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Recent Changes in Crop Production Costs and Implications for Regional Competitiveness

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ABSTRACT: Rapid increases in input prices have cast a large shadow over the enthusiasm created by higher product prices. In this paper we forecast the trends in input prices and use these trends to forecast production costs for corn, soybeans, and wheat at the national level, and for regions within the U.S. Although the Heartland is forecast to maintain its competitive edge in corn costs, the Northern Great Plains and Prairie Gateway regions are forecast to increase their competitive advantage due to using less fertilizer and chemicals on average which results in relative costs decreasing for these regions. For soybeans, the Heartland is forecast to maintain its competitive edge although the Eastern Uplands region was forecast to increase its competitive advantage due to using less fertilizer and chemicals. With wheat, the Prairie Gateway region was forecast to have the best improvement in relative costs, while the Northern Great Plains loses some competitive edge. However, since individual farms have different costs due to physical conditions and timing of input purchases, and crop prices are fluctuating, actual profit levels are hard to predict.

Rapid increases in input prices have cast a large shadow over the enthusiasm created by higher product prices. These patterns gave rise to high hopes of great profits and, at the same time, grave worries of profit robbing costs.

As anyone involved in agriculture is well aware, the largest price increases have occurred with fertilizer and fuel (Table 1). Seed costs have also increased but not to the extent that fertilizer and fuel prices have increased. According to the National Agricultural Statistics Service (NASS), fertilizer prices for the first half of 2008 have increased 73% from the annual average for 2007. Most of that increase, 68%, has occurred from December 2007. Fuel prices for 2008 have increased 60% from 2007 and 39% from December 2007. Seed prices have increased about a third and farm machinery prices have increased just over 10%. Overall, NASS' index for all production items, interest, taxes, and wage rates increased 20% in the first half of 2008 compared to the 2007 annual average. Compared to recent NASS data, prices for fertilizer have increased while fuel prices have decreased. Anecdotal information points to high uncertainty about future fertilizer prices.

Total production costs consist of operating and overhead costs. Operating costs include seed, fertilizer, herbicides, fuel, direct labor, supplies, and similar inputs that are used up within one production cycle. Overhead costs include such items as rent, machinery, maintenance, farm services, overhead interest, taxes, and overhead labor. It is note-worthy that overhead costs vary from about 50% of total production costs for corn to about 60% for wheat and are around 65% for soybeans. Over the last few years, these costs have grown slowly and are not the ones that have been greatly impacted by the recent trends in input prices. It is mostly operating costs, which account for less than a half of total operating costs that have been rising sharply.

In this paper we forecast the trends in input prices and use these trends to forecast production costs for corn, soybeans, and wheat at the national level, and for regions within the U.S. We then draw some conclusions on changes in regional competition as input prices change.

Table 1. Indexes of Prices Paid by Farmers, U.S. Average, 1990-92=100

	Annual 2005	Annual 2006	Annual 2007	Estimated average of first 6 months in 2008	% increase from annual 2007 to June 2008	% increase from December 2007 to June 2008
Commodities and services, interest, taxes, and wage rates (PPITW)	142	150	161	179	17	15
Production items	140	148	161	184	23	19
Feed	117	124	149	189	42	27
Livestock and poultry	138	134	131	125	-3	1
Seeds	168	182	205	243	34	30
Fertilizer	164	176	223	322	73	68
Agricultural chemicals	123	128	131	138	8	7
Fuels	216	239	265	358	60	39
Farm supplies and repairs	140	145	150	151	1	1
Autos and trucks	114	112	111	110	-2	-2
Farm machinery	173	182	192	201	11	12
Building material	142	152	155	160	8	8
Farm services	134	140	146	151	4	4
Rent	129	141	151	163	8	8
Interest payable per acre on farm real estate debt	114	139	154	164	6	6
Taxes payable per acre on farm real estate	154	174	188	203	8	8
Wage rates (seasonally adjusted)	165	171	177	185	3	3
Prod. items, interest, taxes & wage rates (PITW)	142	151	163	184	20	17

Data for this table are taken from the publication Agricultural Prices, June 2008.

