



# Grain Marketing: Getting Back to the Fundamentals

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## ***Forecasting in Agriculture***

Consider, this information for Illinois farmers over 1975-2001

	Corn	Soybeans
Average price	\$2.16/bu.	\$5.85/bu.
66 <sup>th</sup> percentile	\$2.44/bu.	\$6.25/bu.
Revenue gain	\$39.99/acre	\$17.68/acre

## ***Fundamental Analysis***

- Definition: An assessment of price based on the underlying supply and demand factors and the changes in those relationships
- Motivated by economic theory of supply and demand
  - The task of the market is to establish a price that will “clear” the market
- Fundamental analysis can be thought of as the process of anticipating the market clearing price

# ***Fundamental Analysis***

- Techniques: Subjective judgement to sophisticated statistical models
- Goal: Estimate “fundamental value” and compare to market price
  - Bullish:  $\text{Value} > \text{Price}$
  - Bearish:  $\text{Value} < \text{Price}$

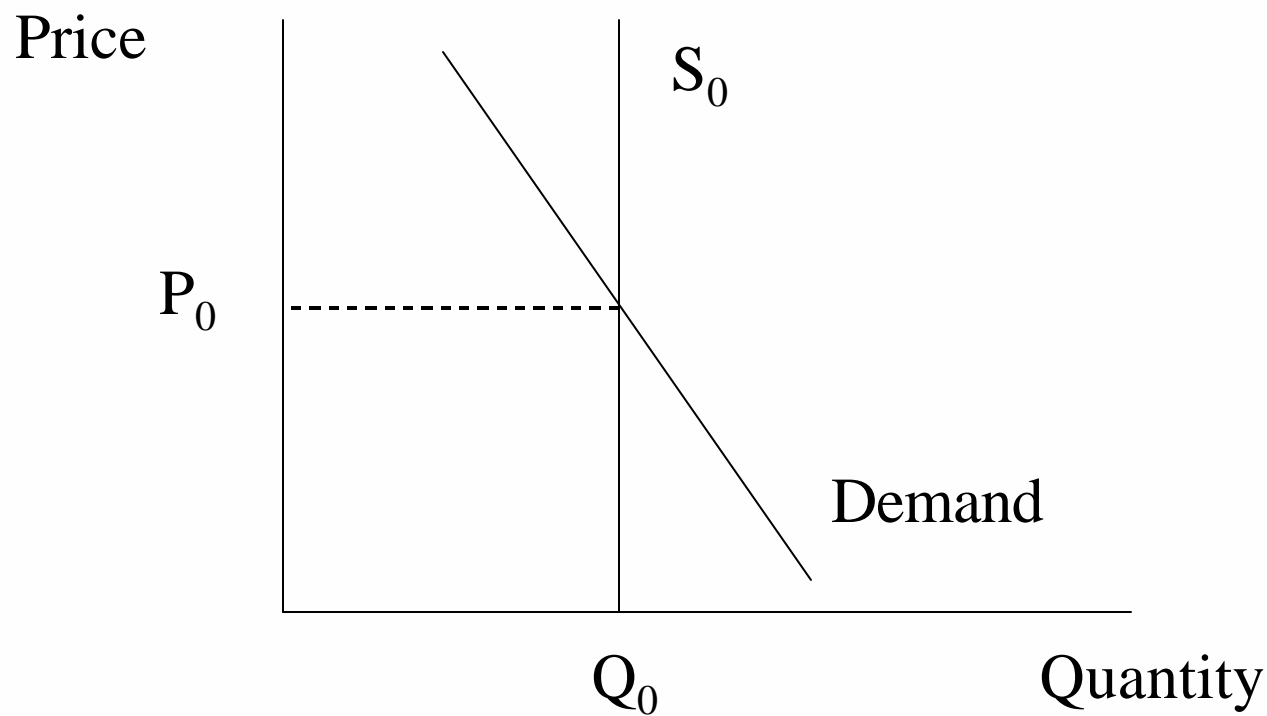
# ***Price Making Forces in the Corn Market***

- Acreage
- Yield
- Weather
- Exchange rates
- Consumer income
- Government policies
- Foreign grain production
- Livestock numbers
- Interest rates
- Consumer income
- Feeding rates
- Livestock prices
- Trade agreements
- World economic growth

## ***Balance Sheets***

- Most popular tool used in fundamental analysis of crop prices
- Unit of analysis is a marketing year
- Constructed for a particular country, region or the entire world
  - Build supply side first
  - Then build consumption, or use, side
  - Price ties both sides together by rationing available supplies to competing uses

# ***Economic Model Underlying Balance Sheets***



## ***Balance Sheet Format for Corn***

Beginning Stocks
+ Production
+ Imports
= Total Supply
Feed and Residual
+ Food, Seed and Industrial
+ Exports
=Total Consumption (Use)
Ending Stocks =Total Supply – Total Consumption



# ***Balance Sheet Format for Soybeans***

Beginning Stocks
+ Production
+ Imports
= Total Supply
Crush
+ Exports
+ Food, Seed and Residual
=Total Consumption (Use)
Ending Stocks =Total Supply – Total Consumption

## ***Forecasting Calendar for 2004/2005 Corn Balance Sheets***

- Fall 2003: First forecasts of supply and use for 2004-2005 marketing year
  - Typically based on trend forecasts, recent history and basic economic relationships
- Spring 2004: Update supply forecasts based on USDA acreage surveys
- Summer 2004: Update supply forecasts based on weather and USDA crop reports

# ***Forecasting Calendar for 2004/2005 Corn Balance Sheets***

- Fall 2004-Summer 2005:
  - Continue to update supply forecasts based on USDA crop reports (Aug-Nov, Jan)
  - Update use forecasts based on:
    - Export sales and inspections reports
    - Quarterly USDA stock estimates
    - Livestock numbers
    - Monthly processing reports

# ***WASDE Balance Sheet Estimates from the USDA***

- WASDE: World Agricultural Supply and Demand Estimates
- Cover all major commodities
- Separate balance sheets maintained for over 90 countries!
- Numerous agencies within USDA participate in “consensus” process
- Serve as the benchmark balance sheet estimates for nearly all market participants

## ***Constructing Early Season 2004/2005 Balance Sheets for Corn***

- The first WASDE estimates will not be released until May 2004
- We will use simple trend projections and last year's values as our starting point

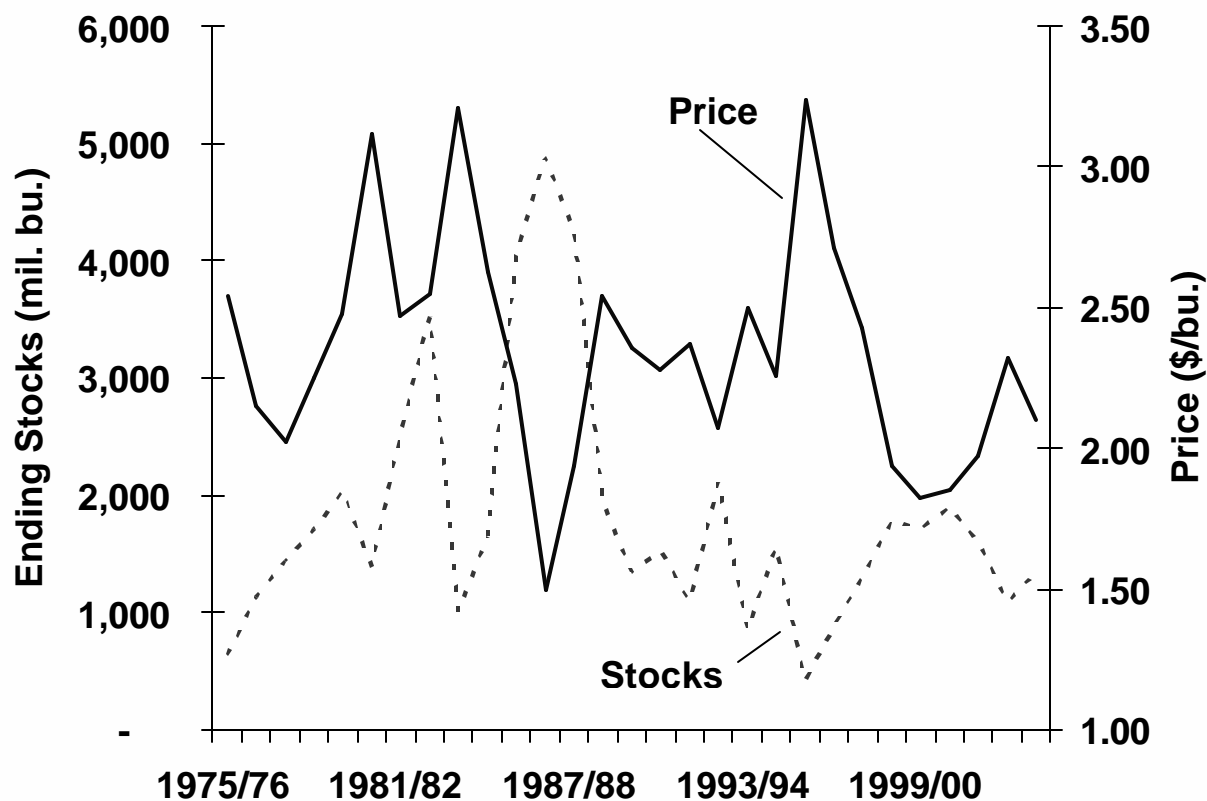
# ***Balance Sheet Format for Corn***

Beginning Stocks
+ Production
+ Imports
= Total Supply
Feed and Residual
+ Food, Seed and Industrial
+ Exports
=Total Consumption (Use)
Ending Stocks =Total Supply – Total Consumption
Price = ???

## ***Ending Stocks and Price***

- Ending stocks indicate the relative balance between supply and demand
  - Ending stocks high, price low
  - Ending stocks low, price high
- Relationship between ending stocks and price is often used to forecast prices

# Corn Ending Stocks and Price, 1975/76-2003/04 \*

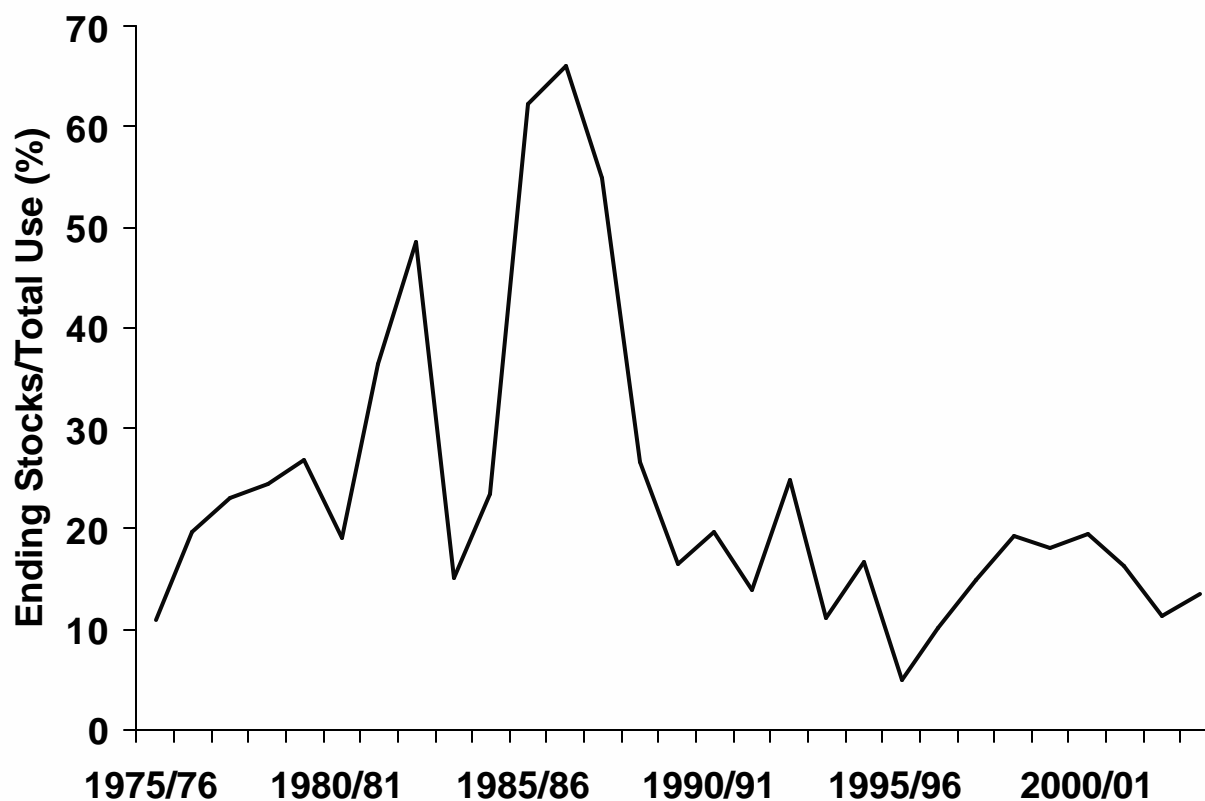


Source: USDA

\*2003/04 Projected



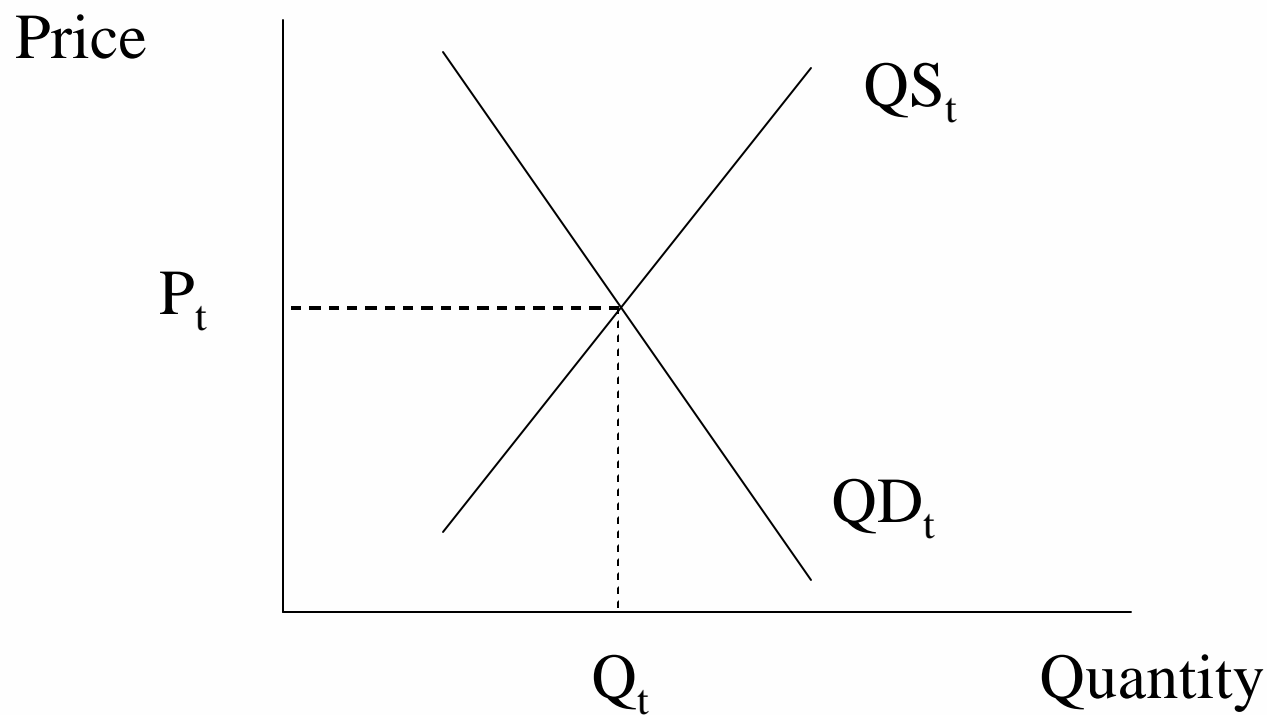
# ***US Corn Ending Stocks/Total Use, 1975/76-2003/04\****



