# Economic Analysis of Farmland Market: An Introduction

**Dr. Wendong Zhang**
Assistant Professor of Economics
wdzhang@iastate.edu

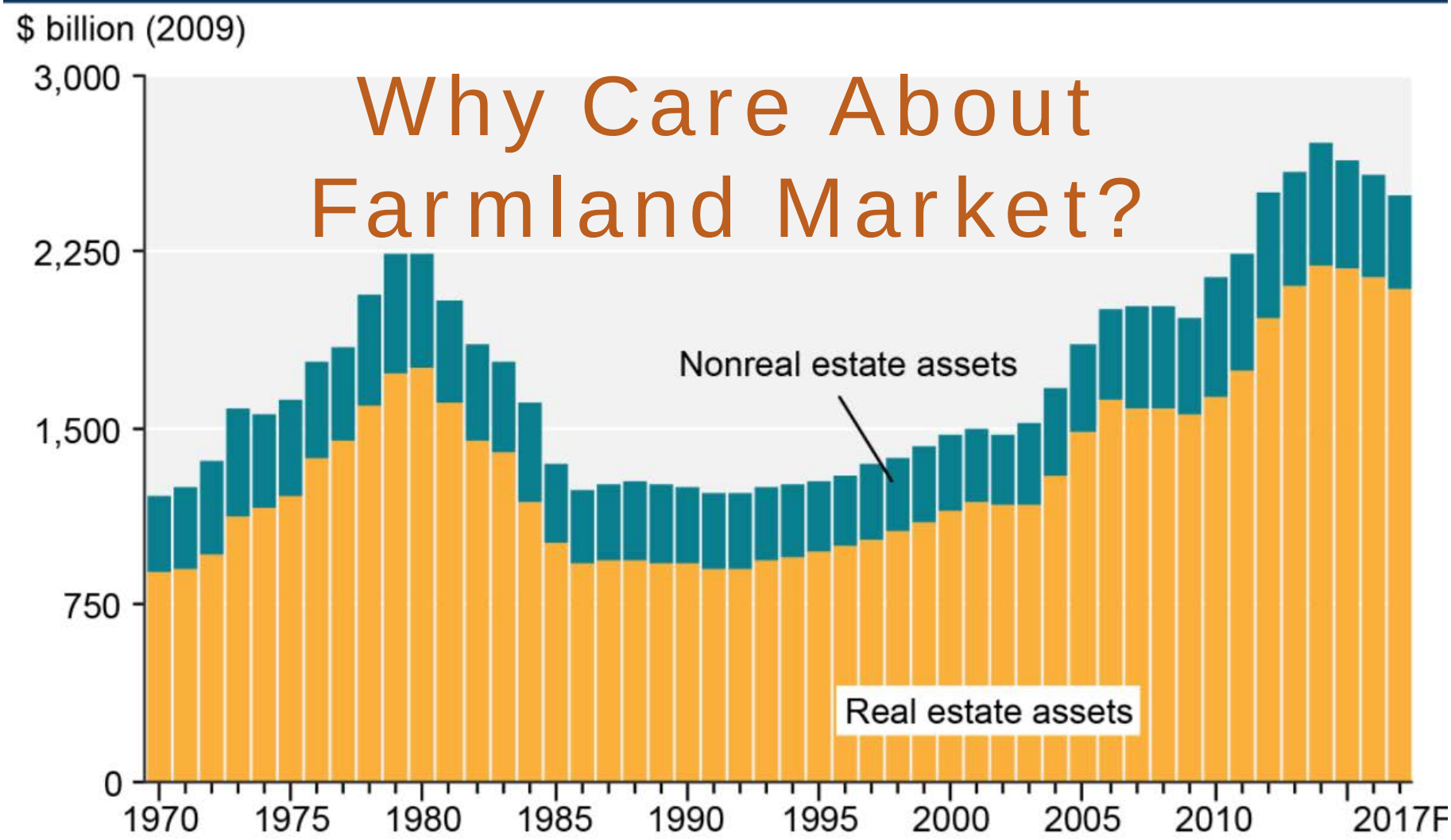
FIN 450X, October 4th, 2017

# A Quick Introduction: Dr. Wendong Zhang

- Grown up in a rural county in NE China
- Attended college in Shanghai and Hong Kong
- Ph.D. in Ag Econ in 2015 from Ohio State
- 2012 summer intern at USDA-ERS on farm economy and farmland values
- Research and extension interests: land value, land ownership, agriculture and the environment, China Ag

# China's Provinces

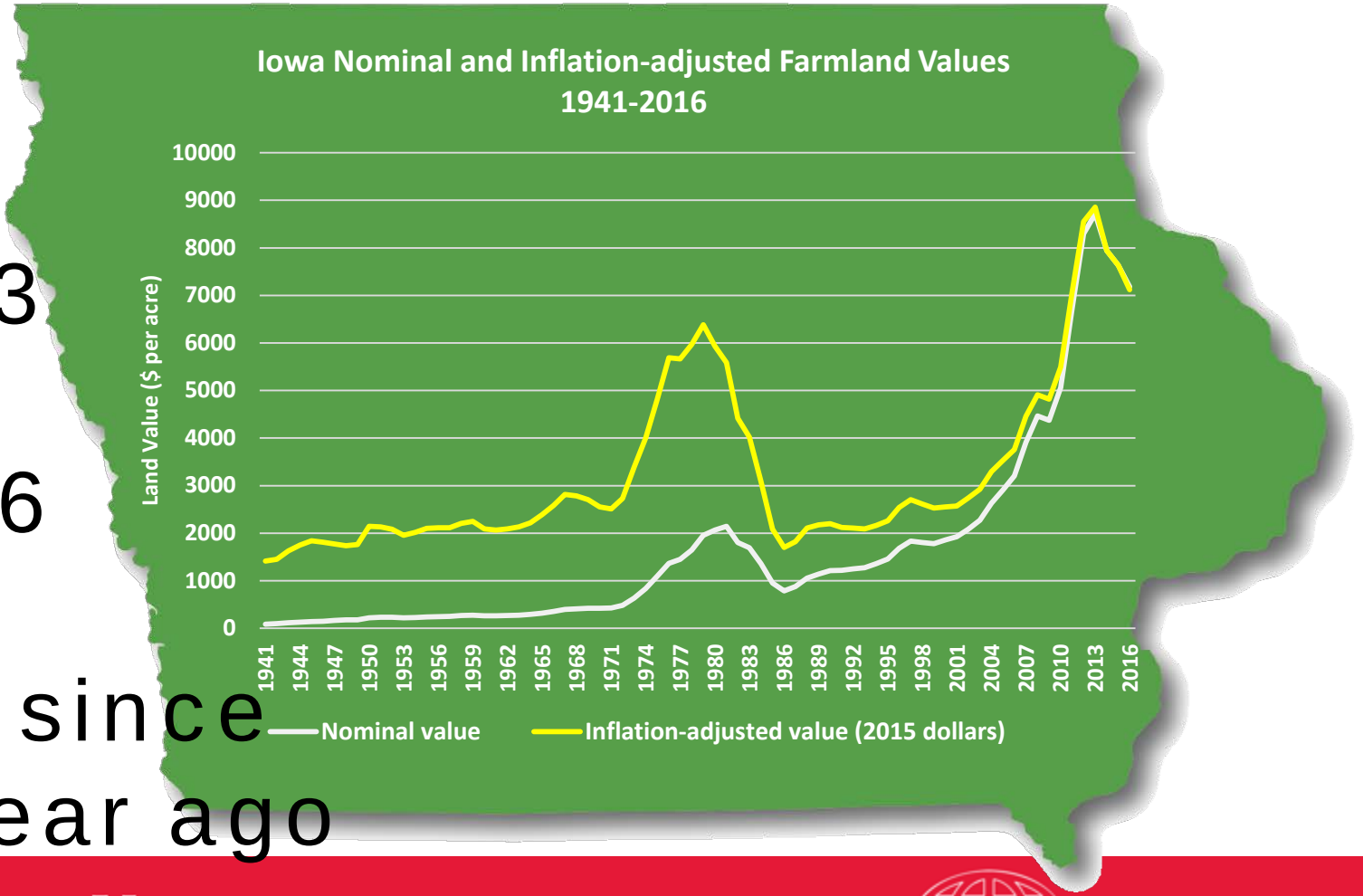
# Why Care About Farmland Market?




Note: F = forecast; data for 2016 and 2017 are forecasts. The GDP chain-type price index is used to convert the nominal (current-dollar) statistics to real (inflation adjusted) amounts (2009=100).
Source: USDA, Economic Research Service, Farm Income and Wealth Statistics.
Data as of February 7, 2017.

