2013

Commodity Prices, Volatility and Risk: Is the Soybean Market Becoming Riskier?

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CORNHUSKER ECONOMICS

University of Nebraska–Lincoln Extension

December 4, 2013

Institute of Agriculture & Natural Resources
Department of Agricultural Economics
http://agecon.unl.edu/cornhuskereconomics

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Market Report	Yr Ago	4 Wks Ago	11/29/13
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight	$125.50	$133.00	$133.11
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	161.64	187.25	193.23
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	153.37	175.86	172.66
Choice Boxed Beef, 600-750 lb. Carcass	195.65	204.56	202.04
Western Corn Belt Base Hog Price Carcass, Negotiated	84.11	82.90	82.17
Pork Carcass Cutout, 185 lb. Carcass, 51-52% Lean	84.68	93.70	88.83
Slaughter Lambs, Ch. & Pr., Heavy, Wooled, South Dakota, Direct	98.50	154.13	159.00
National Carcass Lamb Cutout, FOB	300.54	318.49	348.28
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	8.24	6.93	6.68
Corn, No. 2, Yellow Nebraska City, bu.	7.55	4.17	4.02
Soybeans, No. 1, Yellow Nebraska City, bu.	14.39	12.15	7.13
Grain Sorghum, No. 2, Yellow Dorchester, cwt.	12.73	7.00	12.99
Oats, No. 2, Heavy Minneapolis, MN , bu.	4.04	3.57	3.59
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	+	+	230.00
Alfalfa, Large Rounds, Good Platte Valley, ton.	215.00	135.00	135.00
Grass Hay, Large Rounds, Good Nebraska, ton.	215.00	127.50	115.00
Dried Distillers Grains, 10% Moisture, Nebraska Average.	293.50	205.00	213.50
Wet Distillers Grains, 65-70% Moisture, Nebraska Average.	107.00	64.50	61.00

+ No Market

"Risk is a pervasive but subtle concept, widely used and discussed but not well understood." (Clive W.J. Granger, 2003 Nobel Prize winner)

When we hear and talk about financial markets, the volatility of prices or returns is commonly adopted to discuss risk. It is common to hear in the news that markets have become more volatile (and hence riskier) in recent years. So let us take a look at the soybean market and explore how volatility has evolved over time. Figure 1 (on next page), shows daily nearby futures prices for soybeans between July 1959 and May 2013. We'll split the sample into four periods for our analysis: Aug/59–Jul/72; Aug/72–Jul/88; Aug/88–Jul/05; and Aug/05–May/13.

However, volatility is often discussed in terms of how much prices are changing, so let us talk about percentage price changes instead of price levels. Percentage price changes are calculated as the change in price between today and yesterday, divided by yesterday's price. For example, if today's price is $13.15/bu and yesterday's price was $13.10/bu, the price change is $0.05/bu and the percentage price change is 0.05/13.10 = 0.0038= 0.38%. In other words, today's price of $13.15/bu is 0.38% higher than yesterday's price of $13.10/bu. Figure 2 (on next page), shows daily percentage price changes for soybeans between July 1959 and May 2013, also divided into four sub-periods.

Volatility is often represented by the standard deviation of percentage price changes over a certain period of time, so it measures how much percentage price changes deviate from the average percentage price change of the period. Figure 3 (on next page), shows the calculated volatility (standard deviation) of percentage price changes in each of the four sub-periods in our sample. We can see that volatility in the most recent time period (Aug/05–May/13) is higher than in the previous period (Aug/88–Jul/05), but about the same as

the volatility observed in Aug/72–Jul/88. Even though the soybean market has been more volatile in the last eight years (2005-2013) compared to the 1988-2005 period, recent volatility has been about the same as observed in the 1972-1988 period. Does that mean that the soybean markets have recently been experiencing historically high levels of risk since 1959?