Forecasting Methods

Since we don't know the future with certainty, we estimated future costs using three different methods of forecasting price indices: trend, conservative, and pessimistic. These price index forecasts were then used to forecast cost increases.

Trend

In this method we used current trends to forecast future input price patterns. We projected the price indices for July through December in 2008 based on the monthly patterns exhibited during the first six months. We then averaged the six observed values and six projections to estimate an annual average for 2008. The forecast for 2009 was based on the growth projection of annual costs from 2005 through 2008. This set of predictions incorporated the recent trends in cost structure, but still anchored them to historical patterns. This method of continuing current trends results in a middle-of-the-road forecast compared to the other two methods. Using the trend method, fertilizer prices, for example, were forecast to almost double by 2009 compared to the 2007 index (Table 2).

Conservative

A more conservative forecast method used average annual increases to forecast the future. As a first step, the annual price index for 2008 was estimated as the average of the values observed over the first six months of 2008. The forecast for 2009 was estimated by using the four-year average annual growth rate to increase the 2008 index for each cost category. The forecast obtained under this method reflects the most conservative prediction of where the production costs may be heading. Using the conservative method, fertilizer prices were forecast to increase by 76% from 2007 to 2009.

Pessimistic

Finally, this forecasting method was the most pessimistic one. We entertained a scenario in which the most recent exuberant cost increases continued into the near future. As in the trend method, we constructed projections of cost patterns for the period of July-December 2008. But, instead of averaging the monthly values to obtain the annual cost

estimate, we took the December 2008 projection to be the "annual" cost index for year 2008. To forecast the most drastic possibility for cost behavior in 2009, we took the 2008 values and grew them at the highest annual growth rate observed since 2005. This forecast was designed to provide the worst case cost scenario. Using the pessimistic method, fertilizer prices were forecast to increase by over seven times from 2007 to 2009.

Table 2. Indexes of Prices Paid by Farmers, U.S. Average, 1990-92=100

		Trend		Conservative		Pessimistic	
	Annual 2007	2008	2009	2008	2009	2008	2009
Commodities and services, interest, taxes, and wage rates (PPITW)	161	190	200	179	193	210	273
Production items	161	200	210	184	200	227	319
Feed	149	205	221	189	218	209	294
Livestock and poultry	131	126	123	125	121	127	124
Seeds	205	292	311	243	273	409	818
Fertilizer	223	411	440	322	392	602	1626
Agricultural chemicals	131	140	144	138	143	139	148
Fuels	265	433	457	358	414	562	1190
Farm supplies and repairs	150	153	158	151	155	156	162
Autos and trucks	111	109	107	110	109	106	105
Farm machinery	192	213	222	201	211	225	263
Building material	155	166	173	160	167	172	192
Farm services	146	152	158	151	156	152	159
Rent	151	163	174	163	176	163	178
Interest payable per acre on farm real estate debt	154	164	184	164	185	164	200
Taxes payable per acre on farm real estate	188	203	220	203	222	203	229
Wage rates (seasonally adjusted)	177	182	188	185	191	177	183
Prod. items, interest, taxes & wage rates (PITW)	163	197	208	184	199	219	294
Data for 2007 are taken from the publication *Agricultural Prices*, USDA, National Agricultural Statistics Service (NASS), June 2008							
Forecasts for 2008 and 2009 are based on NASS data as described in the text							

Changes in Production Costs at the National Level

The trend forecast has an increase of 66% in operating costs and 41% in total production costs per acre for corn at the national level in 2009 compared to 2007 (Table 3, Figure 1). This would increase the estimated cost per bushel of corn from $3.01 in 2007 to $3.91 in 2008 and $4.09 in 2009—a 36% increase. The largest portion of the increase came in fertilizer and fuel costs; seed costs also increased substantially.

The conservative method forecasted an increase of 32% in total production costs per acre for corn in 2009 compared to 2007 resulting in an estimated cost per bushel of $3.83 in 2009. The pessimistic method forecast lives up to its name with a 216% increase in total corn costs in 2009 and an forecast total cost of $9.16 per bushel.

