# Simulated Western Kentucky Grain Farm Cash Flows, Working Capital Erosion, and Evaluation of Risk Management Tools to Manage these Risks

By

Todd Davis
Department of Agricultural Economics
University of Kentucky
(todd.davis@uky.edu)
Phone: 270-365-7541 ext. 243

Tyler Mark
Department of Agricultural Economic
University of Kentucky
(tyler.mark@uky.edu)
Phone: 859-257-7283

Johnathan Shepherd
Department of Agricultural Economic
University of Kentucky
(jdshepherd@uky.edu)
Phone: 270-737-4799

***Selected Paper prepared for presentation at the Southern Agricultural Economics Association's 2017 Annual Meeting, Mobile, Alabama, February, 4-7 2017***

Grain farmers have emerged from a period of record commodity prices that resulted from domestic and export demand growth. Soybean exports increased 96% from 2005-2014 and corn for ethanol use increased 224% from 2005-14. The 2010-2012 period also had below-trend yields that contributed to supply not increasing to keep pace with use. The result was a sustained period of higher corn and soybean prices. USDA projects that the rapidly expanding demand growth will slow from 2014 to 2025. Corn export growth is projected at 22% from 2015-2021 after declining 13% from 2005 to 2014 (USDA-OCE 2016). USDA projects soybean export demand to increase by 4% for 2014-2025 (USDA-OCE 2016). Corn ethanol use is projected to decrease by 4% from 2014-2025 (USDA-OCE 2016). As demand growth has slowed, the grain markets have rebuilt ending stocks causing prices to fall to lower levels. The projected U.S. marketing-year average price for corn and soybeans for 2016 is $3.40 and $9.50 (USDA-OCE 2017), respectively. These prices are 51 and 34 percent lower for corn and soybeans, respectively, than the U.S. Marketing-Year Average (MYA) prices for the 2012-2013 marketing-year.

The February 2016 Agricultural Baseline Projections provided by USDA for 2017-2020 predicts lower commodity prices will continue for the near future unless there are production problems or demand shocks to support higher prices. USDA is projecting the U.S. MYA corn price to be $3.30 - $3.45 per bushel for corn and the U.S. MYA soybean price to be $9.40 to $9.45/bushel for soybeans for 2017 – 2020 (USDA-OCE 2016) . These prices are 50% and 35% lower than they were in 2012 for corn and soybeans, respectively. The 2016 Baseline projections remind producers that commodity prices are likely to adjust to lower levels below current operating and fixed costs. This lower equilibrium price is needed to discourage supply and encourage demand. This adjustment process will not take place overnight and will most likely result in producers managing losses as they adjust their cost structure. This adjustment could create significant management challenges depending upon the operation.

For many producers, these prices are below their break-even price. The USDA’s Costs and Returns projections, based on the Agricultural Resource Management Survey (ARMS), for the typical U.S. corn farm shows how quickly operating and overhead costs adjusted higher with the price of corn. The projected average operating expenses in 2005 were $186/acre increasing to $335/acre in 2015 (USDA-ERS 2016). Similarly, the average overhead costs, which are primarily land rent and machinery depreciation, are projected to have increased from $201/acre in 2005 to $342/acre in 2015 (USDA-ERS 2016). This higher cost structure makes marketing at profitable prices more challenging as the corresponding break-even prices have increased from $2.60 per bushel in 2005 to $4.05 per bushel in 2015 to cover operating and overhead costs (USDA-ERS 2016). Managers could still face liquidity issues that lead to insolvency by only covering cash input costs. Managers need to verify that the break-even price also covers principal and interest payments on intermediate and term debt. The break-even price should also provide a contribution to the family living expenses paid from the farm business.

During this period of high commodity prices, Kentucky corn and soybean farmers have enjoyed several years of above-average and record profitability. Farmers participating in the Kentucky Farm Business Management (KFBM) financial management program had an average Net Farm Income (NFI) in 2013 of $544,511. The average NFI in 2014 was $173,564 with a forecast of $95,352 for 2015. Expectations are for even lower NFI for 2016-2020 (Pierce 2016). At the 2015 NFI level, the average KFBM grain producer will have an estimated deficit of $13,000 to cover the cost of family living for the operation

The KFBM data suggest that solvency is not currently a problem, on average, for Kentucky grain farms. The average debt/asset ratio, at 0.32, is on the warning level of the Farm Financial Standards Council Scorecard. The average debt of the farms for 2014 was $2.5 million, but these farms had average asset values of $8 million. Land values remain strong which supports this lower than expected solvency ratio (Pierce 2016). Decreasing land values will erode the strong debt/asset ratio that many KFBM members currently have and make debt issues more of a management challenge in the future.

