Impact of 2013 Premium Rate Changes on Gain and Loss Probabilities in the AIR U.S. MPCI Model

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Introduction

The United States Department of Agriculture's Risk Management Agency (RMA) offers protection to crop insurers in the form of the Standard Reinsurance Agreement (SRA), allowing them to transfer risk to the government by sharing specified levels of underwriting gains and losses. For the 2013 insurance year, the RMA modified the premium rates for corn, cotton, rice, sorghum, soybean, and wheat crops. This will have an impact on premium volumes, county- and state-level gross loss ratios, post-SRA losses and loss ratios, thus directly affecting crop insurance companies' fund allocation, risk management strategies and the placement of reinsurance protection.

AIR has updated its U.S. multiple peril crop insurance (MPCI) model to reflect these recent changes and to provide the U.S. crop insurance industry with the analytical tools to assess the risk and potential opportunities that these recent changes have brought to agricultural portfolio risk management. This paper describes the nature of these changes and their impact on the profitability of the crop insurance industry.

AIR MPCI Model Overview

The AIR MPCI Model for the United States (Figure 1) is a weather-based crop insurance risk model that estimates underwriting gains and losses based on crop yield probabilities in the context of current conditions, including agricultural technology, price volatility, crop insurance policy terms and premium rates, farmer planting and insurance purchasing patterns, and terms of the government's SRA.

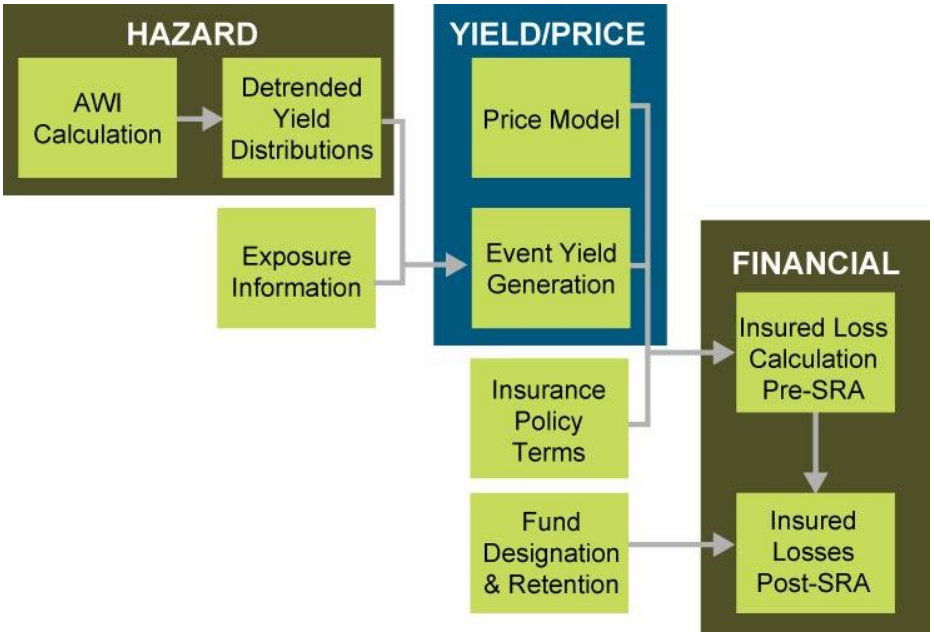

Figure 1. Components of the AIR Multiple Peril Crop Insurance Model for the U.S.

The model is based on high resolution historical weather and soil data and the unique AIR Weather Index (AWI), which isolates the effects of weather on crop yields from the long term trend introduced by technological advances in farming. The resulting detrended yield probabilities provide significantly improved risk estimates. Market price volatility, a critical factor in revenue-based insurance policies, is captured in the yield/price component of the AIR model.

Incorporated in this component of the model are the most recent insurance premium rates, selection of policy types, crop planting decisions, and USDA-specified loss thresholds. Because premium rates by policy type and the mix of policy types have changed significantly over the years, historical loss ratios are less relevant for determining potential losses for an upcoming year.

The latest update to the AIR MPCI model reflects the changes to the 2013 premium rates for corn, cotton, rice, sorghum, soybeans and wheat, allowing companies to assess the risk to their portfolios based on current conditions.

Updates to the AIR Multiple Peril Crop Insurance (MPCI) Model for the United States

The current update to the AIR MPCI Model for the United States reflects the recent changes to the corn, cotton, rice, sorghum, soybeans and wheat crop premium rates for the 2013 insurance year made by the RMA. These premium rate updates affect premium volumes, county- and state-level gross loss ratios, post-SRA losses and loss ratios. Gross losses, or pre-SRA losses, relative to sums insured, or liabilities, are not affected. The model changes and implications for losses and loss ratios are detailed in the sections below.