Throughout our analysis we make one crucial assumption: we hold the consumption of production inputs constant through time and do not allow the regions to vary their input consumption in response to changing prices. This implies, for example, that if an average wheat farm spent $80 per acre on fertilizer in 2006, that same average farm will purchase the same physical mix of fertilizer in 2009 but spending $201 per acre in the trend forecast with the value change reflecting only the price increase and not a change in the amount consumed.

Figure 1. U.S. corn production costs per bushel

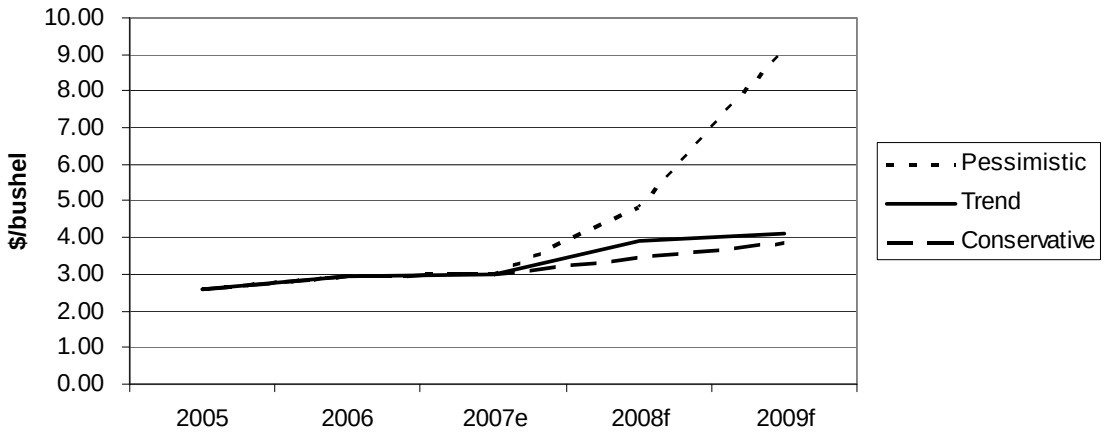

Table 3. U.S. Corn production costs forecast to 2009, $ per planted acre 1/

Forecast method:				Trend		Conservative		Pessimistic	
Item	2005	2006	2007e	2008f	2009f	2008f	2009f	2008f	2009f
Operating costs:									
Seed	40	44	49	70	74	58	65	98	196
Fertilizer 2/	69	80	102	187	201	147	179	274	741
Chemicals	23	24	24	26	27	25	26	26	27
Custom operations 3/	10	11	11	11	12	11	12	11	12
Fuel, lube, and electricity	27	29	32	52	55	43	50	67	143
Repairs	14	14	15	15	16	15	15	16	16
Interest on operating capital	3	5	6	10	12	8	11	14	39
Total, operating costs	186	206	239	372	396	308	358	506	1173
Allocated overhead:									
Hired labor	2	2	2	2	2	2	2	2	2
Opportunity cost of unpaid labor	22	24	24	25	26	25	26	24	25
Capital recovery of mach. and equip.	64	67	70	78	81	74	77	82	96
Opportunity cost of land (rental rate)	93	91	97	105	112	105	113	105	115
Taxes and insurance	7	7	8	8	9	8	9	8	9
General farm overhead	13	13	14	15	16	14	15	16	17
Total, allocated overhead	201	204	216	233	246	229	243	238	265
Total, costs listed	387	410	455	605	642	537	602	744	1438
Yield (bushels per planted acre) 4/	149	138	151	155	157	155	157	155	157
Total cost per bushel	2.60	2.97	3.01	3.90	4.09	3.47	3.83	4.80	9.16

1/ 2005 and 2006 are developed by ERS from survey base year, 2005. 2007 is estimated from NASS cost indices for 2006 and 2007. 2008 and 2009 are forecast using the methods described in text.

2/ Cost of commercial fertilizers, soil conditioners, and manure.

