Fundamental Analysis

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Lecture notes for Econ 235

Notes

Definitions

- *Fundamental analysis* is the use of data, knowledge of markets and other available information to forecast prices:
  - Uses economics theory;
  - Requires much information.
- *Technical analysis* looks backward in time for information and forecast prices based on how markets behave in the past.
  - Technical analysts are sometimes referred to as *chartists* as they use ocular inspection of graphs to discover patterns in the data (e.g. head and shoulders, neckline);
  - Easy, made up rules;
  - Difficult to understand why some still use it. If technical analysis works, it might simply be because many people believe it does work;
  - Hokum! Witchcraft!

Notes

Fundamental analysis

- In this section, we will focus on fundamental analysis.
- We will use the example of the market for corn in the United States.
- I will show you a simple method to predict the price of corn.

Notes

To read, listen or watch!

- Listen or read the Freakonomics podcast titled "The Folly of Prediction."
- Chapters 6 to 11 in Mindy Mallory's textbook contains some of the material we will cover in this section.
- If you want to learn more, you can also refer to Carter (2003).
- If you are interested by predictions in general, check the blog FiveThirtyEight or the book (available on Amazon) by Nate Silver.

Notes

Market efficiency

- *Market efficiency* is the concept that cash, futures and option prices fully reflect all information available at any point in time.
- That is, the supply and demand curves fully captured all information that affect a market.
- Note that if markets are efficient, all new information is immediately incorporated into the price.
- This means that arbitrage opportunities from obtaining new information do not last.

Notes

Market efficiency

- Are markets always efficient?
  - Sometimes information is costly;
  - When information is costly, an efficient market is one where the marginal benefit of trading does not exceed the marginal cost of collecting information;
  - Information may be imperfect (incorrect);
  - Influence other than fundamental information.
- Markets tend to be efficient up to a certain point.

Notes

Fundamental analysis

- Fundamental analysis makes use the market efficiency hypothesis.
- It's because markets are efficient that it is possible to model how they work and make predictions.
- In what follow, we will conduct simple fundamental analysis of the US corn market.

Notes

WASDE

- WASDE is the acronym for *World Agricultural Supply and Demand Estimates*.
- It is a document produced monthly by USDA Office of the Chief of Economist.
  - For the rest of 2017, the WASDE reports will be released on October 12, November 9 and December 12.

Notes

WASDE

- The reports are available at: http://www.usda.gov/oce/commodity/wasde/.
- It is in the May report that USDA begins reporting about the upcoming crop season. That is, the April 2017 report was about the 2016-17 crop season but the May 2017 report was about the 2017-18 crop season.
- For corn and soybeans, the crop year begins on September 1.

Notes

Supply of corn

- Most of the supply of corn in the United States comes from domestic production.
- A small quantity, which tends to be less than one percent, is imported.
- It is important to understand the timing of a market:
  - Farmers make planting decision in the Winter;
  - Planting occurs in the Spring. In May, there are good data about the total acreage planted in corn.
  - Once corn is planted, the domestic supply of corn no longer depends on the price of corn. Farmers will harvest pretty much all that was planted unless some was destroyed (e.g. flood, drought) or that the price is very low.
  - After planting, corn yield depends mostly on weather and to some extent on farm practices.

Notes

Supply of corn

- The September WASDE report forecasts US production of corn for the 2017/18 crop season of 14,184 million bushels.
- Beginning stocks are estimated at 2,350 million bushels.
- Imports of corn are marginal at 50 million bushels.
- This means a total supply 16,585 million bushels of corn for the 2017/18 crop season.

Notes

Demand for corn

- Corn is the main source of feed for livestock.
  - Inelastic demand as animals must be fed.
  - Few substitute feeds (soymeal, forages, barley, DDGS) compete with corn.

