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Benefits and Costs Associated with the Wheat Storage Hedge

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Each year producers must decide whether to store or sell their crop at harvest. Market prices are important in guiding producers on whether to store priced grain for future delivery (referred to as a *storage hedge*), store unpriced grain, or sell. Generally, producers know more about deciding to sell or store unpriced grain than using the storage hedge. This publication explains how a storage hedge works, when to use it, and risks and costs involved. (See glossary for definition of terms.)

The idea behind the storage hedge lies in the relationship between prices of deferred futures and nearby futures and storage costs. As with any grain marketing strategy, there are both advantages and disadvantages to a storage hedge, which are shown in Table 1.

Types of Markets

There are two distinct types of futures markets. A carry futures market offers a "carry"—deferred futures prices are trading above nearby futures prices (+$0.55 in Table 2, below). With an inverted futures market, deferred futures prices are trading below nearby futures prices (-$0.25 in Table 2).

Reasons for the market to offer either a carry or to be inverted typically revolve around supply. In periods of excess supply, a large carry is typically seen. With large supplies, the market is signaling to producers that it wants them to store their grain for future delivery and is willing to pay them to do so—that is, pay the carry. The producer must manage stored grain to keep it in good condition, because losses in quality can result in price discounts. In times of tight supplies, the market signals to producers that it wants their grain soon after harvest by offering higher nearby futures prices compared to deferred futures prices—an inverted market.

Commodity futures markets offer many different contract months. The level of the carry most likely will vary depending on the contract month. Producers should consider choosing the month offering the largest net return (benefit versus cost) from storage while also taking into account other factors competing for the producer's time such as planting. Other costs, such as cash flow needs, debt payment obligations, and the need to free up grain storage for other crops, must also be taken into account.

Taking a Storage Hedge

The storage hedge requires the producer to take two steps—putting the grain in storage and selling (or shorting) the deferred futures contract. In Table 2 this would be the March futures market, ensuring that the producer will receive the +$0.55 premium the market is offering. Keeping the grain in good condition and selling a March futures contract puts the producer in a hedged position. The producer is hedged because price changes will be offset as a result of having stored grain and sold (futures position). See the UK Cooperative Extension publication *Introduction to Futures Hedging for Grain Producers* (AEC-96) for a review of hedging and procedures.

Producers can also hold unpriced grain in storage, which signals an expectation that future prices will be higher than current levels—that is, speculation. The difference between this strategy and the storage hedge strategy is risk. Holding unpriced grain in storage is risky because the producer is unsure whether future prices will be higher or lower than current levels. With the storage hedge, risk is minimized because the producer knows what the benefit is ($0.55, Table 2).

Table 1. Advantages and disadvantages of a storage hedge.

Advantages	Disadvantages
• Capitalizing on a large futures carry[1] • Capitalizing on strengthening basis[2] • Protecting against downside futures price risk	• Incurring losses due to a weakening basis • Obligation to pay storage and interest costs (opportunity cost) • Payment of margin calls could be required (using a hedge-to-arrive contract removes this cost)[3] • Prevents capturing higher futures prices

[1] A large futures carry occurs when deferred futures prices are trading higher than nearby futures prices.
[2] Basis is the difference between cash price and futures price. It represents local supply and demand.
[3] Both a hedge through your own broker and prices that go against your initial position require margin money. If you hedge with your local elevator operator, called a *hedge-to-arrive contract,* the elevator operator takes care of all margin requirements, for which a fee may be charged.

Table 2. Example of both carry and inverted futures markets for wheat, $/bu.

Contract Month	Carry	Inverted
July	$5.00	$5.00
March	$5.55	$4.75
Size of carry market	+$0.55	
Size of inverted market		-$.25

Calculating Benefit of Storage Hedge

A large portion of the cost of storage is the opportunity cost of the income that comes from an immediate cash sale. Foregoing this money and holding grain in storage will cost the producer the interest that could be gained from paying back outstanding loans or from putting money in an interest-bearing account. To calculate the opportunity cost, you need the following information:

- current futures price
- interest rate (which could be an interest-bearing account that you could pay into or a loan accruing interest that you could pay down
- months in storage (which will be divided by 12 because the interest rate is an annual percentage

As an example, say you have an interest-bearing account which pays 5% annually and you place grain in storage for eight months (June through January). The interest foregone in storing grain adds up to $0.167/bu ($5.00/bu X .05 X 8 months /12 months). Opportunity costs increase with time in storage and interest rates, as shown in Table 3 for grain sold at $5 per bushel.