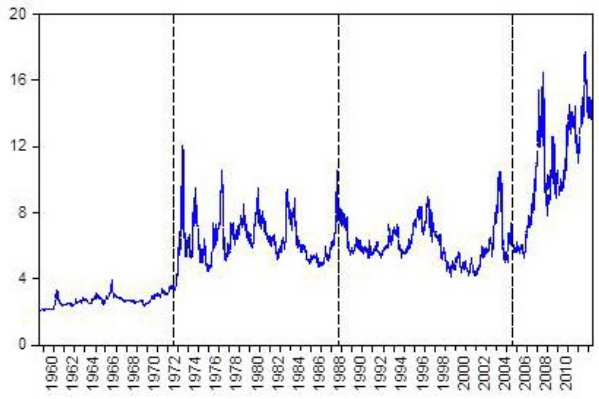

Figure 1. Soybean Nearby Futures Price ($/bu) – July/1959 to May/2013

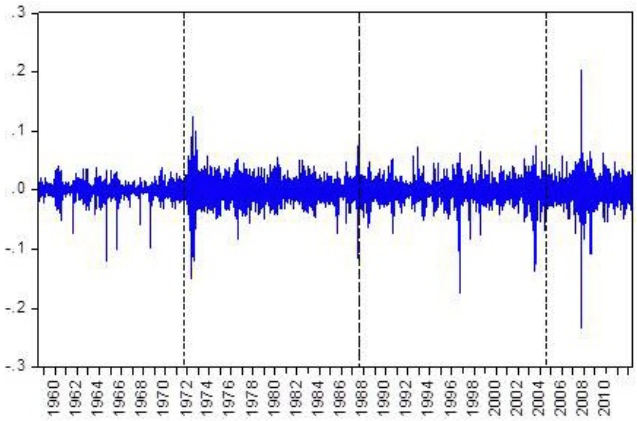

Figure 2. Soybean Percentage Daily Price Changes – July/1959 to May/2013

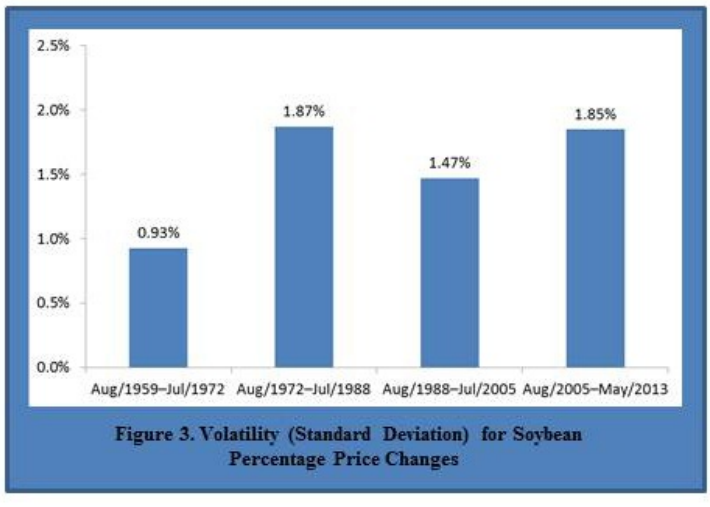

Figure 3. Volatility (Standard Deviation) for Soybean Percentage Price Changes

When we think about risk, what typically comes to mind is the notion of loss. Accordingly, the Merriam-Webster dictionary defines risk as "possibility of loss or injury," "someone or something that creates or suggests a hazard," "the chance of loss or the perils to the subject matter of an insurance contract," "a person or thing that is a specified hazard to an insurer," "an insurance hazard from a specified cause of source," or "the chance that an investment (as a stock or commodity) will lose value." This definition is consistent with findings from research on risk perception. In the context of financial decisions, empirical work has shown that individuals normally think about risk as the failure to achieve a certain goal, while returns beyond that goal are seen as profit opportunities. But this is not the way that volatility is calculated.