The KFBM data show the average working capital declining from over $1 million in 2013 to below $600,000 for 2015. The current ratio (Current Assets/Current Liabilities) was 2.06 in 2013 with the forecasted current ratio for 2015 at 0.52. This erosion in working capital leaves little financial cushion to absorb the impact of lower yields, lower prices or increased costs without significantly impacting the farm's liquidity (Pierce 2016). Managing liquidity problems is important because cash flow problems can evolve into solvency problems for the farm business.

Farm managers need to reduce costs, especially land rent, machinery overhead, and family living expense, to improve profitability and liquidity during this period of lower prices. Managers also have risk management tools available to protect revenue and working capital. The primary risk management tool is revenue protection (RP) crop insurance. RP insurance provides protection against yield risk, price risk or both lower yields and prices. The 2014 Farm Bill also establishes two programs that provide additional risk protection. The ARC-CO program guarantees revenue at the county level based on the product of Olympic average county yield and Olympic average U.S. marketing-year average price. The use of Olympic averages provides some protection against multiple years of low commodity prices as the effect of lower prices will reduce the revenue guarantee gradually over time. Conversely, ARC support levels will only rise slowly should market prices jump as has been observed in the recent past.

The Price Loss Coverage (PLC) program provides protection against lower U.S. MYA price. A PLC payment is triggered whenever the U.S. MYA price is below the program's target price. For corn and soybeans, the PLC target price is $3.70 and $8.40 per bushel, respectively, and the target prices do not change throughout the farm bill.

Managers also have market-based price risk management tools. One tool is cash-forward contracts (CFC) used to establish a fixed cash price. This tool is easy to understand, as managers do not have to use commodity brokers, pay margin calls, or learn futures market terminology. The CFC is a contract made with a grain elevator for a specified quantity, quality, and delivery date.

The effectiveness of risk management tools to offset market revenue loss needs to be better understood as managers adjust to lower commodity prices and experience sticky costs. Crop insurance and ARC-CO adjust to current (RP) and long-term price trends (ARC-CO) which means that the ability to absorb farm-level risk may be quite reduced further out in the planning horizon. Similarly, opportunities to use CFC may be scarce, as markets may not rally to profitable price levels as obtained in previous years. While not widely elected in Kentucky, managers should understand the role PLC could play in managing risk as they contemplate potential changes to the 2014 Farm Bill.

This paper evaluates the impact of lower commodity prices on Western Kentucky corn-soybean case farms from 2016-2020. A Low Cost / Low Debt (LCLD) and High Cost / High Debt (HCHD) farms will simulate returns over input costs, land rent, debt payments and family living for 2016-2020. The model incorporates price and yield risk to simulate the amount of working capital for both farms. Various risk management alternatives are simulated to evaluate the impact on profitability and working capital. Because insurance is the primary risk management safety net available to farmers, the model simulates RP crop insurance ability to protect revenue and working capital. The case farms use the most commonly purchased insurance coverage levels in Western Kentucky of 80% coverage level for corn and 75% coverage level for soybeans. The Farm Bill Title I programs of ARC-CO and PLC are simulated as the "free" safety net programs are available to farmers that have base acres.  A price risk management alternative, cash-forward contracts, will be evaluated to evaluate the impact of a one-time use in 2016 on the long-term profitability and working capital impacts of the business. The complete safety net of RP, CFC, and ARC-CO/PLC is evaluated to better understand the complementary aspects of the market-based and government risk products. A hypothesis is that risk management products have multi-year benefits and this paper will illustrate the benefits of risk management for the LCLD and HCHD farm. The results will be of interest to farmers, Extension agents, agricultural lenders, and policymakers.

**Case Farms Development**

Data from the 2014 KFBM summary are used to develop average balance sheets and income statements for two case farms. The 2014 summary was the most current data available when developing the case farms. The working capital values for cash, grain inventories, and operating loan balances were updated based on KFBM specialists' expert opinion of financial conditions of grain farms in the program as the specialists closed the record books for 2015. These working capital adjustments were incorporated into the 2016 beginning balance sheets for the case farms.

The two case farms illustrate the interactions between efficiency, profitability, and liquidity for Western Kentucky grain farms. Western Kentucky is the primary grain-producing area growing about 80% of the corn and soybeans in the state. The case farms simulated returns and cash flow for an LCLD farm and an HCHD farm. These farms were assumed to have the same amount of tillable acres (2100), same yields (170-bushel corn / 55-bushel soybeans), crop-mix (60% corn / 40% soybeans) and same marketing prices. These assumptions were made to focus the discussion on cost structure, profitability and liquidity.

