PRICE RISK MANAGEMENT—CORN AND SOYBEAN BASIS PROBABILITY DENSITY FUNCTIONS FOR NORTH CAROLINA

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What is Basis?

Evaluating basis can be thought of as the economics of where and when. More concretely, basis can be defined as:

BASIS IS THE DIFFERENCE BETWEEN LOCAL CASH PRICES AND FUTURES PRICES FOR COMMODITIES AT ANY POINT IN TIME:

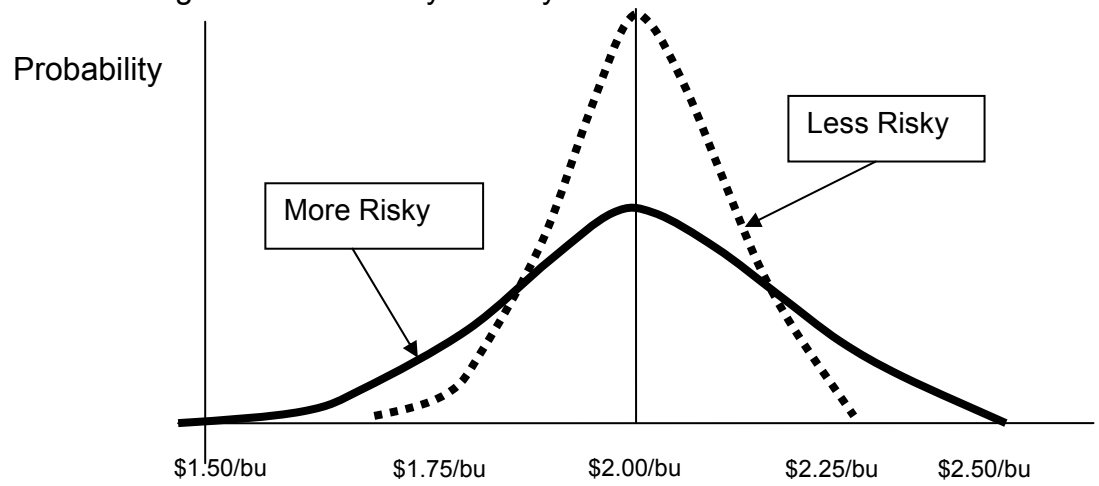
BASIS=LOCAL CASH PRICE-FUTURES PRICE

Most commonly, we talk about the nearby basis, which is the difference in the current local cash price and the NEARBY futures, the price of the futures contract closest to expiration. The local nearby basis is a random variable whose inherest riskiness can be expressed in the form of a probability density functions (PDF).

What is a Basis Density?

A PDF, also commonly referred to as "density function," plots the likelihood of different prices being realized over a range of values with the distance between the curve and the horizontal axis at a particular price representing the probability of that price occurring. The values with the highest probability of being realized have the largest distance between the curve and the horizontal axis, and these high probability values center on the mean of the distribution (or the median if the distribution is not symmetric, but skewed in one direction or the other). Aside from the central tendency of the underlying random variable, the shape of the density function also tells us something about the riskiness or the size of the range of possible values—the wider the PDF, the more risk and the bigger the range in possible values. The thinner or more peaked is the PDF, the less risk and the smaller the range in values. These differences are illustrated in Figure 1 Based on this PDF the most likely price at harvest would be $2.00 (the highest probability) but the price could be as low as $1.50 or as high as $2.50 but these extremes are not very likely. The range of values and the shape of this PDF illustrate the riskiness of the cash price. The less risky PDF, although it has the same most likely outcome of $2.00, has a much smaller range of values and therefore has a much skinner and peaked shape. The range of this less risky PDF is $1.75 to $2.25.

