Corn storage and marketing feasibility

in northern Mississippi

by

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ABSTRACT

On-farm grain storage plays a key role in the production and distribution of corn in the United States. It can have economic impacts on a farm's profitability and production efficiency over time. With the free market system of the United States, market fundamentals are a key component of decisions made on the farm regarding construction of grain storage facilities and how they are used in marketing decisions throughout a given production and marketing year. This analysis researches how grain storage decisions in the Northern Mississippi area are effected by corn basis differentials between the Memphis, TN river market and the Northern Alabama corn market. Corn basis differentials are considered along with annual changes in corn futures market carry in response to variations in grain market fundamentals. The profitability of constructing, maintaining, and operating on-farm grain storage is analyzed based on the local history of the local corn market basis patterns and the carry priced into the corn futures market.

Through this analysis it was found that the biggest obstacle affecting the profitability of on-farm grain storage was the upfront cost of the facility. As costs of the facility were incurred, grain had to be stored for longer periods of time in order to be profitable based on history of improved basis and market carry over time. On-farm storage became profitable over a shorter storage period once the upfront costs of grain storage and handling facilities were paid based on the operating costs and market conditions within the analysis. On-farm storage can be a useful tool for a farm to increase profitability over time, beyond the scope of this analysis. This analysis proves that in the Northern Mississippi area over time, grain storage can be profitable based on improved cash basis and futures

market carry. However, due to ever-changing market conditions, on-farm grain storage does not replace the need for the development of grain marketing plans in order to increase the likelihood of profitability.

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CHAPTER I: INTRODUCTION

On-farm grain storage is an important factor in determining the profitability of farms across the United States. Many factors are considered by farmers when deciding to build on-farm grain storage facilities, including: local markets, harvest capacity, labor, location, cash flow needs, and market prices. Grain storage facilities (grain bins) are considered long-term investments with a high up-front construction cost. Post-harvest grain market fluctuations and seasonal price patterns must be considered when determining whether to build on-farm grain storage facilities.

Northern Mississippi is not a major U.S. corn production area. Corn grown in this region has to be hauled by truck either to Memphis, TN to a river market, or to Northern Alabama to poultry feed mills. These are two different types of markets: Memphis being more of an export-oriented corn market, while the North Alabama corn market is driven largely by local livestock feed demand. These different types of corn markets have led to differing corn basis fluctuations over a marketing year, and may offer advantages over time for better marketing opportunities if on-farm grain storage and handling facilities are available.

The purpose of this research is to determine the profitability of storing corn on-farm in Northern Mississippi based on competitive post-harvest basis improvement and futures market carry. An important aspect of this analysis will involve examination of the cost of constructing, owning, and operating a new on-farm grain storage facility. These costs then will be considered along with historic basis patterns for the past five marketing years from two alternative primary corn markets in the Northern Mississippi area, and futures market carry patterns over time, in order to determine the profitability of building an on-farm grain storage facility.

A secondary goal of this analysis is to provide farmers with an analytical method for determining whether on-farm grain storage is a profitable option based on comparisons of alternative local grain basis patterns and grain futures market carry. The current market situation of high grain stocks and low commodity prices are driving the demand for more on farm efficiency and alternative marketing options for farmers. On-farm grain storage has the potential to improve the operational efficiency and overall profitability of farming operations.

CHAPTER II: LITERATURE REVIEW

On-farm grain storage has been a key component of production agriculture in the United States. Currently 55% of grain storage capacity is located on the farm. While more grain storage has been built in the U.S., on-farm grain storage has declined from its peak percentage-wise in 1992 when on-farm storage accounted for 58.3% of production. The decline in percentage of U.S. grain in storage relative to production has occurred as the construction of new storage facilities has lagged slightly behind the increase in U.S. crop yields (Widmar 2015).

The decision to store grain on-farm should be based on an individual's farm management and marketing plan. Many factors go into this plan such as marketing practices, feeding grain to livestock, transportation and labor constraints during harvest, and the advantages of government programs for financing grain storage construction (General Information on Grain Drying and Management 2017). A factor that could play a role in deciding to store grain or not could be the common practice of postponing income tax obligations from one year to the next by delaying the sale of grain (Brees 2000).

There are a number of potential economic advantages of on-farm storage. Because of post-harvest basis improvements, grain prices tend to be higher after harvest which may justify the retention and storage of grain for some limited period of time into the post-harvest period. On-farm storage also allows the producer flexibility concerning when the grain is sold. The storing of grain on-farm also ensures the producer that storage and handling space will be available during grain harvest, which allows a farmer's harvest operations to progress faster and more efficiently (Edwards 2017).

However, there are also potential disadvantages with on-farm storage. The first is the upfront cost of the storage facility. Fixed costs of the farm increase because of insurance, property taxes, and depreciation incurred as a result of the storage facility construction. These costs will be incurred by the farm over time regardless of whether the grain storage facilities are used or not. Other costs that are incurred as the storage facilities are being used are handling costs, drying costs, grain shrinkage costs, with the largest cost of all being economic opportunity costs of the value of the grain being stored (General Information on Grain Drying and Management 2017). These economic opportunity costs include the interest costs that could have been avoided on various farm expenditures if the grain had been sold at harvest and other cash flow costs consequently being paid in a timelier manner. Once on-farm storage facilities are built, they have an assumed useful life of 25 years in most farm analyses (Edwards 2017).

The ability to perform a wider array of post-harvest marketing strategies is one of the advantages of storing grain on the farm (General Information on Grain Drying and Management 2017). Research shows that farmers who are risk adverse have an incentive to spread grain sales out over a period of time (i.e. over grain storage period) rather than selling all their grain at harvest. This supports the idea that the grain storage period can be used as a diversification strategy in terms of the timing of cash grain sales (Jing-Yi Lia 2003). Once the grain is stored, farmers often look for market signals to make decisions to sell grain or not. Economic theories relating to market efficiency suggest that grain future's prices are the best available source of information on future grain prices (Hudson 2007). However, local cash grain basis trends and seasonal dynamics may be of more value in determining returns to post-harvest grain storage. Typically, periods when there are large available supplies of grain coincide with a higher demand for grain storage space. During these periods, supply-demand forces tend to bring about a higher price for storage to be paid within a local and/or regional grain market. Conversely, periods of small supplies of grain typically coincide with a lower demand for storage and therefore a lower price paid for storage within the market (Widmar 2015).

Higher prices and net returns to grain storage may be realized in three ways: 1) higher cash prices resulting from higher futures prices, 2) higher cash price relative to futures price due to strengthening basis, and 3) by capturing carry in the market. Market carry is defined as the price difference in the deferred futures month's futures contract versus that of the nearby futures contract. If the price of the later or "deferred" month futures contract is higher than the nearby contract, the market is said to have carry "priced in" (Brees 2000).

The storage of grain either on-farm or in off-farm commercial facilities is not a required component of trying to capture gain in futures price alone. Because of the way contracts are traded through straight futures and options contracts, a producer does not have to own or have possession of the physical commodity in order to realize a gain in price of just futures prices. However, basis gains can only be captured in the cash market, therefore the producer must have ownership and possession of the physical commodity in order to participate in the cash market, and have opportunity to benefit from the physical storage of grain in their marketing strategies. With this said, it is commonly held to be true by grain producers and some academics that holding grain unpriced in physical storage for later sale, which is akin to speculating on potential basis gains and market carry, offers the best opportunity over time to the grain producer to get a positive net return on physical storage of crops during the post-harvest period (Brees 2000).

