



ECONOMICS OF COST IN FARM MANAGEMENT

AAE 320

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Agricultural & Applied Economics



AGRICULTURAL & APPLIED ECONOMICS
College of Agricultural & Life Sciences

Learning Goals

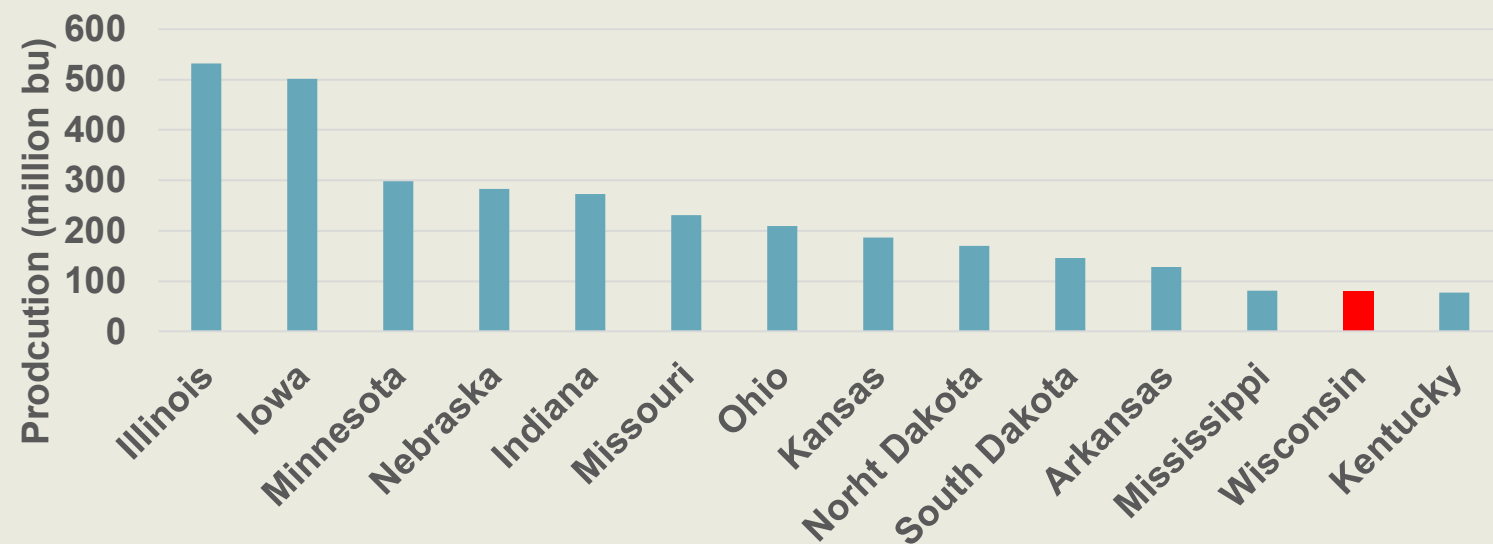
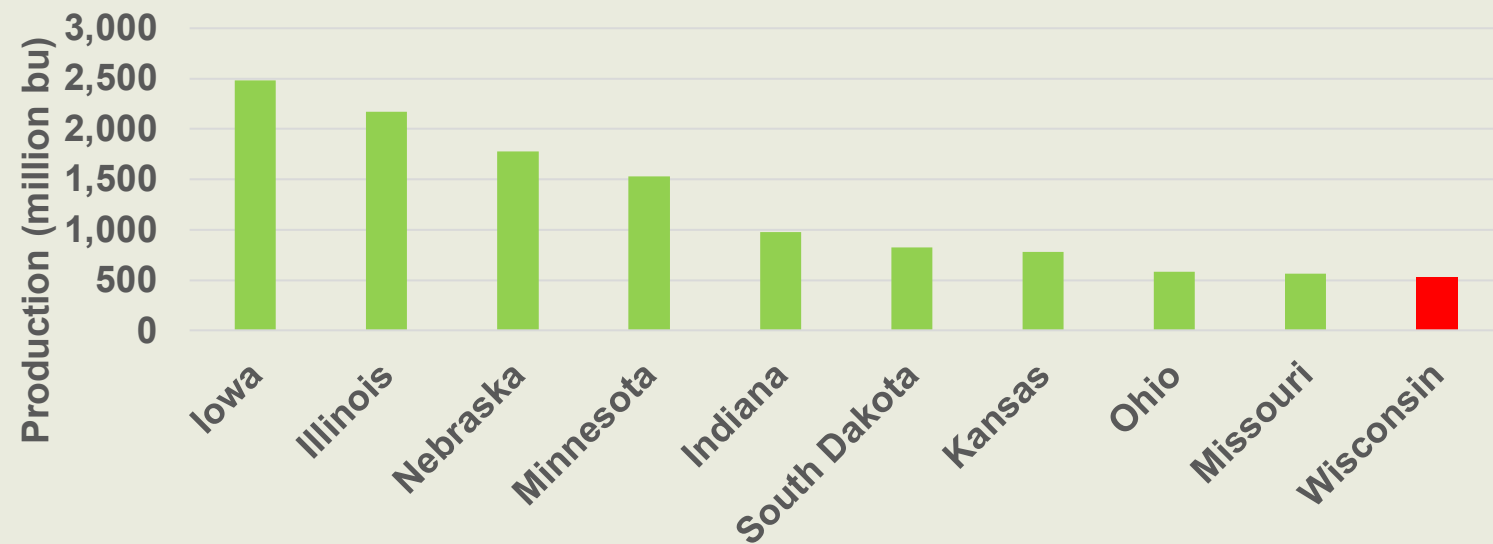
- Understand the major cost categories and the financial scale of farm production based on available cost of production budgets
 - Focus on Midwestern corn and soybean costs
 - Briefly look at dairy
- Examine historical data on farmer costs and prices
 - Margin: average farm price minus average cost of production
- Explore some options for farmers when the price of what they are selling is less than their cost of production

King Corn and Queen Bean

- Projected world production of all grains in 2020 is 2.7 Billion metric tons
- Corn is 43%, Wheat is 28%, Rice is 18% of all grains produced
 - Sorghum, Barley and Oats are the remaining 11%
- **The US produces 1/3 of the world's corn**

- Projected world production of oilseeds in 2020 is 609 Million metric tons
- Soybeans are 61% of this production
- **The US produces 1/3 of the world's soybeans**
 - Brazil produces 36% of the world's soybeans

Top Corn and Soybean Producing States 2019



- Iowa and Illinois 1st and 2nd in each crop
- Wisconsin 10th in corn and 14th in soybean production