Volatility is based on the standard deviation, which takes into account all deviations from the average percentage price change during a period of time. Since it takes into account deviations above and below the average, there is high volatility if either upside deviations or downside deviations are large. But the possibility of losses is not necessarily affected by both types of deviations. A grain producer would probably be more concerned about soybean prices dropping below his cost of production (or any other benchmark), and would likely be happy to see soybean prices rising above his cost of production. On the other hand, a food processor would be more concerned about soybean prices increasing above its break-even price, and not really worried about soybean prices falling below its break-even price. But when we use volatility we are considering both the failure to achieve a certain goal and the possibility of doing better than that goal in the calculation of risk.

Therefore, volatility would be more properly used as a measure of variability. When we say the soybean market has reached a historically high level of volatility in the last eight years, it means that there has been larger dispersion in percentage price prices. This indicates a larger magnitude of downside percentage price changes, and also a larger magnitude of upside percentage price changes. Larger volatility implies more chances of losing, but also more profit potential. This is a standard idea in finance that we sometimes forget: if we want to obtain higher returns

we have to take more risk, i.e., the possibility of higher returns is followed by a chance of larger losses.

Another issue with volatility as a risk measure is that it can be misleading if the distribution of percentage price changes is asymmetric. In this case, there can be more chances to make a profit than a loss (or vice-versa). In fact, a market that exhibits large profit potential and a small chance of losses can have the same volatility as another market with small profit potential and a large chance of loss. So it is worth exploring how percentage price changes in the soybean market have been distributed over time. In Figure 4 (on next page), the percentage price changes were split into positive and negative values and expressed in terms of standard deviation. How many days exhibited positive and negative percentage price changes in each period were then counted. For example, in Aug/05–May/13 there were 172 days with positive percentage price changes within one standard deviation, and 158 days with negative percentage price changes within one standard deviation.

The charts in Figure 4 show that positive percentage price changes happened more often than negative percentage price changes for small values (within one standard deviation). However, positive percentage price changes were less frequent than negative percentage price changes for larger values (greater than two standard deviations). In particular, the last two time periods showed proportionally more negative percentage price changes for extreme values (four standard deviations or more). For example, in 2005-2013 there was only one day with a positive extreme price change (four standard deviations or more) and six days with negative extreme price changes. The discussion of extreme price changes is important but sometimes neglected. Would a business be better off by losing money in 20 days or by losing money in only one day during a certain time period? Now, what if the loss in each of those 20 days was $1,000 (for a total loss of $20,000) while the loss in that single day was $100,000? The frequency of losses is certainly important, but so is the magnitude of those losses.

The purpose of this article is to discuss different ways to measure price risk and expand on the notion of volatility. The main points from the analysis are summarized below.

- There are many ways to measure and think about price risk.
- Volatility shows price variability, which implies both profit potential and chance of losses.
- Looking at historical price changes divided into positive and negative values provides a more complete picture of the frequency and magnitude of profit potential and chance of loss.
- Positive percentage price changes have been more frequent for smaller values, while negative percentage price changes have been more frequent for larger values.
- Negative extreme price changes have become more frequent in the soybean market.

As a final cautionary point, historical data can be used to estimate the volatility of the distribution of percentage price changes for the future, allowing us to forecast how volatile prices will be in the future, or how much can be gained or lost during a certain period. However, those estimates implicitly assume that the future will be similar to the past, i.e., price behavior in the future will resemble observed price behavior during the period whose data was used in the estimates. This can be a dangerous assumption, since the behavior of prices has not been constant over time. Historical data can still be used as a reference for future volatility and other risk measures, but it is recommended to also use stress tests with the estimates. A stress test is essentially an exercise to explore what can happen if volatility levels turn out to be larger than what was initially forecast, and what kind of events (or series of events) can cause those values to be larger than estimated. Stress tests can be particularly useful in environments where price variability keeps increasing, and extreme price changes become more frequent than they used to be in the past, such as what we have been observing in the soybean market in recent years.

