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Stress Tests in Commodity Markets

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Market Report	Yr Ago	4 Wks Ago	3/7/14
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight	$128.00	$140.48	$149.52
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	162.57	209.49	221.09
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	142.09	169.22	177.70
Choice Boxed Beef, 600-750 lb. Carcass	195.02	216.30	233.40
Western Corn Belt Base Hog Price Carcass, Negotiated	71.95	82.97	105.44
Pork Carcass Cutout, 185 lb. Carcass, 51-52% Lean	79.04	90.15	108.08
Slaughter Lambs, Ch. & Pr., Heavy, Wooled, South Dakota, Direct	105.00	160.25	158.00
National Carcass Lamb Cutout, FOB	289.23	369.43	369.88
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	6.87	6.19	6.83
Corn, No. 2, Yellow Nebraska City, bu.	7.39	4.27	4.56
Soybeans, No. 1, Yellow Nebraska City, bu.	14.96	13.08	14.22
Grain Sorghum, No. 2, Yellow Dorchester, cwt.	12.25	7.48	8.07
Oats, No. 2, Heavy Minneapolis, MN , bu.	4.28	4.30	4.61
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	+	+	162.50
Alfalfa, Large Rounds, Good Platte Valley, ton.	227.50	130.00	127.50
Grass Hay, Large Rounds, Good Nebraska, ton.	212.50	107.50	107.50
Dried Distillers Grains, 10% Moisture, Nebraska Average.	268.00	185.00	235.00
Wet Distillers Grains, 65-70% Moisture, Nebraska Average.	103.50	61.00	67.00

+ No Market

In the last few months (*Cornhusker Economics*, 12/04/2013, 12/11/2013 and 2/12/2014), we talked about different ways to think about price risk in the soybean and corn markets. More specifically, two of the most popular risk measures that focus on potential losses: value-at-risk (VaR) and expected shortfall (ES), were discussed. The VaR shows the maximum loss for a given probability during a certain period of time. For example, the VaR for corn in Aug/05-May/13 was -5.62 percent, meaning that there was a 99 percent chance that the daily price change in the corn market would not exceed -5.62 percent, i.e., prices would not drop more than -5.62 percent in 99 out of 100 days. A follow-up question is "How much can we lose in that one day (out of 100 days) when prices drop more than 5.62 percent?" The ES answers this question by showing the average price change when the market goes beyond the VaR value. The ES complements the VaR, and both measures can be used together. In Aug/05-May/13 the ES for corn was -6.89 percent, i.e., in the one percent of the days when prices dropped more than the VaR estimated, the average price change was -6.89 percent.

The information above is relevant for the future as long as one assumes that future market conditions will be similar to what happened in the corn market in 2005-2013. This raises an important issue. This may be a dangerous assumption, since the behavior of prices has not been constant over time – which brings us to the point of today's discussion. Historical data can still be used as a reference for risk measures, but it is recommended to also use stress tests with the estimates. A stress test is essentially an exercise to explore how changes in market conditions affect our estimates for VaR and ES. Stress tests are especially useful during crisis situations when abnormal events happen and usual market relationships no longer hold.

Going back to our study of the corn market between Aug/05-May/13, the daily average of all percentage price

changes in that period was 0.05 percent. Recall that 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 $4.80/bu and yesterday's price was $4.77/bu, the price change is $0.03/bu, and the percentage price change is 0.03/4.77 = 0.0063 = 0.63 percent (i.e., today's price of $4.80/bu is 0.63 percent higher than yesterday's price of $4.77/bu). In addition, volatility was 2.14 percent in the same period. We can use these numbers as a baseline scenario to run a simple example of a stress test. Let's see what would happen to our VaR and ES estimates if the average percentage price change was lower and the volatility was higher. For the percentage price change, let's make it negative and then double it, i.e., we'll work with an average percentage price change of –0.10 percent instead of +0.05 percent. And we'll also double the volatility, making it 4.28 percent rather than 2.14 percent. Table 1 exhibits what VaR and ES would be under these different scenarios. In the first row we see our baseline scenario, reflecting actual market conditions observed in Aug/05–May/13 (VaR = -5.61 percent and ES = -6.89 percent). The second row assumes a lower average percentage price change of –0.10 percent but still keeps the same baseline volatility, resulting in a slightly higher VaR and ES (-5.77 and -7.04 percent, respectively). The third row considers the higher volatility of 4.28 percent but maintains the baseline average price change, now causing a significant increase in VaR and ES (-11.29 and -13.82 percent, respectively). Finally, in the last row we have both alternative scenarios (lower price change and higher volatility), yielding another increase in VaR and ES estimates (-11.44 and -13.97 percent, respectively).