The economics of building grain storage for post-harvest grain sales as part of a grain marketing strategy may or may not prove to be profitable. Many factors that can make grain storage profitable are very difficult to determine in a budget framework. These factors include the benefits of having on-farm storage to insure that harvest progress is smooth and efficient in order to prevent wasted time in bottlenecks at the elevator during harvest. Also, there may not be sufficient evidence that seasonal post-harvest price trends are reliable enough to consistently cover the costs of on-farm storage (Dhuyvetter, et al., 2007).

CHAPTER III: GRAIN STORAGE FACILITY COSTS

3.1 Grain Storage Facility Costs

Cost quotes were acquired from two commercial grain storage facility dealers for a side-by-side comparison in this project (Table 3.1). The first dealer quote was received from was Valley View Agri Systems located in Cleveland, MS. This quote included two 36' by 9 ring GSI brand bins. The capacity of each bin is 22,537 bushels. Options on these bins include: 12 gooseneck roof vents, inside ladder, bin door step, 8" Hutchinson power sweep with 4 total sumps with extended wear package, 10" Hutchinson incline power head with a 10HP single phase motor, a Cor-lock galvanized aeration floor with 12" steel floor supports, a 10HP 230V 1750RPM galvanized centrifugal fan and transition, a heavy duty grain spreader, and a spiral staircase shared between both bins. The cost quote included the concrete base for the bins as well as the total assembly expense for the project. However, this cost quote did not include site preparation and the electrical work to be required for bin operation. The total of the cost quote from the first dealer - Valley View Agri Systems - was <u>$102,342.00</u> received on 11-30-16 – excluding site preparation and electrical work.

The second cost quote received was from CDI LLC in Moulton, AL. This quote included two 42' by 5 ring Sukup brand bins. The capacity of each of these bins is 24,620 bushels. Options on these bins include: 10 roof vents, inside ladder, perforated floor with super wave support, a 10" sweep auger, a 10" unload auger with inclined power head, a 15HP single phase electric auger motor, and a 10HP 230V 1750RPM centrifugal fan. This cost quote included total assembly expenses for the project. However, this cost quote did not include expense estimates for the concrete base, electrical work, or site preparation required for the site. The total for this quote from CDI LLC was <u>$79,948.80</u> received on 12-1-16 – excluding concrete base, electrical work, and site preparation.

The costs for electrical work and site preparation (i.e., "dirt work") were not included by either company in the quotes received, but would be the same for both. An exact quote on the cost of the electrical work was not obtainable because they are likely to vary significantly depending upon the final location selected of the bins on the farm site being considered. To address these questions and account for these expenses in the cost analysis, an estimate of $5,000 was used to cover all electrical work and site preparation required for the construction of the system to be chosen. The quote from CDI LLC did not include concrete. However, the dealer estimated that typically for this size and scale project expenses for the concrete base would be between $20,000 and $25,000. An estimate of $25,000 was added to the quote from CDI LLC for this project to make the two cost estimates competitively equivalent.

3.2 Financing

After estimating the cost of grain bin construction, the cost of financing these two projects was considered (Table 3.2). In this analysis it was assumed that 100% of the cost of each system would be financed. An estimated fixed interest rate of 4.25% was used over a 7-year term loan time horizon. A 7-year term loan time horizon was chosen for the following reasons. First, when dealing with financing investments for a farming operation, using the shortest term possible with financially attainable cash flow requirements is beneficial to the firm in terms of overall financial management goals. This approach allows for flexibility in the event of down or "short" financial years or "troubled financial time periods". This would allow for more flexibility to renegotiate and extend terms of the debt for cash flow purposes if the need arises. A second reason for using a 7-year loan time horizon would be to take advantage of lower interest rates that are available for these intermediate time horizons (as opposed to shorter term credit) in order to lower the overall cost of the project.

The total cost of the Valley View Agri Systems with additional electrical work, and site preparation included was $107,342.00. The annual payment was calculated to be $18,049.79. Total accumulated interest expense over this time frame came to $19,006.56, making the total cost over 7 years equal to $126,348.56. This amounts to a cost of $2.80 per bushel of bin capacity, based on the total capacity of 45,074 bushels for the Valley View Agri Systems or GSI system bid.

The total cost of the CDI LLC system with additional concrete base, electrical work, and site preparation included was $109,948.80. The annual payment was calculated to be $18,488.13. Total interest expense accumulated over this time frame came to $19,468.14, making the total cost over 7 years equal to $129,416.94. This amounts to a cost of $2.63 per bushel of bin capacity based on the total capacity of 49,240 bushels for the CDI LLC or Sukup system bid.

Table 3.1: Grain Bin Cost Estimates

Storage System Characteristics	CDI LLC: Sukup Bin System	Valley View Systems: GSI Bin System
Individual Bin Size (bushels)	24,260 bu	22,537 bu
Total System Capacity	49,420 bu	45,074 bu
Cost Quote (before adjustments)	$79,948.80	$102,342.00
Concrete Base	$25,000.00	In cost quote
Electrical System	$5,000.00	$5,000.00
Total System Cost Estimate	$109,948.80	$107,342.00
Total Interest (Financing) Cost	$19,468.14	$19,006.56
Total System + Interest Cost	$129,416.94	$126,348.56
Total Cost per Bushel of Capacity	$2.63 / bu	$2.80 / bu

Table 3.2: Loan Terms and Cost of Financing Grain Bin Purchase

Items	CDI LLC: Sukup Bin System	Valley View Systems: GSI Bin System
Amount Financed	$109,948.80	$107,342.00
Loan Term (Years)	7 years	7 years
Interest Rate on Loaned Funds	4.25%	4.25%
Annual Interest Payment	$18,488.13	$18,049.79

This analysis shows that although the Sukup bin from CDI LLC was slightly higher in total cost than GSI bin from Valley View Systems, its total cost per bushel was lower because of its larger size.

3.3 Other Financing Option from the USDA

The United States Department of Agriculture (USDA) provides an alternative source of financing grain bin construction. Through the Farm Service Agency (FSA), the USDA offers low interest loans to build grain storage facilities when adequate funding is available for the program. However, for the USDA financing option was not considered for two reasons. First, this analysis focused on determining the competitive market cost of grain bin construction – avoiding consideration of subsidized, artificially low interest loans. Second, since availability of USDA FSA funding for grain bin construction varies over time, this project focused on financing sources that are consistently and reliably available.

3.4 Depreciation

Grain bins are considered a single purpose facility by the United States Internal Revenue Service (IRS). While there are several different methods used to calculate depreciation of grain bins over time for taxation purposes, for this analysis the MACRS method will be used to calculate depreciation over a period of 16 years. The total cost of the project is broken down into percentage increments based on the 150% Declining-Balance Method Half-Year Convention (Table 3.3).

Table 3.3: Annual Tax Deductions from the IRS MACRS 150% Declining-Balance Method Half-Year Convention

Year	MACRS 150% Declining-Balance Half-Year Method % Cost Deductions	CDI LLC: Sukup Bin System	Valley View Systems: GSI Bin System
1	5.00%	$5,497.44	$5,367.10
2	9.50%	$10,445.14	$10,197.49
3	8.55%	$9,400.62	$9,177.74
4	7.70%	$8,466.06	$8,265.33
5	6.93%	$7,619.45	$7,438.80
6	6.23%	$6,849.81	$6,687.41
7	5.90%	$6,486.98	$6,333.18
8	5.90%	$6,486.98	$6,333.18
9	5.91%	$6,497.97	$6,343.91
10	5.90%	$6,486.98	$6,333.18
11	5.91%	$6,497.97	$6,343.91
12	5.90%	$6,486.98	$6,333.18
13	5.91%	$6,497.97	$6,343.91
14	5.90%	$6,486.98	$6,333.18
15	5.91%	$6,497.97	$6,343.91
16	2.95%	$3,243.49	$3,166.59

3.5 Fixed Overhead Costs

Additional fixed annual overhead costs are added to the farm business immediately once the financial obligation of payment is incurred for construction of new grain storage and handling facilities. The first and completely unavoidable cost increase comes in terms of property taxes. Anytime a new structure is built on a farm, it is subject to property tax by the county in the United States in which it is built. An estimate of $1,000 per year was quoted by the Tippah, Mississippi county tax appraiser for the proposed grain bin in this project for an annual property tax expense. For the analysis of this project a cost of $1,250 per year is used for the fixed annual cost of property taxes for these new grain bin facilities (Tables 3.4 and 3.5).