# ISU Land Value Survey – Iowa average farmland value

all farmland 1941–2016



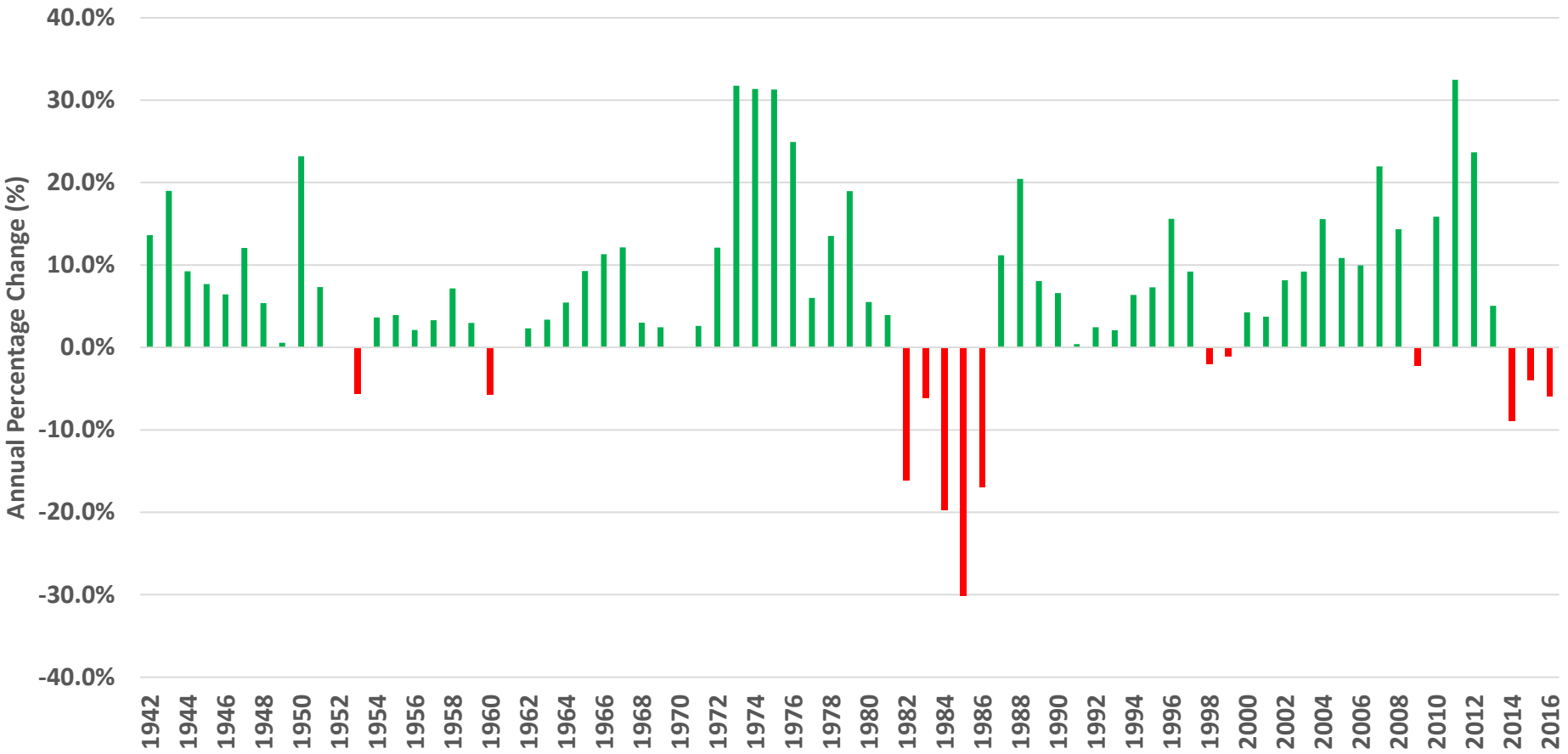

$7,183

As of

Nov 16

-5.9% since one year ago

# % Change in Nominal Iowa Farmland Values 1942-2016



# David Ricardo – Founding Father of Land Economics

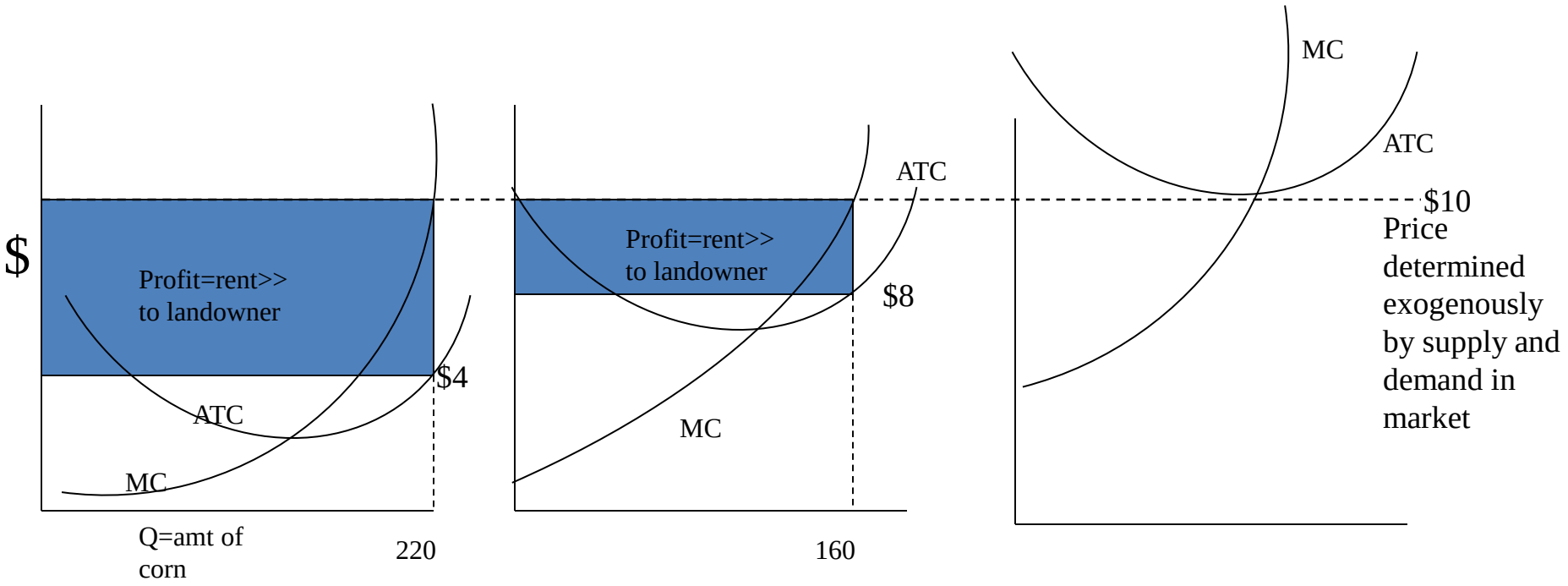
## Legacy: Ricardian Model of Farmland Values

David Ricardo was an English political economist. He was one of the most influential of the classical economists, along with Thomas Malthus, Adam Smith, and James Mill.

# Ricardo model

"A" land has lowest production costs= highest rents

"C" land's rent is 0 because costs are greater than revenue




"A" land "B" land "C" land

**On fertile land, a farmer can produce same amount of corn with fewer inputs**

# Market Value of Land – Capitalization Formula

## Land Value = net income/ interest rate

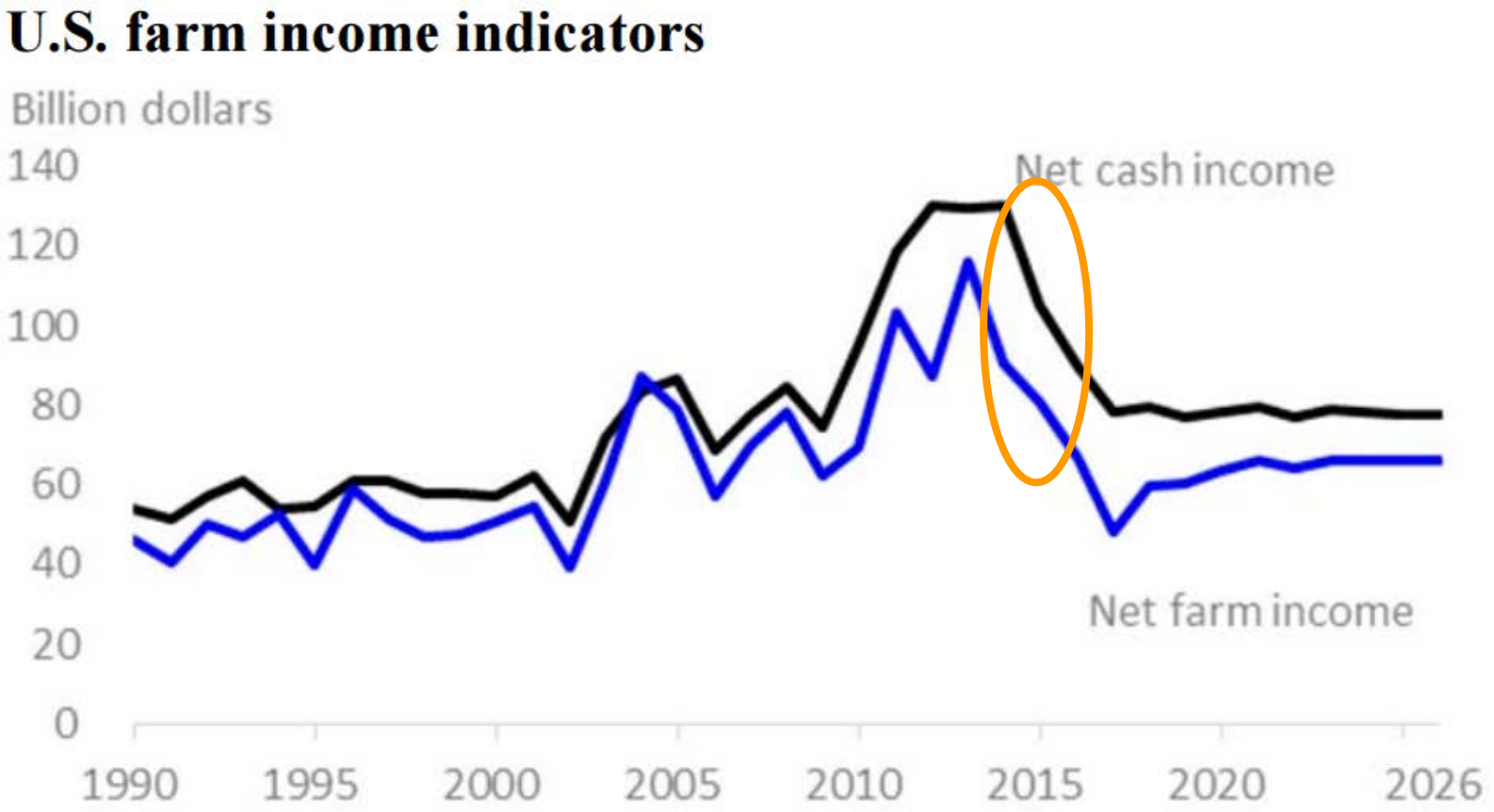
$$PV = \sum_{t=0}^{n} \frac{R}{(1+i)^t}$$

- For simplicity, you could think of land value as the present value of all future annual land rental payments a landowner could charge
- **PV = R/i**

# Guiding Framework

Land Value = localized net income / universal interest rate

# US Farm Income 1990-2026



**Percent change in dollar value of "good" farmland**

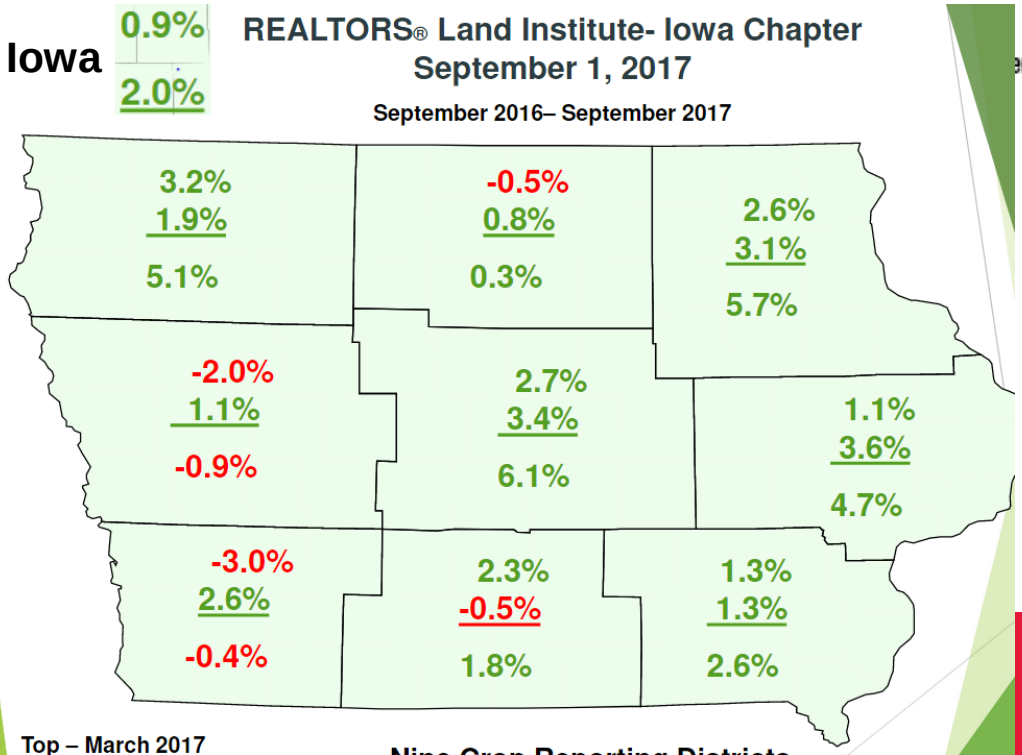
*Top:* April 1, 2017 to July 1, 2017
*Bottom:* July 1, 2016 to July 1, 2017

| | April 1, 2017 to July 1, 2017 | July 1, 2016 to July 1, 2017 |
|---|---|---|
| Illinois | 0 | −3 |
| Indiana | +2 | −1 |
| Iowa | +2 | +3 |
| Michigan | * | * |
| Wisconsin | +1 | +1 |
| Seventh District | +1 | +1 |


ent response.

**Iowa** 0.9% 2.0%

**REALTORS® Land Institute- Iowa Chapter**
**September 1, 2017**




Top – March 2017
Bottom – September 2017

Nine Crop Reporting Districts

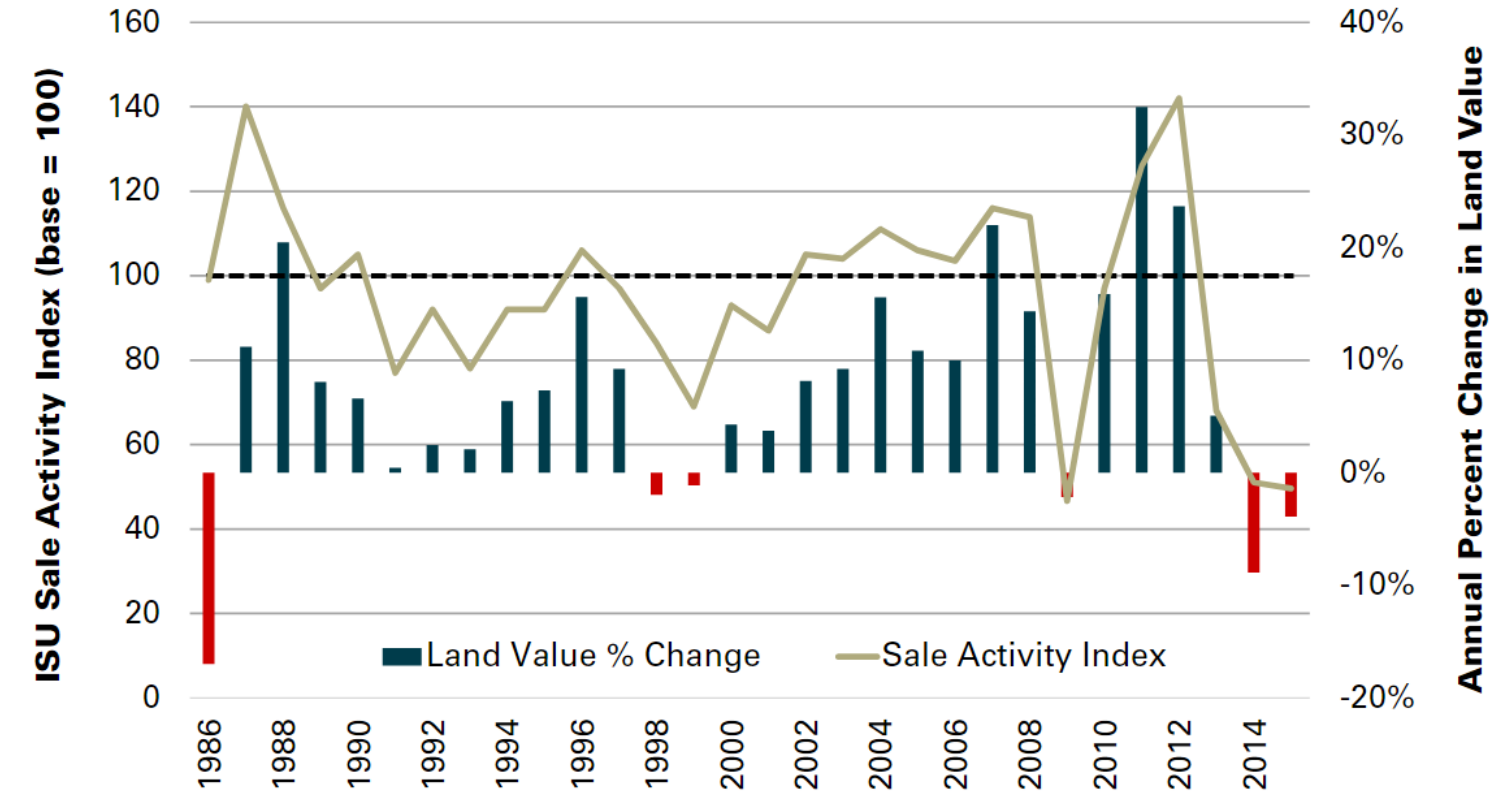
The Des Moines Register
PART OF THE USA TODAY NETWORK


