The Economics of Shallow-Loss Crop Insurance: Deductibles vs. Coinsurance Policies

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Motivation

- New interest in shallow-loss policies.
- New, proposed ARC program in latest version of 2012 Farm Bill.
- Want to evaluate deductibles vs. coinsurance in implementation of shallow-loss policies.
- What can we say about the ARC program's proposed 89% guarantee?
  - Risk management
  - Expected value
  - Loss adjustment expenses

Comparing Policies

- Comparison of actual policies is difficult, e.g. ARC vs. SURE
  - Premium differences?
  - Base/underlying coverage
  - Whole farm vs. single crop
  - SURE's disaster trigger
- For apples-to-apples comparison:
  - Pseudo-ARC vs. pseudo-SURE, both "free" add-ons
  - Assume paid, underlying coverage at same level
  - Mono-crop environment, no disaster trigger

What are we comparing?

	Pseudo-ARC	Pseudo-SURE
Style	Deductible	Coinsurance
Base Covg. (b)	55-85%	55-85%
Guarantee	89%	min(1.15*b, 90%)
Reimb. Rate	100%	60%

- ARC is not specified as an add-on
- Comparisons not reasonable for b ≤ 70%

A Basic Model of Crop Insurance

- Revenues, $Y \sim F$
- Deductible policy has guarantee, T_D, and pays $\max(0, T_D - Y)$
- Coinsurance policy has guarantee, T_C, and pays $C^*\max(0, T_C - Y)$
- Assume farmers risk-averse, care about $E[U(Y)]$