Source: USDA

\*2003/04 Projected

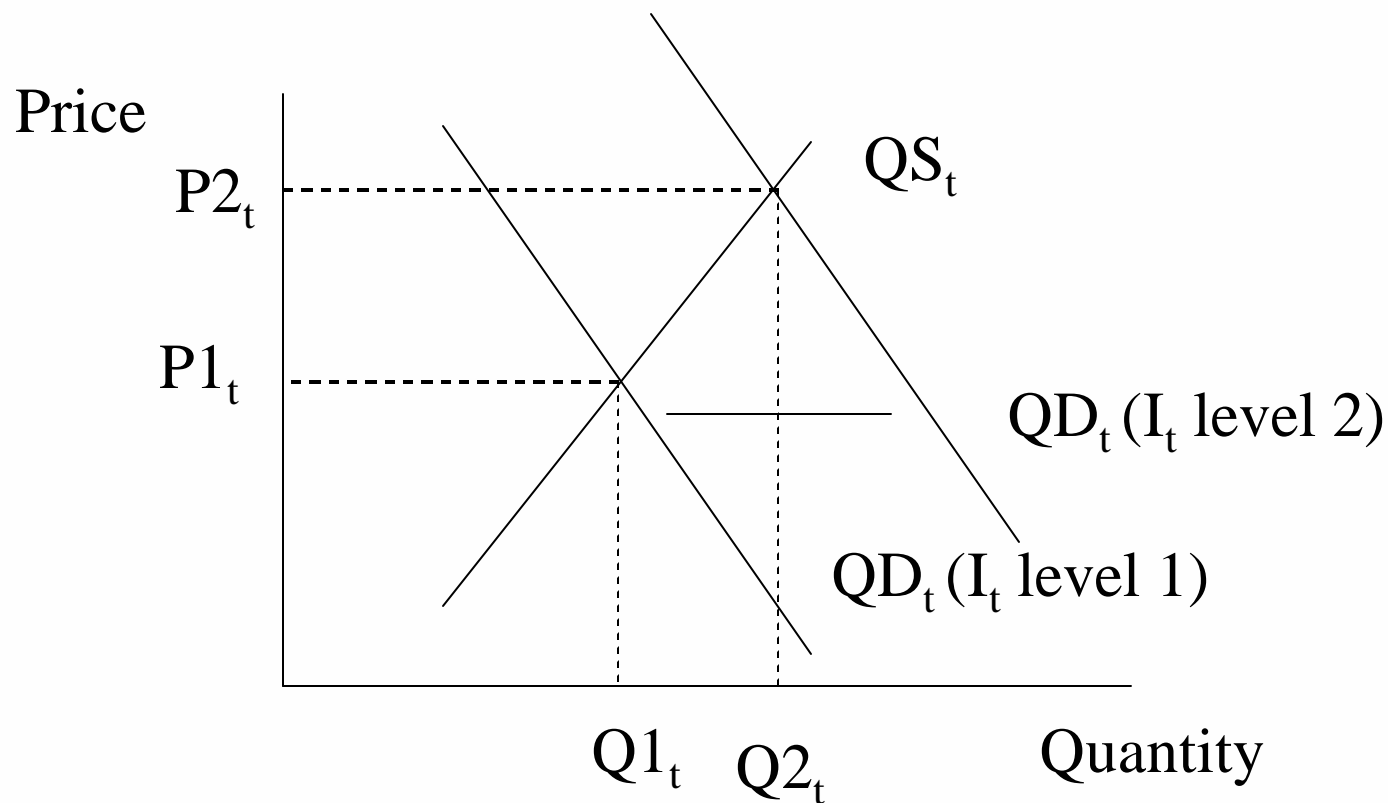
# ***Graphical View of Corn Market***



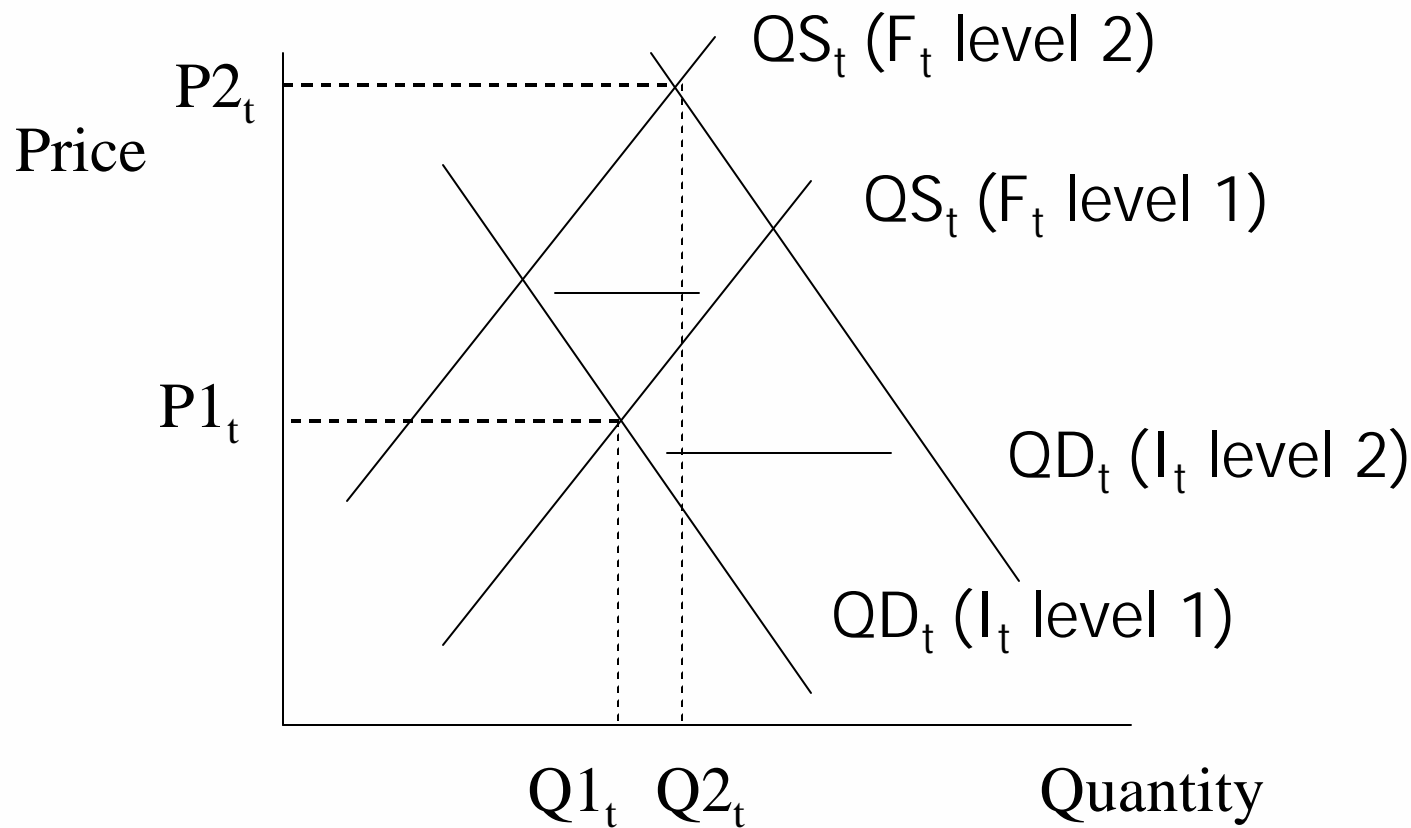
## ***Adding Shifter Variables***

- In the simple model, there is only one equilibrium because nothing ever changes!
- In reality, we know that:
  - Demand curves shift due to changes in the price of substitutes, income and other variables
  - Supply curves shift due to changes in the price of inputs, technology and other variables
- Key point: Changing equilibrium prices and quantities are driven by changes in the level of “shifter variables”

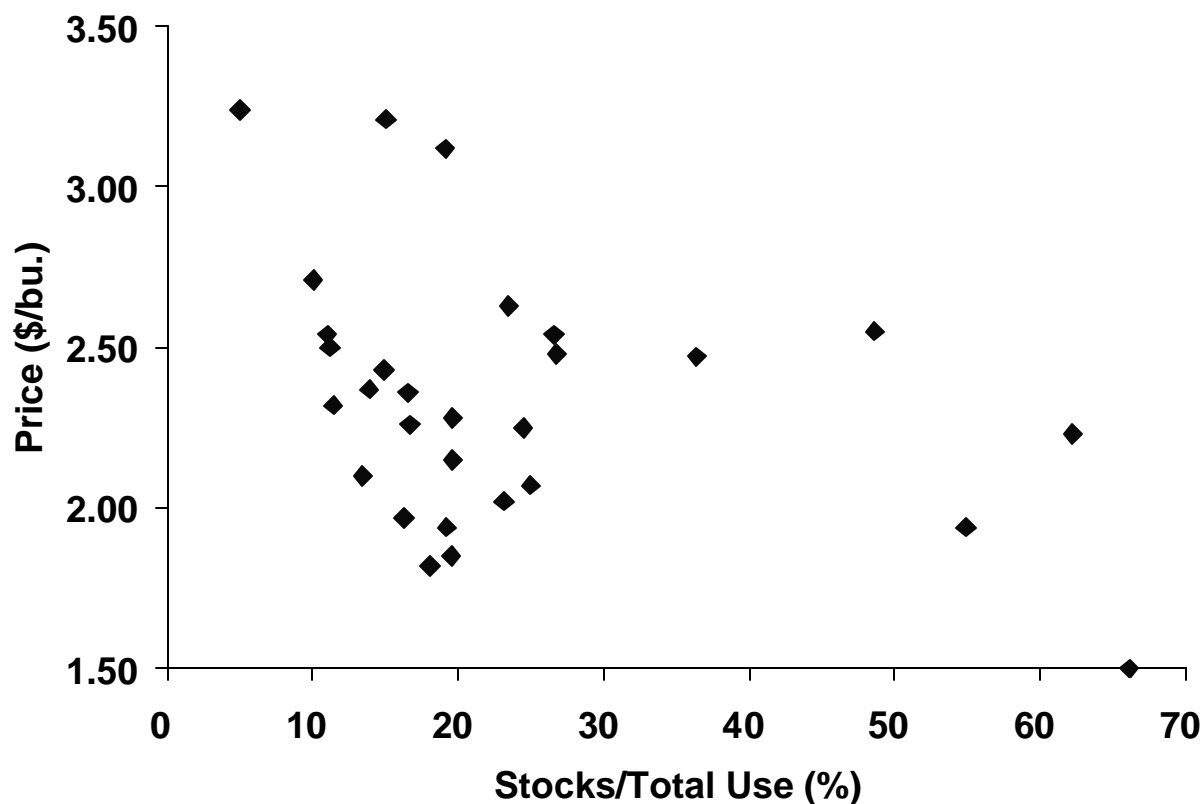
# ***Graphical View of Model with a Single Demand Shifter (Income)***



# ***Model with A Demand Shifter (Income) and Supply Shifter (Fertilizer Price)***



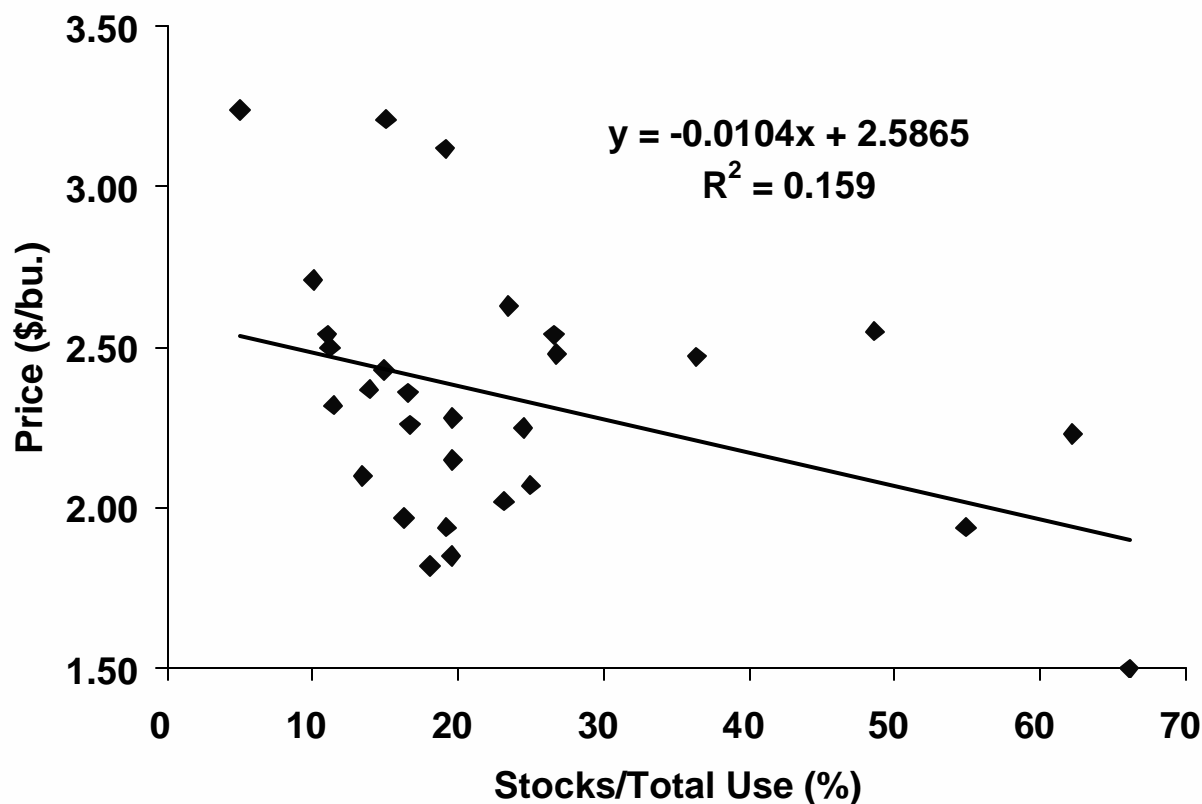
# ***Corn Price and Ending Stocks/Use, 1975/76-2003/04 \****