Federal Reserve Bank of Chicago, July 2017 Ag Letter
Realtor Land Institute

CARD
Center for Agricultural and Rural Development

# The "temporary break" in continued declines results from limited land supply

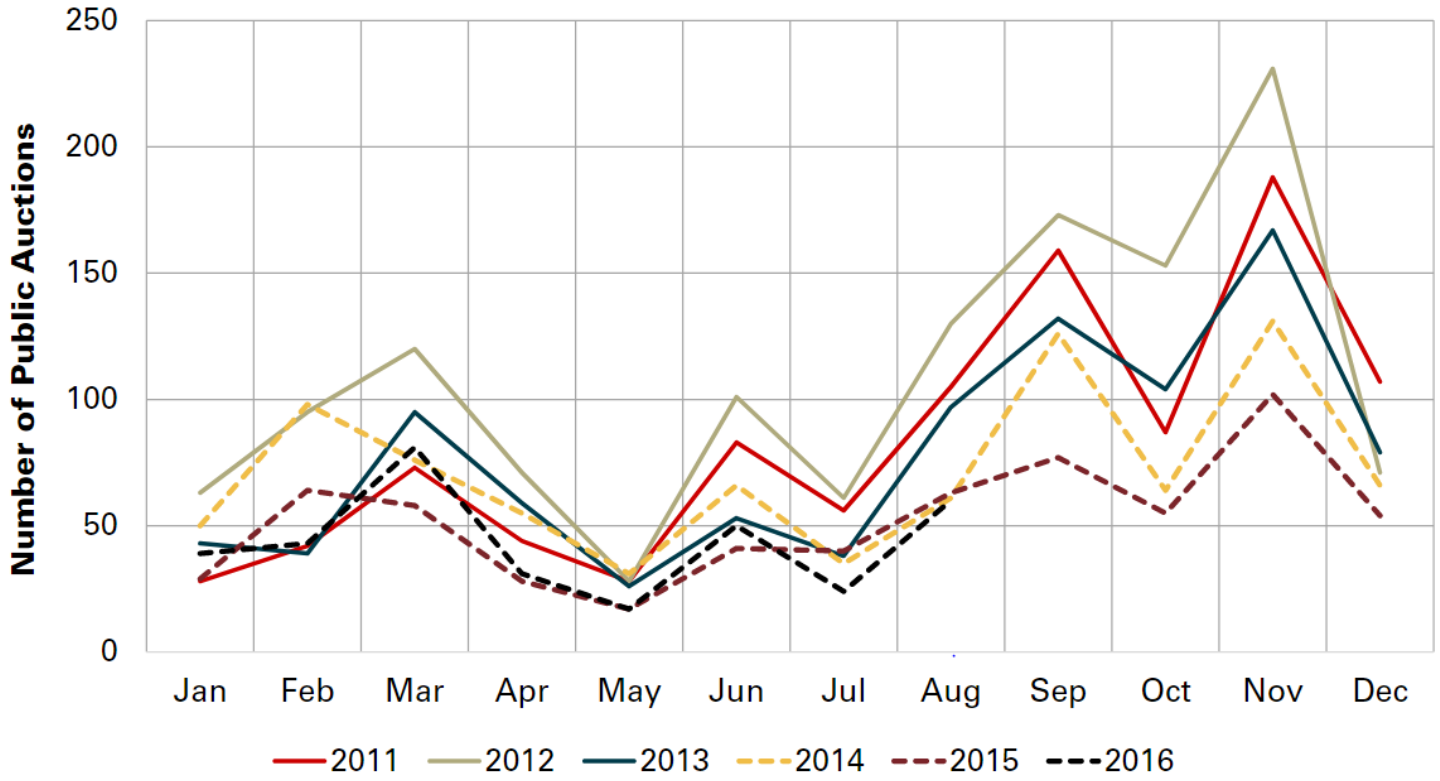
**Figure 1. ISU sale activity index and percentage change in Iowa land value, 1986 – 2015**




Sale activity index = (% Reported More - % Reported Less) * 100 + 100

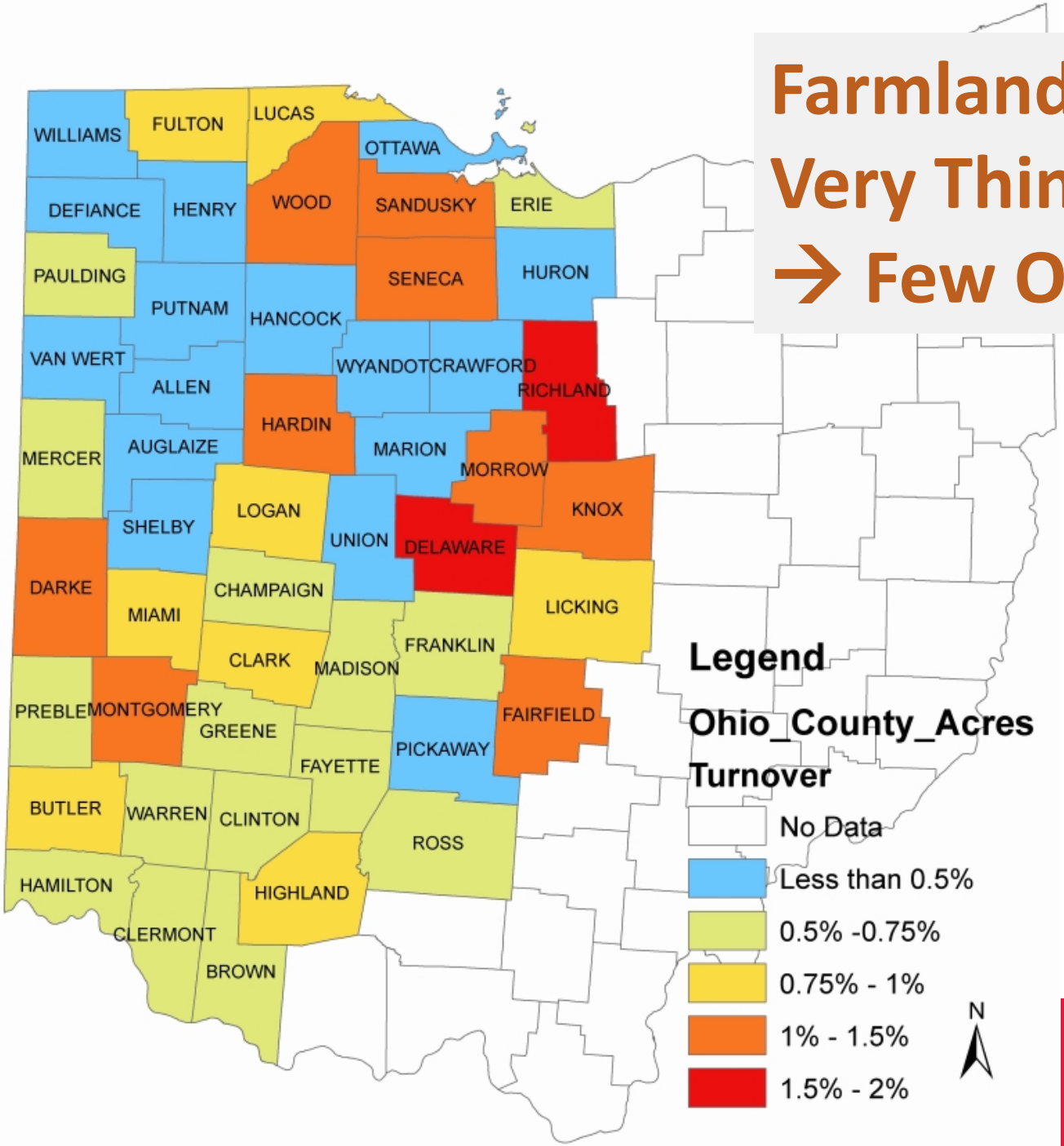
# The "temporary break" in continued declines results from limited land supply

**Figure 2. Number of public auctions by month, 2011 – 2016**




*Data Source: Jim Knuth, Farm Credit Services of America*

# Farmland Market is Very Thin!
# → Few Observations




Annual Agricultural turnover ratio 2001 - 2010

Blue: <0.5%
Red: 1.5-2%

Illinois
<0-3%>

CARD
Center for Agricultural and Rural Development

# Capitalization Formula and Sources of Income

$$V_{it} = E_t \sum_s \frac{R_{is}}{(1+\delta_t)^{s-t}}, where\ s = t, t+1, \ldots$$

$$R_{it} = \beta' \boldsymbol{X}_{it} + \tau_t + \eta_{it}$$

$$V_{it} = E_t \sum_s f(\boldsymbol{A}_{is}, \boldsymbol{N}_{is}, \boldsymbol{U}_{is}, \boldsymbol{M}_{is}; \delta_t), where\ s = t, t+1, \ldots$$

- Agricultural productivity variables **Ait** such as soil quality
- Natural amenities variables **Nit** such as proximity to surface water
- Urban influence variables **Uit** such as surrounding urban population, access to highway
- Agricultural market influence variables **Mit** such as proximity to ethanol plants, grain elevators and agricultural output terminals

# Hedonic pricing model of farmland values

- Log of arm's length agricultural land prices per acre

= parcel characteristics (i.e. parcel size)

- **+ agricultural productivity** variables (e.g. soil quality, slope, distances to ethanol plants, grain elevators)
- **+ agricultural market influence variables**
- (distances to ethanol plants, grain elevators, agricultural terminals)
- **+ agricultural market influence variables * post 2008 indicator**

**+ urban influence variables**

(e.g. dist to nearest city + additional dist to 2nd city +surrounding urban population + gravity index of 3 nearest cities)