Notes

Demand for corn I

- Corn is the feedstock for the production of ethanol.
  - First generation ethanol is produced using corn.
  - For 2017, the Renewable Fuel Standards (RFS) ethanol mandate was supposed to be 15 billion gallons (see EPA).
  - The fixed proportion of ethanol that enters into fuel makes it such that the demand for corn for ethanol production is inelastic.
  - One bushel of corn yields 2.8 gallons of ethanol.
  - This means that for 2017, because of the RFS, at least 5.18 billion bushels of corn will be going into ethanol.
  - This is a minimum. If the price of corn is low and the price of gasoline is high, then the production of ethanol will be superior to the mandated minimum.
  - There is also an export market for ethanol.

Notes

Demand for corn II

  - For example, during the 2013-14 corn marketing year, about 5.13 billion bushels of corn were used to produce ethanol for a total production of ethanol of 14.36 billion gallons. Much in excess of the 13.6 billion gallons of ethanol mandated for 2014.

Notes

Demand for corn

- Some corn also goes into food and industrial products.
  - That demand for corn should be elastic as there are substitutes for corn in industrial products.
  - Small share of the total consumption of corn.
- Export demand for corn.
  - The demand for US corn on the international market is elastic as there are many substitute sources and products.

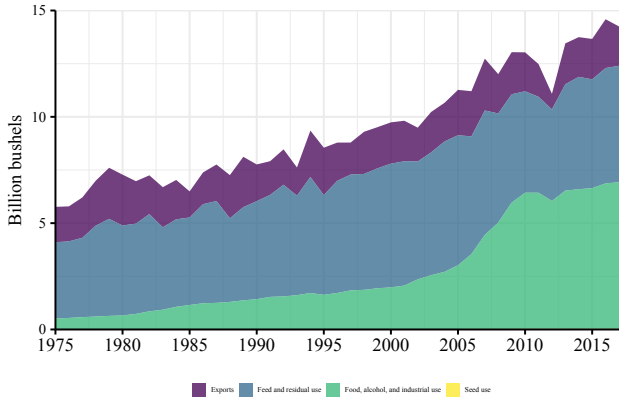
Notes

Demand for corn

- The September WASDE report gives the following break down for the use of corn for the 2016-17 marketing year:
  - Feed and residual: 5,475 million bushels;
  - Ethanol and by-products: 5,475 million bushels;
  - Food, seed and industrial use other than ethanol: 1,450 million bushels;
  - Exports: 1,850 million bushels.
- This makes the projected total use of corn for the 2017-18 crop season equal to 14,250 million bushels.

Notes

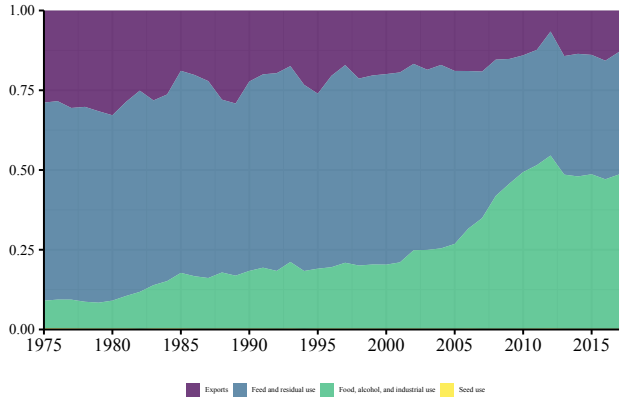
Domestic use of corn



Data source: ERS: Feed grains.

Notes

Domestic use of corn - share



Data source: ERS: Feed grains.

Notes

Stocks I

- USDA September projections for the 2017-18 crop year are as follow
  - Total supply of 16.585 billion bushels.
  - Total use of 14.250 billion bushels.
  - The difference between the supply and use gives a residual of 2.335 billion bushels.
  - This represents the projected stock at the end of the 2017-18 crop year.
- This means of a stock-to-use ratio of 100*2.335/14.250 = 16.39. This is huge.
  - 2012-13: ratio=7.4;
  - 2013-14: ratio=9.1.
  - 2014-15: ratio=15.23.
  - 2015-16: ratio=11.35.
  - 2016-17: ratio=16.47.

