Agricultural Markets and Risk Management Tools

Barry K. Goodwin

North Carolina State University

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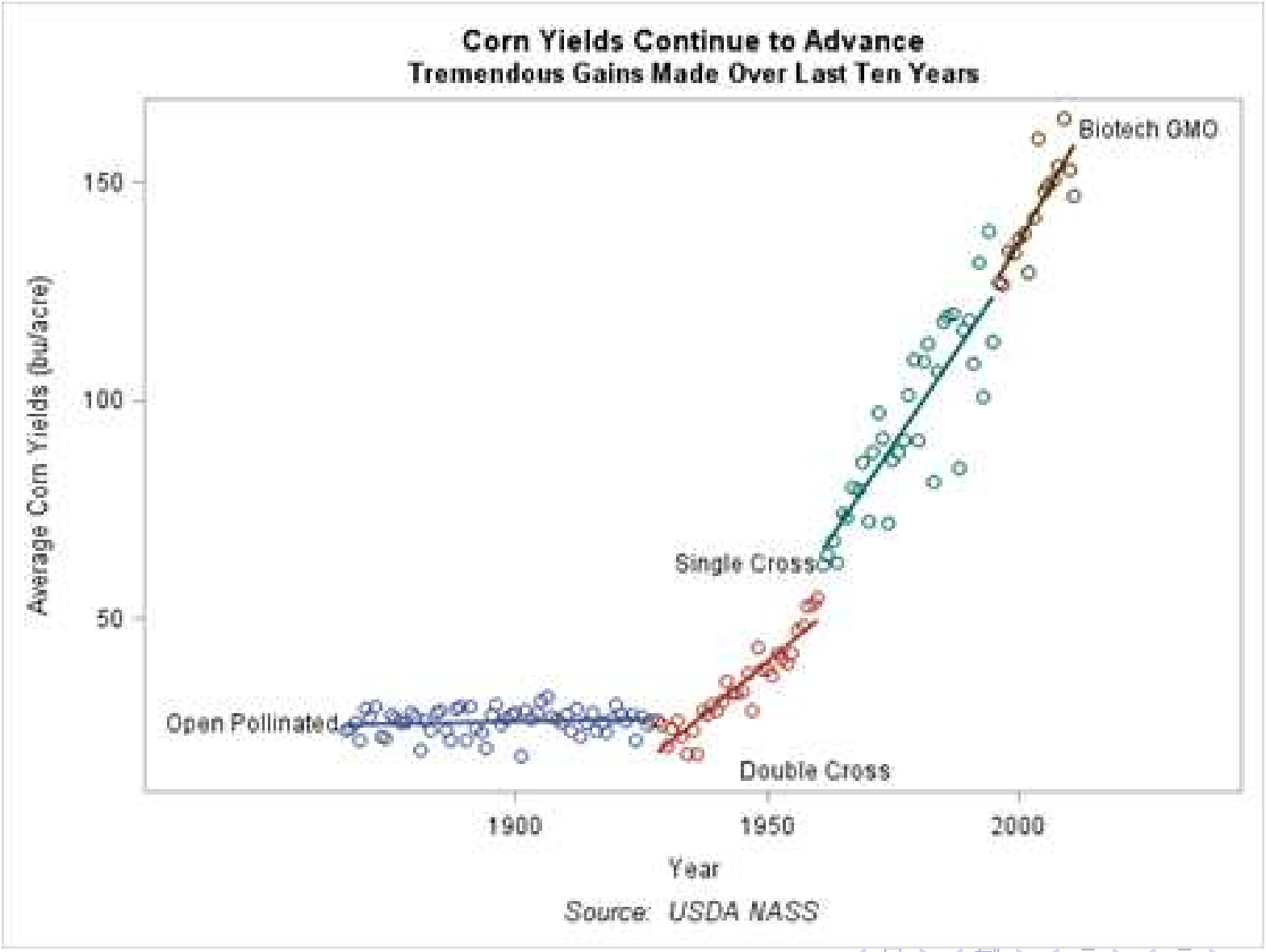
Outline

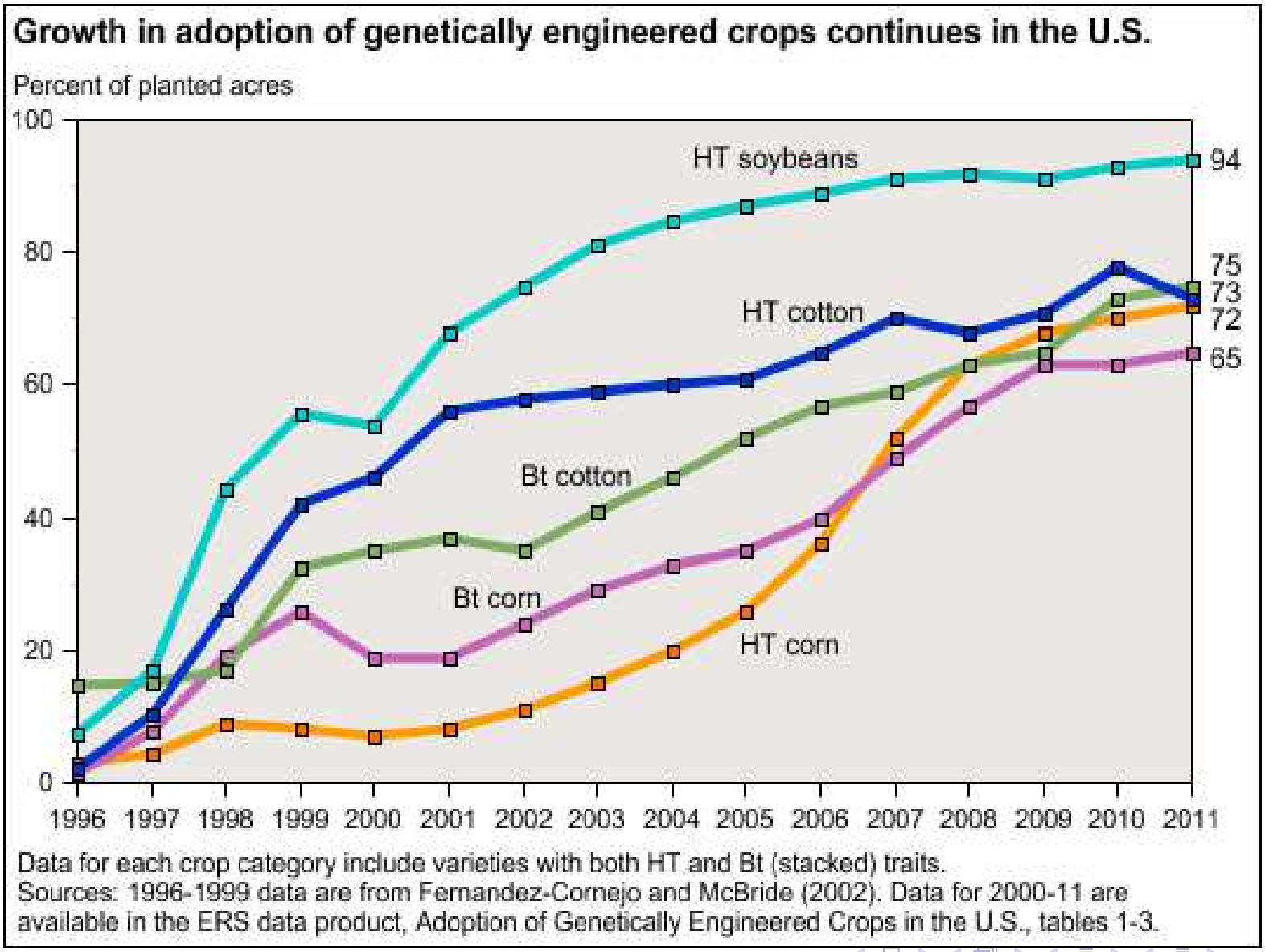
I want to address three specific aspects of agricultural risk management:

- Recent developments in price volatility and yield risk
- The role of policy:
  - Subsidized crop insurance with examples from the massive US program ($115 billion in liability in 2011)
  - The 2012 US Farm Bill, which is currently being debated in Congress (with disturbing developments)
- Very briefly review recent research on developments in the empirical modeling of risk with a focus on revenue insurance (combining aspects of dependent yield and price risks)