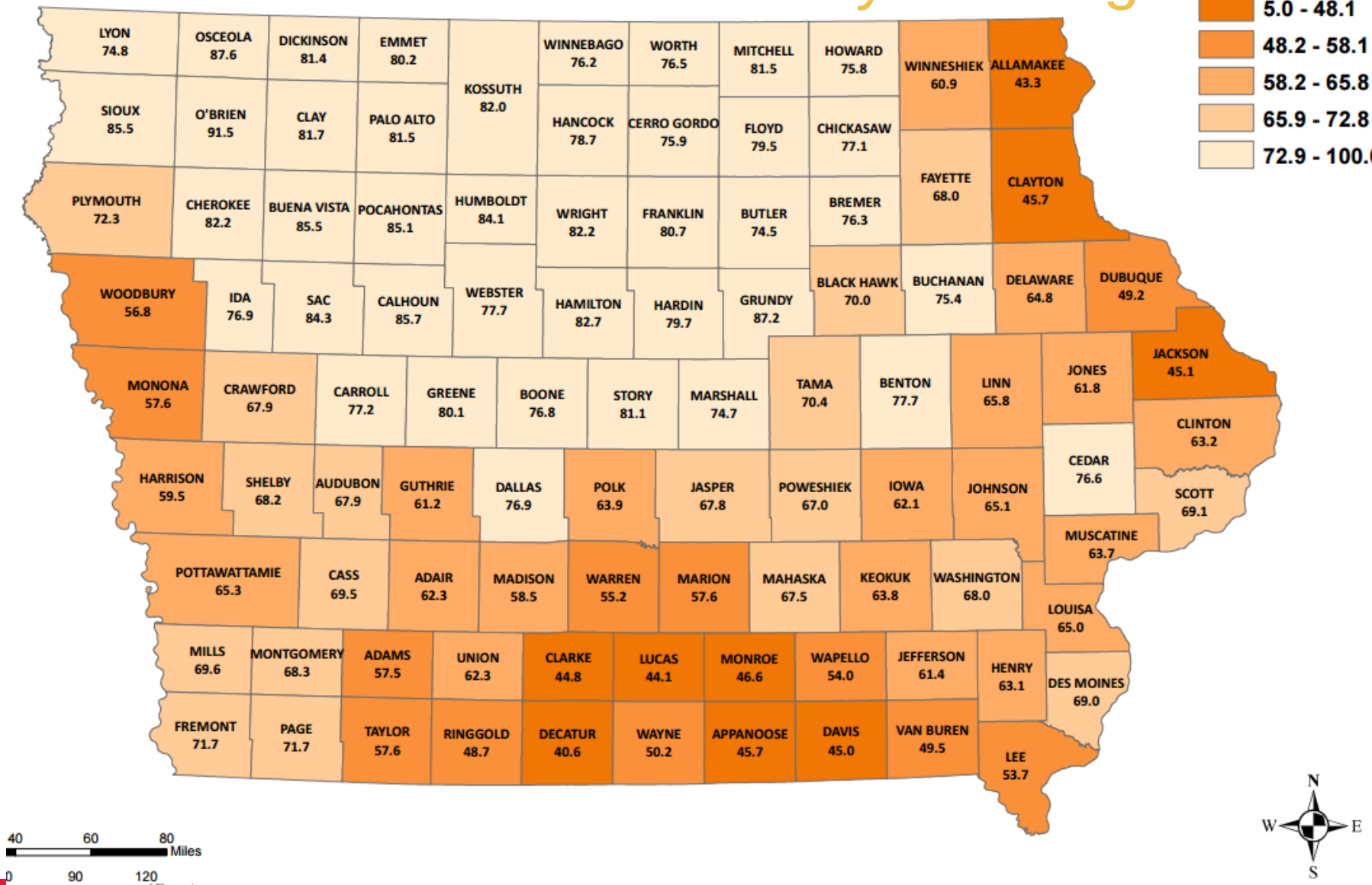
+year fixed effects

+ spatial fixed effects at census tract level

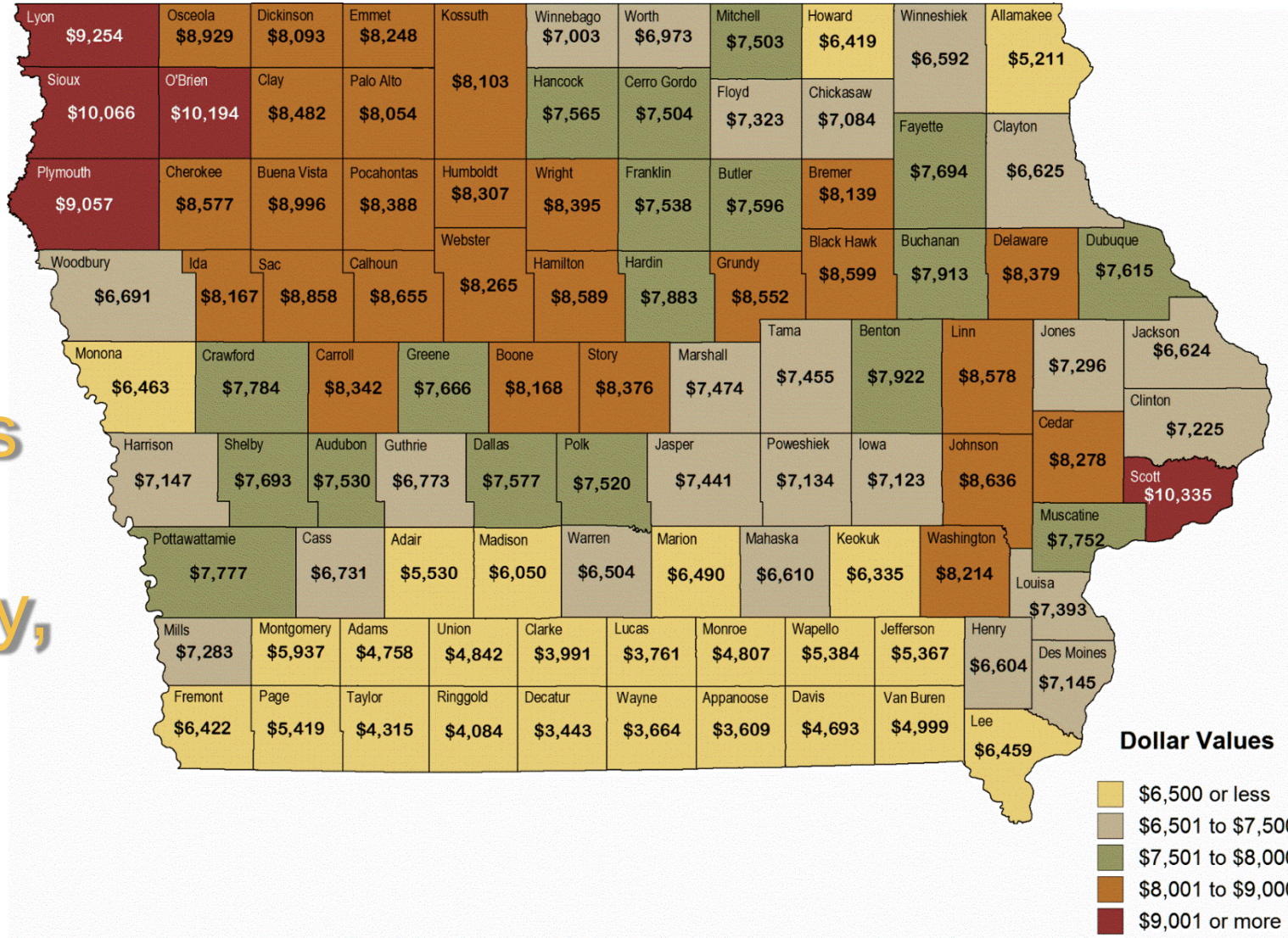
# Marginal values of farmland characteristics: Agricultural productivity variables

| ***Agricultural Profitability Influence Variables - Marginal Value*** | |
|---|---|
| Agricultural productivity index (NCCPI) | + $77.84/ 10% increase |
| Prime soil % of parcel | + $9.3 / 10% increase |
| Steep slope | – $203.11/ from non-steep to steep |
| Distance to nearest grain elevator | – $15.87 / 1 mile further |
| Distance to other agricultural terminal | – $21.04 / 1 mile further |