Table 1 describes the production, cost and financial assumptions for the case farms. The LCLD farm was assumed to have production costs, defined by University of Kentucky Crop Enterprise Budgets, of $407 and $248 per acre for corn and soybeans, respectively (Halich 2016). The LCLD farm assumes 25% ownership of the land base and paid cash rent of $225 on the remaining 75% of the land base. The HCHD farm's production costs were $65/acre greater than that for the LCLD farm reflecting the cost differentials reflected in KFBM data between the most profitable and least profitable farms (Jenkins, 2016). The HCHD farm assumes only 10% ownership of the land base and paying a $25/acre premium for cash rent for the 90% of the rented land base. Both farms were assumed an average yield of 170-bushel corn and 55-bushel soybeans each year of the simulation. Both farms also received the state's MYA price based on the historical price relationship between the U.S. MYA price and Kentucky's MYA price. These assumptions were made to remove the impact of different production levels or different marketing skills from the profitability discussion.

Table 2 summarizes the case farms' beginning balance sheets for January 2016. Both farms started with the same value of grain inventory as they are assumed to have the same production and marketing skills. Similarly, the farms had the same values for machinery/equipment and retirement savings. The intermediate and long-term assets are needed to define the farm's debt structure and the current portion of principal and interest on intermediate term debt and long-term debt due as current liabilities each year of the simulation. The model calculates the accrued interest on this debt as part of the farm's current liabilities[1]

The cash balance for each farm depends upon the financial ratios assumed for each farm. The LCLD farm was assumed to have a debt/asset ratio of 0.30 and a current ratio of 1.35 on January 1, 2016. Further, the LCLD farm's debt structure on January 1, 2016, was 15% current, 30% intermediate, and 55% long-term. The HCHD farm's debt/asset ratio was 0.50 with a current ratio of 0.85 on January 1, 2016. The HCHD farm's debt structure was 18% current, 48% intermediate, and 34% long-term on January 1, 2016. The cash balance for each farm was the amount that meets these financial constraints (Table 2).

Both farms have the same operating note limit of $850,000, which assumes lenders would loan up to 80% of expected operating expense. Access to operating capital is variable and determinant on farm-specific financial characteristics. An assumed access of 80% is consistent, anecdotally, with informal in person lender surveys. The LCLD farm has $135/acre of available credit while the HCHD farm has $17/acre of available credit at the start of the simulation.

**Description of Stochastic Simulation Model**

A stochastic simulation generates correlated distributions of farm-level and county-level yields; revenue protection (RP) crop insurance projected and harvest prices; and the U.S. and Kentucky marketing-year average prices. Stochastic prices were simulated using multivariate empirical distributions in Simetar ®. The historical relationship with the U.S. MYA corn or soybean price defines the deterministic components of the other stochastic prices simulated (Table 3). In this way, the deterministic components adjust to the U.S. MYA price drawn each iteration. The 2016 Agricultural Baseline Projections define the deterministic U.S. MYA prices. The U.S. MYA prices are made stochastic using the error terms of the historical prices as a percentage of the average price. The stochastic components used for the other prices are the percent error terms from the regression equations in Table 3.

The GRK distribution in Simetar ® is used in simulating the farm-level corn and soybean yields. The GRK distribution uses an expert's opinion of the minimum, most likely and maximum yield possible for corn and soybean production. County yields for Union County, Kentucky, are simulated as multivariable empirical distributions with the error terms defined as a percentage deviation from the trend yields (USDA-NASS 2016).

Revenue protection insurance is based on a farm's Actual Production History (APH) yield, which is the average of a minimum of four, and maximum of ten consecutive years of farm-level yields. The stochastic projected and harvest price along with the stochastic farm yield determines if an indemnity is triggered for each iteration. The case farms' APH yield is assumed to be 170 and 55 bushels, respectively, for corn and soybeans for 2016. The APH yield is updated with each iteration and can only increase or decrease by 10% from the previous year to keep the yield from increasing or decreasing rapidly from year to year.

ARC-CO payments are calculated based upon the county's Benchmark Revenue. The Benchmark Revenue is the product of the county Olympic Average Yield and Olympic Average U.S. MYA Price. An ARC-CO payment is triggered whenever the realized county revenue (U.S. MYA price x county yield) is 86% of the benchmark revenue. The ARC-CO payment is limited to 10% of the benchmark revenue. It is assumed that the grain farm has base acres equal to crop acres and in the same percentage as the crop mix (60% corn and 40% soybeans). The stochastic county yields and stochastic U.S. MYA prices determine if a payment triggered for each iteration. The ARC-CO payments cover 85 percent of base acres for the farm.

