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## Impacts of Rising Crude Oil Prices on Corn and Soybean Production Costs

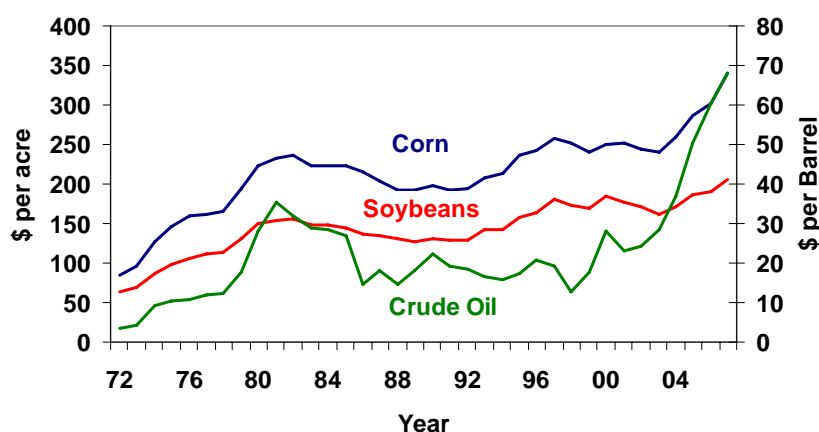
Crude oil prices, corn production costs, and soybean production costs have tended to move together over time. Recently, for example, crude oil prices and production costs have increased dramatically. Between 2003 and 2007, crude oil prices increased by \$39 per barrel (a 138 percent increase), corn production costs in central Illinois on high-productivity farmland increased by \$100 per acre (a 42 percent increase), and soybean costs increased by \$45 per acre (a 28 percent increase). In this paper, data from 1972 through 2007 are used to quantify how crude oil prices and general inflation rates impact corn and soybean production costs.

Between 1972 through 2007, results indicate that each \$1 increase in crude oil price increases corn production costs by \$1.51 per acre and increases soybean production costs by \$.90 per acre. Between 2003 and 2007, crude oil price increases accounted for 58 percent of corn cost increases and 79 percent of soybean cost increases. From 1972 through 2007, inflation accounted for an average yearly increase in production costs of \$3.78 per acre for corn and \$4.26 per acre for soybeans. Due to crude oil price increases, corn costs in 2008 are expected to be \$48 higher than in 2007 and soybeans are expected to increase by \$29 per acre.

### Crude Oil Prices and Production Costs

Figure 1 shows crude oil prices, corn costs, and soybean costs from 1972 through 2007 (see Appendix Table 1 for the data). Crude oil prices were obtained from the Energy Information Administration, an agency of the U.S. Department of Energy. The price reported here is the “composite acquisition cost” to refiners for purchases of crude oil. Corn and soybean costs come from Illinois Farm Business Farm Management (FBFM) for central Illinois grain farms having high quality farmland. Costs represent non-land financial costs. Costs do not include land costs or opportunity charges for unpaid labor or equity capital.

Figure 1. Non-land Financial Costs for Corn and Soybeans in Central Illinois and Crude Oil Prices (Nominal \$).



Crude oil prices and production costs tend to move together. From 1972 through 1982, crude oil price increased from \$3.58 per barrel up to \$35.87 per barrel. During this same period, corn costs increased by \$138 per acre and soybeans costs increased by \$84 per acre. From 1982 through 1986, crude oil prices decreased from \$31.87 to \$14.55 per barrel. During this same period, corn costs decreased by \$44 per acre and soybean costs decreased by \$26 per acre. From 1986 through 2002, crude oil prices varied but did not exhibit an upward or downward trend. During this period, corn and soybean costs increased slightly. Corn costs were \$30 per acre higher in 2002 than in 1986 while soybean costs were \$35 per acre higher. Between 2003 and 2007, crude oil increased from \$28.52 per barrel up to \$67.93 per barrel. During this period, corn costs increased by \$100 per acre and soybean costs increased by \$45 per acre.

Figure 1 illustrates that crude oil prices and production costs are highly correlated. The correlation coefficient between corn costs and crude oil prices is .82 (see Table 1). The correlation coefficient between soybean costs and crude oil prices is .75.

Production costs also are highly correlated with inflation rates. The correlation coefficient between the consumer price index (excluding food and energy costs) and corn costs is .84, higher than the correlation coefficient between crude oil prices and corn costs (see Table 1). The correlation coefficient between the consumer price index (CPI) and soybean costs is .86, again higher than the correlation coefficient between crude oil prices and soybean costs. Because of these high correlations, inflation rates should be considered when linking crude oil prices to production costs. Not doing so could lead to misstatements concerning the impacts that crude oil prices has on production costs.

