

Evaluating the Economics of Grain Storage In Tennessee

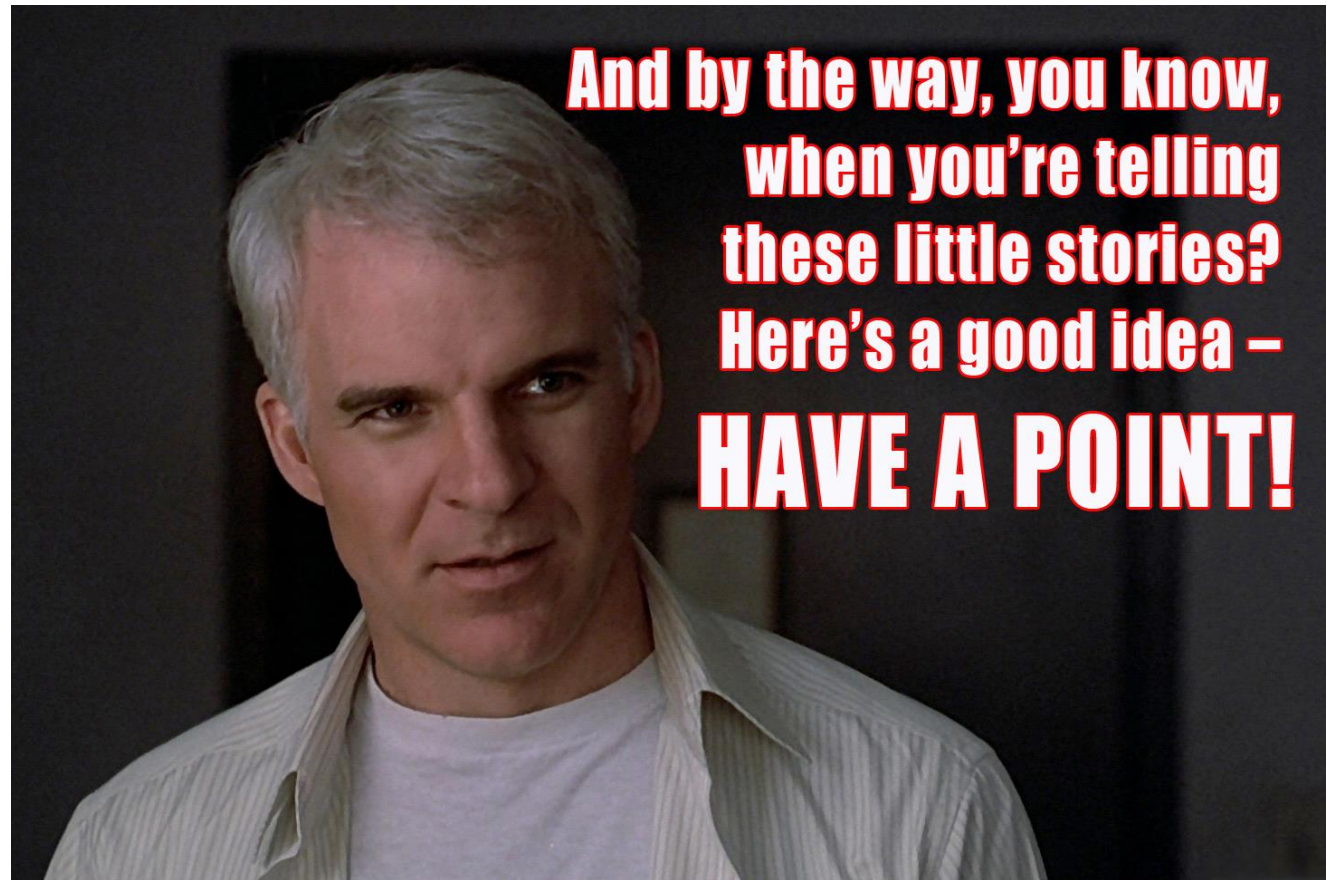
February 2, 2023

2023 West Tennessee Grain &
Soybean Producers Conference

Dr. S. Aaron Smith, Associate Professor and Extension Economist
Department of Agricultural and Resource Economics
University of Tennessee Institute of Agriculture

Email: aaron.smith@utk.edu

Web Page: <https://cropeconomics.tennessee.edu>



HOW DOES STORAGE FIT INTO YOUR CROP MARKETING AND RISK MANAGEMENT PLAN?

Risk Management and Marketing

Price Risk Management

Crop Insurance

Storage

Price Protection



Final Price

Example: Bridging the price risk gap until crop insurance prices are determined – put option

- On November 11, a \$14.00 November 2023 Put Option cost \$1.06.
- On January 27, a \$14.00 November 2023 Put Option cost \$1.09.
- After crop insurance prices are determined:
 - Out-of-the money: exit options position recoup premium.
 - In-the-money: maintain the position as price protection.

Corn Crop Insurance Prices

Commodity Year	Sales Closing Date	Projected Price Market Symbol	Projected Price Date Range	Projected Price	Price Volatility	Harvest Price Date Range	Harvest Price	Harvest less Projected
2011	3/15/2011	ZCZ11	02/01 - 02/28	\$6.01	0.29	10/01 - 10/31	\$6.32	\$0.31
2012	3/15/2012	ZCZ12	02/01 - 02/29	\$5.68	0.22	10/01 - 10/31	\$7.50	\$1.82
2013	3/15/2013	ZCZ13	02/01 - 02/28	\$5.65	0.2	10/01 - 10/31	\$4.39	(\$1.26)
2014	3/15/2014	ZCZ14	02/01 - 02/28	\$4.62	0.19	10/01 - 10/31	\$3.49	(\$1.13)
2015	3/15/2015	ZCZ15	02/01 - 02/28	\$4.15	0.21	10/01 - 10/31	\$3.83	(\$0.32)
2016	3/15/2016	ZCZ16	02/01 - 02/29	\$3.86	0.17	10/01 - 10/31	\$3.49	(\$0.37)
2017	3/15/2017	ZCZ17	02/01 - 02/28	\$3.96	0.19	10/01 - 10/31	\$3.49	(\$0.47)
2018	3/15/2018	ZCZ18	02/01 - 02/28	\$3.96	0.15	10/01 - 10/31	\$3.68	(\$0.28)
2019	3/15/2019	ZCZ19	02/01 - 02/28	\$4.00	0.15	10/01 - 10/31	\$3.90	(\$0.10)
2020	3/15/2020	ZCZ20	02/01 - 02/29	\$3.88	0.15	10/01 - 10/31	\$3.99	\$0.11
2021	3/15/2021	ZCZ21	02/01 - 02/28	\$4.58	0.23	10/01 - 10/31	\$5.37	\$0.79
2022	3/15/2022	ZCZ22	02/01 - 02/28	\$5.90	0.23	10/01 - 10/31	\$6.86	\$0.96

November Futures at \$5.96 February 1, 2023

Source: USDA RMA <https://prodwebnlb.rma.usda.gov/apps/pricediscovery>

Real. Life. Solutions.