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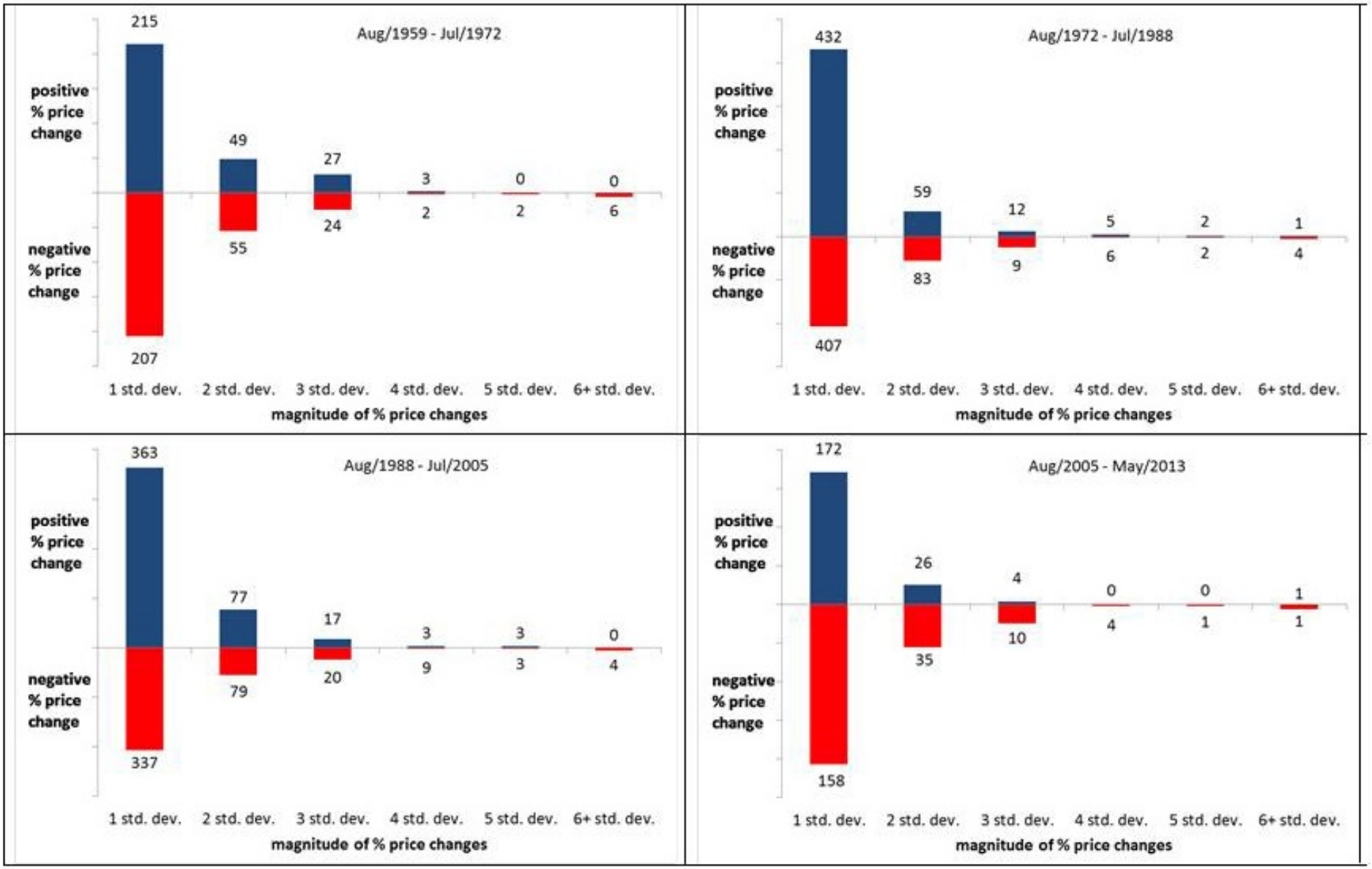

Figure 4. Number of Days with Positive and Negative Percentage Price Changes