Grain Sorghum Pricing Methodology

Background

RMA uses WASDE projections to formulate current price elections for grain sorghum. These projections are based on WADSE models that are not available for public scrutiny. According to RMA data, however, the following table represents the price relationship between corn and sorghum from 1990 to 2009. These ratios are based on published MPCI sorghum/corn ratios for 1990 – 2003 and RMA data sent to those participating in the methodology project for 2004 – 2009. Also in the table are the marketing year average (MYA) price ratios as published by WASDE. RMA has underestimated the MYA by 1.6% over this time period. RMA has also had two years (1990 and 2006) where it underestimated the MYA by over 15%. Modeling the MYA by RMA yields an r-squared (R^2) of only .0003 and a mean absolute percentage error (MAPE) of 5.86.

Year	RMA	MYA - WASDE
1990	71.7%	93.0%
1991	93.5%	94.9%
1992	93.5%	91.3%
1993	91.3%	92.4%
1994	91.7%	94.2%
1995	93.3%	98.5%
1996	94.3%	86.3%
1997	93.9%	90.9%
1998	88.5%	85.6%
1999	92.9%	86.3%
2000	92.1%	102.2%
2001	87.8%	98.5%
2002	99.0%	100.0%
2003	95.5%	98.8%
2004	95.9%	86.9%
2005	92.5%	93.0%
2006	90.0%	108.2%
2007	94.3%	97.1%
2008	93.7%	78.0%*
2009	88.2%	
1990-2008 Averages	91.9%	93.5%

*estimate for 2008 from March 11, 2009 WASDE

Harvest Price

The MYA will act as the proxy for the harvest price to test the model that is discussed below. This is a valid statement since sorghum harvest is spread out over 6 months, so a "harvest price" must reflect an average price obtained from different sources. Grain sorghum price reporting is hard to find at times and reliance on only a few sources at a given time is a dangerous precedence and would not meet the criteria of being both transparent and replicable. The MYA average price is an easily obtained price that fits the criteria of being transparent. Also, prices reported "at harvest" may not reflect the actual price received by producers. During conversations with producers with on-farm grain storage, producers unanimously stated that sorghum was the preferred grain to store since its basis at harvest was the weakest. By marketing the grain at a later date and capturing the basis gain, they make the most money per bushel of grain stored.

Basis Effect

Another key component in the model is the effort to eliminate basis effects. Since grain sorghum basis varies widely across the sorghum belt, a national MYA proxy for the harvest price will target the model to eliminate the basis effect. Grain sorghum and confectionary sunflowers are the only crops that have price elections for revenue insurance products determined by a basis number. For example, the price used to determine the CRC, RA, and GRIP price elections for corn is strictly the futures price of the applicable month based on the location of the policyholder. It does not take into account any basis (with basis being defined as the difference between cash and futures prices). The elimination of the basis is necessary because of two reasons.

First, low basis areas for grain sorghum in the Texas and Oklahoma Panhandles may have greater cash grain sorghum prices than low corn basis areas in central Iowa. Second, when comparing the revenue insurance price elections of corn, soybeans, and wheat with cash prices paid to farmers, all three crops significantly benefited by not being subject to a basis effect in their respective price elections. In 2006, 90% of soybean production, 86% of corn production, and 70% of winter wheat production was grown in states with negative basis for the crops. By having a price election above the cash price, these crops received an artificially high revenue guarantee. Using local elevator bids as of the week ending October 19, 2007, the third-largest county in corn production for 2006 (Kossuth, IA) had corn bids at $0.54/bushel **below** the CBOT current month. Of the top ten producing counties in 2006, the average corn basis was $0.37/bushel below the CBOT current month.

From 2000 – 2006, the average October NASS corn price was $0.21/bushel **below** the CRC harvest price for corn, and the average October NASS soybean price was $0.24/bushel **below** the CRC harvest price for soybeans. During this same time frame, however, the October NASS sorghum price was only $0.07/bushel below the CRC harvest price for sorghum. Even more telling is the comparison of NASS final marketing year prices compared to the CRC harvest price for corn and sorghum. From 2000 – 2006, corn averaged $0.05/bushel **below** the CRC harvest price while sorghum averaged $0.06/bushel **above** the CRC harvest price.

Proposed Methodology

The proposed methodology is an ordinary least squares (OLS) model based on published monthly NASS prices, exports, and total use of sorghum. The model is:

$$SCRINS_t = 1.480 - (0.685)SCR_{t-1} + (0.516)EXUS_{t-1}^2$$

Where:

$SCRINS_t$ is the sorghum-corn ratio used for the insurance price election for year t. This ratio will then be multiplied by the corn price as estimated by WASDE/RMA for APH polices or will be multiplied by the corn futures price for revenue policies. Thus,

Sorghum Price Election for APH Policies$_t$ = (Corn APH Price Election$_t$) x SCRINS$_t$
Sorghum Price Election for Revenue Policies$_t$ = (Corn Futures$_t$) x SCRINS$_t$

SCR_{t-1} is the ratio of sorghum and corn prices defined as:

$$LN(SorghumSep_{t-2}SorghumAug_{t-1})/LN(CornSep_{t-2}CornAug_{t-1})$$

LN is the natural log function.
$SorghumSep_{t-2}SorghumAug_{t-1}$ is the average of the final monthly prices as published by NASS in *Agricultural Prices* for the months of September$_{t-2}$ to August$_{t-1}$ for grain sorghum converted to a price per bushel.
$CornSep_{t-2}CornAug_{t-1}$ is the average of the final monthly prices as published by NASS in *Agricultural Prices* for the months of September$_{t-2}$ to August$_{t-1}$ for corn.

