

# **Prices Over Space & Time**

**Price Analysis: A Fundamental  
Approach to the Study of Commodity  
Prices**



# Prices Over Space and Time

## Highlights

- Learn the costs of storage for farmers.
- Learn **The Forward Curve** in the futures market.
- Learn the financial calculation of full carry and spread.
- Learn to interpret the percent of full carry.
- Learn what drives variation in the basis.

## Check Your Understanding

- Can you calculate the percent of full carry yourself, given only futures prices and financing costs?

# In this section we cover how commodity prices behave over time and space

Following are some important findings:

- Commodity futures contracts have an expiration.
- There are always several contracts trading at any given time with maturities.
- Contracts Trading are increasingly farther into the future, and these contracts will eventually expire and no longer be traded.

# Types Of Contracts:

There are four different types of contracts:

- The contract that is next to expire is called the **Nearby** contract.
- The contract that expires next is called the **First Deferred** contract.
- The contract that expires after that is the **Second Deferred** contract.
- The different contracts trading at any given time make up what is called **The Forward Curve**, etc.

There is valuable information in **The Forward Curve** because it is the market's best guess of what returns to storage will be.

# Storage Costs to the Farmer

Storage costs include the following:

- **Opportunity cost of money:**

If they sell at harvest they can use the money for other things.

- **Interest:**

By deferring the sale of grain, the stockholder may need a bank loan to cover expenses since their main revenue stream is deferred.

- **Storage fees:**

Some farmers or stockholders have their own storage space, but many will need to rent storage space.

- **Drying costs:**

Grain that is just harvested can be around 15% moisture, but must be dried down to closer to 13.5% moisture to safely store for long periods. This involves running a grain dryer that uses fuel and/or electricity.

# Storage Costs to the Farmer (CONT...)

Storage costs include the following:

- **Shrinkage:**

When grain is dried, it actually shrinks leaving less bushels to sell after storage. The shrink factor can be 1.25 to 1.4 percent.

- **Quality deterioration:**

If the grain is not stored under proper condition, quality can deteriorate, and result in dockage being applied by the buyer at the time of sale.

- **Cost of handling:**

Getting the grain into and out of storage results in some costs as well.

# Storage Costs to the Farmer (CONT...)

According to Iowa State University Extension estimated in 2015:

- The storing grain until March costs a farmer roughly \\$.45 per bushel.
- The storing until December cost roughly \\$.30 per bushel which is \\$.15 cents per bushel less than storing until March.
- The he price of the March contract would need to be more than \\$.15 per bushel higher than the December contract.