PLC payments are triggered whenever the U.S. MYA price is less than the Target price with the payments capped at the U.S. Loan rate ($1.95/bushel for corn and $5.50/bushel for soybeans). Potential PLC payments can range from $0 to $1.75 per bushel for corn and $2.90 per bushel per base acre for soybeans. Payments are based on a historic yield with PLC payments covering 85% of base acres for the farm.

The cash market is not simulated in detail as both farm are assumed as average marketers receiving the MYA price for their production. To evaluate the effectiveness of using CFC to protect price, 23% (50,000 bushels) of expected corn production is CFC priced at $4/bushel and 30% (14,000 bushels) of expected soybean production is CFC priced at $11/bushel for 2016. Both crops could have been contracted at these price levels in early June 2016 and were not the maximum pricing opportunities available to farmers monitoring the market. Some farmers in Western Kentucky could have CFC corn at $4.50 and soybeans at $11.25 in 2016 (DTN). This one-time use of this price risk tool is to evaluate if there is any multi-year benefit of improved profitability and improved liquidity.

The simulation model calculates the stochastic return over input costs, cash rent, cash overhead costs, accrued interest, operating debt, current portion of principal for non-current debt, and family living expense. Family living expense is assumed to be $75,000/year for the LCLD farm and $85,000/year for the HCHD farm. Both amounts are less than the average family living expense for KFBM farms (Jenkins 2015).

The simulation model will meet any profit loss by incorporating the loss into operating debt. If the farm has no additional credit to meet the deficit, then the farm uses cash to pay the deficit. Grain inventories are then used to meet any remaining deficit. The simulation ends when the farm runs out of grain inventory as the farm has eliminated working capital.

## Scenarios Simulated

Seven scenarios, described in Table 5, are simulated to illustrate the impact of a sustained period of low prices on liquidity and working capital. The base scenario assumes that the U.S. MYA price follows the projections from the 2016 Agricultural Baseline Projections adjusted by equations in Table 3 to the Kentucky MYA price.  The base scenario is scenario 1 and does not include any risk management tools to protect revenue and working capital (Table 5).

The second scenario assumes that RP crop insurance is purchased annually at the 80% and 75% levels, respectively, for corn and soybeans (Table 5). These are the most commonly purchased coverage levels in Kentucky. The third scenario assumes that farmers only use the ARC-CO farm program to manage risk. In contrast, the fourth scenario assumes that farmers only use the PLC farm program to manage risk. The fifth scenario assumes a one-time use of price risk management (Cash Forward Contracts) in 2016 at $4 and $11, respectively, for corn and soybeans. The amount contracted was 23% of expected corn production (50,000 bushels) and 30% of expected soybean production (14,000 bushels) (Table 5).

The sixth and seventh scenarios combine the price risk, crop insurance, and farm program payments into a complete safety net. Scenario 6 is CFC, RP insurance, and ARC-CO while scenario seven is CFC, RP insurance, and PLC (Table 5).

Each scenario is simulated using Simetar ® for 500 iterations per scenario. The pseudo-random number generator uses a seed to provide the same stochastic prices and yields for each iteration of each scenario. This allows the impact of risk management tools for a specific iteration to be used in illustrating the performance of risk management tools on profitability, liquidity, and working capital for a specific price and yield outcome.

## Case Farms Simulated Results

<u>LCLD Farm</u>

The average simulated per acre returns for the LCLD farm's base scenario (Scenario 1) show that the LCLD farm becomes more profitable if prices adjust higher over the five-year period without any risk management (Table 6). The loss in 2016 is -$310/acre and declines further in 2017. However, the LCLD farm can claw through the profitability problems with returns in 2020 $142/acre greater than the average in 2016 (Table 6).

The use of RP insurance (Scenario 2) in 2016 was not beneficial as the 2016 yield was deterministic in the model and did not trigger an indemnity. The benefit of insurance is demonstrated in the following years, as the average return in 2020 is $20/acre greater than the base case (Table 6).

The ARC-CO program payments in Scenario 3 arrive in the year following the revenue loss. The timing of payments means that farmers will receive an ARC-CO payment based on the 2016 crop sometime after October 1, 2017. As a result, the ARC-CO program does not provide timely assistance to crop related revenue loss. The average return with ARC-CO is improved by $196/acre over the return in 2016 (Table 6). As compared to scenario 1, the average return in 2020 is $55/acre larger with ARC-CO than without (Table 6).