Corn Following Corn

2020

	164 bushels per acre		182 bushels per acre		200 bushels per acre	
	Fixed	Variable	Fixed	Variable	Fixed	Variable
Preharvest Machinery ^{1/}	\$23.20	\$21.20	\$23.20	\$21.20	\$23.20	\$21.20
Seed, Chemical, etc.	Units		Units		Units	
Seed @\$3.22 per 1000 kernel	25,000	\$80.50	30,000	\$96.60	35,000	\$112.70
Nitrogen @\$0.34 per pound	186	63.24	186	63.24	186	63.24
Phosphate @\$0.34 per pound	62	21.08	68	23.12	75	25.50
Potash @\$0.31 per pound	49	15.19	55	17.05	60	18.60
Lime (yearly cost)		12.49		12.49		12.49
Herbicide		31.85		31.85		31.85
Insecticide		23.79		23.79		23.79
Crop insurance		8.70		9.70		10.50
Miscellaneous		9.00		10.00		11.00
Interest on preharvest variable costs (8 months @ 5.8%)		11.10		11.95		12.79
Total		\$276.94		\$299.79		\$322.46
Harvest Machinery						
Combine	\$13.00	\$6.80	\$13.00	\$6.80	\$13.00	\$6.80
Grain cart	6.20	3.00	6.20	3.00	6.20	3.00
Haul	7.05	6.23	7.83	6.92	8.60	7.60
Dry (LP gas @\$1.12 per gallon)	8.20	22.04	9.10	24.46	10.00	26.88
Handle (auger)	2.87	3.21	3.19	3.57	3.50	3.92
Total	\$37.32	\$41.29	\$39.31	\$44.74	\$41.30	\$48.20
Labor						
2.80 hours @ \$14.75	\$41.30		\$41.30		\$41.30	
Land						
Cash rent equivalent	\$183.00		\$219.00		\$255.00	
Total fixed, variable						
Per acre	\$284.82	\$339.43	\$322.81	\$365.73	\$360.80	\$391.86
Per bushel	\$1.74	\$2.07	\$1.77	\$2.01	\$1.80	\$1.96
Total cost per acre	\$624.25		\$688.54		\$752.66	
Total cost per bushel	\$3.81		\$3.78		\$3.76	

^{1/} Chisel plow, tandem disk, apply Nitrogen, field cultivate, plant, and spray. See the Estimated Machinery Costs table.

Corn Following Soybean

2020

	179 bushels per acre		199 bushels per acre		219 bushels per acre	
	Fixed	Variable	Fixed	Variable	Fixed	Variable
Preharvest Machinery ^{1/}	\$19.60	\$17.30	\$19.60	\$17.30	\$19.60	\$17.30
Seed, Chemical, etc.	Units		Units		Units	
Seed @\$3.22 per 1000 kernel	25,000	\$80.50	30,000	\$96.60	35,000	\$112.70
Nitrogen @\$0.34 per pound	131	44.54	131	44.54	131	44.54
Phosphate @\$0.34 per pound	67	22.78	75	25.50	82	27.88
Potash @\$0.31 per pound	54	16.74	60	18.60	66	20.46
Lime (yearly cost)		12.49		12.49		12.49
Herbicide		31.85		31.85		31.85
Crop insurance		8.70		9.70		10.50
Miscellaneous		9.00		10.00		11.00
Interest on preharvest variable costs (8 months @ 5.8%)		9.43		10.31		11.16
Total		\$236.03		\$259.59		\$282.58
Harvest Machinery						
Combine	\$13.00	\$6.80	\$13.00	\$6.80	\$13.00	\$6.80
Grain cart	6.20	3.00	6.20	3.00	6.20	3.00
Haul	7.70	6.80	8.56	7.56	9.42	8.32
Dry (LP gas @\$1.12 per gallon)	8.95	24.06	9.95	26.75	10.95	29.43
Handle (auger)	3.13	3.51	3.48	3.90	3.83	4.29
Total	\$38.98	\$44.17	\$41.19	\$48.01	\$43.40	\$51.85
Labor						
2.55 hours @ \$14.75	\$37.61		\$37.61		\$37.61	
Land						
Cash rent equivalent	\$183.00		\$219.00		\$255.00	
Total fixed, variable						
Per acre	\$279.19	\$297.50	\$317.40	\$324.90	\$355.61	\$351.73
Per bushel	\$1.56	\$1.66	\$1.59	\$1.63	\$1.62	\$1.61
Total cost per acre	\$576.69		\$642.30		\$707.34	
Total cost per bushel	\$3.22		\$3.23		\$3.23	

^{1/} Apply Nitrogen, tandem disk, field cultivate, plant, and spray. See the Estimated Machinery Costs table.

Corn Silage Following Corn

2020

	21 tons per acre		24 tons per acre		26 tons per acre	
	Fixed	Variable	Fixed	Variable	Fixed	Variable
Preharvest Machinery ^{1/}	\$23.20	\$21.20	\$23.20	\$21.20	\$23.20	\$21.20
Seed, Chemical, etc.	Units		Units		Units	
Seed @\$3.22 per 1000 kernel	28,750	\$92.58	34,500	\$111.09	40,250	\$129.61
Nitrogen @\$0.34 per pound	150	51.00	150	51.00	150	51.00
Phosphate @\$0.34 per pound	74	25.16	84	28.56	91	30.94
Potash @\$0.31 per pound	168	52.08	192	59.52	208	64.48
Lime (yearly cost)		12.49		12.49		12.49
Herbicide		31.85		31.85		31.85
Insecticide		23.79		23.79		23.79
Crop insurance		8.70		9.70		10.50
Miscellaneous		9.00		10.00		11.00
Interest on preharvest variable costs (8 months @5.8%)		12.68		13.89		14.96
Total		\$319.33		\$351.89		\$380.62
Harvest Machinery						
Silage harvester	\$49.20	\$31.20	\$49.20	\$31.20	\$49.20	\$31.20
Haul	27.93	26.88	31.92	30.72	34.58	33.28
Store silage (unloader)	8.82	2.73	10.08	3.12	10.92	3.38
Total	\$85.95	\$60.81	\$91.20	\$65.04	\$94.70	\$67.86
Labor						
4.95 hours @ \$14.75	\$73.01		\$73.01		\$73.01	
Land						
Cash rent equivalent	\$183.00		\$219.00		\$255.00	
Total fixed, variable						
Per acre	\$365.16	\$401.34	\$406.41	\$438.13	\$445.91	\$469.68
Per ton	\$17.39	\$19.11	\$16.93	\$18.26	\$17.15	\$18.06
Total cost per acre	\$766.50		\$844.54		\$915.59	
Total cost per ton	\$36.50		\$35.19		\$35.22	

^{1/} Chisel plow, tandem disk, apply Nitrogen, field cultivate, plant, and spray. See the Estimated Machinery Costs table.

Herbicide Tolerant Soybean Following Corn

2020

	50 bushels per acre		56 bushels per acre		62 bushels per acre	
	Fixed	Variable	Fixed	Variable	Fixed	Variable
Preharvest Machinery ^{1/}	\$21.10	\$18.80	\$21.10	\$18.80	\$21.10	\$18.80
Seed, Chemical, etc.	Units		Units		Units	
Seed @\$47.40 per 140,000 kernel	140,000	\$47.40	140,000	\$47.40	140,000	\$47.40
Phosphate @\$0.34 per pound	40	13.60	45	15.30	50	17.00
Potash @\$0.31 per pound	75	23.25	84	26.04	93	28.83
Lime (yearly cost)		12.49		12.49		12.49
Herbicide		41.62		41.62		41.62
Crop insurance		7.70		8.70		9.60
Miscellaneous		9.00		10.00		11.00
Interest on preharvest variable costs (8 months @5.8%)		6.72		6.97		7.22
Total		\$161.78		\$168.52		\$175.16
Harvest Machinery						
Combine	\$8.30	\$4.10	\$8.30	\$4.10	\$8.30	\$4.10
Grain cart	6.20	3.00	6.20	3.00	6.20	3.00
Haul	2.15	1.90	2.41	2.13	2.67	2.36
Handle (auger)	0.88	0.98	0.98	1.10	1.09	1.22
Total	\$17.53	\$9.98	\$17.89	\$10.33	\$18.25	\$10.67
Labor						
2.20 hours @ \$14.75	\$32.45		\$32.45		\$32.45	
Land						
Cash rent equivalent	\$183.00		\$219.00		\$255.00	
Total fixed, variable						
Per acre	\$254.08	\$190.56	\$290.44	\$197.65	\$326.80	\$204.63
Per bushel	\$5.08	\$3.81	\$5.19	\$3.53	\$5.27	\$3.30
Total cost per acre	\$444.64		\$488.09		\$531.43	
Total cost per bushel	\$8.89		\$8.72		\$8.57	