Notes

Stocks II

- One implication is that another good crop next summer will lead to low prices for corn in 2018.

Notes

Fundamental analysis: a small model of the US corn market

- We will use a small economic model.
- The role of the model is to summarize, within a mathematical structure, all the information that we have about the corn market.
- The model helps understand all the assumptions that enter into making a prediction/projection.
- We will look at what are the shapes of the supply and demand curves.

Notes

Fundamental analysis: a small model of the US corn market

- We will view the basic of fundamental analysis by modeling supply and demand curves for the corn market.
- We will pretend that we are May 2017 and that our objective is to *forecast a range of prices* for the corn crop in the Fall of 2017.
- We will then validate the price forecasted with the model with today's price.

Notes

Fundamental analysis: application to the corn market

- Fundamental analysis for the corn market is fairly simple.
- Similar analyses for other grains tend to be more complicated because of trade. Modeling those markets would require the rest-of-the-world (countries other than the United States) supply and demand equations.
- Livestock requires a more complicated model because of the dynamic of production (e.g. cattle and hog cycles) and the importance of input costs.

Notes

Supply of corn

- The supply of corn is almost perfectly inelastic after planting.
- The supply is not perfectly inelastic because of storage carrying over from one year to the other and because of trade.
- As we are interested in a forecast for a period less than one year, so assuming a perfectly inelastic supply of corn between May and November is reasonable.

Notes

Demand for corn

- What value to use for the elasticity of demand for corn?
- It is difficult to find the correct estimate of the elasticity of demand for a product.
- Typically, an elasticity of demand for corn for that time frame of -0.3 is reasonable and been used by other.
- To verify the sensitivity of the results, let's also use alternative values for the elasticity of demand of -0.2 and -0.4.

Notes

Market equilibrium

- Now, we have a good idea of the slopes (elasticities) of supply and demand curves.
- To predict the corn market in the Fall, we derive an expression for the demand curve.
- One simple method is to calculate parameters of a linear demand function using observed prices and quantities.
- Thus, we need information about prices and quantities.

Notes

The price

- The WASDE report gives us a projection of the quantity supplied and the price.
- The WASDE report gives a projection of the *farm* price of corn for the crop/marketing year. This is not what we want.
- What we want is the 2016 December futures corn price when the prediction takes place.
- The reason to use the December corn futures is that it represents what the market thinks the price of corn will be in December. It is also the futures contract that expires soon after harvest.
- Cash prices are based on futures prices.

Notes

What price and data to use to calibrate the demand?

- Remember that we are trying to do a forecast pretending that we are in May 2017.
- We can use only information that was available in May 2017.
- In May 2017, the WASDE reported projected a total supply of corn of 16.410 billion bushels of corn for 2017.
- In the week of the release of the May 2017 WASDE report, the price of corn average ¢388.13 per bushel.

Notes

Calculating the demand curve

- We will calculate the parameters of a linear demand based on the data we observe and values for the elasticity of demand.
- The functional form for the demand curve is:

$$Q = a - bP,$$

where $a > 0$ and $b > 0$ are parameters of the demand function.

- Recall that we can calculate the parameter b based on the value for the elasticity of demand:

$$b = -\eta \frac{Q^d}{P}.$$

- After calculating b, we can then calculate a value for a as $a = Q - bP$.

