Risk Considerations in U.S. Supply Response

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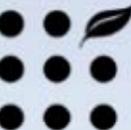
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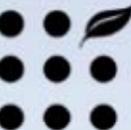
Does Risk Matter?

- **Are risk and/or risk attitudes important in agricultural production decisions?**

- **Partially decoupled payments (e.g., CCPs)**
  - **Lower price risk and affect risk attitudes indirectly through wealth effect**

- **Decoupled payments (e.g., DPs)**
 - **Affect risk and/or risk attitudes indirectly through wealth effect**

Purposes of the Study

- **Revisit an earlier study of acreage decisions under risk for U.S. corn and soybeans by Chavas and Holt (*AJAE*, 1990)**
  - **Estimate a risk response model for major field crops in the Northcentral region using more up-to-date data**

- **Assess the effects of initial wealth and risk on producers' acreage response**

- **Draw implications for effects of decoupled payments (DPs, CCPs) on production decisions**
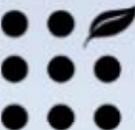
Other Related Studies

- **Modeled risk using variance, standard or absolute deviation of prices or net returns**

- **Risk quite significant in acreage response for California field crops less strictly regulated by government programs (Just, *AJAE*, 1974)**

- **Risk was statistically significant for Kansas wheat--a 1% decrease in standard deviation leads to an increase of 0.06% in wheat acreage (Lin, *AJAE*, 1977)**

- **Risk was found to be moderately significant for onions (Traill, *JAE*, 1978)**
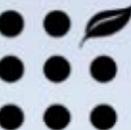
Chavas and Holt (*AJAE*, 1990)

- **Acreage response model under expected utility maximization**

- **Specified and estimated a system of acreage response equations with risk for U.S. corn and soybeans, 1954-85**

- **Included farm value of proprietor's equity as the proxy for initial wealth, an explanatory variable**

- **Gave particular attention to the truncation effects of commodity loan programs on the distribution of commodity prices**

- **Applied symmetry restrictions**
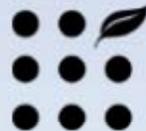
Chavas and Holt, Results

- **Risk and wealth variables play an important role in corn-soybean acreage decisions**

- **Risk elasticities w.r.t. variances of prices are small**
  - **Not statistically significant for corn**
  - **-0.087 for soybeans**

- **Elasticities w.r.t. initial wealth are generally small**
  - **0.087 for corn**
  - **0.270 for soybeans**
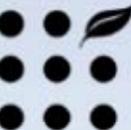
Theoretical Framework

- **Chavas-Holt theoretical model was adopted**

- **Model maximizes expected utility for a farm household subject to a budget constraint**

- **Planted acreage is a function of**
  - **Expected net returns,**
  - **Second and (possibly) higher moments of the distribution of net returns, and**
  - **Farm household's wealth**

- **Unless risk neutrality is assumed, homogeneity restrictions do not apply**

- **Symmetry restrictions apply to the acreage equations**
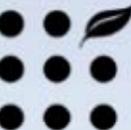
Homogeneity and Symmetry Constraints

$A_c = a_{11} + b_{11} NRT_c + b_{12} NRT_s + b_{13} NRT_w$

$A_s = a_{21} + b_{21} NRT_c + b_{22} NRT_s + b_{23} NRT_w$

$A_w = a_{31} + b_{31} NRT_c + b_{32} NRT_s + b_{33} NRT_w$

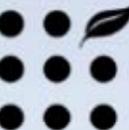where A   = acreage planted,

NRT = expected net returns

subscripts c, s, w refer to corn, soybeans, and wheat

Homogeneity: (applies only under risk neutrality)

e.g., $b_{13} = - (b_{11} + b_{12})$

Symmetry constraints:

$b_{21} = b_{12}; \ \ b_{31} = b_{13}; \ \ b_{32} = b_{23}$

Estimation of the Empirical Model

- **Forward looking**
  - **Expected farm prices are based on new crop futures prices**

- **Acreage response for corn, soybeans, and wheat**

- **The model is estimated using**
  - **Pooled time-series (1991-2001) and**
  - **Cross-section (8 states) state-level data for the Northcentral region**

- **Symmetry constraint is imposed**

- **"Farm operator household net worth" is used as proxy for initial wealth**
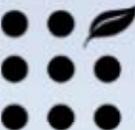
Estimation of the Empirical Model (Cont.)