**Table 1. Correlation Coefficients between Corn and Soybean Costs, Crude Oil Prices, and Consumer Price Index (without Food or Energy), 1972 - 2007.**

Per Acre Cost Item <sup>1</sup>	Crude Oil Price <sup>1</sup>	CPI <sup>1</sup>
Corn	0.82	0.84
Soybeans	0.75	0.86

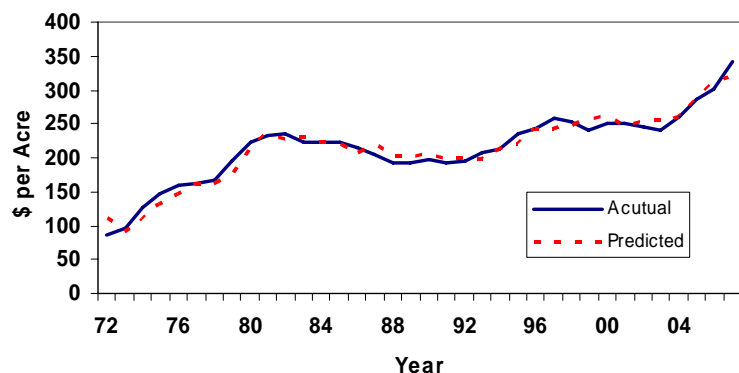
<sup>1</sup> See Appendix Table 1 for data.

### Crude Oil and Inflation Impacts on Production Costs

Production costs for corn and soybeans were mathematically related to two factors: crude oil prices and the CPI. Linear regressions were first used to quantify the relationships. Differences between actual values and predicted values from the model were positively related across time. This means that if a predicted value was below the actual value in one period the predicted value was more likely to be below the actual value in the next time period. Conversely, a predicted value above the actual value in one period was more likely to lead to a predicted value above the actual value in the next time period. Hence, linear models allowing autoregressive structure in errors were used to estimate the relationships (see Appendix Table 2 for regression results).

Predictions from the model fit actual data well (see Figure 2). Predictions from the model explained 96 percent of the variability in corn costs. For soybeans, the model explained 96 percent of the soybean cost variability.

**Figure 2. Actual Costs Versus Predicted Non-land Costs for Corn, 1972 through 2007.**



Over the 1972 through 2007 time period, a \$1 increase in crude oil price resulted in a \$1.51 increase in per acre corn costs. For soybeans, a \$1 increase in crude oil price resulted in a \$.90 increase in per acre costs.

The average increase in the CPI from 1972 through 2007 was 4.6 percent. On average, inflation caused a \$3.78 per acre increase in production costs for corn per year and a \$4.26 increase in soybean costs per year. Cost increases due to inflation were the highest from 1979 through 1982, a period of high inflation. Between 2003 and 2007, inflation rates without food or energy have been near average. As a result, corn and soybean cost increases due to inflation are near average.

### **Cost Increases between 2003 and 2007**

Between 2003 and 2007, corn costs increased by \$100 per acre. Model results indicate that \$59 of the corn cost increase is associated with crude oil price increases ( $\$59 = \$39 \text{ crude oil price increase} \times \$1.51 \text{ cost increase per } \$1 \text{ crude oil price increase}$ ). Model results suggest that inflation accounts for \$14 of the corn increase. On a percentage basis, crude oil increases account for 59 percent of the cost increase and inflation accounts for 14 percent of the cost increase.

Between 2003 and 2007, soybean costs increased by \$45 per acre. Model results indicate that \$39 of the cost increase is associated with crude oil price increases. Inflation accounts for \$8 of the cost increase. On a percent basis, crude oil price increases account for 78 percent of the increase in soybean costs while inflation accounts for 18 percent of the increase.

### **Future Changes in Crude Oil Prices**

Model results can be used to predict corn and soybean costs based on anticipated crude oil prices. Forecasts of costs should be viewed with caution as oil prices are outside the range of prices used to estimate the model. Often, poor forecasting experience occurs in these cases. Given this caution, model results suggest the following.

The first acquisition price for crude oil in 2007 was \$68 per barrel. Currently, crude oil prices are over \$100 per barrel. Model results suggest these oil price increases will result in significantly higher corn and soybean cost increases in 2008. For example, a \$100 crude oil price would imply that corn costs in 2008 will be \$48 higher than in 2007 due to oil price increase. Soybean costs are projected to be \$29 per acre higher in 2008 than in 2007.

Large increases in crude oil prices could lead to significantly higher corn and soybean costs. For example, a \$120 crude oil price implies a \$78 increase in corn costs, a 23 percent increase over 2007 corn costs. Soybean costs would increase by \$47 per acre given the \$120 crude oil price, a 23 percent increase over the 2007 soybean cost. A \$150 crude oil price results in a \$124 corn cost increase (36% over 2007 levels) and a \$74 soybean cost increase (36% over 2007 levels).

### **Summary**

The majority of corn and soybean production costs increases occurring between 2003 through 2007 can be attributed to crude oil price increases. If crude oil prices continue to rise, production costs for corn and soybeans likely will continue to rise.