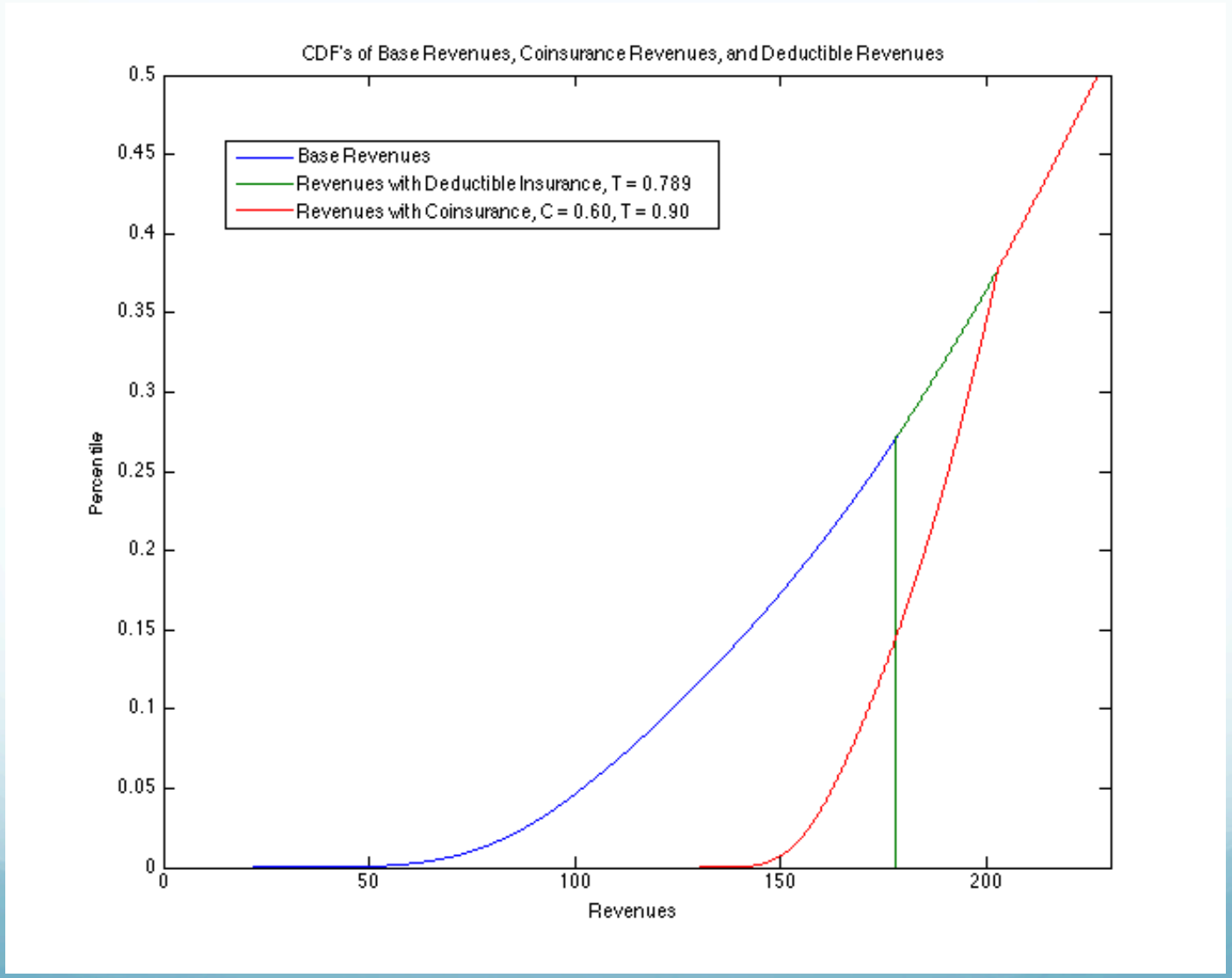
Results

- Coverages induce new distributions:
  - $Y_D = Y + \max(0, T_D - Y)$ $\quad Y_D \sim F_D$
  - $Y_C = Y + C^*\max(0, T_C - Y)$ $\quad Y_C \sim F_C$
- When $E[Y_D] = E[Y_C]$, we show:
  - $Y_D >_{SSD} Y_C >_{SSD} E[Y_C]$
  - $Y_C >_{SSD} Y_{C'}$ if $T < T'$ and C, C' adjust accordingly
  - Orderings are robust to adding a 'payments floor'

Implementing Pseudo-Policies

- Base coverage, b
- Base coverage is a stop-loss/deductible coverage, with a guarantee, $T_G = b*E[Y]$, and fair premium, P
- Insured revenues, $Y_G \sim F_G$
- Deductible policy (pseudo-ARC), has guarantee, T_D, and pays $\max(0, T_D - Y_G)$
- Coinsurance policy (pseudo-SURE), has guarantee, T_C, and pays $C*\max(0, T_C - Y_G)$

Comparing the CDF's



Intuition

For shallow-loss policies:

- Same fair value implies deductible preferred to coinsurance preferred to fixed payment.
- Same fair value implies lower coinsurance threshold, T_C , is preferred.
- EU-equivalent policies, $E[U(Y_D)] = E[U(Y_C)]$, means coinsurance must have higher expected value.
- Not what we observe with ARC. The higher EV is compensating a negative risk premium.