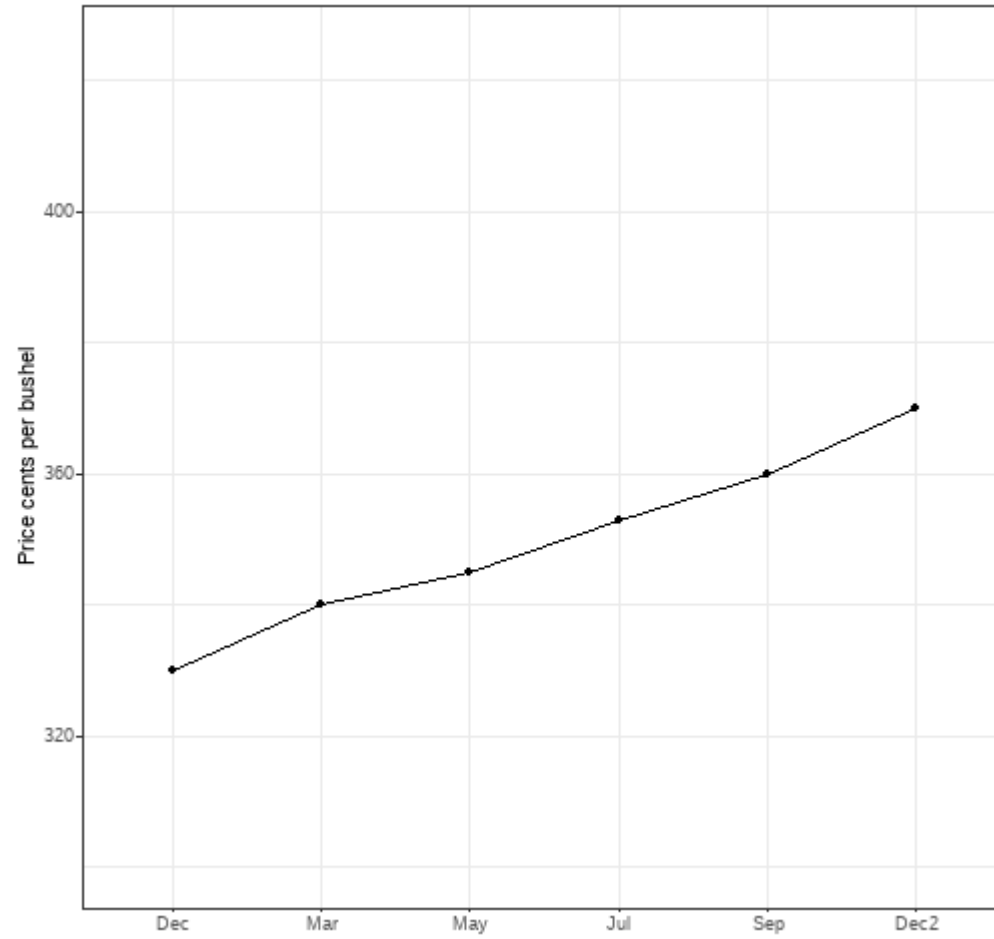


# An Increasing Forward Curve

Figure 1 illustrates the forward curve on September 26, 2016.

- **The Forward Curve** represents the return to storage and it shows the extra money can be made.
- December corn is worth 330 cents per bushel and March corn is worth 340 cents per bushel.
- When stocks are plentiful the market offers a premium to store.

Increasing Forward Curve from Sep 26, 2016



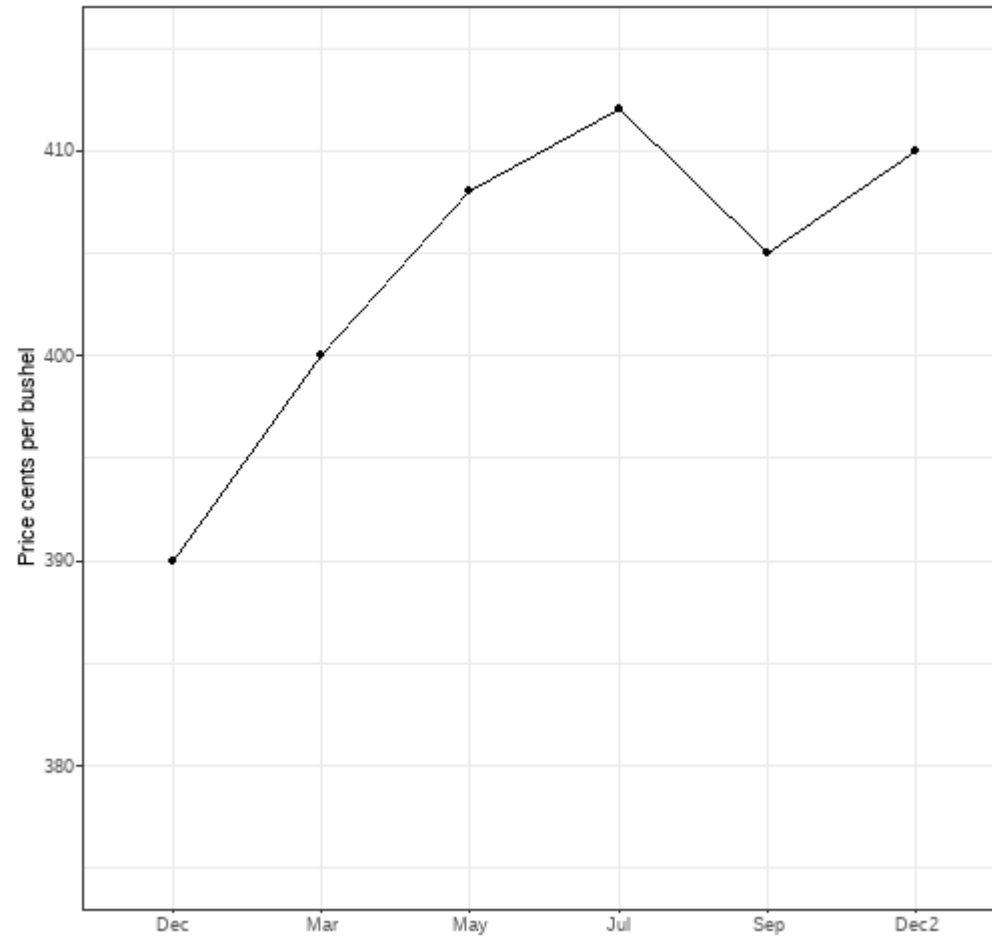
The price relationship is 'discovered' and changes everyday is called a "Carry Market" or "Contango Market", or sometimes it is said to be the market is "In Full Carry".