3/ Cost of custom operations, technical services, and commercial drying.

4/ Yields for 2005-2007 are actual yields. Yields for 2008 are estimated using NASS data. Yields for 2009 are the maximum of the 2008 yield adjusted by the average % change from 2005-2008 or the simple averages of 2005-2008.

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For soybeans, the trend forecast has an increase of 46% in operating costs and 26% in total production costs per acre at the national level in 2009 compared to 2007 (Table 4, Figure 2). This would increase the estimated cost per bushel of soybean from $7.16 in 2007 to $8.63 in 2008 and $8.52 in 2009. The decrease in the cost per bushel in 2009 is due to a higher yield which was forecast using the average yield of 2005-2007 yields. The conservative method forecasted an increase of 21% in total production costs per acre for soybeans in 2009 compared to 2007 resulting in an estimated cost per bushel of $8.17 in 2009. The pessimistic method forecast resulted in a 105% increase in total soybean costs per acre in 2009 and a forecast total cost of $13.90 per bushel.

Figure 2. U.S. soybean production costs per bushel

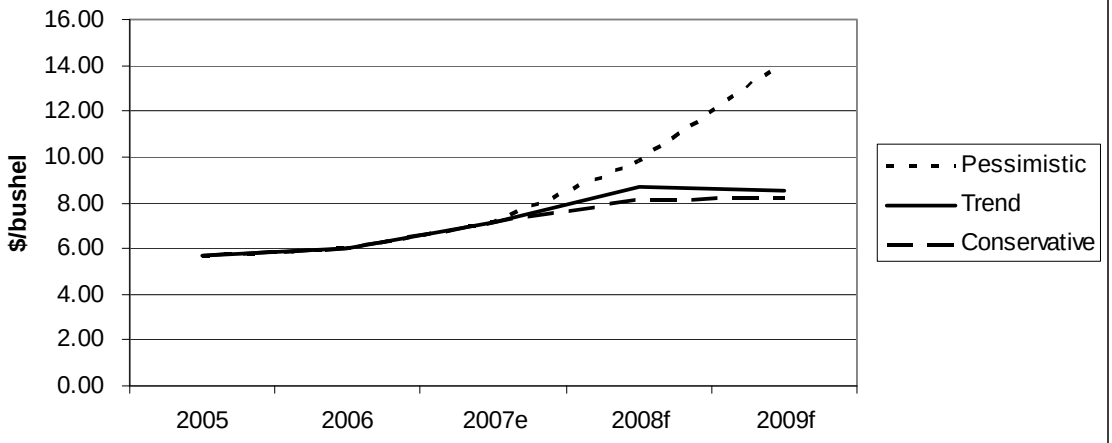


Table 4. U.S. Soybean production costs forecast to 2009, $ per planted acre 1/												
Forecast method:					Trend			Conservative			Pessimistic	
Item	2005	2006	2007e		2008f	2009f		2008f	2009f		2008f	2009f
Operating costs:												
Seed	33	34	38		55	58		45	51		77	153
Fertilizer	10	11	14		26	28		20	25		38	102
Manure	1	1										
Chemicals	14	14	14		16	16		15	16		15	16
Custom operations	7	7	7		8	8		8	8		8	8
Fuel, lube, and electricity	14	16	17		29	30		24	27		37	78
Repairs	11	12	12		12	13		12	12		12	13
Interest on operating capital	2	2	3		4	5		3	4		5	13
Total, operating costs	90	97	107		149	157		128	144		192	384
Allocated overhead:												
Hired labor	2	2	2		2	2		2	2		2	2
Opportunity cost of unpaid labor	17	17	17		18	18		18	19		17	18
Capital recovery of machinery and equipment	50	51	54		60	63		57	60		63	74
Opportunity cost of land(rental rate)	87	88	95		102	109		102	110		102	112
Taxes and insurance	6	7	7		8	8		8	8		8	9
General farm overhead	12	13	13		14	14		13	14		14	16
Total, allocated overhead	174	178	189		204	215		200	213		207	231
Total, costs listed	264	275	295		352	373		328	357		400	615
Yield (bushels per planted acre) 4/	47	46	41		41	44		41	44		41	44
Total cost per bushel	5.68	5.99	7.16		8.70	8.56		8.10	8.20		9.87	14.12

1/ 2005 and 2006 are developed by ERS from survey base year, 2005. 2007 is estimated from NASS cost indices for 2006 and 2007. 2008 and 2009 are forecast using the methods described in text.