Figure 1: Probability Density Function for Cash Corn Price



Just as the local cash price is a random variable, the nearby futures price is a random variable whose inherent riskiness can also be expressed in the form of a PDF. The above formula shows how basis is calculated as the difference in local cash price and the futures prices and reveals that the PDF for the basis values can also be thought of *conceptually* as the difference of the PDFs for the local cash price and futures price, respectively. This is shown in Figure 2 below where the shape of the basis PDF resembles the difference in the local cash price PDF and the futures price PDF.

A noticeable feature of comparing the shape of the PDFs is that the basis PDF is skinnier, or more peaked, than either of the local or futures price PDFs. These shape characteristics come about because the basis PDF has less risk in dollar terms than either the local cash price PDF or the futures price PDF. In other words, the range of possible values of the basis is much smaller than that of either the local cash price or the nearby futures price.

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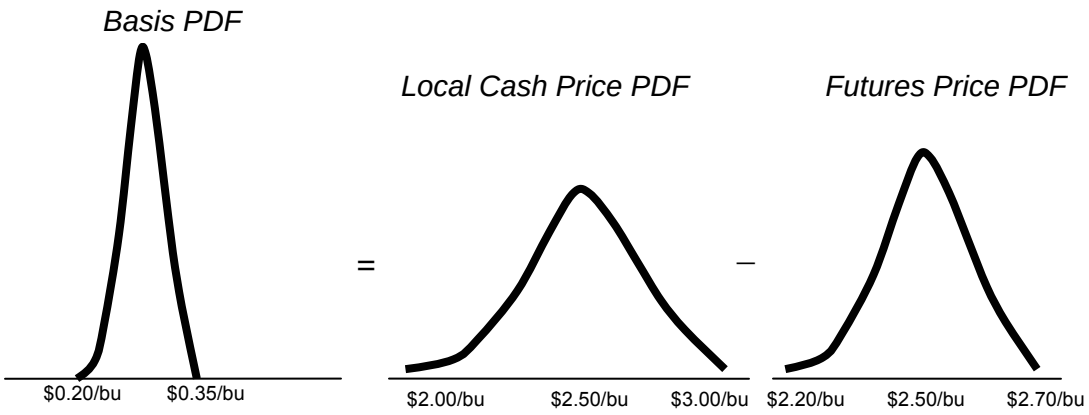
Figure 2: Basis, Cash Price and Futures Price (PDFs)



How Knowledge of The Local Basis Density Can Be Helpful For Price Risk Management—— Hedging

The fact that basis risk is less than price risk (either local or futures prices) is fundamental to hedging. Unless there is a perfect correlation between the local cash price and futures price there will always be some level of basis risk. However, basis risk tends to be significantly less than price risk, since it represents the difference in two series which are correlated, and so hedgers can reduce their exposure to *price* risk by taking an appropriate position in the futures or options market and accept in return an exposure to *basis* risk. Of course, to be attractive, the basis risk must be (significantly, enough less to cover the costs of hedging) less than the price risk for the hedger to make hedging worthwhile. In order to make this assessment, it is important to have a sense of what the PDF for basis looks like. Basis risk cannot be eliminated with a hedge but the premise is that it is much more bearable than the higher price risk.

The futures and options markets allow producers to gather significant amounts of information concerning the riskiness of futures price levels (the shape of the PDF) as well as the opportunity to hedge and offset this risk. Options premiums on the underlying futures price offer a quick gauge on the inherent price risk. However, information concerning the local basis is less readily available. This is due to the necessity of needing to track historical local prices in order to calculate basis. This can be time consuming. The purpose of this publication and supporting tables and figures is to document comprehensively and illustrate summary statistics and estimated densities for this important random variable. Understanding or having a feel for what this PDF looks like will enhance a producer's ability to make effective risk management decisions and to evaluate current bids and offers.