# An Increasing Forward Curve (CONT...)

This example illustrates a phenomenon that often occurs:

- **The Forward Curve** is upward sloped until September and it flattens and returns to storage go away.
- In September we begin to see the next year's crop come onto the market.
- In 2015, the market was asking farmers to keep storing through July, but no longer.
- Holding the grain from July - September could expect to lose as much as 4 cents per month.

Increasing Forward Curve from Sep 25, 2015



# A Decreasing Forward Curve

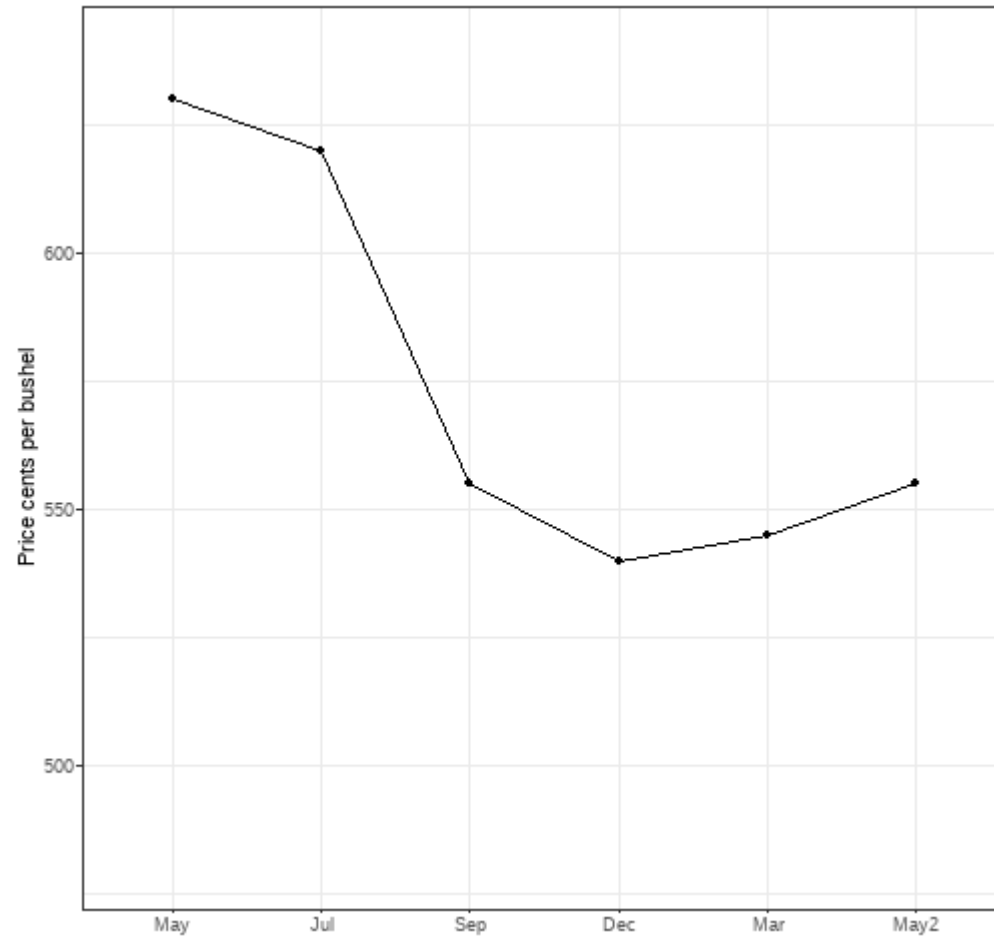
- 2012 was a significant drought year that resulted in:
  1. Poor yields
  2. High prices
  3. Low forecasted ending stocks.
- The supplies were tight and **The Forward Curve** tends to be downward sloped.
- The market is incentivising everyone to bring grain onto the market.