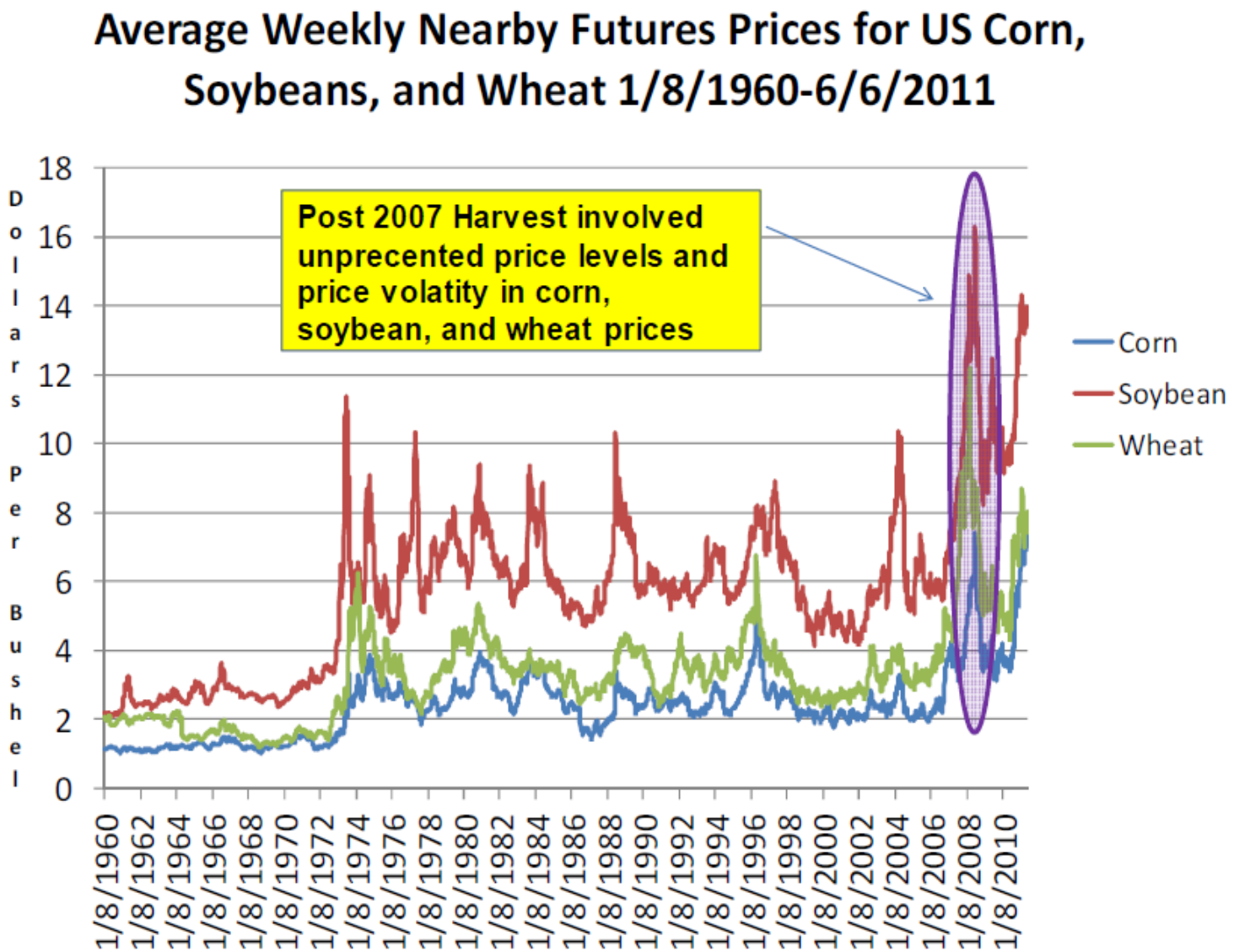
US Corn Yields



Adoption of Biotech Crops in the US

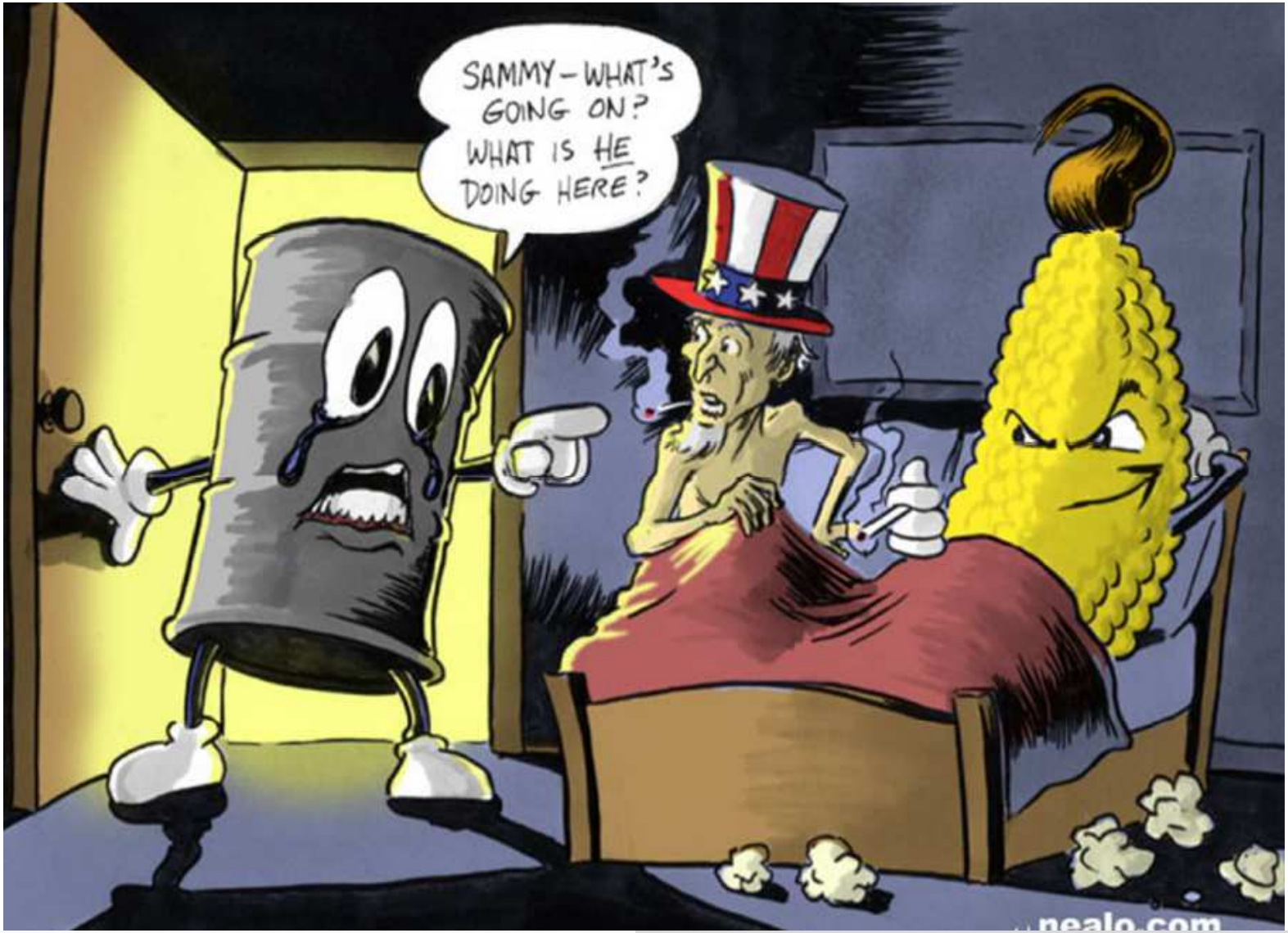


Recent Price Volatilities



What's Driving Price Volatilities?

