# PURDUE AGRICULTURAL ECONOMICS REPORT

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## JUNE 2017

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## FINANCIAL VULNERABILITY IN THE CURRENT DOWNTURN: A STRESS TEST OF MIDWESTERN CORN-SOYBEAN FARMS

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The agricultural sector is facing uncertainty from many directions. These include global supply and demand uncertainties, evolving biofuels policies, trade uncertainties, exchange rates, interest rates, and geopolitical conflicts, among others. Any of these could make farms vulnerable to financial erosion, or even financial failure.

Given these increasingly complex and worrisome uncertainties, the admonition of Nassim Nicholas Taleb of Black Swan fame should be remembered. "Black swans" which are highly unlikely but critically significant events cannot be predicted, so the focus should be on positioning a business to maintain resiliency and reduce vulnerability should the bad event arise. In that spirit, this article will focus on the implications of the current and future uncertain market and financial conditions on the resiliency and vulnerability of Midwestern farms.

### The Financial Situation

The U.S. farming sector exhibited very strong financial performance during the 2007-2013 period in terms of cash flow, high incomes, debt servicing, and equity accumulation. However, that strong performance has been accompanied by increased volatility. This increased volatility is a result of wide fluctuations in crop and livestock product prices, input costs and to volatile production due to both more variable yields in crops and losses from disease such as avian influenza and PED in hogs. That has created more operational and financial risk for farm businesses. Even though the variability of prices as a percentage of the average price has not changed much compared to the past, higher costs and the fixed nature of some of these costs has increased the variability of both operating margins and net income on both an absolute and relative basis dramatically.

The amount of financial leverage (debt relative to equity capital) in the industry generally declined from 1990 to 2013, with debt-to-equity falling to a low near 13% in 2013. This suggest that debt servicing risk for the sector is less than it was, for example, in the 1980's. However, after 2013, farm debt has once again been rising relative to equity reaching 16% in 2017 (USDA). While debt levels are still modest sector wide, industry averages do not accurately reflect the true financial risk for individual farms. Larger scale farmers who have been growing rapidly have leverage positions more than double the industry average (Hoppe and Banker, 2010). Also, "shadow bank" financing in the form of loans and leases from captive finance companies (for example Deere Financial Services) and merchant and dealer credit from input suppliers is not well documented and is likely to be under-reported in the widely referenced USDA data.

Low interest rates are another factor that may be masking the dangers of debt servicing capacity. Interest rates on debt have been abnormally low. Rising rates will increase the debt servicing requirements for farmers who have not converted from variable to fixed rate loans. In addition, operating credit lines have increased for many producers, and interest rates on these loans are reset at renewal, and thus will increase when market rates rise.

Debt servicing ability can also be impact by high cash rents. Some farmers have signed longer term (3 year), high fixed rate cash rent leases to obtain control of land rather than purchase that land. These arrangements result in fixed cash flow commitments irrespective of productivity and prices much like a principal and interest payment on a mortgage. Farmers are also facing more strategic risks than they have in the past such as disruptions in market access and in supplier relationships including the possible loss of a lender, loss of landlords, regulatory and policy changes, food safety disruptions, and reputation risk, etc.

U.S. agriculture is notorious for its boom and bust cycles. Strong global food demand and robust biofuels markets strained global production capacity during the 2007-13 period. The prospects of tight global supplies spurred booming farm incomes. Historically low interest rates quickly capitalized these high incomes into record high farmland values. But as with past booms, the prospects of a permanent "golden era" in agriculture quickly faded. High farm incomes stimulated world production and the promise of global demand growth rates weakened resulting in low agricultural commodity prices and incomes. These leaner farm incomes were unable to support the record-high farmland prices. As a result, many farmers that thought they were seizing the emerging opportunities may be left empty-handed as market and financial conditions have changed.

Consequently, farmers, lenders, policy makers, and the academic world are asking many "what if" questions: What if commodity prices continue to be depressed? What if seed prices don't go down more; or cash rents don't adjust? What if land values decline further? With all the "what if" questions in mind, farmers and economists are concerned about the incidence and intensity of financial stress the farming sector might encounter in the future

Table 1. Comparison of Farm Size with 50% Land Owned and 25% Debt-to-Asset Ratio

| | Size of Farm (acres) | | |
|---|---|---|---|
| | 550 | 1200 | 2500 |
| Annual Net Farm Income (mean) | $49,800 | $37,600 | $166,200 |
| Change in Net Worth (3-year; mean) | -$32,300 | $114,900 | $926,900 |
| Working Capital to Value of Farm Production | | | |
| Mean | 32.9% | 45.5% | 49.5% |
| Percent greater than 35% | 43.1% | 96.1% | 99.9% |
| Debt-to-Asset Ratio | | | |
| Mean | 22.1% | 15.8% | 13.0% |
| Percent greater than 55% | 0.0% | 0.0% | 0.0% |
| Term Debt Coverage Ratio | | | |
| Mean | 0.9 | 1.2 | 1.5 |
| Percent greater than 1.1 | 23.2% | 76.1% | 97.9% |
| Percent with Positive Cash Position | 24.3% | 83.8% | 98.4% |

**Stress Test: How Many Farms Are Vulnerable?**

To obtain some insight into these questions, the financial performance of various Midwest grain farms with different size, ownership status, and capital structures were examined under the shocks of volatile crop prices, yields, fertilizer prices, farmland value, and cash rents (Boehlje and Li, 2013). Monte Carlo methods were used to generate simulated crop prices and yields, fertilizer prices, farmland value and cash rents. The farms were of three sizes 550, 1200, and 2500 acres. They had three different ownership levels of 15%, 50%, and 85% with the remainder cash rented. Finally, they had two capital structures as measured by their debt-to-asset ratios of 25% and 50%.

The data used to estimate these distributions come from historical observations for the period 1970 to 2010. The Monte Carlo technique randomly draws values from the historical distributions to populate a financial budgeting model which generates financial projections for a three-year period. This budgeting activity was conducted 1000 times which resulted in distributions of possible financial outcomes that are driven by the distributions of price, yield, farmland value, and cash rents as the drivers of the financial outcomes. Various financial measures and ratios generated by this model were used to evaluate the income, cash flow, debt servicing, and equity position of the various farm situations.

Given 50% land ownership and a 25% debt-to-asset ratio, the percentage of farms that have a positive cash balance after meeting all the financial obligations and family living expense increases with farm size (Table 1). Unfortunately, only 24% of the smaller farms (550 acres) have a positive cash position by the end of the three-year period. Larger farms have better profitability measured by net farm income and operating profit margin ratio, as well as lower volatility of these measures. At the end of the three-year projection period, larger farms have a higher average working capital to value of farm production (WC/VFP) ratio, and a higher percentage of farms with the WC/VFP ratio exceeding 35% was 99.9% for the 2500 acre farms compared to just 43.1% for the 550 acre farms. Repayment capacity, as measured by the term debt coverage ratio (net farm income divided by annual term debt principal and interest payments), is also higher for larger farms, with a mean value of 1.5 and 97.9% of the time they exceeded the underwriting standard of 1.1. The 550 acre farms had a mean value of 0.9 and only 23.2% of the time exceeded the1.1 standard.