Farmers also receive the PLC program payments (Scenario 4) at the same time as ARC-CO payments. PLC improves the average return by $205/acre from 2016 to 2020. ARC-CO is projected to make larger payments earlier in the period, which would have an immediate and greater benefit to meeting cash flow deficits and reducing the use of working capital than with the PLC program (Table 6).

A one-time use of CFC in 2016 (Scenario 5) provides a benefit in 2016 of $27/acre over the base scenario. The one-time benefit cascades through the farm's ability to cash flow, which reduces the need to increase operating debt, spend savings, or liquidate grain inventories. These benefits pass through to the year 2020 where the average return is $2-/acre greater than the return for the base scenario (Table 6).

The combined safety net for insurance, cash forward contracting, and ARC-CO (Scenario 6) and PLC (Scenario 7) allows the LCLD farm to become the most profitable, on average, by 2020. The ARC-CO and PLC payments improve average returns by $203 and $230/acre for scenario 6 and scenario 7, respectively, over the farm's return in 2016 (Table 6).

The probability of obtaining a positive return by the year 2020 is 21% for the base scenario (Table 7). The risk management tools improve the likelihood of becoming profitable by 2020 with the combined safety net of RP insurance, CFC, and ARC-CO (Scenario 6) having a 52% probability of positive returns. The RP, CFC, and PLC safety net (Scenario 7) has a 44% probability of positive returns in the year 2020 (Table 7).

The LCLD farm ends 2016 with a current ratio of 1.31 with liquidity problems reducing the current ratio in 2017 for Scenarios 1 and 2. The base scenario eventually has a current ratio greater than two by 2019 (Table 8). The individual risk management tools improve liquidity for the LCLD farm with the current ratio greater than 3.7 for Scenarios 2 through Scenario 7 in the year 2020 (Table 8).

While there is zero probability of the current ratio reaching zero in any year simulated, the LCLD farm does risk having liquidity concerns of a current ratio less than 1. The current ratio in the year 2020 has a 19% probability of being less than one for the base scenario (Table 9). Risk management reduces this risk with the full safety net (Scenario 6) having a 1% probability of the current ratio less than one in the year 2020. The sizeable ARC-CO payments made in the early years provides longer-term benefit by reducing the need to use working capital or increase operating debt (Table 9).

While not shown here, the benefit of risk management for the LCLD farm is the ability not to have to liquidate cash, grain inventory, or accumulate additional debt. The LCLD farm can carry additional bushels into the next year to sell grain at a higher springtime price to become more profitable. The lower debt also reduces the farm's cost structure due to lower principal and interest payments due each year. While risk management does not fully compensate for a loss, the payments allow the LCLD to preserve working capital to manage future revenue risk.

HCHD Farm

The HCHD farm has a cost and debt structure that makes the probability of obtaining positive returns less likely than that for the LCLD farm. For the base scenario, the average per acre return declines from -$592 to -$888 from 2016 to 2020 (Table 10). The same risk management tools, with the same risk management payments as the LCLD farm, are simulated for the HCHD farm. Risk management products provide limited benefits for the HCHD farm as compared to the LCLD farm. For example, ARC-CO improved average returns by the year 2020 by $180/acre for the LCLD farm (Table 6). The average return for the HCHD farm with ARC-CO declines by $317/acre by the year 2020 (Table 10). This result is consistent for the other risk management tools (Table 1). The combination of gradually increasing prices coupled with risk management products are not enough to provide relief for the farm that has poorly structured debt and an inefficient cost structure. The risk tools do not provide enough benefit to allow this farm to pay down debt or preserve working capital for the next year (Table 10). There is zero probability of having a positive return in any year for any scenario.

While not shown, the HCHD farm starts the simulation with very little available operating credit, which is exhausted in the first year. There is zero probability of regaining credit which removes one strategy in managing liquidity. Since credit is constrained, the next source of liquidity is cash, which is also limited. The simulation allocates all available cash in the first year simulated, and the farm does not restore cash in years 2017 to 2020.

As a result, the HCHD farm manages liquidity through grain sales. The average grain inventory value for the base case falls from $679,295 in 2016 to $40,225 in 2020 (Table 11). There is an 82% probability of depleting grain inventory by the year 2020 for the base case (Table 12). Risk management tools can reduce the likelihood of running out of grain by the year 2020. However, the complete safety net of RP, CFC, and ARC-CO still has a 52% probability of running out of grain by the year 2020 (Table 12).