2/ Cost of commercial fertilizers, soil conditioners, and manure.

3/ Cost of custom operations, technical services, and commercial drying.

4/ Yields for 2005-2007 are actual yields. Yields for 2008 are estimated using NASS data. Yields for 2009 are the maximum of the 2008 yield adjusted by the average % change from 2005-2008 or the simple averages of 2005-2008.

For wheat, the trend forecast has an increase of 61% in operating costs and 33% in total production costs per acre at the national level in 2009 compared to 2007 (Table 5, Figure 3). This would increase the estimated cost per bushel of wheat from $5.76 in 2007 to $6.75 in 2008 and $6.82 in 2009. The conservative method forecasted an increase of 26% in total production costs per acre for wheat in 2009 compared to 2007 resulting in an estimated cost per bushel of $6.47 in 2009. The pessimistic method forecast a 157% increase in total corn costs in 2009 and a forecast total cost of $13.19 per bushel.

Figure 3. U.S. wheat production costs per bushel

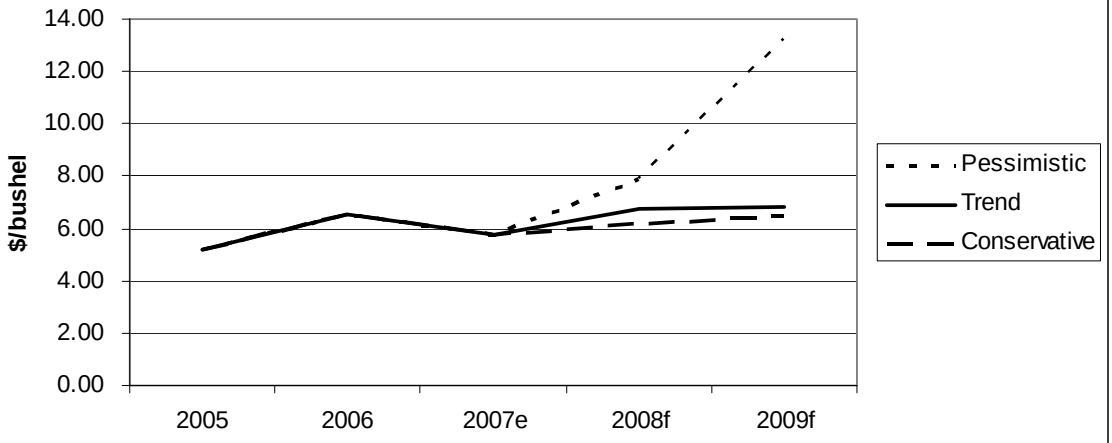


Table 5. U.S. Wheat production costs forecast to 2009, $ per planted acre 1/											
Forecast method:				Trend			Conservative			Pessimistic	
Item	2005	2006	2007e	2008f	2009f		2008f	2009f		2008f	2009f
Operating costs:											
Seed	8	8	10	14	14		11	13		19	38
Fertilizer 2/	26	28	36	66	71		52	63		97	263
Chemicals	9	9	9	10	10		9	10		10	10
Custom operations	7	7	7	7	8		7	7		7	8
Fuel, lube, and electricity	16	18	20	32	34		27	31		42	89
Repairs	12	12	13	13	13		13	13		13	14
Interest on operating inputs	1	2	3	4	5		3	4		5	15
Total, operating costs	79	85	97	147	156		123	142		194	436
Allocated overhead:											
Hired labor	2	2	3	3	3		3	3		3	3
Opportunity cost of unpaid labor	21	22	22	23	24		23	24		22	23
Capital recovery of machinery and equipment	49	51	54	60	63		57	60		63	74
Opportunity cost of land (rental rate)	41	41	44	47	50		47	51		47	52
Taxes and insurance	7	7	7	8	9		8	9		8	9
General farm overhead	8	9	9	9	10		9	10		10	11
Total, allocated overhead	128	132	139	150	158		147	156		153	172
Total, costs listed	207	217	236	297	314		271	298		348	608
Yield (bushels per planted acre) 4/	40	33	41	44	46		44	46		44	46
Total cost per bushel	5.20	6.53	5.76	6.75	6.82		6.15	6.47		7.90	13.19