These results suggest that smaller farms with one-half or more of their farmland rented and with modest leverage of 25% debt-to-asset ratio as is typical of young farmers, are highly vulnerable to price, cost, yield, and asset value shocks.

Large farms often have some advantages in terms of volume of production and in spreading fixed costs over large output. In this study, larger farms show superior financial performance and resiliency, but there are some important additional reasons why. In the model, family living expenses are assumed to be the same for both size farms, and thus the income available after these family expenses is much lower for smaller farms. Another model assumption was that no off-farm income was available to supplement any of the farming businesses. Thus the funds available for debt service on these smaller farms is much less, resulting in working capital, cash flow, and debt service problems. In reality, small farms often supplement family living expenses with off-farm income or have other farm enterprises such as livestock or specialty crops.

Different land ownership arrangements have a dramatic impact on the vulnerability of the smaller (550 acre) farming

Table 2. Comparison of Land Tenure for 550 Acre Farms with 25% Debt-to-Asset Ratio

| | % of Land Owned | | |
|---|---|---|---|
| | 15% | 50% | 85% |
| Annual Net Farm Income (mean) | -$2,100 | $49,800 | $98,900 |
| Change in Net Worth (3-year; mean) | -$130,400 | -$32,300 | $76,000 |
| Working Capital to Value of Farm Production | | | |
| Mean | 17.3% | 32.9% | 49.6% |
| Percent greater than 35% | 0.5% | 56.9% | 90.8% |
| Debt-to-Asset Ratio | | | |
| Mean | 32.6% | 22.1% | 17.1% |
| Percent greater than 55% | 0.0% | 0.0% | 0.0% |
| Term Debt Coverage Ratio | | | |
| Mean | 0.6 | 0.9 | 1.7 |
| Percent greater than 1.1 | 0.5% | 23.2% | 83.8% |
| Percent with Positive Cash Position | 0.3% | 24.3% | 74.8% |

operations (Table 2). Those 550 acre farms with 85% of their land owned not only have substantially higher incomes than those who rent a higher proportion of their land, they are also able to accumulate additional equity over the three-year period ($76,000), reduce their leverage position to 17.1%, and have strong working capital and cash positions. In contrast, farms with only 15% of their land owned have negative net income ($2,100), lose equity ($130,400), increase their leverage position to 32.6%, and have a very weak term debt coverage ratio of 0.6 with almost no chance (0.5%) of being greater than 1.1. The farms that rent a large proportion of their land are very vulnerable to financial stress from price, cost, yield, or asset value shocks even with crop insurance and hedging strategies in place.

Table 3 compares financial characteristics of 2500 acre farms with 25% and 50% debt-to-asset ratios. Increasing the leverage from 25% to 50% reduced income only modestly from $166,200 with a 25% debt-to-asset ratio to $134,800 with a 50% debt-to-asset ratio. The change in income when more debt is used is the result of higher interest cost. In addition to lower income, the farm with a higher leverage position has lower net worth accumulation and cash flow. Even with a higher initial leverage position, these farms still have relatively strong working capital, debt servicing, and cash positions. Thus, larger farms, as characterized in this study, have only modest vulnerability to higher leverage positions and are more resilient to shocks in prices, costs, yields, and asset values.

These "stress test" results suggest that the financial vulnerability and resiliency of Midwest grain farms to price, cost, yield, and asset value shocks are dependent on their size, ownership tenure, and leverage positions. Farms with modest size (550 acres) and with a large proportion rented are very vulnerable irrespective of their leverage positions. These same modest size farms are more financially resilient if they own a higher proportion of their land. Large farms with modest leverage (25% debt-to-asset ratio) that combine rental and ownership of the land they operate have relatively strong financial performance and limited vulnerability to price, cost, yield, and asset value shocks. In addition, these farms can increase their leverage from 25% to 50% (in this study) with only modest deterioration in their financial performance and a slight increase in their vulnerability.

Just because the entire agriculture sector is still in an overall strong position with debt-to-asset ratio of 14% (USDA, 2017) this study shows that some common farm types are vulnerable to price, cost, yield, and asset value shocks and that cash flow and debt servicing problems are going to continue and may grow depending on the direction of the agriculture economy.

**Eroding Financial Position: The Lender Responds**

What insights does this "stress test" analysis provide concerning the current downturn? How might future events evolve that would create a 1970's-80's boom-bust cycle?

U.S. farm debt accumulation has not accelerated in the last decade as it did during the 1970s. But the distribution of debt among farmers is important. Recent analysis of the financial condition of farmers indicates that those who are younger (less than 35 years of age) have significantly higher debt loads and debt-to-asset ratios than the industry average (Briggeman 2011; Ellinger 2011). As indicated earlier, larger and rapidly growing farmers are more highly leveraged than the industry average. The real risk is that these farmers are currently losing money and consequently burning up working capital or borrowing to cover operating losses, which reduces their financial resiliency.

Similar to past farm booms, low interest rates fostered the capitalization of rising farm incomes into record high farmland values. Accommodative monetary policy by the Federal Reserve pushed nominal interest rates to historic lows. The surge in U.S. farmland prices outpaced the rise in cash rents. In fact, the average price-to-cash rent multiple, which is similar to a price-to-earnings ratio on a stock, surged to a record high of over 30 in various Corn Belt states (Langemeier et al., 2016).

The potential for higher interest rates also present a future risk. Higher interest rates have two distinct impacts on U.S. agriculture (Henderson and Briggeman, 2011). Rising interest rates place upward pressure on the dollar, which trims U.S. agricultural exports, farm profits, and farmland prices. In addition, higher interest rates also boost the capitalization rate, which weighs further on farmland prices. The impacts are compounded on highly leveraged farms as higher interest rates reduce incomes and raise debt service burdens, as the 1920s and 1980s demonstrated.

When land values were rising, farmers were aggressive land buyers not only to acquire the income from that land, but also to capture the wealth effect of anticipated higher land values. That wealth effect did not just show up in land purchases but also in purchases of more machinery and facilities because of their stronger financial positions. These purchases were often made by larger growth-oriented farmers who had higher leverage positions.

Even if they had sufficient cash to make sizeable down payments, these transactions have changed the structure of the balance sheet by reducing current assets while increasing non-current assets, and adding to current liabilities by the amount of the annual principal and interest debt servicing requirement. Thus, the liquidity position of the business as defined by working capital or the current asset/current liability ratio was reduced, making these firms more vulnerable to income shocks.