The HCHD farm reinforces the concept that risk management tools are not a silver bullet cure for farms with cost structure, debt structure, and leverage problems. While the risk tools allowed the LCLD farm to avoid a fatal blow low prices or low yields, the HCHD farm was not able to overcome the structural problems to improve the liquidity and profitability problems.

There is a 100% probability of the HCHD farm having a current ratio less than one for all years simulated for all scenarios. The issue is the likelihood of having a current ratio equal to zero. Table 13 shows the probability of a zero current ratio is 81% for the base case in the year 2020. The risk management safety net provides some assistance; however, the probability of having a zero current ratio is 52% for the RP insurance, CFC and ARC-CO safety net (Scenario 6) (Table 13).

## Implications and suggestions for future research

The implications for farmers, Extension personnel, agricultural lenders, and policymakers are that this period of low prices will require more engaged managers, lenders and educators. Farmers more similar to the HCHD farm should engage lenders to work on plans to shift current debt towards long-term debt to lighten the annual debt and interest obligations. The cost cutting measures providing the most benefit are the sticky costs of cash rental rates, family living expense and overall machinery overhead expense. These costs will adjust slowly, and this adjustment process is not included in the simulation. The results can be considered a worst-case scenario. The warning signs are there for those farms with uncompetitive cost structures or poorly structured debt.

The LCLD farm shows that some farms may be able to strategically benefit in this environment in expanding their operation as long as cost and debt structured are controlled. While this may be a paradoxical outcome, the LCLD farm manages liquidity through the operating note. This naïve management strategy implies that more diligent managers with efficient cost structures could finance expansion without risk exposure.

Policymakers should understand that risk management tools of crop insurance and ARC-CO provide a safety net that ebbs and flows with the market price. As prices have moved lower since the 2014 Farm Bill was enacted, this safety net is much lower than originally envisioned. Farms that are efficient without debt issues (LCLD farm) can still use this safety net to work through a sustained period of low prices. This safety net does not help farms like the HCHD farm, as the payments are still not enough to improve the liquidity challenges.

As policymakers contemplate the next farm bill, the issue may be one of evaluating the effectiveness of a revenue-based vs. price-based safety net. A farm-level revenue program would provide the best protection. Unfortunately, this type of policy is not financially feasible for the Federal government. A price risk program, like PLC, may provide better protection as long as the government can continue to finance target prices at their current levels.

Farm managers should strive for efficiency. They should also evaluate what price is needed from the market and use price risk tools when pricing opportunities are available. The long-term benefits of reducing revenue risk are surprising. While managers strive to sell at the market peak, the benefit of avoiding a low price cannot be underestimated.

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Table 1. Production, Price, and Cost Assumptions for LCLD and HCHD Case Farms.

| | 2016<br>Low Cost/Debt | 2016<br>High Cost / Debt |
|---|---|---|
| Crop Acres | 2,100 | 2,100 |
| Crop Mix | 60% Corn / 40% Soybeans | |
| Average Yield (bu/acre) | | |
| Corn | 170 | 170 |
| Soybeans | 55 | 55 |
| Average Sales Price ($/bu) | | |
| Corn | $3.50 | $3.50 |
| Soybeans | $9.50 | $9.50 |
| Cash Production Costs ($/acre) | | |
| Corn | $407 | $472 |
| Soybeans | $248 | $313 |
| | | |
| % Owned | 25% | 10% |
| Average Cash Rent ($/acre) | $225 | $250 |

Table 2. Beginning Balance Sheet for the Low Cost / Low Debt and High Cost / High Debt Case Farms.

| | 2016<br>Low Cost/Debt | 2016<br>High Cost / Debt |
|---|---|---|
| Beginning Cash Balance | $226,656 | $10,607 |
| Grain Inventory Value | $679,295 | $679,295 |
| | | |
| Machinery/Equipment | $1,571,785 | $1,571,785 |
| Retirement Accounts | $300,798 | $300,798 |
| | | |
| Land | $3,097,500 | $1,239,000 |
| Buildings & Improvements | $186,918 | $74,767 |
| | | |
| Total Assets | $6,062,952 | $3,876,253 |
| | | |
| Total Debt | $1,813,714 | $1,938,126 |
| Total Current Debt | $671,074 | $811,650 |
| | | |
| Debt/Asset | 0.30 | 0.50 |
| Current Assets / Current Liabilities | 1.35 | 0.85 |
| Working Capital ($) | $234,877 | -$150,836 |

Table 3. Regression Coefficients and Standard Errors for the Deterministic Component of Simulated Prices.