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How Knowledge Of The Local Basis Density Can Be Helpful For Price Discovery—Transforming Nearby Futures Prices

Perhaps the greatest value gained from knowledge of historical basis densities is using it to evaluate current cash price offers and for local price discovery. Cash bids are set by buyers using the nearby futures price and adjusting it to their local situation to arrive at their cash bids to sellers. The result of that adjustment is called the basis, or the amount that the offer price differs from the nearby futures price. Sellers can determine the current basis provided by the bids and compare that to the historical basis. This relationship can be represented as:

NEARBY FUTURES PRICES ARE TRANSFORMED INTO LOCAL PRICES BY ADDING BASIS TO REFLECT LOCAL MARKET CONDITIONS:

CURRENT CASH PRICE = CURRENT NEARBY FUTURES PRICE + HISTORICAL BASIS

Local buyers use futures prices as a guide to demand and supply conditions in the greater market and then add an adjustment to reflect local market conditions. If there are no unusual positive or negative impacts on the local demand and supply situation, it is common for local buyers to use the historical basis at the same time in previous years as a first-best guess of an appropriate adjustment to the nearby futures prices. Furthermore a basis that is stronger (more positive) than the historical basis in a current bid would indicate a strong desire from the buyer for the commodity than would normally be expected. This might be appropriate if the buyer expects that supplies might not be as plentiful as in previous years in the same time period. Conversely, a weaker basis than the historical basis would indicate a weaker desire from the buyer for the commodity than would normally be expected. This might be appropriate if the buyer expects high than normal supplies due to very favorable growing conditions.

How Knowledge Of The Local Basis Density Can Be Helpful For Forward Pricing Decisions—Evaluating Forward Contract Offers

Historical basis data are used as a measuring stick to determine if the basis is relatively weak or relatively strong at any point in time compared to previous levels of basis at the same point in time. One need only compare a current basis to the distribution of historical levels to decide if the current basis is stronger or weaker than normal for any point in time. Assuming there are no major changes in the market environment, a basis stronger than the historical basis in a current bid would indicate a stronger desire from the buyer for the commodity than would normally be expected. That would be a signal that the current bid is a relatively "attractive" bid to consider. Conversely, a weaker basis than the historical basis would indicate a weaker desire from the buyer for the commodity than would

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normally be expected. That would be a signal that the current bid is relatively "unattractive".

All forward pricing is done using futures markets and estimates of basis levels at harvest. Typically, we expect cash forward pricing to closely follow this formula:

FORWARD PRICE OFFERS TRANSFORM HARVEST-TIME FUTURES PRICES INTO FIRM DELIVERY PRICE OFFERS USING BASIS TO REFLECT LIKELY LOCAL MARKET CONDITIONS AT HARVEST:

FORWARD CONTRACT PRICE OFFER ≈ HARVEST CONTRACT FUTURES PRICES + HISTORICAL BASIS AT HARVEST

The harvest contract futures price plus the historical basis at harvest can be combined to calculate a projected forward contract price for delivery at harvest. This projected forward contract price can be compared with a forward bid offer to evaluate the "attractiveness" of the forward bid offer. For corn, it is the December futures contract, for soybeans, the November futures contract, and for wheat, the July futures contract, that are considered to be the harvest futures contracts (i.e., the futures contracts that expire closest to but not before the typical harvest time period for the regions of interest).

A stronger than expected basis in conjunction with an acceptable price level may signal an opportunity to eliminate price and basis risk by agreeing to a forward price contract. This strategy is advantageous in that it provides protection from any declines in price levels or weakening basis. The primary disadvantage with this strategy is that it also precludes benefiting from price rallies or a strengthening in basis once the contract is entered into. Of course, there are also production risk considerations, as the producer is under contract to deliver the amount of grain specified.

Local Data for North Carolina 1980(1)-2005(5)
[Corn markets=21, Soybean Markets 17]

Supplementary Historical Local Corn Price, Corn Basis, Corn Basis Densities, and Summary Statistics
http://www.ag-econ.ncsu.edu/faculty/piggott/corndensity_risk.html

Supplementary Historical Local Soybean Price, Soybean Basis, Soybean Basis Densities, and Summary Statistics
http://www.ag-econ.ncsu.edu/faculty/piggott/soydensity_risk.html

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