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Abstract

Using agricultural professionals' forecasts of future farmland values and corn and soybean cash prices for their service area, we analyze whether their land and corresponding crop price expectations are consistent. We find that changes in expected land prices over time are positively correlated with expected crop price changes, suggesting these two forecasts are somewhat consistent. More importantly, we find that the linkage between these two forecasts is significantly stronger in the medium- and long-term as opposed to the short-term, as well as a substantially stronger correlation for districts that have heavier reliance on crop production as a net farm income source.

Acknowledgement

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Expert opinion surveys are commonly used to forecast future events, such as political election results or critical future market outcomes such as oil and gas prices, inflation and interest rates, economic growth, and key commodity market fluctuations. With respect to agricultural markets, agricultural commodity futures and options markets are typically used to gauge critical movements in key markets like corn or soybeans. On the other hand, there are few surveys that consistently and systematically solicit opinions of agricultural professionals or producers regarding future farmland price changes.[1] One prominent example is the survey of farm managers and rural appraisers at the annual Soil Management and Land Valuation (SMLV) conference organized by Iowa State University. In many of these opinion surveys, respondents are expected to forecast both future land and crop prices (Federal Reserve Bank of Chicago 2017; Purdue University and the CME Group 2017). However, as far as we know, the previous literature hasn't closely examined the relationship between respondents' land and crop price forecasts in these expert or producer opinion surveys.

Using individual responses from 162 agricultural professionals that attended the May, 2016 SMLV conference, we examine the consistency between agricultural professionals' land price forecasts with their corresponding corn and soybean price forecasts. We examine the consistency of these price forecasts in three dimensions: first, we examine the temporal consistency of price forecast within an individual market—corn, soybean, or land—over time. Second, using correlation statistics, we explore whether agricultural professionals' price forecasts are consistent across agricultural commodity markets, and more importantly, whether they are consistent across crop and land markets. Third, we examine how the relationships between these expectations vary across the forecasting horizon (short- vs. medium-to-long-term) and reliance on crop income.

Data

Sponsored by Iowa State University College of Agriculture and Life Sciences and Iowa State University Extension and Outreach, the SMLV conference is regularly attended by farm managers, rural appraisers, real estate brokers, and others interested in the land market in Iowa and across the Midwest. This is the longest running conference at Iowa State—its ninetieth meeting was held in 2017. The SMLV conference has consistently received strong support from the Iowa Chapter of American Society of Farm Managers and Rural Appraisers throughout the years. Every year, the Iowa Appraiser Examining Board and Iowa Real Estate Commission approve the conference for six hours of continuing education credits for renewal of real estate, appraiser, and broker licenses. At the conference, participants get an update on various current issues in farm management, rural property appraisal, and the agricultural sector in general. In addition, since 1964, every participant has an opportunity to "gaze into their crystal ball" and provide their estimates of future corn and soybean prices and land values in Iowa.

Figure 1 shows the half-page sheet presented to conference participants on site asking about their estimates of future land values, as well as corn and soybean prices. At the May 2016 conference, 186 out of 280 conference participants completed and returned their estimates, providing our study sample. We further deleted 24 observations with missing values on either land or crop forecasts. The final data consist of 162 observations.

We solicited participants' opinion-based farmland price forecasts for five horizons, which is a mix of short-, medium-, and long-term forecasts. The short-term forecast estimates land prices six months after the conference (November 2016). The medium-term forecasts explore land values in the two-to-five-year range (November 2017 and November 2020). The long-term projections look 10 to 25 years out. In addition to land value questions, participants are also

asked to predict corn and soybean cash prices for their service area in November 2016, 2017, and 2020.

In this article, we are interested in the consistency of land and corn price forecasts from the SMLV conference. We are particularly interested in whether the land price implied in a respondent's crop price forecast is consistent with the self-reported land price forecast for the same horizon. As a result, we mainly rely on the short- and medium-term land and crop price forecast questions in this article. We drop the long-term forecast questions for 2025 and 2040 as there are no corresponding forecasted commodity prices.

Results – Graphical Analysis

I. Time Consistency of Expectations

Table 1 summarizes the data and Table 2 presents the correlation statistics between short-term (six-month) expectations with medium-term (18-month and 54-month) expectations for both crop and land prices. The three graphs shown in Figure 2 further provide graphical evidence of consistency of price forecasts over time for corn, soybean, and land prices. They clearly reveal a strong (greater than 0.8) correlation between agricultural professionals' short-term, six-month expectation with their medium-term, 18-month price expectation in each of the markets. This suggests that agricultural professionals who hold a more optimistic view of near-term crop or land market values within six months tend to project higher 18-month corn prices than their peers—the corn price forecasts for 2016 and 2017 are mostly clustered between $3.00/bushel and $4.00/bushel, or more specifically between $3.50/bushel to $4.00/bushel, with a few pessimistic agricultural professionals projecting a $2.00/bushel corn price. Similarly, those who reported much higher soybean or land price forecasts for 2016 compared to others tend to forecast higher prices for these markets for 2017 or 2020 as well.

As of May 2016, the price estimate for November 2016 seems to be less correlated with that of November 2020, when compared to the correlation between the November 2017 and November 2020 price expectations, suggesting that most agricultural professionals forecast a turnaround in the crop and land markets in late 2017 and a transition from dwindling crop and land prices to a slow rebound.