- (Untruncated) expected net returns equal the expected farm price times the trend yield, minus a covariance term and variable costs of production

- (Untruncated) price variances are a weighted sum of the squared deviations of past prices from their expected values, with weighting scheme

  - t-1, 0.5
  - t-2, 0.3
  - t-3, 0.2

- Truncated expected net returns, variances, and covariances of commodity prices are included as explanatory variables
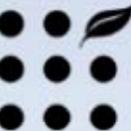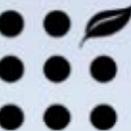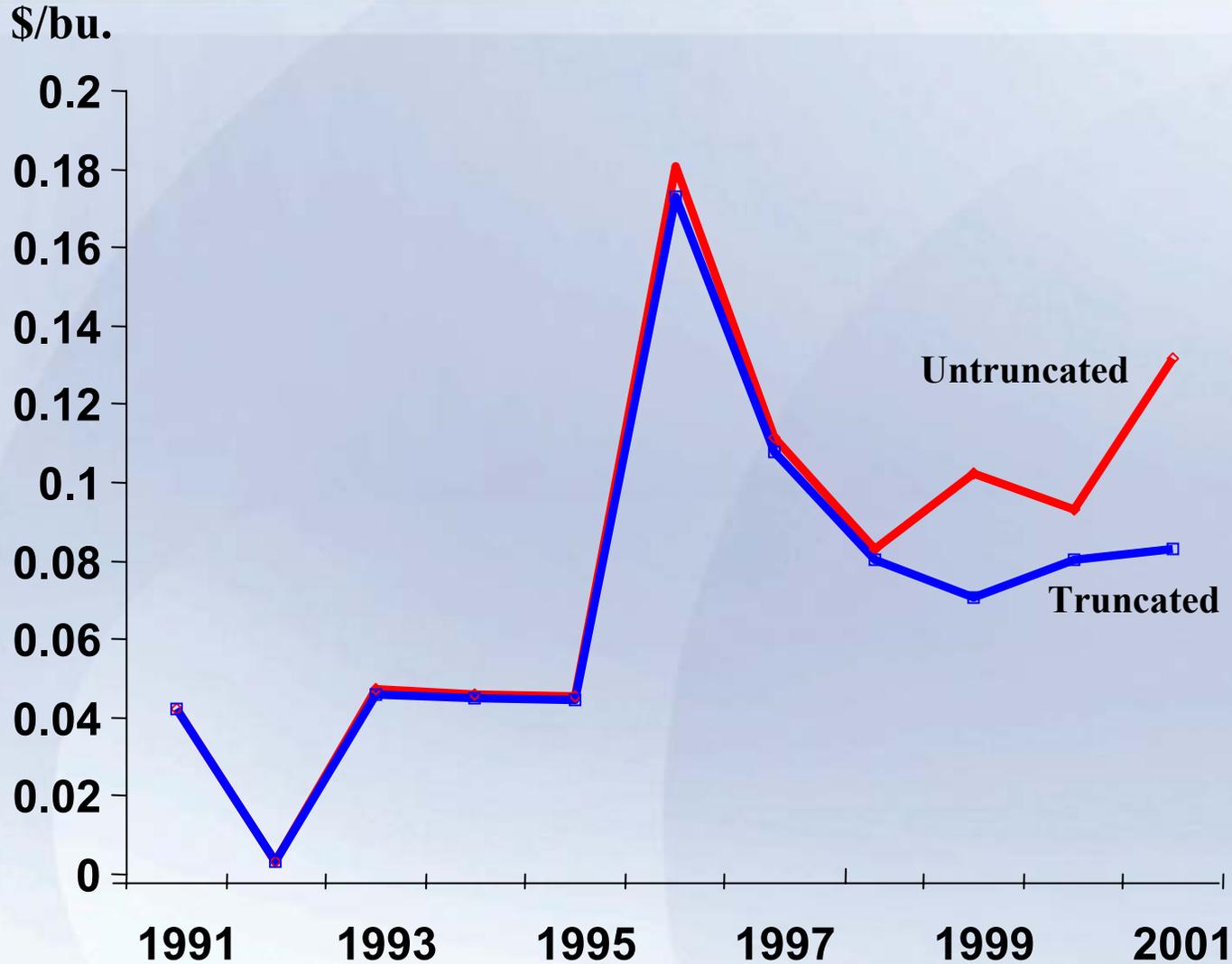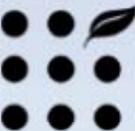
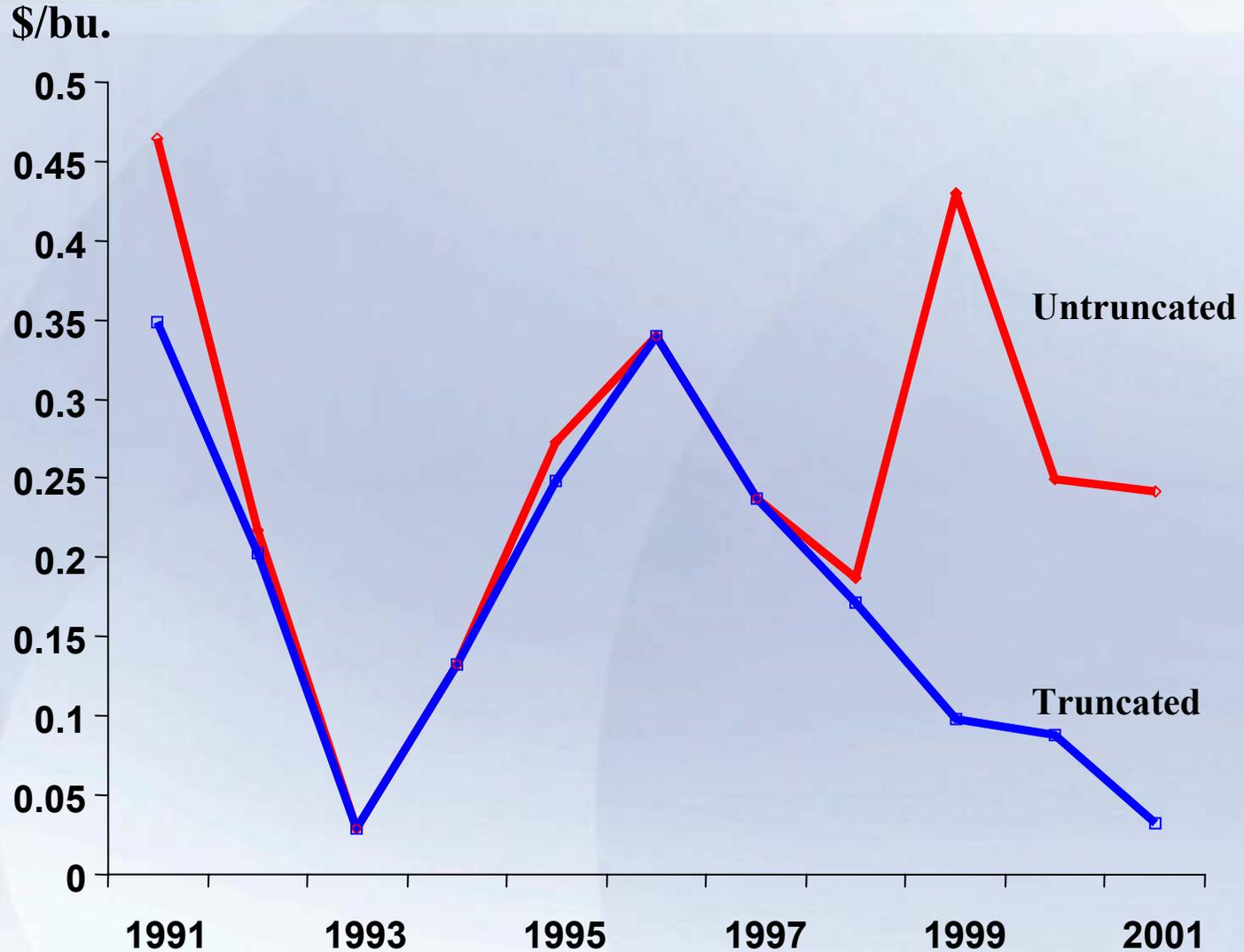# Corn farm price distribution in Illinois, 2001