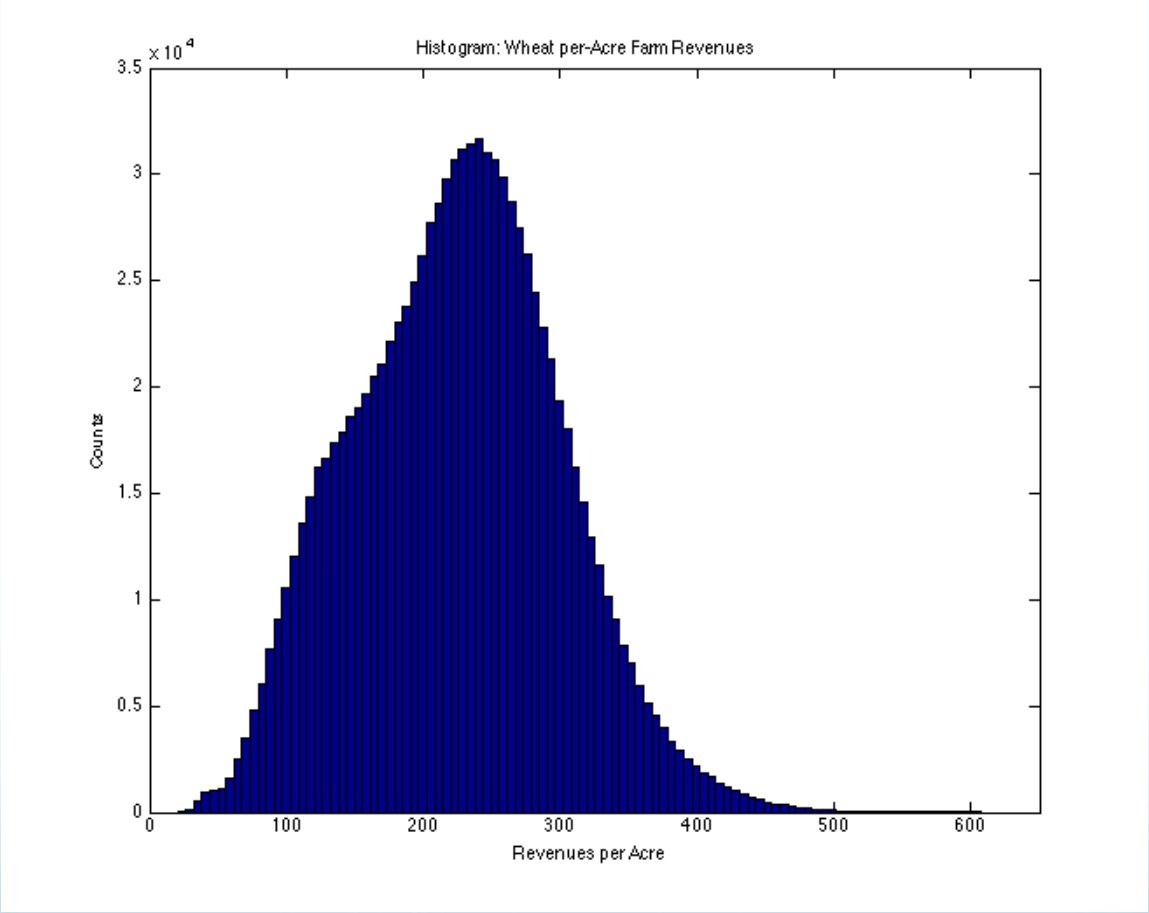
Generating Revenue CDF

- Hyde County, SD, Spring Wheat.
- USDA/NASS Yield Data, 1975-2008.
- Expected and Realized Prices from MGE Futures.
- Same method as last year
  - Bootstrapped regressions of price/yield deviates
  - Variation from repeated regression estimates
  - Pairwise block-bootstrap of county yields with national prices, preserves rank correlations
  - Blown-up to farm-level with scaled white noise

Wheat Revenues per Acre

- Price-yield deviates coefficient: – 0.955
- Price-county yield correlation: – 0.464
- Simulated farm-county yield correlation: 0.968
- Price-farm yield correlation: – 0.164
- Mean Revenues per Acre: $225.34
- Std. Dev. of Revenues: $74.48

Histogram: Revenue per Acre



Pseudo-ARC vs. Pseudo-SURE

- Comparing as if free add-on coverage
- Base coverage levels, b = 55-85% (5% increments)
- Want to identify **indifferent** ARC threshold, T_D, such that E[U(Y)] is equal across policies
- Assume CARA-utility: U(Y) = 1 – exp(– a*Y)
- Test across many levels of R_A coefficients
- Results are robust to CRRA specification as well, e.g. U(Y) = log(Y), or to scaling up acres