The next fixed annual overhead cost to consider is structural insurance. The cost of insurance of the proposed facility was $780 by Farm Bureau. These two costs would still be incurred annually whether the bins were in use or not. The structural insurance can be an optional cost, but is likely to be required by lending institutions if grain bin construction cost were financed. However, once the cost of grain bin construction were paid for continuing to pay for structural insurance coverage would be more of personal preference rather than an unavoidable overhead expense, but still should be included in an economic analysis.

Table 3.4: Annual Variable and Fixed Costs of Grain Storage

Items	Variable Cost	Fixed Cost	Total Cost
Utilities	$1,500		
Content Insurance	$850		
Maintenance	$500		
Property Tax		$1,250	
Structural Insurance		$750	
Totals	$2,850	$2,030	4,880

3.6 Variable Costs

Variable costs associated with grain bins include operating costs such as handling costs and content insurance on the grain stored (Tables 3.4 and 3.5). Utility costs will be incurred on a monthly basis throughout the year whether the grain bins are in use or not. However, the cost will vary from month to month according to how much grain is being moved into and through the bins and how much the fans are being run to keep the grain in good condition.

Content insurance will vary based upon the value of the crop in the bin. This can vary widely from year-to-year based on the level of market prices of the crop and type of crop being stored. For operating costs analysis of this project a $1,500 annual estimate for utility cost will be used. Content insurance coverage was quoted from commercial business sources as costing $840 annually based on $250,000 of coverage.

For this project, grain storage and handling facility maintenance costs are estimated at $500 annually. Actual grain handling and monitoring cost is estimated at $0.06 per bushel - covering both unloading into the grain storage facility and then eventually loading back out of the bins. This rate is sufficient enough to handle the additional fuel and other equipment costs incurred by the handling and monitoring the grain during the storage period.

Another variable cost that should be considered of storage is the trucking cost between the field and the grain bin. Because of variability in the distance between farms, an estimate of an average cost of $0.10 per bushel is used an annual basis. This rate will adequately cover hauling expenses from all of the farms in the farm business involved, regardless of distance from the bin in this analysis (Tables 3.4 and 3.5). Trucking cost from the farm to either of the markets in this analysis is not a considered cost factor in this analysis because the cost of hauling the grain to market will be equal whether the decision is to store the grain is made or not.

Table 3.5: Annual Variable, Fixed, and Handling Costs of Grain Storage

Items	Variable + Fixed Cost per bushel	Handling Cost per bushel	Total Operating Cost per bushel
CDI LLC (Sukup bins)	$0.10	$0.16	$0.26
Valley View Systems (GSI bins)	$0.11	$0.16	$0.27

3.7 Economic Opportunity Costs

The economic opportunity cost of the value of grain stored rather than sold at harvest without storing is one of the most important and most often overlooked variable costs to consider when analyzing the cost of storing grain. From an economic perspective, grain being stored in the bin can be considered another form of money or a type of unpriced economic asset. The monetary value of unsold grain is storage should be evaluated for its potential to generate more income from alternative uses, such as reducing future cost expenditures such as interest cost to be paid on carryover loan principle balances.

In this analysis, the opportunity cost on unpaid loan balances is assumed to be 4.25% annually. This equals the interest rate used on the financing of the grain bin investments considered in this analysis. One possible opportunity to consider is to use the cash from harvest grain sales to purchase inputs for the next year's crop at an early purchase discounted rate rather than waiting until the following spring. Based on an average price of $4.25 for corn in the northern Mississippi region, with the 4.25% interest rate opportunity cost, economic opportunity costs ranged from a minimum of $0.02 per bushel for one month's storage up to a maximum $0.15 per bushel for a maximum of ten months storage. These economic opportunity cost estimates are based on using the bins at maximum storage capacity (Tables 3.6 and 3.7).

Table 3.6: Economic Opportunity Cost of Grain Storage by Grain Value

Items	CDI LLC: Sukup Bin System	Valley View Systems: GSI Bin System
Storage-Handling Capacity	49,240 bu	45,074 bu
Value of Corn	$4.25 /bu	$4.25 /bu
Total Value of Grain Bins	$209,270.00	$191,564.50
Annual Opportunity Cost Interest on Unsold-Stored Grain	4.25% annually	4.25% annually

Table 3.7: Economic Opportunity Cost of Grain Storage by Time (Months)

Item	Three (3) Months Storage (to December)	Six (6) Months Storage (to March)	Ten (10) Months Storage (to July)
Accumulated % Interest	1.063%	2.125%	3.542%
CDI Sukup (Total $)	$2,223.49	$4,446.99	$7,411.65
CDI Sukup ($/bu)	$0.05	$0.09	$0.15
VVS GSI (Total $)	$2,035.37	$4,070.75	$6,784.58
VVS GSI ($/bu)	$0.05	$0.09	$0.15

Economic opportunity costs can vary with ever changing market conditions such as increasing interest rates and fluctuating market prices. By increasing the price of corn to $5.75 per bushel and increasing interest rates to 6.25% the economic opportunity cost ranged from a minimum of $.03 per bushel for one month storage to $.30 per bushel for up to a maximum ten months of storage. By decreasing the price of corn to $2.75 per bushel at leaving interest rates at 6.25% the economic opportunity cost ranged from a minimum of $.01 per bushel for one month storage to $.14 per bushel for up to ten months of storage.

CHAPTER IV: MARKET ANALYSIS

4.1 Introduction

This chapter will discuss different ways that the southeastern U.S. corn market was analyzed to determine returns to post-harvest grain storage facility investments and marketing strategies. The first part of this analysis will involve analysis of the corn futures market and the carry that is priced into corn future's prices over a period of time. The second part of the analysis will focus on seasonal post-harvest trends in southeastern U.S. Cash corn markets in northern Mississippi and nearby Memphis, Tennessee and northern Alabama area. The third part of the analysis will be dealing with basis of the corn market in these same southeastern U.S. regions.