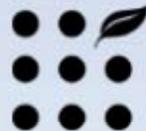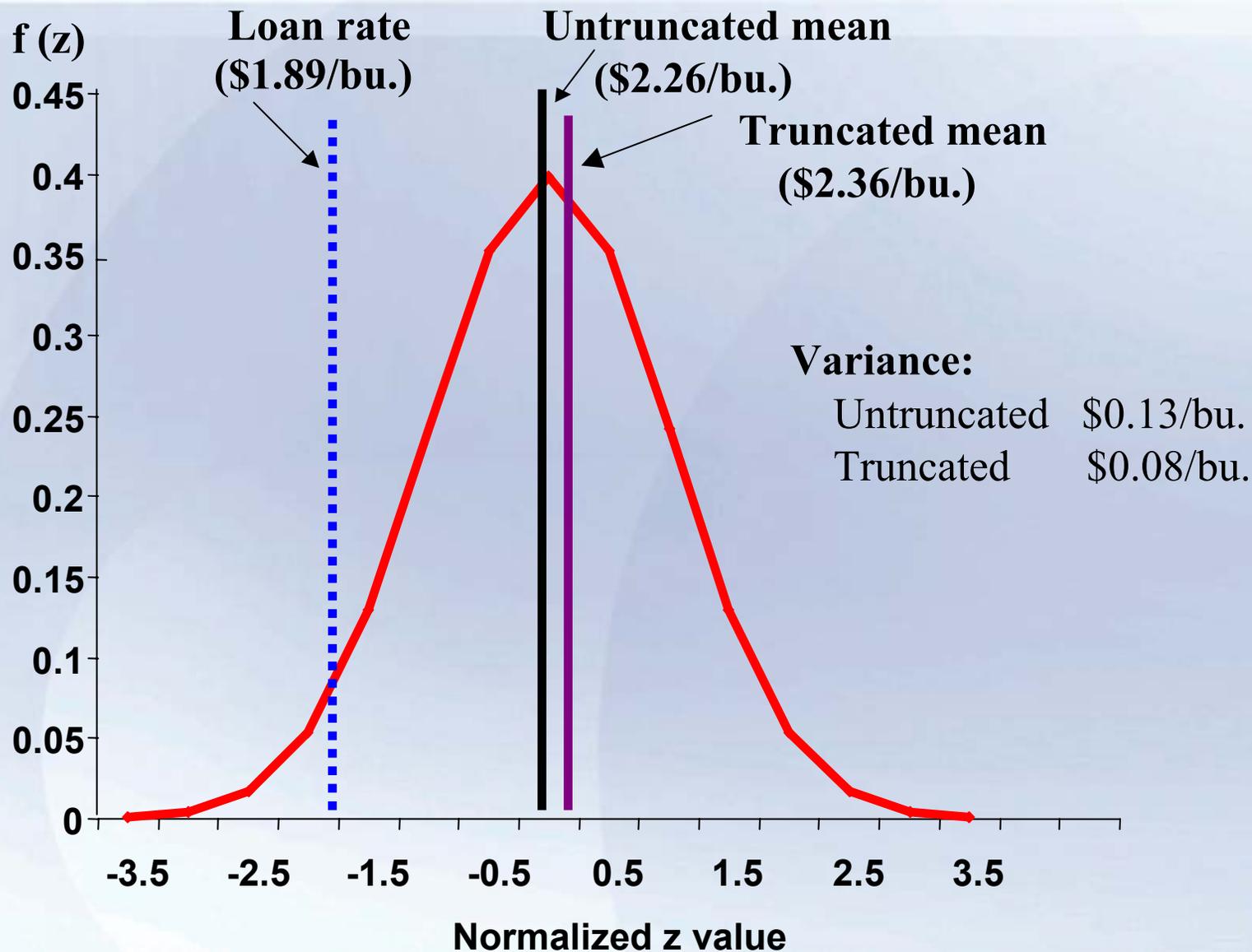
Soybean farm price distribution in Illinois, 2001
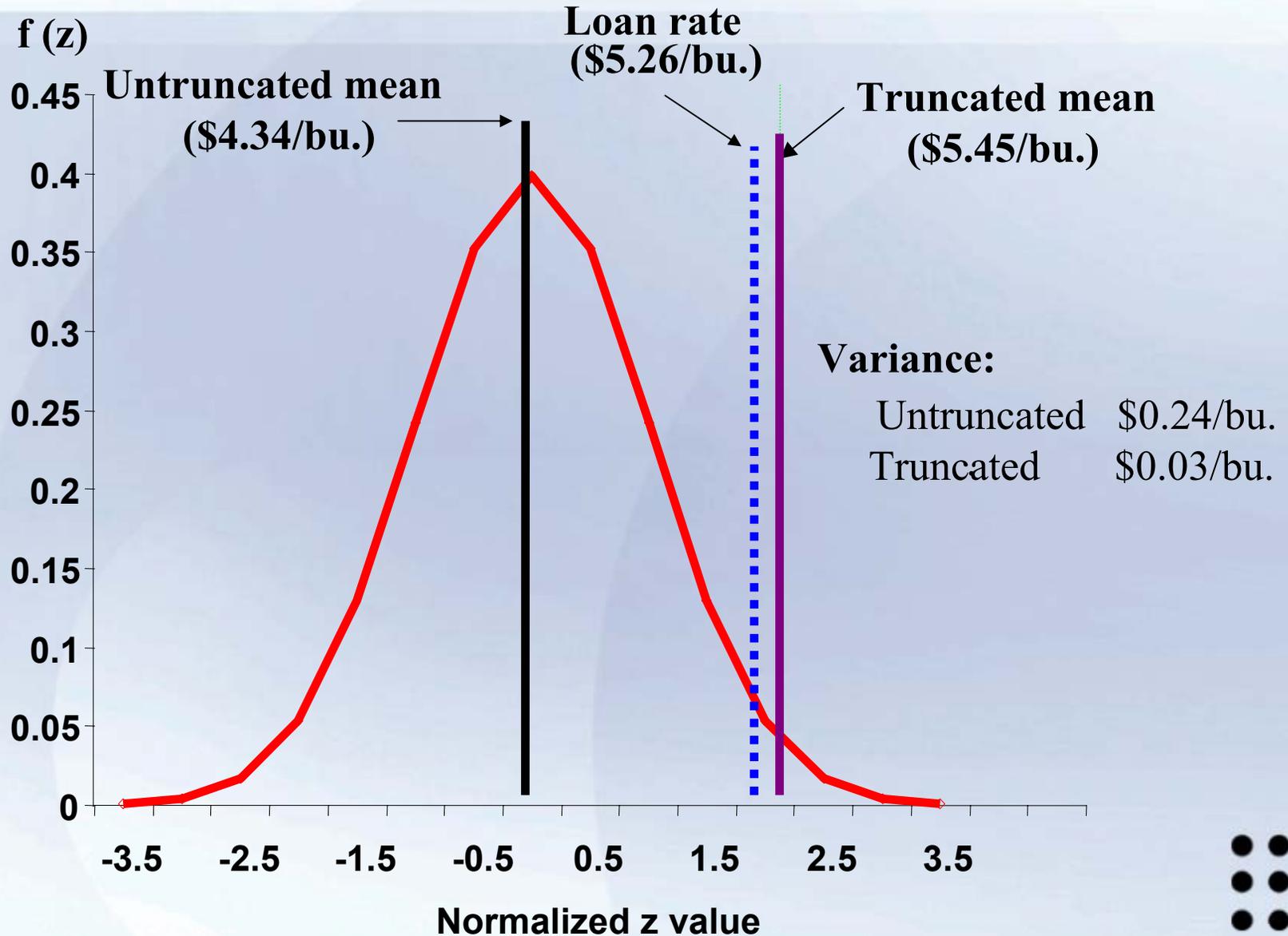
Variance of corn farm price distribution in Illinois, 1991-2001