II. Cross-Market Consistency of Expectations

Cross-market correlation in forecasted prices

Next, we examine whether the reported price forecasts are consistent across different agricultural commodity groups, and more importantly, whether the commodity price forecast is consistent with land price forecast. First, Figure 3 shows the correlation between the corn and soybean price forecasts for both November 2016 and November 2020. The strong correlation between corn and soybean price forecasts for both 2016 and 2017 clearly shows that the participating agricultural professionals realize the interconnectedness across agricultural commodity markets and have a similar view regarding the future trends for corn and soybean prices. It is also interesting to see that the crop price forecasts for 2020 are more dispersed compared to those for 2016, suggesting heterogeneous expectations regarding the future corn-to-soybean price ratios, which has significant implication of crop rotation choices.

We further compare the reported corn price forecast by a respondent with their reported land price forecast for 2016 and 2020. Figure 4 shows a scatterplot of respondents' corn price forecasts with same-year land price forecasts. A visual examination of Figure 4 seems to suggest that there is no obvious correlation or clear trend between the corn price and land price forecasts. The lack of correlation is true for both 2016 and 2020 values. As discussed earlier, it seems that the participating agricultural professionals' corn price forecasts are more clustered between

140 $3.00/bushel and $4.00/bushel, however, their land price forecasts have a much larger
141 variability, ranging from $4,000/acre to $10,000/acre.

142 Table 3 presents cross-market correlation statistics between the corn and soybean markets, as
143 well as crop and land market price expectations. This table shows a similar pattern as in Figures
144 3 and 4 but it also investigates the correlation between soybean price forecasts and land price
145 forecasts. While the correlations remain very consistent among the crop price projections over
146 the various time periods, the correlations between the crop price and land value projections
147 evolves over time with the higher correlations being observed as the time gap between the crop
148 price and land value projection period grows.

149 It seems rational to suggest that agricultural professionals seem to rely on corn (soybean) futures
150 prices when reporting corn (soybean) price forecasts, and thus report a fairly similar value. In
151 contrast, these participants may rely more on the recent farmland transactions or appraisals in
152 their local service areas as a reference for the future farmland market. As shown in Figure 1, we
153 ask participants to forecast land prices for their service area (i.e., the area in which they provide
154 professional service), which helps explain the wide range in their responses for the forecasted
155 land prices. In other words, the agricultural professionals may rely on different information when
156 forecasting crop and land prices—the crop futures market could easily be used as a benchmark
157 when forecasting crop prices, however, land price is driven by a host of other characteristics
158 beyond crop prices, including, most notably, land quality, crop yields, and crop-livestock mix, as
159 well as local market characteristics like proximity to urban areas.

160 ***Cross-market correlation in forecasted price changes***

Differences in information sources and systems resulted in the seemingly apparent lack of correlation between forecasted crop prices and land prices. However, because the comparison in Table 3 is for price levels rather than changes in forecasted prices over time, this does not necessarily mean that they are inconsistent, as agricultural professionals' expected land market fluctuations may still be correlated with expected crop market fluctuations. As the results in Table 3 showed, the correlation structure strengthens as the time gap between the forecast periods grows.

We examine whether there is a positive relationship between changes in their corn price forecasts from 2016 to 2017 or from 2016 to 2020 and changes in land prices for the same time period. With USDA and the Federal Reserve frequently reporting changes in farm income and asset values, it is possible that agricultural professionals are forecasting future market trends in percentage change terms. Figure 5 shows two scatterplots and the fitted linear regression line connecting percentage change in a respondent's corn price forecast from 2016 to 2017 with the percentage change in their land price forecast. It shows that there is a positive relationship between corn price changes and land price changes from 2016 to 2017.

Short-term vs. Long-term correlation

Economic theory of land value argues that the farmland market represents the net present value of all future income streams, and farmland is often treated as a long-term investment. As a result, land price changes are not only linked with contemporaneous crop market fluctuations, but also reflect future crop market changes, in addition to other factors such as interest rates, land quality, urban influences, etc. As a result, we perceive a stronger correlation between crop price outlook with land price outlook in the longer term than that in the short-term, especially given that

agricultural professionals seem to benchmark their crop price forecasts to prices from the futures markets.

The upper part of Figure 5 focuses on the short-term expectation changes from 2016 to 2017, while the lower part shows the medium-to-long-term expectation changes from 2016 to 2020. This reveals that there is a positive relationship between corn price changes and land price change, and the positive correlation is stronger for the medium-term expectation changes than for the short-term. The fitted line suggests that a one-percent increase in expected corn price from 2016 to 2017 would lead to about a corresponding 0.2 percent expected rise in land value, while a one-percent increase in expected corn price from 2016 to 2020 would lead to a corresponding 0.4 percent increase in expected land value. The higher magnitude suggests that the short-term land value expectations by agricultural professionals could be influenced by a host of factors other than crop price fluctuations, however, their medium-to-long-term land value expectations are more aligned with fluctuations in underlying assets such as corn.