The analysis above demonstrates one method to run a stress test. We take a given time period as a baseline scenario and explore how our variables of interest (in this case, VaR and ES) would change under different alternative scenarios. For example, if we believe that the next few years will have lower average percentage price changes (–0.10%) and/or higher volatility (4.28%) compared to Aug/05–May/13, then Table 1 shows all the possible combinations for our VaR and ES estimates for the near future.

There are still other approaches to stress tests. We can also focus on specific events that have already been observed in the past. They can be either events that happen with some frequency over time (such as changes in government programs), or events that are rare but much more significant if they occur (such as a drought like in 2012). For example, what if there is another drought like the one in 2012 within the next three years? What would happen to grain prices? And just as importantly, if I am a grain producer, how will such an event affect my production and marketing plans? What should I do to prepare for it? What should I do to recover after it?

Another approach to stress testing concentrates on hypothetical events that usually have not occurred before. This does not necessarily mean that we can make up anything here. Ideally, we want to explore reasonable events that have never happened before. An example is the current political situation in the Ukraine. As far as we know, there is no clear indication that it has significantly affected grain markets in the country. But what if the situation deteriorates to the point of compromising the sale of Ukrainian grain to other countries? How would international grain prices react to such an event?

The discussion above suggests that the implementation of stress tests is not always simple. Several important decisions are necessary to run a stress test: the time frame of the analysis; what variables we want to explore; and

Table 1. Stress Test for VaR and ES Estimates in the Corn Market

Scenarios	VaR	ES
Baseline Scenario (Aug/05-May/13) **average price change = +0.05%** **volatility = 2.14%**	**-5.61%**	**-6.89%**
Lower Price Changes + Baseline Volatility average price change = -0.10% volatility = 2.14%	-5.77%	-7.04%
Higher Volatility + Baseline Price Changes average price change = +0.05% volatility = 4.28%	-11.29%	-13.82%
Lower Price Changes + Higher Volatility average price change = -0.10% volatility = 4.28%	-11.44%	-13.97%

how many alternative scenarios we want to consider, among others. Note that the number of calculations and potential outcomes can increase rapidly if we explore more variables of interest and keep adding new alternative scenarios. This can make the process longer and harder to analyze. In addition, there is often the challenge of imagining alternative scenarios and their magnitudes. Trying to envision events that never occurred before is especially complex. It is not easy to anticipate an event that has never happened before, and then evaluate how markets will react to this never-before-seen event.

Despite the challenges to implementing stress tests, they can be very useful as a tool to disseminate information and quantify potential losses under different scenarios. Note that stress tests do not always give us precise answers, and in many cases this is not their main purpose. Sometimes stress tests can be more useful as an exercise to help us think carefully about our strategies related to marketing, risk management, etc. This is a very important point about stress tests. The simple fact that we are considering different scenarios, thinking carefully about their implications to our businesses, and evaluating how prepared we are to deal with them can provide more important insights than the actual number generated at the end of the stress test.

Doing stress testing exercises in a systematic way can help us identify potential flaws in our strategies that might have been underestimated or overlooked, and then adjust them accordingly. We cannot predict the future and may not be able to accurately estimate what will happen under distinct scenarios, but thinking carefully about how different events can affect our businesses and being prepared for them already gives us a competitive advantage. As the scientist Louis Pasteur used to say, "Chance favors the prepared mind."

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