Peanut Price Methodology

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The pricing methodology for the peanut crop insurance program is based on a formulation of a series of factors. These factors are determined from a system of equations relating series of historical peanut prices relative to several pricing data sources available from the commodity markets. The factors derived from this system of equations and subsequent conversions are used to relate the price of in-shell peanuts to the prices of commodities traded on futures exchanges. The same factors utilized to translate the futures prices observed during the discovery period for the array of commodities into a projected price for peanuts will also be used to determine the harvest price for peanuts in the same insurance period.

A system of equations relates peanut market variables with a number of other variables at monthly intervals. The peanut market variables are the average monthly prices of shelled, medium runner peanuts and the available quantity of total domestic stocks. These are variables that move contemporaneously and both reflect supply and demand activity in the peanut market. Peanut stocks are reported each month by the United States Department of Agriculture (USDA)[1]. The monthly price associated with shelled, medium runner peanuts are based on an average of prices provided by peanut brokers. Another source of shelled, medium runner peanut prices is the monthly Rotterdam prices for shelled U.S. runner peanuts[2]. The Rotterdam prices represent the amount paid for peanuts at a European trading point, and from 2003[3] through 2013, the monthly prices have averaged $0.0803 per pound above those of the broker prices representing sales in the U.S. These shelled Rotterdam and broker peanut price series track rather well with one another with the differential reflecting shipping and transaction costs associated with selling the peanuts oversees.

The relationship between the shelled peanut prices and peanut stocks are evaluated with several other values in the system of equations. For peanut stocks, in addition to peanut prices, the relationships between the monthly averages of closing prices for other commodity contracts as well as short and mid-term cycle variables were evaluated. For shelled peanut prices, in addition to peanut stocks, an indicator of lagged international peanut prices as well as the monthly averages of closing prices for December wheat, cotton, soybean oil, and soybean meal were included as formula associations. The relationships in the two equations provide relatively good explanations of the variations in shelled peanut prices and peanut stocks. For the purpose of evaluating shelled peanut prices in the determination of the projected and harvest prices for the peanut crop insurance program, the predicted monthly price of shelled runner

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[1] As of the date of this publication, the most recent monthly national peanut stocks data (in 1,000 lbs.) are available from NASS at quickstats.nass.usda.gov and archived data are available as the USDA Economics, Statistics, and Market Information System NASS peanut stocks and processing at usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1118. At the end of each month, stocks data for the previous month are published. The most recent available stocks data are utilized in factor determination.

[2] The Rotterdam peanut price survey is maintained by Oil World (www.oilworld.biz). As of the date of this publication, the monthly prices (CIF in dollars per metric ton) for U.S. medium (40/50 count per ounce) runners are available as the USDA Economics, Statistics, and Market Information System Foreign Agricultural Service summary report of *Oilseeds: World Markets and Trade* usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1490.

[3] The transition out of the federal peanut quota program took place as a result of the 2002 Farm Bill. 2003 represents the first full year without a quota program.

peanuts is given as:

$$\hat{P}_{sp} = W_0 \times P_{wh}^{E_{wh}} \times P_{ct}^{E_{ct}} \times P_{so}^{E_{so}} \times P_{sm}^{E_{sm}} \quad (1)$$

where

$\hat{P}_{sp}$ is the predicted monthly price of shelled (medium runner) peanuts in dollars per pound;

W_0 is the price weighting factor for shelled peanuts;

E_{wh}, E_{ct}, E_{so}, and E_{sm} are the exponent factors associated with the prices for the respective exchange commodities: wheat (wh), cotton (ct), soybean oil (so), and soybean meal (sm); and

P_{wh}, P_{ct}, P_{so}, and P_{sm} are the monthly averages of daily settlement prices for the respective harvest year's commodities' December futures contracts, rounded to the nearest whole cent, for the exchange commodities: wheat (wh), cotton (ct), soybean oil (so), and soybean meal (sm).