Table 4 offers additional insights on the pairwise correlation statistics between the percentage changes in expected crop prices with percentage change in expected land prices by analyzing the linkage between soybean price expectations with land price expectations. Interestingly, the correlation between soybean price changes with land price expectations for both short-term and medium-to-long-term is statistically higher than that between corn and land price expectations, this suggests agricultural professionals seem to place a higher weight on fluctuations in the soybean market than the corn market when forecasting future farmland prices. This could be a result of growing significance of soybean in the crop mix in Iowa and across the Midwest over the past century, especially over the last fifty years (USDA NASS 2017c).

Correlation for crop-intensive vs. non-crop-intensive regions

The final aspect of the cross-market correlation we examine is the difference resulting from the variation in crop-livestock mix and thus the varying degree of reliance on crop income. The capitalization model suggests that localized land market tends to result from localized farm income trends, and thus we argue that for regions that rely more heavily on crop production and crop income, the crop market movements would be more significantly capitalized and correspondingly we could expect to see a greater correlation in agricultural professionals' crop price predictions with land price predictions for these crop-intensive regions. In light of this, we broke the nine crop reporting districts in Iowa into two distinct groups—crop-intensive districts in which crop production and crop income plays a relatively larger role in driving net income, including Northwest, North Central, West Central, and Central Iowa; and non-crop-intensive districts in which crop income plays a relatively smaller role and other sources of income, such as livestock income or pasture production, can provide more influence. Although this is a distinction between areas in Iowa, the logic that greater correlation between crop and land market movements for crop-intensive areas applies well beyond the state.

Table 5 replicates the correlation statistics shown in Table 4, but rather than pooling all observations, we separately correlate expected land price change with expected corn price change for crop-intensive districts and non-crop-intensive districts. We reconfirm our findings earlier that there is a stronger link between expected crop price changes with expected land price changes in the medium-to-long-term as opposed to short-term, regardless of crop intensity. More interestingly, our results reveal a much stronger correlation between crop market movements and land market fluctuations. In crop-intensive districts, a one-percent increase in expected corn prices from November 2016 to November 2017 would lead to a 0.25 percent increase in the

corresponding expected land prices, which is substantially higher than the average marginal effect for the non-crop-intensive districts.

Conclusions and Practical Implications

Using agricultural professionals forecasts of short- and medium-term farmland values and crop prices in the future for their service area at Iowa State University's SMLV conference, we provide the first formal examination whether and how their land and corresponding corn and soybean price expectations are consistent. Our results demonstrate that a positive correlation between expected crop price changes and expected land price changes, suggesting that these two forecasts are consistent. More importantly, we find that while the correlation between the six-month, short-term land and crop price forecasts are relatively small, the medium-term land value forecast is more strongly associated with corresponding corn and soybean price forecasts. In addition, our results reveal much stronger correlation between these two forecasts for crop reporting districts with more intensive crop production and thus heavier reliance on crop income as a source for farm income. Finally, the preferences of agricultural professionals are stable over time, with more optimistic professionals forecasting higher values for both short- and medium-term forecasts than their peers.

This paper has important practical implications for farm management and land investment and appraisals. First, our results show that experts' opinion surveys land price expectations are somewhat rational in the sense that their movements are positively correlated with fluctuations in crop market fundamentals. Secondly, the medium-term expectation is more closely tied with market fundamentals while short-term expectation is often in response to a host of instantaneous factors that may not drive long-run land market movements. Finally, expected land prices for a local area are governed by factors that influence the net income in that area most, and factors

other than crop prices, such as livestock market trends and recreation demand, are critical for land market trends in non-crop-intensive areas.

Although this paper uses data from agricultural professionals based in Iowa, the results and implications are relevant for other Corn Belt states. We recognize that more work is needed to further examine the cross-market correlation between crop and land price forecasts, in particular a formal model to link crop prices and margins to land values over time. Currently, we are also examining the accuracy of the crop and land price forecasts through comparison with the realized future values, and investigating how agricultural professionals form these short-term and long-term land price expectations.

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Tables and Figures

Figure 1. Land and commodity price forecast sheet at the 2016 SMLV conference.

2016 Estimated Land and Commodity Prices

Name of primary county that you provide service in: _____

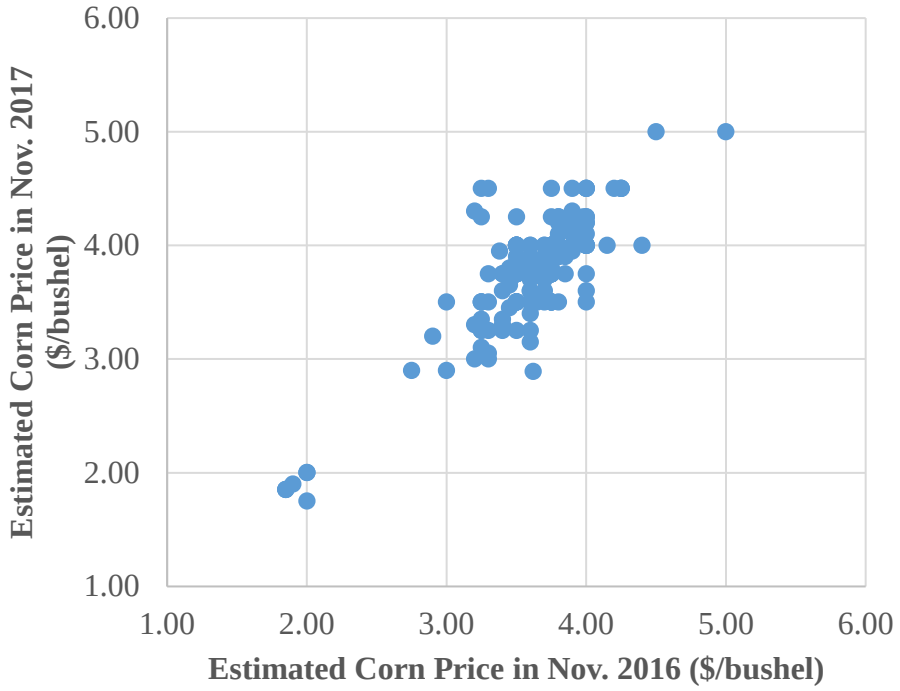
Number of counties that you provide service in: _____