# A Decreasing Forward Curve (CONT...)

In 04-03-2012, **The Forward Curve** are as shown in figure 3. Its in the spring, before the drought has happened.

- The supplies were already tight going into 2012.
- **The Forward Curve** is downward sloped, sometimes called **Inverted** or **Backward** market.
- The returns to storage are negative, through the summer of 2012, even before the drought.
- As of 4-13-2012, the market 'thought' that the 2012 harvest would be good, because the price levels drop substantially.
- The return to storage between December 2012 and March 2013 is positive on 4-13-2012.

Decreasing Forward Curve from Apr 13, 2012



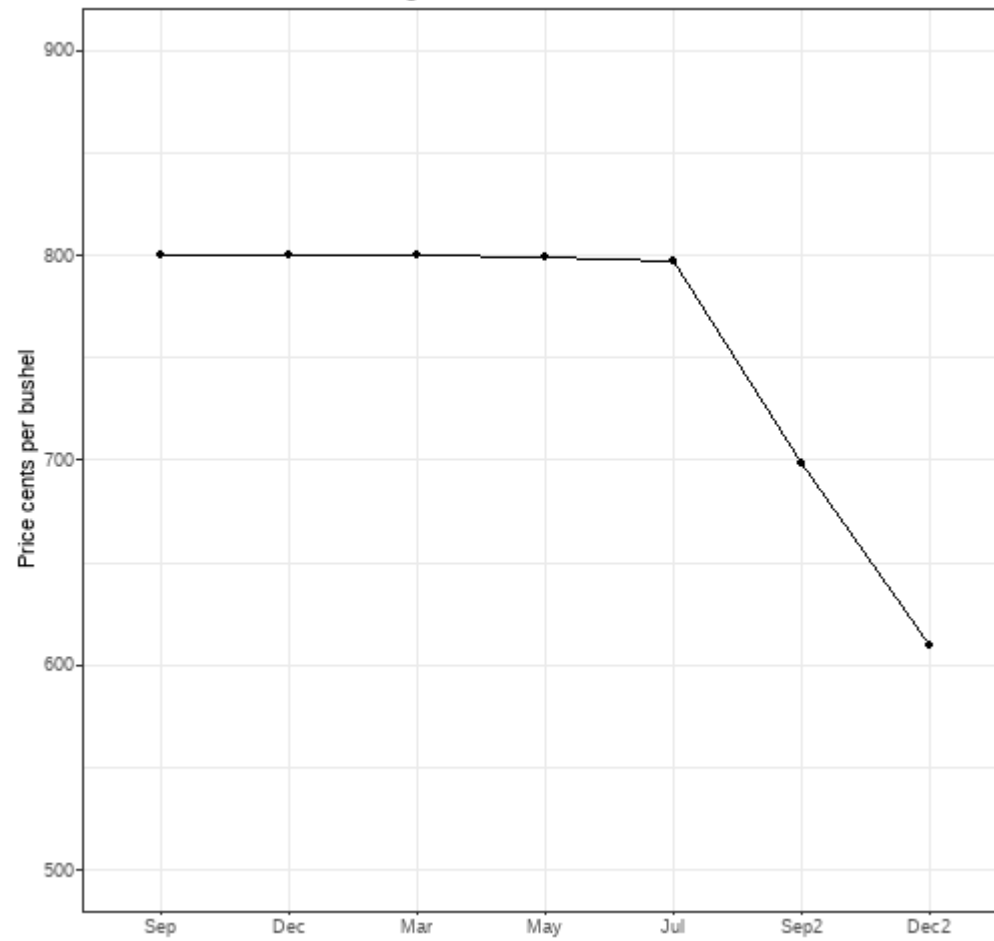


# A Decreasing Forward Curve (CONT...)

Lets look at the forward curve on 8-01-2012.