Source: USDA

\*2003/04 Projected

# ***Corn Price and Ending Stocks/Use, 1975/76-2003/04: Linear Model\****



Source: USDA

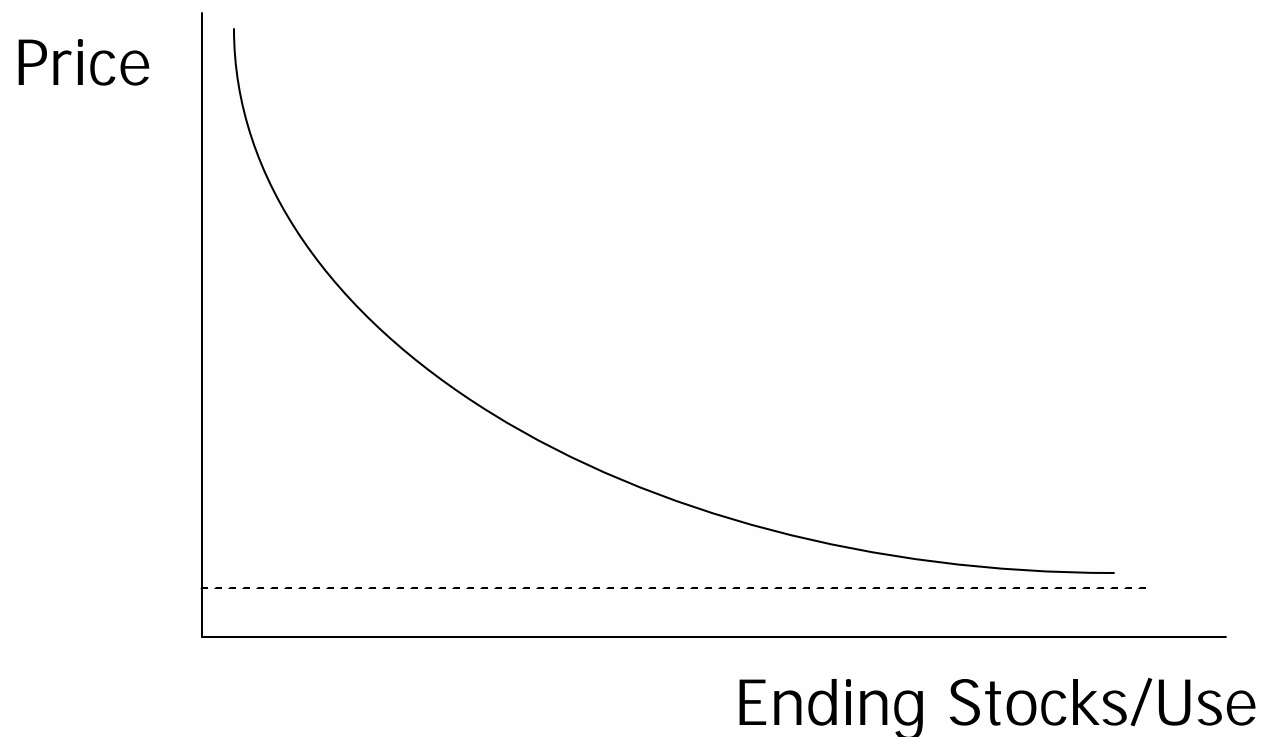
\*2003/04 Projected

# ***Logical Characteristics of Relationship Between Price and Stocks***

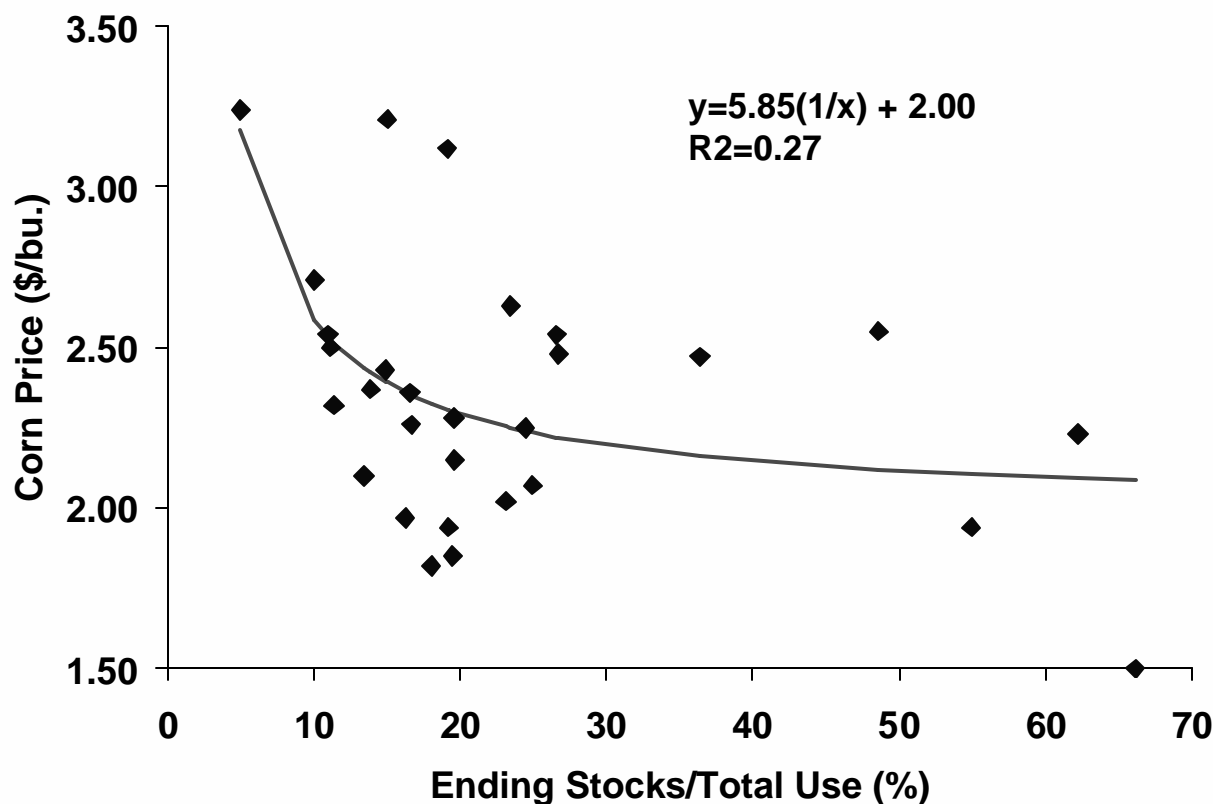
- As ending stocks approach zero, theoretically, there is no upper limit for price
- As ending stocks get very large, price is unlikely to go below some minimum “reservation” level



# ***Theoretical Functional Form Between Price and Ending Stocks***



# ***Corn Price and Ending Stocks/Use, 1975/76-2003/04: Reciprocal Model\****



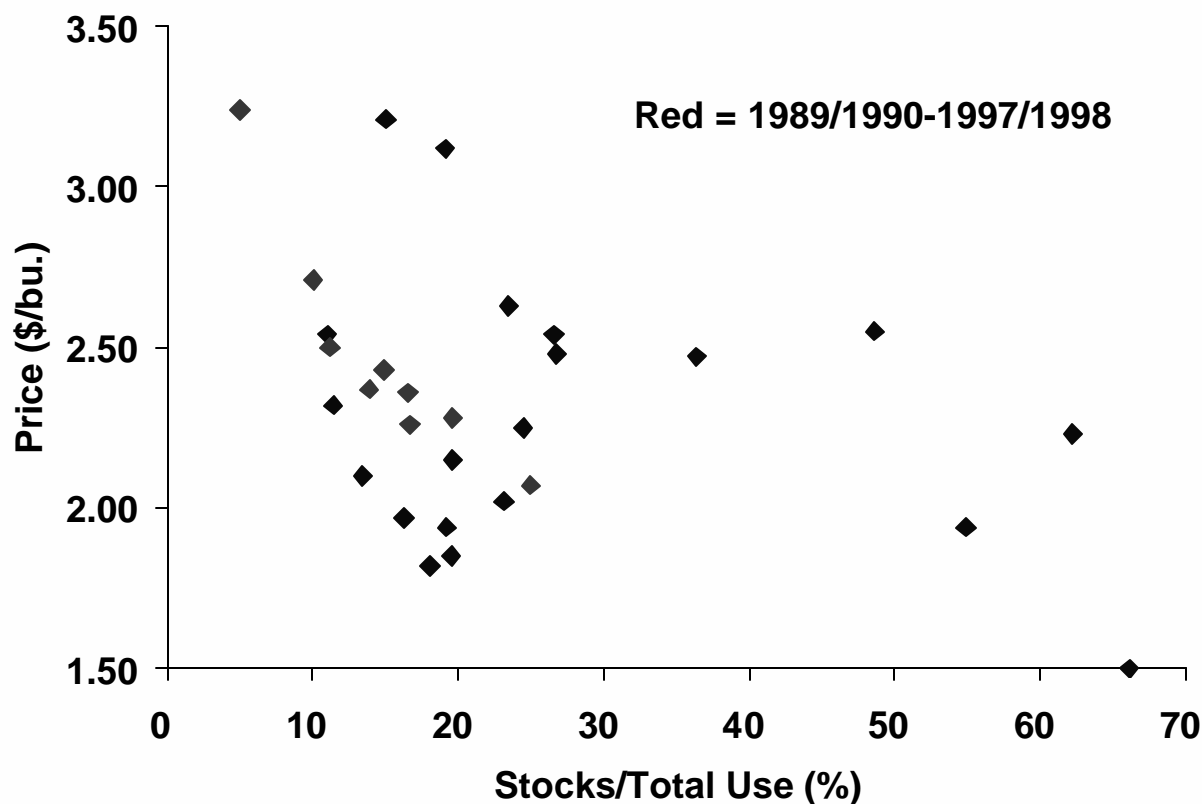
Source: USDA

\*2003/04 Projected

## ***Different Approaches to Account for Shifts in Relationship***

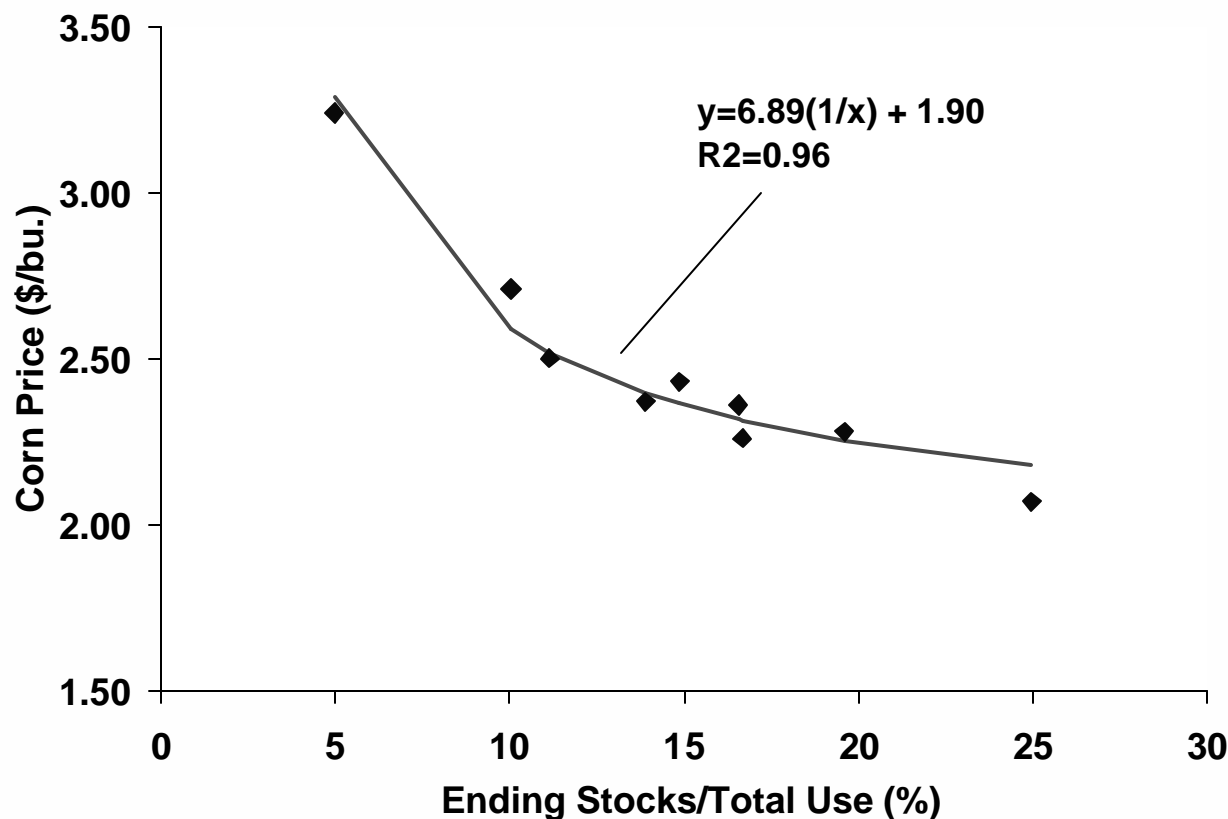
- Include shifter variables directly in the pricing model and estimate one model for the entire sample period
- Estimate separate pricing models for sub-periods
  - The level of shifter variables is assumed to be relatively constant within a sub-period