Please circle your primary occupation:
Farm Manager Rural Appraiser Broker/Realtor Ag Lender Other

Number of years of experience you have in your primary occupation: _____ **Years**

Your Estimate for Your Service Area	**LAND**	**CORN**	**SOYBEAN**
November 1, 2016	$ /Acre	$ /Bu.	$ /Bu.
November 1, 2017	$ /Acre	$ /Bu.	$ /Bu.
November 1, 2020	$ /Acre	$ /Bu.	$ /Bu.
November 1, 2025	$ /Acre		
November 1, 2040	$ /Acre		

Figure 2. Scatterplot between 6-month vs. 18-month crop and land expectation.



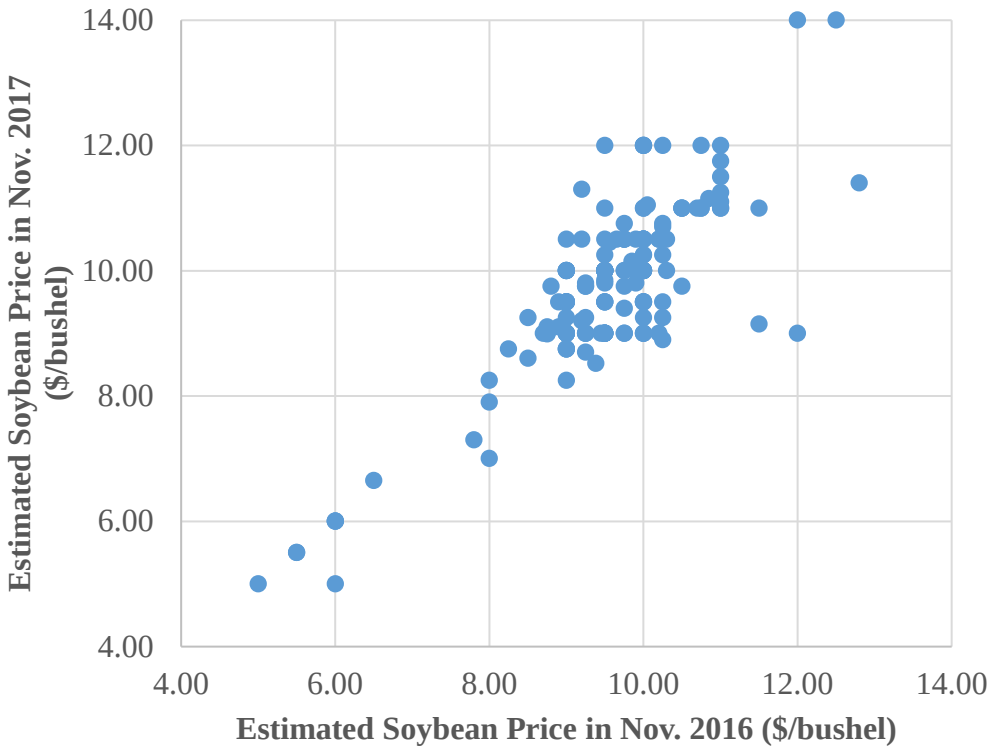


Figure 2 (continued). Scatterplot between 6-month vs. 18-month crop and land expectation.