Changes to Premium Rates for the 2013 Insurance Year

The AIR MPCI Model for the United States uses exposure data, including premiums, premium rates and pricing, provided by the RMA. This information is used to determine gross losses, gross loss ratios, post-SRA losses, and post-SRA loss ratios. Updates to any of these data pieces will influence losses and loss ratios.

For the 2013 insurance year, RMA updated the premium rates for corn, cotton, rice, sorghum, soybeans and wheat crops. The changes between the old and new rates are shown in Table 1. In general, rates were reduced for soybeans and rice in relevant states. For corn, cotton and wheat (only spring wheat considered), the premium rates were changed upwards and downwards depending on state. For sorghum the rates were generally increased in relevant states.

Table 1. Average Percent Change of Premium Rate by State

State	Corn	Soybeans	Cotton	Rice	Wheat	Sorghum
AL	2	-2	-4	0	0	0
AK	0	0	0	0	0	0
AZ	-10	0	-12	0	0	0
AR	9	-10	-15	-4	0	12
CA	-12	0	10	-14	0	0
CO	4	-11	0	0	0	-5
CT	17	0	0	0	0	0
DE	-13	-13	0	0	0	0
DC	0	0	0	0	0	0
FL	0	-3	0	0	0	0
GA	-2	-9	-6	0	0	3
HI	0	0	0	0	0	0
ID	-14	0	0	0	0	0
IL	-4	-9	0	0	0	-11
IN	-3	-8	0	0	0	11
IA	-6	-9	0	0	0	0
KS	4	-9	1	0	0	-1
KY	-3	-3	0	0	0	15
LA	-2	-5	-15	-14	0	1
ME	0	0	0	0	0	0
MD	-6	-12	0	0	0	0
MA	15	0	0	0	0	0
MI	-4	-7	0	0	0	0
MN	-3	-4	0	0	-10	0
MS	8	-2	-10	-11	0	14
MO	1	-7	-14	1	0	-9
MT	-12	0	0	0	-14	0
NE	-6	-13	0	0	0	4
NV	0	0	0	0	0	0
NH	0	0	0	0	0	0
NJ	8	-4	0	0	0	0
NM	-14	0	11	0	0	-1
NY	7	6	0	0	0	0
NC	-8	-9	-19	0	0	0
ND	11	2	0	0	8	0

State	Corn	Soybeans	Cotton	Rice	Wheat	Sorghum
OH	1	-8	0	0	0	0
OK	3	0	8	0	0	5
OR	0	0	0	0	0	0
PA	7	-11	0	0	0	0
RI	5	0	0	0	0	0
SC	0	-8	-11	0	0	0
SD	15	2	0	0	10	11
TN	-4	-9	-7	13	0	-1
TX	0	-14	5	-12	0	-5
UT	0	0	0	0	0	0
VT	15	0	0	0	0	0
VA	-4	-8	-2	0	0	0
WA	-9	0	0	0	0	0
WV	-11	0	0	0	0	0
WI	-5	0	0	0	0	0
WY	-2	0	0	0	0	0

Premium Rate Changes Impact Gross Loss Ratios

The changes to premium rates impact policy portfolios in a variety of ways. However, it is important to stress that gross losses are driven solely by yields and prices (price change between planting and harvest) as determined by the stochastic yield and price catalog. Therefore, with respect to yields and price scenarios, the stochastic catalog will not change in the current model update.

In contrast, the gross loss ratio, which is defined as loss (indemnity) over premium, does change in this release of the model for the portion of a portfolio containing corn, cotton, rice, sorghum, soybeans and wheat crops. Calculating this change for all crops depends on two factors: the shares of these crops for a book of business, as well as the proportion of each individual crop compared to the rest in a given book because the rate of premium change differs between each crop.

In general, the premium rate changes will affect total premium volumes. The Table 2 values reflect the premium volumes by state if the 2013 premium rate changes had been applied in 2012, and thus account for 2012 premium values. To determine these values, it was assumed that the premium rate changes impact the base rate of all policies and not the price risk component of the policies. In addition, there is no differentiation made between insurance type, coverage level, or county—and this assumption is carried for the following analyses.

Furthermore, it is possible to determine gross loss ratios using the premium volume changes. In Alabama, for example, premium volumes decreased approximately 0.7% due to the application of the premium rate changes. Accordingly, Alabama gross loss ratios increased approximately 0.6% due to the premium rate changes.