At the same time, farmers who are expanding rapidly have also been aggressive bidders in the land rental market. High and fixed cash rental arrangements have become increasingly common and some of these agreements are for multiple years (2-3 years) at relatively high fixed rates. These high multi-year cash rents result in increased future fixed cash costs much like mortgage obligations on land debt. These "pseudo-debt" financial obligations are typically not reported on the balance sheet, but they are similar to capital lease obligations which increase the leverage and typically reduce the working capital/liquidity position of the business.

During the boom, strong cash positions and concerns about high tax liabilities resulted in significant purchases of depreciable machinery and equipment, which moved assets from the current to non-current category without restructuring the liabilities, thus creating an additional imbalance in the balance sheet. Low crop prices and weak operating margins have more recently caused larger operating lines, which increases leverage and further reduces liquidity.

This increasingly misaligned balance sheet with a higher portion of current vs. non-current liabilities increases the vulnerability of the business to income shocks from lower prices, lower yields, or high costs. Such shocks decrease margins and cash flows as well as inventory positions, and could quickly result in a working capital position below lender underwriting standards. A typical lender response in this situation is to suggest liquidating inventories and using the proceeds to reduce operating debt. However, for farmers who file Schedule F tax returns, this could trigger significant tax obligations since the tax basis on raised grain and livestock for Schedule F tax-filers is zero. Thus, the full proceeds at sale are taxed as ordinary income which reduces the liquidity position even further.

An alternative lender response is to restructure the debt and move some of the current obligations to non-current using the appreciated value of farmland as security. This approach results in leveraging the capital gain in farmland - the leverage effect of capital gains. During the boom, lenders often resisted increasing loan to value ratios on farmland purchases but are now encouraged to monetize capital gains in land by extending additional credit based on the higher land values. Higher land values and the resulting increased equity positions would appear to provide adequate security and secondary repayment capacity to support the larger debt load, but what if land values continue to decline? Clearly, the debt per dollar of revenue generated from the

Table 3. Comparison of Debt-to-Asset Ratio for 2500 Acre Farms with 50% of Land Owned

| | Debt-to-Asset Ratio | |
|---|---|---|
| | 25% | 50% |
| Annual Net Farm Income (mean) | $166,200 | $134,800 |
| Change in Net Worth (3-year; mean) | $926,900 | $474,900 |
| Working Capital to Value of Farm Production | | |
| Mean | 49.5% | 30.1% |
| Percent greater than 35% | 99.9% | 54.4% |
| Debt-to-Asset Ratio | | |
| Mean | 13.0% | 35.6% |
| Percent greater than 55% | 0.0% | 0.0% |
| Term Debt Coverage Ratio | | |
| Mean | 1.5 | 1.1 |
| Percent greater than 1.1 | 97.9% | 61.8% |
| Percent with Positive Cash Position | 98.4% | 53.7% |

land will be higher if price declines and what if lower incomes are permanent rather than temporary. The business is now very vulnerable to further income shocks or asset value deterioration - the working capital position has been destroyed and credit reserves have been fully used. Permanently lower incomes and/or higher interest rates will not only create debt servicing problems, but also reduce the discounted cash flow and thus weaken the demand for farmland.

**Summary: More Farm Adjustments to Come**

U.S. net farm income is projected to drop for the fourth consecutive year in 2017 (USDA). More importantly total sector income in 2017 is expected to be only one-half of the record 2013 level. Farmland values in Indiana declined by 11.7% between 2014 and 2016, with the 2017 results to be published in the August 2017 *Purdue Agricultural Economics Report*, (Dobbins and Cook, 2016). Surveys from the Federal Reserve Banks indicate that land values in the Corn Belt continue to show generally softer values, and debt servicing challenges are increasing.

"Stress-test" results reported here suggest that the financial vulnerability and resiliency of Midwest grain farms to price, cost, yield, and asset value shocks are dependent on their size, ownership tenure and leverage positions. Farms with modest size (550 acres) and with a large proportion of their land rented are very vulnerable irrespective of their leverage positions unless they have significant income from off-farm sources or livestock or specialty crop enterprises. These same modest size farms are more financially resilient if they own a higher proportion of their acreage and therefore rent a small portion. Larger size farms (2500 acres) with modest leverage (25% debt-to-asset ratio) that combine rental and ownership of the land they operate have relatively strong financial performance and limited vulnerability to price, cost, yield, and asset value shocks.

Our results suggest that the statement that farmers are resilient to price, cost, yield, and asset value shocks because of the current low use of debt in the industry (currently a 14% debt-to-asset ratio for the farming sector) does not adequately recognize the financial vulnerability of many typical family farms to those shocks. Not nearly as many farm families are expected to have to sell assets or face bankruptcy compared to the 1980s bust, but many will still face cash flow and debt servicing problems and will need to make major adjustments to reduce their costs or extend their loan repayment terms.

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## INTRODUCING PIFF: THE PURDUE INITIATIVE FOR FAMILY FIRMS!

**MARIA I. MARSHALL**, PROFESSOR OF AGRICULTURAL ECONOMICS AND PIFF DIRECTOR

**RENEE WIATT**, FAMILY BUSINESS MANAGEMENT SPECIALIST


The Purdue Initiative for Family Firms (PIFF) is a new program housed in the Department of Agricultural Economics. PIFF is an integrated research, outreach, and teaching program. It offers educational programs that address the major competencies needed for effective family business ownership and management. The goal of the initiative is to prepare family business stakeholders strategically, financially, and emotionally for the significant and sometimes unpredictable transitions and decisions that must be made, to determine the success and continuity of the family business.

PIFF provides multi-generational family businesses with sound business management resources aimed at improving personal leadership performance and driving operational growth. PIFF's ambition is to prepare family business owners, managers, and stakeholders (including non-owner spouses and future owners) to be effective stewards of their family enterprises.

PIFF publishes a quarterly newsletter that will house an article from each part of the pie (shown here) and on the PIFF website at (the website can be found at https://ag.purdue.edu/agecon/PIFF/Pages/PIFF.aspx). The four quarters of the pie include topics of: estate and personal financial planning, strategic business planning, maintaining family bonds, and leadership and succession planning. Each section houses articles, guides, and assessments of related topics, which can be viewed online or downloaded. Also found on the website is a *Question of the Month*, PIFF Research, and an option to subscribe to our quarterly newsletter and more.

PIFF will continue to do research targeted at providing valuable information that family businesses can directly implement. The information that PIFF provides is targeted for all family businesses from farms and agribusinesses to local retail businesses. An example of such research would be the *FB-BRAG*, a new assessment aimed at examining family business functionality. The FB-BRAG allows users to measure family business functioning in a way that holistically incorporates family and business functionality into one assessment. The *FB-BRAG* can be downloaded here.