Additionally, a higher cash grain price increases the opportunity cost. In Table 3 the initial price is $5. In Table 4, where the initial price is $7, using a 5% interest rate while storing grain for eight months increases the opportunity cost by $0.067 ($0.233-$0.167) per bushel over that of a $5/bu cash price.

Basis is the other source of cash price risk. The futures price plus basis results in the local cash price. Consequently, basis can be calculated by taking the difference between the local cash price and the futures price. The two primary factors that impact basis are transportation costs and local supply and demand. Improvements in basis from the time of the current cash price to that of delivery increase producer returns. A weakening of basis reduces producer returns. Producers should monitor basis regularly and take advantage of strong basis offers by signing a basis contract (which would be for February delivery if selling on a March futures contract). As an alternative, producers can use the storage hedge through a cash-forward contract.

Table 3. Lost opportunity cost as a result of storing grain at $5/bu over time at different interest rates.

	Time Grain Stored (Months)					
	4	6	8	10	12	14
Interest Rate	Cost, $/bu					
2.0%	$0.033	$0.050	$0.067	$0.083	$0.100	$0.117
3.0%	$0.050	$0.075	$0.100	$0.125	$0.150	$0.175
4.0%	$0.067	$0.100	$0.133	$0.167	$0.200	$0.233
5.0%	$0.083	$0.125	$0.167	$0.208	$0.250	$0.292
6.0%	$0.100	$0.150	$0.200	$0.250	$0.300	$0.350
7.0%	$0.117	$0.175	$0.233	$0.292	$0.350	$0.408
8.0%	$0.133	$0.200	$0.267	$0.333	$0.400	$0.467

Note: Costs do not account for physical storage costs due to bin depreciation or variable costs associated with maintaining grain quality.

Table 4. Opportunity cost of storing grain at $7/bu over time at different interest rates.

	Time (Months)					
Interest Rate	4	6	8	10	12	14
2.0%	$0.047	$0.070	$0.093	$0.117	$0.140	$0.163
3.0%	$0.070	$0.105	$0.140	$0.175	$0.210	$0.245
4.0%	$0.093	$0.140	$0.187	$0.233	$0.280	$0.327
5.0%	$0.117	$0.175	$0.233	$0.292	$0.350	$0.408
6.0%	$0.140	$0.210	$0.280	$0.350	$0.420	$0.490
7.0%	$0.163	$0.245	$0.327	$0.408	$0.490	$0.572
8.0%	$0.187	$0.280	$0.373	$0.467	$0.560	$0.653

Note: Costs do not account for physical storage costs coming from bin depreciation or variable costs associated with maintaining grain quality.

Managing Storage Costs

Storing crops requires constant monitoring to ensure quality so that market discounts won't be incurred and profit margins negatively impacted. Freshly harvested crops should be dried as soon as possible to prevent sprouting and suppress insect and/or mold activity. When grain is exposed to constant air conditions (temperature and relative humidity) for a sufficient period of time, it will reach a stable level, known as the equilibrium moisture content (Table 5). Keeping the storage environment dry (with relative humidity of air space between grain kernels below 65%) is the most cost-effective way of controlling mold growth and the mycotoxins mold can produce. For wheat storage, with average day-night temperatures in July and August approaching 80 degrees or more, the recommended percentage of moisture for wheat that meets this condition is 12.5% or lower.

The cost to dry wheat below the base/market level of 13.5% moisture per bushel can be figured, for each point of moisture removed, at about 0.5 cents with unheated air drying, 2.3 cents with bin drying, and 3.3 cents with high-temperature drying. Drying costs will vary with the price of energy, labor, and equipment. Drying is a cost-effective way to control insects and mold. Moreover, drying costs are generally much less than other steps that may need to be taken if these problems occur during storage, as shown in Table 6. More information on drying and storing wheat is provided in Chapter 10 of the UK Cooperative Extension publication *A Comprehensive Guide to Wheat Management in Kentucky* (ID-125) at http://www.bae.uky.edu/Publications/IDs/ID-125.pdf.

Storing a product for an economic advantage requires good insect pest management. The presence of insects or insect damage can defeat the entire advantage of holding the wheat past harvest. *See the Controlling Insects in Stored Wheat: A Checklist* in this publication.