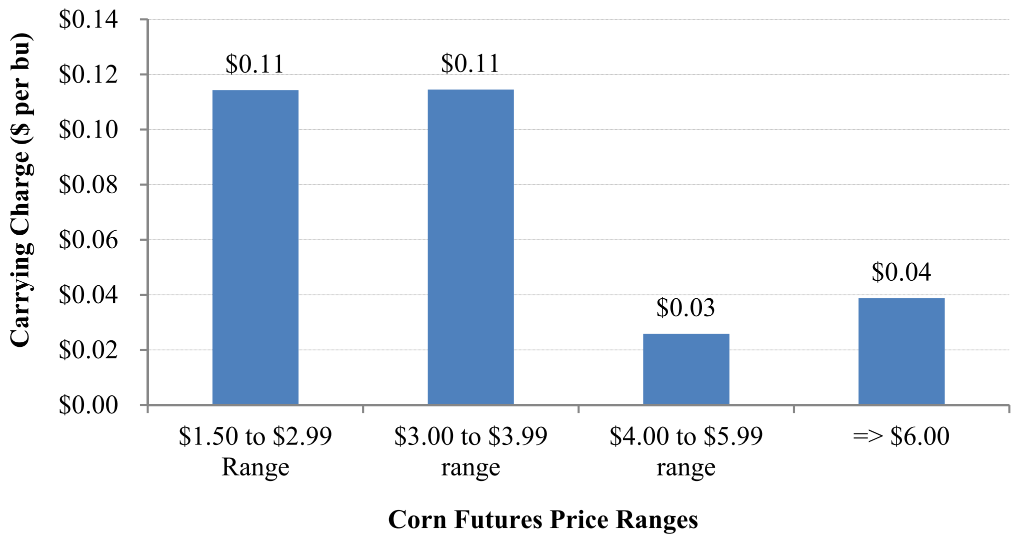
4.2 Futures Market Carrying Charges

Corn futures are most commonly traded on the Chicago Mercantile Exchange (CME) in contracts of 5,000 bushels in size, with smaller mini-contracts of 1,000 bushels also available. The different contract months in which corn futures contracts are traded are March, May, July, September, and December of any given year. This analysis will focus primarily on the September contract in comparison to the December, March, and July contracts.

The purpose of this part of the analysis is to find out how much "carry" is priced into the market in "deferred" months compared to the futures price at the beginning of harvest. Farmers' decisions to either sell or store grain into the post-harvest period primarily begin during harvest. The CME September corn futures contract will be focused on in this analysis because it represents market conditions at the beginning of harvest for the area being studied (i.e., the southeastern United States). For this analysis, the closing price of the first trading day of September was used in order to calculate any post-harvest carrying charges priced into the corn futures market. "Carry" that is priced into the market at harvest is calculated by subtracting the closing price of the September harvest time futures contract from the closing price of each of the succeeding deferred contracts. Historic price data for CME September, December, March, and July contracts were analyzed. This project focused on corn market data for a period of 17 years, from 2000 through 2016.

The first corn futures price spread to be analyzed is September-December or "SEP-DEC" (Figure 4.1).

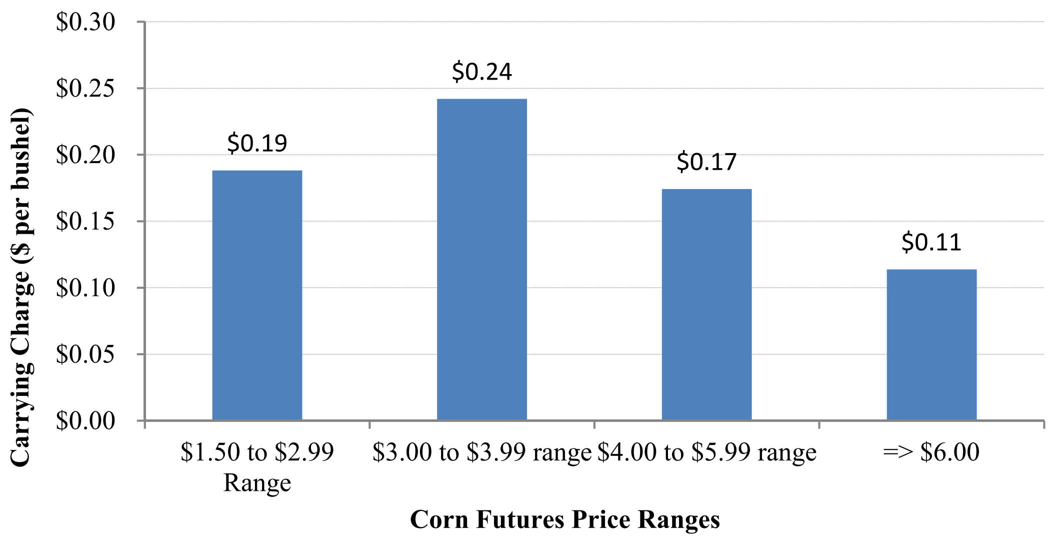
Figure 4.1: SEP-DEC CME Corn Futures Carrying Charges by Futures Price Range (Years 2000-2016)



Fifteen out of 17 years since and including year 2000 market carry from the September to December CME corn futures contract were positive, with December corn futures being more than the previous September corn futures. The two years in which there was no positive carry in the corn futures market were 2012 and 2013. Over the 17 year time span, the overall average of the carry in the September to December contract was $0.09 per bushel.

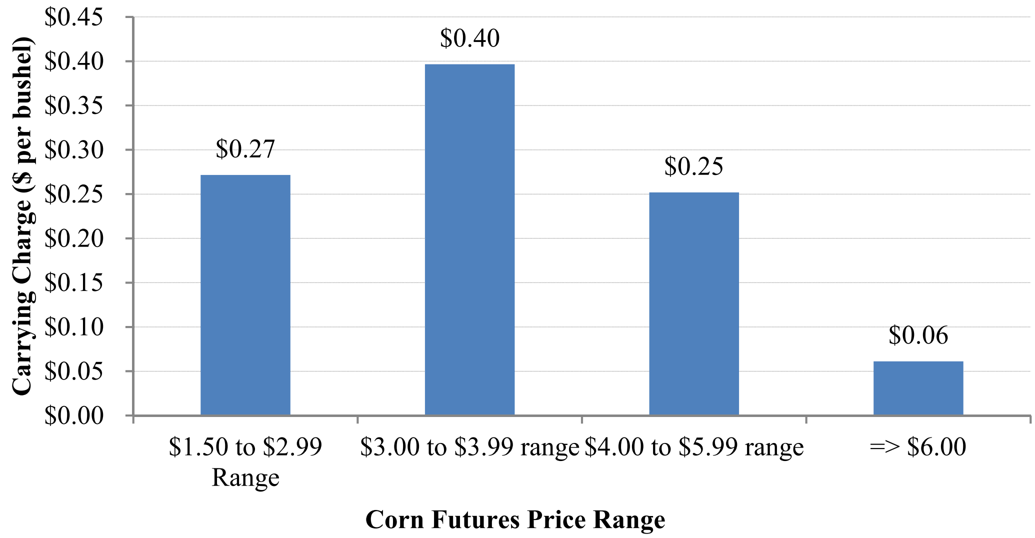
The second CME corn futures spread analyzed is September to March, or SEP-MAR. Sixteen out of 17 years carry in the market from the September to the March contract was positive. The only year it was negative was 2013. Over the 17 year time span, the overall average of the carry in the March contract compared to September was $0.20 per bushel (Figure 4.2).

Figure 4.2: SEP-MAR CME Corn Futures Carrying Charges by Futures Price Range (Years 2000-2016)



The third spread analyzed is the September to July or SEP-JULY. Sixteen out of 17 years the carry in the market from the September to July contract was positive. The only year it was negative was 2012. Over the 17 year time span, the overall average carry in the July contract compared to September was $0.31 per bushel (Figure 4.3)

Figure 4.3: SEP-JULY CME Corn Futures Carrying Charges by Futures Price Range (Years 2000-2016)



Throughout the 17 years since and including year 2000 that market carry was analyzed, corn prices ranged from just below $2.00 per bushel to just over $8.00 per bushel. Eleven out of those 17 years corn prices were below $4.00. The years when corn futures prices were below $4.00 tended to have the highest amount of carry priced in. During four out of the 17 years when corn prices were between $4.00 and $6.00 per bushel, carry in the market declined from the highs which occurred during the years of lower prices. The two years during the 17 year span in which corn prices were above $7.00 per bushel had the lowest amount of carry priced in it.