The price weighting factor, W_0, includes the composite influence weight of variables in the system of equations other than the exchange commodities. These factors are derived using monthly data beginning after the end of the quota program and extending to the last available period prior to projected price discovery period[4].

Farmer stock peanut prices reflect the prices received by growers for peanuts prior to shelling. Peanuts can be shelled soon after harvest or stored for months in the shell[5]. The USDA National Agricultural Statistical Service (NASS) maintains ongoing surveys of in-shell peanut prices by type and location[6]. Both weekly and monthly in-shell peanut prices are published. Given that the NASS survey represents the price paid for in-shell peanuts that are shelled within a given time period, such as a week, the peanut prices reported by NASS could be comprised of several transaction dates during which the price was actually determined (either a price paid the day they were shelled or from over a year prior via a contract). Since a significant inventory is often carried in a potentially year-round shelling operation, the time lag between price changes in the shelled and when those prices are reported by the NASS survey for in-shell peanut markets must be considered. The time lag can be reconciled by selecting a time lag interval in the monthly data that minimizes the relative variability between historical data characterizing the shelled price and NASS in-shell peanut price information. Although this interval can change from year to year, the optimum interval based on available data reflects a nine month lag

[4] The current sales closing dates for peanut insurance are January 31st, February 28th, and March 15th depending on the state in which the peanuts are planted; the corresponding price discovery periods last for approximately a month and begin December 15th, January 15th, and February 1st.

[5] Most harvested peanuts are shelled; only a small percentage is kept in-shell for various in-shell consumer products. The length of time peanuts can be stored in-shell depends on the type of storage. In-shell peanuts can be stored for longer periods if refrigeration is available.

[6] As of the date of this publication, the peanut price survey data are available from NASS at quickstats.nass.usda.gov.

between shelled and in-shell peanut prices.

The USDA Farm Service Agency (FSA) marketing loan rate for peanuts has traditionally been utilized as a benchmark for quoting peanut prices in the contracts established between peanut producers and shellers. They are structured as the loan rate plus a contract premium. Growers can put their harvested production under the USDA loan program prior to shelling. The loan rate, minus some transaction and interest deductions depending on the amount of time peanuts are under loan, becomes the minimum price expectation for growers. Since the price of shelled peanuts is notably higher than that of in-shell peanuts due to the expense of shelling and cleaning, a grower would expect that the in-shell price would be significantly lower than the shelled price on a per pound basis. Given the limited availability of information characterizing the expected contract premium for all production in a given year prior to the insurance program sales closing date, an alternative methodology was developed. That methodology is to assess the in-shell peanut price using the NASS survey price of in-shell peanuts, the USDA peanut marketing loan rate, and the shelled peanut price with the respective time lag interval. This is stated as:

$$P_{N,t} = \pi_t P_{sp,t-9} + (1 - \pi_t) P_{LR,t-9} \tag{2}$$

where

$P_{N,t}$ is the NASS monthly survey price for in-shell peanuts in month t;

$P_{sp,t-9}$ is the shelled medium runner peanut price in month $t - 9$;

$P_{LR,t-9}$ is the loan rate for in-shell peanuts in month $t - 9$; and

π_t is the weight assigned to the shelled price in month t.

This formulation simply states that the in-shell price is influenced by both the marketing loan rate[7] and the shelled price. If the time lag in the NASS reported in-shell peanut price corresponds with the prices observed in the shelled peanut market approximately nine months prior, then the formulation implies that the NASS price in the current month reflects the nine month prior shelled market peanut price[8]. Following this reasoning, the weight assigned to the shelled peanut price to arrive at the NASS price in month t would be:

$$\pi_t = \left(P_{N,t} - P_{LR,t-9}\right) / \left(P_{sp,t-9} - P_{LR,t-9}\right) \tag{3}$$

[7] At the time of this publication, the marketing loan rates for peanuts by type are available from the USDA Farm Service Agency at www.fsa.usda.gov/FSA/webapp?area=home&subject=prsu&topic=col-nl-pp. Archived values for the marketing loan rates are available at www.fsa.usda.gov/Internet/FSA_File/peanut.xls.