# ***Corn Price and Ending Stocks/Use, 1989/90-1997/98 \****



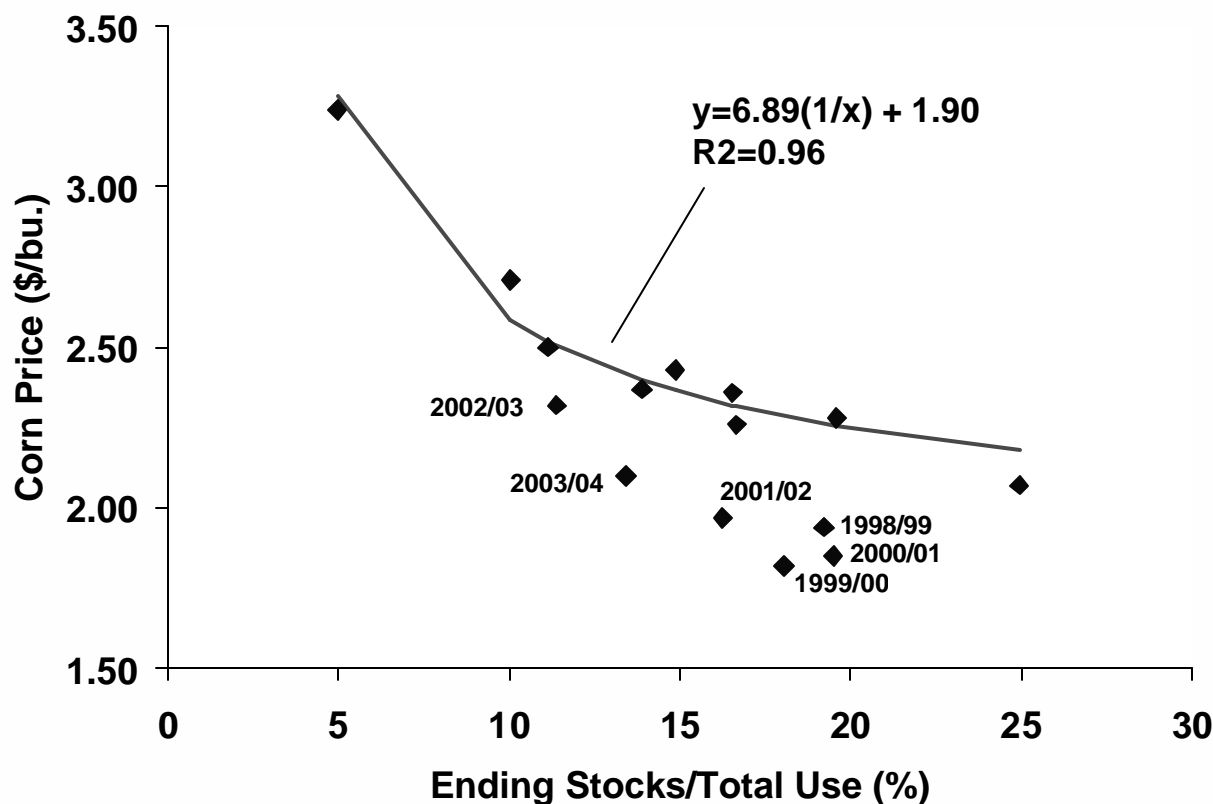
Source: USDA

# ***Corn Price and Ending Stocks/Use, 1989/90-1997/98: Reciprocal Model\****



Source: USDA

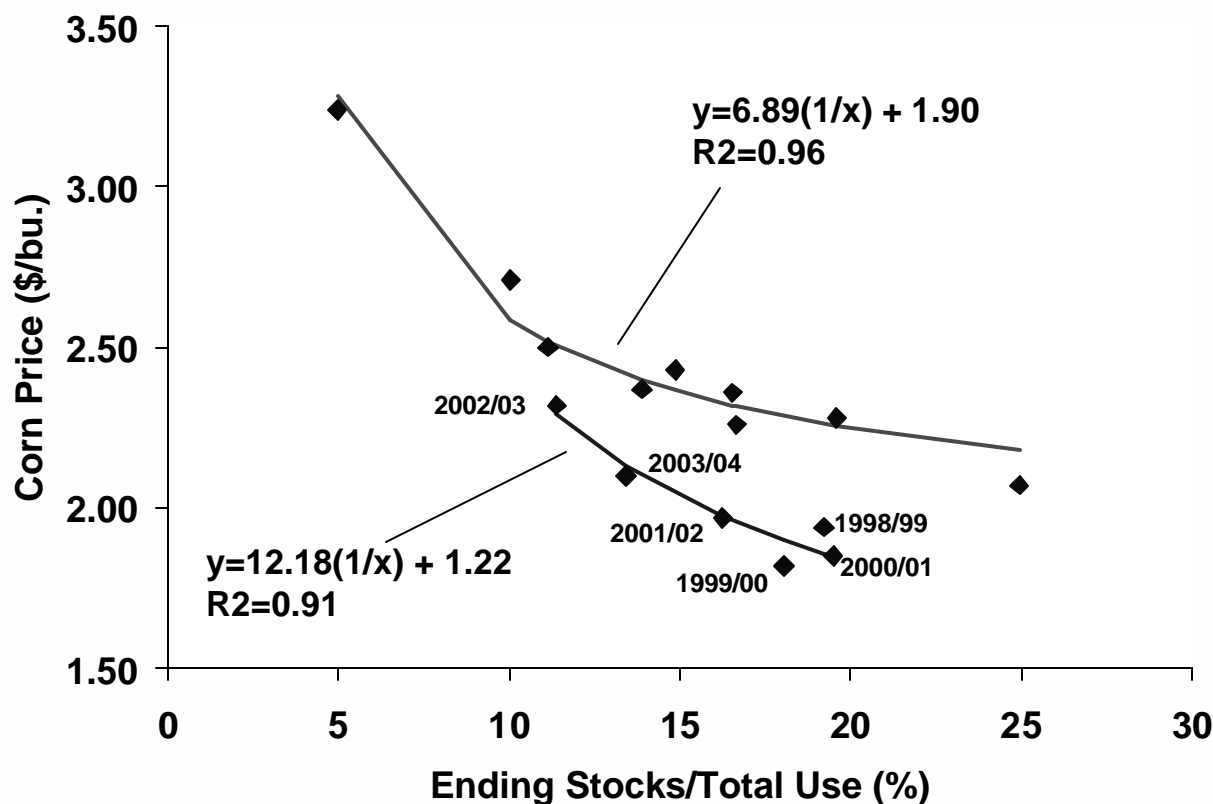
# Corn Price and Ending Stocks/Use, 1989/90-2003/04: Reciprocal Model\*



Source: USDA

\*2003/04 Projected

# Corn Price and Ending Stocks/Use, 1989/90-2003/04: Reciprocal Models\*



Source: USDA

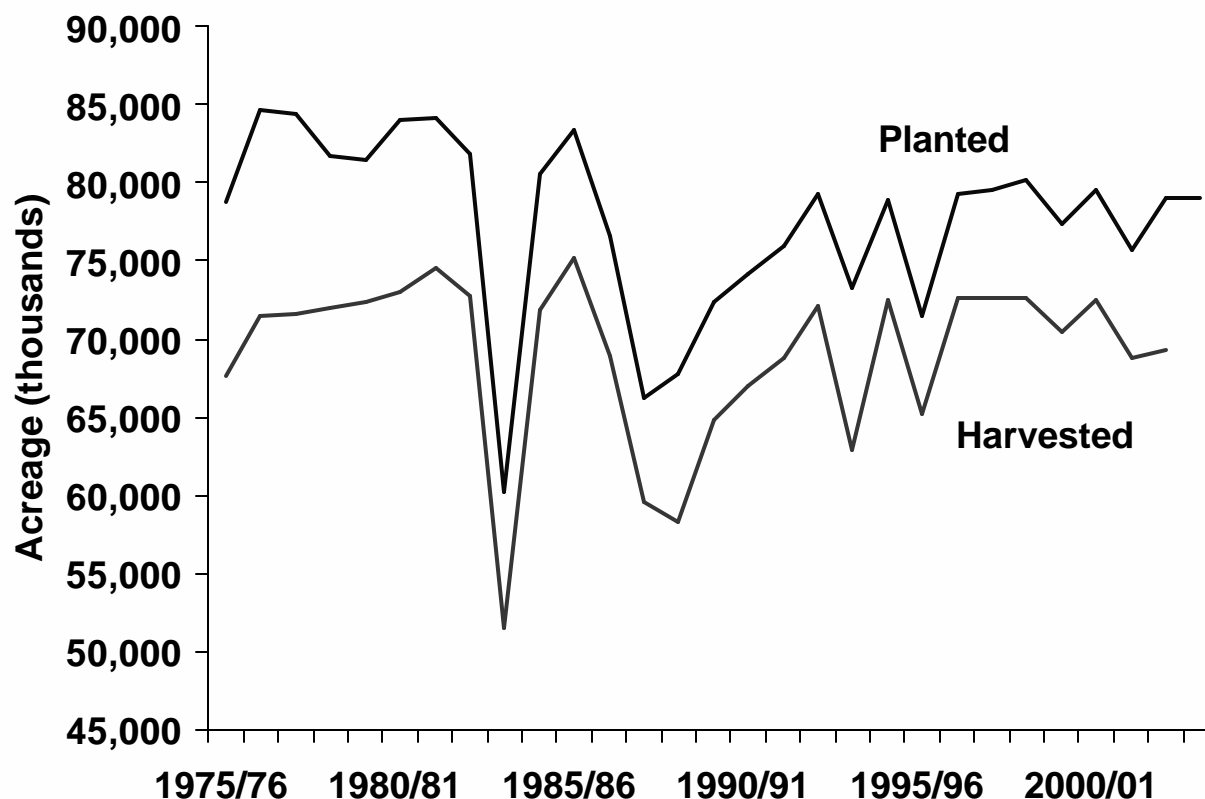
\*2003/04 Projected

## ***What Changed During the Last Six Marketing Years?***

- All else equal, supply shifted to the right
- Or, demand shifted to the left
  - FSI demand?
  - Export demand?
  - Feed demand?
  - Stock demand?
- Some combination of supply and demand shifts

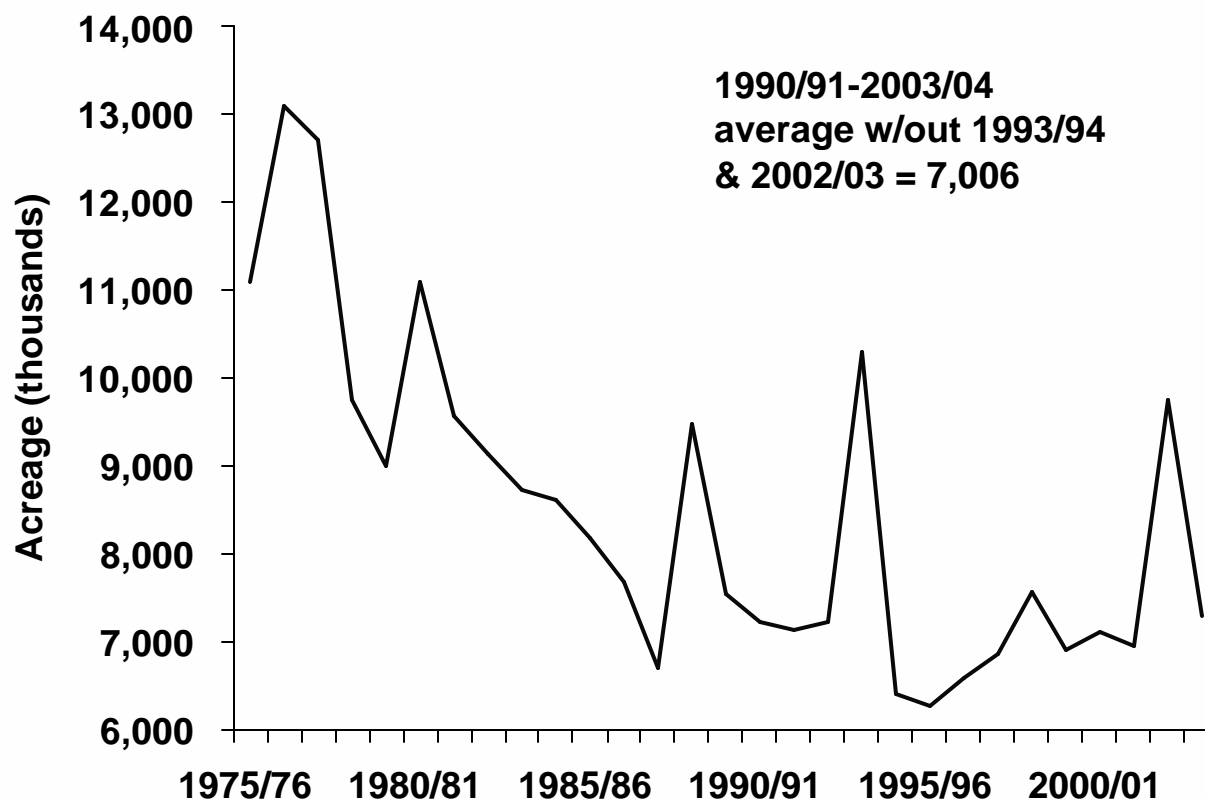


# ***US Planted and Harvested Corn Acreage, 1975/76-2003/04***



Source: USDA

# ***Difference Between US Planted and Harvested Corn Acreage, 1975/76-2003/04***



Source: USDA

# ***Factors Affecting Acreage Decisions***

- Economic theory suggests the following variables are important in farmer's acreage decisions,
  - Expected product price
  - Expected price for products that substitute in production
  - Input prices
  - Technological change
  - Risk
  - Government programs
  - Lagged effects