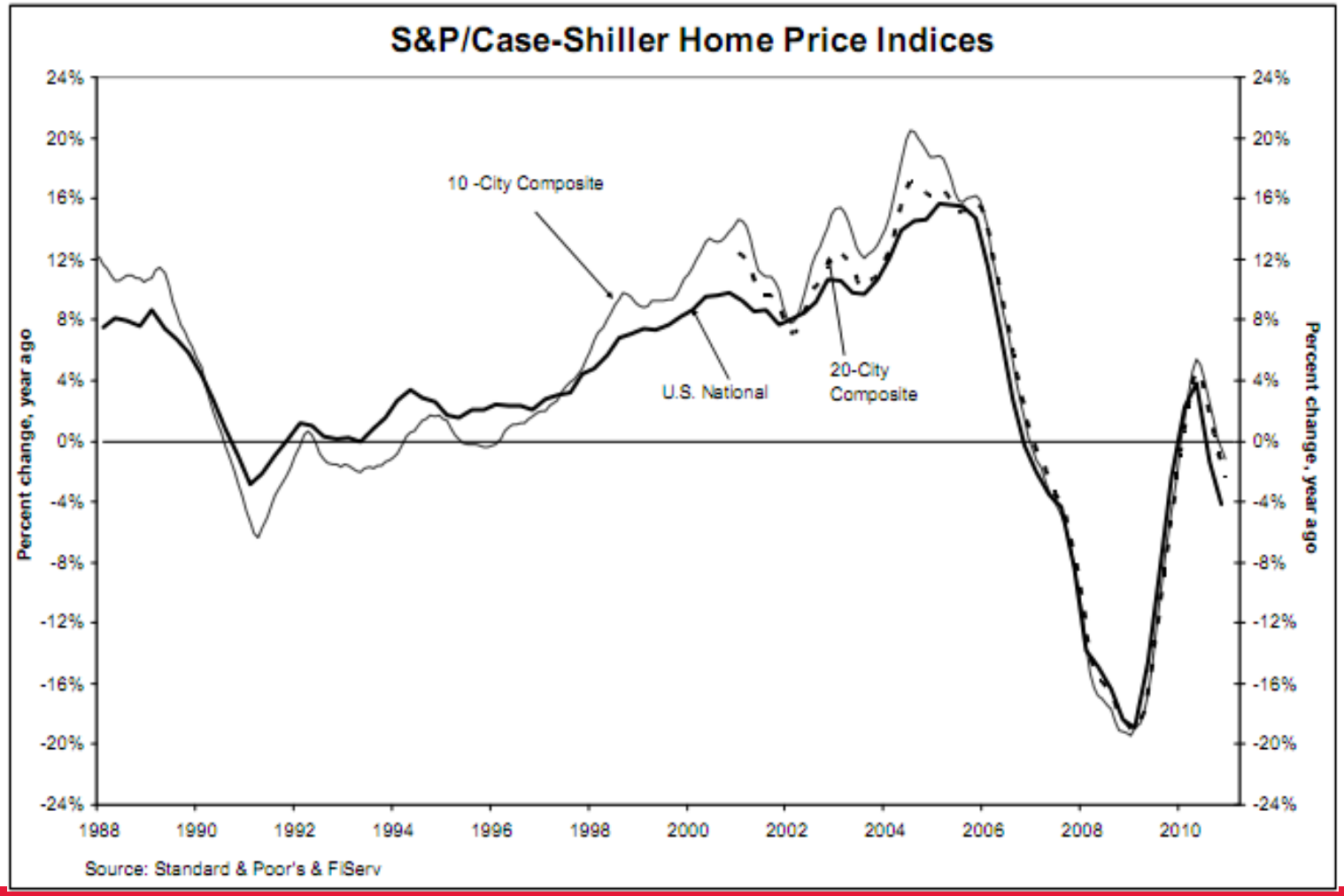
# CSR2 – Corn Suitability Rating



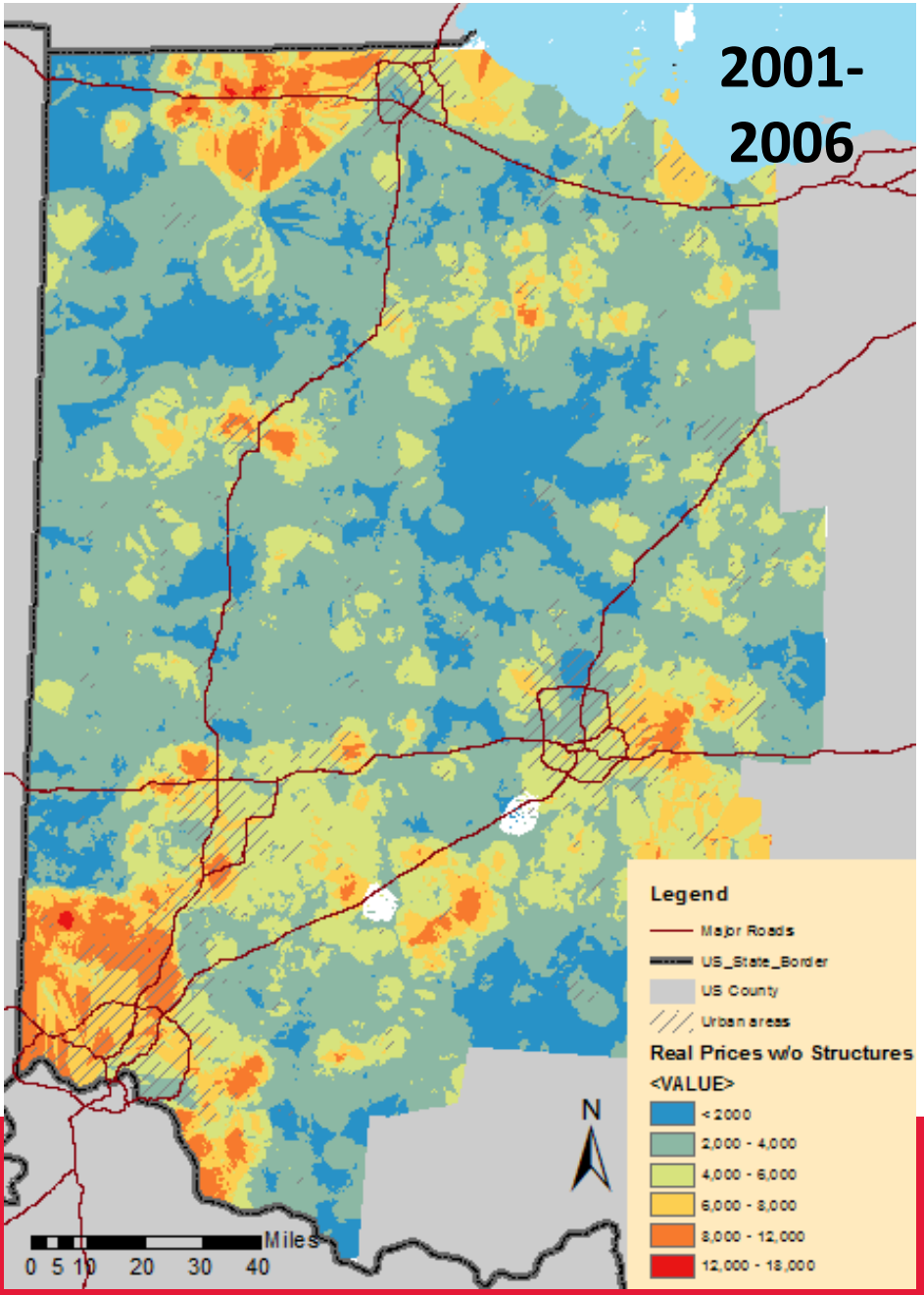
# Land Values by County, 2016

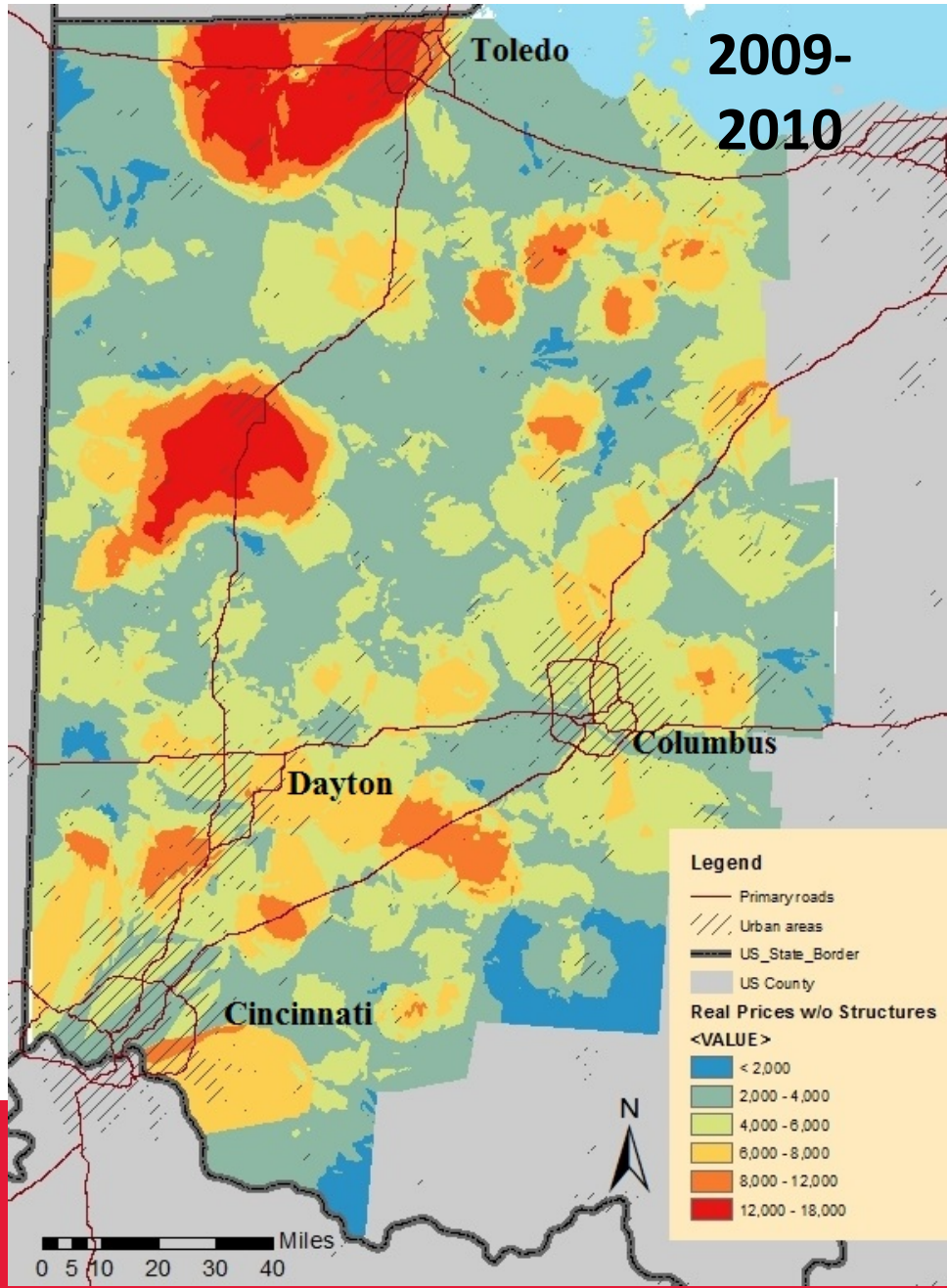


# Urban Influence and Farmland Values – Housing Market Bust

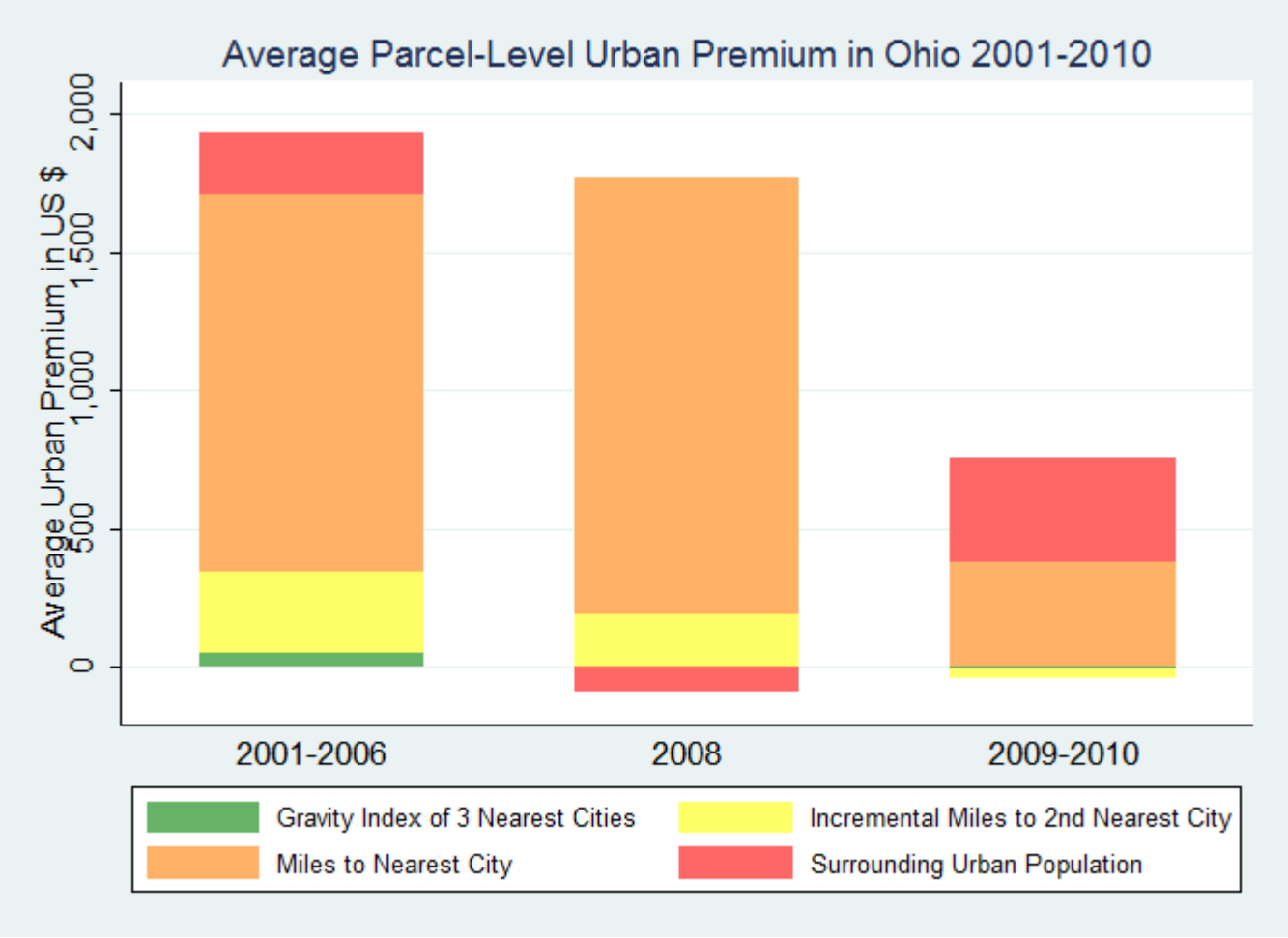


# Ohio Cropland Sale Prices 2001-2010



# The evolution of urban premium over time



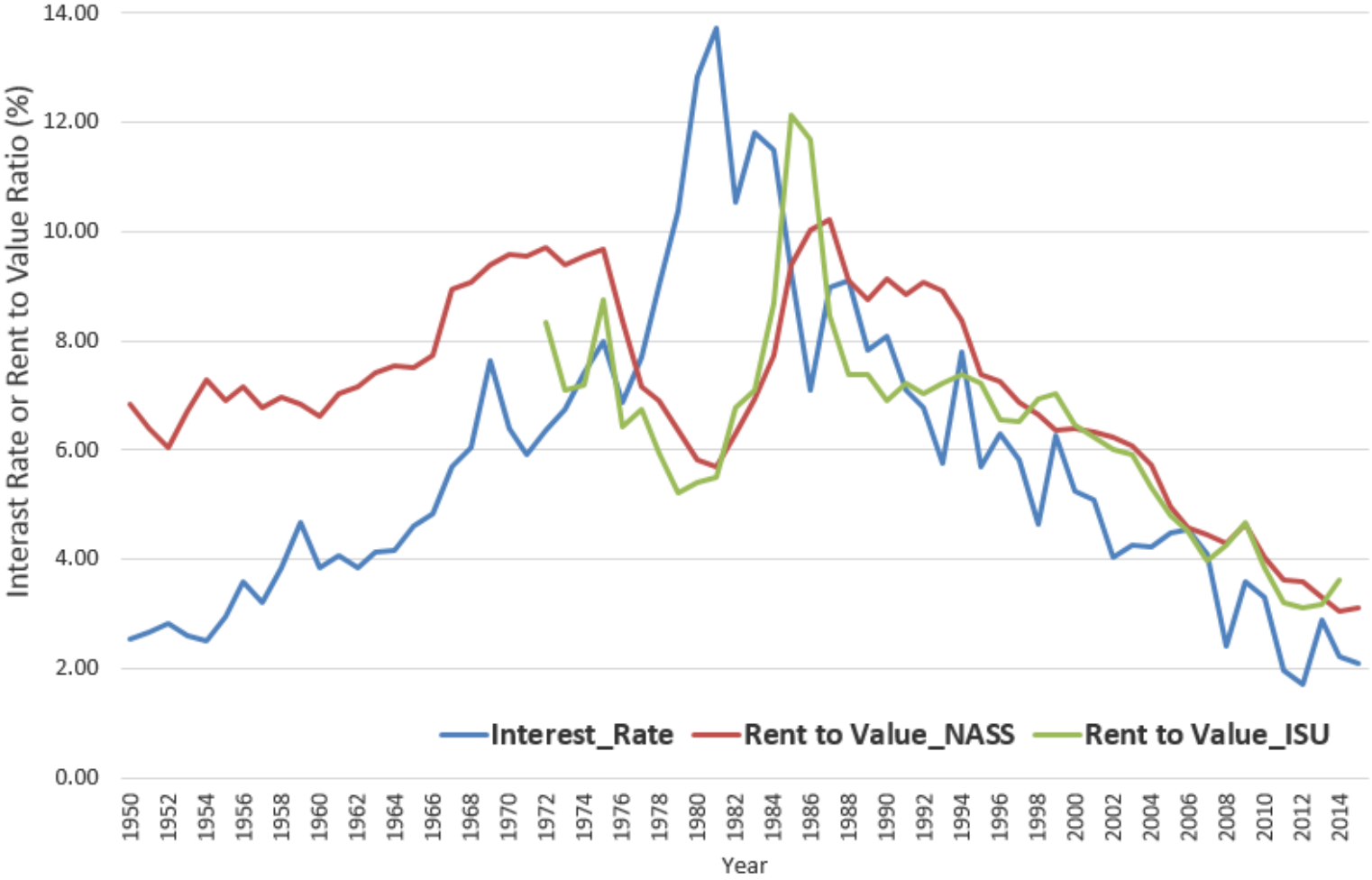
# Land Values by District and Land Quality, Nov 2016

| District | Average Value | % Change | High Quality | % Change | Medium Quality | % Change | Low Quality | % Change |
|---|---|---|---|---|---|---|---|---|
| **Northwest** | $9,243 | **-4.6%** | $10,650 | -5.2% | $8,468 | -4.1% | $6,019 | -3.7% |
| **North Central** | $7,562 | **-5.0%** | $8,442 | -5.9% | $6,992 | -4.9% | $5,164 | -3.9% |
| **Northeast** | $7,313 | **-7.0%** | $8,892 | -7.1% | $6,994 | -6.2% | $4,847 | -7.5% |
| **West Central** | $7,358 | **-8.7%** | $8,874 | -8.4% | $6,870 | -9.4% | $4,577 | -9.9% |
| **Central** | $7,841 | **-7.8%** | $9,299 | -7.8% | $7,186 | -7.4% | $5,158 | -2.5% |
| **East Central** | $7,917 | **-6.9%** | $9,502 | -7.6% | $7,396 | -6.8% | $5,153 | -4.0% |
| **Southwest** | $6,060 | **-4.9%** | $7,527 | -6.3% | $5,683 | -5.9% | $4,189 | **2.9%** |
| **South Central** | $4,241 | **-3.6%** | $5,980 | -7.2% | $4,128 | -3.6% | $2,892 | **5.2%** |
| **Southeast** | $6,716 | **-2.6%** | $9,265 | -2.8% | $6,283 | -3.7% | $3,783 | -0.4% |
| | | | | | | | | |
| **Iowa Avg.** | **$7,183** | **-5.9%** | **$8,758** | **-6.5%** | **$6,705** | **-5.9%** | **$4,665** | **-3.5%** |