Insect pest management in stored wheat is generally a preventive measure. Many of the most important techniques for pest management are used before and during harvest and are non-chemical. Though pesticides may be added to wheat that is being binned, they will not last long due to the grain's heat and bin temperatures. Of even greater concern is the lack of a control option for insect pests as the grain is being removed for delivery, which usually occurs late in the winter when it is too cold to fumigate. So, preplan and be proactive: reduce the initial insect population, slow insect growth when possible, and monitor the grain to detect developing problems early.

Table 6 provides a complete example of the benefits and costs associated with a wheat storage hedge. In this example, wheat is put in storage at $5 per bushel, and the market is offering a $.55 per bushel carry, or $.55 more for delivering off the March contract. Costs associated with storing, miscellaneous costs, and opportunity cost total $.50 per bushel. The return after costs is $.05, so that in this example, the benefits of storing are almost equal to the costs. Returns would increase with either a larger carry or lower storage costs.

In summary, the storage hedge can be profitable when the futures market is offering a large carry and the producer follows storage guidelines. The market can incentivize storage by offering a price in the future that is greater than the cost of storing grain until that time. Storing grain to avoid price discounts requires minimizing the chance of damage from insects and moisture. Benefits of storage, that is, the carry, continuously change and should be monitored closely when deciding to take advantage through a storage hedge of the positive returns of storage.

Table 5. Equilibrium moisture content (EMC) of soft red winter wheat based on temperature and relative humidity.

	Relative Humidity (%)							
	30	**40**	**50**	**60**	**65**	**70**	**80**	**90**
Temp. ˚F	**Equilibrium Grain Moisture Content (%)**							
35	10.2	11.3	12.3	13.4	14.0	14.7	16.1	18.2
40	10.0	11.1	12.1	13.2	13.8	14.4	15.9	18.0
50	9.6	10.7	11.8	12.9	13.4	14.1	15.5	17.6
60	9.3	10.4	11.4	12.5	13.1	13.7	15.1	17.2
70	9.0	10.1	11.1	12.2	12.8	13.4	14.8	16.9
80	8.7	9.8	10.8	11.9	12.5	13.1	14.5	16.6
90	8.5	9.6	10.6	11.6	12.2	12.8	14.2	16.3

Source: American Society of Agricultural and Biological Engineers Standard D245.4.

Controlling Insects in Stored Wheat: A Checklist

Prior to Harvest

- ☐ Clean all equipment thoroughly to remove old grain, trash, and debris that might contaminate the new crop, including combines, carts, trucks, receiving pits/hoppers, and bins. Use pressurized air/water for conveyors; use a broom, shovel, and vacuum for storage bins.
- ☐ Remove spilled grain around pits/hoppers and storage bins to prevent contamination.
- ☐ Treat bin walls and flooring with an approved residual insecticide (compounds currently approved are Tempo and Storcide II). *Note:* Most stored grain insects are resistant to malathion, so it is not recommended!
- ☐ Treat the outside base of all bins with an approved residual insecticide such as Tempo.
- ☐ Mow, spray, or remove weeds/grass/vegetation around storage bins.
- ☐ Consider fumigation of the area under perforated floor. (The product currently approved is Phosphine). *Caution:* Fumigants are extremely toxic, restricted-use pesticides and require formal training for safe use. It is recommended that producers hire a professional fumigator if possible. If not, producers should obtain, review, understand, and strictly follow the product's label and application manual. See UK Cooperative Extension publication *Insecticide Recommendations for Small Grains*–2011(ENT-47) for currently registered products.

During Harvest

- ☐ Consider the application of an approved insecticide such as Storcide II on unheated wheat as it's transferred into storage. It is best to use a different product than what is used ito treat the interior of the bin.
- ☐ Consider the application of "cap-out" treatment to the wheat surface after the bin is full.
- ☐ Dry wheat to 12.5 % moisture if it will be held through July. This practice keeps the air space between wheat kernels dry (at approximately 65% humidity), which retards insect activity and mold growth. This moisture, or "shrink," cost amounts to 4 cents/bu when wheat is $7/bu).