Table 2. Average Percent Change of Total Premium Volumes for All Crops and All States

State	Premium Change
AL	-0.7%
AZ	-5.0%
AR	-3.5%
CA	-0.5%
CO	0.6%
DE	-5.8%
FL	0.0%
GA	-2.0%
ID	-0.1%
IL	-2.7%
IN	-2.4%
IA	-3.5%
KS	-0.3%
KY	-1.2%
LA	-3.9%
MD	-4.1%
MI	-2.2%
MN	-1.8%
MS	-0.6%
MO	-1.6%
MT	-6.3%

State	Premium Change
NE	-3.7%
NJ	1.0%
NM	-0.2%
NY	2.4%
NC	-4.6%
ND	2.9%
OH	-1.6%
OK	0.5%
OR	0.0%
PA	1.3%
SC	-2.9%
SD	5.3%
TN	-3.1%
TX	0.8%
UT	0.0%
VA	-2.3%
WA	0.0%
WV	-5.2%
WI	-1.9%
WY	-0.4%
US	-1.2%

Premium Rate Changes Impact Post-SRA Loss Ratios

Changes to corn, cotton, rice, sorghum, soybeans and wheat premium rates will affect post-SRA loss ratios, i.e. loss ratios after the application of SRA rules and regulations. Note that increases in state-level gross loss ratios do not relate to post-SRA loss ratios in a proportional manner.

Figure 2 demonstrates the complex relationship between the gross and post-SRA loss ratios using the example of the Commercial Fund for Group 1 states, including IL, IN, IA, MN and NE. The post-SRA loss ratio as it relates to the gross loss ratio levels is indicated by the blue line. For low gross loss ratios up to 50%, any change in the gross loss ratio will have only a minimal impact on the post-SRA loss ratios. Similarly, for large gross loss ratios above 220%, any change in the gross loss ratio will again only have a minimal impact on the post-SRA loss ratios. In between these two gross loss ratio boundaries, the relationship between gross loss ratios and post-SRA loss ratios is more linear; note that this is still not quite a one-to-one relationship, which is indicated by the black line.

As a result, AIR researchers expect that the change in premium rates will have a smaller effect on the lower end of the exceedance probability (EP) curve, i.e. low gross loss ratios, and on the upper end. The middle range of the EP curve will show the largest change, and this is shown in Table 5.

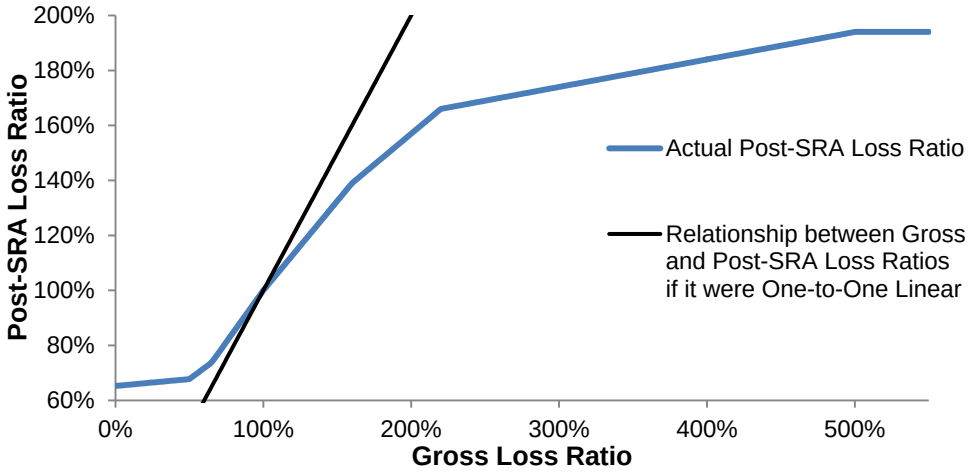

Figure 2. Translation of Gross Loss Ratios to Post-SRA Loss Ratios for Commercial Fund, Group 1 States (blue line). A One-to-One Relationship between Gross and Post-SRA Loss Ratios Is also Provided (black line).

General Impact of Model Updates on the Modeled Loss Ratios

The previous sections detailed the types of premium rate changes made to corn and soybean crops, as well as how these changes will affect gross and post-SRA loss ratios. Accounting for all the modeled changes, the overall effect of the corn, cotton, rice, sorghum, soybeans and wheat premium rate changes nationwide on the industry profitability is summarized in Table 3.