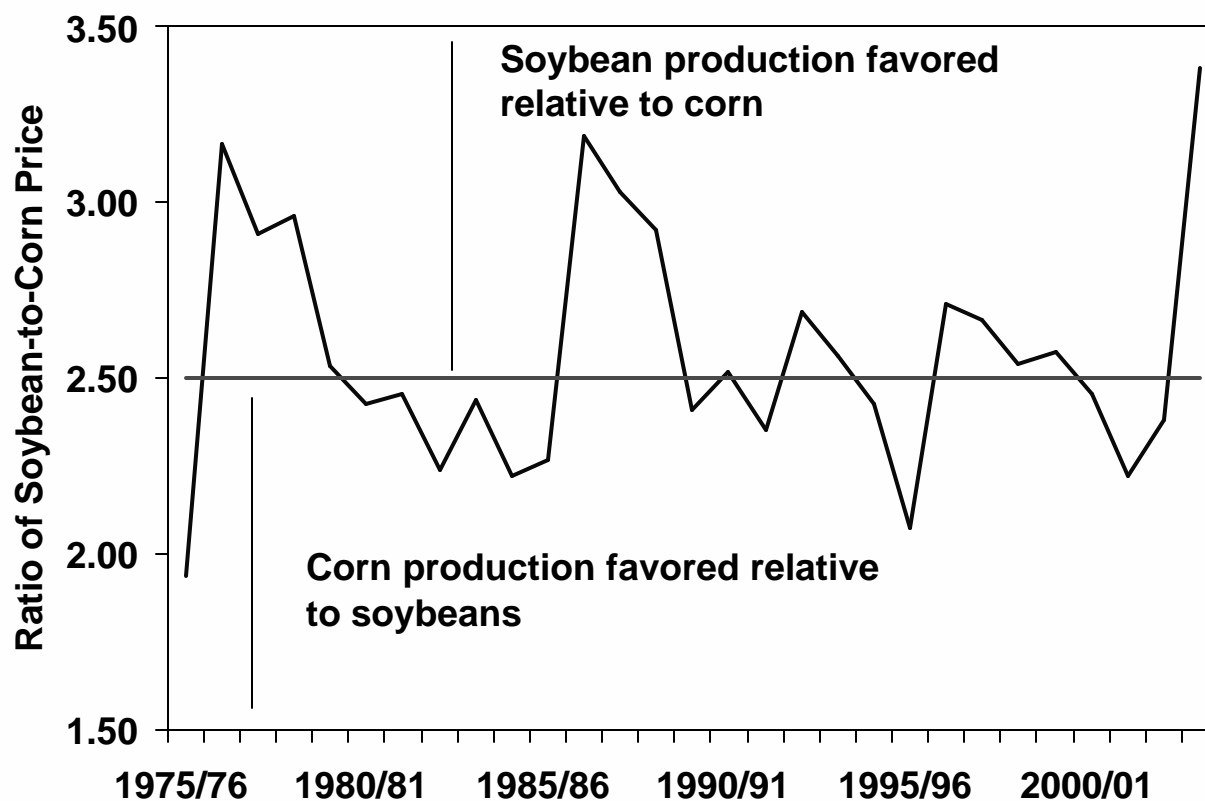
## ***Ratio Indicators***

- Given the complexities, analysts often combine variables into ratios that provide important “indicators” for supply decisions
- For crops, one of the most widely-followed is the ratio of soybean to corn prices
- Corn and soybeans “compete” for the same resources in production
- Opportunity cost concept

## ***Soybean-Corn Price Ratio***

- Indicator of incentives to switch acreage between soybeans and corn
- Key is the breakeven ratio (BEPR)
  - Ratio that equates the expected net returns from producing corn and soybeans
  - 2.5 typically is assumed BEPR
  - Assumes constant relative level of production costs and yields

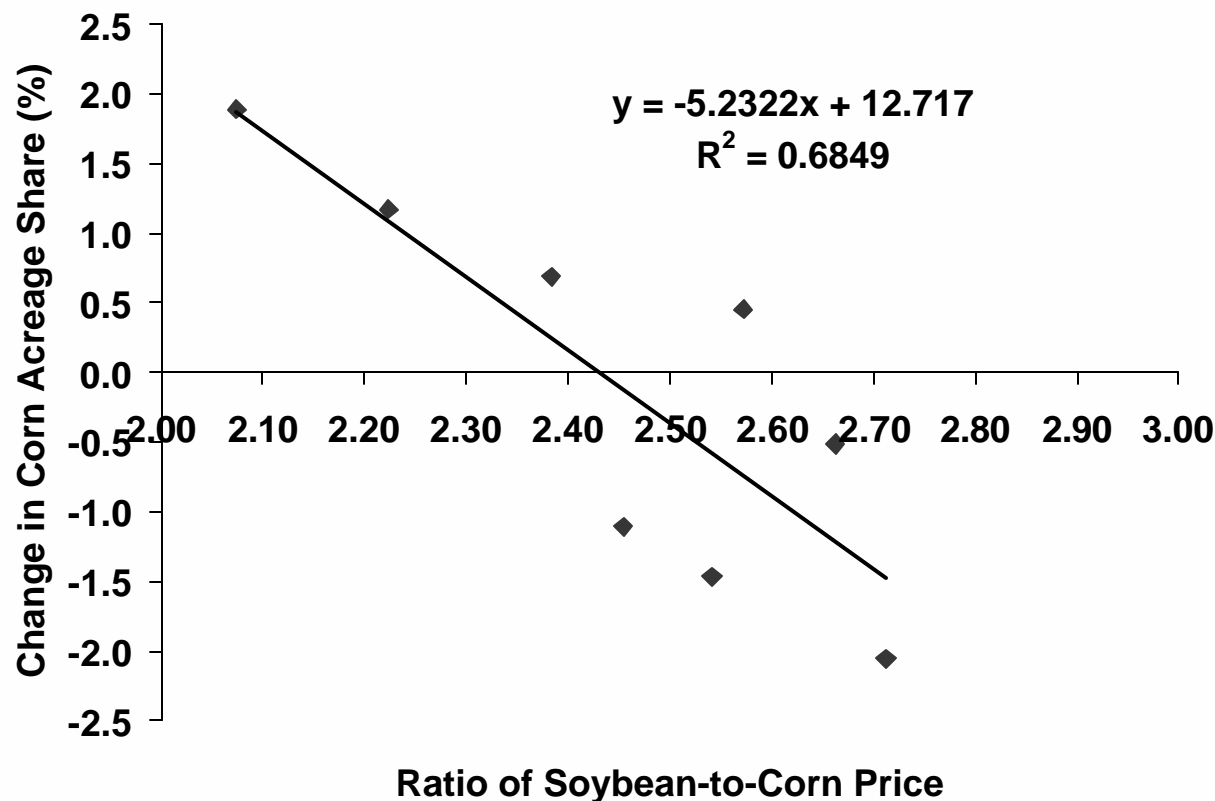
# ***Annual Average Soybean/Corn Price Ratio in the US, 1975/76-2003/04***



Source: USDA

\*2003/04 Projected

# ***Change in Corn Acreage Share and Soybean/Corn Price Ratio, 1996/97- 2003/04***



# ***The Relative Level of Government Price Support***

- 2000:
  - National average loan rate for soybeans \$5.26/bu.
  - National average loan rate for corn \$1.89/bu.
  - Ratio: 2.78, soybean production clearly encouraged relative to corn
- 2004:
  - National average loan rate for soybeans \$5.00/bu.
  - National average loan rate for corn \$1.95/bu.
  - Ratio: 2.56, soybean production slightly encouraged relative to corn



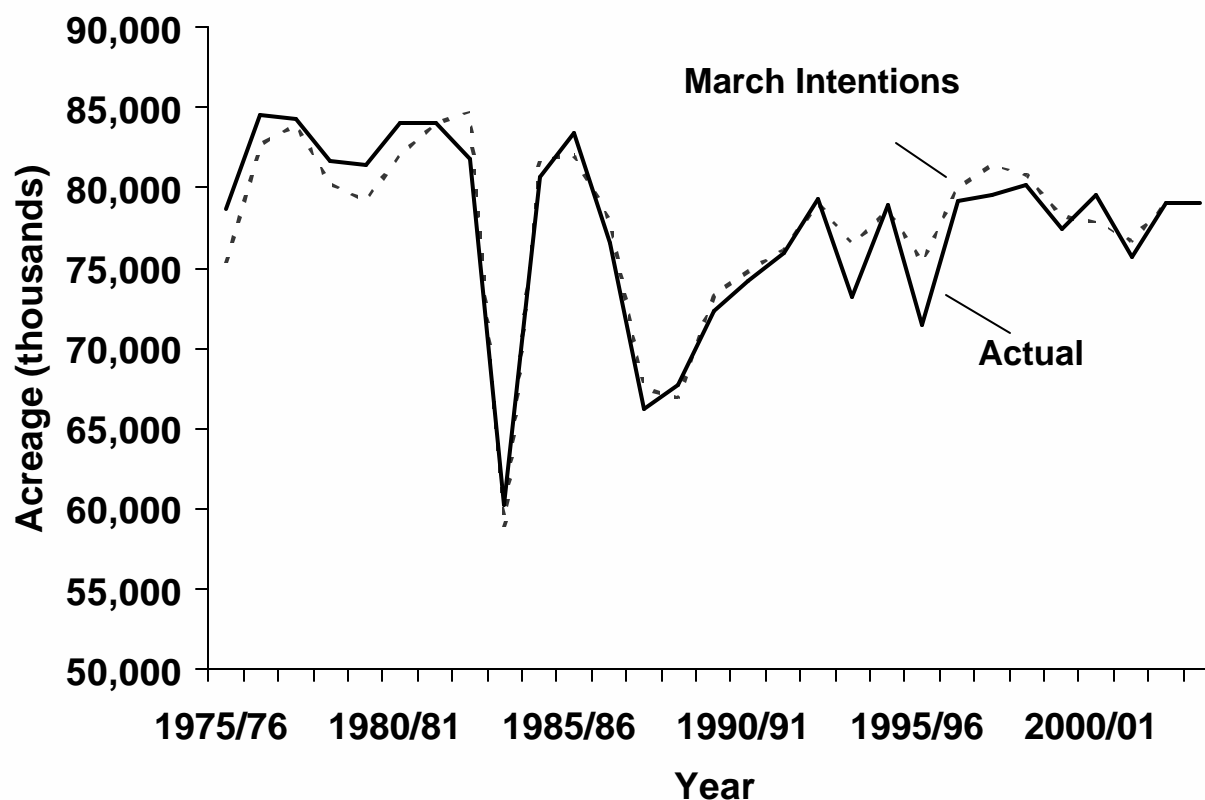
# ***Limitations of Soybean-Corn Price Ratio***

- Profitability of soybeans and corn can change due to:
  - Price of soybeans rising relative to corn, and vice versa
  - Input prices for soybeans rise relative to corn, and vice versa
  - Technology can improve for soybeans relative to corn, and vice versa

## ***USDA Acreage Surveys***

- Another alternative approach is to directly survey farmers about their planting intentions
- USDA surveys farmers about acreage planting intentions in March and June
- Since the USDA acreage surveys are so widely followed, it is important to examine the accuracy of these intentions

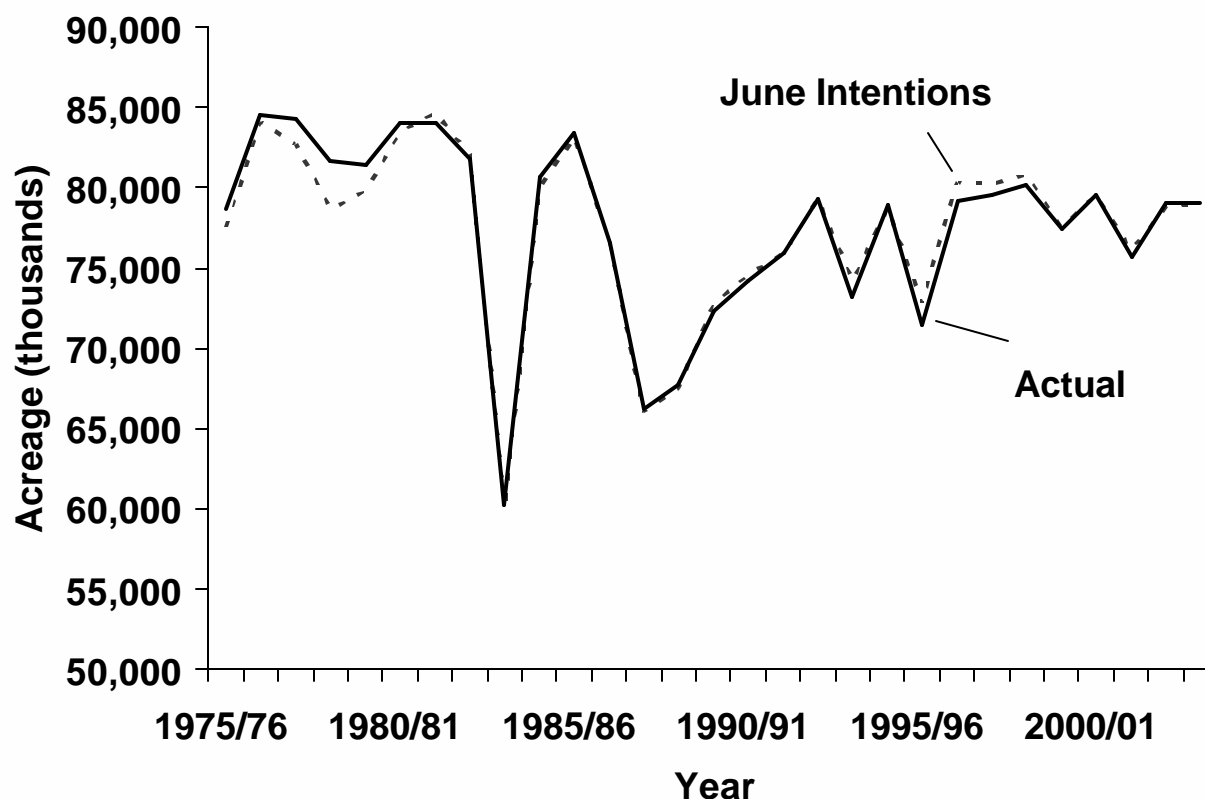
# ***March USDA Planting Intentions and Actual Planted Corn Acreage, 1975/76-2003/04***