Soybean Crop Insurance Prices

Commodity Year	Sales Closing Date	Market Symbol	Projected Price Date Range	Projected Price	Price Volatility	Harvest Price Date Range	Market Symbol	Harvest Price	Harvest less Projected
2011	3/15/2011	ZSF12	02/01 - 02/28	\$13.52	0.24	10/01 - 10/31	ZSF12	\$11.71	(\$1.81)
2012	3/15/2012	ZSF13	02/01 - 02/29	\$12.60	0.18	10/01 - 10/31	ZSF13	\$14.48	\$1.88
2013	3/15/2013	ZSF14	02/01 - 02/28	\$12.91	0.18	10/01 - 10/31	ZSF14	\$12.93	\$0.02
2014	3/15/2014	ZSF15	02/01 - 02/28	\$11.41	0.13	10/01 - 10/31	ZSF15	\$10.32	(\$1.09)
2015	3/15/2015	ZSF16	02/01 - 02/28	\$9.78	0.16	10/01 - 10/31	ZSF16	\$8.66	(\$1.12)
2016	3/15/2016	ZSF17	02/01 - 02/29	\$8.90	0.13	10/01 - 10/31	ZSF17	\$10.07	\$1.17
2017	3/15/2017	ZSF18	02/01 - 02/28	\$10.23	0.15	10/01 - 10/31	ZSF18	\$9.88	(\$0.35)
2018	3/15/2018	ZSF19	02/01 - 02/28	\$10.21	0.13	10/01 - 10/31	ZSF19	\$8.83	(\$1.38)
2019	3/15/2019	ZSF20	02/01 - 02/28	\$9.63	0.12	10/01 - 10/31	ZSF20	\$9.12	(\$0.51)
2020	3/15/2020	ZSF21	02/01 - 02/29	\$9.21	0.11	10/01 - 10/31	ZSF21	\$11.45	\$2.24
2021	3/15/2021	ZSF22	02/01 - 02/28	\$11.81	0.19	10/01 - 10/31	ZSF22	\$12.43	\$0.62
2022	3/15/2022	ZSF23	02/01 - 02/28	\$14.30	0.2	10/01 - 10/31	ZSF23	\$14.44	\$0.14

November Futures at \$13.60 February 1, 2023

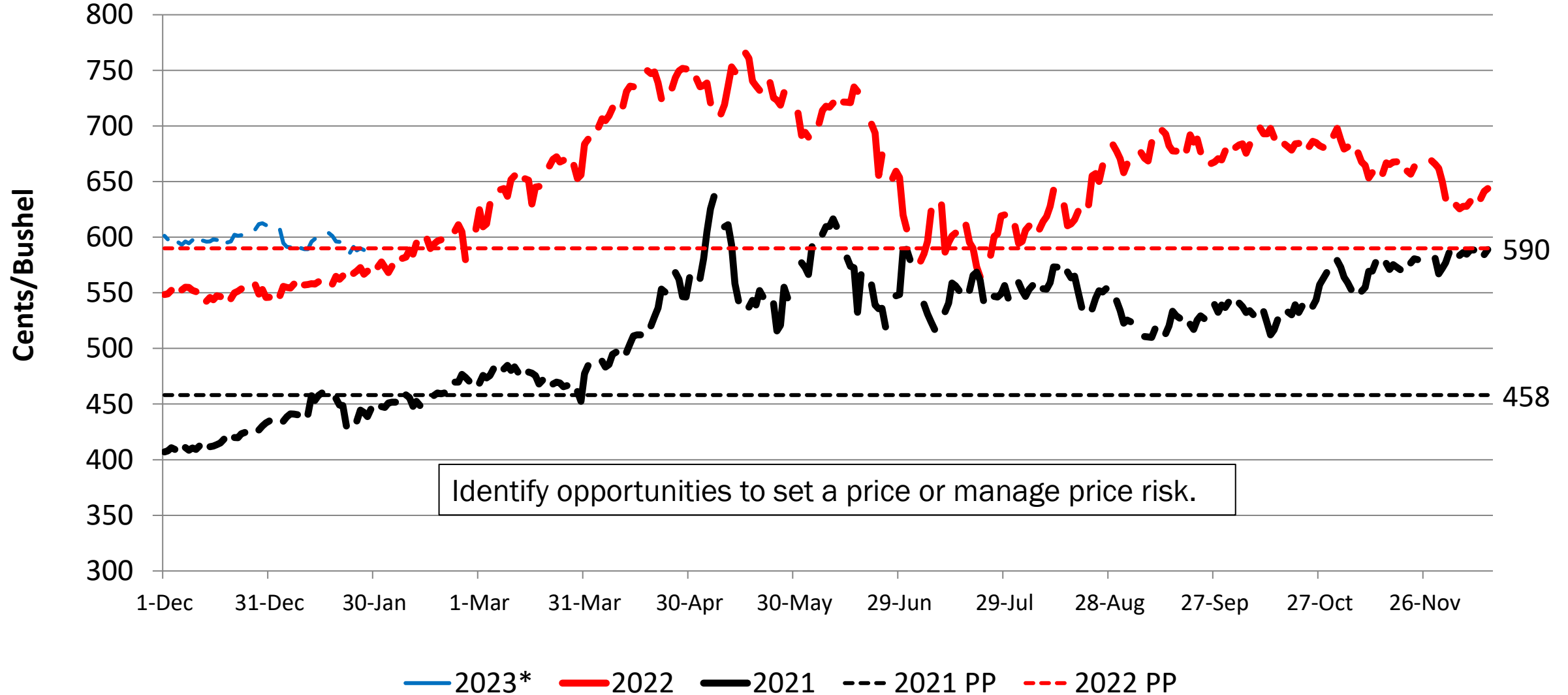
Source: USDA RMA <https://prodwebnrb.rma.usda.gov/apps/pricediscovery>

Real. Life. Solutions.