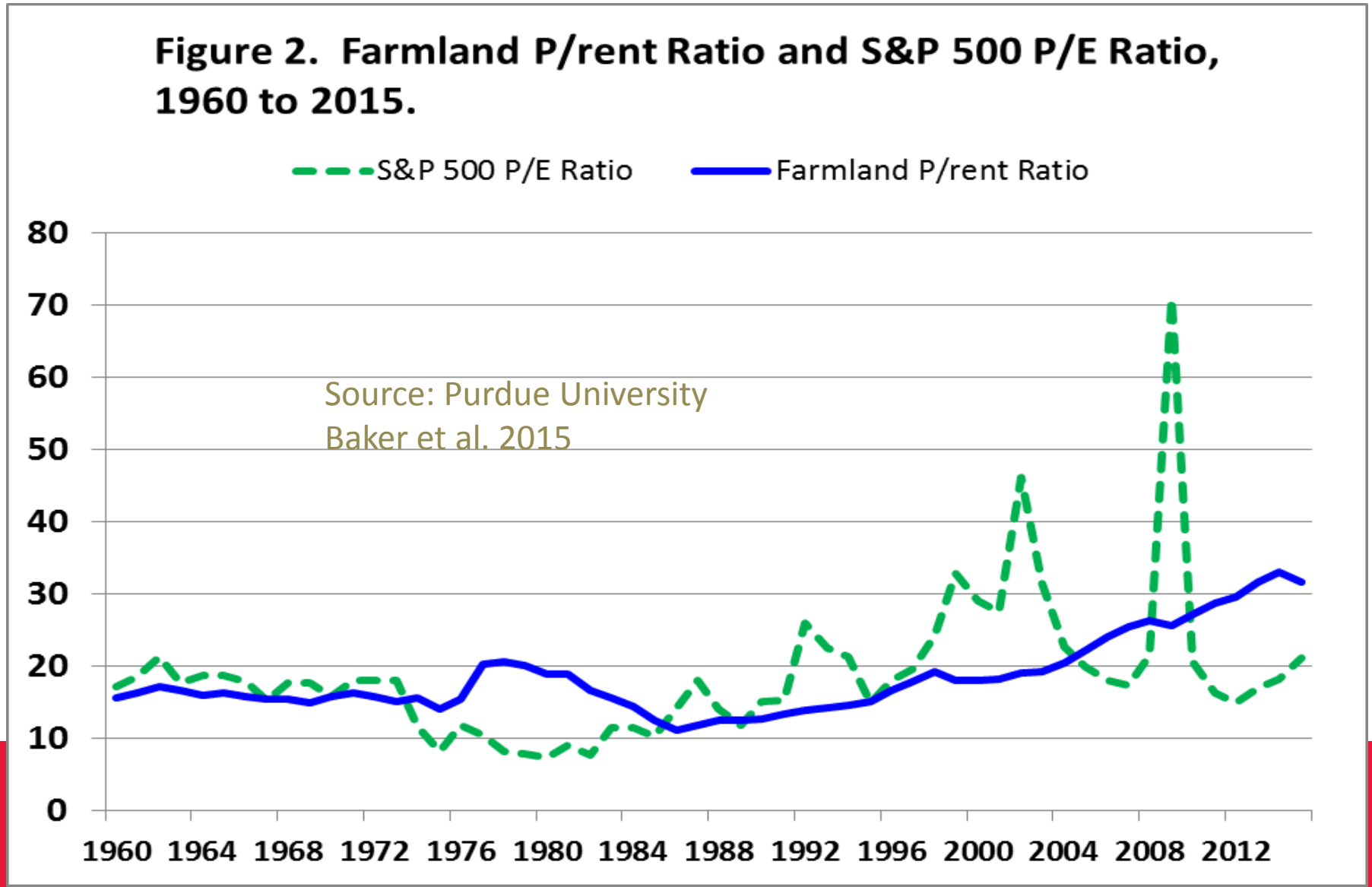
# Livestock and Crop Inventory by District

| | Inventory 2012 | | | | Harvested Acres 2015 | |
|---|---|---|---|---|---|---|
| | Chickens, Layers | Hogs | Milk Cows | Cattle | Corn | Soybean |
| Northwest | 30% | 26% | 29% | 22% | 15% | 16% |
| North Central | 64% | 16% | 4% | 6% | 14% | 13% |
| Northeast | 1% | 12% | 51% | 16% | 12% | 8% |
| West Central | 0% | 13% | 1% | 13% | 15% | 16% |
| Central | 3% | 13% | 1% | 7% | 15% | 14% |
| East Central | 1% | 5% | 10% | 11% | 10% | 10% |
| Southwest | 0% | 2% | 0% | 9% | 7% | 9% |
| South Central | 0% | 2% | 1% | 9% | 4% | 5% |
| Southeast | 1% | 11% | 3% | 6% | 7% | 8% |
| | | | | | | |
| State Inventory | 20.4 million | 60.5 million | 0.17 million | 2.34 million | 13.2 million | 9.8 million |

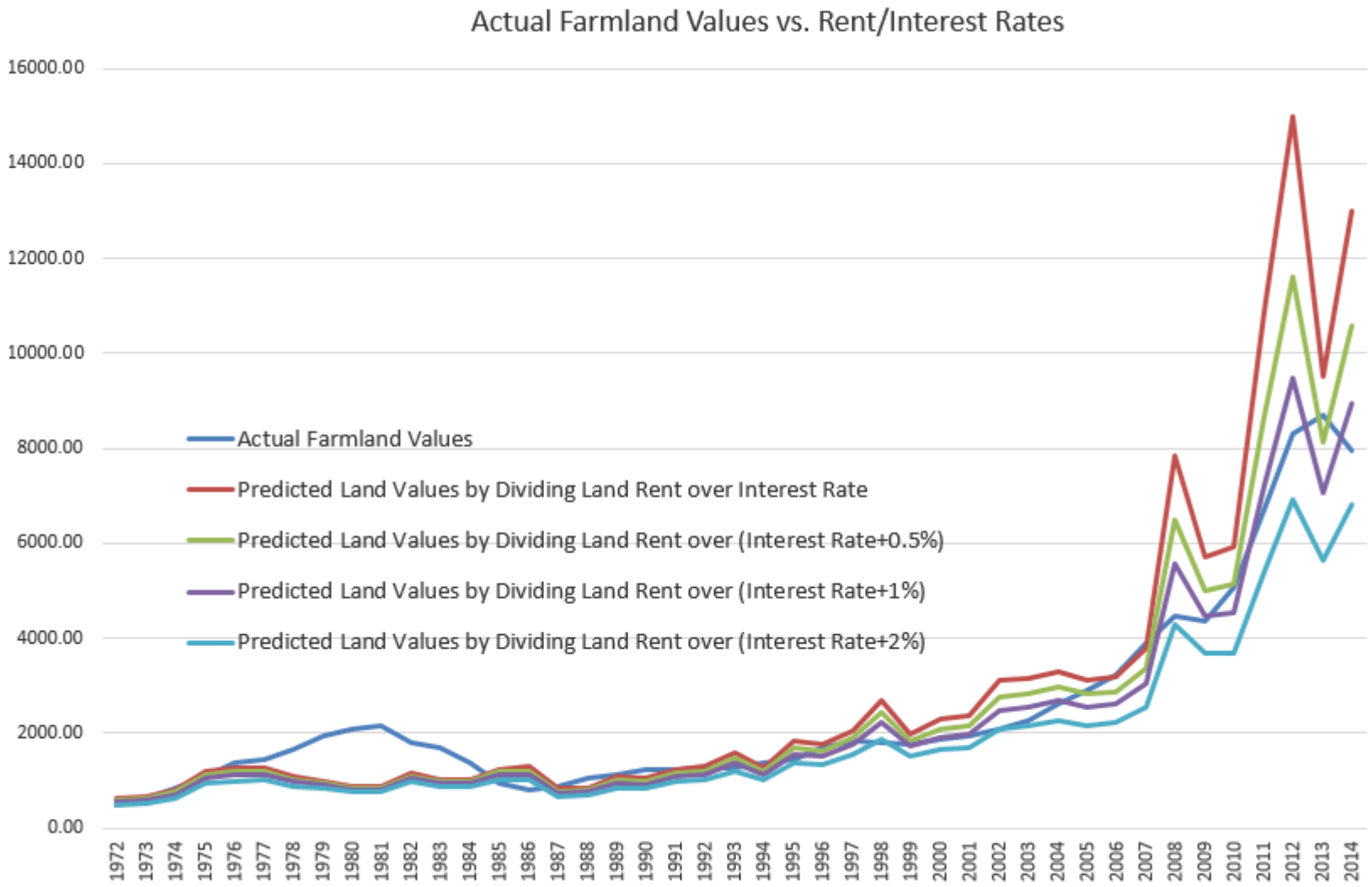
# Capitalization Rate (Cap Rate)
# Rent to Value Ratio