Table 3. Change in Overall Profitability (All States, All Crops)

Average Post-SRA Loss Ratio for Total Industry Exposure	
Prior to Change	**After Change**
84.1.%	84.5%

Due to the changes in premium rates, the overall premium for the total United States will be reduced by 1.2% (Table 2). This will reflect a 1.0% increase in the gross loss ratios, but only a 0.4% increase in the post-SRA loss ratios, as shown in Table 3.

SRA rules and regulations reduce the change realized by the post-SRA loss ratios. For example, in Iowa and Illinois almost all the insured value is in corn and soybean crops. The premium rates decrease by 9% for soybeans in both states, by 4%for corn in Illinois, and by 6% for corn in Iowa, where the gross loss ratio will increase proportionally. After SRA processing, the effect of this premium rate decrease is an increase of the post-SRA average annual loss ratios. The changes in post-SRA average annual loss ratio values are listed by state in Table 4. Note that the net effect of this premium rate decrease in Illinois is an increase of the post-SRA average annual loss ratio of 0.87%. For the entire U.S., the increase in the post-SRA loss ratio is 0.39%.

Table 4. Percent Change in Post-SRA Average Annual Loss Ratios

	Percent Change in Post-SRA Average Annual Loss Ratios
USA	0.39%
AL	0.27%
AR	1.56%
AZ	2.18%
CA	0.19%
CO	-0.33%
DE	2.09%
FL	0.00%
GA	1.11%
IA	1.17%
ID	0.13%
IL	0.87%
IN	0.88%
KS	0.13%
KY	0.54%
LA	2.30%
MD	1.48%
MI	0.94%
MN	0.54%
MO	0.63%

	Percent Change in Post-SRA Average Annual Loss Ratios
MS	0.28%
MT	2.84%
NC	2.24%
ND	-1.24%
NE	1.39%
NJ	-0.27%
NM	0.22%
NY	-1.25%
OH	0.54%
OK	-0.26%
OR	-0.01%
PA	-0.39%
SC	1.40%
SD	-1.90%
TN	1.69%
TX	-0.31%
UT	-0.01%
VA	1.04%
WA	0.00%
WI	0.77%

Percent Change in Post-SRA Average Annual Loss Ratios	
WV	2.05%

Percent Change in Post-SRA Average Annual Loss Ratios	
WY	0.11%

Table 5 shows the percent change in post-SRA loss ratios between the updated model and the prior version by return period for the entire United States and select states (Illinois and Texas). Overall, the total United States experienced increased post-SRA modeled loss ratios for every return period.

Illinois and Texas were chosen because they represent different types of premium rate changes. In Illinois, a Group 1 state, the corn and soybean premium rates decreased by 4% and 9% respectively between 2012 and 2013. This translates to increased post-SRA modeled loss ratios as compared to the previous model version for every return period.

In contrast, the premium rate for the major crop cotton increased by 5% in Texas, a Group 2 state, between 2012 and 2013. This then translated to slightly reduced modeled loss ratios for every return period.

Table 5. Comparison of Previous Release and Current Post-SRA Loss Ratios

Total U.S.	
EP (Return Period)	Percent Change in Loss Ratios
50% (2 yr)	0.25%
10% (10 yr)	0.67%
5% (20 yr)	0.66%
2% (50 yr)	0.38%
1% (100 yr)	0.40%
0.2% (500 yr)	0.33%

Illinois	
EP (Return Period)	Percent Change in Loss Ratios
50% (2 yr)	0.10%
10% (10 yr)	1.43%
5% (20 yr)	0.38%
2% (50 yr)	0.56%
1% (100 yr)	0.66%
0.2% (500 yr)	0.00%

Texas	
EP (Return Period)	Percent Change in Loss Ratios
50% (2 yr)	-0.48%
10% (10 yr)	-0.23%
5% (20 yr)	-0.23%
2% (50 yr)	-0.22%
1% (100 yr)	-0.10%
0.2% (500 yr)	-0.11%

Conclusion

The industry-standard AIR MPCI Model for the United States provides program analysis for all MPCI reinsurance submissions and complete, multi-program portfolio loss analysis. Model results allow crop insurers to make better decisions in fund allocation and retention level strategies to better manage this complex risk.

For the 2013 crop year, the AIR model has been updated with the most current data to reflect the RMA's premium rate changes for corn and soybeans. On a nationwide basis, these changes represent a modeled post-SRA loss ratio increase of 0.4 percentage points. Actual companies may experience higher or lower loss ratio changes based on the geographic distribution of their portfolios, their individual market share by state, the mix of policy types written, the portion of policies designated to the Assigned Risk Funds by policy type, and the amount of premium retained in the Commercial Funds.

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