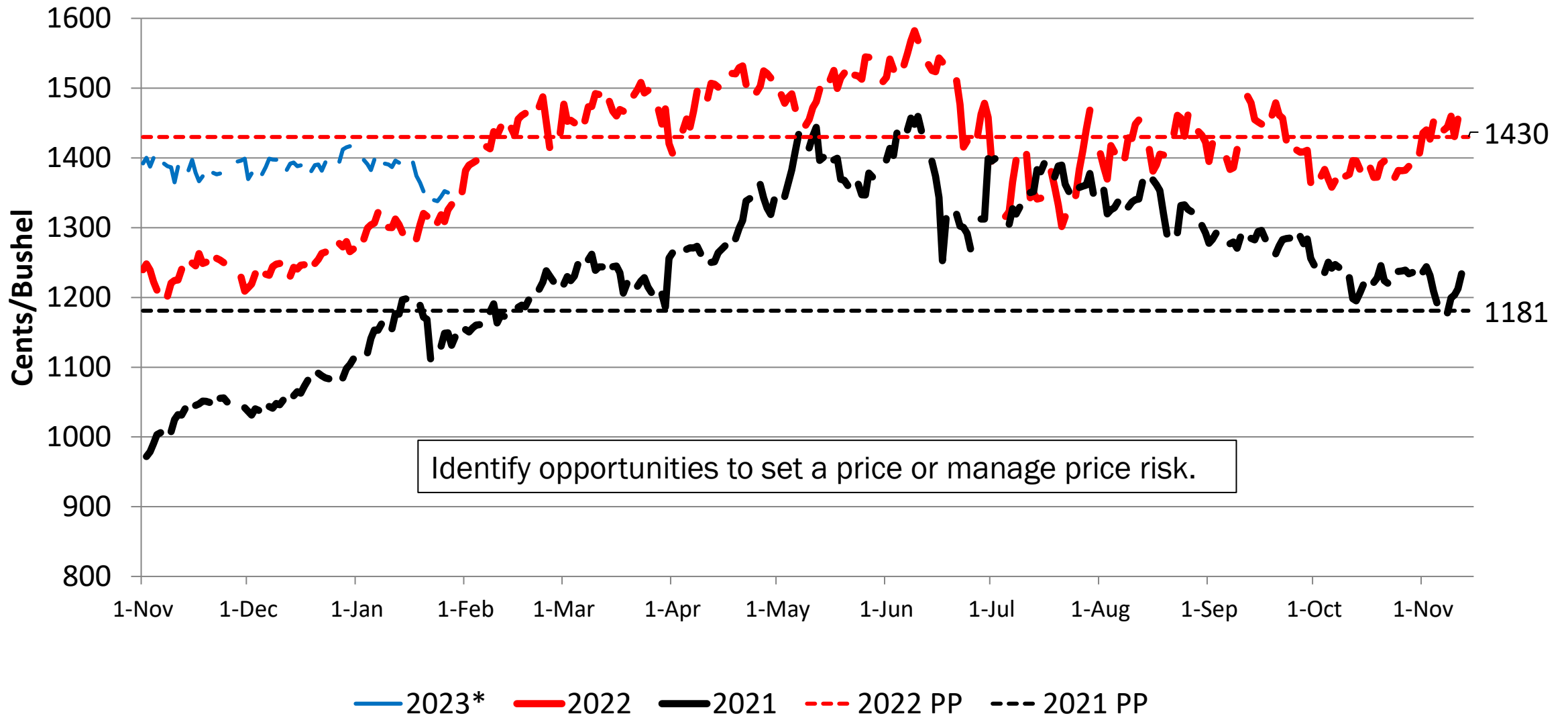
Breaking Down Price Risk

- Cash price target for 2023 for corn of \$6.50
 - \$6.00 futures price (92% of price risk)
 - \$0.50 basis (8% of price risk)
- Buy a \$5.00 December Put Option for 30 cents setting a \$4.70 futures floor.
 - This removes 78% ($\$4.70/\6.00) of the futures price risk (72% of total price).
 - Leaves the upside open in futures markets and the flexibility to set basis at a later date.
 - Can be combined with a more complex options strategy to lower premium costs.