## GMOS: PURDUE PUTS SCIENCE FORWARD FOR THE PUBLIC

**JESSICA EISE**, DIRECTOR OF COMMUNICATIONS, DEPARTMENT OF AGRICULTURAL ECONOMICS

Most Midwest farm families raise genetically engineered crops, yet some of their city cousins are uncertain about consuming them. How come? In part, it is due to the fact that as farming becomes more complex, it also becomes increasingly challenging to communicate, particularly when the public is evermore distanced from the farm. One of the issues that has suffered the most is that of genetically modified organisms (GMOs). In 2015, the Pew Research Center conducted a study of opinion differences between scientists and the public. The largest discrepancy of opinions concerned the safety of GMOs.

Of the scientists polled, 88% indicated that GMOs were safe to eat. Amongst the public, only 37% agreed.

This study reveals an underlying truth. The science of GMOs was evolving but the scientific communication about GMOs was not. The result of a lack of good science communication about GMOs caused a factual void. Society at large, as the Pew study shows, became increasingly suspicious of this issue. This was due in part to the complexity of GMOs, but also to misinformation, rumors and misunderstandings wrought by poor communication. The result has been unfortunate but understandable. Many consumers have adopted a self-protective attitude towards GMOs based on suspicion and fear.

To help fill this void and to better respond to public interest through improved communication, the Purdue College of Agriculture launched an initiative called *The Science of GMOs*, which can be found at [www.ag.purdue.edu/gmos](www.ag.purdue.edu/gmos). This is a website with the sole intent of sharing scientifically sound, unbiased information on genetically modified organisms with the public. The content is generated by Purdue faculty and staff in the College of Agriculture with no outside funding. These researchers and professors range from entomologists to experts in botany all the way to molecular physiologists.

The project was developed for use by food consumers and the broader public. We were guided by three principles. The first was a simple but commonly overlooked communication principle: People do not listen to what you think is important, they listen to what they think is important. As such, we picked the questions the broader public were asking on GMOs and sought to answer them directly.

The second principle was to maintain an attitude of understanding and to view the public as an intelligent and rational audience who needs and wants sound information. People felt that their GMO questions and concerns were being ignored. As a result, they felt frustrated. This frustration led to, in certain cases, a sense that important issues were being hidden from them. With this lack of trust, we understood that it could take time to rebuild good communication and to get the scientific facts out there.

The third principle was to allow our audience to decide for themselves. The role of scientists is not to tell people what to believe. Once provided with sound information and analysis, people not only can, but should make up their own minds. It is not the place of science to dictate to others what they should or should not feel. On the contrary, it is our role to simply provide the best contextualized information and analysis, and allow others to draw their conclusions. As we say on the website, “Knowing more equips us to make the best decisions for ourselves and generations to come.” We do not tell anyone what their opinion should be regarding the use of GMOs.

*The Science of GMOs* incorporates three information formats: the written word, a summary graphic and a filmed interview with a scientist. The website answers the eight GMO questions shown below. Our hope is that this site will be an evolving resource to address GMO questions. As such, we hope to help clarify some of the concerns around GMO issues and to fill a bit of the communications void.

## 85TH ANNUAL PURDUE FARM MANAGEMENT TOUR | CARROLL AND HOWARD COUNTIES JUNE 22ND AND 23RD, 2017

**THURSDAY, JUNE 22**

**Scott Farms (7877 W 1100 N, Delphi, IN 46923): Interview at 12:30 p.m. and mini-tours to follow.**
Scott Farms is a diversified crop farm. Operators include Brian, John, and Robert. Crops produced include corn, waxy corn, popcorn, soybeans, seed soybeans and wheat. Scott Farms has a long history associated with specialty crops, such as waxy corn. Specialty crops are utilized to enhance profitability and mitigate risk. As part of the farm's efforts to improve its fertility program, variable-rate technology, side dressing of nitrogen, and drone technology are utilized. The use of cover crops has also been incorporated into the cropping systems. Mini-tours will include a discussion of specialty crop production as well as a discussion of technology utilized on the farm.

**Mylet Farms (5227 N 400 E, Camden, IN 46917): Interview at 3:30 p.m. and mini-tours to follow.**
Tom and Neal Mylet operate Mylet Farms along with input from several other family members. Their focus is on efficiency and innovation. In addition to farming, Neal is the principal behind a startup technology company that already has 12 patents. His most recent innovation is a grain unloading app that you can run from your smartphone. At Mylet Farms, you will have a chance to see how they have automated their grain system. In addition to focusing on their farming operation, the Mylets are very involved in their community and recently coordinated a virtual people-to-people exchange with Carroll County 4-H members and a group in Moscow. The Mylets tour stop will also provide an opportunity to view the Tribine Harvester with its unique harvesting design.

**Indiana Master Farmer Awards Dinner –6:00 p.m. at Wabash & Erie Canal Conference Center (1030 W. Washington, Delphi, IN 46923):**
Pre-registration is required by Friday, June 16. Custom Select Catering will provide a special meal for the event. A ticket ($25) is required. Registration form at: https://ag.purdue.edu/agalumni/Documents/17MasterFarmerDinnerReservationForm.pdf

**FRIDAY, JUNE 23**

**Kirkpatrick Farms (13961 E 300 S, Greentown, IN 46936):**
**Interview at 8:30 a.m. and mini-tours to follow.**
Bryan and Susan Kirkpatrick and their daughter, Andrea, operate Kirkpatrick Farms. They raise corn and soybeans with an emphasis on food-grade corn. Kirkpatrick Farms focuses on improving the health and productivity of the land they farm and were early adopters of farming technology, which will be showcased during the tour. Additionally, Bryan has been a Beck's Hybrids Seed Dealer for over 40 years and has built his business through a focus on customer service.

**Maple Farms (3924 S 250 E, Kokomo, IN 46902):**
**Interviews and mini-tours at 11:30a.m.**
**Pre-register for the free lunch here:**
https://ag.purdue.edu/commercialag/pages/programs/Farm-Tour.aspx
The Agricultural Outlook Update with Dr. Chris Hurt will follow the Maple Farms interview and mini-tours.

Maple Farms is a family partnership, with three generations of the family actively involved in the farm. Maple Farms primarily grows food-grade corn and seed soybeans. One of the keys to Maple Farm's success is attention to details, especially with respect to communication among family members, employees and landlords. To better manage their operation and prepare the farm for transition to another generation, Maples worked with management consultants to develop a strategic plan for Maple Farms. While at Maple Farms, you will gain insights into how they have structured their operation to ensure continuity across generations.