# Farmland Price/Rent Ratio vs. S&P 500 P/E Ratio

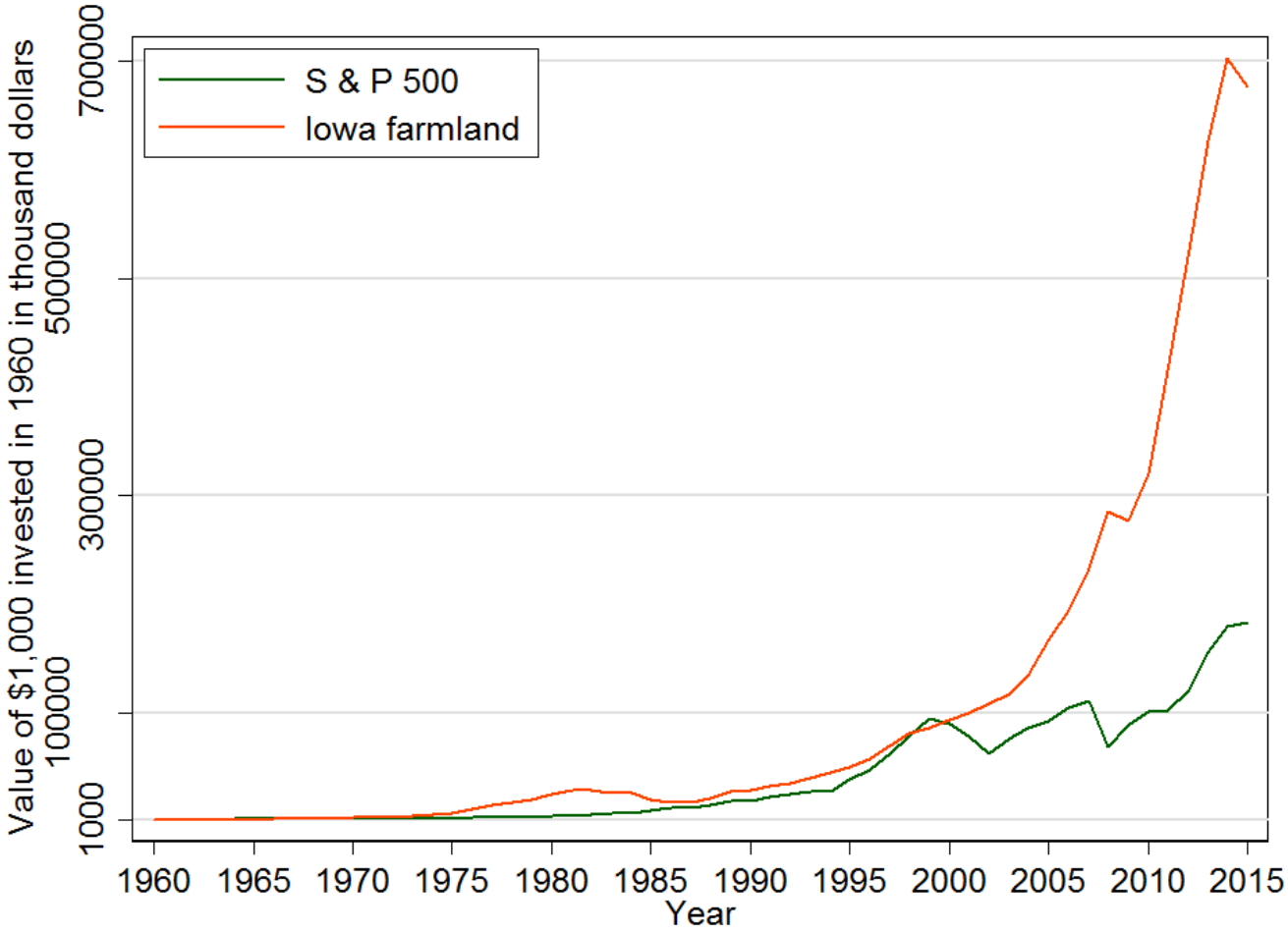


# Farmland Values vs. Capitalized Land Values



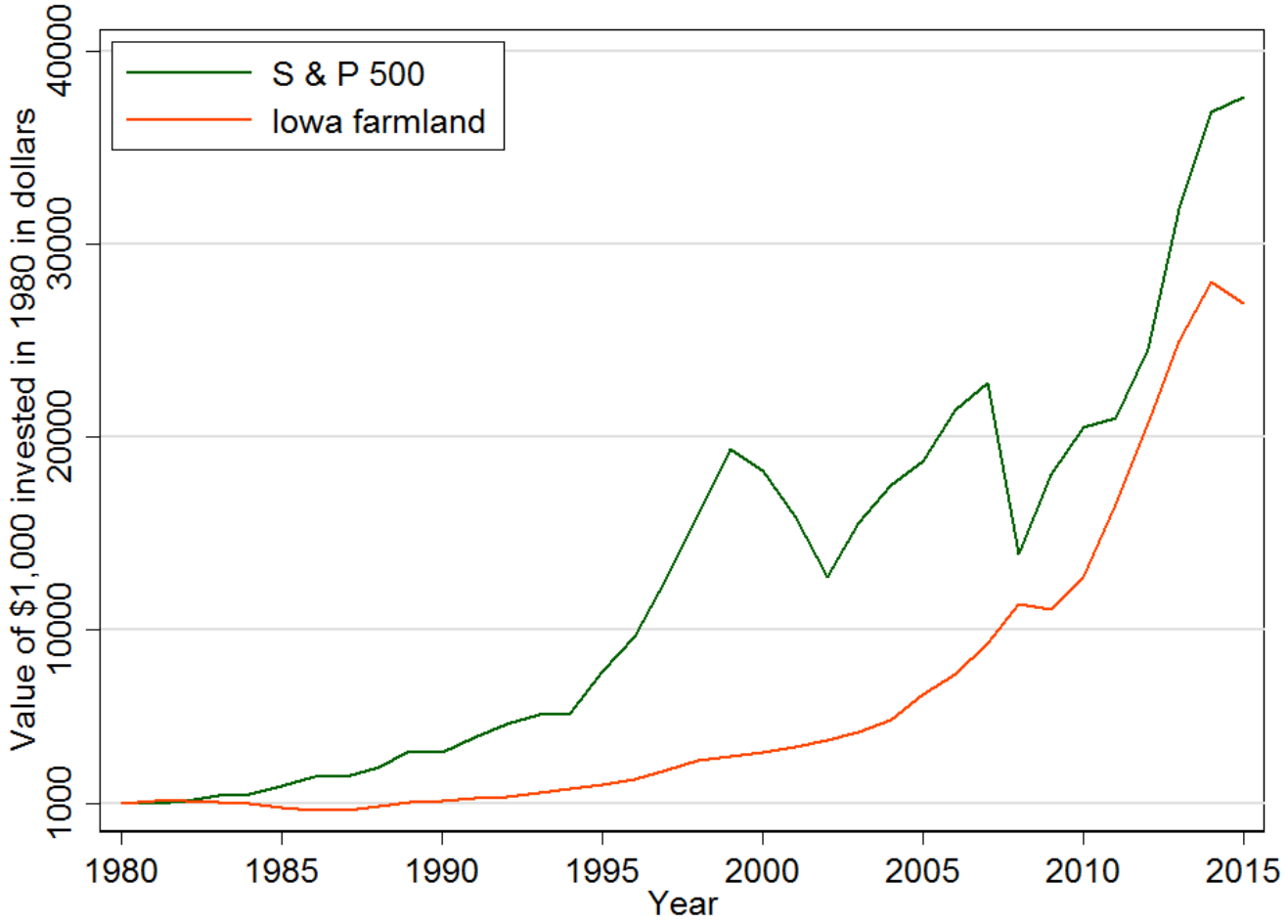
# S&P 500 vs. Farmland Values: A Question of Timing

**1960**



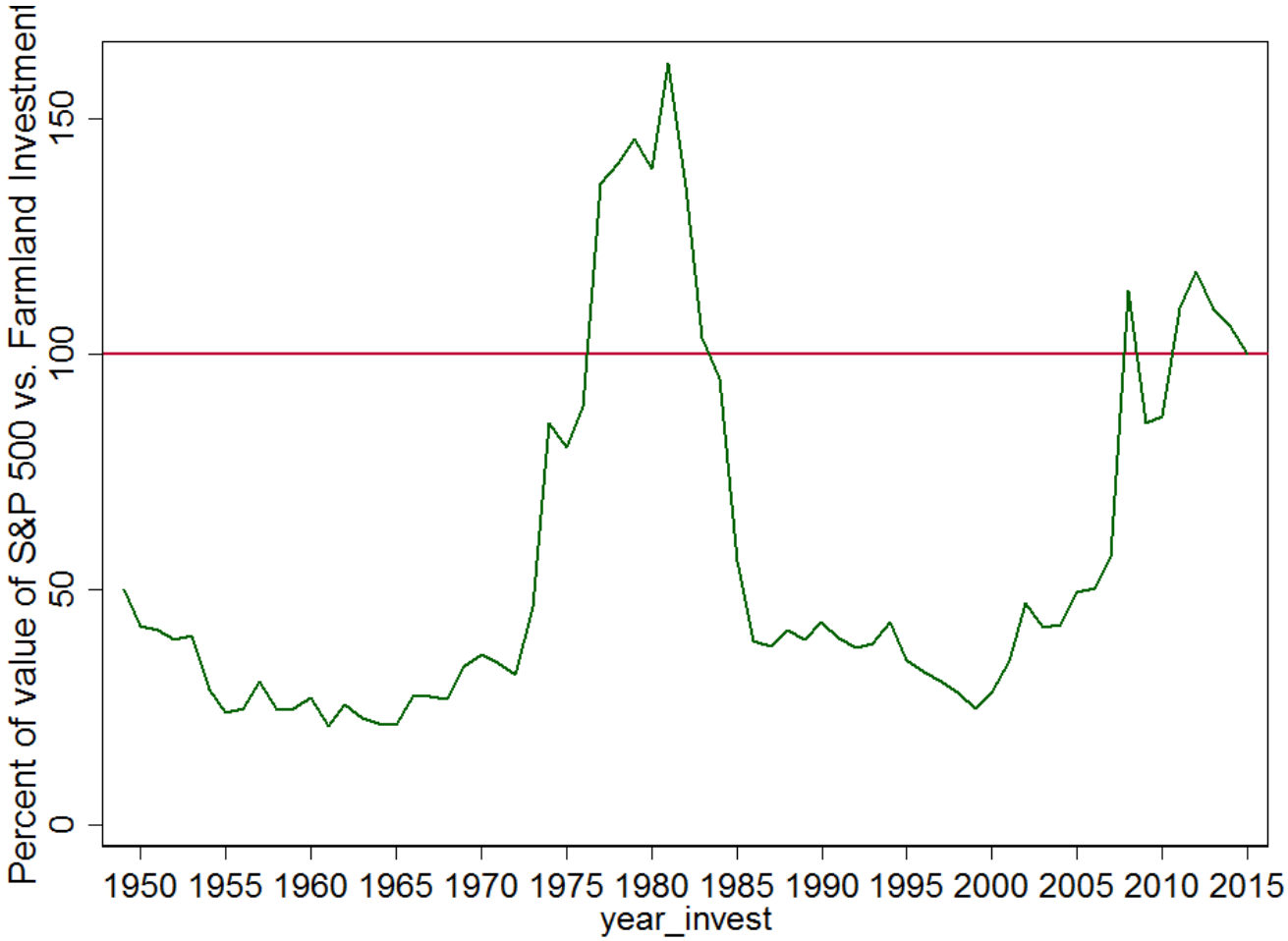
# S&P 500 vs. Farmland Values: A Question of Timing

**1980**



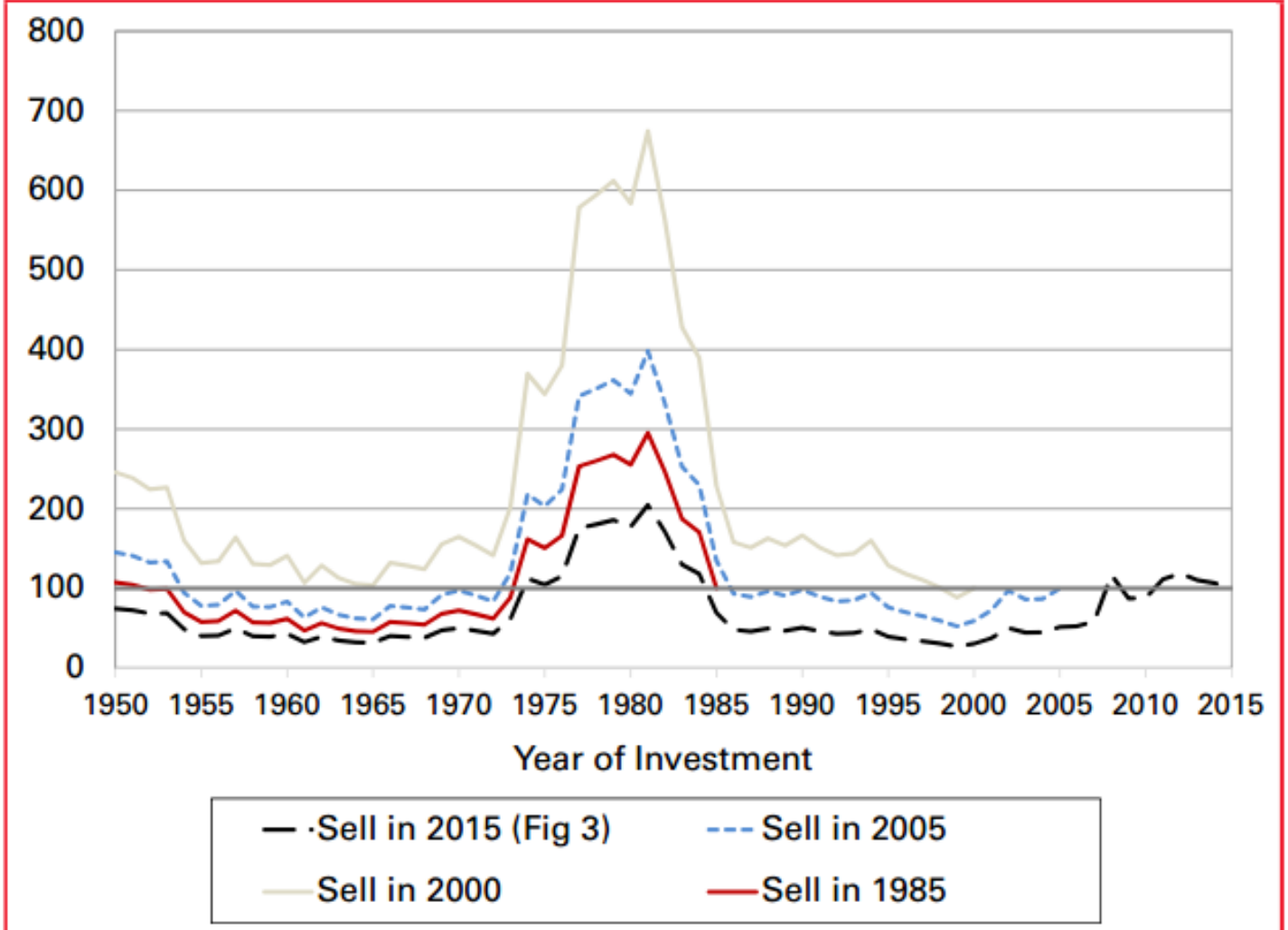
# S&P 500 vs. Farmland Values: A Question of Timing 1950-2015

**Return to S & P Investment Relative to Iowa Farmland Investment**

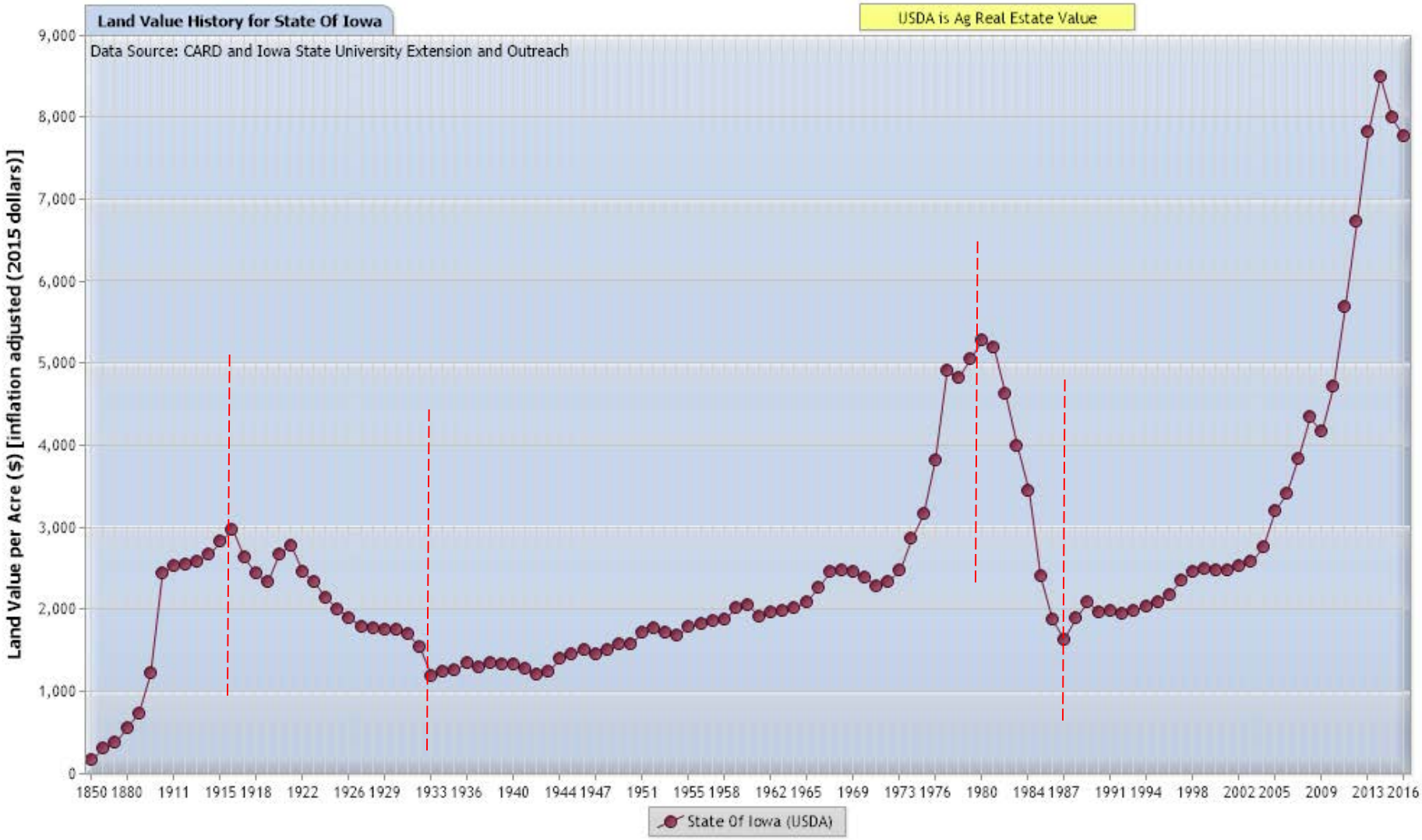


# S&P 500 vs. Farmland Values: A Question of Timing 1950-2015

**Figure 4. Return to an investment in the S&P relative to an investment made in Iowa farmland by year of investment and year of selling that investment**



