

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:

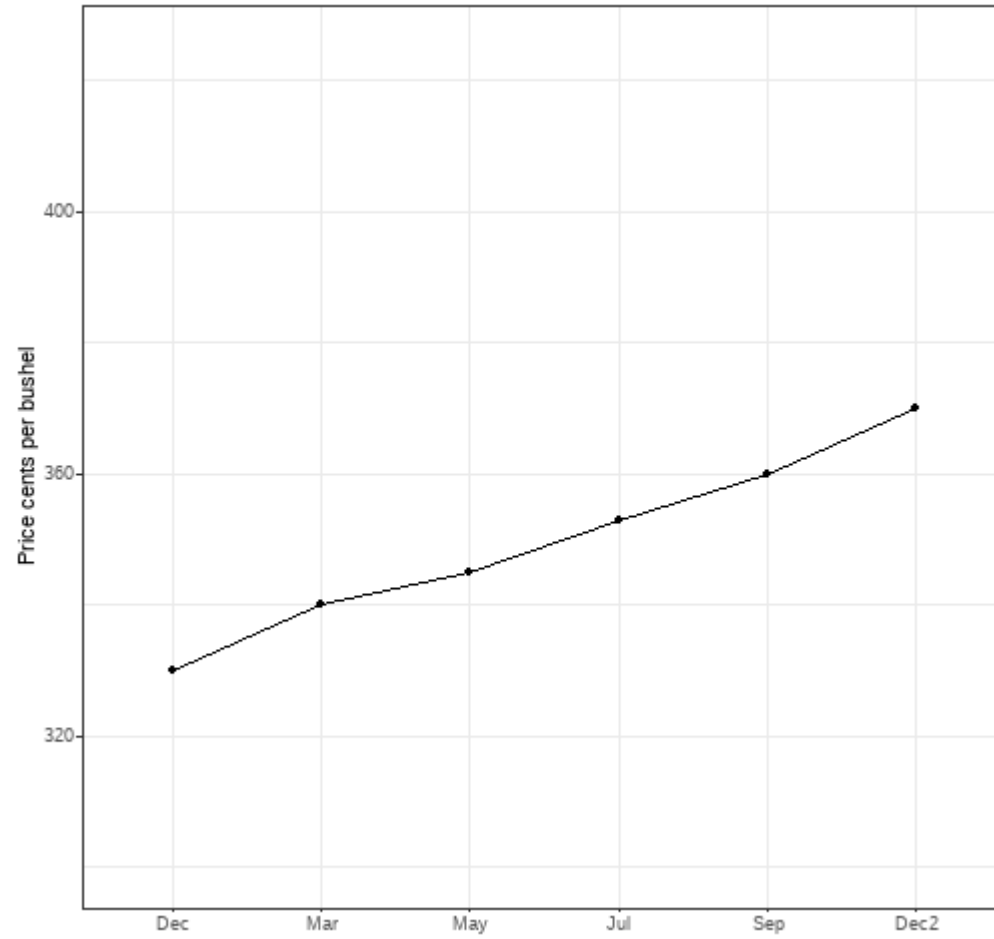
- The storing grain until March costs a farmer roughly \\$.45 per bushel.
- The storing until December cost roughly \\$.30 per bushel which is \\$.15 cents per bushel less than storing until March.
- The he price of the March contract would need to be more than \\$.15 per bushel higher than the December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