| Independent Variable | Intercept Coefficient and Standard Error | Slope Coefficient and Standard Error | Dependent Variable | R-Square |
|---|---|---|---|---|
| KY Corn MYA Price | 0.2311 *** (0.0395) | 0.9759 *** (0.0125) | U.S. Corn MYA Price | 0.994 |
| RP Corn Projected Price | 0.6857 *** (0.1742) | 0.8522 *** (0.0548) | U.S. Corn MYA Price | 0.8796 |
| RP Corn Harvest Price | 0.5312 * (0.3306) | 0.8521 *** (0.1042) | U.S. Corn MYA Price | 0.6697 |
| KY Soybean MYA Price | 0.2410 *** (0.0533) | 0.9887 *** (0.0070) | U.S. Soybean MYA Price | 0.998 |
| RP Soybean Projected Price | 1.1692 ** (0.6250) | 0.8592 *** (0.0816) | U.S. Soybean MYA Price | 0.7707 |
| RP Soybean Harvest Price | -0.0284 (0.1926) | 1.0040 *** (0.0251) | U.S. Soybean MYA Price | 0.9797 |

A *, **, *** indicates the coefficient is significant at the 10%, 5%, and 1% level, respectively.

Table 4. Deterministic Prices and Yield Components for Stochastic Simulation for Each Year Simulated.

| **Variable** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|
| Corn Farm Yield | 175 | 175 | 175 | 175 | 175 |
| Soybean Farm Yield | 55 | 55 | 55 | 55 | 55 |
| Corn County Yield | 144.1 | 145.4 | 146.6 | 147.8 | 149.1 |
| Soybean County Yield | 42.5 | 43.2 | 43.9 | 44.6 | 45.2 |
| U.S. MYA Price Corn | $3.25 | $3.57 | $3.80 | $3.87 | $3.86 |
| U.S. MYA Price Soybeans | $9.05 | $9.44 | $9.64 | $9.94 | $9.93 |
| KY MYA Price Corn | $3.40 | $3.72 | $3.94 | $4.01 | $4.00 |
| KY MYA Price Soybeans | $9.19 | $9.57 | $9.77 | $10.07 | $10.06 |
| RP Projected Price Corn | $3.86 | $3.73 | $3.92 | $3.98 | $3.98 |
| RP Projected Price Soybeans | $8.85 | $9.28 | $9.45 | $9.71 | $9.70 |
| RP Harvest Price Corn | $3.49 | $3.57 | $3.77 | $3.83 | $3.82 |
| RP Harvest Price Soybeans | $9.75 | $9.45 | $9.65 | $9.95 | $9.94 |

Table 5. Description of Scenarios Simulated for the Western Kentucky Grain Farms.

| Scenario | Description |
|---|---|
| 1 | The base scenario where stochastic prices follow the 2016 Agricultural Baseline Projections adjusted to Kentucky MYA prices using equations in Table 3. |
| 2 | RP insurance is purchased at 80% level for corn / 75% level for soybeans with both Projected and Harvest prices stochastic functions of the U.S. MYA price (Table 3). |
| 3 | Farm participates in ARC-CO program and has base equal to acres cropped |
| 4. | Farm participates in PLC program and has base equal to acres cropped |
| 5 | Price risk management in 2016 with corn CFC at $4 on 23% of projected production and soybeans CFC at $11 on 30% of projected production. |
| 6 | Combines CFC (#5), RP Insurance (#2) and ARC-CO (#3) for the complete safety net. |
| 7 | Combines CFC (#5), RP Insurance (#2) and PLC (#4) for the complete safety net. |

Table 6. Average Simulated Returns for the LCLD Farm for the Simulated Scenarios.

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 | Scenario 6 | Scenario 7 |
|---|---|---|---|---|---|---|---|
| 2016 | -$310 | -$310 | -$246 | -$304 | -$283 | -$219 | -$277 |
| 2017 | -$318 | -$309 | -$219 | -$276 | -$290 | -$182 | -$239 |
| 2018 | -$284 | -$265 | -$170 | -$224 | -$261 | -$123 | -$179 |
| 2019 | -$225 | -$199 | -$114 | -$159 | -$204 | -$60 | -$107 |
| 2020 | -$168 | -$136 | -$66 | -$99 | -$148 | -$16 | -$48 |

*Scenarios Defined in Table 5.

Table 7. The Probability of the LCLD Farm Having Negative Returns by the Year and Scenario Simulated.