- By August 1, we are in the midst of a major drought, yields will be low along with the ending stocks.
- In 2013, **The Forward Curve** is downward sloped for the entire marketing year until the next harvest is expected.
- On 4-13-2012, the market was offering about 5 cents per month to store from December 2012 to March 2013.
- By 8-01-2012, the market was offering -1 cent for storage during the same time period.

Flat Forward Curve from Aug 1, 2012

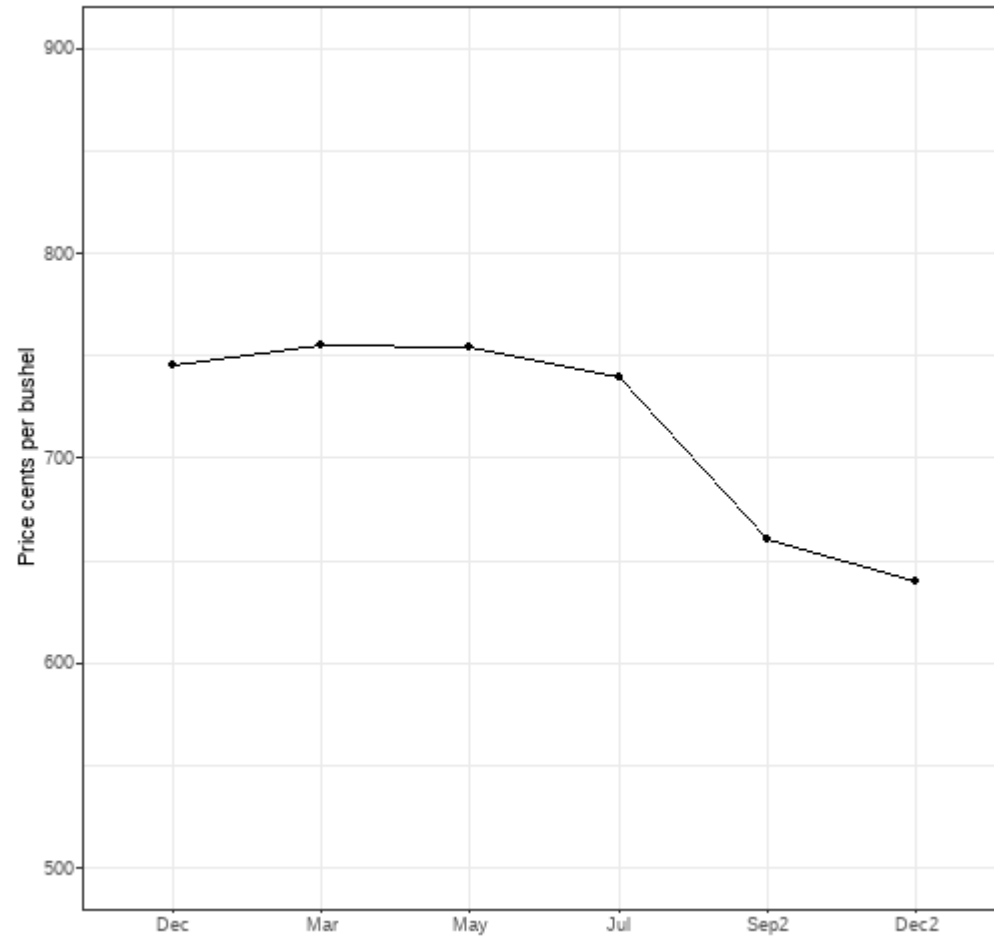


# A Decreasing Forward Curve (CONT...)

To illustrate the forward curve changed between August and December 2012:

- The time in which harvest occurred and we learned the bad yields turned out to be.
- We show the forward curve on 12-03-2012 in figure 5.

Flat and Falling Forward Curve from Dec 3, 2012



# Forward Curve Cases with Hypothetical Data (CONT...)

- When prices move up or down, the front end of the forward curve is more responsive.
- We will illustrate this with both increasing prices and decreasing prices.
- The examples in the next slide show the first five contracts on the forward curve plotted on four consecutive days.
- The price data in these examples are hypothetical, but represent what usually happens to the forward curve when prices.

