. Individual farm revenues and yields are not considered. It is possible that your individual farm may experience reduced revenue or yield and not receive an indemnity under this plan.
- **Yield Protection** - Insurance coverage providing protection only against a production loss.
- **Revenue Protection** - Insurance cover age providing protection against loss of revenue due to a production loss, price decline/increase, or a combination of both.

Cotton in Florida, Continued

- **Revenue Protection with Harvest Price Exclusion** - Insurance coverage providing protection only against loss of revenue due to a production loss, price decline, or a combination of both. The harvest price is not excluded for determining value of production in loss determination.
- **Stacked Income Protection (STAX)** - An area based policy available in all counties where cotton crop insurance is currently offered. You may buy STAX as a stand-alone policy or as a companion policy with your yield or revenue policy. STAX provides coverage for a portion of the expected revenue for an area. The trigger for a loss is based on an area loss in revenue.

Cotton in Florida, Continued

- **Supplemental Coverage Option** - This policy endorsement provides additional coverage for a part of your cotton policy deductible up to the 86 percent coverage level. SCO may be added to individual yield or revenue plans. The coverage is based on your expected crop value. The trigger for a loss is based on an area loss in yield or revenue.

Subsidy Level

Item	Coverage Level (Percent)							
	50	55	60	65	70	75	80	85
Premium Subsidy	67	64	64	59	59	55	48	38
Your Premium Share	33	36	36	41	41	45	52	62

Florida Insurance

Plan	Delivery	Level	Policies Sold	Policy Premium	Policies Indemified	Units Earning Premiums	Units Imdemified	Endorsed Acres
				Cotton				
RP	RBUP	Acres	727	278	6	1,242	7	79,859
SCOR	RBUP	Acres	6	0	0	0	0	0
STAXP	RBUP	Acres	52	37	0	195	0	0
YP	RBUP	Acres	100	40	5	114	7	5,232
	RCAT	Acres	82	43	0	48	0	13,697
YP Total			182	83	5	162	7	18,929
				Soybean				
RP	RBUP	Acres	553	46	6	157	20	6,346
RPHPE	RBUP	Acres	1	0	0	0	0	0
YP	RBUP	Acres	125	20	1	35	2	2,232
	RCAT	Acres	118	14	0	16	0	1,970
YP Total			243	34	1	51	2	4,202

Florida Insurance, Continued

Plan	Delivery	Liabilities	Total Premium	Subsidy	Indemnity	Loss Ratio
			Cotton			
RP	RBUP	36,318,542	7,257,883	4,474,658	157,982	0.02
SCOR	RBUP	0	0	0	0	0
STAXP	RBUP	1,441,496	498,994	402,128	0	0
YP	RBUP	2,029,861	317,291	191,655	318,298	1
	RCAT	2,231,362	97,677	97,677	0	0
YP Total		4,261,223	414,968	289,332	318,298	0.77
			Soybean			
RP	RBUP	1,317,169	338,633	203,959	24,984	0.07
RPHPE	RBUP	0	0	0	0	0
YP	RBUP	397,399	49,612	29,389	8,641	0
	RCAT	115,644	7,026	7,026	0	0
YP Total		513,043	56,638	36,415	8,641	0

Some Nuts and Bolts of Insurance

- The real effort is typically to get an estimate of the distribution of crop yields and prices.
- For valuation purposes, the yields can either be based on the farmer's own yields (APH) or county level yields.
- Price distributions are typically based on futures prices.

Actual Production History (APH)

- The farmer must report ALL production.
- The 10 years may stretch back as far as needed to get 10 years of actual history. For example, if you have a rotation of crops every year, it could take up to 20 years to get 10 years of actual records.
- If the farmer does not have enough records to make up at least four years, the APH will be based on a combination of actual and county T-Yields (or a factor of).
- In one year, if the farmer's Actual Yield is less than 60 % of the county T-Yield, the farmer has the option to utilize a plugged yield for that year to help stabilize the APH if YA is elected.

Tippecanoe County, Indiana

Year	Value	Price
2007	159.9	3.68
2008	180.0	4.04
2009	179.0	3.66
2010	175.1	4.82
2011	160.2	5.94
2012	112.0	7.43
2013	185.1	4.17
2014	206.6	3.54
2015	147.9	3.97
2016		3.44
2017	180.3	3.32
Mean	168.6	4.36
Std Dev	25.63	1.26

Likelihood of Yield Payoff – Normal Distribution

Coverage	Yield Trigger	Normalized Outcome	Probability of Payment	Expected Payoff	Premium Subsidy	Subsidy Amount
65	109.60	2.302	0.0107	0.41	59 %	0.24
70	118.03	1.973	0.0242	1.02	59 %	0.60
75	126.46	1.645	0.0500	2.34	55 %	1.29
80	134.89	1.316	0.0941	4.92	48 %	2.36
85	143.32	0.987	0.1618	9.55	38 %	3.63

- `https://www.rma.usda.gov/Fact-Sheets/Springfield-IL-Region-Fact-Sheets/Corn-2018-IL-IN-MI-OH`

Indiana Corn Insurance

Plan	Delivery	Level	Policies Sold	Policy Premium	Policies Indemified	Units Earning Premiums	Units Imdemified	Endorsed Acres
ARP	RBUP	Acres	2,022	1,564	628	4,209	1,581	454,175
ARPHP	RBUP	Acres	31	27	4	51	9	4,480
AYP	RBUP	Acres	354	242	0	476	0	47,550
AYP	RCAT	Acres	4	4	0	4	0	1,642
AYP Total			358	246	0	480	0	49,192
RP	RBUP	Acres	23,076	17,504	8,457	30,672	12,152	3,715,630
RPHPE	RBUP	Acres	243	183	66	293	78	43,268
SCOR	RBUP	Acres	42	32	0	113	0	0
SCOY	RBUP	Acres	1	0	0	0	0	0
YP	RBUP	Acres	1,059	746	241	1,214	347	78,157
	RCAT	Acres	190	124	2	200	2	29,489
YP Total			1,249	870	243	1,414	349	107,646
Corn Total			27,022	20,426	9,398	37,232	14,169	4,374,391

Indiana Corn Insurance, Continued

Plan	Delivery	Liabilities	Total Premium	Subsidy	Indemnity	Loss Ratio
ARP	RBUP	338,051,419	29,959,595	13,257,778	5,334,335	0.18
ARPHP	RBUP	3,158,084	203,708	89,874	17,801	0.09
AYP	RBUP	35,213,013	1,596,112	818,538	0	0
AYP	RCAT	623,063	12,856	12,856	0	0
AYP Total		35,836,076	1,608,968	831,394	0	0
RP	RBUP	2,056,874,310	176,575,538	101,622,527	55,566,684	0.31
RPHPE	RBUP	25,151,471	1,018,206	557,791	439,558	0.43
SCOR	RBUP	456,911	151,029	98,175	0	0
SCOY	RBUP	0	0	0	0	0
YP	RBUP	38,385,433	1,722,694	1,007,220	705,438	0.41
	RCAT	5,316,829	95,336	95,336	3,084	0.03
YP Total		43,702,262	1,818,030	1,102,556	708,522	0.39
Corn Total		2,503,230,533	211,335,074	117,560,095	62,066,900	0.2