Rising energy costs have brought into existence an era of higher production costs for corn and soybeans. These higher costs necessitate higher corn and soybean prices for farmers to be profitable.

## Acknowledgments

Data used in this study comes from the local Farm Business Farm Management (FBFM) Associations across the State of Illinois. Without their cooperation, information as comprehensive and accurate as this would not be available for educational purposes. FBFM, which consists of 6,000 plus farmers and 60 professional field staff, is a not-for-profit organization available to all farm operators in Illinois. FBFM field staff provides on-farm counsel with computerized recordkeeping, farm financial management, business entity planning and income tax management. For more information, please contact the State FBFM Office located at the University of Illinois Department of Agricultural and Consumer Economics at 217-333-5511 or visit the FBFM website at [www.fbfm.org](http://www.fbfm.org).

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Anuj Gupta is a former undergraduate student in the Department of Agricultural and Consumer Economics. Work on an independent project contributed to this paper.

**Appendix Table 1. Corn and Soybean Costs, Crude Oil Prices and the Consumer Price Index, 1972 - 2007.**

Year	Non-Land Financial Costs		Crude Oil Price	CPI
	Corn	Soybeans		
	\$ per Acre		\$ per Barrel	Index
1972	85	64	3.58	44.0
1973	96	69	4.15	45.6
1974	127	87	9.07	49.4
1975	146	98	10.38	53.9
1976	160	105	10.89	57.4
1977	162	111	11.96	61.0
1978	166	113	12.46	65.5
1979	195	130	17.72	71.9
1980	224	150	28.07	80.8
1981	233	154	35.24	89.2
1982	236	156	31.87	95.8
1983	223	148	28.99	99.6
1984	224	148	28.63	104.6
1985	224	145	26.75	109.1
1986	215	137	14.55	113.5
1987	204	134	17.90	118.2
1988	192	130	14.67	123.4
1989	192	127	17.97	129.0
1990	198	131	22.22	135.5
1991	193	129	19.06	142.1
1992	194	128	18.43	147.3
1993	208	142	16.41	152.2
1994	213	142	15.59	156.5
1995	236	158	17.23	161.2
1996	243	164	20.71	165.6
1997	258	180	19.04	169.5
1998	252	173	12.52	173.4
1999	241	169	17.51	177.0
2000	250	184	28.26	181.3
2001	251	176	22.95	186.1
2002	245	172	24.10	190.5
2003	241	161	28.53	193.2
2004	260	171	36.98	196.6
2005	287	187	50.24	200.9
2006	302	190	60.24	205.9
2007	341	206	67.93	210.7

<sup>1</sup> Costs are non-land financial costs for grain farms with high-productivity farmland who are enrolled in Illinois Farm Business Farm Management (FBFM).

<sup>2</sup> Crude oil price for acquisition costs by refiners in \$ per barrel as reported by the Energy Information Agency at [http://tonto.eia.doe.gov/dnav/pet/pet\\_pri\\_rac2\\_dcu\\_nus\\_a.htm](http://tonto.eia.doe.gov/dnav/pet/pet_pri_rac2_dcu_nus_a.htm).

<sup>3</sup> Consumer price index without food or energy items as reported by the Bureau of Labor Statistics, U.S. Department of Labor at [www.bls.gov/cpi](http://www.bls.gov/cpi).

**Appendix Table 2. Regression Results Relating Non-Land Financial Costs for Corn and Soybeans to Crude Oil and the Consumer Price Index, 1972 - 2007.**

Independent variable	Per Acre Costs <sup>1</sup>	
	Corn	Soybeans
Intercept	72.065 * (25.130)	57.634 * (17.220)
Crude oil prices <sup>2</sup>	1.511 * (0.349)	0.896 * (0.232)
CPI (without food or energy) <sup>3</sup>	0.794 * (0.198)	0.466 * (0.135)
Rho <sup>4</sup>	0.863 * (0.007)	0.870 * (0.082)
Adjusted r-square	0.955	0.951
Standard error of estimate	11.063	7.340

<sup>1</sup> Per acre costs are for Central Illinois farms with high-productivity farmland enrolled in Illinois Farm Business Farm Management. Costs are all non-land financial costs

<sup>2</sup> Crude oil price for acquisition costs by refiners in \$ per barrel as reported by the Energy Information Agency at [http://tonto.eia.doe.gov/dnav/pet/pet\\_pri\\_rac2\\_dcu\\_nus\\_a.htm](http://tonto.eia.doe.gov/dnav/pet/pet_pri_rac2_dcu_nus_a.htm).

<sup>3</sup> Consumer price index without food and energy items as reported by the Bureau of Labor Statistics, U.S. Department of Labor at [www.bls.gov/cpi](http://www.bls.gov/cpi).

<sup>4</sup> Rho captures autoregressive dependence in errors.

\* indicate significant at the 1 percent test level.