[8] At the time of this publication, the overall marketing loan rate for peanuts is set at $0.1775 per pound. According to the USDA Farm Service Agency (cf. www.fsa.usda.gov/Internet/FSA_File/peanutmals_ldps.pdf), the Commodity Credit Corporation (CCC) "utilizes the national loan rate of $355 per ton and five year average quality factors, along with a three-year simple average of weighted production to determine the specific crop year loan rate for the type of peanuts (Runner, Spanish, Valencia, or Virginia)." Although the marketing loan rates for the different peanut types change from year to year, the changes are typically within zero to three hundredths of a cent per pound.

where, for the purpose of price determination for the peanut crop insurance program, this value will be constrained to be a percentage in the interval [0, 1]. An estimate of this weighting percentage in a given month, $\bar{\pi}_t$, is based on the data for the previous twelve months, or

$$\bar{\pi}_t = \frac{1}{12}\sum_{i=1}^{12} \pi_{t-i} \quad . \tag{4}$$

Based on the computations above, the Peanut Formula Price (PFP) for Runner peanuts can be determined for the peanut crop insurance program. The purpose of the Peanut Formula Price is to elicit a farmer stock equivalent price for peanuts based on the relationship between peanut prices and those of other commodities traded on public futures exchanges. Prior to the respective regional price discovery periods, the factors will be evaluated based on information available up until the point at which the factors are released and prior to the applicable discovery period (i.e. the most recent information available on prices and peanut stocks). Utilizing the factor specification in Formula (1) and adapting the grower price determination weighting in Formula (2) to elicit contemporary in-shell prices, the Peanut Formula Price in month t, $P_{F,t}$, is calculated as

$$P_{F,t} = \bar{\pi}_t \hat{P}_{sp} + (1 - \bar{\pi}_t) P_{LR,t} \tag{5}$$

where $P_{LR,t}$ is the prevailing USDA peanut marketing loan rate. This series of equations can be simplified into the Peanut Formula Price equation of:

$$P_{F,t} = C + W \times P_{wh}^{E_{wh}} \times P_{ct}^{E_{ct}} \times P_{so}^{E_{so}} \times P_{sm}^{E_{sm}} \tag{6}$$

where C is an additive price constant and W is the in-shell peanut price weighting coefficient for the commodity price formulations. For runner peanuts, the six factors, C, W, E_{wh}, E_{ct}, E_{so}, and E_{sm}, are utilized during both the projected and harvest price discovery periods to determine the formula price for peanuts based on the corresponding discovery prices of the December Chicago Mercantile Exchange (CME) futures contracts for wheat, soybean oil, and soybean meal and the Intercontinental Exchange (ICE) December futures contract for cotton.

The NASS in-shell peanut price survey information will also be utilized to estimate formula prices for the other insurable peanut types of Spanish, Valencia, and Virginia. The price ratios between these other peanut types and runner peanuts are calculated based on monthly averages of the weekly NASS survey prices for the respective types. Twelve-month averages are used to reflect a more typical price relationship within a crop year. Since the survey reporting for Valencia peanuts has been sparse, particularly in recent years, the crop insurance price for Valencia peanuts is based on the prices for the Virginia type, which demonstrates the most similar valuation to the Valencia of the types for which adequate price information is available. The price ratios for 2007 through 2013 are presented in Table 1.

The price ratios are determined prior to each projected price discovery period and will take into account

the type-specific loan rates in scenarios of depressed market conditions and expert assessments of market dynamics. These ratios will formulate the type factor, T_X, which will be multiplied by the formula price presented in Equation (6) to determine the formula price for projected and harvest prices for Runner, Spanish, Valencia, and Virginia peanuts. Since Runner peanuts are utilized to determine the formula price, the type factor for Runners will be equivalent to one.