Notes

Calculating the demand curve

- The calibration of the demand uses a total quantity of corn of 16.410 billion bushels and a futures price of December corn of ¢388.13 per bushel.
- Let's do the calculations here assuming that the elasticity of demand is $\eta = -0.4$.
- The value of the parameter b is

$$b = -\eta \frac{Q}{P} = 0.4 \frac{16.410}{388.13} = 0.0169.$$

- The value of the parameter a is

$$a = Q + bP = 16.410 + 0.0169 * 388.13 = 22.974.$$

Notes

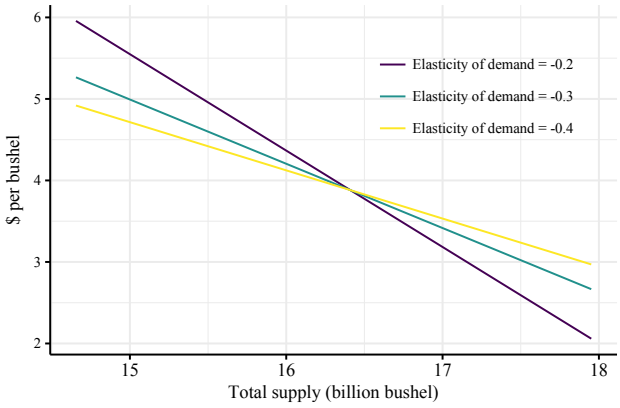
Calculating the demand curve

Table : Demand parameters

	$\eta = -0.2$	$\eta = -0.3$	$\eta = -0.4$
a	19.692	21.333	22.974
b	0.0085	0.0127	0.0169

Notes

Demand curves for corn



Notes

Demand curve in function of yield I

- The previous figure shows demand lines in function of the total quantity of corn.
- For some people, it is however easier to think in terms of yield.
- Yield is also the most significant source of uncertainty. Thus, a prediction conditional on corn yield is relevant.
- The total quantity supplied (Q) is equal to the harvest (H), plus the corn in storage at the beginning of the crop year (S):

$$Q = H + S.$$

- Imports are negligible and ignored.
- The May 2017 WASDE reported beginning stock of 2.295 billion bushels. So, let's assume this number as the beginning stock ($S = 2.295$).

Notes

Demand curve in function of yield II

- The harvest (H) is simply the product of the acres harvested(A) and the yield (y):

$$H = A * y.$$

- Thus, we can write that:

$$A * y = Q - S.$$

- Thus from the previous expression, we can recover the implied yield from a given total supply as

$$y = \frac{Q - S}{A}.$$

- In May 2017, WASDE predicted harvested acreage for corn of 82.4 million acres for 2017. So, let's use $A = 82.4$.
- Now, we can calculate the implied yield from a total quantity of corn supplied.

Notes

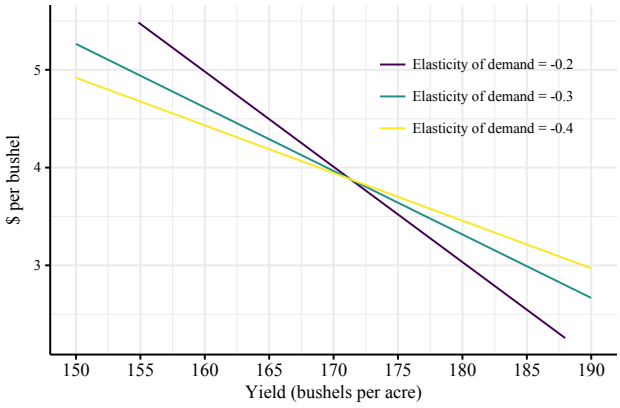
Demand curve in function of yield III

- For example, if the total quantity supplied is 16 billion bushels, we can calculate that the implied yield in bushels per acre is

$$y = 1000 * \frac{16 - 2.295}{82.4} = 166.3.$$

Notes

Demand curves in function of yield



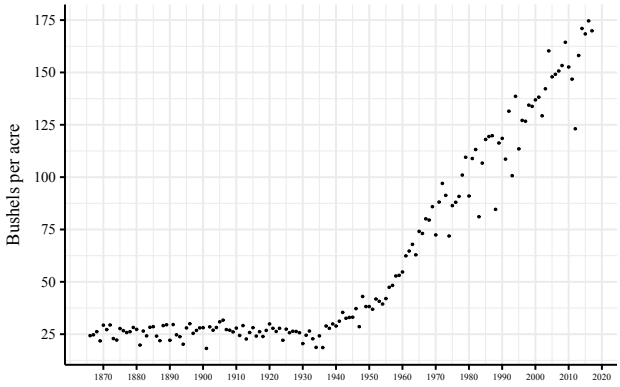
Notes

Prediction: what corn yield to use?