It appears that during times of plentiful corn supplies and resulting lower harvest prices, the corn market is signaling through larger carrying charges to hold corn in storage for sale later time in the marketing year. Restated, the presence of larger carrying charges is the market's signal to hold grain in storage for sale later in the marketing year. Conversely, during times of short or "tighter" corn supplies and higher prices, the market pays less (i.e., “lower” carry) to hold the grain in order to encourage selling the grain sooner rather than later – encouraging sellers to store grain for a shorter period of time.

4.3 Cash Corn Markets

Two primary cash corn markets were analyzed for this project. The first market is the Memphis, Tennessee cash market and the other is the North Alabama cash market. Both of these markets are located within 100 miles of the area analyzed near Walnut, Mississippi, and are primary destinations of the corn grown in the region. Cash corn market price data for these locations were taken from USDA Agricultural Marketing Service (AMS) online resources. The time period for the corn price data analyzed is from the beginning of 2011 until the end of 2016. Weekly low and high cash price bids for both locations are reported. The average corn low-high price range for the Memphis, Tennessee market over this time period was \$5.25-\$5.33 per bushel. The average corn low-high price range for the North Alabama market was \$5.69-\$6.18 per bushel (Figures 4.4 and 4.5).

Figure 4.4: Cash Corn in Memphis, TN and Northern Alabama (Years 2011-2016)

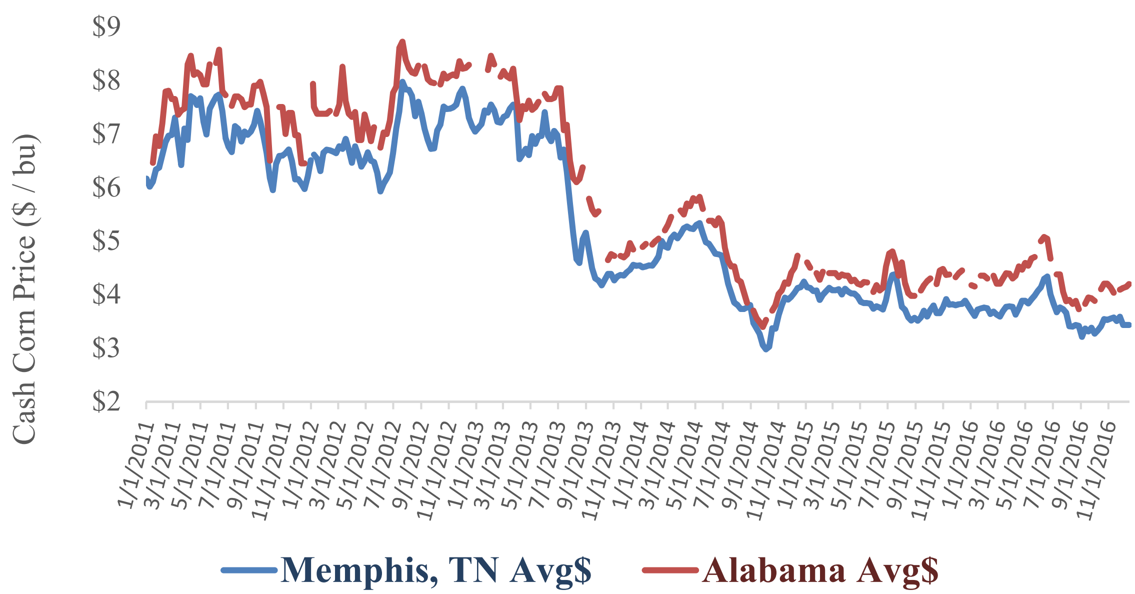
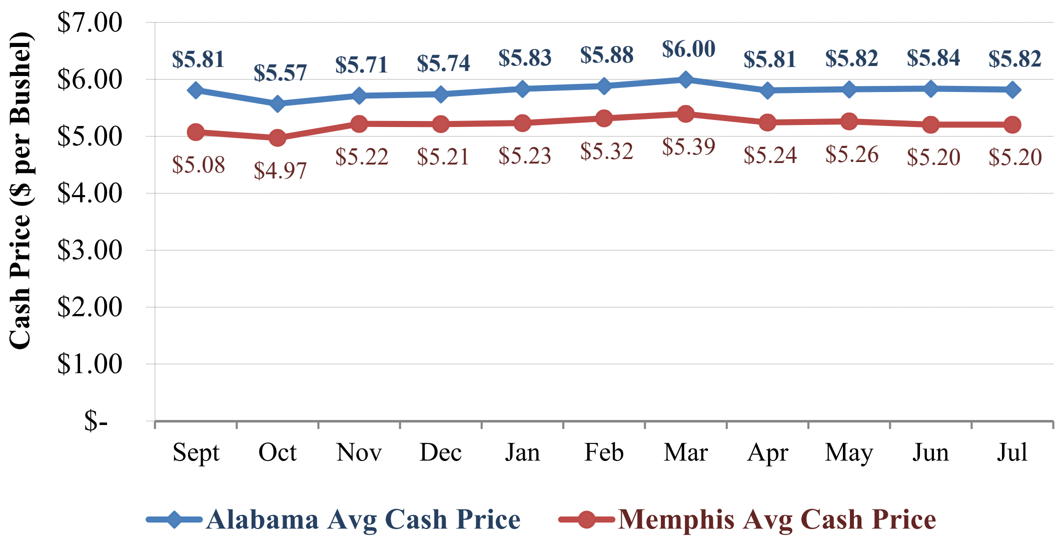


Figure 4.5: Monthly Average Cash Corn Prices in Memphis, TN and Northern Alabama (Years 2011-2016)



The sizable difference in cash corn prices between these two locations is a result of differences in the type grain markets. The Memphis, Tennessee corn market is a river terminal that is export-oriented and exhibits lower prices. On the other hand, the North Alabama corn market is geared toward end users such as poultry feed mills and generally has higher cash corn prices. This difference in local / regional corn market factors and influences is not explicitly discussed by the USDA's AMS market price reporting system.

4.4 Corn Market Basis

In agricultural markets for corn and others grains, "basis" is defined as the difference between local, location specific cash grain prices and underlying, publicly traded futures prices from which the local cash grain price is adjusted on a daily basis. Local cash corn prices in the United States are largely determined by a "basis" adjustment off of the upfront or lead Chicago Mercantile Exchange (CME) corn futures prices. This analysis focused on weekly cash corn prices, with local corn cash basis calculated off of lead futures contract closing prices on the same day.

The cash market cash price and basis data in this study was divided into five marketing years. The corn marketing year used in this study was from September until July of the following year. August was left out of this analysis because it is the transition period from old crop to new crop – with some corn harvest in the southern U.S. beginning in August. The cash prices for each month were averaged for each market from the weekly reported cash prices.

Differences exist between the local cash corn prices and basis of the North Alabama market and the Memphis market for the time period analyzed. These dissimilarities in local corn basis levels clearly show the differing focus of these two geographic markets. Seasonal corn basis bids in the Memphis, Tennessee region reflect export-oriented river market conditions (Figure 4.6). Corn basis levels in the North Alabama region reflect "high demand - short supply" market conditions, with a focus on meeting ongoing livestock feed demands (Figure 4.7). Over the 55 months and five 11 month marketing years (i.e., September through July), the Memphis cash corn market price never exceeded the cash corn price in the North Alabama market.

The corn basis levels of both markets were calculated monthly for the period and compared (Figure 4.8). In only two months out of 55 months analyzed for this study did the Memphis corn market have a basis advantage (i.e., more positive) over the North Alabama corn market. In nine months out of 55, the Memphis market averaged a positive corn basis whereas the North Alabama corn market had a positive average basis 52 out of 55 months. On average, the most positive (i.e., "strongest) basis months for the Memphis corn market were during the months of September and October (Figures 4.6 and 4.8). North Alabama cash corn price and basis bids ranged from $0.25 to $1.14 per bushel better than the Memphis corn market on a cash basis. Over this five year period, the North Alabama cash corn market had a $0.59 average advantage over the Memphis cash corn market.