1/ 2005 and 2006 are developed by ERS from survey base year, 2005. 2007 is estimated from NASS cost indices for 2006 and 2007. 2008 and 2009 are forecast using the methods described in text.

2/ Cost of commercial fertilizers, soil conditioners, and manure.

3/ Cost of custom operations, technical services, and commercial drying.

4/ Yields for 2005-2007 are actual yields. Yields for 2008 are estimated using NASS data. Yields for 2009 are the maximum of the 2008 yield adjusted by the average % change from 2005-2008 or the simple averages of 2005-2008.

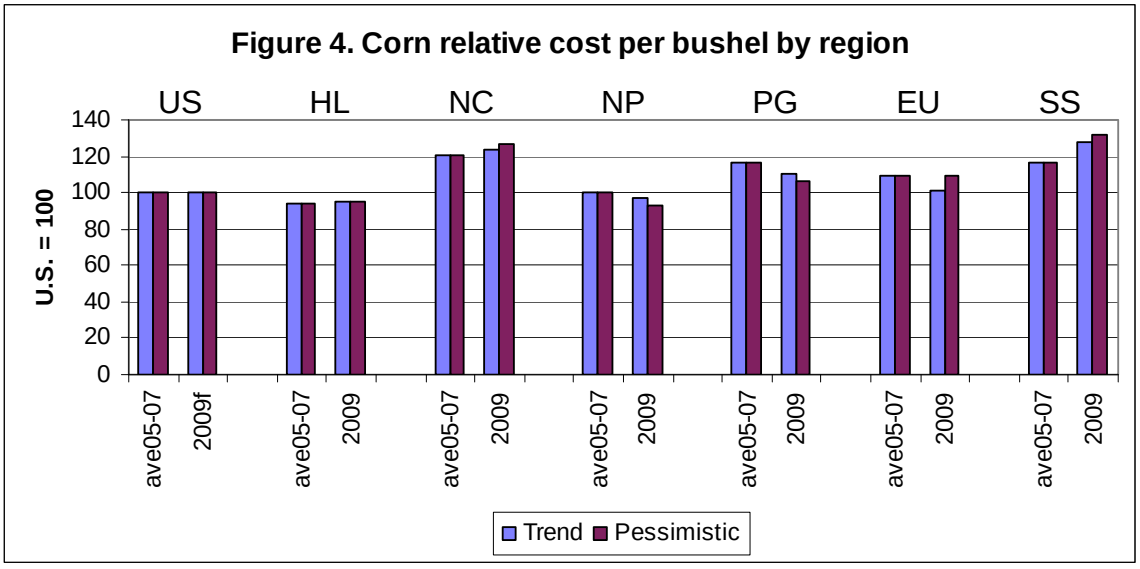
Changes in costs and relative costs across regions by crop

Now that we have examined the changes in aggregate predictions for production costs, we turn our attention to how these patterns are likely to impact each region and relative costs between regions. For example, it is reasonable to expect that the regions that use more fertilizer will see their total costs rise more in response to an increase in fertilizer prices than would regions that use less fertilizer. The differing production cost structure among regions is responsible for these distortion of relative costs patterns. We define a region's relative cost as fraction of the region's production costs to the average value for all U.S. farms in any given year. The change in regional relative costs, therefore, is defined as a change in this fraction from one year to the next. Although the cost of transportation to the final port will have an effect on final profitability estimates, that analysis is beyond the scope of this manuscript due to the complexity of changing geographic demand patterns driven by changes in demand for grains for bio fuels, especially, and other factors as well.