# Forward Curve Cases with Hypothetical Data (CONT...)

## Prices Increasing

- Figure 6. Forward Curve with Prices Increasing, Contango to backwardation
  - On day 1, the market is clearly in contango, as the forward curve is upward sloped.
  - From day 1 through day 4, the prices are rising each day, with the front end of the forward curve.
  - On day 4, the prices have risen enough that the market is now in backwardation with the front month higher than the first deferred.

# Forward Curve Cases with Hypothetical Data (CONT...)

## Prices Decreasing

- Figure 7. Forward Curve with Prices Decreasing
  - On day 1, the market is in Contango in this example.
  - From day 1 to day 4, prices are falling.
  - From day 1 to day 3 the forward curve is getting steeper because price declines in Dec are larger than the price declines in March.
  - The price declines in March are larger than the price declines in May.
  - This indicates that from day 1 to day 3, the market is not yet at **Full Carry**; as prices are declining.
  - From day 3 to day 4, however, the market is at **Full Carry** because the price decline is constant all the way up the forward curve.

# Forward Curve Cases with Hypothetical Data (CONT...)

## Some Caveats

- The effect of the price changes on the shape of the forward curve is typically observed.
- There can be fundamental changes in the market that affect the parts of the forward curve.
- This could cause a larger price change in the middle or back end of the forward curve.
- The front end of the forward curve will be more volatile than the back end as depicted in figures 6 and 7.



# Financial Full Carry

- The costs of storage to the farmer is the opportunity.
- The cost of money resulting from deferring a sale to predict with certainty any individual farmer's decision to store.
- There is a concept called **Financial Full Carry** that simply includes interest costs and the premium charges on shipping certificates.

$$\textit{Financial Full Carry} = \textit{ndays} \left( \frac{i}{360} * F + P \right)$$

- Where *ndays* = the number of days between the first delivery day in the nearby contract and the first delivery day in the deferred contract.
- *i* = three month LIBOR interest rate + 200 basis points.
- *F* = futures price, and *P* = the current premium charge on shipping certificates.

# Financial Full Carry (CONT...)

- For example:
  - There are 90 days between delivery period of the December and March contract.
  - If the LIBOR rate is .3%, financing costs are 200 basis points above LIBOR, the corn futures price is \ \$3.50 per bushel, and the premium charge on shipping certificates is 0.165 cents per bushel per day, then **Financial Full Carry** is:
  - The CME Group uses simple interest to calculate the financial full carry in other contexts, so we adopt it here for our definition of financial full carry.

$$\text{Financial Full Carry} = 90 * (0.023/360 * 350 + 0.165 = 16.86 \text{ cents per bushel})$$

# Financial Full Carry (CONT...)

- The **Financial Full Carry** between the December and the March contract would be 16.86 cents. It is called **Financial Full Carry**.
- The spread between December and March contracts cannot be wider than this amount.
- If it were wider, say 30 cents, then a storage arbitrage would be possible.
- Hold the shipping certificate until March 1st at a cost to you of 16.86 cents per bushel.
- Then, use the shipping certificate to deliver on your short March futures position.
- Your futures trades just earned 30 cents, while holding the shipping certificate only cost 16.86 cents, leaving you with a profit of 13.14 cents per bushel.

# Financial Full Carry (CONT...)

- The concept of **Financial Full Carry** is really just a benchmark.
- Most importantly, any individual's ability to capitalize on the arbitrage is predicated at the ability to borrow for 200 basis points over LIBOR.
- Percent of **Full Financial Carry** is a metric that is widely followed because it gives similar information as the shape of the forward curve across time.
- In our example, percent of **Full Carry** =  $100 * 30/16.86 = 177.94\%$   
(remember this was an extreme example to illustrate the potential for arbitrage).

$$(\text{Percent of Full Carry} = 100 * \frac{\text{Futures Calendar Spread}}{\text{Full Financial Carry}})$$

# Calendar Spreads

- **The Forward Curve** and returns to storage from the perspective of a farmer or other who holds physical stocks of grain.
- Speculators watch the price spread between futures contracts and trade them to bet on whether or not returns to storage will increase or decrease.
- These kinds of spreads are called *Calendar Spreads* and they are done by performing the following type of trade.