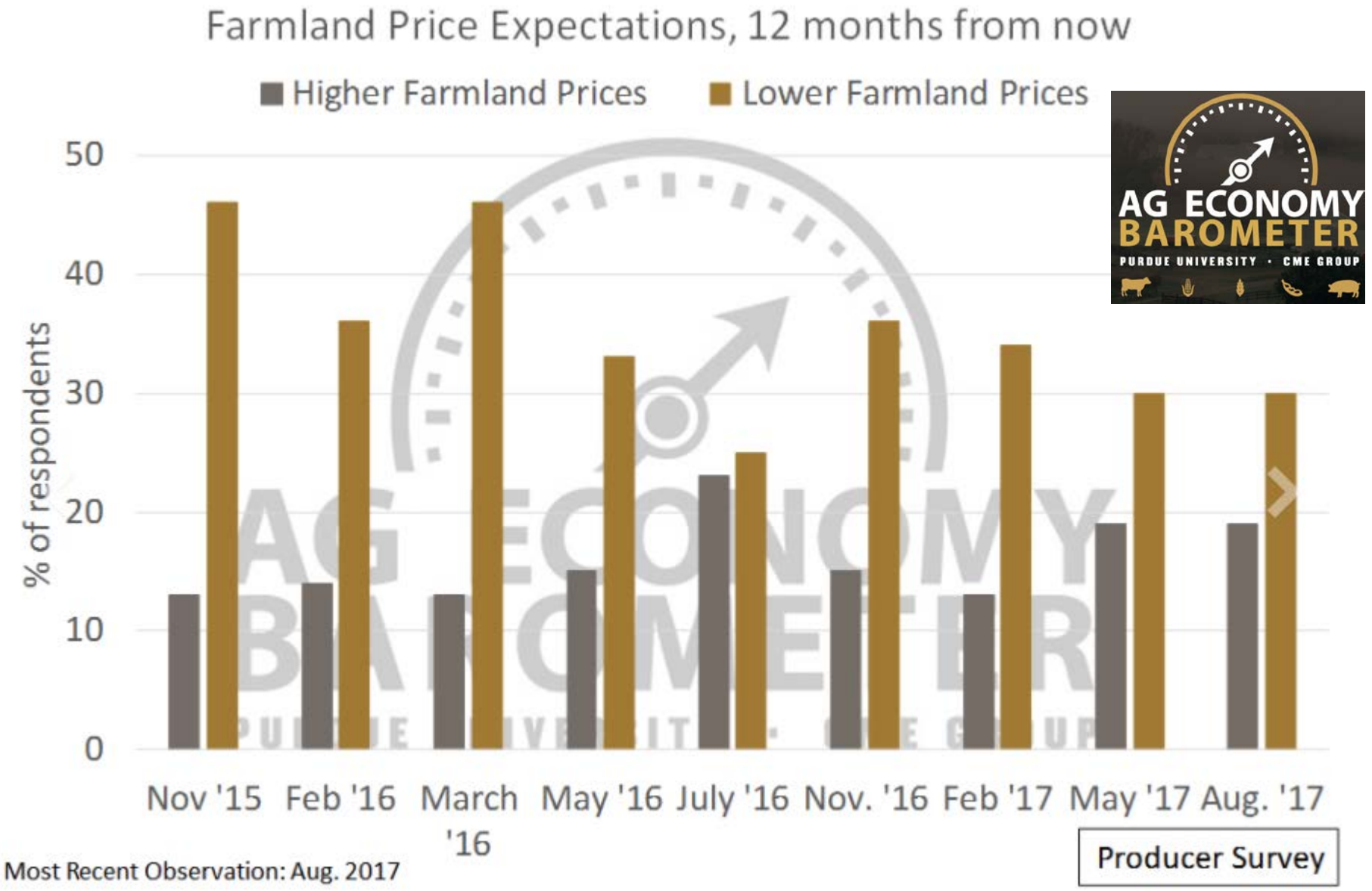
# Iowa Ag Real Estate Values 1850-2016



# A replay of 1920s or 1980s farm crisis?

| Average % change in inflation-adjusted values per year | | | |
|---|---|---|---|
| **Golden Eras** | | | |
| | ***Land*** | ***Gross Income*** | ***Net Income*** |
| ***1910-1920*** | 1.2% | 0.8% | 0.2% |
| ***1973-1981*** | 9.7% | 0.9% | -3.2% |
| ***2003-2013*** | 11.1% | 4.5% | 8.1% |
| **Crises and Declines** | | | |
| | ***Land*** | ***Gross Income*** | ***Net Income*** |
| ***1921-1933*** | -5.8% | -1.9% | -1.0% |
| ***1981-1987*** | -15.0% | -2.5% | 2.6% |
| ***2013-2017*** | -4.5%* | -4.5% | -9.8% |

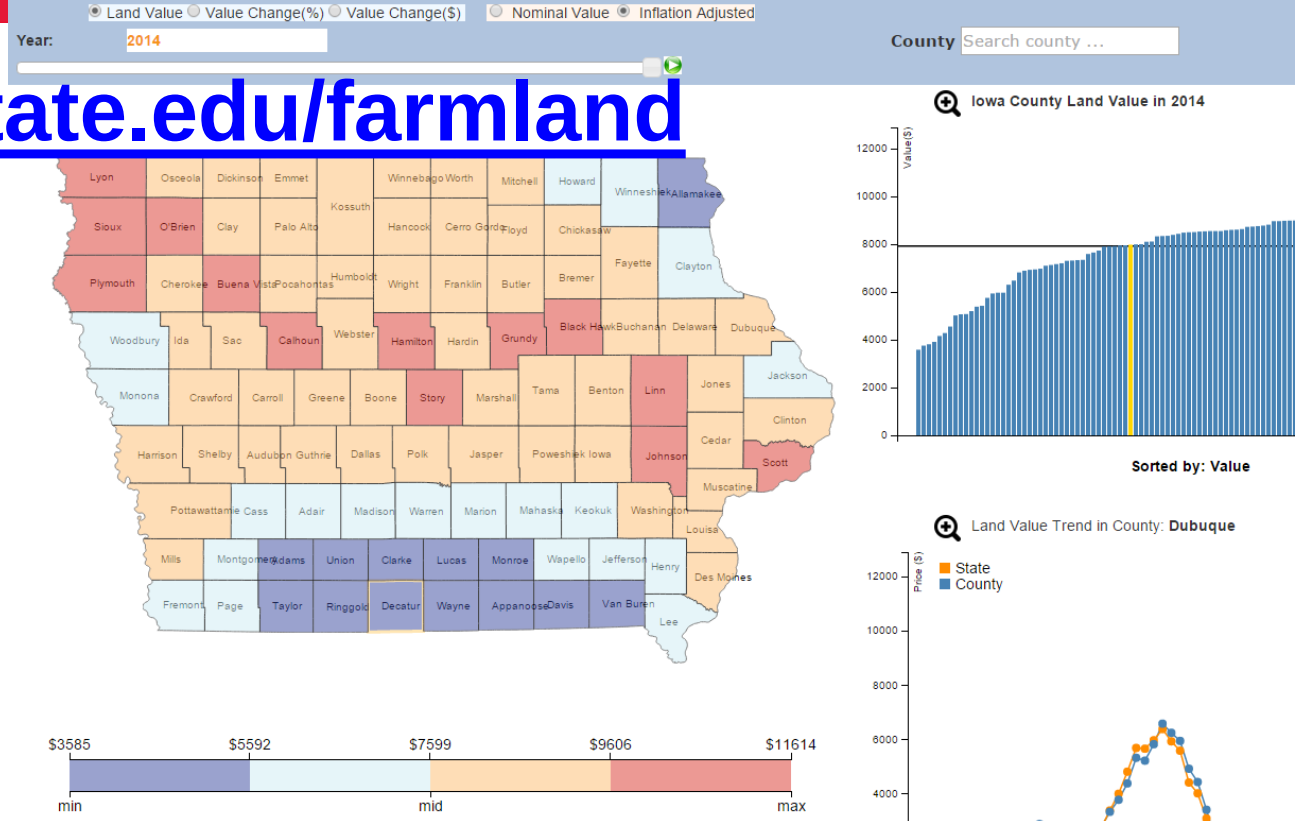
Note: The average land value change from 2013 to 2017 is approximate because 2017 land values are unknown. The 1910–1933 gross and net farm income changes are for the whole United States due to limited data at the state level. Land values are based on USDA Census of Agriculture and USDA NASS Land Value and Cash Rent Survey, while the data on farm income is from the USDA Economic Research Service Farm Income and Wealth Statistics database.

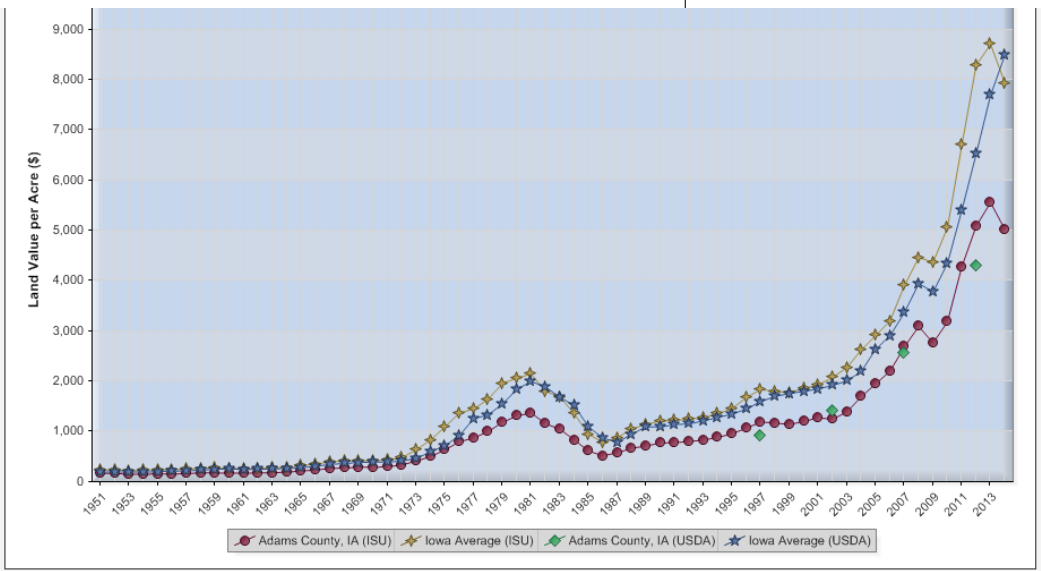

Farmland Price Expectations, 12 months from now
Higher Farmland Prices
Lower Farmland Prices
AG ECONOMY BAROMETER
PURDUE UNIVERSITY · CME GROUP
% of respondents
50
40
30
20
10
0
Nov '15
Feb '16
March '16
May '16
July '16
Nov. '16
Feb '17
May '17
Aug. '17
Most Recent Observation: Aug. 2017
Producer Survey

# http://card.iastate.edu/farmland

# Iowa Farmland Value Portal

# twitter #ISUland value




IOWA STATE UNIVERSITY
Extension and Outreach


FARMLND
C-MAX
CROPMKT

# If you only remember one thing

- **PV = R/I**
- **Land Values =**

  **Net Income/Discount Rate**

**Land Value Depends on the Source of Income**

# Thank You!

**Wendong Zhang**
Assistant Professor and Extension Economist
478C Heady Hall
Iowa State University
515-294-2536
wdzhang@iastate.edu
http://www2.econ.iastate.edu/faculty/zhang/
http://card.iastate.edu/farmland/