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 | Scenario 6 | Scenario 7 |
|---|---|---|---|---|---|---|---|
| 2016 | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| 2017 | 100% | 100% | 98% | 100% | 100% | 98% | 99% |
| 2018 | 97% | 96% | 86% | 91% | 96% | 81% | 88% |
| 2019 | 89% | 86% | 72% | 79% | 87% | 60% | 72% |
| 2020 | 79% | 73% | 60% | 65% | 76% | 48% | 56% |

*Scenarios Defined in Table 5.

Table 8. Simulated Current Ratio for the LCLD Farm by Year and Scenario.

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 | Scenario 6 | Scenario 7 |
|---|---|---|---|---|---|---|---|
| 2016 | 1.31 | 1.31 | 1.31 | 1.31 | 1.31 | 1.31 | 1.31 |
| 2017 | 1.23 | 1.23 | 1.51 | 1.25 | 1.31 | 1.63 | 1.33 |
| 2018 | 1.41 | 1.46 | 2.26 | 1.71 | 1.48 | 2.55 | 1.90 |
| 2019 | 2.10 | 2.33 | 3.89 | 2.98 | 2.27 | 4.80 | 3.61 |
| 2020 | 3.31 | 3.79 | 5.98 | 4.77 | 3.66 | 7.39 | 5.99 |

*Scenarios Defined in Table 5.

Table 9. Probability of the LCLD Farm Current Ratio being Less than One by Year and Scenario.

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 | Scenario 6 | Scenario 7 |
|---|---|---|---|---|---|---|---|
| 2016 | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 2017 | 19% | 19% | 1% | 16% | 2% | 0% | 1% |
| 2018 | 27% | 24% | 6% | 16% | 17% | 2% | 8% |
| 2019 | 26% | 22% | 7% | 15% | 20% | 3% | 7% |
| 2020 | 19% | 15% | 5% | 10% | 13% | 1% | 4% |

*Scenarios Defined in Table 5.

Table 10. Average Simulated Returns for the HCHD Farm for the Simulated Scenarios.

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 | Scenario 6 | Scenario 7 |
|---|---|---|---|---|---|---|---|
| 2016 | -$592 | -$592 | -$528 | -$586 | -$565 | -$501 | -$559 |
| 2017 | -$708 | -$699 | -$609 | -$666 | -$684 | -$576 | -$633 |
| 2018 | -$840 | -$824 | -$741 | -$788 | -$827 | -$698 | -$752 |
| 2019 | -$874 | -$857 | -$810 | -$836 | -$870 | -$773 | -$807 |
| 2020 | -$888 | -$874 | -$845 | -$859 | -$886 | -$815 | -$836 |

*Scenarios Defined in Table 5.

Table 11. Average Grain Inventory Value for the HCHD Farm by Year and Scenario.

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 | Scenario 6 | Scenario 7 |
|---|---|---|---|---|---|---|---|
| 2016 | $679,295 | $679,295 | $679,295 | $679,295 | $679,295 | $679,295 | $679,295 |
| 2017 | $424,595 | $424,595 | $554,750 | $436,707 | $472,036 | $602,186 | $484,142 |
| 2018 | $144,287 | $156,196 | $300,391 | $205,120 | $168,621 | $365,703 | $257,576 |
| 2019 | $66,107 | $78,019 | $169,455 | $113,573 | $73,533 | $219,952 | $149,665 |
| 2020 | $40,225 | $50,160 | $107,031 | $73,785 | $43,233 | $148,858 | $100,633 |

*Scenarios Defined in Table 5.

Table 12. The Probability of the HCHD Farm Depleting Grain Inventory for Each Year and Scenario Simulated.

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 | Scenario 6 | Scenario 7 |
|---|---|---|---|---|---|---|---|
| 2016 | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 2017 | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 2018 | 41% | 37% | 13% | 26% | 29% | 5% | 15% |
| 2019 | 71% | 68% | 46% | 59% | 69% | 36% | 49% |
| 2020 | 82% | 77% | 63% | 71% | 80% | 52% | 62% |

*Scenarios Defined in Table 5.

Table 13. The Probability of the HCHD Farm Having a Current Ratio Equal to Zero for Each Year and Scenario Simulated.

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 | Scenario 6 | Scenario 7 |
|---|---|---|---|---|---|---|---|
| 2016 | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 2017 | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 2018 | 41% | 36% | 13% | 26% | 29% | 5% | 15% |
| 2019 | 71% | 68% | 46% | 59% | 69% | 36% | 49% |
| 2020 | 81% | 77% | 63% | 71% | 79% | 52% | 61% |

*Scenarios Defined in Table 5.