US ethanol policy has some relevance



Some Perspective

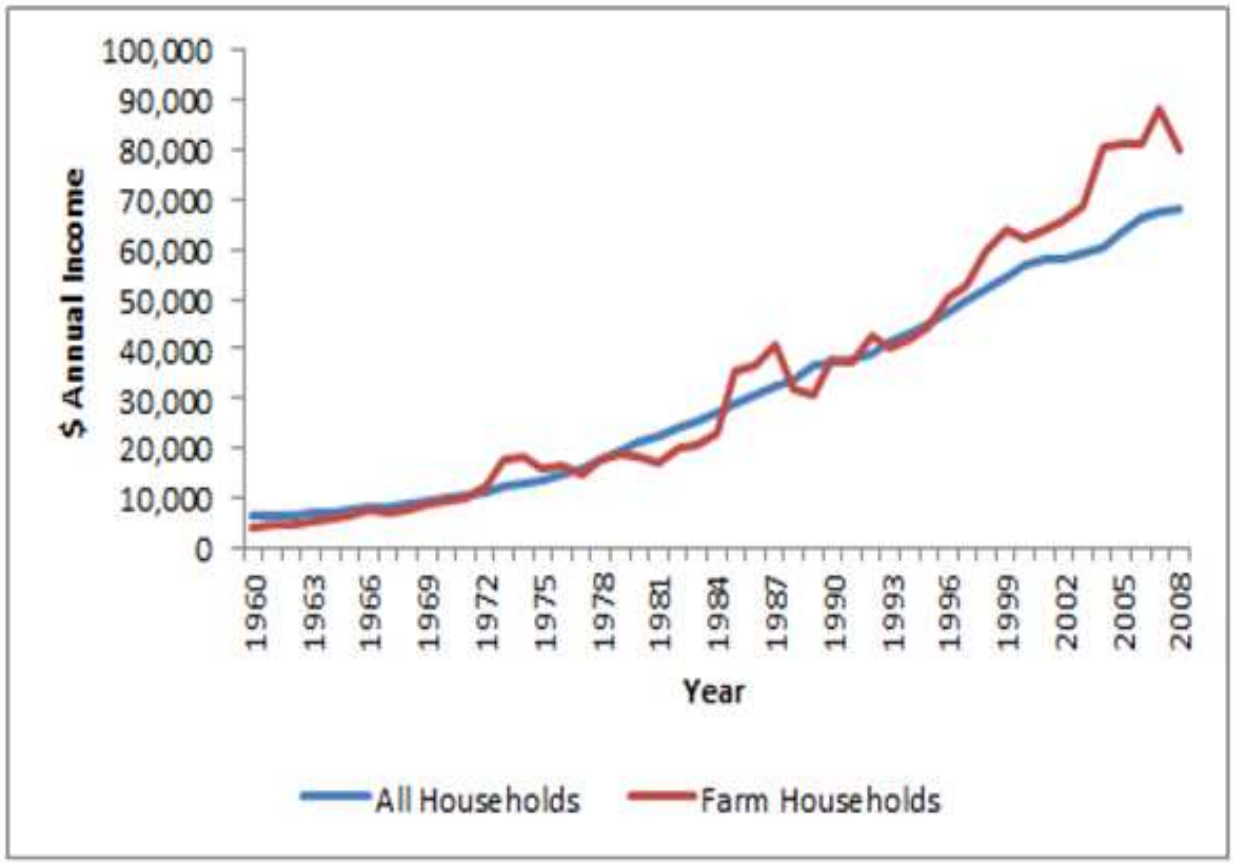
Net Cash Income in 2011F

Income Statement U.S. Farm Sector 2007-2011F

	2007	2008	2009	2010	2011F	2008 v. 2007	2009 v. 2008	2010F v. 2009	2011F v. 2010F
Cash Receipts	288.5	316.7	288.6	314.4	365.9	9.8%	-8.9%	8.9%	16.4%
Crops	150.1	175.0	168.3	172.9	220.6	16.6%	-3.8%	2.7%	27.6%
Livestock	138.5	141.6	120.3	141.4	165.4	2.2%	-15.0%	17.5%	17.0%
Direct Govt. Pay	11.9	12.2	12.2	12.4	10.6	2.5%	0.0%	1.6%	-14.5%
Gross Cash Income	318.0	350.4	322.8	345.0	396.1	10.2%	-7.9%	6.9%	14.8%
Cash Expenses	240.6	261.8	248.4	252.7	286.2	8.8%	-5.1%	1.7%	13.3%
NET CASH INCOME	77.4	88.6	74.4	92.3	109.9	14.5%	-16.0%	24.1%	19.1%

Source: http://ers.usda.gov/Briefing/FarmIncome/Data/nf_t2.htm

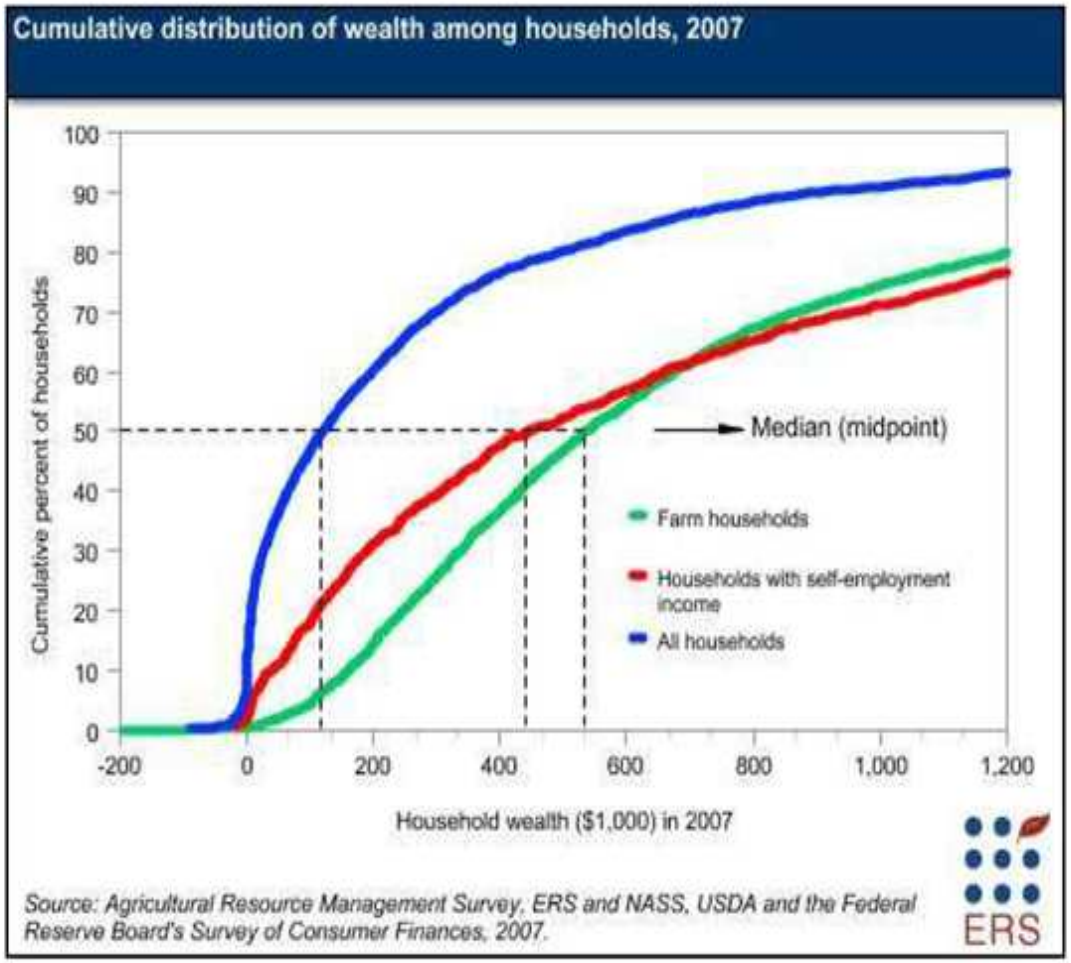
Farm Household Income



Household Incomes; Source: USDA-ERS Farm Household Economics and Well-Being Briefing Room;

(http://www.ers.usda.gov/Briefing/WellBeing/farmhouseincome.htm)

Farm Household Wealth



Household Wealth Distribution; Source: USDA-ERS Farm Household Economics and Well-Being Briefing Room (Mary Ahearn); (http://www.ers.usda.gov/Briefing/WellBeing/farmhouseincome.htm)