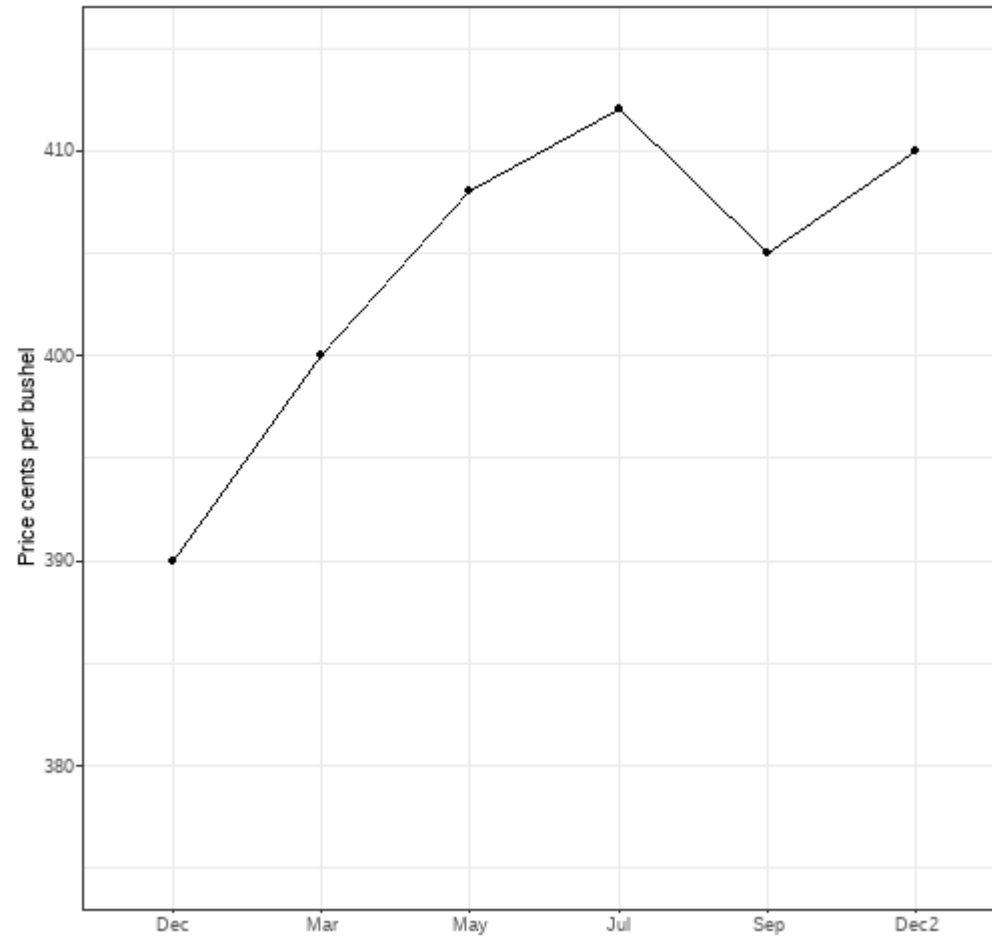
- The price relationship is 'discovered', and changes everyday.
- When it is upward sloped it is called a "Carry Market" or "Contango Market", or sometimes it is said to be "In Full Carry".

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

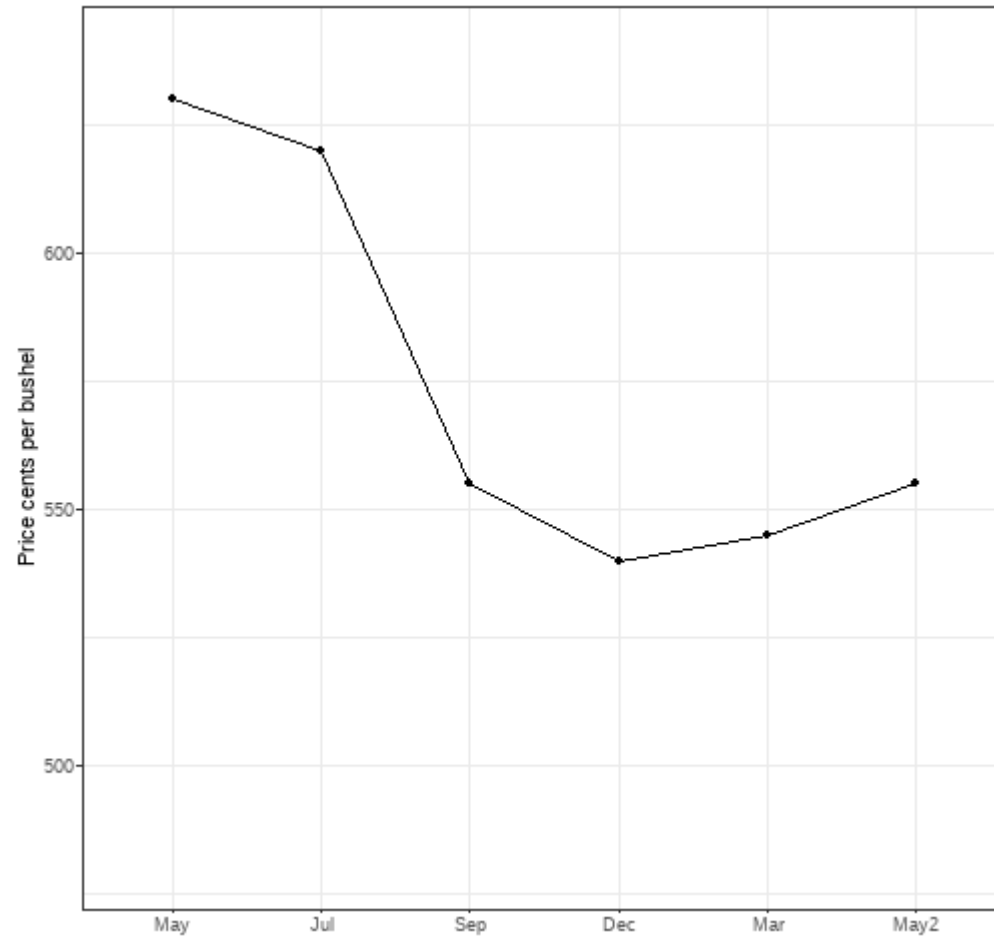
- 2012 was a significant drought year that resulted in:
 1. Poor yields
 2. High prices
 3. Low forecasted ending stocks.
- The supplies were tight and **The Forward Curve** tends to be downward sloped.
- The market is incentivising everyone to bring grain onto the market.