Corn

Although the Heartland is forecast to maintain its competitive edge in costs per bushel, the Northern Great Plains and Prairie Gateway regions are forecast to increase their competitive advantage due to using less fertilizer and chemicals on average which results in relative costs decreasing for these regions (Figure 4). Northern Crescent, Eastern Uplands, and Southern Seaboard regions are forecast to have higher relative costs and thus lose some competitive advantage most likely driven by using relatively more fertilizer and spending more on equipment repairs.

Figure 4. Corn relative cost per bushel by region

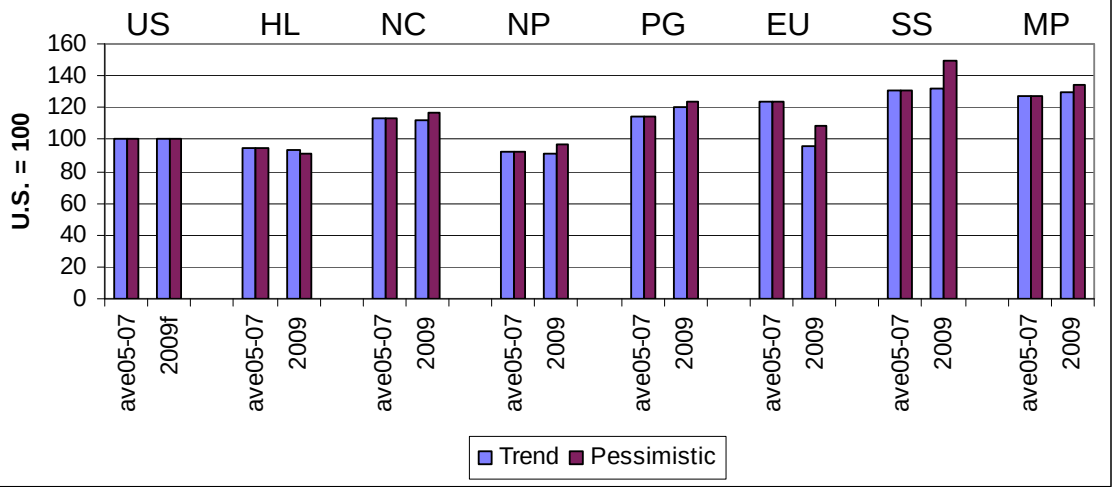


US = United States, HL = Heartland, NC = Northern Crescent, NP = Northern Great Plains, PG = Prairie Gateway, EU = Eastern Uplands, SS = Southern Seaboard.

Soybean

Although the Heartland is forecast to maintain its competitive edge in costs per bushel, the Eastern Uplands region was forecast to increase its competitive advantage due to using less fertilizer and chemicals on average which results in relative costs decreasing for these regions (Figure 5). Northern Great Plains was forecast to maintain or have a slight decrease in its competitive advantage. Northern Crescent, Prairie Gateway, Southern Seaboard, and Mississippi Portal regions were forecast to have higher relative costs and thus lose competitive advantage.