Source: USDA

\*2003/04 Projected

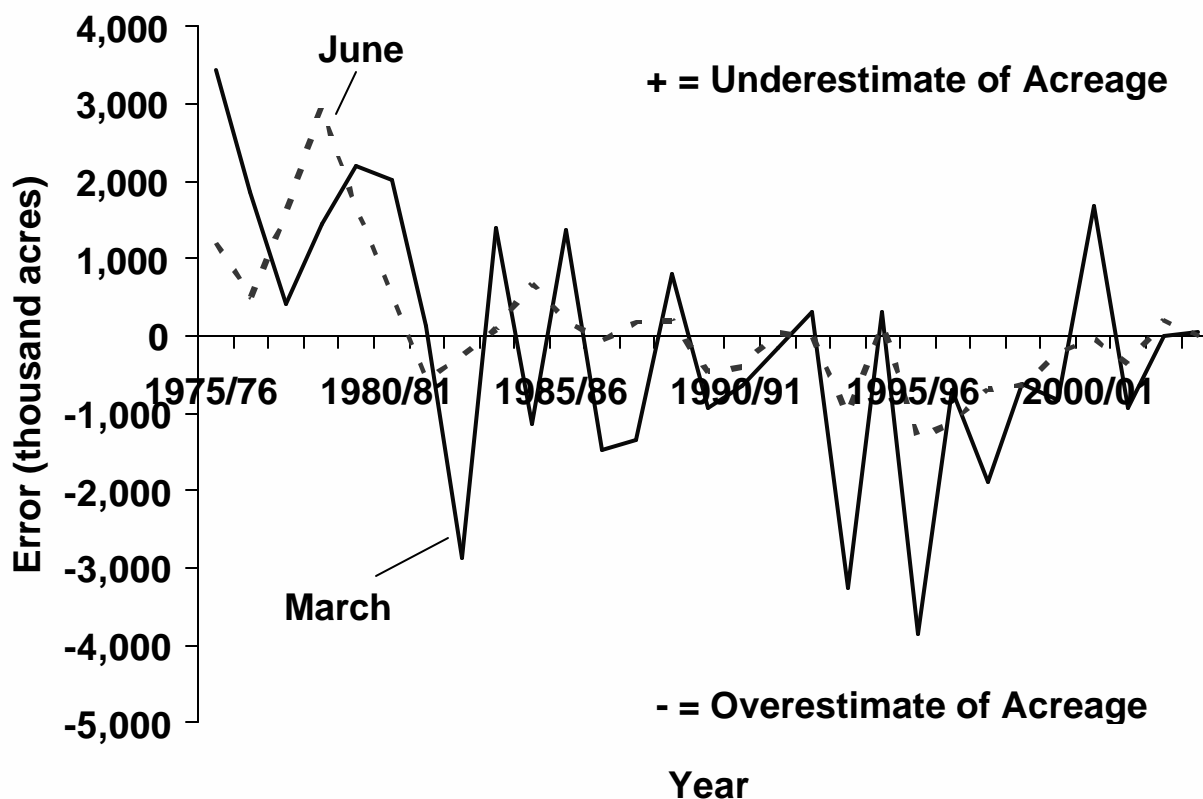
# ***June USDA Planting Intentions and Actual Planted Corn Acreage, 1975/76-2003/04***



Source: USDA

\*2003/04 Projected

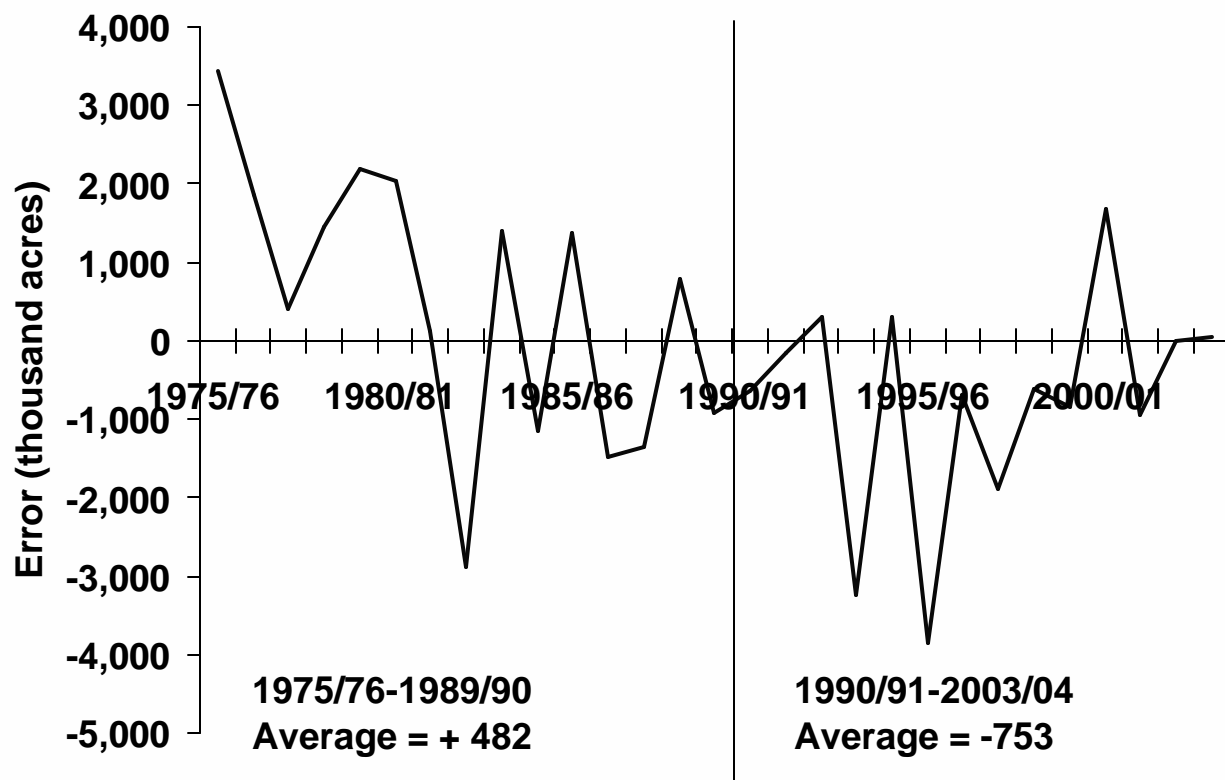
# ***Error for March and June Planting Intentions for US Corn Acreage, 1975/76-2003/04***



Source: USDA

\*2003/04 Projected

# ***Error for March Planting Intentions for US Corn Acreage, 1975/76-2003/04***



Source: USDA

\*2003/04 Projected

## ***Conclusions***

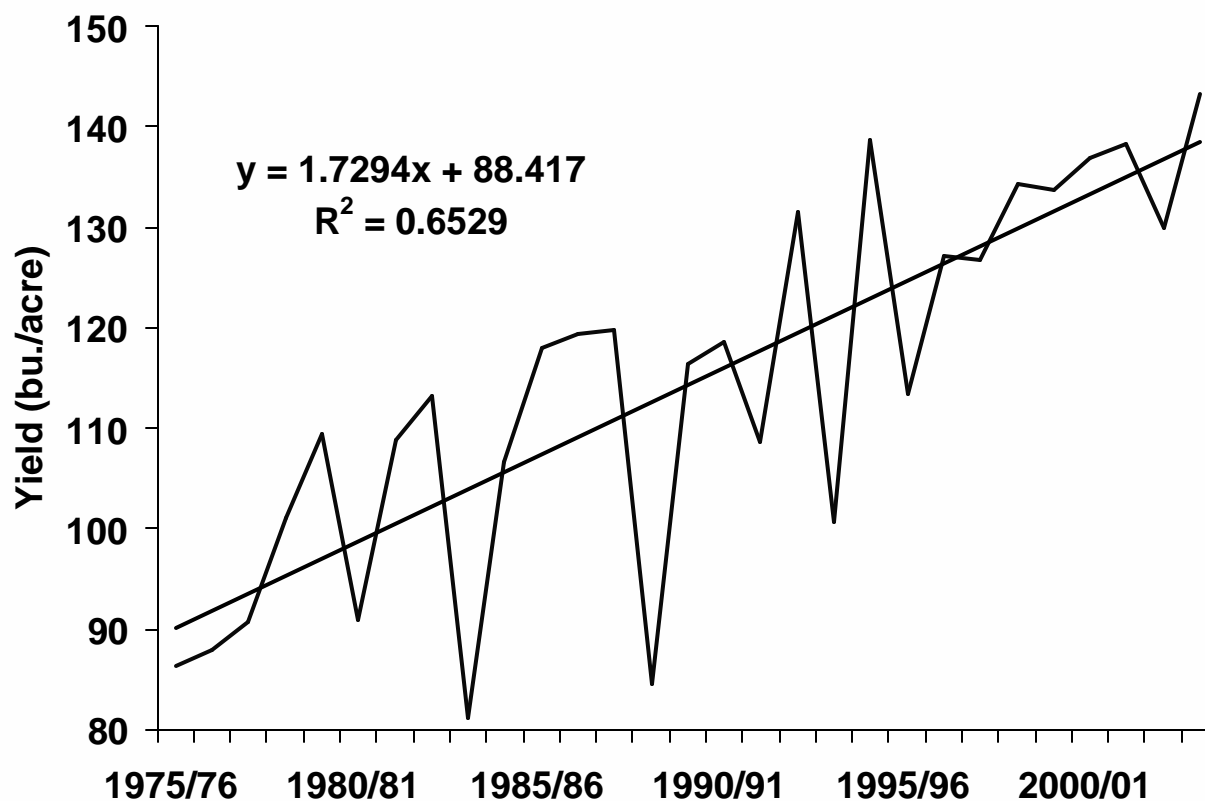
- Overall, evidence suggests that USDA acreage surveys provide good forecasts of actual planted acreage
- Typically, only small changes in corn and soybean planted acreage forecasts after the USDA releases the June acreage survey

## ***Early Forecasts of Yield***

- Consider this question: Previous to about June 1, what information do we have that is useful for predicting corn and soybean yields?
- During this period, we have little or no current information that is relevant to predicting yield
- We will have to rely on past history of yields as our best data for forecasting at this point



# ***US Corn Yields, 1975/1976-2003/04: Linear Trend***



Source: USDA

\*2003/04 Projected

# ***Early Season Production Forecasts***

- Combine:
  - Planted acreage forecast
  - Harvested acreage forecast
  - Trend yield forecast

# ***Improving on Trend Yield Forecasts***

- More accurate yield forecasts can be generated as the following information becomes available,
  - Planting dates
  - Crop conditions
  - Rainfall
  - Temperature
  - Disease
  - Insect infestations

# ***A Timeline for Corn Yield Forecasting***

- Previous to June 1:
  - Trend yield forecasts
- June 1 to July 31:
  - USDA/NASS crop conditions ratings
  - Statistical models based on temperature, rainfall and other data
- August 1 to November 1:
  - USDA/NASS yield forecasts
  - USDA/NASS crop condition ratings
  - Statistical models based on temperature, rainfall and other data

# ***USDA/NASS Forecasts of Corn Yields***

- Corn yield forecasts made for the following dates:

– August 1	Forecast
– September 1	Forecast
– October 1	Forecast
– November 1	Forecast
– January 1	“Final”

## ***Release Schedule***

- Reports released to the public about the 10<sup>th</sup> of each month
- Note that planted acreage estimates are also updated for each report
- Usually, little change in acreage from June planting intentions report, so nearly all of the variation in crop size forecast is due to yields

## ***Components of NASS Forecasts***

- Reported NASS yield forecasts are based on two types of information
  - Farm operator survey
  - Objective yield survey

## ***Farm Operator Survey***

- Farmers' assessment of yield prospects
- Samples drawn from a list frame consisting of the names, addresses, and telephone numbers of producers
- Same sample of farmers used for all forecast months
- Drawn from list frame developed for June Agricultural Survey



## ***Objective Yield Survey***

- Enumerators visit fields and record information about yield potential
- Sample fields are selected randomly from the area frame for the June Agricultural Survey
- Fields selected only for major producing states
- Same fields visited for each report
- Counts and measurements made in two plots in each field

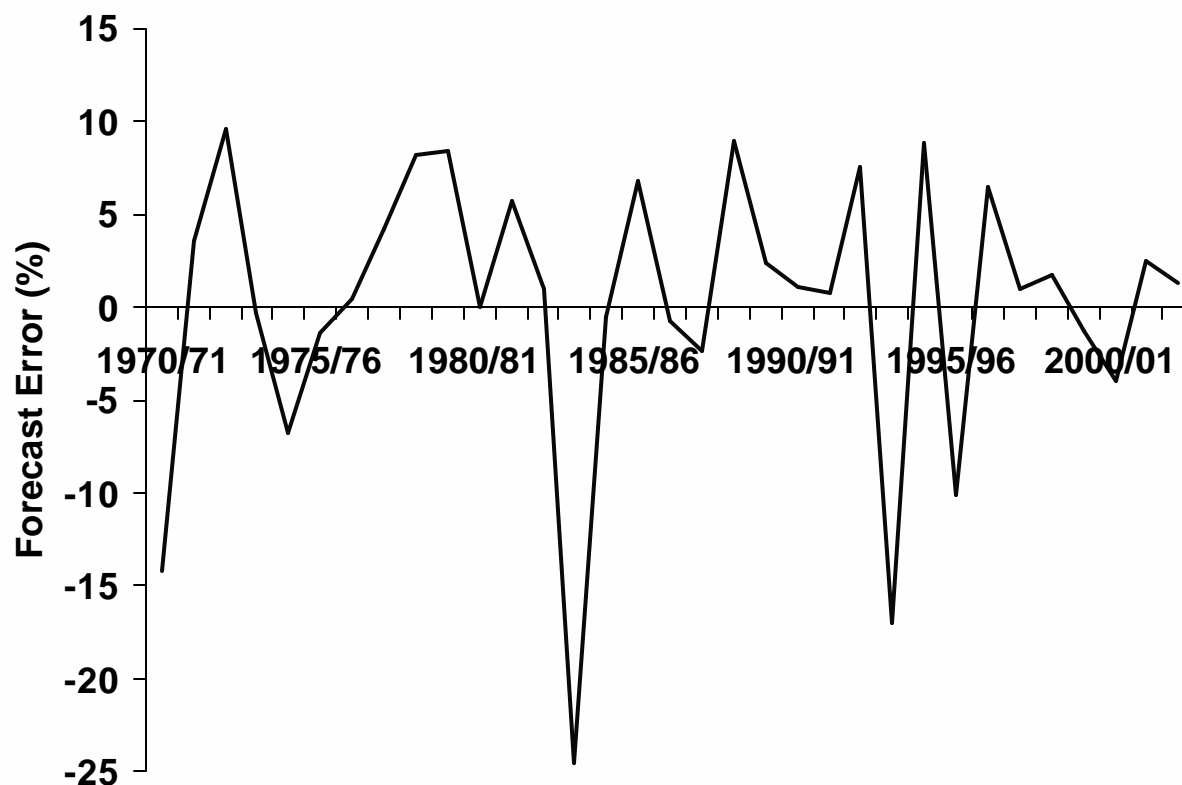
## *Objective Yield Measurements*

- Corn
  - Rowspace
  - 2 rows x 15 ft
  - Stalks
  - Ears & ear shoots
  - Ears with kernals
  - Kernal row length
  - Ear diameter
  - Ear weight
- Soybeans
  - Rowspace
  - 2 rows x 3.5 ft
  - Plants
  - Lateral branches
  - Blooms, dried flowers & pods
  - Pods with beans
  - Pod weight