- Corn yield is the main source of uncertainty in performing this prediction.
- In May 2017, WASDE projected a yield of 170.7 bushels per acre for the 2017 corn crop.
- Typically, projections use trend yields.
- Let's look at historical data on corn yields.

Notes

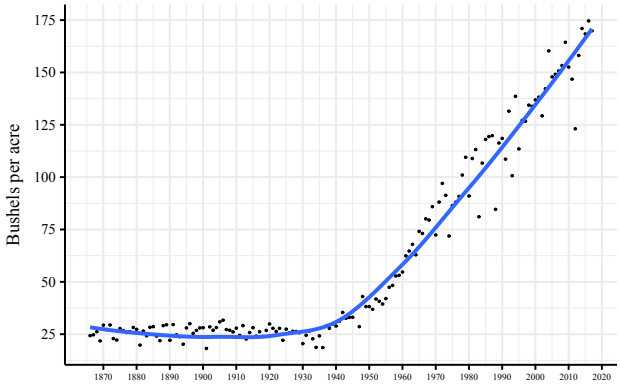
Historical corn yields



Data source: http://www.nass.usda.gov/Statistics_by_Subject/index.php.

Notes

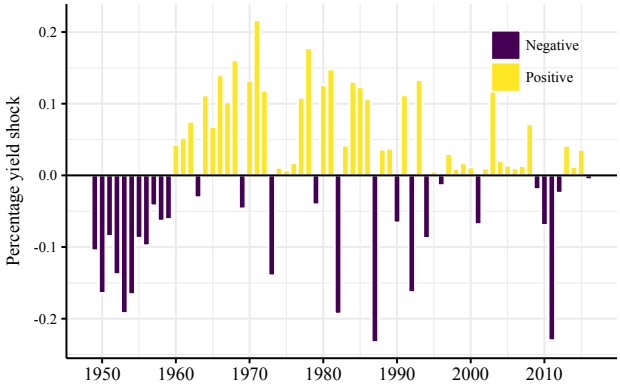
Historical corn yields - with trend



Data source: http://www.nass.usda.gov/Statistics_by_Subject/index.php.

Notes

Recent percentage deviations in corn yields from trend



Notes

Prediction: what corn yield to use?

- From the previous slide, a trend yield of 170 bushels per acre is reasonable.
- For a sensitivity analysis, let's use alternative corn yields of 150 and 175 bushels per acre.

Table : Corn yield expectation

Min	Median	Max
150	170	175

Notes

Prediction using median expected yield

- Let me do an example of the calculations assuming a yield of 170 bushels per acre.
- Given the assumption on the yield and assuming that harvested acreage equals the WASDE projection, the harvest would be 170 bushel per acre * 82.4 million acres = 14.008 billion bushels.
- We can add to the harvest USDA May 2017 stock prediction of 2.295 billion bushels to find a total supply of corn of 14.008 + 2.295 = 16.303 billion bushels.

Notes

Prediction using median expected yield

- I will show the calculations using the demand curve with an elasticity of -0.4.
- To predict the price, we must use the inverse demand function:

$$P = \frac{(a - Q)}{b}.$$

- Thus, from our assumptions on yield, acreage and elasticity, we can predict that the price of corn will be:

$$\frac{(22.974 - 16.303)}{0.0169} = \$3.94/bu.$$

- We can repeat these calculations with other values for the elasticity of demand and for other values for the expected yield.