Breaking News—June 21, 2012

US Senate passes 2012 Farm Bill

Important Points

- Price levels and volatilities have increased tremendously, appearing to have reached a new equilibrium
- This fact is shaping the direction of US policies
  - US farm income at record high levels
  - Support levels that are tied to revenues (prices and/or yields) are ratcheting the guarantee each year (currently only ACRE)
  - Outside of crop insurance, which is growing more costly every day, current policies are not delivering the transfers that farmers want (prices are too high)
  - Crop insurance is expanding significantly, both in the US and around the world.
  - Subsidized crop insurance is currently the most costly of US agricultural policies–approximately $9 billion each year
- One of the great mysteries of agricultural policy—
  - Theory predicts risk averse agents will always take actuarially fair insurance
  - Yet, crop insurance nearly always requires significant subsidies to get farmers to participate

Revenue Risk

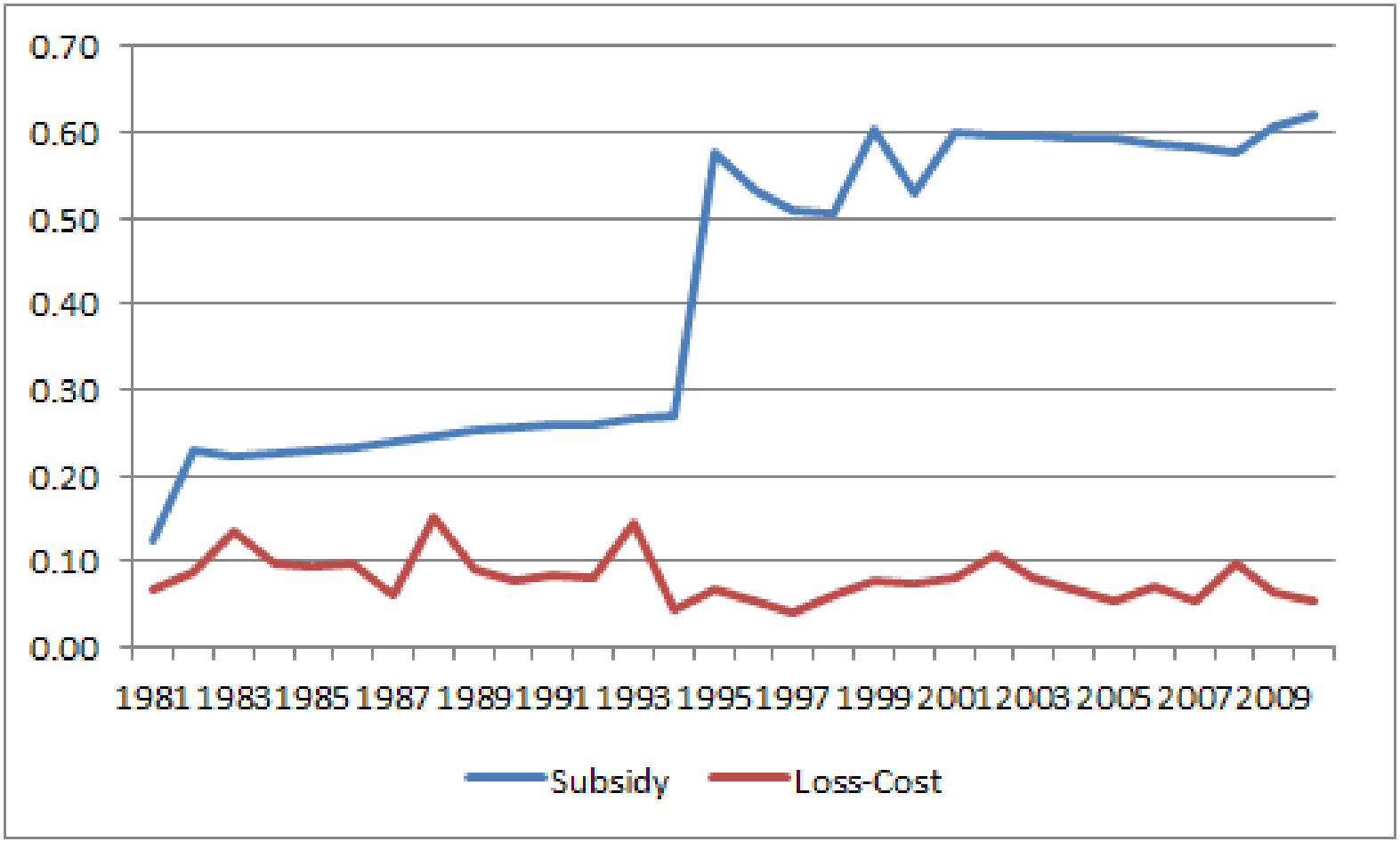
- So, we have two recent factors driving farm revenues
  - High price levels and high volatility
  - Upward trending yields with diminishing yield risk
- This suggests a focus on revenue risk rather than just yield risk or price risk
- The proper forecast and measurement of yield risk depends on the dependence of multiple sources of risk
  - Price and yield (negative dependence)
  - Yields for alternative crops (usually positive dependence)
  - In the US (and elsewhere), this has corresponded to a significant shift toward revenue protection
    - Revenue protection accounts for about 75% of total liability in the federal program
    - Revenue guarantees play a major role in 2012 Farm Bill discussions

US Crop Insurance

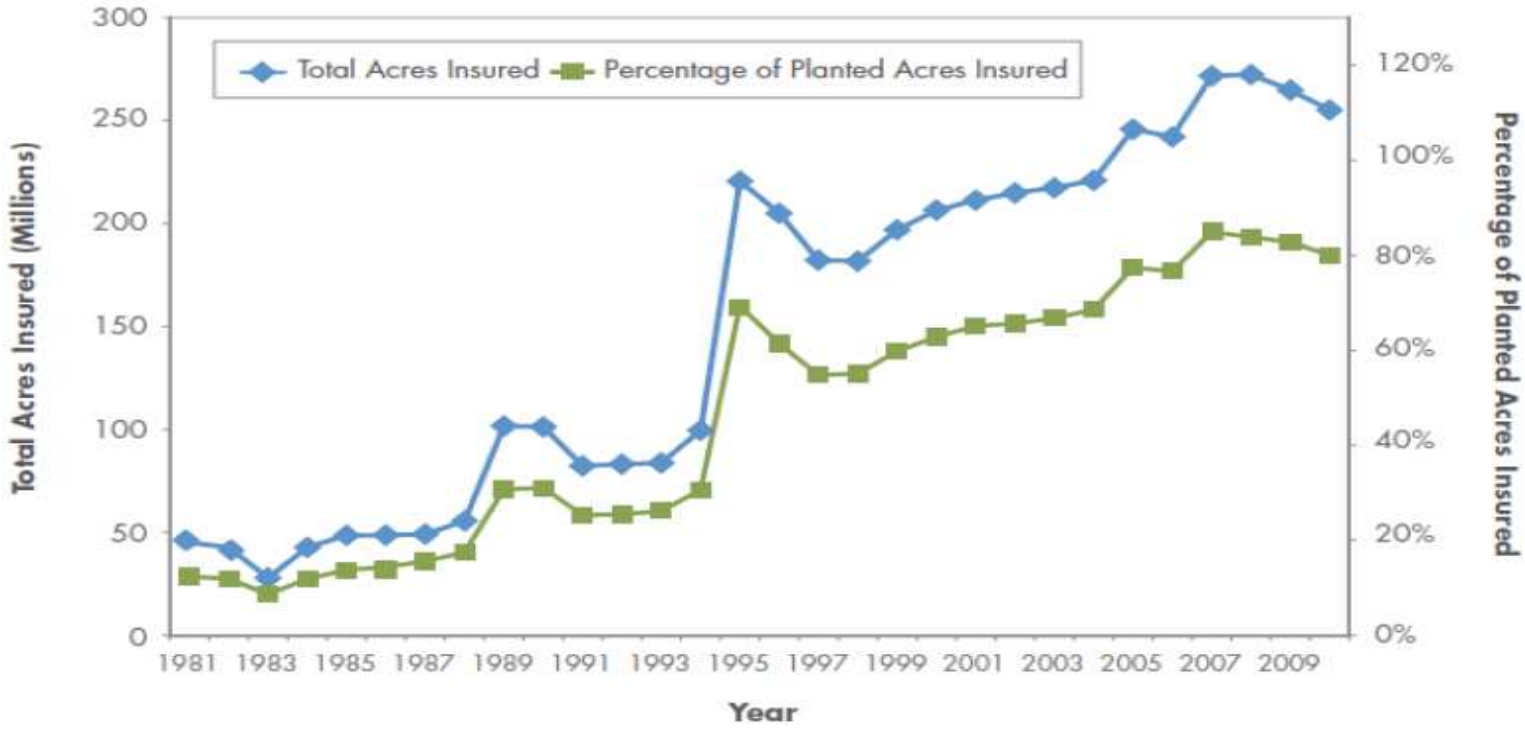
Salient facts about the US federal crop insurance program