## ***Preparation of Crop Reports***

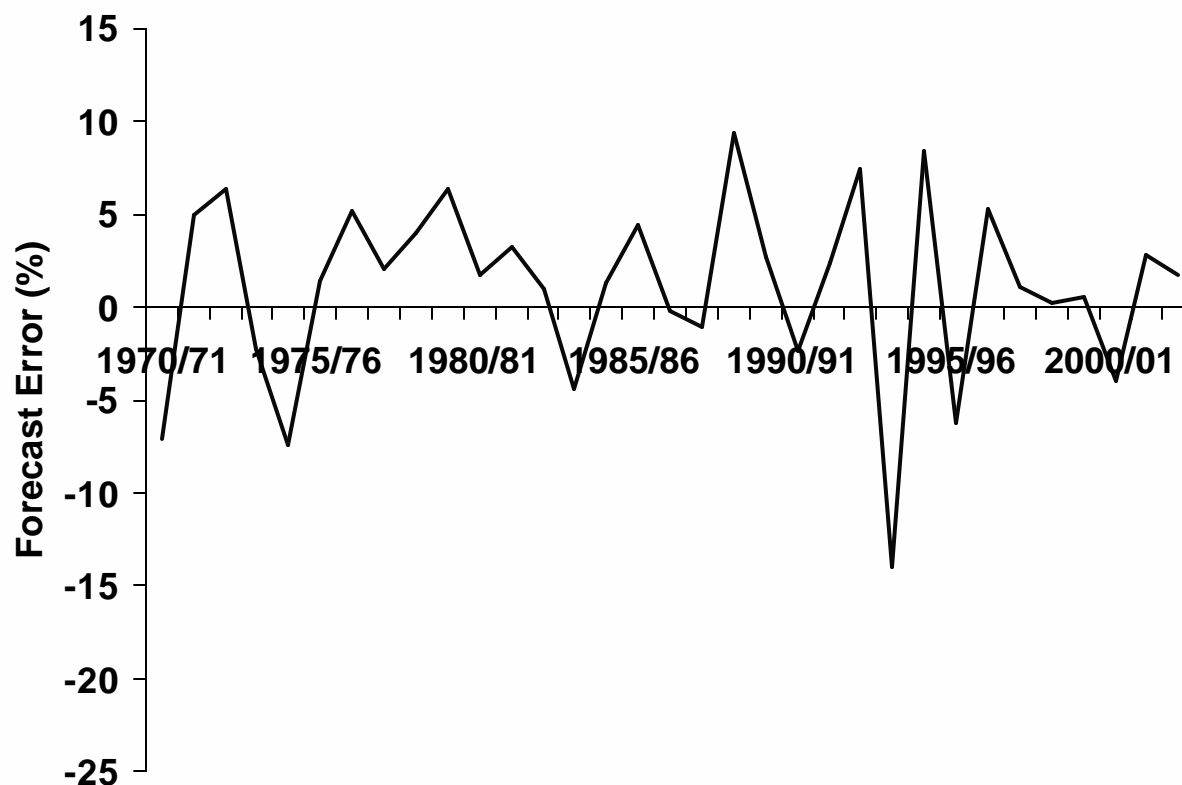
- Agricultural Statistics Board reviews all indications and determines final national and regional yield estimates
- Farmer and objective yield indications are combined in a multistage process
  - Both statistical and judgmental techniques used

# ***Errors for USDA August Corn Production Forecasts, 1970/71- 2002/03***



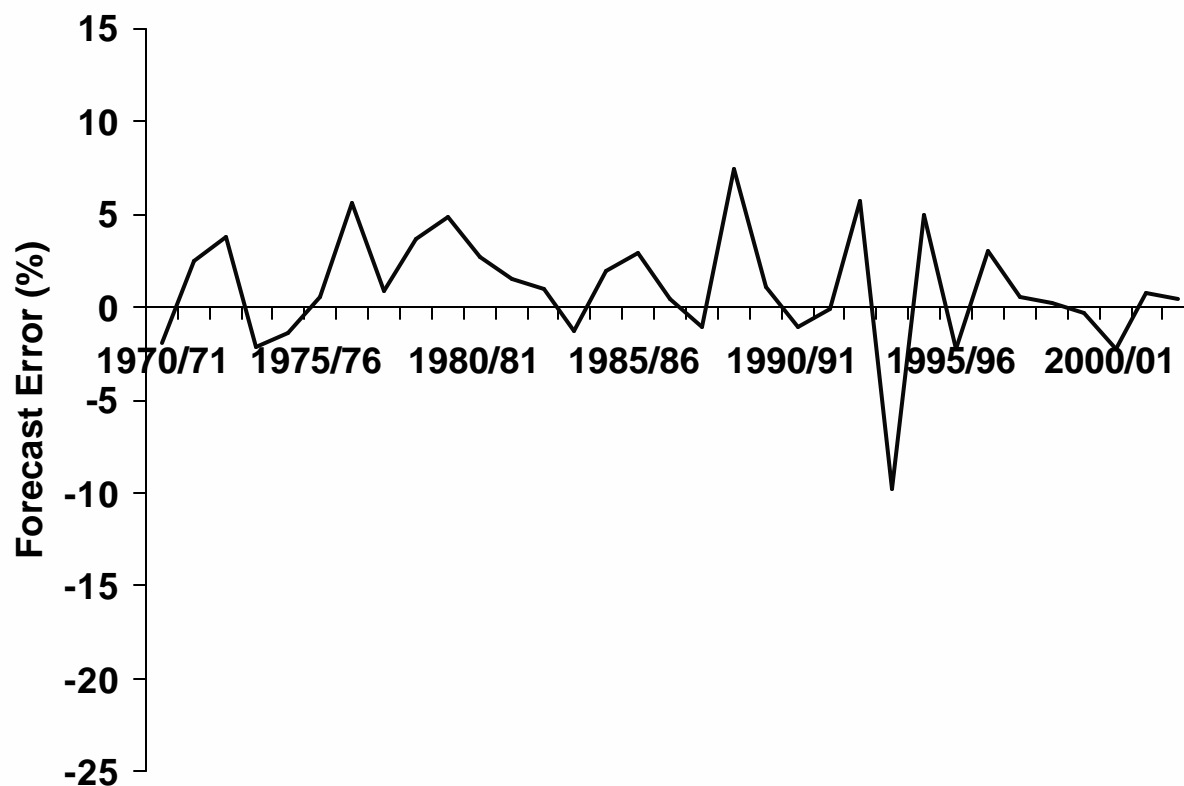
Source: USDA

# ***Errors for USDA September Corn Production Forecasts, 1970/71- 2002/03***



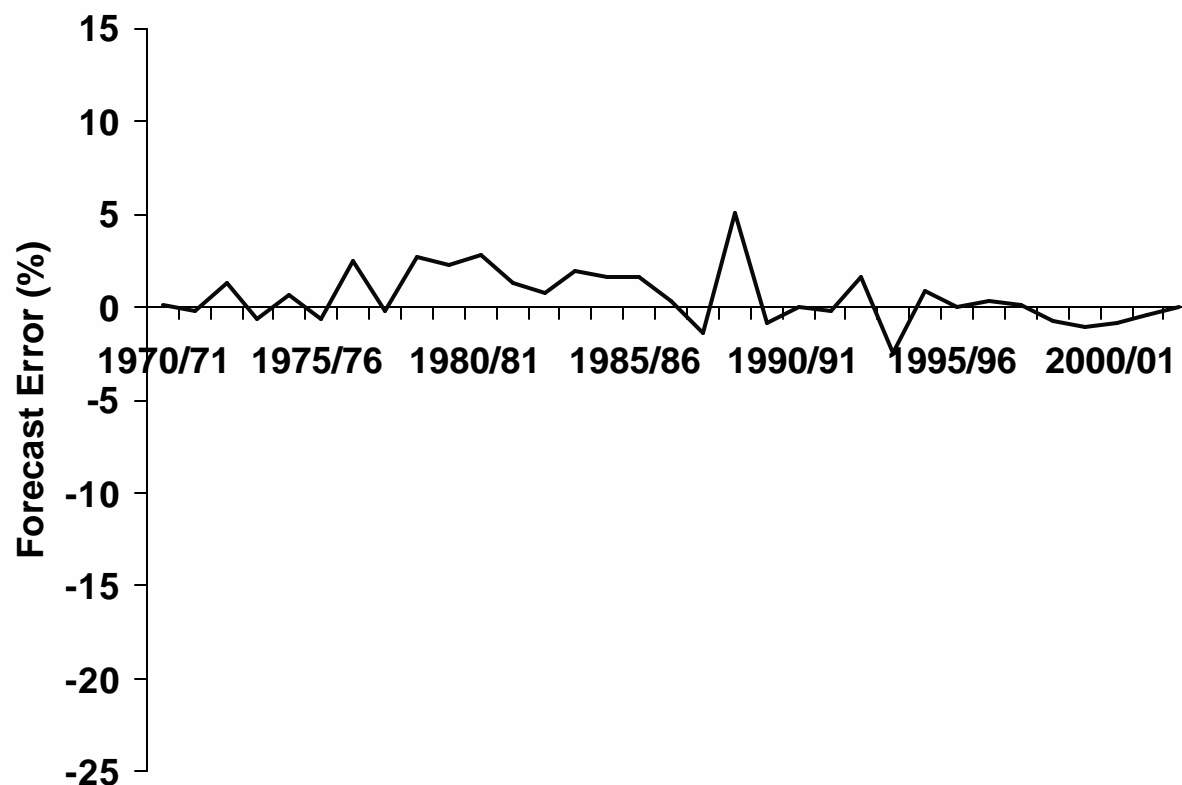
Source: USDA

# ***Errors for USDA October Corn Production Forecasts, 1970/71- 2002/03***



Source: USDA

# ***Errors for USDA November Corn Production Forecasts, 1970/71- 2002/03***



Source: USDA

## ***Conclusions***

- Overall, evidence suggests that the USDA performs reasonably well in forecasting corn production
- Market participants view USDA corn production forecasts as important new information
- The following publication contains a complete analysis:
  - Darrel L. Good and Scott H. Irwin. “Understanding USDA Corn and Soybean Production Forecasts: An Overview of Methods, Performance and Market Impact.” AgMAS Project Research Report 2003-07, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, October 2003.



## ***Forecasting Calendar for 2004/2005 Corn Use Categories***

- Fall 2003: First forecasts of use for 2004/05 marketing year
  - Typically based on trend forecasts, recent history and basic economic relationships
- Spring and Summer 2004: Update use forecasts based on US and world production prospects
- 2004/05 Marketing Year: Update use forecasts based on export sales and inspections reports, quarterly USDA stocks reports and USDA livestock inventory reports

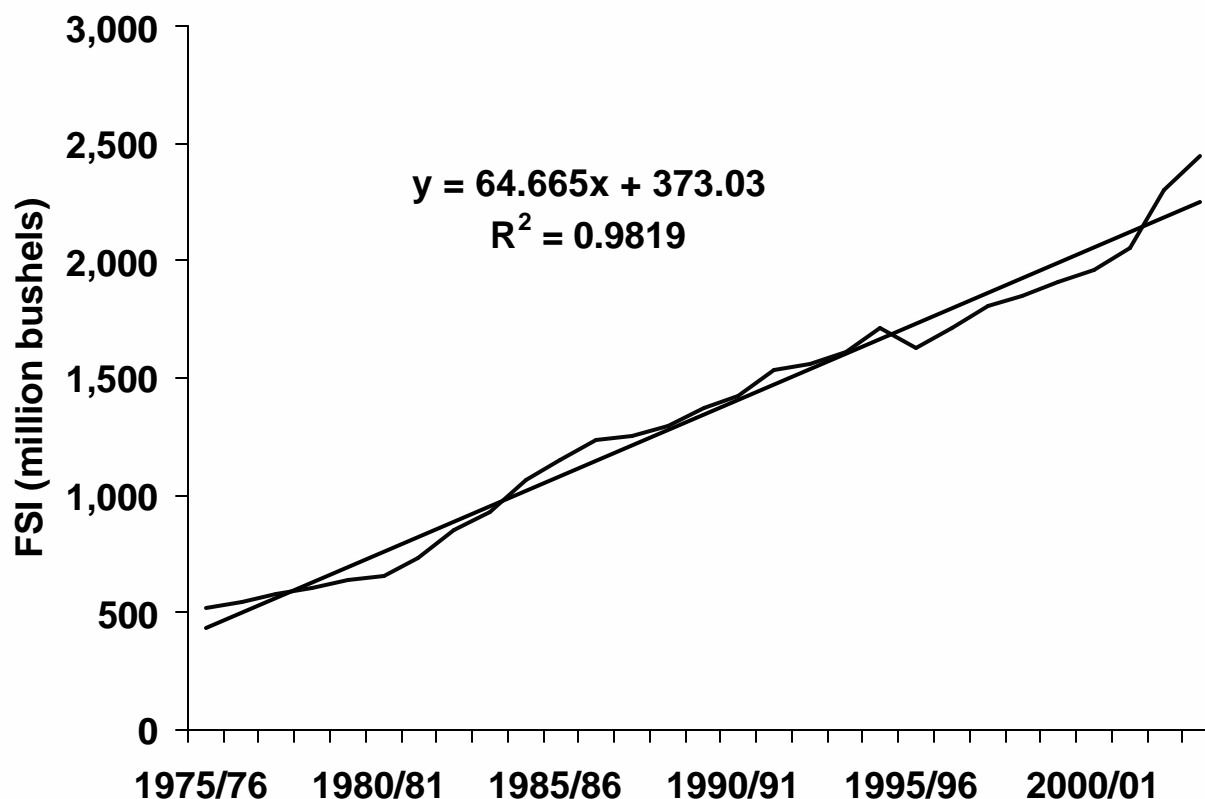
# ***Corn: Food, Seed, and Industrial Use***

- Rapid growth in last 20 years
  - About 10% of use in early 1980s
  - About 20% currently
- Largest components are:
  - Corn sweeteners for food and soft drinks
  - Corn starch for construction uses
  - Ethanol for fuel
  - Cereals, snack foods
  - Only ethanol use has been growing recently

## ***Corn: Forecasting Food, Seed, and Industrial Use***

- Food component tends to grow at the rate of population growth
- Relatively price insensitive
- Corn sweetener and ethanol use is critically affected by government policies
  - Sugar program
  - Ethanol subsidies