Figure 4.6: Corn Bases in Memphis, Tennessee (Marketing Years 2011/12 - 2015/16)

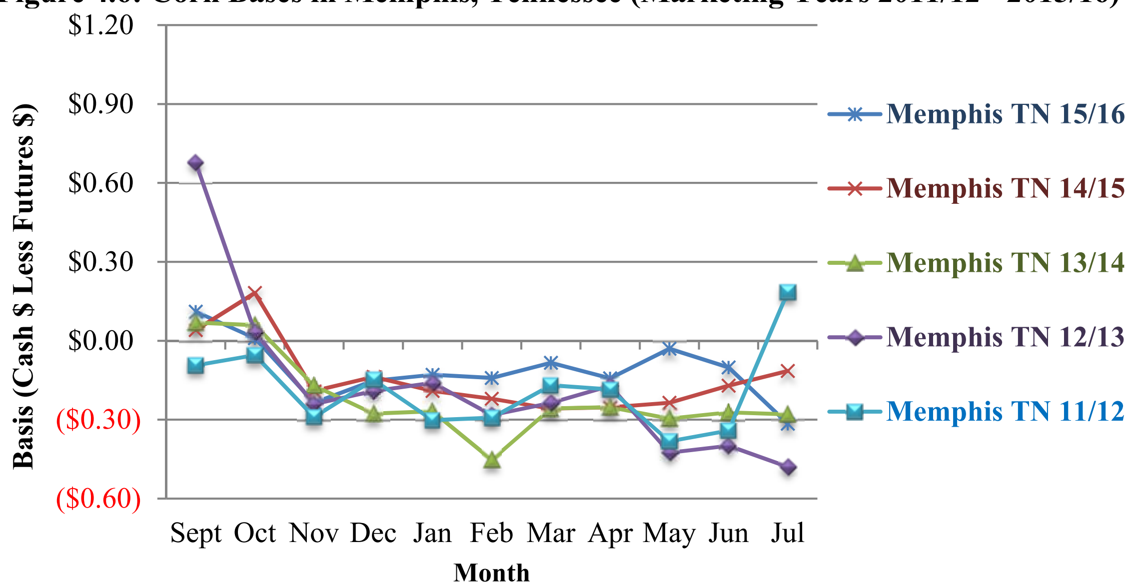


Figure 4.7: Corn Bases in Northern Alabama (Marketing Years 2011/12 - 2015/16)

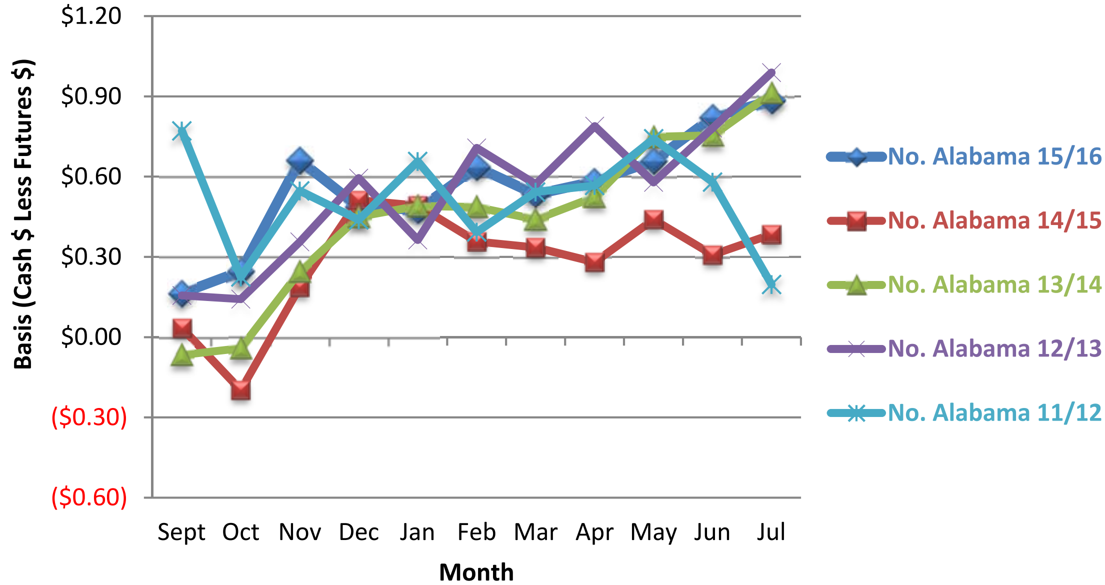
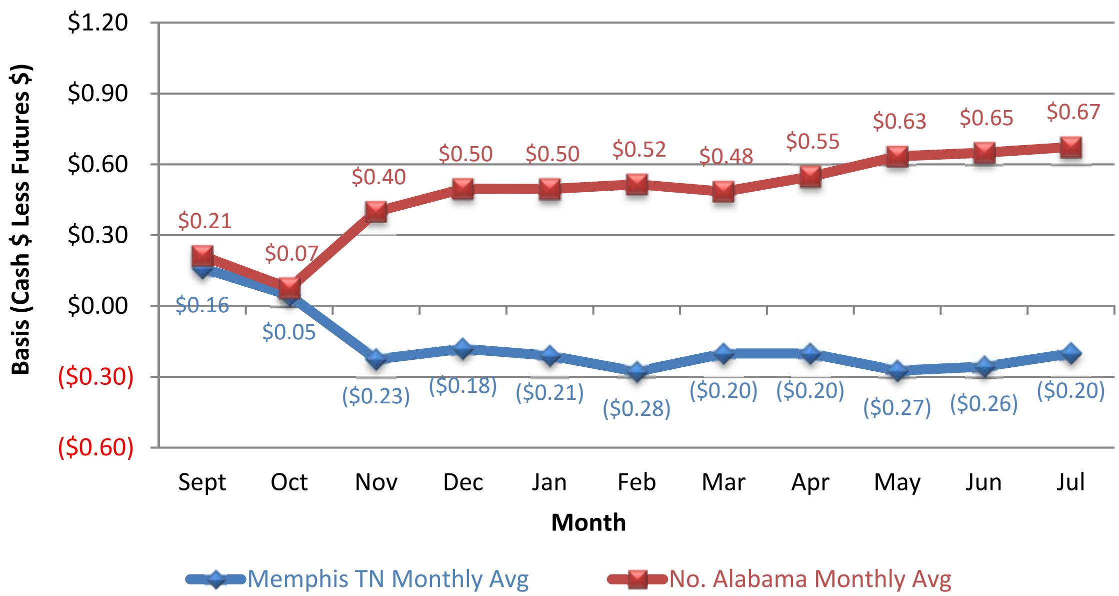


Figure 4.8: Average Monthly Corn Basis in Memphis, Tennessee and Northern Alabama (Marketing Years 2011/12 - 2015/16)



Corn basis in the Memphis market has tended to trend lower into the fall, and to remain at low, post-harvest levels for the remainder of the marketing year (i.e., through June and July). The seasonal export-orientation of the Memphis corn market contributes to this pattern. The United States' Mid-South region is not known as a primary corn growing part of the nation. However, because corn of the Mid-South is harvested earlier than most of the Corn Belt, it is positioned time-wise to fill early export orders of corn from the United States. Typically then in October, as the Mid-South harvest is completed and the Corn Belt harvest begins, greater quantities of U.S. corn begins to move from the Corn Belt into export market river channels such as the one in Memphis. This causes the demand for "early" corn from the Memphis region to diminish – explaining the lower trending basis throughout the marketing year in the Memphis corn market (Figures 4.6 and 4.8).