- $115 billion in liability in 2011
- Total premium in 2011 was $12 billion
- Premium subsidy $7.42 billion
- Implies 62% subsidy
- Subsidy paid as a percentage of premium such that rising prices (which we have seen in recent years) imply much larger costs to taxpayers
- Touted as a "public–private" partnership (beware!)
- Latest CBO score $91 billion over 10 years
- Governed by complex (and favorable to companies) reinsurance agreement
- Recent calls for Congress to raise guarantee to 90% ("shallow losses") of expected revenue

Premium Subsidies and Loss-Cost



US Crop Insurance Statistics: Participation



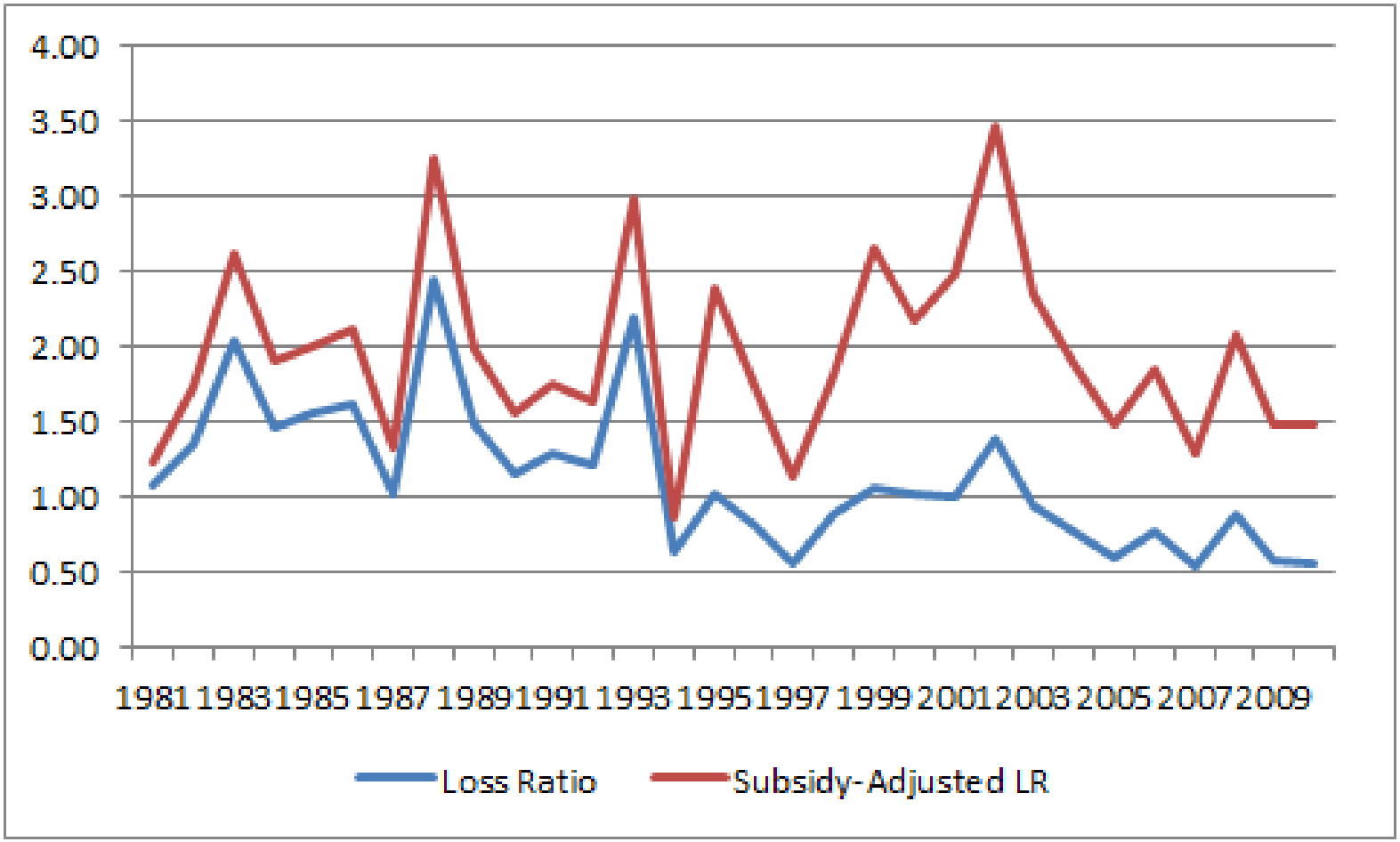
SOURCE: Data on insured acres were obtained from the US Department of Agriculture (USDA) Risk Management Agency (RMA); data on annual acres planted to crops were obtained from the USDA National Agricultural Statistical Service.

Source: Smith (2012)

US Crop Insurance Statistics: Liability and Premium

Source: Smith (2012)

Loss Ratios


4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009
Loss Ratio
Subsidy-Adjusted LR

Key Policy Questions

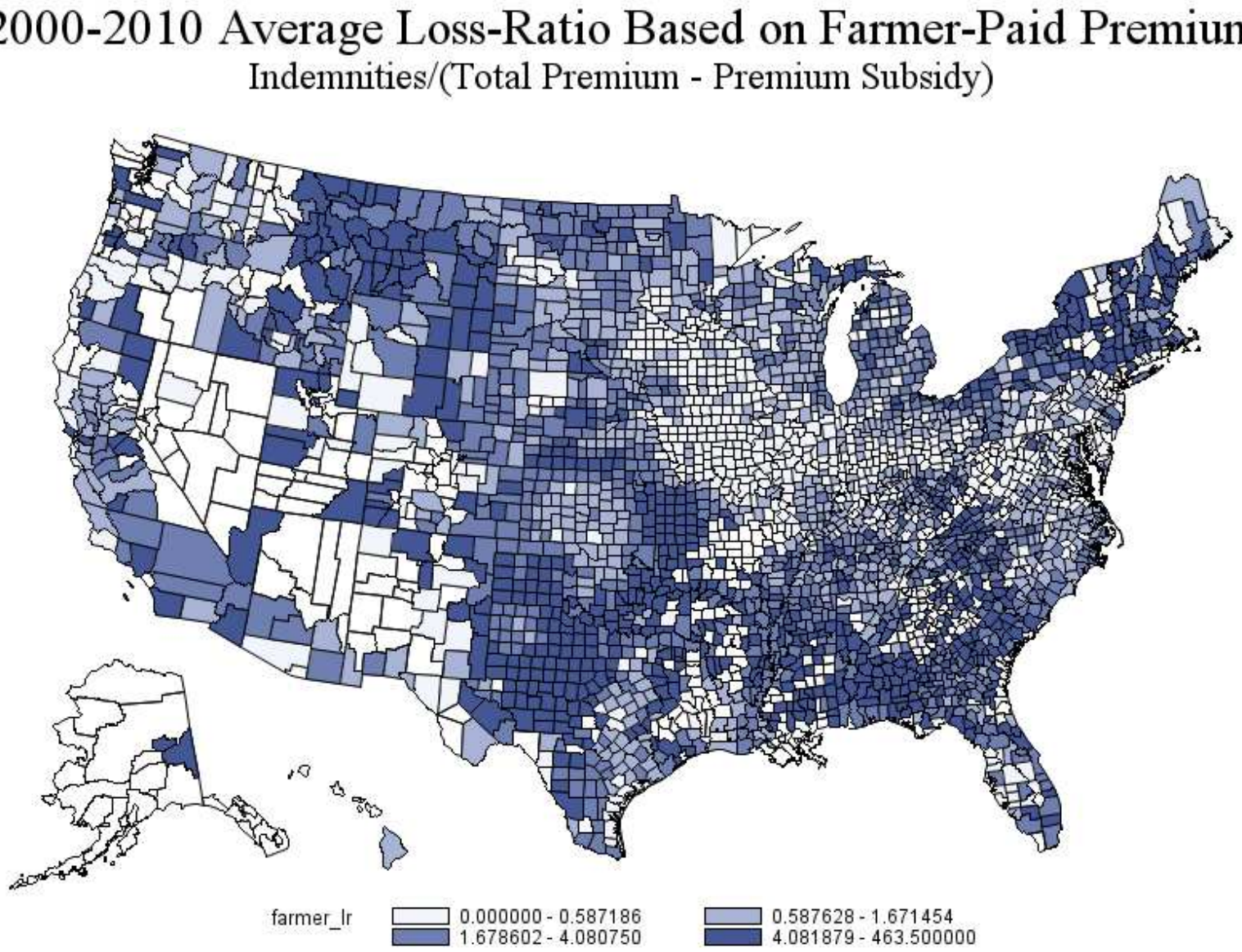
- Has the market failed to provide private crop insurance?
  - Systemic risk too much for private reinsurance?
  - CDG swap market (a form of reinsurance) has trillions in capacity
  - Difficulties in measuring "all risks" for MPCI coverage.
- Or, has the private market been crowded out by subsidies? (No private market can compete with 60% premium subsidy and A&O subsidy)
- A fundamental principle of the US program is that no subsidized plan should displace a private plan already in market. And yet ...
- Private mechanisms for managing revenue risk have long been in use:
  - Options
  - Forward contracts
  - Private specific peril insurance