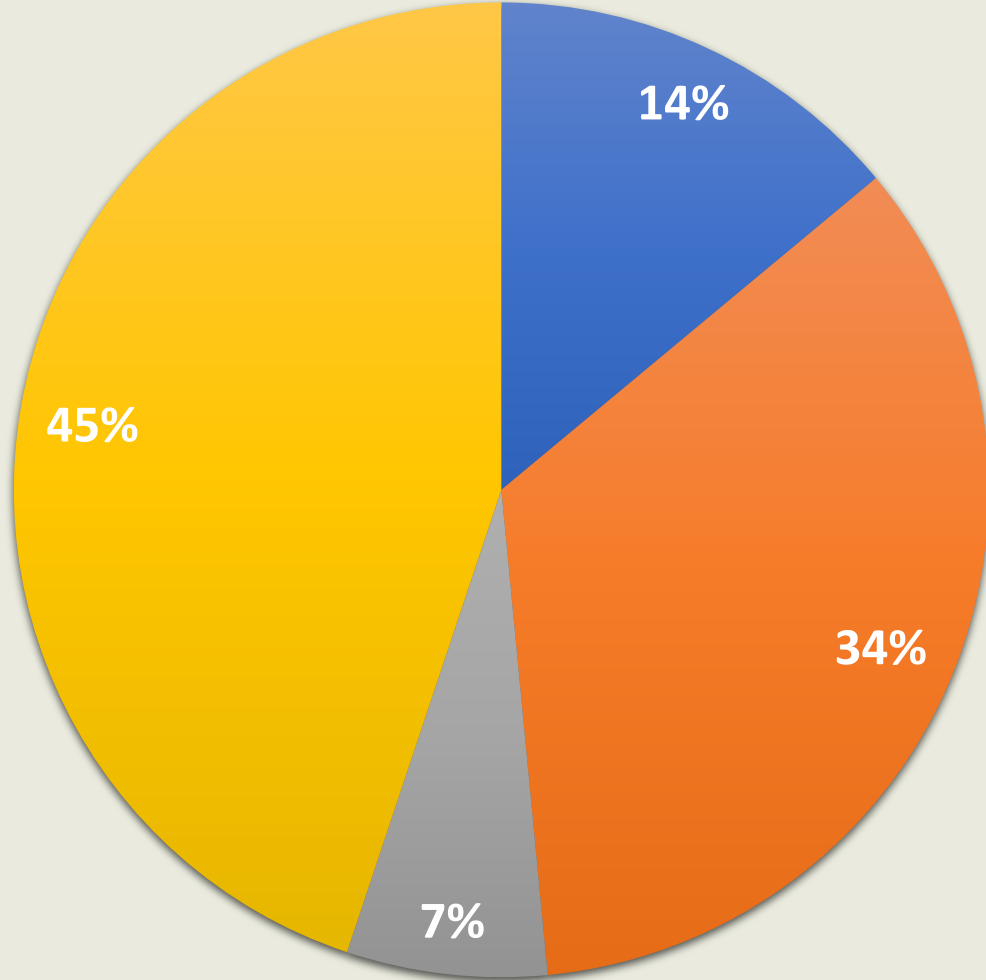
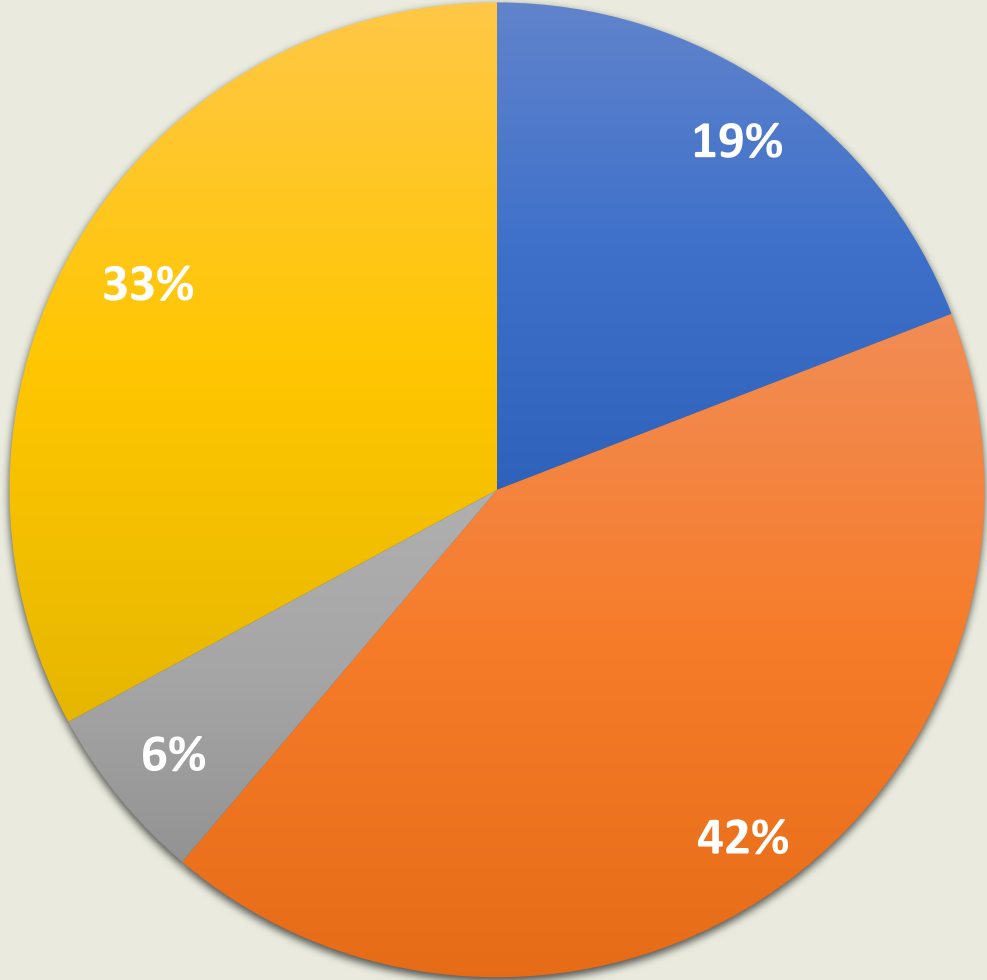
^{1/} Chisel plow, tandem disk, field cultivate, plant, and two sprays. See the Estimated Machinery Costs table.

^{2/} Estimates do not include any insecticide or fungicide costs.