The average basis over the 5 years analyzed for the Memphis, Tennessee market was $-0.17 per bushel, i.e., 17 cents / bushel under CME corn futures. The range was from -$.48 (under) to $0.19 over lead corn futures. There was one exception during this period as the Memphis corn basis was $0.68 over in September, 2012. This happened due to the 2012 drought and major short crop, which caused corn to be shipped north from Memphis to Corn Belt ethanol plants for a short period of time (Figures 4.6 and 4.8)

Conversely, in the North Alabama corn market, basis levels have tended to be the least positive (i.e., "weakest") during the months of September and October. This North Alabama seasonal basis pattern for the early fall month occurs due to the tendency for more abundant supplies to be available in that region during harvest months, which coincides with less urgency in demand for corn at harvest to fill immediate user needs. But then following U.S. harvest-time corn basis weakness in October, the demand for corn for local livestock feed use in North Alabama has continued throughout the year – with corn needing to be "pulled" into the region from elsewhere.

The North Alabama corn market signals this "demand pull" through stronger or "narrowing" corn basis levels – first from October basis weakness into stronger basis trends into the November through March time period, and then with still stronger basis levels from March through July (Figure 4.8). The average basis over the five years analyzed for the North Alabama market was $0.47 over futures, ranging from $-0.20 under to $0.99 over futures (Figures 4.7 and 4.8).

In summary, over the five year period, from 2011 to 2016, the basis in North Alabama averaged $.64 better than the Memphis market. The fall harvest basis during September and October were always the closer of the two markets during the 2011/12 through 2015/16 time period. However, each month as time moved forward through the marketing year, the basis in the North Alabama corn market strengthened in comparison to the Memphis corn market.

4.5 Other Factors

The North Alabama corn market shows an advantage in cash and basis price over the Memphis market. However, the difference in the two types of markets also means possible difference on discount schedules, unloading times, moisture restrictions, and other factors that can have an impact on marketing and delivery decisions. Trucking distance and cost to each market is relatively equal however; logistics of grain hauling availability and options in the local area are also another factor to consider when deciding to build grain storage facilities. This is a common factor in the area of study that has been a key component of building grain storage facilities. While this analysis is strictly dealing with corn market price and basis factors and storage cost, these other factors should also be considered when making marketing decisions.

CHAPTER V: PROFITABILITY ANALYSIS

5.1 Purpose

The purpose of this analysis is to determine if on-farm grain storage would be profitable over time through improved basis and market carry. This chapter will put together the findings through the research conducted and lead to the final conclusion of the project.

5.2 Storage Costs

The first cost analyzed was the actual price of the storage facility. Quotes were received from two companies on two slightly different size grain bins. After all costs were calculated, the net cost of each option was within a few cents per bushel of one another. For the profitability analysis of this project, the higher priced quote was used. The cost of building the facility and financing for seven years came to $0.40 per bushel per year.

Fixed overhead costs associated with building the grain bins were analyzed. These costs include an estimate for property taxes and structural insurance. The fixed overhead costs came to a total of $0.045 per bushel. Variable operating costs - including utilities, content insurance, maintenance, and grain handling costs – were estimated to be $0.21 per bushel. Variable cost includes hauling grain to the grain bin from the field and an estimated utility's expense.

Annual depreciation costs were calculated to match IRS tax depreciation schedules for a 16 year period. Depreciation schedules from the IRS were used even though this analysis was calculated on a pre-tax basis. Depreciation costs on the grain facilities investment for the first seven years of facility ownership were estimated to vary from $0.14 to $0.23 per bushel.

After the previously mentioned costs were estimated for the first seven years of grain facility ownership, financing expenses were estimated. With interest costs from financing the purchase included, the average cost to own and operate the grain storage and handling facility came to \$0.83 per bushel per year. However, after the bins were paid for in year 7 the cost to own the grain bins decreased to \$0.41 per bushel per year. This cost estimate included fixed, variable, and depreciation expenses.

The economic opportunity cost of storing grain was also considered. This cost was broken down on a monthly basis, and estimated by considering opportunity cost interest expenses at a 4.25% annual rate on a corn price of \$4.25 per bushel for unsold grain. The longer period of time that grain is stored, the more this economic opportunity cost of not selling corn and using the money for other financial management-related uses will increase on a per bushel basis. The economic opportunity cost of storing grain is the most variable of all the costs considered here when deciding whether or not to sell or store grain at harvest. This cost is especially difficult to determine and account for in cash sale versus storage decisions in volatile, fast changing corn market conditions. (Refer to the previous discussion and examples in section 3.7 related to economic opportunity costs)

5.3 Basis

The basis levels of the Memphis and North Alabama corn market were calculated by subtracting the weekly reported cash grain prices by the USDA from the weekly closing price of the nearby futures on the CME (Chicago Mercantile Exchange). The USDA reports a high and low cash grain price for each market each week. This results in two basis values when subtracting each from the weekly CBOT closing price. However, for this analysis and in order to be more accurate from a profitability standpoint, the lowest cash grain bid each week was used to calculate the basis. This allows for the minimum basis from the data to be observed for this analysis. The weekly cash grain price data was taken and basis was calculated from the weekly nearby corn futures closing prices. This basis data was then averaged monthly for September through July of each year from September 2011 through July 2016. This data was used to analyze five marketing years in both the Memphis, Tennessee and North Alabama corn markets. The average basis of the Memphis corn market for this five year time frame was $0.17 under futures. The average basis for the North Alabama corn market was $0.47 over futures over the same time period. Over the total of five years analyzed, the North Alabama corn market has averaged a $0.64 advantage over the Memphis market in basis alone. However, in order to find out the potential gain in basis from post-harvest storage of corn, calculations of the monthly average basis were compared to the harvest basis. For this analysis, the September basis will be used to represent the harvest basis.

Since the analysis showed the North Alabama corn market with such a large basis advantage over the Memphis market, <u>all profitability analysis of storing was based on storing and selling into the North Alabama corn market</u>. Gain in basis was calculated by subtracting the average September basis from the month that delivery is planned. This gave the net basis gain from the time period over which grain is to be stored. For this analysis December, March, and July are the months in which basis gain was calculated. The average basis gain from September until December was $0.28 per bushel. The average basis gain from September until March was $0.63 per bushel, and the average basis gain from September until July was $0.82 per bushel.

5.4 Carry in the Market

The final part of this analysis is carry in the market. Since the scenarios being examined are to store corn for later sale at a future time, the sale of corn against a "deferred" futures contract (i.e., "further out") in time rather than the nearby futures contract at harvest was considered. The difference in the prices of these corn futures contracts from contract month to contract month reflects the "carry" in the market. The "deferred" contracts used in this analysis are December (DEC), March (MAR), and July (JUL). These contracts were compared back to the September (SEP) contract in order to calculate the carry in the market.

The average carry over the past seventeen years from SEP until the DEC corn futures contract was $0.09 per bushel. The average carry from SEP until MAR corn futures contracts was $0.20 per bushel, and the average from SEP until the following JUL corn futures contract is $0.31 per bushel. These average carrying charges were used in the profitability analysis of storage. It is notable that in eleven out of seventeen years considered, the market carry was slightly higher than these averages. This was caused by the behavior of corn spreads during the years when corn futures prices were below $4.00 per bushel. During the 6 years of the last 17 when the average corn price was above $4.00, the average carry in the corn futures market was slightly lower. This suggests that as corn prices have moved higher over the last 17 years, the less the corn market has been less willing to price carry into deferred corn futures contracts.