Key Research Issues

Things that Fabian and I will be working on–

- Demand for insurance
- Why do we always see large subsidies being needed for participation?
- Adverse selection and distortions in participation
- Moral hazard—do subsidies induce distortions?
- First principles—risk subsidies induce more risk
- Heterogeneity in benefits may cause distortions
- Revenue insurance has ratcheting support level–WTO implications? Distortions?
- What is the role for private crop insurance?
- The utility of index insurance
- How does one address tail risk with multiple (dependent) sources of risk?

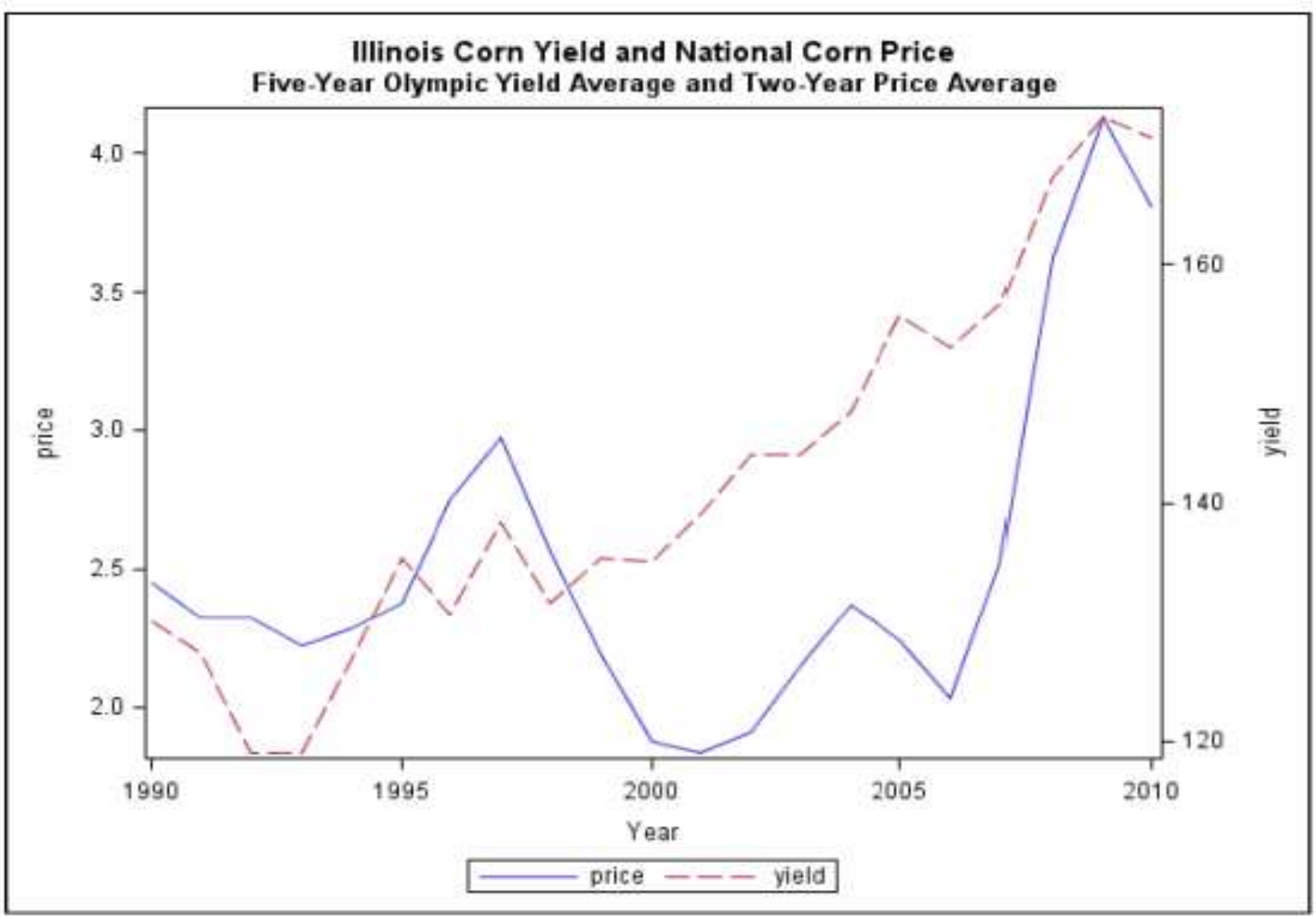
Spatial Heterogeneity of Loss Ratios



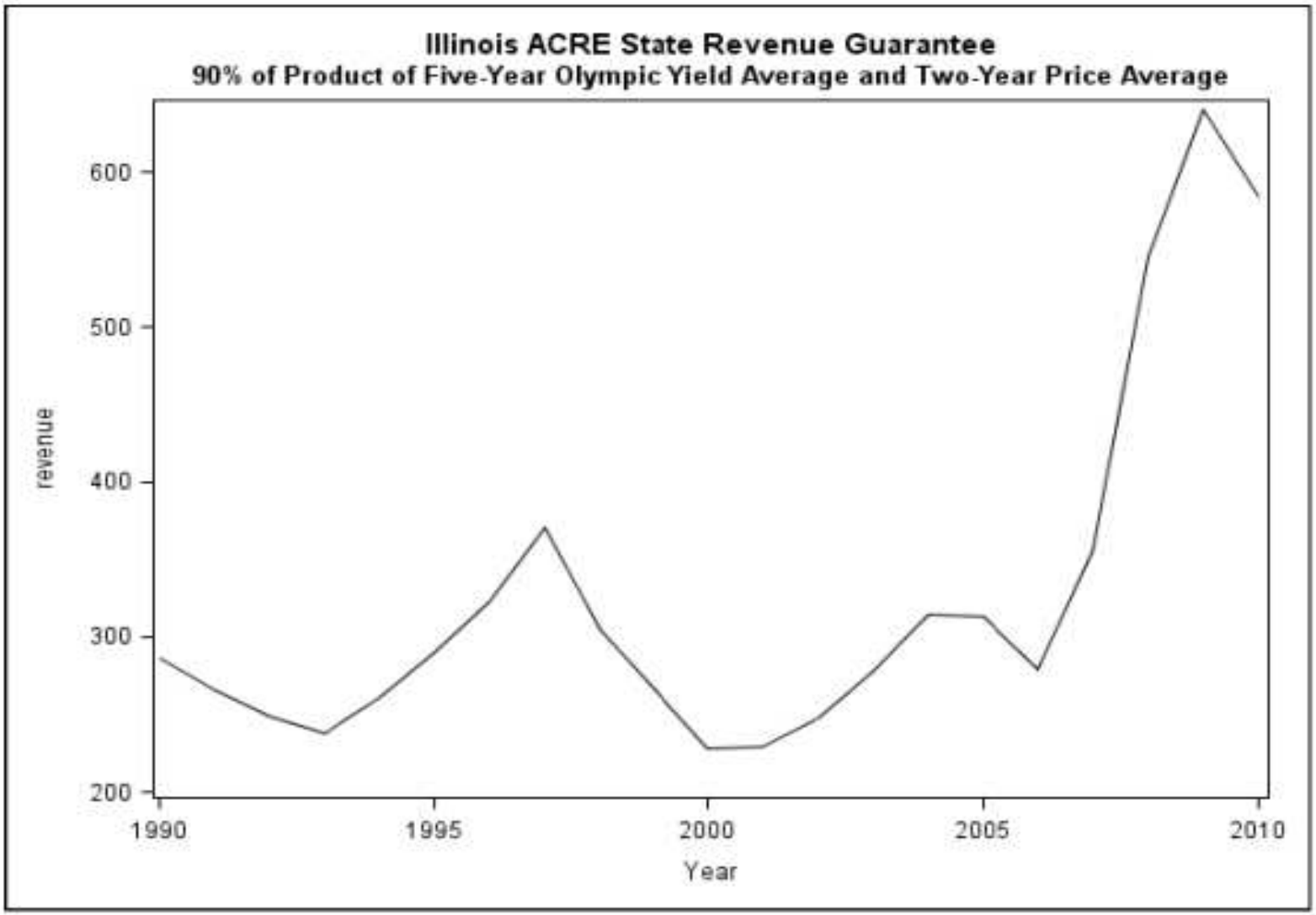
The 2012 Farm Bill and "Shallow Losses"

- Current crop insurance limited to 85% coverage (expected yield/revenue)
- US Senate passed 2012 Farm Bill June 21, 2012 (now goes to House)
  - Will cost almost $1 trillion over 10 years
  - Eliminates direct payments ($5 billion/year)
  - Eliminates CCP and ACRE
  - Introduces "shallow loss coverage" to cover part of the 15% deductible
  - Predicted to save $23 billion
  - However, that estimate is based on current price trends
  - We have shown that prices at levels recently seen would raise spending significantly