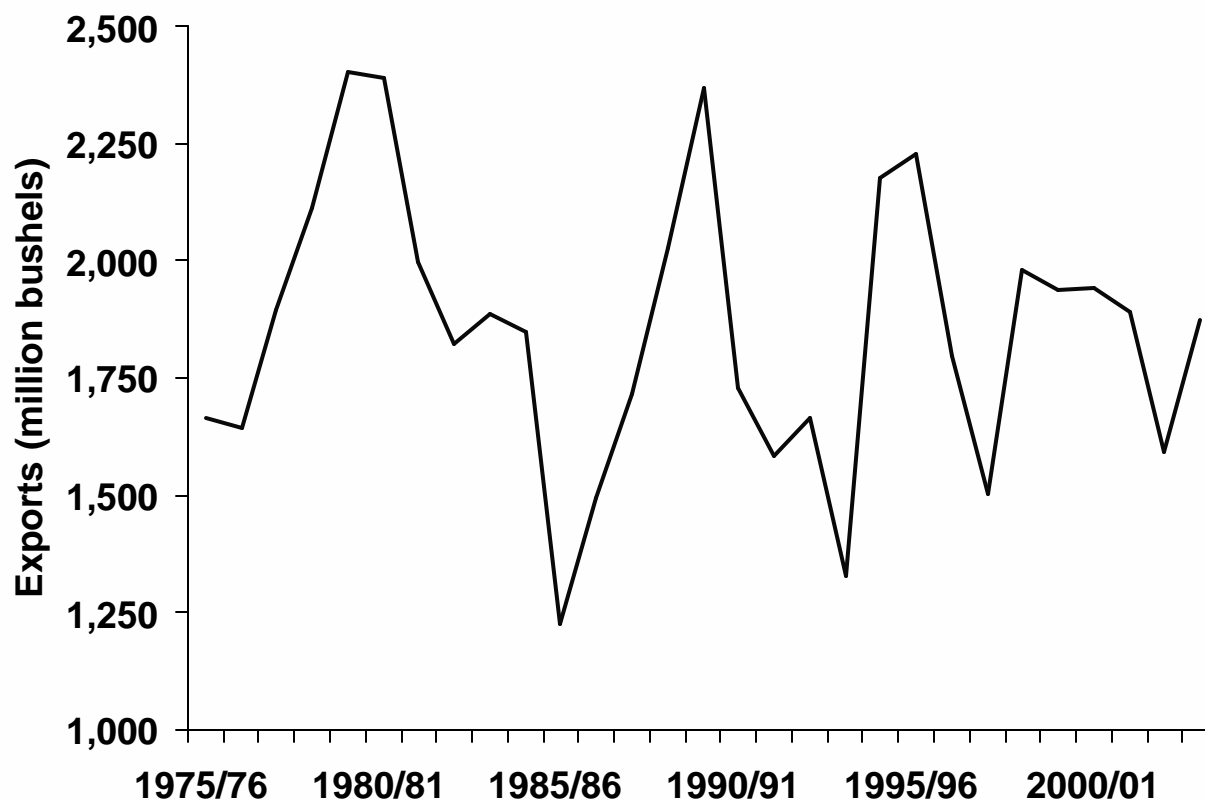
# ***Food, Seed, and Industrial Use of Corn, 1975/76-2003/04 \****



Source: USDA

\*2003/04 Projected

# ***Corn Exports, 1975/76-2003/04 \****



Source: USDA

\*2003/04 Projected

## ***Corn: Forecasting Exports***

- Large variation year-to-year and difficult to forecast
- Factors to consider
  - Crop production in importing and exporting countries
  - Prices in competing export countries
  - Exchange rates
  - Government export subsidy programs both in the US and other countries
  - Economic growth
  - Livestock numbers outside the US

## ***Corn: Domestic Feed and Residual Use***

- Largest component of corn use
- Averages about 60% of total corn consumption
- Primary driver of corn prices
- Largely dependent on the number of “grain consuming animal units”

## ***Corn: Residual Use***

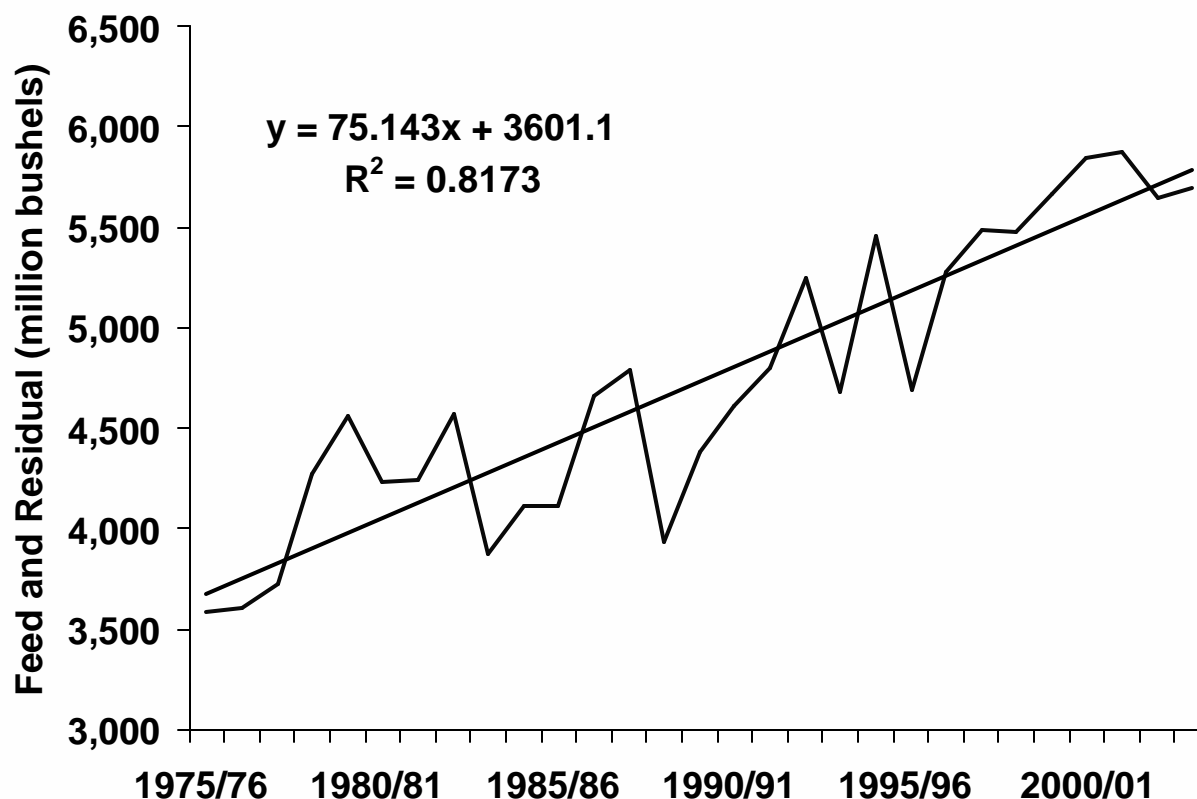
- Wherever possible, use is cross-checked with objective information source
  - Export loadings at US ports
- Not all use can be cross-checked
- Leads to a category for “residual” or “unaccounted” use
  - Reflects measurement error in one or more use categories or in production estimates
  - Lumped together with feed usage in corn balance sheet



## ***Corn: Forecasting Domestic Feed and Residual Use***

- Related directly to the number of beef, pork and poultry animals on feed
- Number of animals on feed is, in turn, related to expected profits to livestock production
- Profitability depends on:
  - Livestock prices
  - Price of feed including corn
- Also have to account for relative price of feed inputs, such as sorghum and wheat
- Complex!

# Domestic Feed and Residual Use of Corn, 1975/76-2003/04 \*



Source: USDA

\*2003/04 Projected

## ***Changes in Demand***

- Changes in quantity demanded and demand are NOT the same thing
- Change in quantity demanded
  - Movements along a demand curve
- Change in demand
  - Shifts in the demand curve

## ***Demand and Use***

- Demand and use are also not the same thing
- Use (usage, utilization, consumption)
  - Equilibrium quantity observed in a market
  - Equals both the quantity demanded and quantity supplied

# ***First Balance Sheet Estimates For 2004/05***

Item	USDA	USDA	Your Estimate
	2002-03	2003-04	2004-05
Planted Acreage (1,000 acres)	79,054	79,066	79,250
Harvest Acreage (1,000 acres)	69,313	71,765	72,250
Yield (Bushels)	130	143	140.3
Beginning Stocks (million bushels)	1,596	1,086	1,349
Total Production (million bushels)	9,008	10,278	10,137
<b>Total Supply (million bushels)</b>	<b>10,619</b>	<b>11,374</b>	<b>11,496</b>
Feed and Residual (million bushels)	5,642	5,700	5,720
Food, Seed, and Industrial (million bushels)	2,298	2,450	2,520
Exports (million bushels)	1,592	1,875	1,875
<b>Total Consumption (million bushels)</b>	<b>9,533</b>	<b>10,025</b>	<b>10,115</b>
<b>Ending Stocks (million bushels)</b>	<b>1,086</b>	<b>1,349</b>	<b>1,381</b>
Ending Stocks/Total Consumption (%)	11.4	13.5	13.6
Average Price (\$/bu.)	2.32	2.10	2.12

# ***Calculating the 2004/05 Price Forecast for Corn Using the Ending Stocks Model***

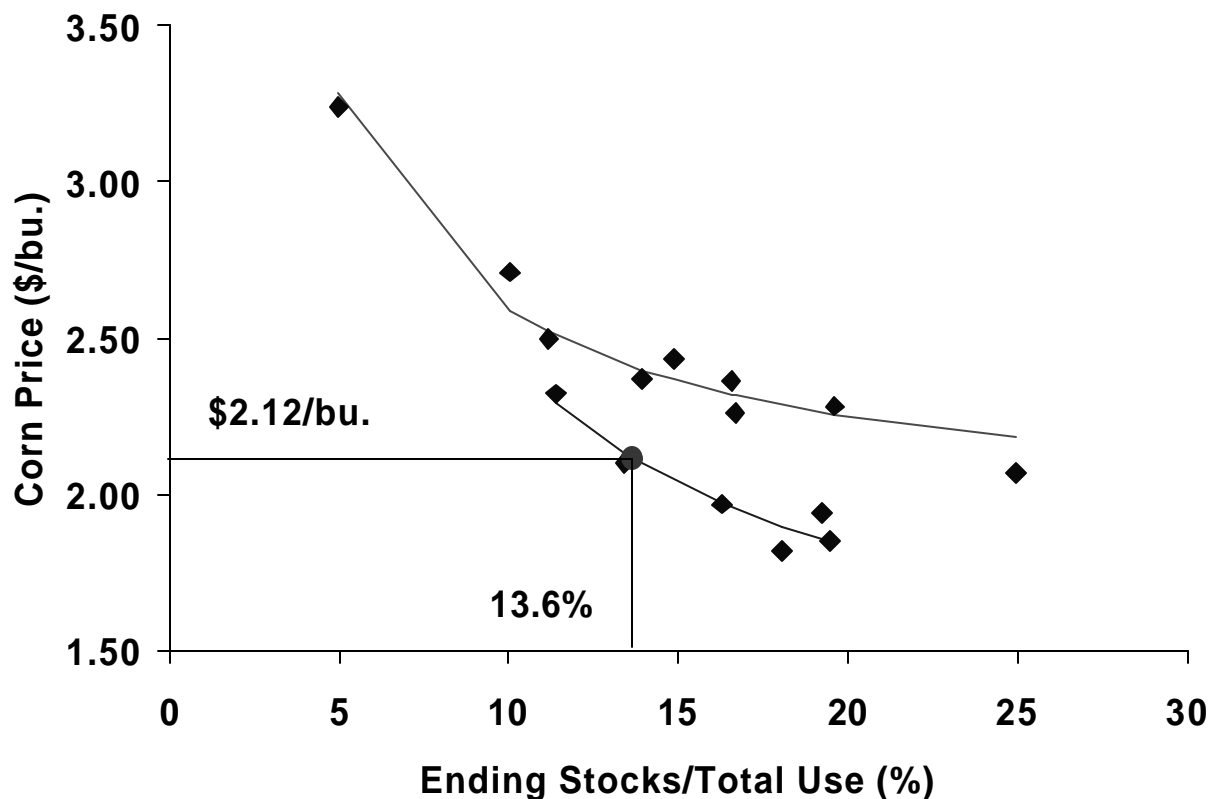
$$\frac{1}{\text{Ending Stocks/Total Use}} \times \text{Slope} + \text{Constant} = \text{US Average Farm Price}$$

$$\frac{1}{\text{Ending Stocks/Total Use}} \times 12.18 + 1.22 = \text{US Average Farm Price}$$

$$\frac{1}{13.6} \times 12.18 + 1.22 = \text{US Average Farm Price}$$

$$0.073 \times 12.18 + 1.22 = \$2.12$$

# Forecasting the 2004/05 Corn Price Using the Ending Stocks Model



Source: USDA

# Computing the 2004/05 Corn Price Implied from the Futures Market

Calendar Month	Corn Futures Contract	11/21/03 Futures Price	Central Illinois 3-Yr. Avg. Basis	Central Illinois Cash Price Implied by Futures	Illinois 5-Yr. Avg. Marketing Weight	Price Weight
			---\$/bu.---		---%---	
Sep-04	Dec-04	2.45	-0.21	2.23	6.8	0.15
Oct-04	Dec-04	2.45	-0.17	2.28	11.6	0.26
Nov-04	Dec-04	2.45	-0.13	2.32	6.0	0.14
Dec-04	Dec-04	2.45	-0.10	2.35	6.6	0.16
Jan-05	Mar-05	2.49	-0.15	2.34	20.4	0.48
Feb-05	Mar-05	2.49	-0.11	2.38	7.2	0.17
Mar-05	Mar-05	2.49	-0.09	2.40	8.4	0.20
Apr-05	May-05	2.52	-0.11	2.41	6.2	0.15
May-05	May-05	2.52	-0.10	2.42	5.6	0.14
Jun-05	Jul-05	2.55	-0.10	2.45	6.2	0.15
Jul-05	Jul-05	2.55	-0.11	2.44	7.6	0.19
Aug-05	Sep-05	2.55	-0.11	2.44	7.4	0.18
Central Illinois Farm Price Forecast Implied from Futures						\$2.36
Central Illinois Basis Adjustment Relative to US Average						-\$0.05
<b>US Average Farm Price Forecast Implied from Futures</b>						<b>\$2.31</b>
<b>US Average Farm Price from Ending Stocks Model</b>						<b>\$2.12</b>