Corn \$655/ac

2020

Soybean \$488/ac



■ Machinery ■ Inputs ■ Labor ■ Land
Average of corn following corn and corn following soybeans medium yield case

■ Machinery ■ Inputs ■ Labor ■ Land
Medium yield case

Costs by Acres Planted (2020)

Acres	Total Costs		Machinery and Inputs		Land and Labor	
	Corn	Soybean	Corn	Soybean	Corn	Soybean
100	\$66,542	\$48,809	\$40,697	\$23,663	\$25,846	\$25,145
250	\$166,355	\$122,023	\$101,743	\$59,158	\$64,614	\$62,863
500	\$332,710	\$244,045	\$203,485	\$118,315	\$129,228	\$125,725
750	\$499,065	\$366,068	\$305,228	\$177,473	\$193,841	\$188,588
1,000	\$665,420	\$488,090	\$406,970	\$236,630	\$258,455	\$251,450
1,500	\$998,130	\$732,135	\$610,455	\$354,945	\$387,683	\$377,175
2,000	\$1,330,840	\$976,180	\$813,940	\$473,260	\$516,910	\$502,900

- Corn: average of corn following corn & corn following soybeans medium yield
- Soybeans: medium yield case

AgFA Based Dairy Enterprise Budgets

2015-2017 Per Cow Average of Three Herd Size Ranges

100-200, 200-500, 500-1,000 Cows

(One cow unit = 85% lactating, 15% dry)

PRICE AND PRODUCTION CHARACTERISTICS	100-200	200-500	500-1,000
Annual Production, lbs per Cow	22,506	25,902	26,701
Herd size (lactating + dry) ¹	134	329	656

VARIABLE COSTS (VC)			
Feed ³	1,940	1,960	1,980
Labor	713	962	696
Breeding	69	92	65
Car, truck, and freight expenses			
Veterinary & medicine	118	159	144
Milk Testing & Registration			
Livestock supplies	283	419	541
Fuel and Oil			
Bedding			
Repairs			
Marketing & hauling, user entry	81	93	107
Utilities			
Replacement heifers ⁴	308	360	416
Custom hire			
Rent/Lease			
Agronomic (chemical, fertilizer, seed)			
Other			
Other			
Other			
Operating interest ⁵ , interest rate	5.50%	94	109
TOTAL VC	3,606	4,153	4,054

Source: <https://cdp.wisc.edu/category/dt/dt-financial/>

FIXED COSTS (FC)	lbs/cow	22,506	25,902	26,701
	Cows	134	329	656
Depreciation		487	491	425
Interest		121	102	81
Taxes		46	30	27
Insurance		80	62	42
Housing				
Livestock:				
Depreciation		41	71	86
Insurance, percent of repl. heifer & cull cow price	0.00%	-	-	-
Interest, percent of repl. heifer & cull cow price	0.00%	-	-	-
Hired labor that is salaried/fixed charge ⁷				
Management charge	0.00%	-	-	-
Other				
Other				
TOTAL FC		775	756	661
TOTAL COSTS OF PRODUCTION Per Cow Unit		4,381	4,909	4,715

COSTS OF PRODUCTION PER CWT			
VC before labor and operating interest		12.44	11.90
Total Variable Costs (TVC)		16.02	16.03
Total Cash Costs: (TVC + Cash Fixed Costs)		17.12	16.78
Total Costs: (Total Cash Costs + Depreciation)		19.47	18.95
Total Costs + Management Charge		19.47	18.95

Feed Cost	\$8.62/cwt	\$7.57/cwt	\$7.42/cwt
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\$18.95/cwt x 259 cwt/cow = \$4,908/cow

Costs by Herd Size (WI 2015-2017)

Herd Size	Cost per Cow	Total Cost	Herd Size	Cost per Cow	Total Cost
100	\$4,381	\$438,100	600	\$4,715	\$2,829,000
150	\$4,381	\$657,150	700	\$4,715	\$3,300,500
200	\$4,381	\$876,200	800	\$4,715	\$3,772,000
250	\$4,909	\$1,227,250	900	\$4,715	\$4,243,500
300	\$4,909	\$1,472,700	1,000	\$4,715	\$4,715,000
350	\$4,909	\$1,718,150	1,250	\$4,715	\$5,893,750
400	\$4,909	\$1,963,600	1,500	\$4,715	\$7,072,500
450	\$4,909	\$2,209,050	1,750	\$4,715	\$8,251,250
500	\$4,909	\$2,454,500	2,000	\$4,715	\$9,430,000

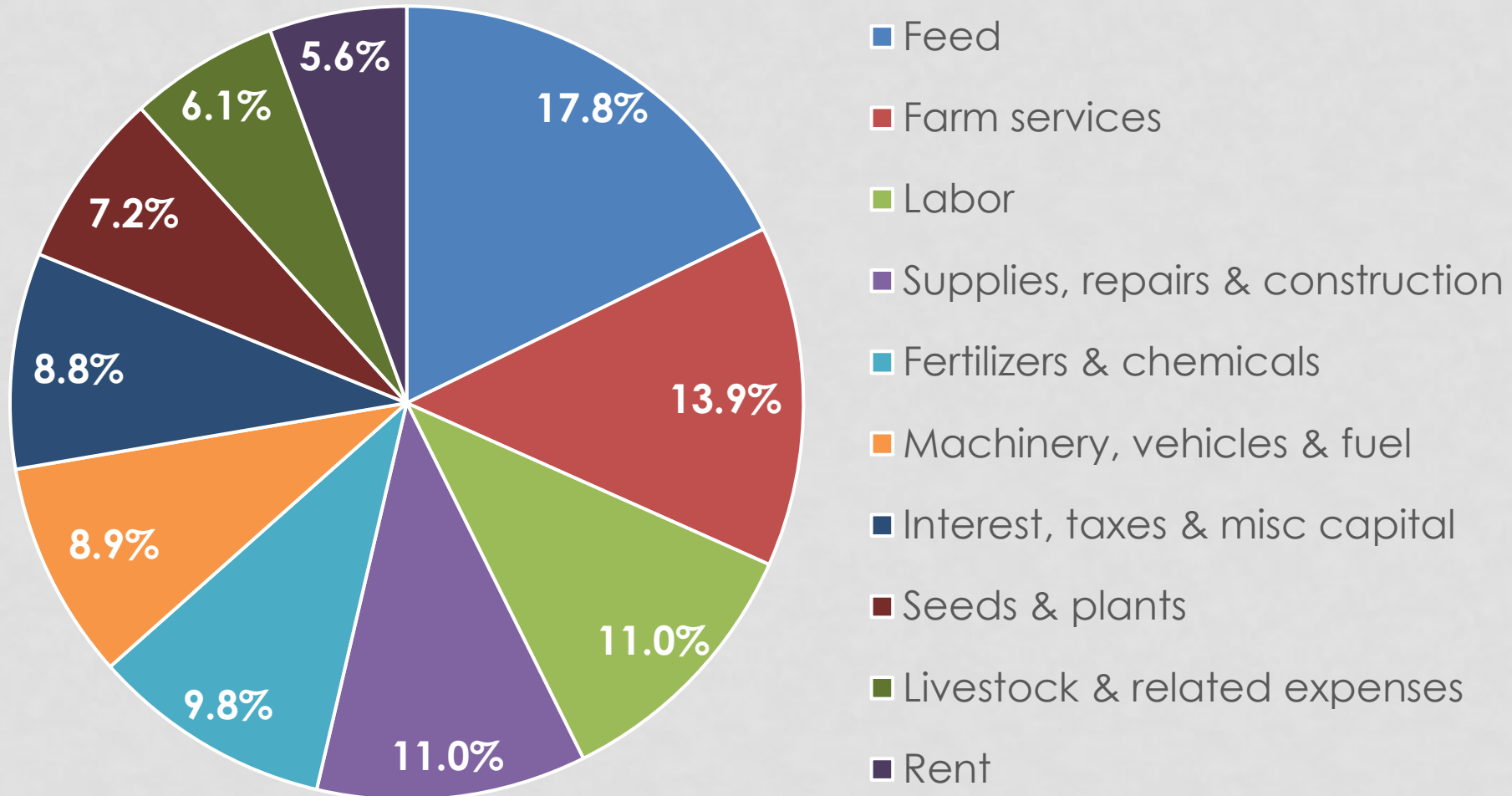
Milk Cost of Production (\$/cwt) **2014-2016**