  - Most certainly would be challenged in WTO
  - Coupled support—60/75% of acreage is basis for payments
  - Last minute amendment restored conservation compliance as requirement for insurance subsidies

Lessons from the 2008-2012 ACRE Program



Lessons from the 2008-2012 ACRE Program



Issues in Revenue Coverage—Dependence

- Correlation relationships play very important role in pricing revenue coverage
- Livestock margin plans have $1.1 billion in liability
- Recently introduced livestock margin plans involve multiple overlapping options contracts
- Margin plans:
  - Cover margin between input prices and output price (e.g., cattle prices, hog prices, milk prices, corn prices, soybean meal prices)
  - Structured as Asian option
  - Requires estimation of a large number of different correlation relationships
  - Little attention has been paid to how these dependent relationships should be modeled
- Remember that price insurance is readily available in the private markets (options markets) but without taxpayer subsidies

State Dependence in Spatial Correlation (Goodwin 2001):

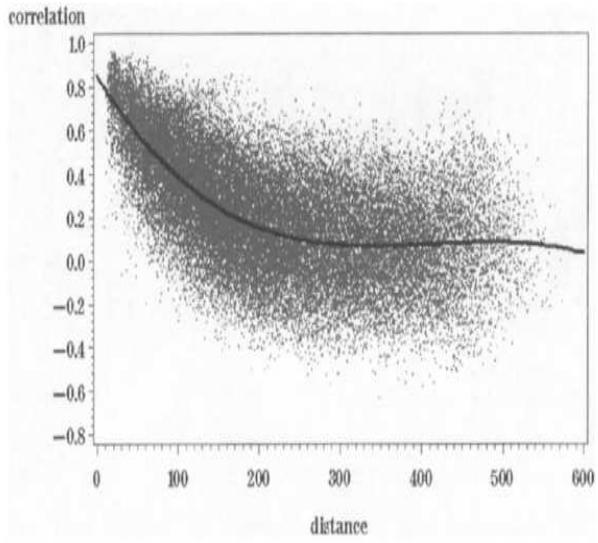


Figure 2. Pearson correlation coefficients vs. distance: normal yield years

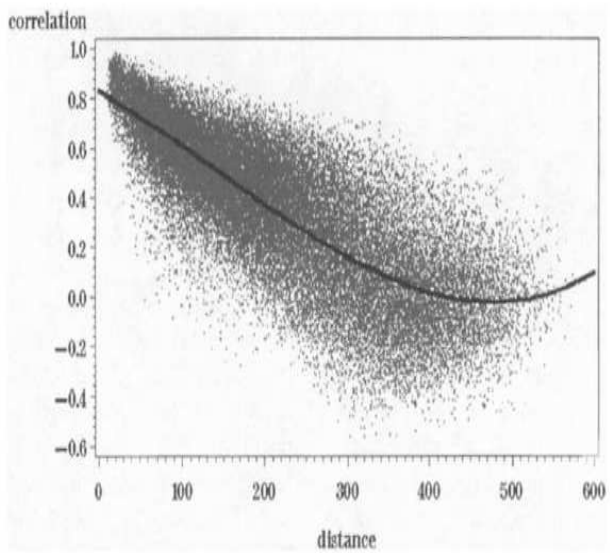
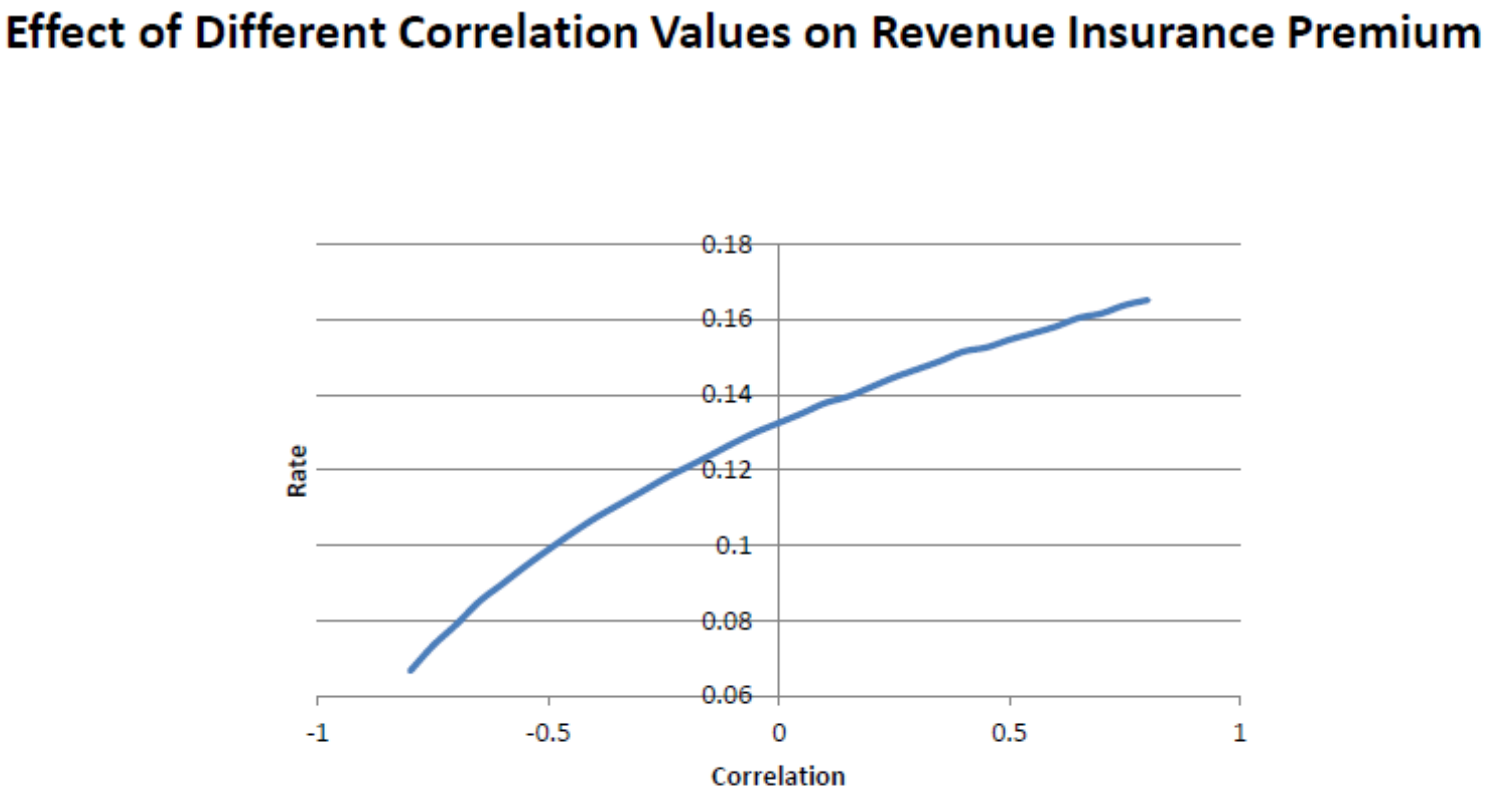