## CORN AND SOYBEAN STORAGE RETURNS IN A WILD DECADE

**CHRIS HURT**, EXTENSION ECONOMICS

The past decade was a wild price ride! The boom began in the fall of 2006 with nearby corn futures at $2.25 per bushel. The first wave of the boom took nearby corn futures to a high of $7.65 by June 2008. Then the U.S. and world economies fell into a deep recession with a financial and housing crisis in the U.S. in late 2008 and 2009. Nearby corn futures fell to $3.00 a bushel in late 2008 and at times in 2009. Then the second boom began in late 2009 moving nearby futures from $3 to the ultimate high near $8.50 during the drought of 2012. Prices then generally moved lower in 2013, 2014, and 2015 as increased production replenished depleted world inventories.

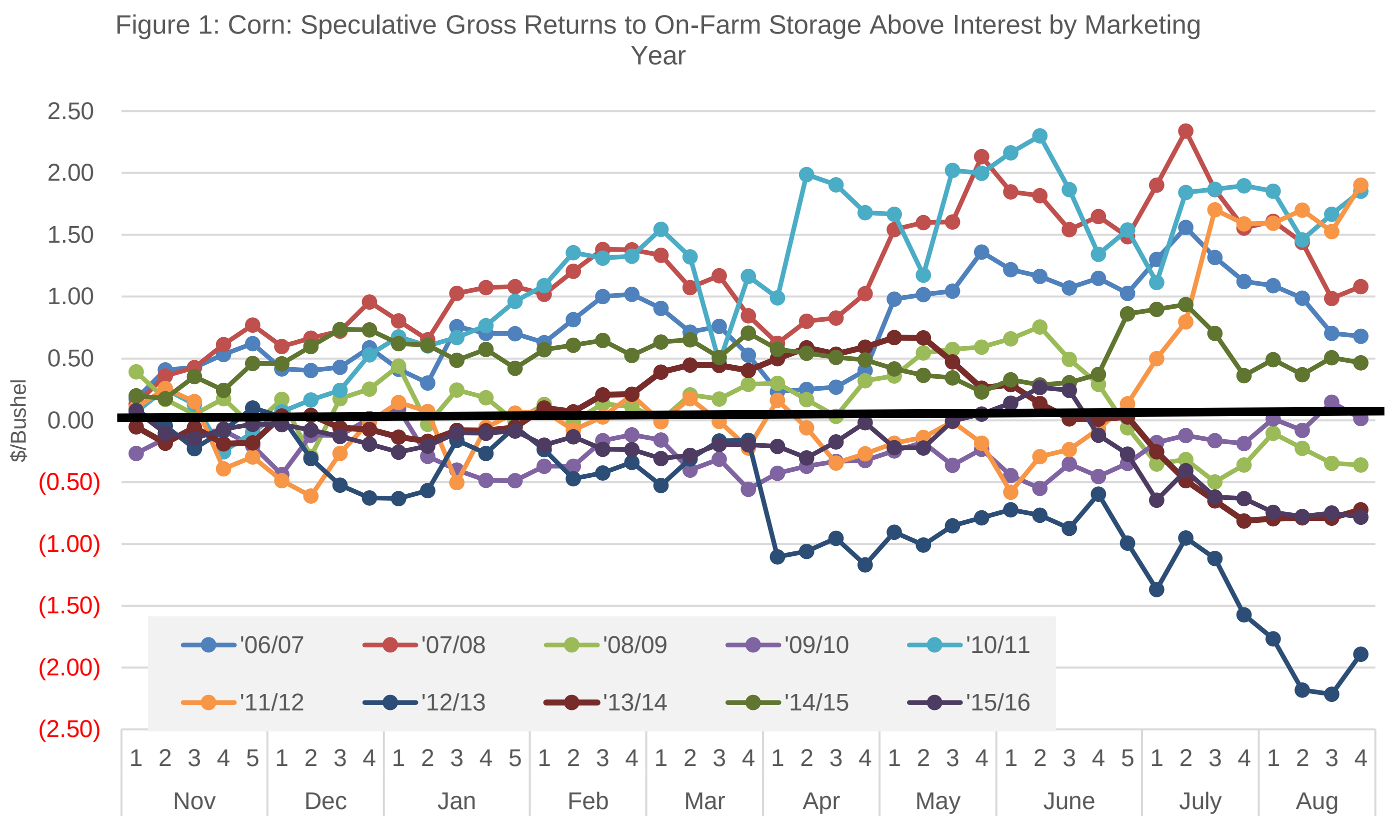
Given the wide price swings of the past decade what was the impact on storage returns? In an attempt to answer that question this article will estimate the speculative storage returns by year, and on average, over the past decade for a central Indiana farm.

What does "speculative" storage returns mean? It is assumed that the farm operator puts grain in storage at harvest and hopes prices will rise by more than storage costs through the storage season. This is among the simplest pricing strategies and is probably the most frequently used strategy among Midwest farm managers. The word "speculation" is used to indicate that the grain is unpriced while it is in storage. Therefore, it will become more valuable if cash prices rise, or less valuable if cash prices decline during the storage season. Returns are estimated for both "on-farm" and "commercial storage" like at a grain elevator that is licensed to store farmers' grain.

### How Returns Were Calculated

Price bids were collected each Wednesday evening from a central Indiana grain elevator that can ship unit trains to the Southeastern U.S. They are also a federally licensed grain warehouse and provide storage for farmers. Weekly bids were collected for the 10 marketing years in the study. The marketing year for corn and soybeans begins in September and extends through the following August. The first marketing year in the study was the 2006/07 marketing year that spans the 12 months from September 2006 through August 2007. The final marketing year was 2015/16 representing the crop harvested in the fall of 2015 and marketed through August 2016. At the time of writing, this was the most recent marketing year for which all data was available.

It was assumed that corn harvest prices were the last two weeks of October each year. For soybeans, it was




assumed that the first two weeks of October was the harvest price. On-farm storage and commercial storage costs were added to the harvest price. Interest costs were added weekly to both on-farm and commercial storage. Yearly interest rates were at the six-month certificate of deposit rate or the prime rate whichever was higher. For the 10 year data period, the average of the annual interest rates was 3.55%. In the case of commercial storage, elevator charges were added as well. These were a flat charge for use of storage until January 1, and then a monthly charge starting in January. Over the 10 year period, the average flat charge was 17 cents per bushel and then 3 cents per bushel per month starting in January.

The question being asked is, "are cash bids each week during the storage season high enough to cover the harvest value plus accumulated storage costs up to that point? Returns to on-farm storage were calculated as the weekly bid price minus the harvest price plus accumulated interest cost. For commercials storage, returns were calculated as the weekly bid price minus the harvest price plus accumulated interest and commercial storage charges.

On-farm storage returns reported here are actually a gross return since the costs of grain facilities and operation costs are not included. The on-farm returns are a return for the investment and costs to operate the grain system. It is important to note this difference between on-farm and commercial storage returns. The commercial storage fees at a grain elevator cover their costs for bins, grain handling equipment, labor, shrinkage, grain loss, and insurance. In this study, these costs are not charged for the on-farm storage situation. So, if the gross returns to on-farm storage were 40 cents per bushel per year this means that the farm manager is receiving 40 cents per bushel per year for the ownership costs of the on-farm storage system and for the labor and management costs of that system.