5.5 Profitability

Based on the factors considered in this analysis, profitability was estimated based on storing grain from September (SEP) until December (DEC), September (SEP) until

March (MAR), and September (SEP) until July (JULY). Storing grain from September until December has had an average gain of $0.28 per bushel from basis improvement and an average of $0.09 per bushel from market carry – resulting in $0.37 per bushel in revenue from basis improvement and carry gains in the market. The costs associated from storing grain from September until December was $0.83 per bushel for cost of the facility and $0.06 for the economic opportunity cost of capital. This calculates to be an average loss of $0.51 per bushel for storing grain from September until December over the time period considered. After year 7 when the cost of new grain storage facilities are paid for, and cash ownership costs drop to $0.41 per bushel, there would still be an estimated average loss of $0.09 per bushel from storing grain from September to December.

Storing corn from September (SEP) until March (MAR) had an average gain of $0.63 per bushel from basis improvement, and a gain of an average of $0.20 per bushel in futures carry, resulting in $0.83 per bushel in added revenue from corn basis improvement and from futures market carry. Cost associated with storing corn from September until March includes $0.83 per bushel cost of the facility, and a $0.11 per bushel economic opportunity cost of capital. This calculates to be a loss of $0.11 per bushel for storing grain from September until March. After year 7 when the new grain storage facilities are paid for and the direct cash costs of the facility drop from $0.83 to $0.41 per bushel, then an average profit of $0.33 per bushel would have been earned for storing grain from September until March.

Storing corn from September (SEP) until July (JULY) had a gain of $0.82 per bushel in basis improvement, and an average gain of $0.31 per bushel in futures carry, resulting in a $1.13 per bushel gain in revenue from basis improvement and futures carry.

Costs associated with storing from September until July included $0.83 per bushel for cost of the facility and $0.15 per bushel in economic opportunity cost of capital. This calculates to be a profit of $0.15 per bushel for storing grain from September until the following July. Once the grain storage facilities are paid for and the direct cash costs of the facility drop from $0.83 to $0.41 per bushel, a calculated profit of $0.57 per bushel occurs for storing grain from September until the following July.

5.6 Sales Timing and Profitability

Based on this analysis, at this location in the southeastern U.S. corn market, storing corn on-farm has been profitable on average in recent years, and perhaps can be in the future, due to a basis improvement and futures carry at certain periods of time. Typically the grain sales of a farming operation are "divided up" and/or spread over a period of time rather than occurring all at any one time during a marketing year. Knowing this and learning from the profitability analysis, the conclusion can be drawn that in order for grain storage to have paid for itself by basis gains and future market carry, the majority of grain would have had to have been stored for longer periods of time into the marketing year in order to at least break even or become profitable. In this analysis, once the cost of new grain storage and handling facilities are paid for in year seven, then direct cash storage costs decrease as well as the amount of time needed to store corn in order to become profitable from a basis improvement and futures market carry standpoint.

CHAPTER VI: CONCLUSIONS

This analysis is useful in helping farmers to understand how to analyze whether purchasing grain storage facilities can provide returns based on potential basis improvements and possible gains from post-harvest futures carrying charges. This analytical framework provides a means for calculating returns to on-farm storage using grain basis history and patterns of change in futures carrying charges without needing to speculate on whether futures prices will rise or fall during the storage period. This analytical framework also provides a useful way for determining how economic opportunity costs may affect the profitability of storing grain over a period of time.

However, while the analytical approach is broadly applicable in general, the specific results of this analysis are limited in that they represent a specific geographic region of the United States (i.e., the southeastern U.S.) with corn market prices that reflect broader market conditions since the 2011/12 through 2015/16 marketing years. In applying this analytical framework for a particular farm in other future grain market contexts, current grain market conditions at the time and local-regional market factors will need to be accounted for, along with interest rates impact on economic opportunity costs, etc..

This analysis does not take in account possible corn or other grain futures prices either rising or falling significantly over time, or possible yet unexpected seasonal post-harvest grain price rallies in response to more extreme market events and influences. It also does not take in account other factors such as grain quality deterioration that can have an effect on the value of grain during the storage period – and which in turn could have a direct effect on the cost and returns of storing grain for later cash sale. This analysis does not take into account cash flow needs of the farmer. Typically farmers will not sell 100% of their grain at one given time. Grain sales are planned according to cash flow needs as well as market prices. As sales are made scaled over a specific time period the average net return to grain storage can vary significantly than the results of this analysis. However, a farmer can use this analysis to gain a better understanding of different ways a grain storage facility can provide a return on investment over time.

Grain storage facilities on-farm also provides a farmer with ways to be more efficient during harvest. Having guaranteed space available on-farm during harvest when local commercial facilities are "busy" is a great asset to have during the busy fall season – helping to avoid "bottlenecks" at elevators and the inefficiency of a combine sitting idle in the field waiting for empty grain trucks to return. These efficiencies provided by having on-farm grain storage facilities are difficult factors to quantify with a specific cost measurement within themselves. However, this analysis provides a way of determining or quantifying how much it costs over time just to own the grain storage facility. This provides a farmer with a clearer picture of just what the cost of convenience and efficiency would be if the grain storage facility was built for that factor only in mind. Grain storage convenience costs can be compared to the cost of owning trucks or the cost of hiring more custom trucking during harvest to accommodate grain handling capacity needs. By comparing these costs and labor costs associated with each option a farmer can determine which best fits their own operation.

According to this analysis, the biggest obstacle in whether grain storage is profitable or not is the upfront cost of the facility. The increase in basis over time and market carry from September until March in this analysis for this geographic corn market did not cover the combined cost of the facility and the economic opportunity cost of capital.

However as basis improved and market carry increased into July during the post-harvest period, the cost of the facility and operating costs were adequately covered under the given market conditions in this analysis. Once the grain storage and handling facilities were paid for in year seven of the analysis, and only operating costs of the grain storage facilities were being paid, then post-harvest grain storage became profitable by March through basis improvement and futures market carry, with the profitability increasing into the July timeframe.

In the shorter run, even after year seven storage costs were paid for, storage from September to December still resulted in a $0.09 loss given the costs, basis patterns, and futures carry history considered in this analysis. However, even though losses are incurred during the short term time frame (SEP to DEC) of grain storage, these losses could be analyzed as or considered to be a cost of harvest efficiency at the farm level. According to farm-level focused applied research, grain bins can increase the efficiency of a farm's harvest operations through having storage space available in order to prevent or avoid harvest delays due to bottlenecks. Though it is beyond the scope of the applied research of this project, if the benefit of harvest efficiency is larger than the loss on short term storage during the SEP to DEC period, then grain bins would still be profitable overall for the farm operation.

Although this analysis provides the farmer with opportunities to consider to increase revenue for the farm through post-harvest grain storage, it does not necessarily provide a clear path forward or clear guidance on how to become a better marketer of grain. Both the strength and weakness of this analysis is its reliance on historic corn cash and futures price patterns. While history is likely the best predictor of the future in the grain markets and in other markets as well, yet the factors affecting grain markets may change along with the level, seasonality, and volatility of the markets themselves. In order for on-farm storage of corn in this case, or other grain, to be profitable, careful planning and execution of grain sales over the storage period will be necessary. Those using post-harvest grain storage will need to be aware of current market conditions and potential changes in market structure, conditions, and price behavior as they make their grain storage and marketing decisions.

In conclusion, on-farm grain storage can be a useful and profitable practice for a number of different reasons. This analysis indicates that on-farm grain storage would have been profitable under the conditions analyzed for grain markets in this particular part of the United States over the period of time considered. That is some indication that it may continue to be profitable in the future.

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