December Corn Futures and Projected Price for Crop Insurance



November Soybean Futures and Projected Price for Crop Insurance



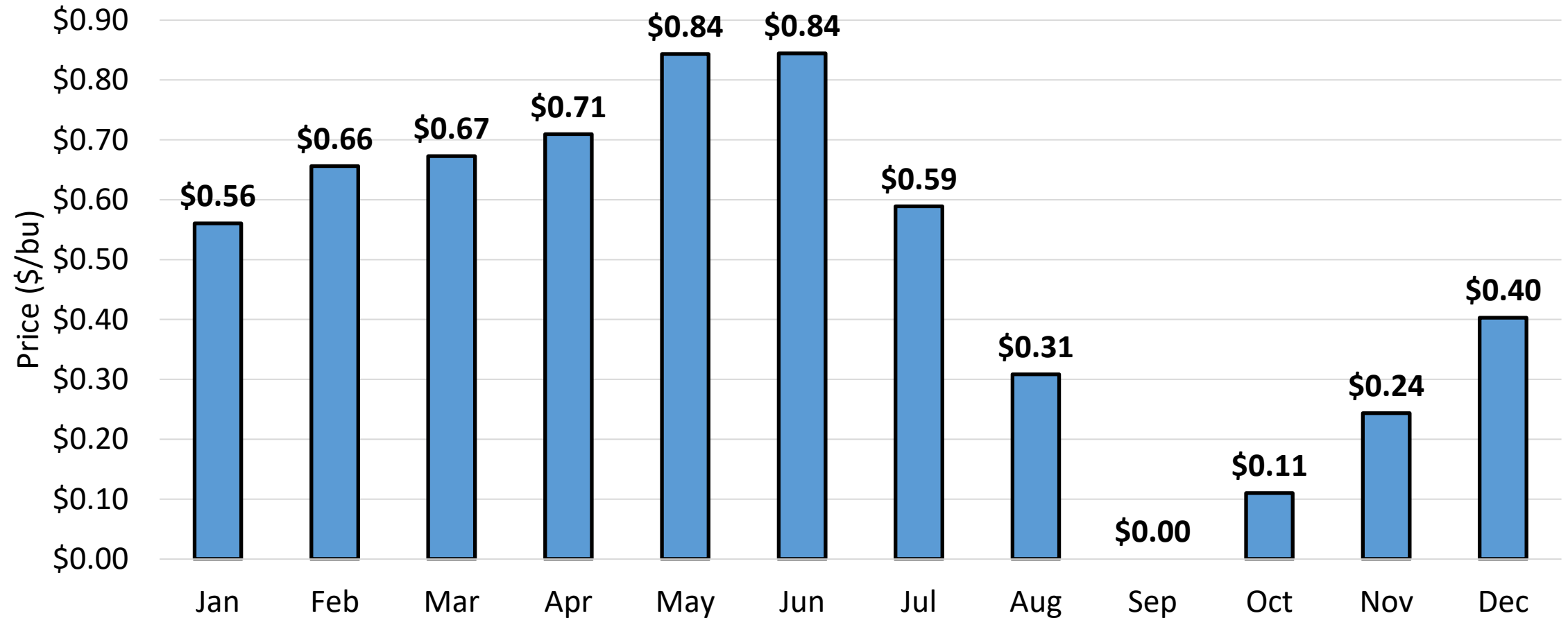


STORAGE

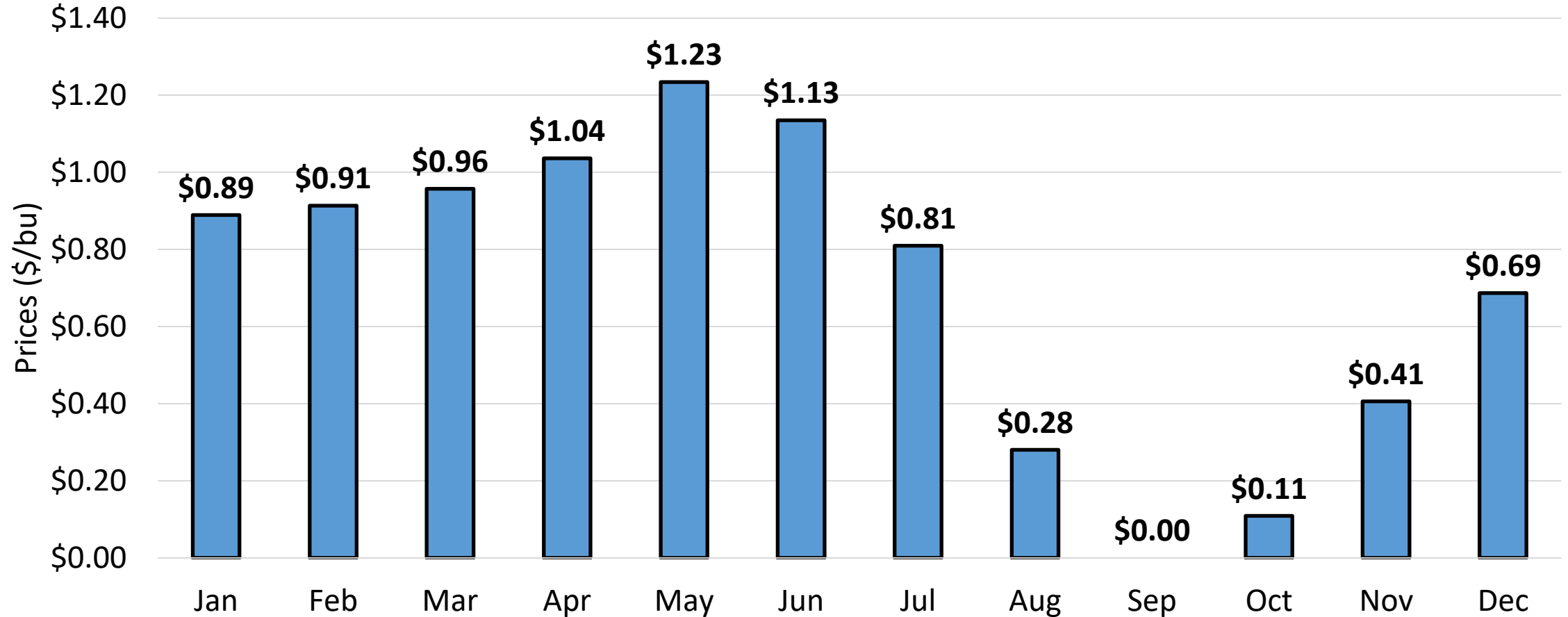
Storage Advantages

- Reduce harvest delays
- Allow for higher harvest moisture (drying and aeration)
- Spread out labor requirements
- Avoid seasonal price lows
- Extend the marketing window
- Reduce production risk in the marketing cycle
- On demand sales to terminal markets

Tennessee Corn 10-Yr Average Improvement in Cash Prices at Elevators and Barge Points



Tennessee Soybean 10-Yr Average Improvement in Cash Prices at Elevators and Barge Points



Grain Bags Versus Bins

- Grain bins can be constructed in a wide variety of sizes and configurations.
 - Constructing grain bins can be a capital-intensive undertaking.
- Grain bags have grown in popularity among mid-south producers.
 - Bags typically range in size from 10,000 to 18,000-bushels and allow for up to six months of storage.
 - Storage can be rapidly adjusted to increase capacity in years of abundant production.



Advantages and Disadvantages for Grain Bags and Grain Bins

<u>Bags</u>	
Advantages	Disadvantages
Reduced harvest delays / transportation cost	Cannot harvest at higher moisture levels
Field's edge storage	No drying capability or aeration
Adjustable storage amount	Possible wildlife and human damage
Loads and unloads faster than a grain bin	Loading / unloading can be difficult
No fixed structure on farm	Not suited for long term storage in the Midsouth
Does not affect land taxes	Partial storage can be problematic (loading and unloading should be completed once the process begins)
	Bag disposal

<u>Bins</u>	
Advantages	Disadvantages
Longer storage	Fixed structure
Drying and aeration possible	More difficult to expand storage rapidly within in a season
Depreciable asset	May effect land taxes
Harvest at higher moisture levels / earlier harvest	Higher upfront cost
Load and unload in multiple truck loads	Potentially higher transportation cost
Wider variety of grain storage (ie soybeans)	May increase insurance
Not prone to as much human and animal damage	

Grain Bag Cost Excel Decision Aid

Grain Bag and Bin Storage **UT EXTENSION**
Version 1.0 2021 INSTITUTE OF AGRICULTURE
THE UNIVERSITY OF TENNESSEE

Aaron Smith, Associate Professor - Crop Marketing Specialist

Office: (865) 974-7476 Email: aaron.smith@utk.edu

Charles Martinez, Assistant Professor

Office: (865) 974-7476 Email: cmart113@utk.edu

Christopher R Narayanan, Extension Area Specialist III

Hence Duncan, UT Extension Intern 2021

Spreadsheet cells highlighted in orange can be modified by users to reflect their specific situation.