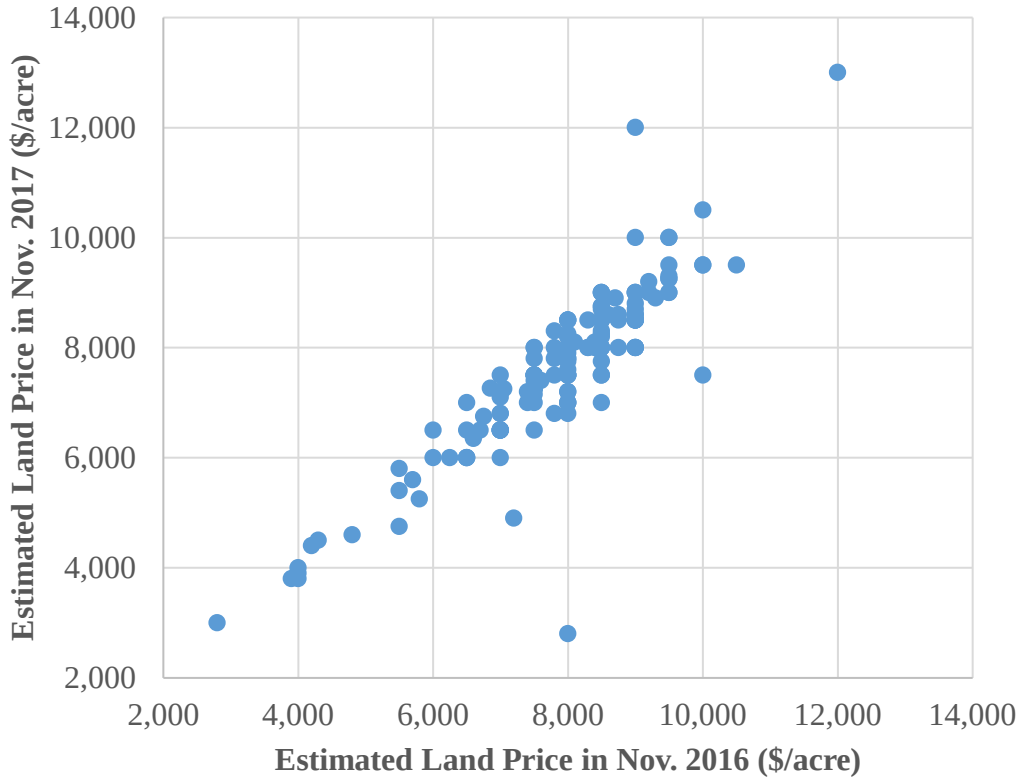
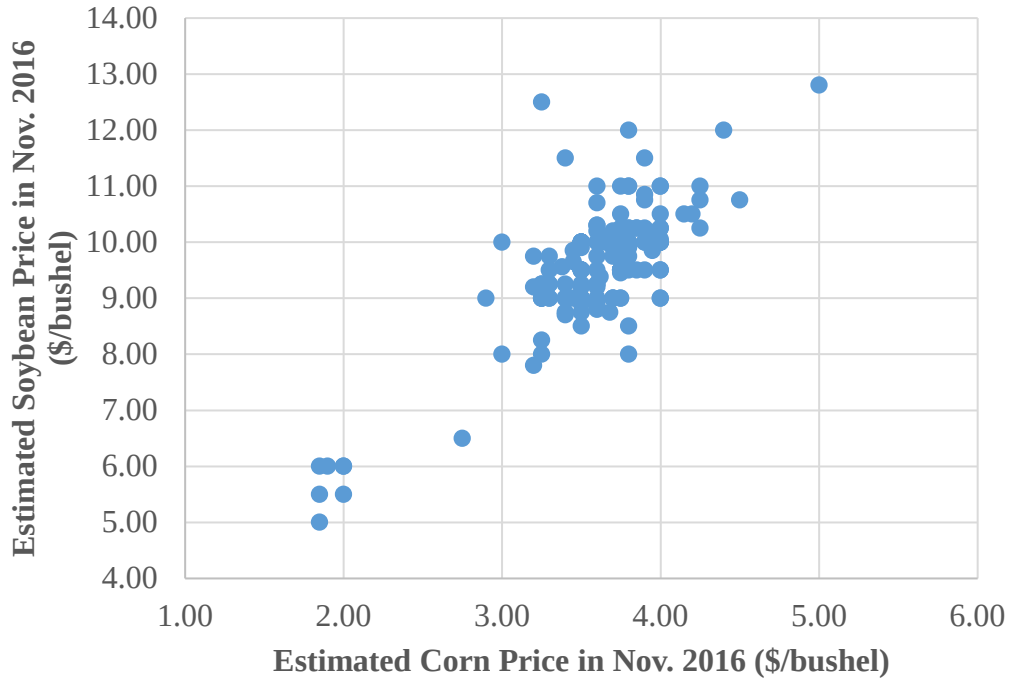


Figure 3. Scatterplot between corn and soybean expected prices.