Herd Size	AgFA (UW)	FINBIN (U of MN)
< 50	\$18.30	\$21.46
50 to 99	\$17.62	\$18.58
100 to 199	\$17.56	\$18.12
200 to 499	\$17.40	\$18.09
500 to 999	\$16.67	
> 500		\$17.94
All Data	\$17.58	\$18.36

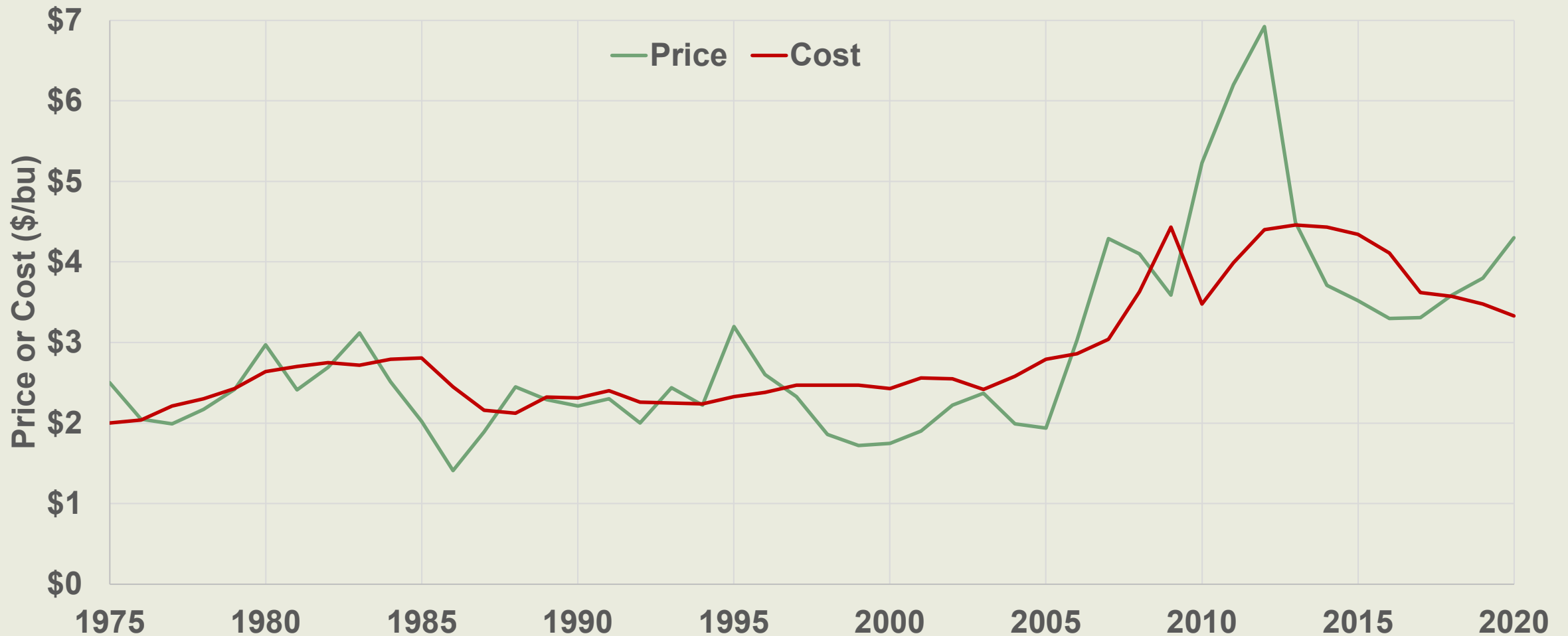
WI Farm Production Expenditures in 2018 by Major Category