Disclaimer: Significant variability in inputs, prices, and production practices exist across operations and from region to region. The information contained in this spreadsheet relies on estimates and assumptions specific to Tennessee. This information should not be construed as a reflection of all circumstances across the state, as regional variability does exist. To improve the value of this tool, users are encouraged to use inputs, prices, production practices and management that are employed on their specific operation.

The University of Tennessee is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA institution in the provision of its education and employment programs and services. All qualified applicants will receive equal consideration for employment and admission without regard to race, color, national origin, religion, sex, pregnancy, marital status, sexual orientation, gender identity, age, physical or mental disability, genetic information, veteran status, and parental status.

Orange Cells
Should be
User
Specified



UTIA INSTITUTE OF
AGRICULTURE
THE UNIVERSITY OF TENNESSEE

Start

Grain Bin Costs

Establishment Costs

- Bin size / price
- Construction Costs
 - Bin (Tank)
 - Floor
 - Fan
 - Sweep Auger
 - Any additional Options
 - Labor
 - Freight
 - Discounts (?)
 - Concrete
 - Gravel / Site Preparation
 - Electrical / Energy
- Capital Recovery
- Varies tremendously (~\$0.30 per bushel annualized)

Operating Costs

- Labor (loading and unloading)
- Diesel Price
- Interest Rate
- Taxes and Insurance
- Repair and Maintenance
- Shrinkage/handling loss
- Site Maintenance
- Machinery Fuel & Lubrication
- Insecticides
- Sensors /monitoring charges
- Varies tremendously (~\$0.20 per bushel)

Grain Bin Storage Estimate

Table 4. Assumptions

Select Bin Size	80,000	Bushels
	Value	Unit
Estimated price	\$6.00	\$/bu
Bin Size	80,000	bu
Bin Price	\$200,834	\$/bin
Labor Rate	\$15.61	\$/hr
Diesel Price	\$4.50	\$/gallon
Interest Rate (Operating)	8.5%	%
Interest Rate (Fixed)	7.5%	%
Taxes, Insurance, & Housing	2.0%	% of purchase price
Machinery - Repair and Maintenance	4.0%	% of purchase price
Bin - Repair and Maintenance	1.0%	% of purchase price
Estimated Shrinkage/Spoilage	1.0%	%

Table 7. Estimated Costs

Operating Costs	Quantity	Unit	Cost per unit	Unit	Total Cost	\$/bu
Site Maintenance	1	bin	\$500.00	\$/bin	\$500	
Labor Loading	80	hrs/bin	\$15.61	\$/hr	\$1,249	
Labor Unloading	80	hrs/bin	\$15.61	\$/hr	\$1,249	
Repair & Maintenance	\$1,655	\$	-	\$	\$1,655	
Machinery Fuel & Lubrication	\$4,352	\$	-	\$	\$4,352	
Insecticides	800	lb	\$2.00	\$/lb	\$1,600	
Sensors	8	# per bin	\$15.00	\$/sensor	\$120	
Labor - Bin Repair and Monitoring	1	hrs/bin	\$15.61	\$/hr	\$16	
Operating Interest					\$456	
Total Operating Costs					\$11,197	\$0.140
Ownership Costs						
Capital Recovery (Depreciation + Interest)					\$22,199	
Taxes, Insurance, and Housing					\$393	
Total Ownership Costs					\$22,592	\$0.282
Shrink/Storage Loss					\$4,800	\$0.060
Operating + Ownership + Shrink/Storage Loss Costs					\$38,589	\$0.482

Table 5. Construction Costs

	Price
Bin (Tank)	\$99,123.21
Floor	\$38,618.14
Fan	\$15,129.10
Sweep Auger	\$13,246.02
Additional	\$7,293.18
Labor	\$32,000.00
Freight	\$3,600.00
Discount	(\$21,676.21)
Bin Total	\$187,333.44
Concrete	\$10,934.00
Gravel	\$566.33
Site Prep	\$500.00
Electrical	\$1,500.00
Total:	\$200,833.77

Table 6. Construction Costs

Machinery	Purchase Price (\$)	Useful Life (years)	Salvage Value (\$)
Truck Auger	\$4,650	10	\$233
Fill Auger	\$19,925	10	\$996
Tractor	\$125,000	15	\$10,000
Bin	\$200,834	25	\$0

Tractor PTO HP	120
Share of Tractor Annual Use	5.0%

Print

Grain Bag Costs

Fixed Costs

- Loader
- Unloader
- Tractor

Variable Costs

- Bag Size / Price
- Labor Rate
- Diesel Price
- Interest Rate
- Taxes, Insurance, & Housing
- Repair and Maintenance
- Storage / Handling Loss

Grain Bag Storage Estimate

Table 1. Assumptions

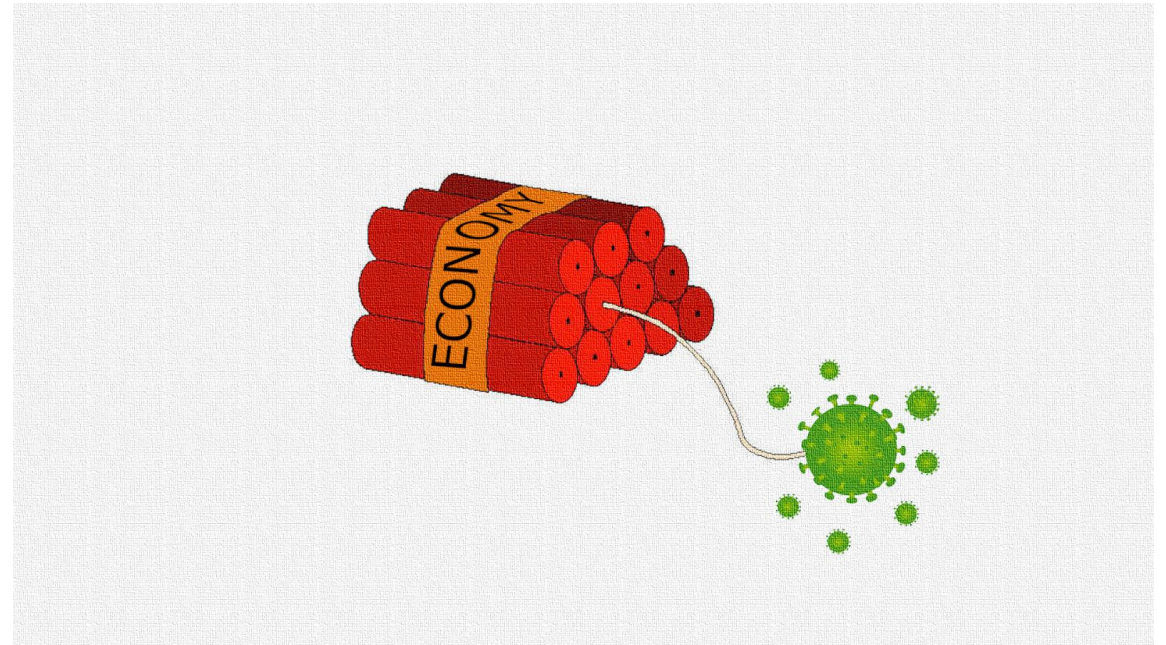
	Value	Unit
Acres	400	acres
Estimated Yield	200	bu/acre
Estimated Production	80,000	bu
Estimated Price	\$6.00	\$/bu
Bag Size	16,000	bu
Bag Weight	450	lbs
Bag Price	\$1,100	\$/bag
# of Bags	5	# (rounded up)
Labor Rate	\$15.61	\$/hr
Diesel Price	\$4.50	\$/gallon
Interest Rate (Operating)	8.5%	%
Interest Rate (Fixed)	7.5%	%
Taxes, Insurance, & Housing	2.0%	% of purchase price
Repair and Maintenance	4.0%	% of purchase price
Handling / Storage Loss	1.0%	%