Indifferent Thresholds

- $R_A = 0.001$

Guarantees:

Base (Pct)	Base ($)	ARC, Indiff. (Pct)	ARC, Indiff. ($)	SURE (Pct)	SURE ($)
55.00%	$123.94	60.33%	$135.95	63.25%	$142.52
60.00%	$135.20	65.79%	$148.26	69.00%	$155.48
65.00%	$146.47	71.26%	$160.58	74.75%	$168.44
70.00%	$157.74	76.74%	$172.93	80.50%	$181.40
75.00%	$169.00	82.22%	$185.27	86.25%	$194.35
80.00%	$180.27	86.35%	$194.57	90.00%	$202.80
85.00%	$191.54	88.09%	$198.49	90.00%	$202.80

EV and Risk Premium

- $R_A = 0.001$

Base (Pct)	EV[SURE]	EV[ARC, Indiff.]	Risk Premium (SURE to ARC)	EV[ARC, 89%]
70.00%	$10.84	$10.84	$0.0007	$19.34
75.00%	$14.24	$14.24	$0.0009	$19.34
80.00%	$17.23	$17.22	$0.0007	$19.34
85.00%	$18.59	$18.59	$0.0001	$19.34

Impacts on Loss Adjustment Expense

- Another possibility is that the higher threshold reflects savings of loss adjustment expenses; moving to deductible policy means fewer claims.
- Simple econometric model of claims costs:

$$LAEperUnit = a + b \cdot totalclaims + c \cdot indemnityperUnit + \epsilon$$

...with fixed per-claim costs and variable costs with the size of indemnities. *b* represents returns to scale.

Preliminary LAE Data

- LAE as percent of gross premium, 1995-2010
  - Grant-Thornton Report, 2011 survey of crop insurers
- RMA Summary of Business, 1995-2010
  - Premium, Indemnity, No. Claims by crop, county, coverage level and year.
- All data are national, annual aggregates
  - N=16 for the regression.

Regression Results

Source	SS	df	MS
Model	119641.421	2	59820.7107
Residual	17655.4409	13	1358.11084
Total	137296.862	15	9153.12416

Number of obs =	16
F(2, 13) =	44.05
Prob > F =	0.0000
R-squared =	0.8714
Adj R-squared =	0.8516
Root MSE =	36.853

expperu	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
uindem	-.0002527	.0000517	-4.89	0.000	-.0003644	-.0001411
indemper	.0439411	.004917	8.94	0.000	.0333186	.0545636
_cons	132.4082	36.85007	3.59	0.003	52.79845	212.0179

Estimating Claims Savings

- Average unit size: 80.67 acres
- Fixed claims cost per unit: $132.41
- Variable adjustment cost: 4.39% of indemnity
- Returns to scale: – 0.025c per claim, nationally
  - 599,080 avg annual units w/earned premium (wheat)

Claims Savings (Cost)

Claims savings per acre (*b*=0.85, vs. Pseudo-SURE):

- Saved fixed costs per acre (fewer claims):

$(F_{0.9} - F_{0.89})*132.41/80.67 =$ $0.017

- Lost fixed-cost economies of scale (fewer claims):

$-(F_{0.9} - F_{0.89})*0.00025*599{,}080/80.67 =$ – $0.0193

- Lost variable adjustment cost (higher EV):

$-0.0439*\Delta EVperAcre =$ – $0.0329

Total: – $0.0352

What Did We Learn?

- Deductible policies provide better risk management
- Shallow-loss risk premiums are often very low; these policies bite near the peak of the distribution
- ARC 89% threshold is paying higher expected value; higher EV dominates the cost difference
- Back-of-the-envelope: no LAE savings
- Same cost ARC policy should have pseudo-SURE indifferent threshold.

Future Research

- Better loss adjustment expense data
- Expansion to more crops
- Testing for robustness to different estimates of revenue/yield distribution

Questions?