# Calendar Spreads (CONT...)

- Following are the same logic about below mentioned:
  - Expected scarcity of stocks
  - Returns to storage
  - Incentives for the market to bring stocks to the market, if the price goes up.
  - The nearby contract and front end of the forward curve react the most strongly, deferred contracts will also go up, but by a lesser amount.
  - If the price goes down, the nearby contract will change the most; the deferred contract will also go down, but less so.

# A speculator places, the following trades if they are bullish (bearish):

## Bullish - think prices are going up

- Buy Nearby: Dec 2017
- Sell Deferred: March 2018
  - You are betting the prices in general will go up, but the nearby will go up more than the deferred contracts.
  - Any information event suggests supplies will become tighter should make prices go up in general.
  - And, reduce the incentive to the store. Thus, making this a profitable calendar spread trade.

# A speculator places, the following trades if they are bullish (bearish): (CONT...)

## Bearish - think prices are going down

- Sell Nearby: Dec 2017
- Buy Deferred: March 2018
  - You are betting the prices will go down in general, but that the nearby will go down more than the deferred contracts.
  - Any information suggests supplies will become more plentiful should make prices go down in general.
  - And, should increase incentives to store. Thus making the bearish calendar spread profitable.



# Price Variation Over Space

- Future price represent the expected future price of the commodity in a very specific location.
- A location that is 'Regular' for delivery is a location designated by the commodity exchange.
- Where, stocks of a commodity represented by a futures contract may be delivered in fulfillment of the contract.
- This is where the spot, cash, price, or converge with the futures price.

# Price Variation Over Space (CONT...)

- The price of the future contract represent the expected future price only at these locations (technically whichever is cheapest to deliver).
- The degree to which the futures price is indicative of the expected future spot price at locations far from Northern Illinois can vary.
- In rural U.S, grain elevators, ethanol plants, soybean crushers, feed yards and biodeisel manufacturers dot the landscape every few miles.
- These entities buy essentially all of the grain and oilseed crop that is not used on-farm for livestock feeding.
- They post bids to buy every day they are open. They offer to buy as a cash sale, or on forward contract for delivery one to three months ahead.

# Price Variation Over Space (CONT...)

- In the case of the forward contract, the farmer will go in to the elevator and sign a contract to deliver a specific number of bushels within a specified window of time.
- Usually, the prices quoted by grain elevators and other prices is relative to the futures contract price, or basis.
- Depending on how far the location is from the Illinois river, this difference may be large, but still the futures price is the reference point.
- The basis is often quoted as 'over' or 'under' the futures price.
- For example, an elevator might post bids to buy for **−27** cents. This means **27** cents under the futures price. A bid of **31** would be read as **31** cents over the futures price.

# Definition of Basis

- Basis is always defined as Spot Price minus Futures price.

$$\textit{Basis} = \textit{Spot} - \textit{Futures}$$

- Basis reflects the price differential over space relative to the futures price. Basis is influenced by
  - Transportation Costs
  - Local Supply and Demand Conditions
  - Interest and Storage Charges (this reflects that there is also a small time component as well as spatial)
  - Other Handling, Shipping and other Costs

# Definition of Basis

- Transportation costs are built into basis because large users of grain are not located in large production region. E.g.
  - Cattle feed yards in Western Kansas and Nebraska
  - Chickens in the South
  - Hogs in North Carolina
- Grain is shipped by rail and/or truck to locations across the country.
- Areas of grain surplus generally have a negative basis, the spot price is less than the futures.
- Areas of grain deficit generally have a positive basis, the spot price is greater than the futures.

# Definition of Basis (CONT...)

- Local supply and demand conditions are also important.
- Occasionally, there will be localized production problems.
- The biggest recent example comes from the demand in ethanol production in the U.S. was felt greatest in Iowa.
- Billions of gallons of capacity in ethanol production came online in Iowa.
- The corn basis was affected With additional large consumers of corn located throughout Iowa.
- There was more localized demand for corn. The ethanol plants and grain elevators had increased localized competition from 2005-10.

# Terminology

- Farmers and grain handlers alike watch the basis closely.
- The discussion of changes in the basis is common. When the basis is increasing, in most cases that means becoming 'less negative'.
- The basis is **strengthening**. When the basis is decreasing, or becoming 'more negative', we say the basis is **weakening**.

**CHAPTER END**