$EXUS_{t-1}$ is defined as:

$$((SorgExpAug_{t-1}/SorgUseAug_{t-1}) + (SorgExpSep_{t-1}/SorgUseSep_{t-1}) + (SorgExpOct_{t-1}/SorgUseOct_{t-1})) / 3$$

$SorgExpAug_{t-1}$ is the WASDE **projection** of sorghum exports in August
$SorgUseAug_{t-1}$ is the WASDE **projection** of sorghum usage in August
$SorgExpSep_{t-1}$ is the WASDE **projection** of sorghum exports in September
$SorgUseSep_{t-1}$ is the WASDE **projection** of sorghum usage in September
$SorgExpOct_{t-1}$ is the WASDE **projection** of sorghum exports in October
$SorgUseOct_{t-1}$ is the WASDE **projection** of sorghum usage in October

For example, to calculate the sorghum price election for revenue products in 2008, the following data would be used:

Sorghum NASS Prices

Sep06	Oct06	Nov06	Dec06	Jan07	Feb07	Mar07	Apr07	May07	Jun07	Jul07	Aug07	$SorghumSep_{t-2}$ $SorghumAug_{t-1}$
4.28	5.17	5.83	6.09	6.31	6.98	6.62	5.96	6.48	6.12	5.52	5.93	3.3269

Corn NASS Prices

Sep06	Oct06	Nov06	Dec06	Jan07	Feb07	Mar07	Apr07	May07	Jun07	Jul07	Aug07	$CornSep_{t-2}$ $CornAug_{t-1}$
2.2	2.54	2.87	3.01	3.05	3.44	3.43	3.39	3.49	3.51	3.32	3.26	3.1258

SCR_{t-1} is then defined as LN(3.3269)/LN(3.1258) = 1.0547

Sorghum Export and Usage Projections

	Exports	Usage	Ratio
Aug07	200	445	0.4494
Sep07	220	465	0.4731
Oct07	275	490	0.5612
		$EXUS_{t-1}$	0.4946

$SCRINS_t = 1.480 – (0.685)(1.0547) + (0.516)(0.4946)^2 = 0.8838$

Sorghum price election for revenue $products_{2008(3/15\ SCD)}$ = \$5.40 x 0.8838 = \$4.77/bu

This model has an R^2 of 0.394 and a MAPE of 4.61. Both SCR_{t-1} [Prob(t) = 0.006] and $EXUS_{t-1}$ [Prob(t) = 0.042] are significant at the 95% level. Since this is an OLS model, the average of the predictions is the average of the given MYA prices, so it does not underestimate the MYA as does the RMA historical prices. The largest overestimation in the model is 10.4% in 2008. The largest underestimation in the model is 9.1% in 2002.

Limitations

Sorghum pricing can be heavily influenced by small changes in other dynamics given the small size of the sorghum crop. Renewable fuels policies can have large impacts on sorghum prices in the very near future. Once USDA implements section 9005 of the 2008 Food, Conservation, and Energy Act (Farm Bill), sorghum could become a preferred ethanol feedstock due to its definition as an advanced biofuels feedstock. Once EPA publishes rules on the implementation of the renewable fuels standard (RFS) in the 2007 Energy Independence Security Act (Energy Bill), sorghum could again benefit greatly from the production of advanced biofuels. In a paper by Martinez and Malaga[1], spot cash sorghum prices and corn futures prices are at the following ratios at the given location: Gulf Port – 1.01; Kansas City – 0.99; and Texas Gulf – 0.99. This is attributed to the ethanol demand in the sorghum market.

The other large limitation in this model is the underlying assumption that the MYA and NASS prices are representative of the prices received by producers. NASS reporting is voluntary and very large sorghum buyers **do not** report to NASS on their purchases. Due to this, NASS data is incomplete and may underestimate the price of sorghum by 3 – 4% for a given year. This incomplete pricing data makes this model, or any model using this data, inferior to a model based on better pricing data.

Due to these limitations, RMA should not use this methodology for more than two years – crop years 2010 and 2011. Within two years, renewable fuels programs and rules should be implemented. With this implementation, sorghum markets may dramatically change and this model may not be applicable given the emphasis on biofuels. [2] A better methodology at that time may be to examine the RFS schedule, FSI projections, and other biofuel market indicators.

[1] Paper submitted for publication to *Journal of Agribusiness.*

[2] The addition of the food, seed, and industrial (FSI) use numbers published by WASDE were examined for addition to the model, but they were not statistically significant.