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

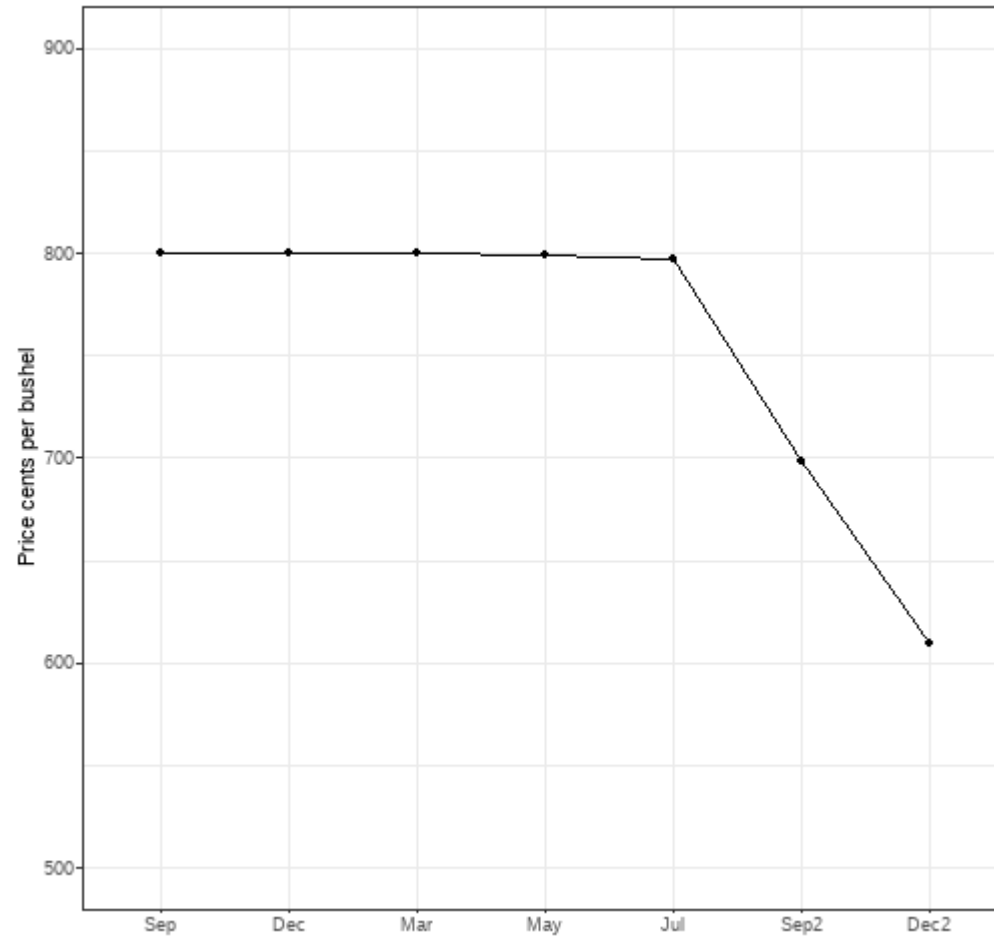


A Decreasing Forward Curve (CONT...)