US Farms: \$358 Billion in 2019

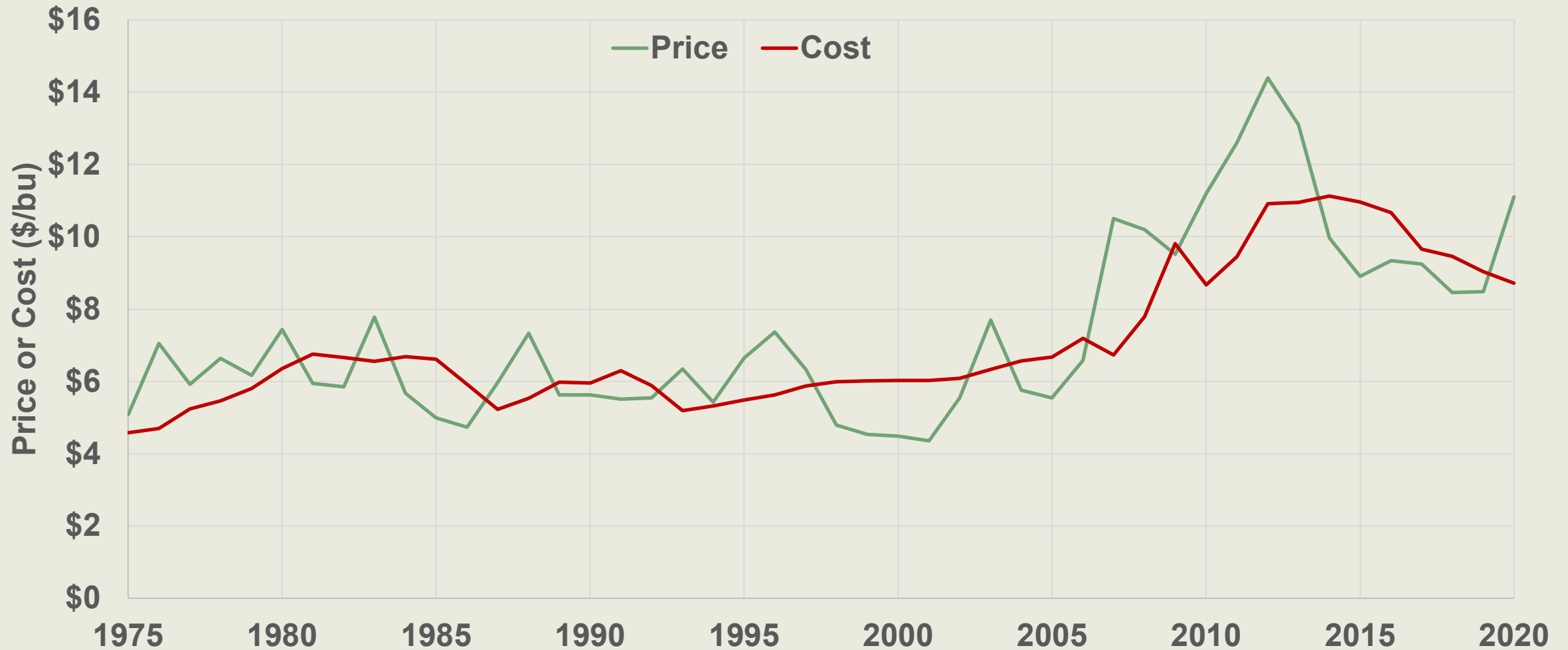
\$10 Billion in 2018, >\$155,000/farm



Historical Prices and Costs for Iowa Corn



Historical Prices and Costs for Iowa Soybeans