**Corn Storage Returns**

The past decade was a volatile period with wide price swings. This likely means that gross speculative storage returns were highly variable depending on price movements in each marketing year.

Figure 1 shows those gross returns for on-farm storage by marketing year. The horizontal axes represents weeks of the storage season. Remember that harvest price was considered to be the last two weeks of October, so the first week of November is the first week for which the gross storage returns are calculated. Those extend to the end of August the following summer. Each month has at least four weeks, or sometimes 5 weeks.

The vertical axis is the gross storage returns per bushel above interest. Note the 0.00 line. Observations above this point are positive returns and observations below are negative returns or losses.

The range of gross storage gains or losses is remarkable. In some years speculative gross return for on-farm corn storage gains were over $2 per bushel and in one year were over $2 per bushel of loss. This is even more remarkable when considering that the average U.S. farm price of corn for the previous decade covering the 1996 to 2005 crops was only $2.15 per bushel.

This figure also points out that speculative return risks or uncertainty tends to increase with the length of storage time. This can be seen by observing how results for the 10 years are more tightly clustered for storage into winter, through March as an example. Then, especially starting in April and extending through storage to August, the results tend to have increasing variability.

Why does this occur? There is an increasing amount of new information influencing prices as more time passes after harvest. During the wintertime, the size of the fall harvest is reasonably closely estimated by USDA. Markets are learning about the demand structure, but demand generally does not have as much volatility as supply. As late winter and spring approach, there is new information coming to the market regarding South American production and the anticipation of the U.S. planted acreage for the next crop and the potential for U.S. production. Then as the spring and summer progress, much more information becomes known about the size of the U.S. and other Northern Hemisphere crops.

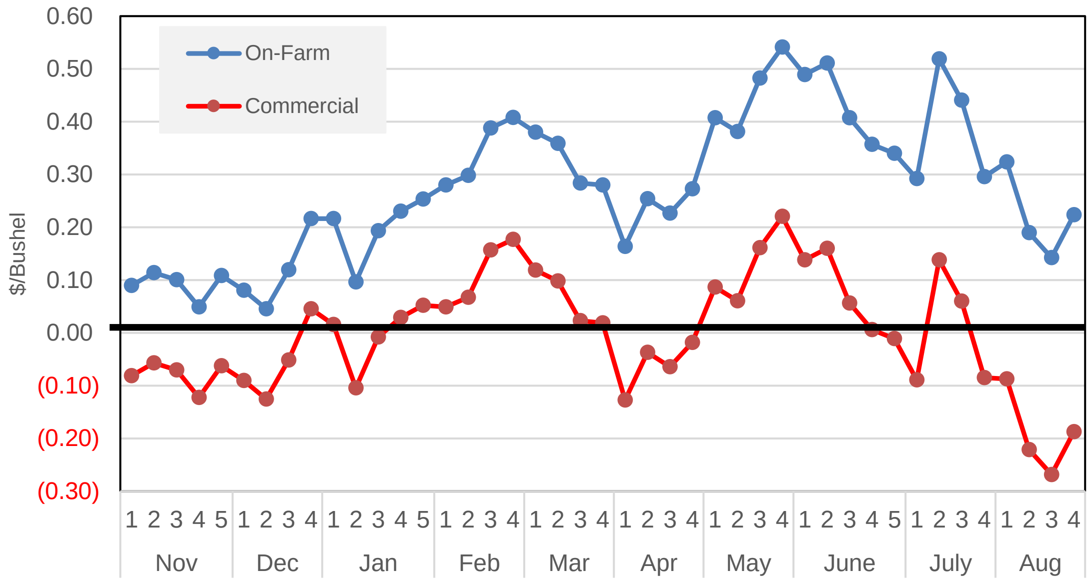
As new information comes to the market there is some randomness to this information if viewed over a number of years as in the 10 years shown here. Randomness simply means that in some years the majority of the new information is bullish and causes prices to overall rise, and in some years the new information tends to be bearish and results in a tendency for overall lower prices.

Two examples will make this last point. On the high return side, one of the years that provided a $2 per bushel positive return to storage was the corn harvested in the fall of 2011. That was the 2011/12 marketing year. By the late summer of 2012, drought had set in and corn prices rose sharply providing the $2 speculative gross return to on-farm storage.

The $2 loss per bushel was the next year 2012/13. In the fall of 2012, prices were record high as corn usage from the tiny 2012 drought crop had to be cut back. At our elevator, cash prices at harvest in 2012 were $7.67 per bushel. However, the 2013 yields returned to normal and a record size crop was seen by August with cash prices dropping to about $5.60 by August of 2013.

A final observation is that a number of the 10 years were unprofitable with negative gross margins. Generally, three or four years out of 10 had negative gross margins for most weeks.

Figure 2: Corn: 10 Year Speculative Returns to Storage: 2006/07 to 2015/16 Marketing Year Averages




What about the averages over the entire 10 year period? This information is shown in Figure 2 for corn. It includes the 10 year gross returns for on-farm and net returns for commercial storage. Remember that the difference between the two is that commercial storage has added costs that includes an average of 17 cents as a flat fee for storage until January 1 and then 3 cents per bushel per month starting January 1. Thus for the months of November through December the returns for commercial storage are 17 cents per bushel less than on-farm. For August, they are 41 cents per bushel less. This is composed of the 17 cent flat fee plus 8 months of storage at 3 cents per month ($.17 + (8 * $.03) = $.41).

On average, gross returns to on-farm storage for corn were highest in February and early March and again in May and early June. At the peaks, these 10 year average gross returns were $.40 to $.50 per bushel per year over the 10 years. A more conservative approximation, assuming one may not hit the highs, is $.30 to $.40 per bushel per year across the February through May period.

What does this mean? Since bin costs and labor are not included in the on-farm storage costs, it should be thought of as the returns to the farm for the costs of owning the grain system; providing the labor and management to operate it; and taking the risk associated with on-farm storage, (some grain going out of condition and theft are two examples).While these gross returns show the highest returns were in May or early June, active farmers want to reserve those days to plant the next crop, rather than haul grain from on-farm bins to market. For this reason, working with buyers to deliver corn in late winter and then seek free DP (Delayed Pricing) with final pricing to be made by summer is a possible strategy.

Another way for a farm manager to think about this is to ask if $.40 to $.50 per bushel per year is enough gross return to cover all the costs and associated risk with owning and operating the grain system. The more conservative number for this historic corn data would be $.30 to $.40 per year.

On average, storage deep into the summer tends not to pay. Most years do not have a traditional late July and August drought. As a result, there is a tendency for storage returns to drop after early July.

The pattern of returns during this most recent 10 years is similar for commercial storage. The returns shown are the average over the 10 year period and do cover all costs, so are net returns.