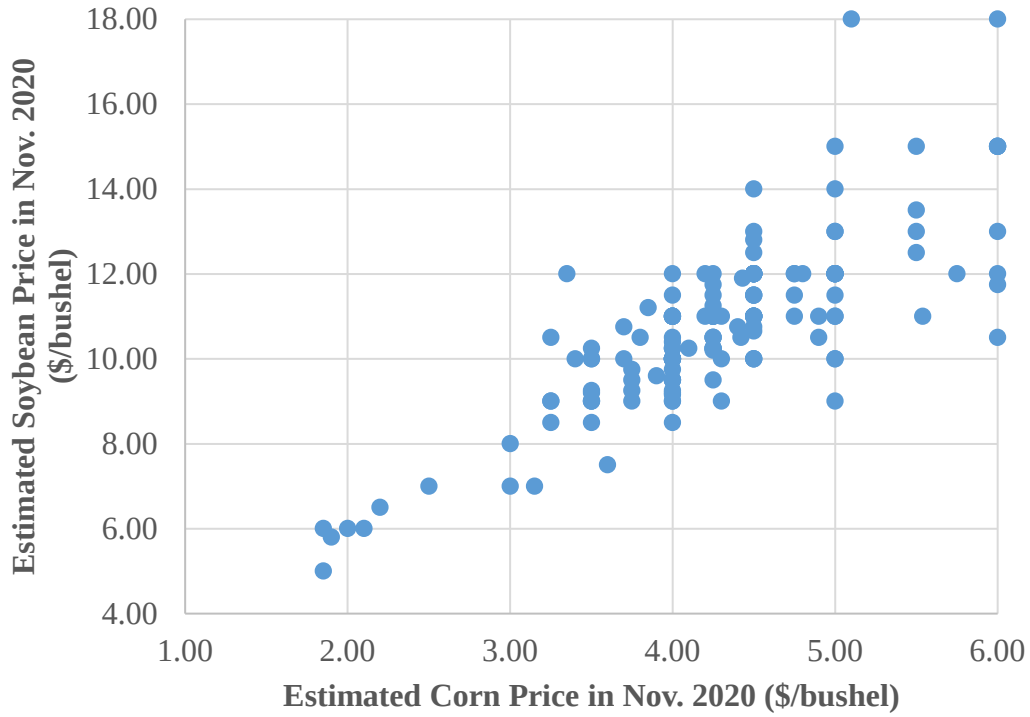
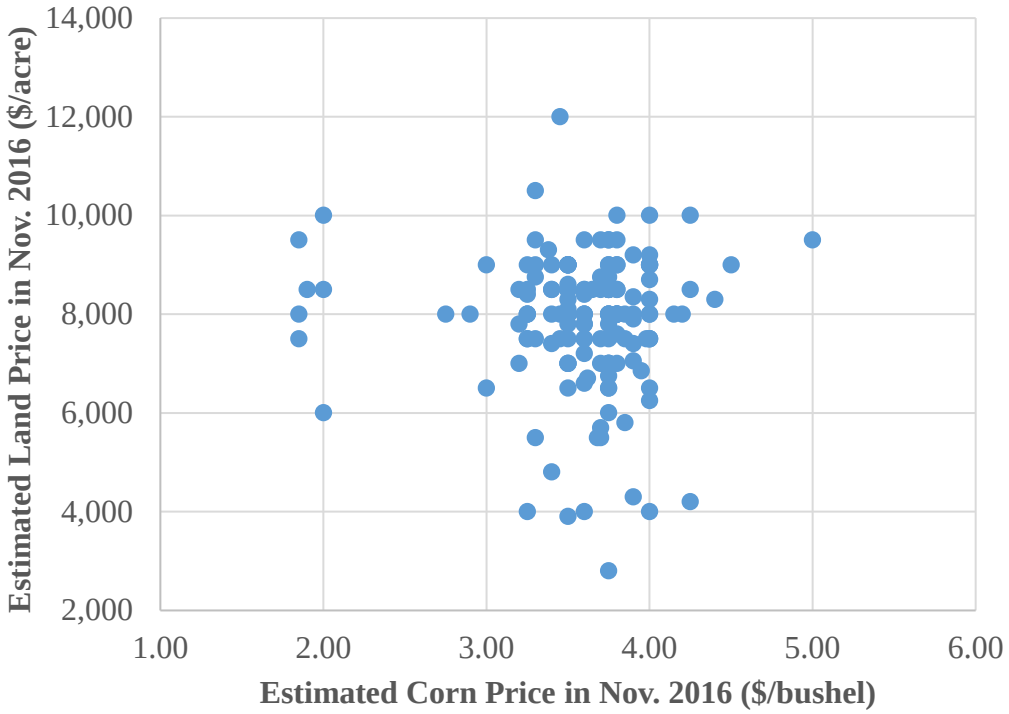


Figure 4. Scatterplot between corn and land expected prices.