Historical Margins for Iowa Corn and Soybeans

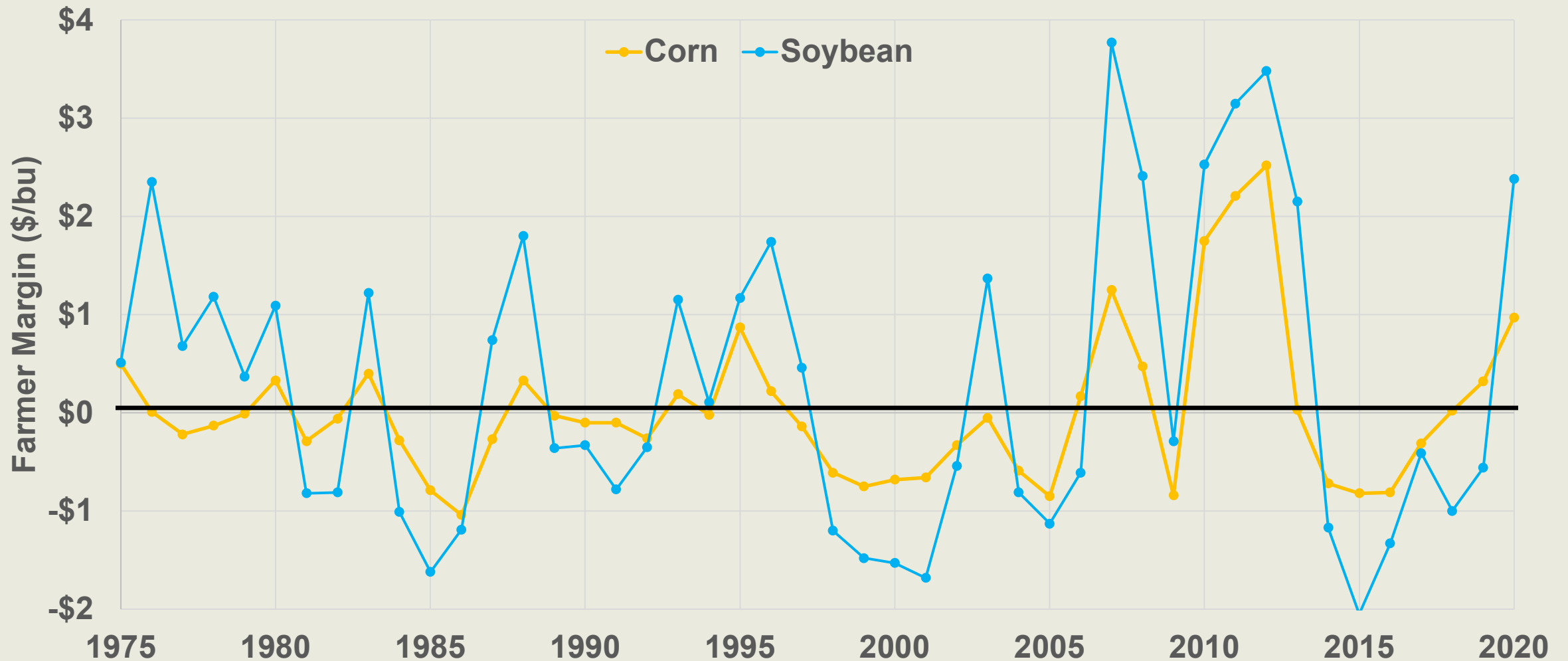
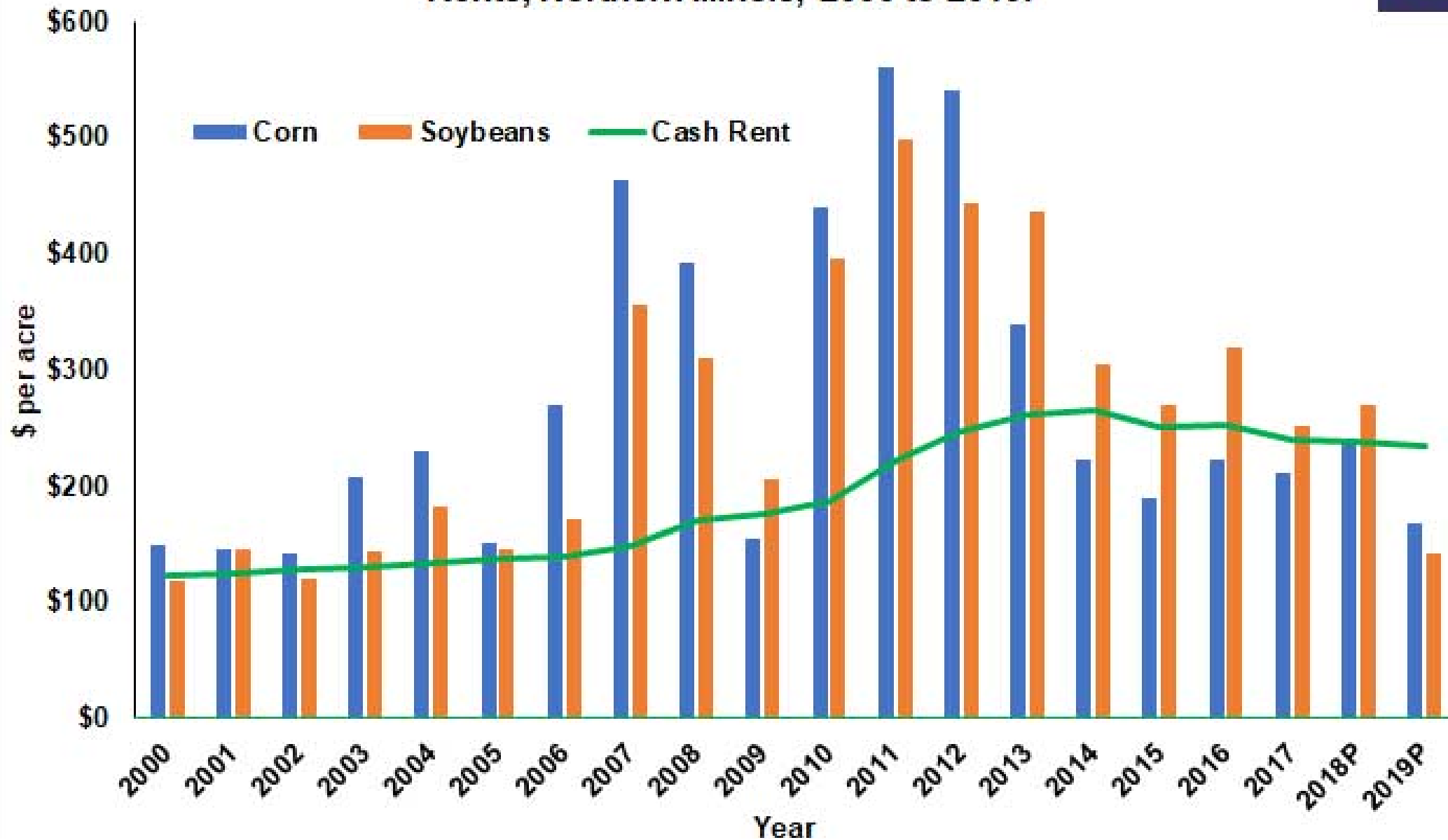
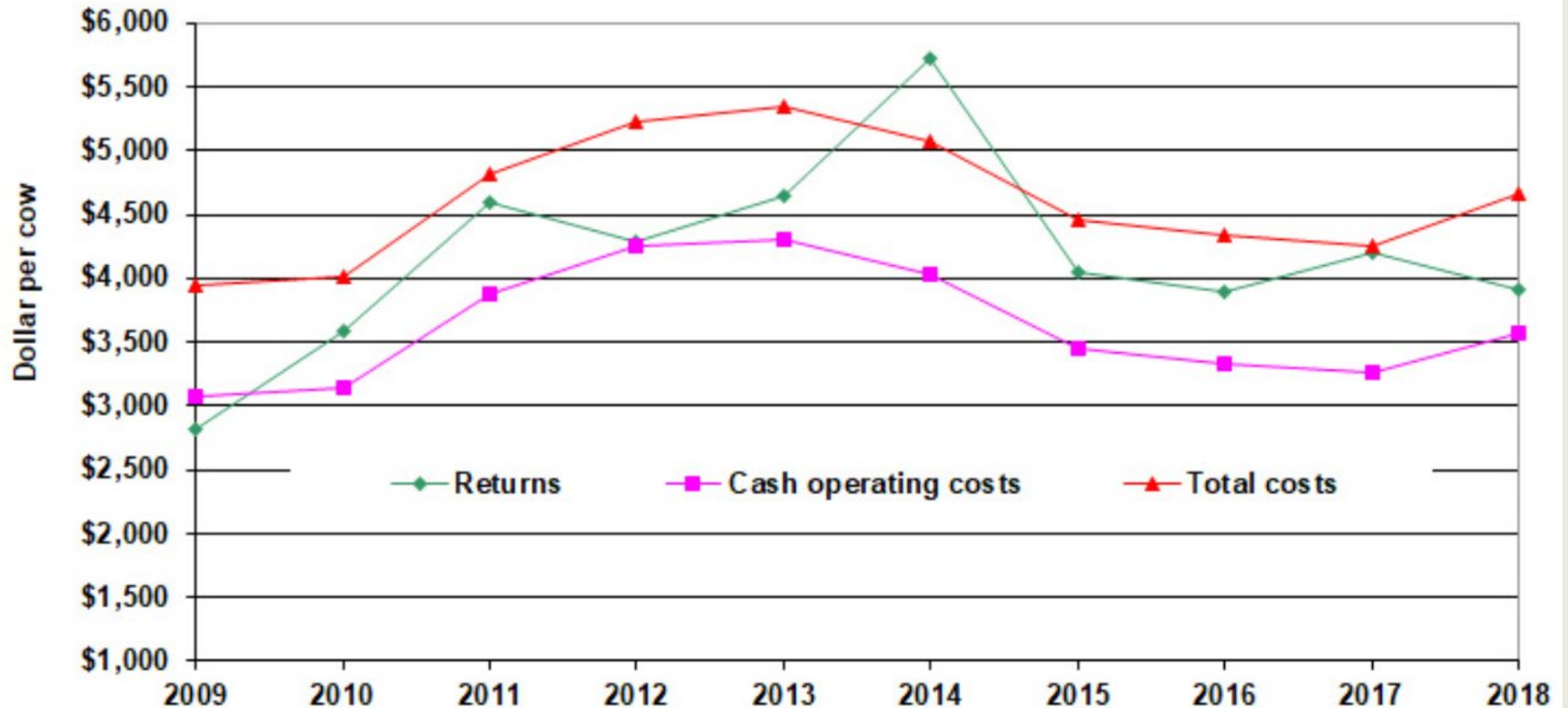