For the 10 year period studied, there were positive commercial storage returns in a little less than one-half of the weeks. Those positive returns were around February and again in May and early June. Peak net returns were around $.20 per bushel per year on average over the 10 years. Past storage studies have tended to show that commercial storage to the February and March period was optimal over time. However, in the past decade represented by this study, the ultra-low interest rates may be contributing to positive storage returns into the spring.

**Soybean Storage Returns**

A similar evaluation was made for on-farm and commercial soybean storage where a farm manger would put grain in storage at harvest and then speculate for higher prices through the storage season. Weekly returns to storage through the storage season were calculated for the most recent 10 marketing years from 2006/07 through 2015/16. The harvest price for soybeans was considered to be the first two weeks of October so storage returns are reported beginning the third week of October.

Soybean storage returns also varied widely over these volatile price years. On-farm gross returns to speculative storage varied from $7 per bushel positive returns to nearly $3 a bushel of loss at the extremes as shown in Figure 3. The $7 gain came from soybeans harvested in the fall of 2007 with prices exploding by the spring of 2008 during the first price boom. The nearly $3 of loss was for the 2012 crop where harvest prices were at record highs due to the drought and then fell sharply by August of 2013 as near-record production was being anticipated for the fall of 2013.

For soybeans during these 10 years, there were only one or two years that tended to have gross storage return losses. Corn in contrast had three or four.

Average speculative returns to soybean storage was strong over these 10 years as shown in Figure 4. Gross returns to on-farm storage averaged over $2 a bushel for storage until June and early July. Since costs for the grain system and labor and management to operate it are not included for on-farm storage, this $2 gross return can be thought of as the return to cover those costs.

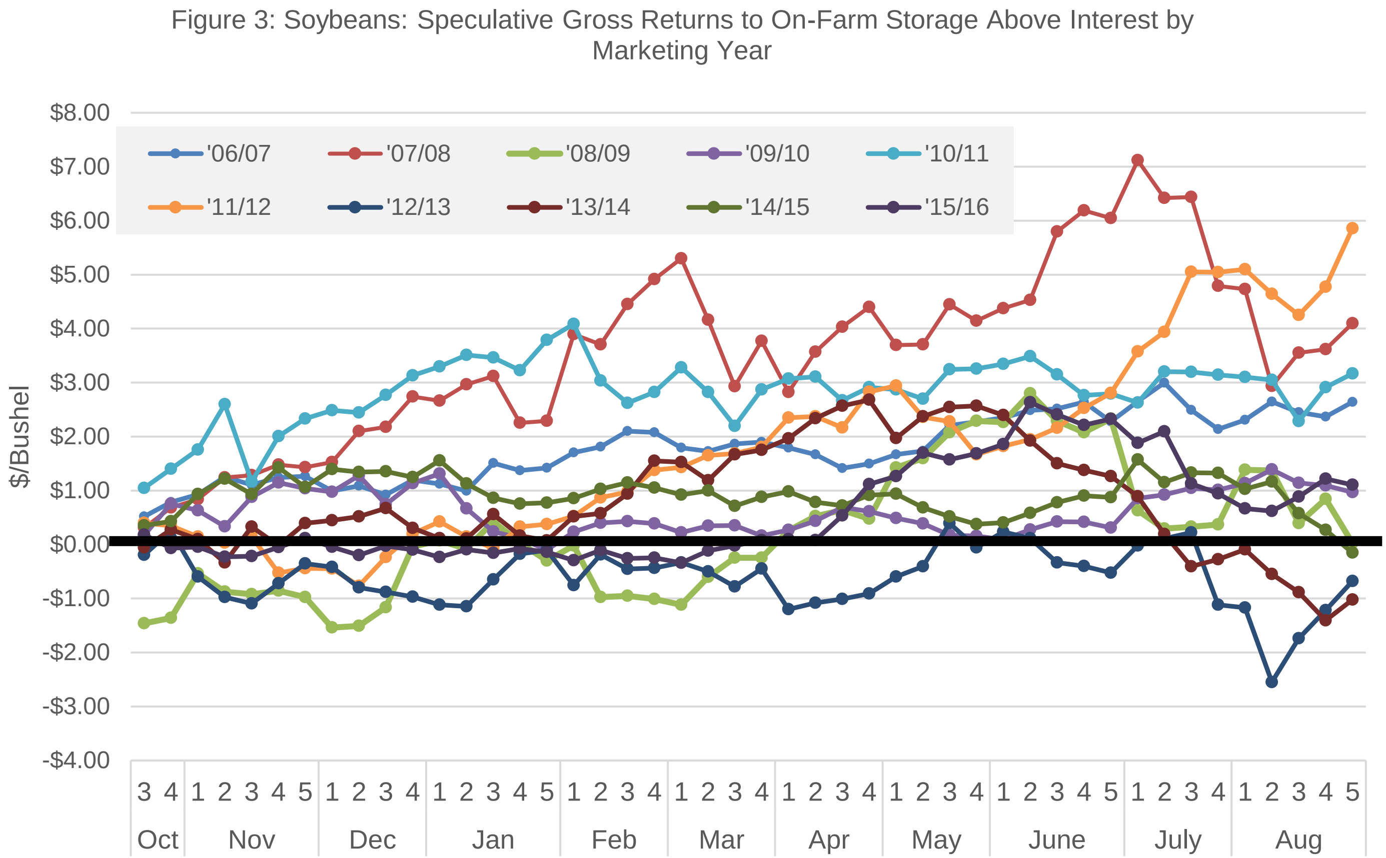
Average net returns to commercial storage were strongly positive as well. Returns were positive and increasing from immediately after harvest until June and early July. Returns for both categories dropped in late July and August.

**Summary**

This article reports on the returns to storage for corn and soybeans during the most recent 10 marketing years spanning 2006/07 to 2015/16. The returns are calculated as if a farm manager put grain in storage at harvest and then waited for prices to rise. As such, the owner is speculating on the price to rise by enough to cover the harvest value plus storage costs.

For this analysis, grain bids from a central Indiana grain elevator were collected each Wednesday evening over the 10 year period. Storage returns for corn and soybeans are reported weekly. On-farm storage returns include interest but not charges for grain facilities and the labor and management to operate the on-farm grain system. This means on-farm returns are the gross returns to cover the costs of the facilities and labor and management to operate them. Commercial storage charges are included for elevator storage and thus represents a net return.