Table 1: Twelve-Month Moving Average Prices for Peanut Types Relative to the Price of Runners Based on Weekly NASS Peanut Prices

Year	Spanish	Valencia†	Virginia
2007	0.996	1.105	1.105
2008	1.095	1.092	1.092
2009	1.126	1.068	1.068
2010	1.014	1.213	1.213
2011	1.181	1.178	1.178
2012	1.220	1.131	1.131
2013	1.058	1.093	1.093

† Values for Valencia peanuts were adopted from Virginia peanuts due to a lack of consistent survey data for Valencia peanuts in recent years.

Prior to each projected price discovery period, the factors for the four peanut types will be available as

$$PFP_X = T_X \times \left(C + W \times P_{wh}^{Ewh} \times P_{ct}^{Ect} \times P_{so}^{Eso} \times P_{sm}^{Esm}\right) \quad (7)$$

where

X is the peanut type: Runner, Spanish, Valencia, or Virginia;

PFP_X is the Peanut Formula Price in dollars per pound for peanut type *X*;

T_X is type factor: Runner, Spanish, Valencia, or Virginia;

C is the additive price constant;

W is the price weighting coefficient; and

E_{wh}, E_{ct}, E_{so}, and E_{sm} are the exponent factors associated with the prices for the respective exchange commodities wheat (wh), cotton (ct), soybean oil (so), and soybean meal (so).

Implied volatility is utilized as a basis for determining price risk for most commodities with revenue crop insurance options. Since comparable information is not available for peanuts, the volatilities observed in the futures exchanges for the commodities used in the Peanut Formula Price determination are also utilized in the volatility determination. The relationship between the moving 12-month variability of the

monthly historical shelled peanut prices and the monthly average of the daily settlement prices for the December contracts of wheat, cotton, soybean oil, and soybean meal is formulated in a similar manner to that of the shelled peanut price equations. This relationship is assessed in the period prior to the respective projected price discovery periods. During the projected price discovery period, the variability factors are used to derive an implied volatility for peanut prices using the respective implied volatilities of the exchange-traded commodities. The implied volatility associated with peanuts would then be based on the following formulation:

$$\hat{\sigma}_{PFP} = V \times \sigma_{wh}^{\gamma_{wh}} \times \sigma_{ct}^{\gamma_{ct}} \times \sigma_{so}^{\gamma_{so}} \times \sigma_{sm}^{\gamma_{sm}} \quad (8)$$

where:

$\hat{\sigma}_{PFP}$ is the implied volatility associated with the projected Peanut Formula Price;

V is a coefficient value assessed from the functional relationship between the historical volatility of peanuts and select commodities traded on the futures exchanges;

$\sigma_{wh}, \sigma_{ct}, \sigma_{so}, \sigma_{sm}$ are the implied volatilities associated with the futures prices of wheat (wh), cotton (ct), soybean oil (so) and soybean meal (sm), respectively, as determined in the corresponding price discovery period based on the prevailing USDA Risk Management Agency (RMA) methodology for assessing volatility[9]; and

$\gamma_{wh}, \gamma_{ct}, \gamma_{so}, \gamma_{sm}$ are exponent factors assessed from the functional relationship between the historical volatility of peanuts and that of the wheat (wh), cotton (ct), soybean oil (so) and soybean meal (sm) futures contracts from their respective commodity futures exchanges (CME and ICE).

The specifications for the price discovery periods, contract commodities, and price factor formulations by peanut type can be found in the Commodity Exchange Price Provisions (CEPPs) for peanuts.

[9] As of the date of this publication, the method utilized by the Risk Management Agency to determine price volatility for commodities with revenue insurance options is described in the February 2011 *Volatility Factor Calculation Methodology* found at www.rma.usda.gov/pubs/2011/volatilitymethodology.pdf.