Table 2. Machinery Assumptions

Machinery	Purchase Price (\$)	Useful Life (years)	Salvage Value (\$)
Loader	\$44,801	10	\$5,000
Unloader	\$50,861	10	\$5,000
Tractor	\$125,000	15	\$10,000
Tractor PTO HP	120		
Share of Tractor Annual Use		5.0%	

Table 3. Estimated Costs

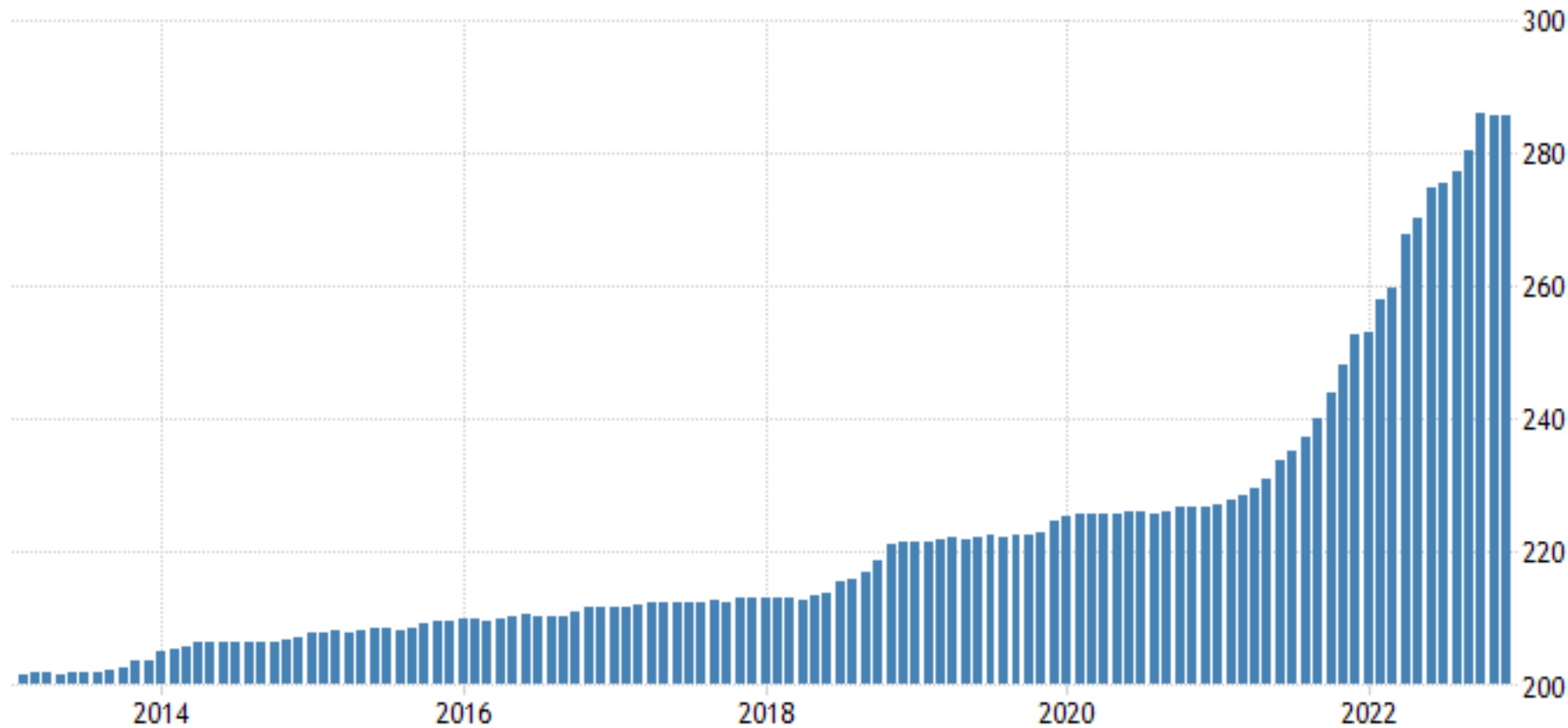
Operating Costs	Quantity	Unit	Number of people	Cost per unit	Unit	Total Cost	\$/bu
Site Preparation	5	bags	-	\$5.00	\$/bag	\$25	
Bag	5	bags	-	\$1,100	\$/bag	\$5,500	
Labor Loading per Bag	1.2	hrs/bag	2	\$15.61	\$/hr	\$187	
Labor Unloading per Bag	1.2	hrs/bag	2	\$15.61	\$/hr	\$187	
Machinery Repair & Maintenance	\$2,248	\$	-	-	\$	\$2,248	
Machinery Fuel & Lubrication	\$326	\$	-	-	\$	\$326	
Bag Sealing	5	bags	-	\$15.00	\$/bag	\$75	
Insecticides	800	lb	-	\$2.00	\$/lb	\$1,600	
Sensors	2	# per bag	-	\$15.00	\$/Sensor	\$150	
Labor - Bag Repair and Monitoring	2	hrs/bag	-	\$15.61	\$/hr	\$156	
Bag Disposal/Ton	5	bags	-	\$25.00	\$/ton	\$28	
Operating Interest						\$446	
Total Operating Costs						\$10,929	\$0.137
Ownership Costs							
Capital Recovery (Depreciation + Interest)						\$13,919	
Taxes, Insurance, and Housing						\$1,124	
Total Ownership Costs						\$15,043	\$0.188
Shrink/Storage Loss						\$4,800	\$0.060
Operating + Ownership + Shrink/Storage Loss Costs						\$30,772	\$0.385



Interest Rates, Machinery Cost, Construction Materials, and Energy


WHAT'S IMPACTING STORAGE COSTS?