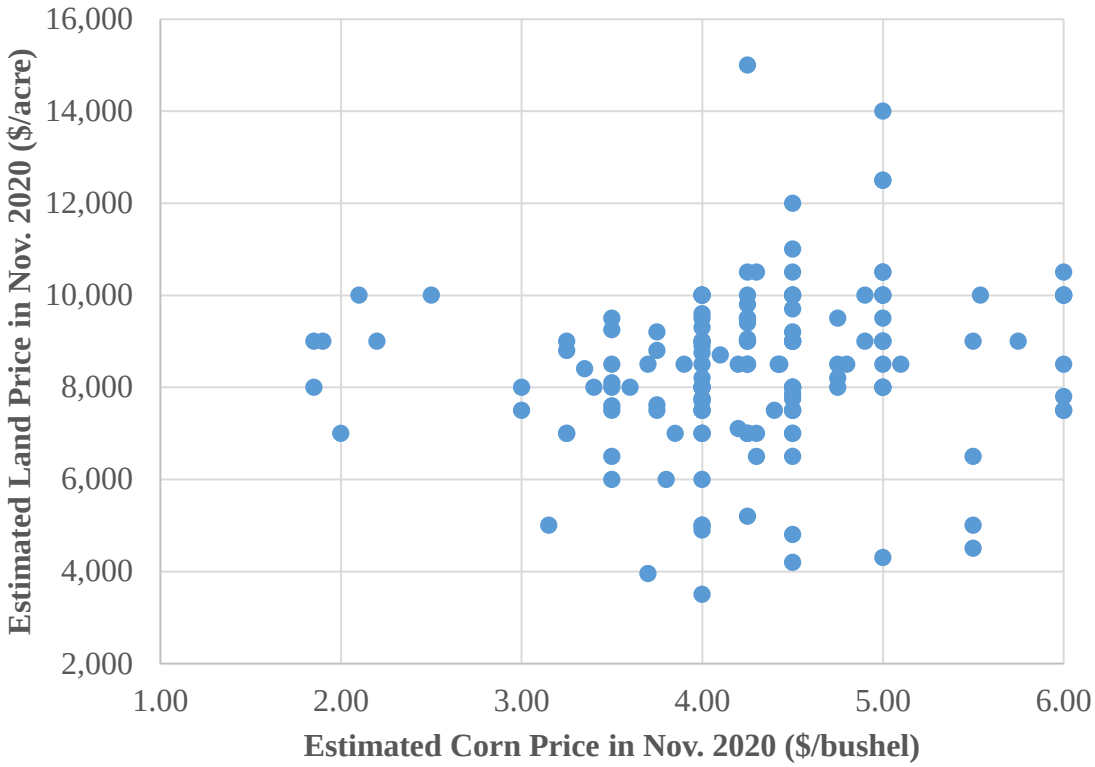
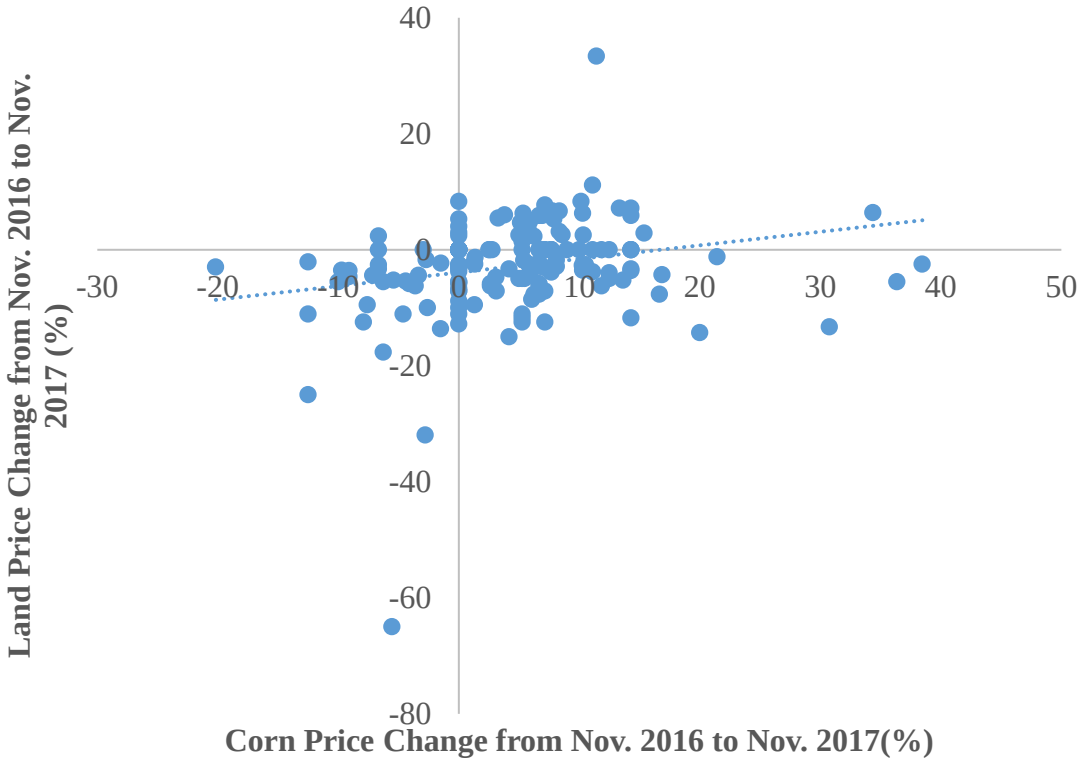
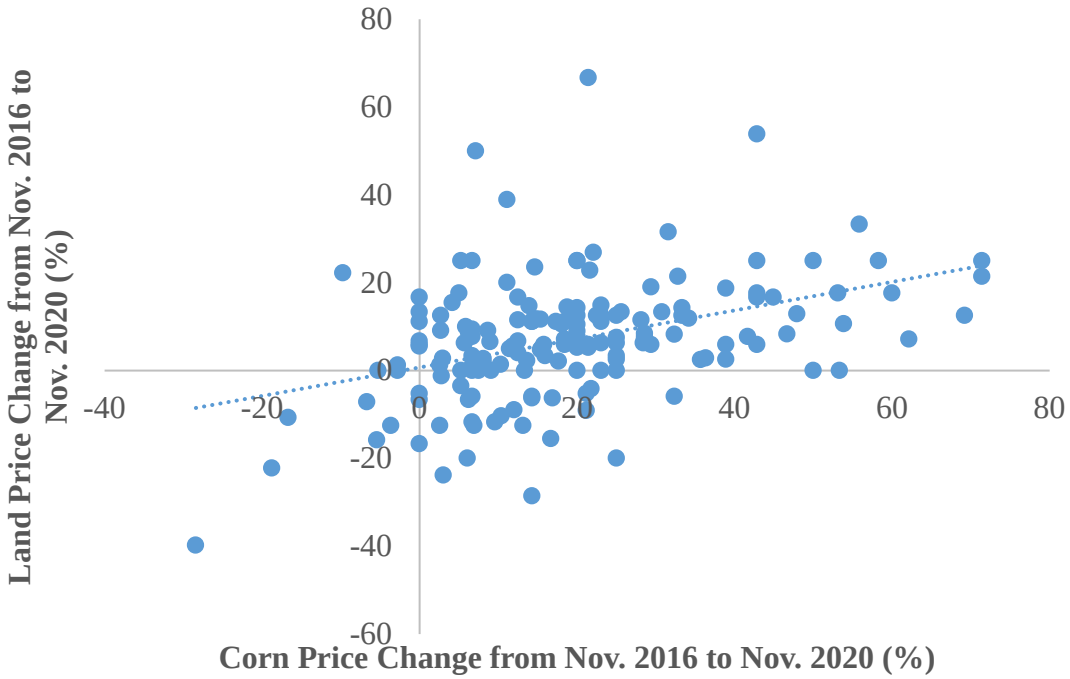


Figure 5. Correlation between corn price changes with land price changes.