Figure 1. Operator and Land Return for Corn and Soybeans, and Cash Rents, Northern Illinois, 2000 to 2019P



<https://farmdocdaily.illinois.edu/2018/09/2019-crop-budgets-suggest-dismal-corn-and-soybean-returns.html>

Figure 1. Returns and Costs to Produce Milk, 2009 to 2018
Interest, depreciation, and labor charges are included in total costs only.



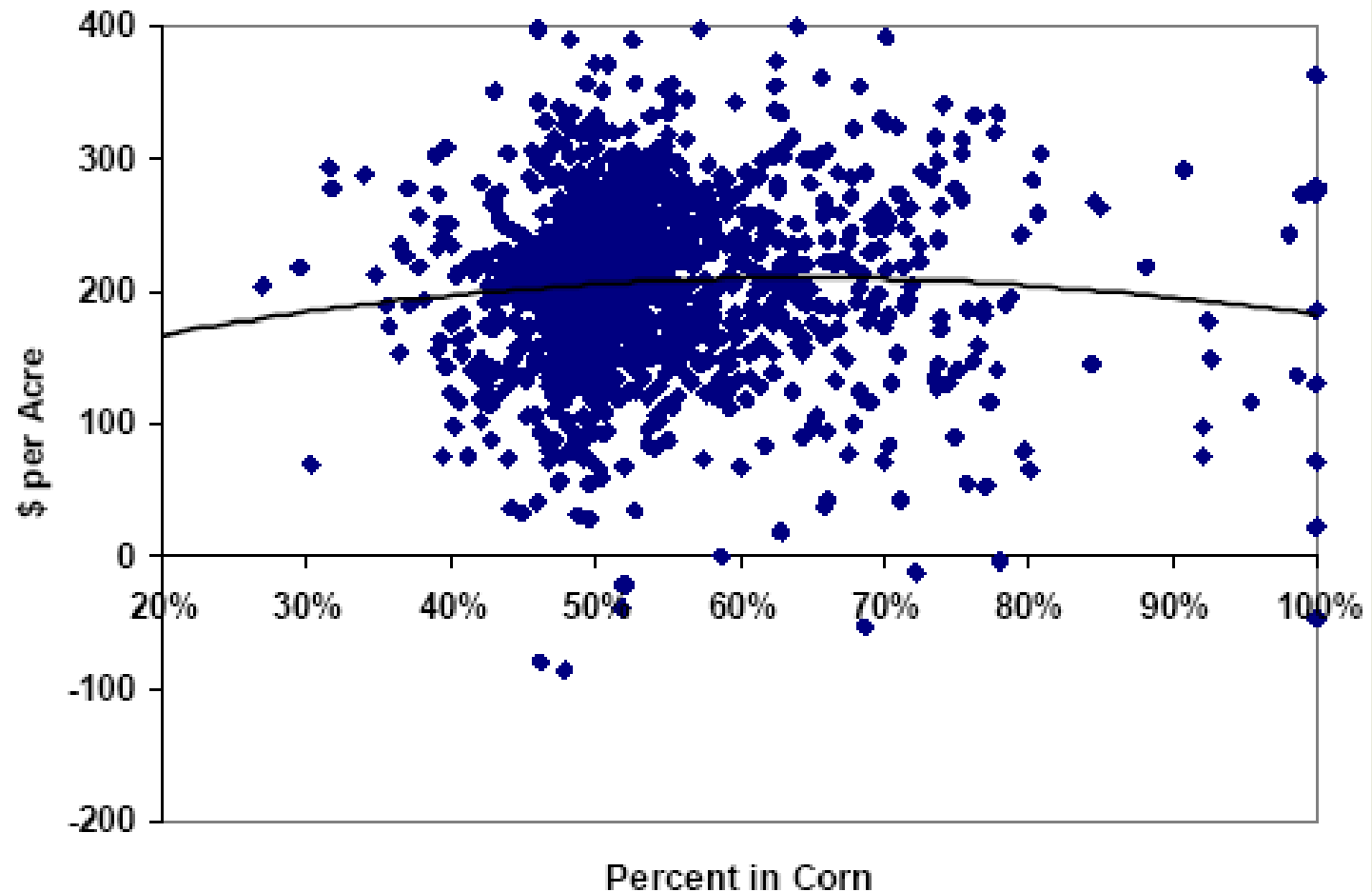
Main Point

- Farms commonly go through periods when prices are below their cost and times when their prices are above their cost
 - Sometimes these periods can be quite long
- These price & cost estimates are averages, not what every farmer gets, lots of variability exists
- These are the “Full” cost of production, including non-cash and opportunity costs for land, management and labor
 - What does it mean to not cover all of your non-cash costs?
 - What does it mean to not cover all of your opportunity costs?
- These cycles often counterbalance each other, but sometimes they coincide to create lots of farm stress and even a farm crisis
- Regardless: All farms will deal with times of financial stress & crisis

Why farmers need to estimate their own cost of production

- Cost estimates per bu or per acre are averages, not what every farm experiences
- Tremendous variability exists among farms and farmers
- Mike Duffy's Rule of Thirds
- Mark Stephenson's 20% Observation

Operator and Land Return by Percent of Land in Corn, 2006



Gary Schnitkey "Crop Production Cost and Rotation Decisions"

<http://www.farmdoc.illinois.edu/presentations/2007%20items/ifes2007/Farm%20Economic%20Summit%20-%20Schnitkey.pdf>

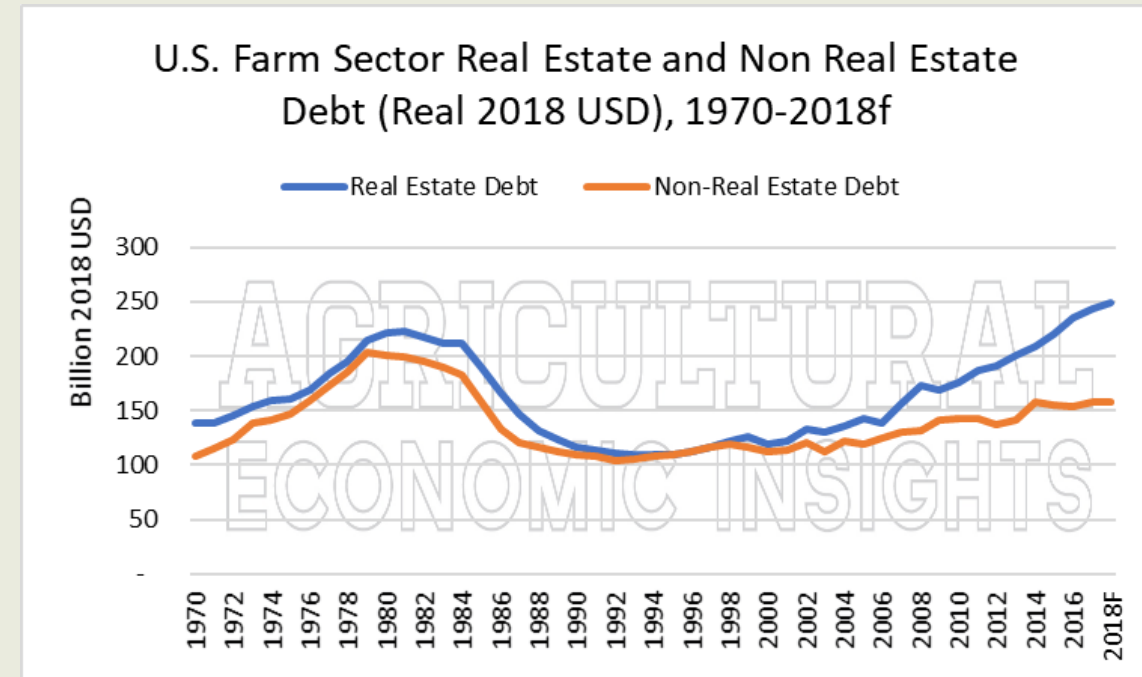
Farmer Tactics

Know your Cost of Production

- Optimize variable input costs: fertilizer, herbicide, seed, ...
- Outsource activities that others can do at lower cost (partial budget analysis)
- Sell machinery, keep older machinery, share machinery, do custom work
- Use yield monitors to find unprofitable parts of fields and stop farming them
- Switch to crops with lower cost per acre to plant: soybean, wheat, hay or forage, so you need a smaller operating loan
- Negotiate lower land rents, or shift to flex leases
- Develop a Marketing Plan
 - Lots of online resources, Extension, marketing clubs, hire a service
 - Goal is to get higher prices than you would normally be getting

Farmer Tactics

- Accept below normal returns to survive for future profits
 - Can you add to your off-farm income to cover family expenses?
 - Will the bank let you “eat your equity” to survive?
 - Refinance operating loan or rolling line of credit back into the farm mortgage
- Use yield monitors to find unprofitable parts of fields and stop farming them
 - Need to know your cost of production
- UW Extension (2017): Grain Crops Management in Low-Margin Years
 - <http://ipcm.wisc.edu/blog/2017/03/videos-grain-crops-management-in-low-margin-years/>
 - https://fyi.uwex.edu/fieldcroppathology/files/2017/01/TeamGrainsFactSheet_FINAL_2.pdf



Long-Term Reality of Farming

- The number of farms in the US has been declining since 1935, average farm size and herd size has been increasing
- Farms face continuous pressure from consolidated input suppliers and output buyers on either side of them in the supply chain
- Cochrane's Treadmill, technology adoption and cost efficiency [covered later]
- Inelasticities allow them to make money in good times (but endure low returns in bad times), but on average earn a normal return [covered later]
- Land & managerial ability are essential assets that allow them to make money
- Agriculture like many businesses values relationships: If you work with farmers, be aware of their financial ups and downs and be ready to work with them in hard times, and they will often remember you in the good times

Summary: Learning Goals

- Understand the major cost categories and the financial scale of farm production based on available cost of production budgets
 - Farmers spend a lot of money, sell a lot of production
- Farmers go through time periods, sometimes long time periods, when prices are below their cost of production
 - All farms will deal with times of financial stress & crisis
- Explored some management options for farmers when facing thin or negative margins
 - Cost of production, optimizing inputs, partial budget analysis, marketing, farm finance