After Harvest

- ☐ Insert pit traps into stored grain to track insect activity, and check traps weekly during the summer. See UK Cooperative Extension publication *Suffocation Hazards in Grain Bins* (AEN-39) to review safe methods of inspecting stored grain.
- ☐ Check for leaks in the bin around ladders, roof vents, temperature cables, and other openings.
- ☐ After binning for stability, check wheat temperature and moisture weekly.
- ☐ Consider fumigation of wheat prior to sale if insect populations reach economic thresholds. *Caution:* Fumigants are extremely toxic, restricted-use pesticides and require formal training for safe use. It is recommended that producers hire a professional fumigator if possible. If not, producers should obtain, review, understand, and strictly follow the product's label and application manual. See UK Cooperative Extension publication *Insecticide Recommendations for Small Grains*–2011(ENT-47) for currently registered products.

Table 6. Example worksheet for calculating and comparing costs and benefits of the storage hedge.[1]

				($/bu)
Futures	Nearby	July	A	$ 5.00
	Deferred	March	B	$ 5.55
Carry (B – A)			C	$ 0.55
Costs		Bin Preparation	D	$ 0.05
		Drying 4 pts[2]	E	$ 0.10
		Insecticides	F	$ 0.05
		Fumigation	G	$ 0.10
		Insurance	H	$ 0.02
		Miscellaneous[3]	I	$ 0.01
		Opportunity Cost of Money (5%)	J	$ 0.17
		Total Cost (sum of D through J)	K	$ 0.50
Return (C – K)				$ 0.05

[1] Grain bin equipment costs are not included in the analysis because of differences in costs associated with bins of different ages and sizes.
[2] Cost varies by price of fuel, type of drying system, and how much the grain needs to be dried.
[3] Miscellaneous costs include labor costs associated with monitoring stored grain and fumigation treatments.

For More Information

See the following UK Cooperative Extension publications:

Introduction to Futures Hedging for Grain Producers (AEC-96) at http://www.ca.uky.edu/agc/pubs/aec/aec96/aec96.pdf

A Comprehensive Guide to Wheat Management in Kentucky (ID-125) at http://www.bae.uky.edu/Publications/IDs/ID-125.pdf

Insecticide Recommendations for Small Grains–2011 (ENT-47) at http://pest.ca.uky.edu/EXT/Recs/ENT47-SmallGrain.pdf

Suffocation Hazards in Grain Bins (AEN-39) at http://www.ca.uky.edu/agc/pubs/aen/aen39/aen39.pdf

Aeration, Inspection, and Sampling of Grain in Storage Bins (AEN-45) at http://www.bae.uky.edu/publications/AENs/AEN-45.pdf

Glossary

Basis—Difference between the current cash price of a commodity and the futures price of the same commodity.

Basis contract—Contract calling for the future delivery of a commodity at a specified basis. Futures price has not been locked in.

Cap-out treatment—An insecticidal treatment added to the top (exposed) surface area of stored grain.

Carry market—Price pattern at which time prices for futures contracts with later maturity dates are higher than prices for contracts with earlier maturity dates.

Cash-forward contract—Contract calling for the future delivery of a commodity at both a specified price and time.

Contract month—Month in which a commodity futures price is established.

Deferred futures—Distant futures contact months.

Deferred futures price—Price associated with a distant futures contract.

Equilibrium moisture content—Stable level reached when grain is exposed to constant air conditions (temperature and relative humidity) for a sufficient period of time.

Futures contract—An obligation to buy or sell a specific quantity and quality of a commodity at a certain price at a specified future date.

Futures carry—See *carry market*.

Hedge—Participating in the futures markets to neutralize the effects of commodity price risk in the cash market. Delivery location is left open but the time (futures contract month) has been determined. Leaves basis unpriced.

Hedge-to-arrive contract—Same as a hedge except the producer guarantees the grain to an elevator and in return the elevator operation takes care of contract specifics such as margin money.

Inverted futures market—Occurs when futures contracts for the nearer months are trading at a price premium compared to the more distant months.

Margin call—Call received by a futures or options trader receives a margin call when the market has moved against the trader's position. Additional funds are required to bring the account balance back up to the original margin deposit.

Nearby futures—The futures contract closest in time.

Nearby futures price—Price associated with the futures contract that is closest in time.

Opportunity cost—Cost of an alternative that must be foregone in order to achieve another choice.

Short—To sell a futures or options contract.

Speculation—Participating in futures or options markets only to make a profit.

Short hedge—When one holds grain and at the same time takes a short position (i.e., sells) in the futures market.

Strengthening basis—When cash is getting stronger relative to futures.

Weakening basis—When cash is getting weaker relative to futures.

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