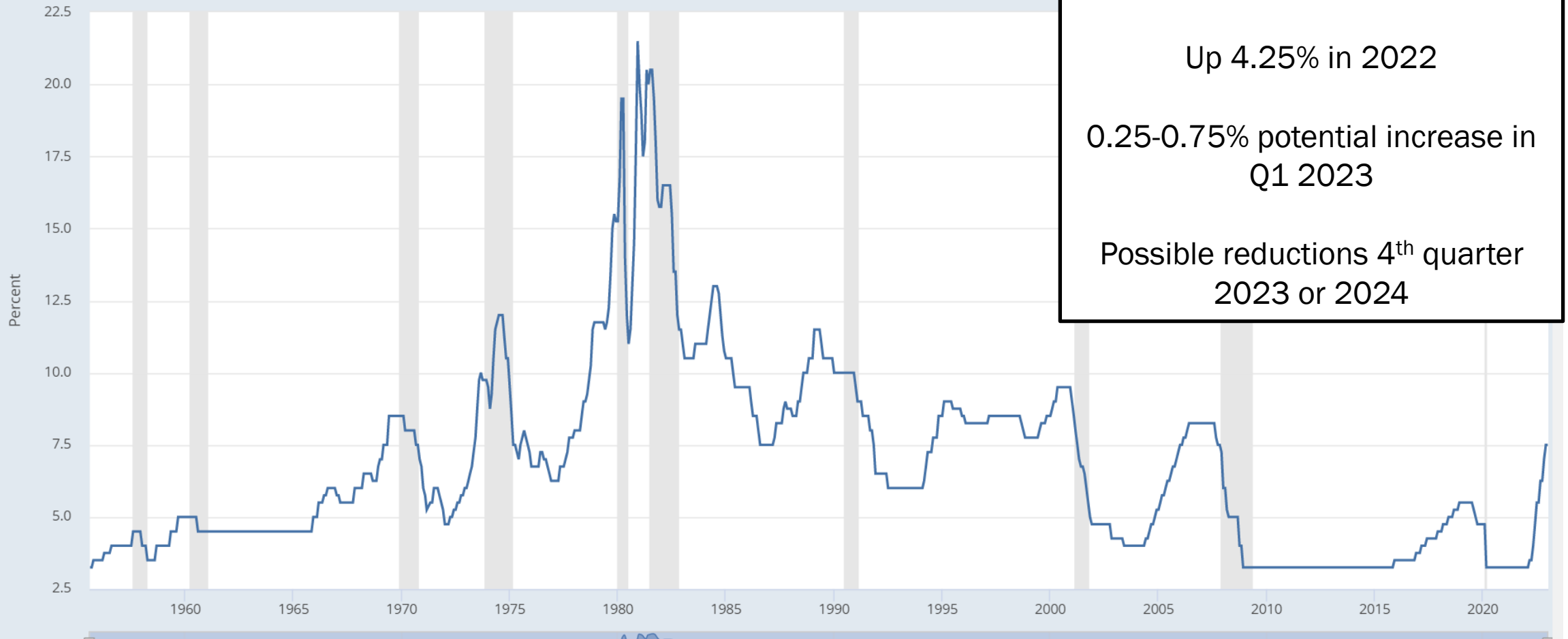
Producer Price Index by Industry: Farm Machinery and Equipment Manufacturing was 285.735 Index Dec 1982=100 in December of 2022



Farm machinery in December 2022 was up ~ 30% compared to 2020.

Bank Prime Loan Rate

FRED  — Bank Prime Loan Rate



Source: <https://fred.stlouisfed.org/series/DPRIME>

Rising interest rates will cost you money

\$1,250,000 Operating Utilization

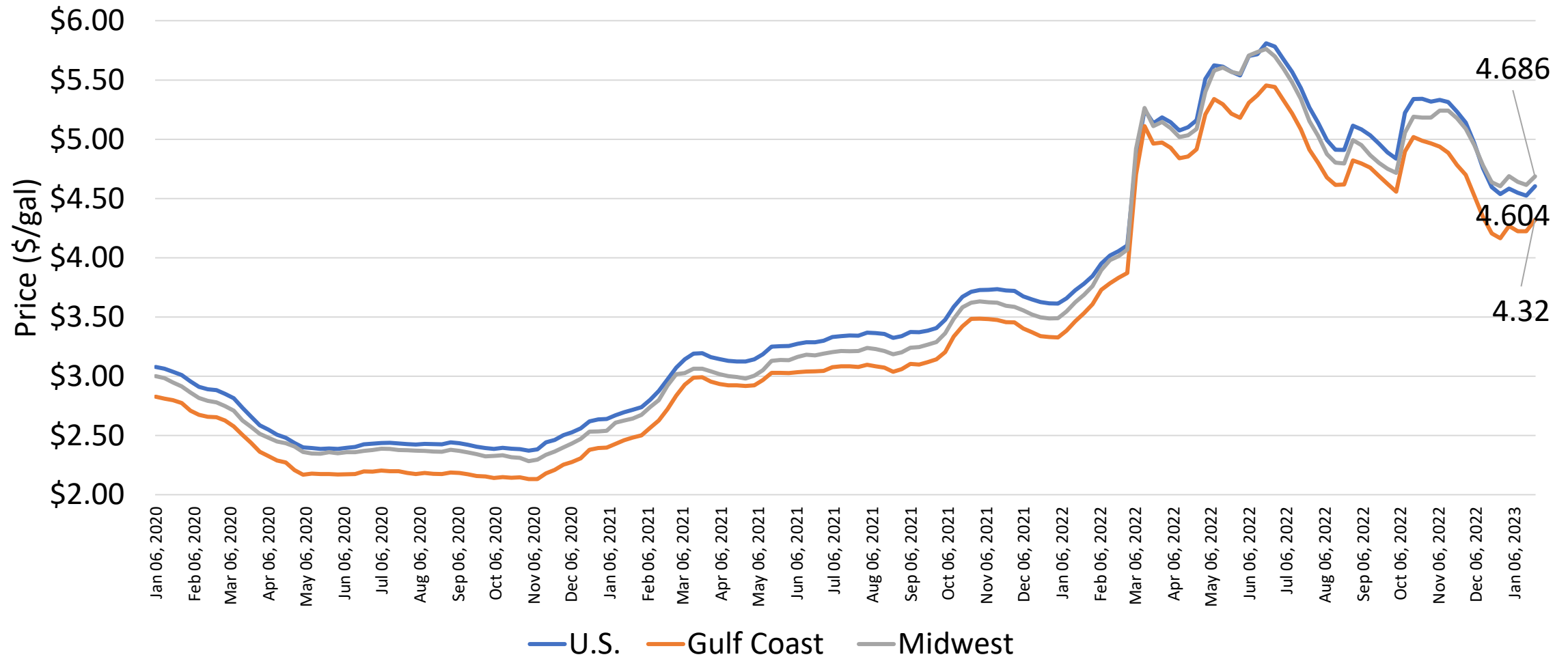
Interest Rate	3.25%	5.5%	7.5%
Interest	\$40,750	\$68,750	\$93,750
Change	-	\$28,000	\$53,000
Increase (\$/acre)	-	\$11.20	\$21.20