Notes

Predictions for the price of corn

Table : Prices prediction with expected yield

Yield (bu/acre)	$\eta = -0.2$	$\eta = -0.3$	$\eta = -0.4$
150	$\$5.96/bu$	$\$5.26/bu$	$\$4.91/bu$
170	$\$4.01/bu$	$\$3.97/bu$	$\$3.94/bu$
175	$\$3.52/bu$	$\$3.64/bu$	$\$3.70/bu$

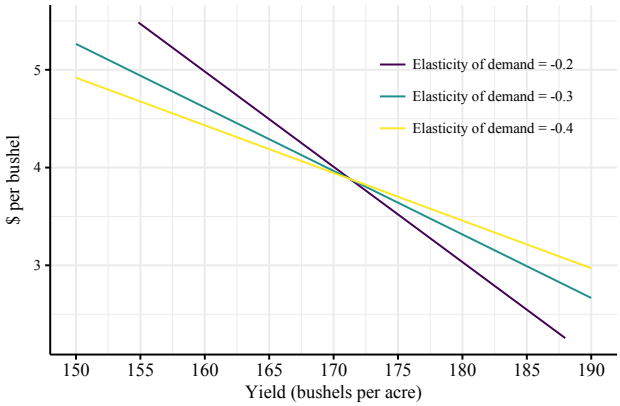
Notes

What does it say?

- The prediction assuming 170 bushels per acre and an elasticity of -0.3 says that the price of corn in Fall 2017 would be about $\$3.97/bu$.
- Lower yield at 150 bushels per acre causes the price to increase by more than a $1.00 per bushel.
- Higher yield at 175 bushels per acre causes the price to decline by about $0.50 per bushel.

Notes

Demand curves in function of yield



Notes

Elasticity of supply

- The supply of corn is assumed perfectly inelastic.
  - Could repeat the prediction using an elasticity of supply of 0.1.
- The assumption regarding yield is the one that influences the prediction the most.
  - The prediction assumes corn yield that is typical of what has been observed in recent years.

Notes

What does the model mean?

- The simple model summarizes (quantifies) all information about the market into one equation for the demand.
- The information missing is regarding production, i.e. yield.
- Thus, given the model, the only data to input is yield, which is the variable with the most uncertainty.

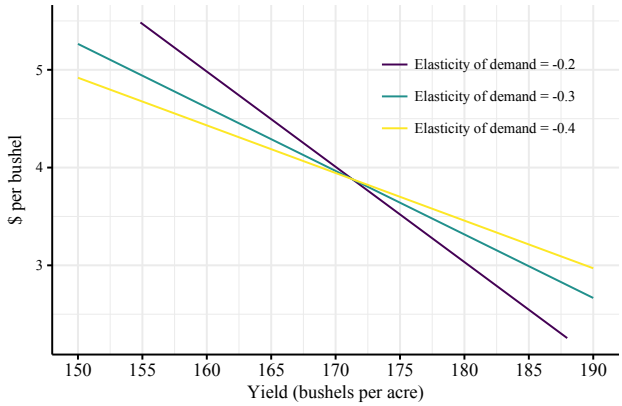
Notes

How well does the simple prediction perform?

- Retrospectively, we can look at how well the forecast worked.
- The next two slides show the demand curves and a point for the futures price in September 2017 and the yield reported in the September 2017 WASDE reports.
- The model is off by about \$0.40/bu. That is quite a lot. In previous years, this simple model had worked much better.
- An explanation is that the market did not believe the earlier yield estimates from the USDA, which happened to be quite accurate.