The most recent 10 marketing years included a price boom and price moderation cycle. In addition, there were wide swings in world production, and a severe financial crisis and the subsequent "Great Recession" in 2008 and 2009



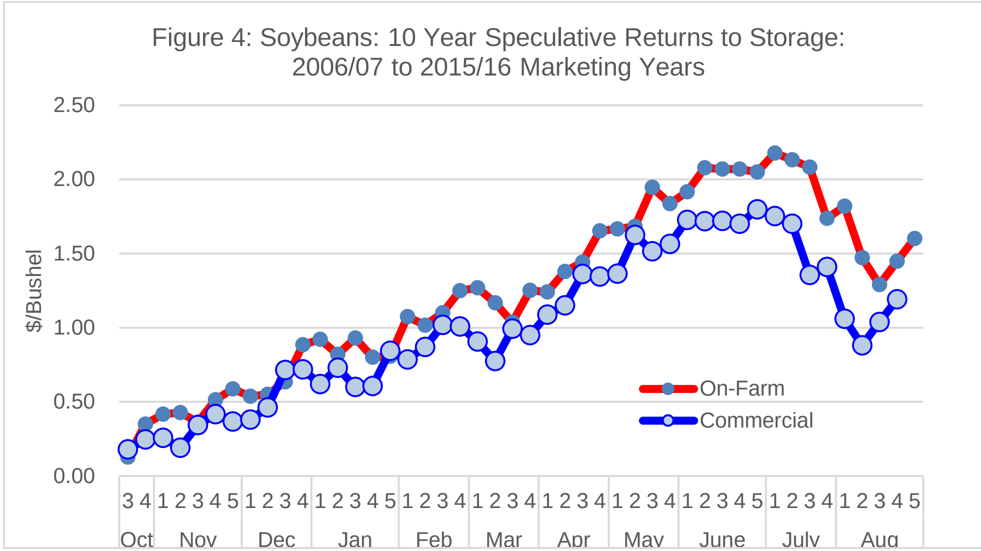

The study showed that the riskiness of storage returns tends to increase the longer grain is stored. This is because there is an increasing amount of new market information as time passes after harvest. This new information has some randomness from year to year and may result in price tendencies after harvest that can be bullish, bearish, or neutral.

The recent past has been a volatile period for grain and soybean prices and this is reflected in wide swings in the speculative returns to storage. For corn, the extremes ranged from over $2 a bushel of positive gross returns to over $2 a bushel of loss. For soybeans, the range was from $7 a bushel of positive returns to nearly $3 a bushel of loss.

Gross returns for on-farm corn storage averaged about $.30 to $.50 for storage selling at the optimum time during these 10 years. This can be viewed as the return for the on-farm investment in the grain facilities and the operation and management of that system. Two periods of storage were near optimum. One was to sell corn in late February and March and the second was in May and early June. Commercial corn storage returned positive average returns in less than half of the weeks during the storage season. Optimum commercial returns were in the range of $.10 to $.20 per bushel per year on average and focused on selling around February and another period in May and early June.

Returns for soybean storage during these volatile price years were more positive than corn. Gross returns for on-farm soybean storage was about $1 per bushel per year by February and kept rising to near $2 per bushel per year by June and early July. Commercial soybean storage net returns reached about $1.70 per bushel by June and early July.

## Implications for Farm Managers




1. Speculative storage returns can vary sharply from year to year. Much of that volatility is driven by the new information that comes to the market during the storage season such as the size of the Southern Hemisphere crops and growing conditions in the U.S. during the next production season.
2. The longer one stores into the storage season the great the volatility in storage returns (on average). For example storing grain into July of the following summer can result in higher or lower old crop speculative storage returns depending on supply and demand conditions that are evolving for the new crop.
3. This study and others suggest that storage into late July and August has diminishing storage returns when returns are averaged over a number of years. In most years, there is not a late summer drought and thus late July and August are transition periods when crop prices are moving from the higher old crop prices to lower new crop prices.
4. Soybean storage returns in this study were very large with on-farm gross returns of $1 to $2 per bushel per year. This is much higher than in previous studies and may be related to the upward shifting Chinese demand during the study period. The U.S. shipped about 400 million bushels of beans to China from our 2006 crop. That grew to an astounding 1.1 billion bushel by the 2015 crop, the last year in this study. Sharply increasing demand could have provided a more bullish overall pattern to soybean prices. Then again, the abnormally high storage returns to soybeans may just be related to the specific years in the study and the unique set of events during these years.
5. For those without on-farm storage, selling corn out of the field at harvest was not such a bad strategy in these 10 crop years as more than one-half the weeks resulted in negative commercial storage returns. However, those that do not store should consider starting to forward price in the spring and add to the amount priced by very early July if their yield prospects are favorable.
6. One golden storage rule is to strongly consider <u>not</u> storing in years that are likely to provide negative storage returns. That is generally a year when the national crop is small, like in a drought year. Characteristics of those years are when the nearest futures prices are higher than futures prices into the storage season and/or when cash bids for harvest delivery are higher than the bids for delivery later in the storage season like in January, March or May. The 2012 drought-reduced crop provided these conditions at harvest. If one had not stored that year and simply sold at harvest, they would have avoided

negative storage returns and noticeably raised the average returns over the entire 10 year period

7. Every year can be different and reading the storage signals in that crop year and adjusting storage strategy can increase storage returns if one is able to correctly read the signals. However, for those who are not able to accurately adjust to storage signals a routine strategy that uses some of the seasonal pricing points shown in this article may be preferred. In any case avoiding storage in years like 2012 as outlined in #6 is to be considered.
8. Grain elevator managers and other buyers tend to be experts at understanding the storage signals and in making decisions about storage. Talk with them, learn from them, and discuss potential storage returns each season with them. However, remember that for the grain they buy and store for the elevator, they are generally futures hedgers. That is a topic for another article as farmers can also be futures hedgers.

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## A SPECIAL THANK YOU TO GERRY HARRISON

We want to say a special Thank You to Gerry Harrison in his retirement year. Gerry was the co-founder of the *Purdue Agricultural Economics Report* back in 1973. He has been the heart and soul of the publication for the past 44 years and the sustaining energy of the publication. His contributions have been as editor, serving on the editorial board, writing articles, and helping to make the PAER among the most widely distributed publications of the Department.

Gerry earned both Ph.D. and Juris Doctorate degrees making him one of the few who was highly trained in both farm management and legal issues. The focus of his work is in farm management, estate planning, federal tax laws, business succession planning, and the whole range of legal issues that surround Indiana agriculture such as farmland leasing, conservation easements, mineral leases, like-kind exchanges, and many more.

He is well remembered by students for courses he taught on campus including Ag Law, Estate Planning, and Federal Income Tax Law. Through the Purdue Extension Service he reached virtually everyone in Indiana and Midwest agriculture. He offered an extensive list of articles and references to the legal questions in agriculture and he made those readily available on the web. He taught countless seminars to farmers, landowners, professional farm managers, lawyers, accountants, and certified financial planners. He was always available by phone and e-mail to take legal questions.

Again we Thank Gerry for the *Purdue Agricultural Economics Report*, for his many years of nurturing this publication, and for his contributions to Indiana agriculture and beyond.

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