Figure 3. Pearson correlation coefficients vs. distance: extreme yield years

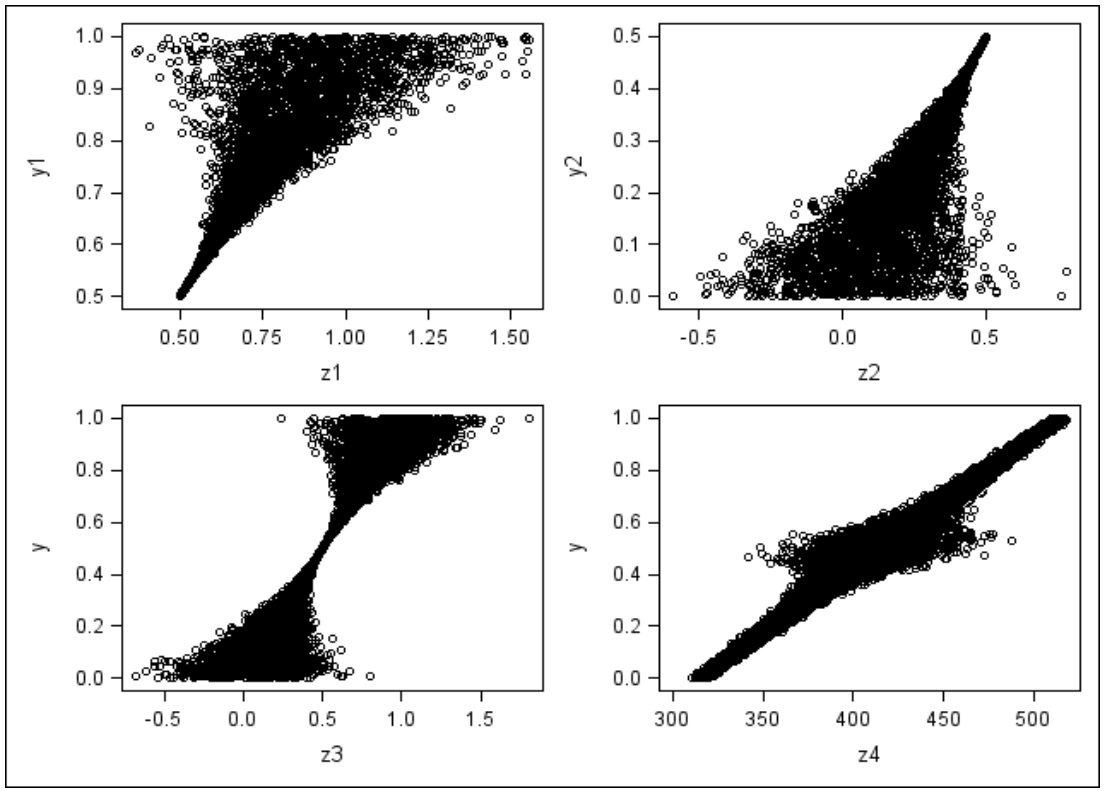
Revenue Rate and Correlation



Copulas

- A copula is a function that joins the marginal distribution functions to form the multivariate distribution function
- For an m-variate function F, the copula associated with F is a distribution function $C : [0,1]^m \rightarrow [0,1]$ that satisfies

$$F(y_1, ..., y_m) = C(F_1(y_1), ..., F_m(y_m),$$



Our Approach

- Use common methods (with Gaussian copula as benchmark) to estimate joint distributions for yields and prices
- Illustrative example considers a portfolio comprised of an equivalent number of acres of corn and soybeans for four prominent Illinois counties
- Consider a much broader approach to estimating the joint distribution—Vine Copulas
- Use model selection criteria to evaluate alternatives and to choose relevant copulas at each point in the vine
- Data–driven process to select from a range of 17 different copulas: Gaussian, Student t, Clayton, Gumbel, Frank, Joe, Clayton-Gumbel, Joe-Gumbel, Joe-Clayton, Joe-Frank, (With rotated versions of all)
- Estimate by standard ML procedures

Premium Rates

Table 6: Simulated Revenue Insurance Premium Rates

Insurance Instrument	Clayton	Gumbel	Gaussian	t	Canonical Vine
75% Revenue Guarantee					
Corn Revenue County 1	0.0142	0.0113	0.0017	0.0020	0.0042
Corn Revenue County 2	0.0151	0.0111	0.0014	0.0017	0.0030
Corn Revenue County 3	0.0153	0.0118	0.0014	0.0020	0.0035
Corn Revenue County 4	0.0134	0.0099	0.0011	0.0013	0.0035
Soybean Revenue County 1	0.0125	0.0094	0.0025	0.0032	0.0041
Soybean Revenue County 2	0.0100	0.0072	0.0013	0.0016	0.0024
Soybean Revenue County 3	0.0113	0.0087	0.0022	0.0027	0.0037
Soybean Revenue County 4	0.0124	0.0084	0.0015	0.0015	0.0024
Corn Revenue Total	0.0102	0.0043	0.0009	0.0013	0.0032
Soybean Revenue Total	0.0088	0.0049	0.0012	0.0017	0.0028
Total Revenue	0.0070	0.0015	0.0003	0.0006	0.0017
95% Revenue Guarantee					
Corn Revenue County 1	0.0628	0.0634	0.0365	0.0365	0.0466
Corn Revenue County 2	0.0622	0.0619	0.0346	0.0347	0.0446
Corn Revenue County 3	0.0625	0.0626	0.0361	0.0367	0.0458
Corn Revenue County 4	0.0619	0.0610	0.0345	0.0344	0.0457
Soybean Revenue County 1	0.0530	0.0522	0.0380	0.0401	0.0452
Soybean Revenue County 2	0.0509	0.0506	0.0353	0.0354	0.0418
Soybean Revenue County 3	0.0544	0.0542	0.0390	0.0399	0.0461
Soybean Revenue County 4	0.0529	0.0513	0.0351	0.0346	0.0405
Corn Revenue Total	0.0579	0.0559	0.0340	0.0343	0.0447
Soybean Revenue Total	0.0500	0.0478	0.0351	0.0358	0.0424
Total Revenue	0.0437	0.0392	0.0288	0.0297	0.0375

Summary and Conclusions

- US Congress shows little intent to significantly cut subsidies
- Though cuts in food stamps are being proposed
- Seems to be little concern about WTO obligations
- Shallow loss coverage appears to be an attempt to remove nearly all risk from agriculture
- Does anyone know of another small business sector that is treated this way?
- Ever expanding crop insurance raises concerns about distortions in behavior
- Subsidies for ACRE, ARC, revenue insurance, most certainly tied to the market price (WTO implications?)
- A very rich research agenda
  - Great data sets
  - A place where econometrics and policy intersect and have real-world implications
  - Still much we don't understand about risk attitudes and subsidized insurance