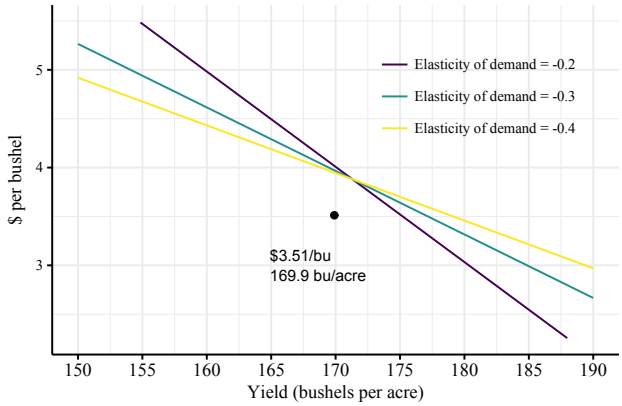
Notes

Demand curves in function of yield



Notes

Demand curves in function of yield with 2017 data



Notes

Price of the December 2017 futures contract

Notes

Can we say something about 2018? I

- Suppose that the stock of corn on October 2018 equals the stock projected in the latest WASDE report: 2.335 billion bushels.
- Given the low prices for corn and soybeans, it would not be surprising that the area harvested of corn next year to be low. Suppose that next summer that the total area harvested of corn equals 83 million acres.
- Suppose that next year corn yields are right along the trend at 170 bushels per acre.
- In total, it means for next year a total supply of corn of 83*170/1000 + 2.335 = 16.445 billion bushels.
- With the demand derived using an elasticity of -0.3, the projected price for corn in Fall 2017 is $3.83 per bushel.
- If the yield is 175 bushels per acre, then the projected price goes down to $3.60 per bushel.

Notes

Can we say something about 2018? II

- If the area harvested is 83 million acres and the yield is 170 bushels per acre, then the project price is $3.53 per bushel.
- These projections are likely too high because they are based on a calibration price of $3.88/bu that was observed last May. A price of closed to what has been observed lately, about $3.50/bu, would work better.
- It is quite early to project corn price for Fall 2018. We can say however that if the crop next year is decent that the price of corn will be less than $4 per bushel. With another bumper crop, it could even be closed to $3 per bushel.
- What is the futures price for corn for December 2018?
- What could change between now and December 2018? NAFTA...

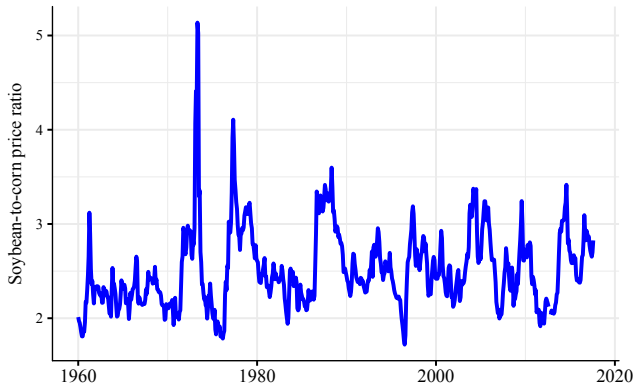
Notes

Other commodities

- For other agricultural commodities this simple framework might not work as well:
  - Change in supply and demand conditions because of trade;
  - Production dynamic.
- The prices of some commodities are linked through fairly constant ratios:
  - This reflects that these commodities are substitutes in supply and/or demand.

Notes

Soybean to corn price ratio



Source: Price data were downloaded from

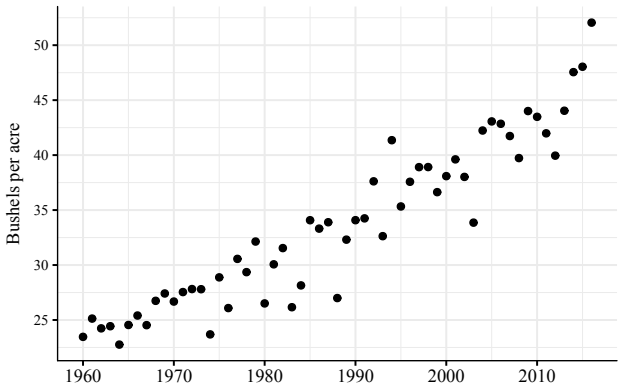
Notes

Prediction for the price of soybeans

- Since 1960, the soybean-corn price ratio has been on average 2.51.
- Since 2000, the soybean-corn price ratio has also been on average 2.56.
- Based on that ratio, it is possible to make a simple prediction of the price of soybeans.
- For example, at the forecast of \$3.97/bu, the ratio implies a \$10.16/bu for soybean.
- That forecast will however be less precise as there is also uncertainty regarding the value of the ratio.
- The soybean-corn price ratio is a rule of thumb that has been losing favor.