Variance of soybean farm price distribution in Illinois, 1991-2001

Estimated acreage share equations: 1991-2001

	Corn	Soybeans	Wheat
Expected net returns:			
Corn	0.072	-0.064	-0.001
	(2.99)***	(-3.23)***	(-0.16)
Soybeans	-0.064	0.060	0.0003
	(-3.23)***	(3.10)***	(0.05)
Wheat	-0.001	0.0003	0.010
	(-0.16)	(0.05)	(1.58)

- Net returns for corn and soybeans are highly significant with expected signs

- Net returns for wheat also has expected sign, but is not as significant

Figures in parentheses are t-ratios

*, **, *** Statistically significant at 10%, 5% and 1% level
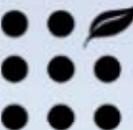
Estimated acreage share equations: 1991-2001 (Cont.)

	Corn	Soybeans	Wheat
Variance of prices:			
Corn	3.411 (0.16)	-11.917 (-0.65)	--
Soybeans	6.134 (1.38)	-8.701 (-2.31)**	--
Wheat	--	--	-2.437 (-1.13)

- **Of all estimated coefficients of price variances, only the variance of soybean prices is significant with expected sign in soybean acreage equation**
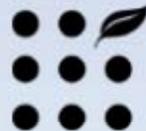
Estimated acreage share equations: 1991-2001 (Cont.)

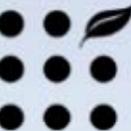|	Corn	Soybeans	Wheat
Covariance of prices:			
Corn and soybeans	-26.772 (-0.92)	32.087 (1.33)	--
Corn and wheat	--	--	13.841 (1.94) *
Soybeans and wheat	--	--	-3.345 (-0.94)

- **Of all estimated coefficients of the covariance of prices, only the covariance of corn and wheat prices is significant**

	Corn	Soybeans	Wheat
Wealth effect:			
Wealth	-0.191	0.397	1.546
	(-1.77) *	(6.41)***	(6.39)***

- **While initial wealth has positive effects on soybean and wheat plantings and is highly significant, the effect is negative for corn**

- **An increase in initial wealth would lead to greater plantings of major field crops, consistent with the risk preference of decreasing absolute risk aversion**
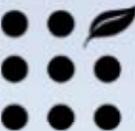
Interpretations of Results

- **The risk elasticity with respect to the variance of soybean prices in soybean equation is small**
  - **-0.044 at mean values**
  - **Somewhat smaller than previous studies' findings— -0.087 (Chavas and Holt) and -0.06 (Lin)**

- **The wealth elasticity, however, differs**
  - **-0.063 for corn**
  - **0.139 for soybeans**
  - **0.003 for wheat**

- **Own-price elasticities**
  - **0.331 for corn**
  - **0.253 for soybeans**
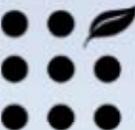
Implications for CCP Effects on Acreage

Because of high soybean prices in recent years,

- **No impact of variance of soybean prices on soybean acreage if expected soybean farm price is at the 2002/03-2004/05 average ($6.23/bu.)**

- **No impact on soybean acreage even if the expected farm price is 90% of the 2002/03 – 2004/05 average ($5.61/bu.)**
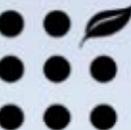
Implications for CCP Effects on Acreage
(Scenario Analysis)

- CCP will kick in when the national average farm price falls below the target price minus direct payment rate ($5.36/bu.)

Scenario:

Soybean farm price = 80% of the 2002/03 – 2004/05 average ($4.98/bu.)

- A $0.36/bu. CCP will kick in
  - CCP would lower variance of soybean farm prices by 49.9%

- CCP effect on soybean acreage would be small—an increase of 2.94%
  - increase of 2.20% through risk reduction
  - increase of 0.74% through higher price

Conclusions

- **Preliminary results suggest that the effects of risk on supply response for major field crops are not strong**

- **However, risk could be significant for individual farms in the U.S. as well as those in the EU**

- **An increase in initial wealth would lead to greater acreage of major field crops, consistent with the risk preference of decreasing absolute risk aversion**

- **Expanded soybean and wheat acreage associated with an increase in wealth comes partly at the expense of corn plantings**

- **Need to further study risk/wealth effects in farm households, particularly with regard to DPs and CCPs**