303 **Table 1. Summary Statistics of Land and Crop Price Expectations**

Variables	Unit	Mean	Std Dev	Min	Median	Max
Corn 2016	**$/bushel**	3.59	0.46	1.85	3.69	5.00
Corn 2017	**$/bushel**	3.75	0.55	1.75	3.80	5.00
Corn 2020	**$/bushel**	4.27	0.81	1.85	4.25	6.00
Soy 2016	**$/bushel**	9.54	1.16	5.00	9.53	12.80
Soy 2017	**$/bushel**	9.74	1.38	5.00	9.92	14.00
Soy 2020	**$/bushel**	10.75	1.96	5.00	10.75	18.00
Land 2016	**$/acre**	7,880	1,341	2,800	8,000	12,000
Land 2017	**$/acre**	7,649	1,470	2,800	8,000	13,000
Land 2020	**$/acre**	8,399	1,733	3,500	8,500	15,000
Corn change ‘16-‘17	**%**	4.42	8.49	-20.16	5.26	38.15
Corn change ‘16-‘20	**%**	19.02	17.48	-28.41	16.30	71.43
Soy change ‘16-‘17	**%**	2.06	7.64	-25.00	2.44	26.32
Soy change ‘16-‘20	**%**	12.66	15.34	-41.67	10.00	75.61
Land change ‘16-‘17	**%**	-2.87	8.36	-65.00	-2.60	33.33
Land change ‘16-‘20	**%**	6.89	13.88	-29.76	6.59	66.67
Total Observations			162			

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306 **Table 2. Correlation between Short-term and Medium-term Crop and Land Expectations**

Panel I: Corn		
Nov. 2016 vs. Nov. 2017	**Nov. 2017 vs. Nov. 2020**	**Nov. 2016 vs. Nov. 2020**
0.8455	0.6239	0.7171
Panel II: Soybean		
Nov. 2016 vs. Nov. 2017	**Nov. 2017 vs. Nov. 2020**	**Nov. 2016 vs. Nov. 2020**
0.8344	0.6233	0.7869
Panel III: Land		
Nov. 2016 vs. Nov. 2017	**Nov. 2017 vs. Nov. 2020**	**Nov. 2016 vs. Nov. 2020**
0.8860	0.7578	0.8038

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Table 3. Cross-market Correlation between Short-term and Medium-term Crop and Land Expectations

Panel I: Corn vs. Soybean		
Nov. 2016 vs. Nov. 2017	**Nov. 2017 vs. Nov. 2020**	**Nov. 2016 vs. Nov. 2020**
0.8008	0.8049	0.8056
Panel II: Corn vs. Land		
Nov. 2016 vs. Nov. 2017	**Nov. 2017 vs. Nov. 2020**	**Nov. 2016 vs. Nov. 2020**
-0.0403	0.0087	0.1487
Panel III: Soybean vs. Land		
Nov. 2016 vs. Nov. 2017	**Nov. 2017 vs. Nov. 2020**	**Nov. 2016 vs. Nov. 2020**
-0.0793	-0.0005	0.1520

Table 4. Correlation between Expected Crop Price Changes with Expected Land Price Changes

Panel I: Expected Corn Price Change vs. Expected Land Price Change	
Corn ‘16-‘17 vs. Land ‘16-‘17	**Corn ‘16-‘20 vs. Land ‘16-‘20**
0.2374	0.4087
Panel II: Expected Soybean Price Change vs. Expected Land Price Change	
Soybean ‘16-‘17 vs. Land ‘16-‘17	**Soybean ‘16-‘20 vs. Land ‘16-‘20**
0.2525	0.4464

Table 5. Correlation between Expected Corn Price Changes with Expected Land Price Changes for Crop-Intensive and Non-Crop-Intensive Districts

Panel I: Crop Intensive Districts	
Corn '16-'17 vs. Land '16-'17	**Corn '16-'20 vs. Land '16-'20**
0.2638	0.3526
Panel II: Non-Crop-Intensive Districts	
Corn '16-'17 vs. Land '16-'17	**Corn '16-'20 vs. Land '16-'20**
0.2043	0.2745

Footnotes

[1] Federal Reserve Bank of Chicago's Ag Credit Survey seeks ag lenders' forecasts on future farmland value changes since then early 1990s (Federal Reserve Bank of Chicago 2017), and USDA Economic Research Service used to survey producers regarding future farmland prices in the 1980s (USDA ERS 1985), and in 2016 Purdue University started a monthly Ag Economy Barometer based on a nationwide sample of producers which includes questions on directions of future farmland value expectations (Purdue University and the CME Group 2017).