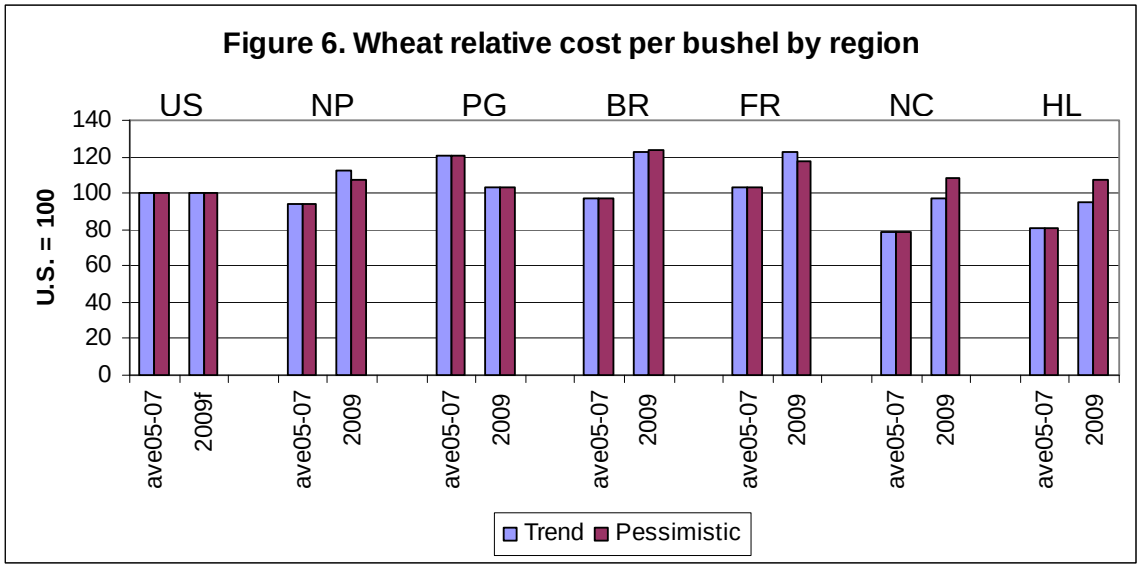
Figure 5. Soybean relative cost per bushel by region



US = United States, HL = Heartland, NC = Northern Crescent, NP = Northern Great Plains, PG = Prairie Gateway, EU = Eastern Uplands, SS = Southern Seaboard, MP = Mississippi Portal.

Wheat

With wheat, the Prairie Gateway region was forecast to have the best improvement in relative costs, while the Northern Great Plains loses some competitive edge (Figure 6). All other regions were forecast to have an increase in relative costs and thus lose competitive costs.



US = United States, NP = Northern Great Plains, PG = Prairie Gateway, BR = Basin and Range, FR = Fruitful Rim, NC = Northern Crescent, HL = Heartland.

Thus given the recently observed production cost patterns, we can conclude that the Heartland will continue to remain competitive in corn and soybean, but the Northern Great Plains will lose competitive advantage in wheat to the Prairie Gateway. The Northern Great Plains and Prairie Gateway regions were forecast to gain advantage in corn production. Eastern Uplands was forecast to gain advantage in soybean production.

Changes in costs across crops by region:

We have noticed so far that under all of the forecasting methods, production costs for corn grow the most. Cost of producing wheat is growing a little slower and is followed by soybean production costs. We have four regions that grow all three of the crops and we can examine whether given each region's specific production cost structure this pattern still holds. We can also see how relative costs affect each region's competitive advantage.

The above mentioned order holds in the case of *Northern Plains*. However, while the relative costs for growing soybeans increase, the relative costs of growing corn and wheat drop, which is what gives this region a relative advantage in producing these two crops.

For *Prairie Gateway*, the costs of growing wheat outgrow those of producing corn. Relative costs of wheat production increase, they slightly increase and then

decrease for soybeans, and decrease for corn. Thus, corn becomes a more desirable commodity for this region.

In *Northern Crescent* the relative costs for production of all crops rise, thus making crop farming less attractive here overall. However, this is more pronounced for wheat than corn or soybeans.

Finally, in *Heartland* producing wheat is most expensive in both the absolute and relative terms. And while the relative costs of corn production rise only slightly, they actually decrease for soybeans, thus, giving this region a competitive edge in growing soybeans.

Conclusion

Rising costs have not impacted all crops and all regions in the same way. While some regions – Northern Crescent, for example, -- have become less competitive overall, Northern Great Plains gained a competitive edge in corn, but loses its edge slightly in wheat. Heartland remains competitive for all 3 crops. Corn has been affected by the rising input prices more than wheat. Soybeans stand the least affected. Thus, despite increasing costs, Heartland and Northern Great Plains remain competitive and important production areas. However, since individual farms have different costs due to physical conditions and timing of input purchases, and crop prices are fluctuating, actual profit levels are hard to predict.