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

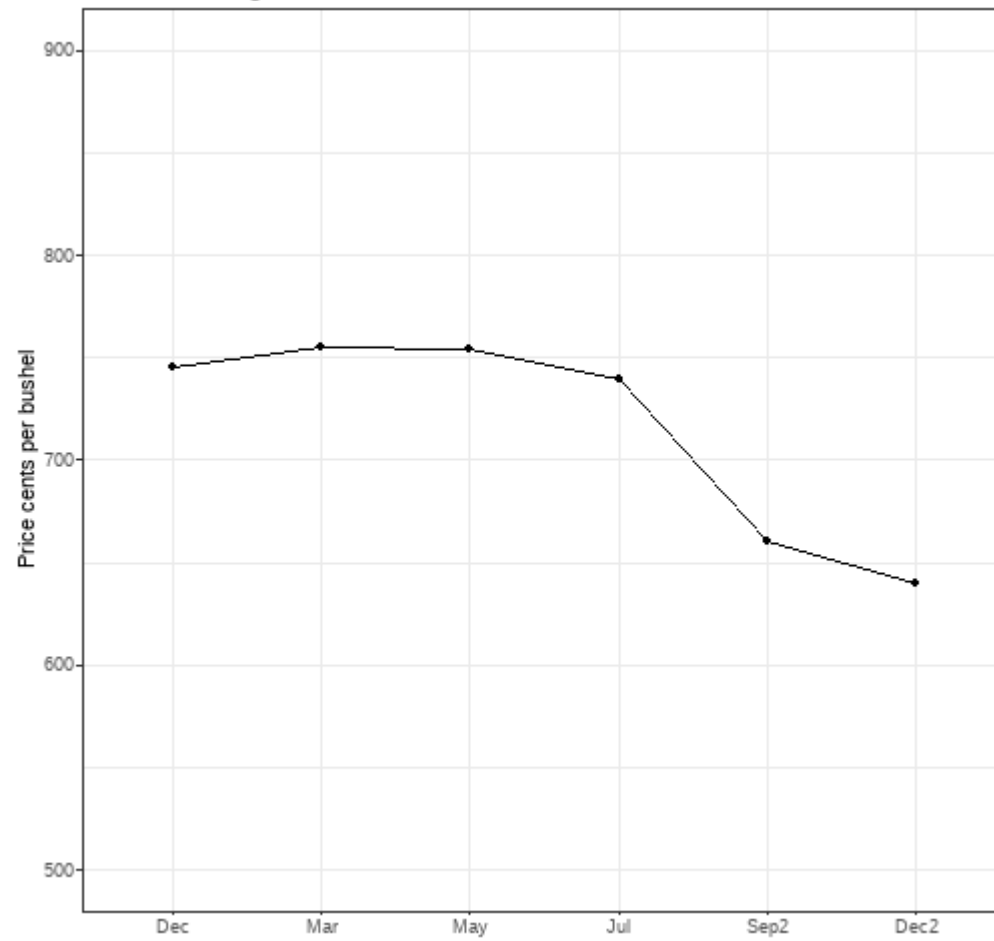


A Decreasing Forward Curve (CONT...)

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



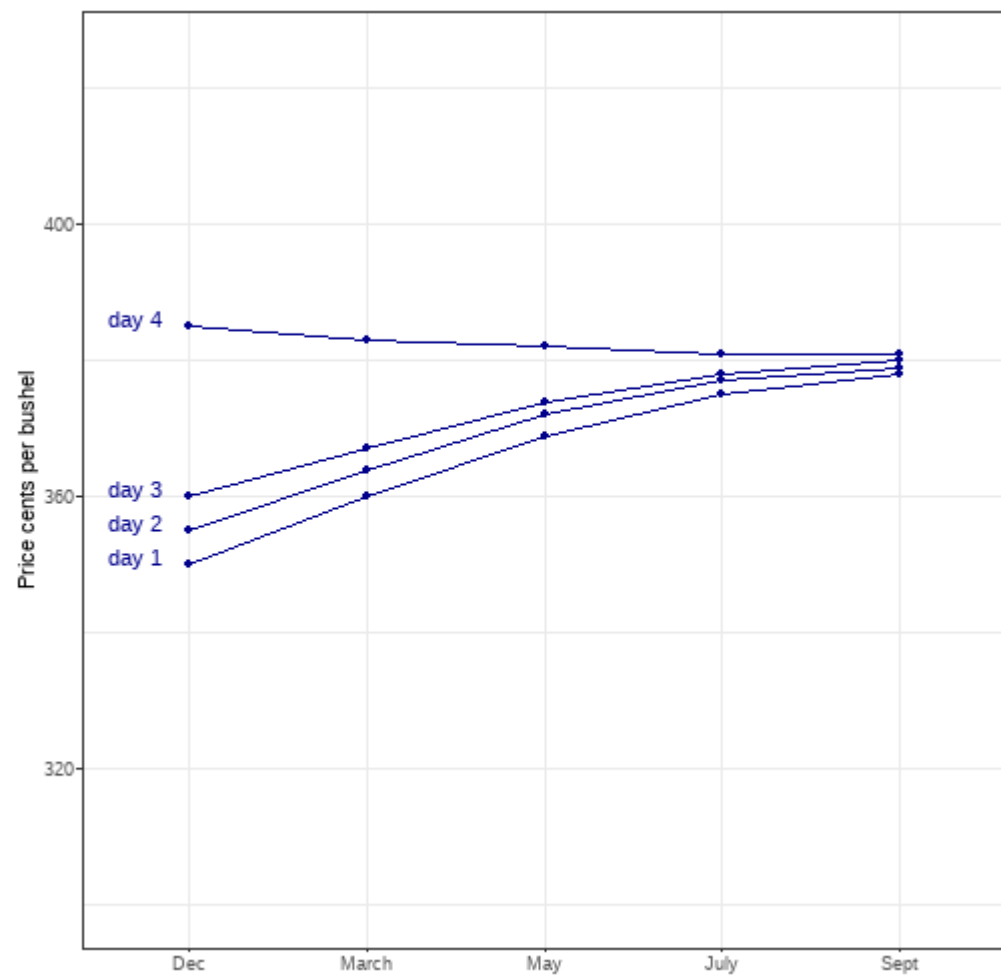
Forward Curve Cases with Hypothetical Data (CONT...)

- 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

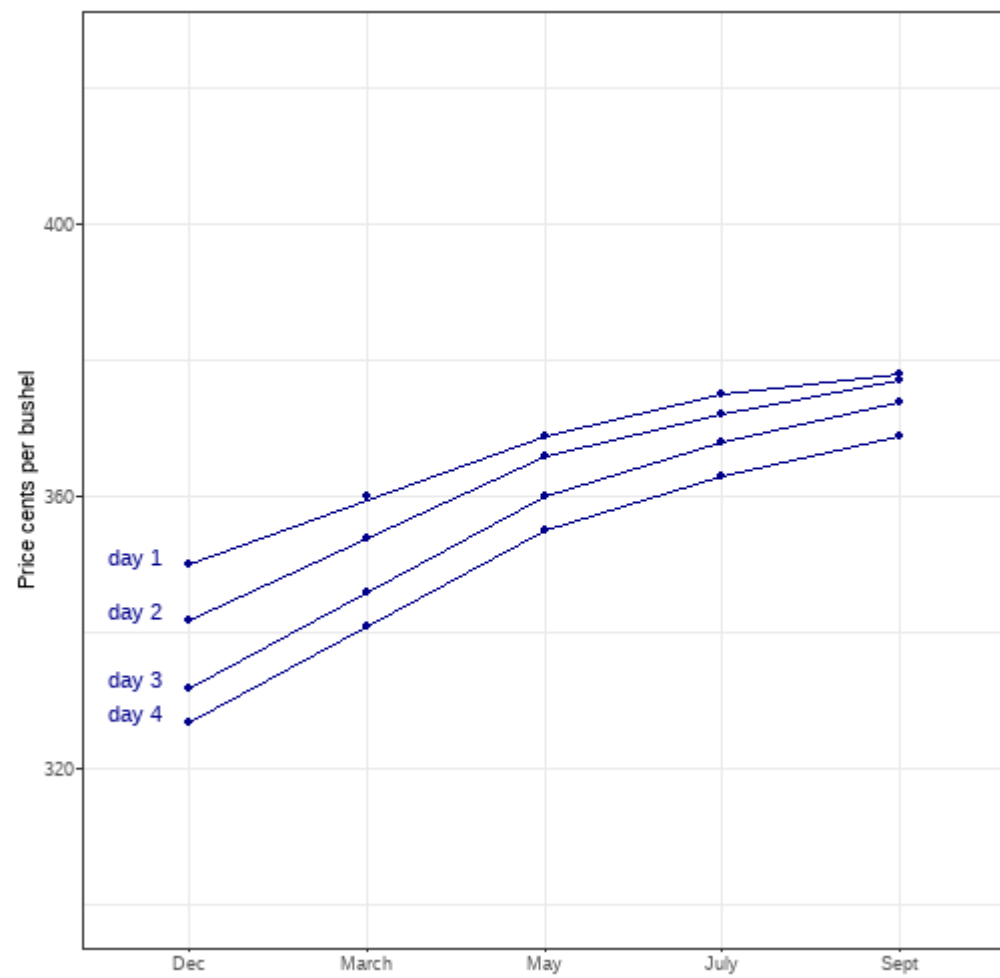
- Figure 6. Forward Curve with Prices Increasing, Contango to backwardation
 - On day 1, the market is clearly in contango, as the forward curve is upward sloped.
 - From day 1 through day 4, the prices are rising each day, with the front end of the forward curve.
 - On day 4, the prices have risen enough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

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

- 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