Notes

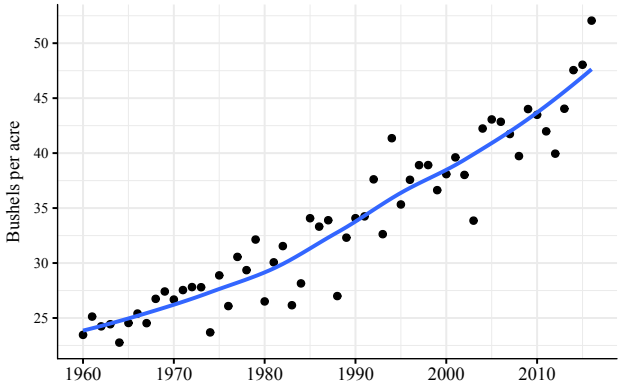
FYI - soybeans historical yields



Data source: http://www.nass.usda.gov/Statistics_by_Subject/index.php.

Notes

FYI - soybeans historical yields



Data source: http://www.nass.usda.gov/Statistics_by_Subject/index.php.

Notes

Can we trust predictions/projections? I

- **Prediction:** a statement about the way things will happen in the future that might be based on experience and knowledge.
- **Projection:** an estimate of a future situation based on a study of a present situation.
- What we want is a projection that offers a description of what will happen in the future conditional on the conditions currently observed.
- Projections are an effort to foresee what is going to happen in the future.

Notes

Can we trust predictions/projections? II

- A prediction or a projection should always come with a time stamp and an expiration date.
  - A prediction uses information available at a specific date. Soon after, that information may no longer be true.
  - If there is no expiration date to a prediction, a prediction like this is always correct: "Iowa State Cyclone will one day win the College Football Playoff National Championship."
  - A statement such as "Iowa State Cyclone will win the College Football Playoff National Championship by 2022" is much more meaningful.
- A projection is good if it derives from reasonable assumptions and from the correct model.

Notes

Can we trust predictions/projections? III

- If only one assumption does not hold, then the projection will not materialize.
  - The case of the 2012 corn crop with the drought is a good example.
  - There are always a lot of assumptions in one projection. Given all those assumptions, how can someone put any trust into a projection?
- Markets are difficult to project as there are a lot of variables to take into account.

Notes

Can we trust predictions/projections? IV

- Those that make predictions/projections are not held accountable for bad forecast.
  - Someone who made a correct prediction will brag about it while someone who made a wrong prediction will keep quiet.
  - There is little to no punishment to those who make wrong predictions while a correct prediction may receive a lot of press coverage.
- Media tend to seek people who make bold prediction/projection because they are more entertaining.
  - Listen or read the Freakonomics podcast titled "The Folly of Prediction" for some discussion about this.

Notes

What is the value of a prediction?

- For a speculator, a projection about future prices can be very valuable.
  - Speculation is all about taking risk to gain profit from variations, or non-variations, in prices.
- For a hedger, the issue is more regarding the probability that a price rises or declines.
  - The objective should then be about knowing the risk that the price goes beyond a certain threshold rather than knowing exactly what the price is going to be.
  - Although a projection can be valuable, it is understanding the events that affect a price that matter the most and understanding how likely those events are to happen.

Notes

What to make of predictions/projections?

- Given all the uncertainty, can you fully trust a prediction/projection when making decisions?
- You are the judge!

References

Carter, C.A. 2003. *Futures and Options Markets: An Introduction*. Waveland Press, Inc.

Notes

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