Assumptions: 2,500 acres.

Weekly Nearby Natural Gas Closing Price,



Weekly Retail No 2 Diesel Prices (\$/gal), 2020-2023



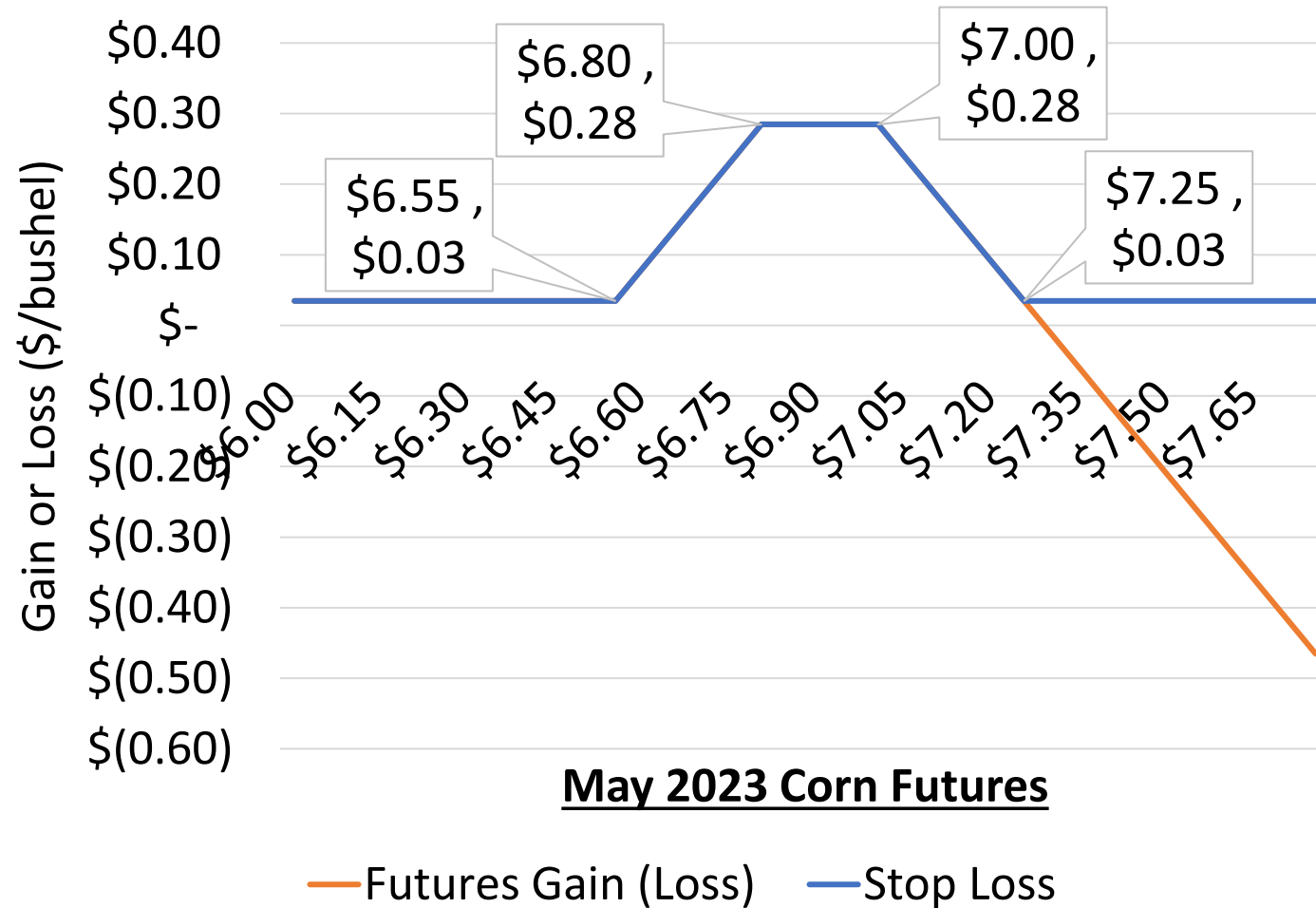
Data Source: <https://www.eia.gov/petroleum/gasdiesel/>

Real. Life. Solutions.

Post Harvest Price Risk Management for Crop in Storage

- Unpriced
- Contracted
- Set futures; leave basis unfixed
- Set basis; leave futures unfixed
- Option floor or other option strategy

Example Corn Option Strategy



May Contract		
Action	Strike	Premium
Sell Put	\$ 6.80	\$0.25
Sell Call	\$ 7.00	\$0.17
Buy Put	\$ 6.55	\$0.14
Stop (Buy) @ \$7.25		

Take Home Message

- Storage is one of the most advantageous marketing and risk management tools for Tennessee.
- Costs are substantially higher for grain infrastructure
 - Increased purchase price and establishment costs
 - Higher finance / capital recovery expense
- Price Risk Management + Crop Insurance + Storage



February 2, 2023

Dr. S. Aaron Smith Associate Professor and Extension
Economist

Department of Agricultural and Resource Economics
University of Tennessee Institute of Agriculture

Email: aaron.smith@utk.edu

Web Page: <https://cropeconomics.tennessee.edu>



THANK YOU

This material is based upon work supported by USDA/NIFA under Award
Number
2021-70027-34722



National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE