

Response to the comments submitted by Commenter A

We appreciate the careful comments made by Commenter A and its consultants. We agree that rating and risk measurement in an environment where the underlying structure of the agricultural economy is constantly evolving presents important challenges. Before proceeding to specific responses to the detailed comments, we would offer a few general observations. First, the federal crop insurance program is impressive in its breadth and variety. It is important to recognize that transparency and manageability considerations necessarily demand that a single broad approach to rating be used and that the RMA must work within these rather significant constraints. That said, there are many reasons to raise concerns with some of the arguments advanced in the comments received on this report.

First, it should be recognized that the crop insurance program and, further, the entire underlying structure of production agriculture, is constantly evolving. As we emphasized in the report, very significant changes include the 1994 Crop Insurance Reform Act, the introduction of revenue insurance products, changes in technology, profound shifts in participation, and the fundamental changes brought about by the 2000 ARPA legislation. These changes raise questions about the commenters' criticisms as well as their proposed alternatives to the methods currently used by RMA, which have the benefit of careful attempts to make adjustments that allow consistent comparisons to be made over time and across areas when establishing rates. Any arguments (along with their supporting statistical tests) that make sweeping statements based upon conveniently-defined periods of study (e.g., 1980-2008) and that present probability values from formal statistical tests conducted while ignoring many of these complicating factors (as well as many other conditions that further complicate formal statistical inference) are suspect.

The relevant question is not whether an assumption of a constant CV of yields is valid in every case considered but rather is whether a superior approach is available and practical to implement. Though it is an untestable tautology, we are confident in stating that one can almost always select a statistical test and apply it to a conveniently chosen period of data or set of insurance units and obtain formal statistical test results that will reject any approach to rating in at least some cases. Providing an exhaustive battery of testing that reveals an approach that cannot be rejected by any and all data sets and/or specifications is not just a task beyond the objectives of this report—it is a task that is impossible by its very nature. For example, tests provided in the comments that seem to refute the loss-cost rating approach are themselves flawed by the period of time used in the tests, the changing structure of crop insurance and production agriculture, as well as by formal statistical issues such as cross-sectional dependence, systemic risk, and unobserved heterogeneity in the data generating processes. Our specific responses should be viewed within this context.

Comment

1. A comprehensive review of the rating methodology requires that the empirical performance of that rating methodology be examined and differences between expected and actual loss experience reconciled. While there are difficulties in conducting these

analyses, they must be conducted nonetheless. If an empirical analysis of the ratings methodology cannot be conducted, then it is also impossible to base rates on historical experience. It is important to note that corn has a low loss ratio performance over the entire modern time period of the program, and that the loss ratio performance is not converging to the experience of other crops. Further, corn is a large and important participant in the program. Hence, corn's loss ratio experience, even if the overall program is judged to be meeting an aggregate loss rate target, violates basic tenets of equity.

Response: Commenter A review discusses at length the relative merits of using a loss ratio to assess crop insurance actuarial soundness. We are cognizant of the historical data suggesting that corn has experienced relatively good loss ratios over the period examined by Commenter A. However, we cannot support the simple historical loss ratio as the way to evaluate the program's performance. As noted in a later comment as well, rate adequacy is a prospective, rather than a retrospective concept. A rate is reasonable and not excessive, inadequate, or unfairly discriminatory if it is an actuarially sound estimate of the expected value of all future costs associated with an individual risk transfer. (Statement of Principles Regarding Property and Casualty Insurance Ratemaking, Casualty Actuarial Society 1988). In the report, we explained why the simple loss ratio gives an inaccurate picture of the rate adequacy of the current program. The loss ratio fails to account for changes in rates, coverage levels, shifts to revenue insurance and a host of other factors. We also showed that in a short time series historical loss experience in low risk regions will appear actuarially unfair even when it is not. Or conversely, it will appear that rates are too low when this is not true in the long-run.

2. Additional analyses of the underlying assumptions and requirements of the loss cost methodology should be conducted. The loss cost methodology is the basis for determining yield risk of a very important program, yet the connections to empirical evidence about the same remains limited. Loss experience will always be important in setting rates; however, the experience that has accumulated from the application of the existing methodology should be reconciled with expected performance of the system.

Response: See our responses to the comments below.

3. Appropriately "re-weighting historical experience" is a common theme of several recommendations, and should be pursued. The *Review* recommends this approach for weighting observations for weather events. We suggest that the re-weighting applications be expanded to include at least: (1) weighting insurance experience by the percentage of production acres insured; and (2) reweighting scaled yield losses in historical loss ratios.

Response: We appreciate the support for our recommendation. It is our opinion that the proposed study might go a long way toward reconciling the disagreements Commenter A may have with our report. It is our conclusion that many of the disputes that arise regarding appropriate RMA rates stem from alternative views of a relatively short times series of experience in a dynamic and evolving risk environment. We suspect that refinements to the weighting of loss history will result in the loss cost approach being less affected by unusual

weather experience in a relatively short time-series. We appreciate the suggested weighting factors but would recommend that the weights should be determined based on statistical validity. We have not predetermined what those weights should be. They may look something like those proposed by the COMMENTOR A or they may not. We have refrained from prejudging that issue in the report, but did suggest some possible approaches which we believe have merit.

4. While we support RMA's efforts in moving to the Combo product, we are concerned that this may imply an increase in premiums for revenue products, especially for some crops that have historically low loss ratios. More empirical work is needed before the conversion along with the development of accurately calibrated set of initial base rates.

Response: The proposed rating of the Combo policy is based upon a coherent, comprehensive, and conceptually grounded approach to product design which builds a revenue distribution from well-established parametric methods. Further, this approach utilizes market-based measures of price volatility, which provide more accurate and timely measures of overall revenue risk. Concerns regarding increases in prices should be tempered by the recognition that premiums that recognize the relevant volatility of the market, such as those proposed for the Combo, will realize lower costs as the Combo is introduced by virtue of lower market volatilities (as compared to 2008 and 2009). It is our understanding that RMA will be discussing these issues independently of the present report. In any case, the Combo rating methods, which largely follow those already established for RA and RA-HPO, are technically correct whereas alternatives, such as the methods used to determine CRC rates, are not correct and are not based upon a coherent, statistically-sound methodology.

5. Commenter A believes that additional effort should be expended toward incorporating yield trends into the analysis and ratemaking methods. The current omission of trend effects could explain the relatively low performance for corn relative to other crops. Incorporating yield trends into the Actual Production History would be a useful improvement to the system independently or in concert with other recommendations in the Review.

Response: The trend issue is multifaceted. Often it is considered only in the context of defining the expected yield (i.e. is there a lag in the expected yield which results in under-insurance relative to the selected coverage level?). It is our conclusion that several issues are intertwined. First, has trend changed in a way that makes the historical lag in coverage different than with the current program? If not, then adjusting the APH for trend may require an adjustment in the rates which incorporated historical lags. Second, the relationship between yield trends and yield risk is an issue we investigated and believe still needs further investigation. As we discuss more fully in our comments to the addendum to your review, this is a truly difficult issue to quantify in a small sample. We cite work and do some analysis that suggests that there is a relationship between yield trend and variability. But credible analysis of changes in yield variance requires more data than are required to estimate a mean effect. We believe that the relationship between yield trend and appropriate rates can best be addressed while controlling for weather. And the use of data cut off at 1980 simply is misleading.

The overall conclusion of the “A Comprehensive Review of the RMA APH and COMBO Rating Methodology” is that the current method used by RMA to determine the base premiums rates does a reasonably good job at meeting their objective of resulting in actuarially fair premiums. This conclusion implies that the recent favorable loss experience that has led to large underwriting gains by crop insurance companies is accounted for by more favorable growing conditions in the recent period. Furthermore, the authors implicitly assume that the premium rate reductions in the biotech endorsements properly take into account any warranted reduction in premium rates due to less risky corn hybrids.

Response: We appreciate this comment as it has caused us to clarify and restate some of our conclusions. We will attempt to address the most salient from among his comments and make sure that our intent is not misconstrued. We do not draw any conclusion regarding recent underwriting gains. Several factors go into those calculations including the terms of the Standard Reinsurance Agreement (SRA) which are not addressed by this report. We suggested several changes to the RMA rating system some of which we believe will have significant impacts on underwriting gains/losses. What we do conclude is that looking at a short series of yields or loss experience can lead to erroneous conclusions and that a longer weather series would help avoid these erroneous conclusions.

However, this conclusion rests on the RMA assumption that proportionate crop risk is constant over the time period in which their rate making data is collected. Constant proportionate yield risk means that if a drought of a given severity caused a 30% yield loss in 1988, then the same drought in 2008 would lead to a 30% yield loss. If instead, yield loss in 2008 from a 1998-style drought is 20%, then crop insurance rates may be 50% too high. The authors of the study attempt to test the assumption of constant yield risk and find little evidence to contradict the RMA assumption. However, conceptual and modeling flaws invalidate their approach. An alternative approach that uses more appropriate county level data and more precise weather data finds strong evidence that proportionate yield risk for corn has declined since 1980. The amount of the decline suggests that county crop insurance rates for corn are too high. How much of this decrease is already reflected in the biotech endorsement is an area that needs more analysis.

It seems that Commenter A believes that the RMA rating procedure implies the assumption of a constant coefficient of variation in yields. We conclude that in its simplest form that may be an assumption of the loss cost approach, but RMA actually makes several adjustments to data that make this criticism nothing more than a case of knocking down a strawman. For example, the following list of rating adjustments alter the standard loss cost approach

- ***spreading of catastrophic risk within a state and crop***
- ***the adjustment of reference yields and exponents over time***
- ***the creation of the biotech endorsement***
- ***adjustments for prevented planting and replant payments***
- ***the capping and capping of rate changes***
- ***the use of expert judgment***

Additionally, we propose several additional changes that would modify the basic loss cost approach such as including additional variables and reweighting experience.

Further to this point and as we have argued above, presumptions of a constant yield CV or any other fixed relationship between the mean and variance of yields loses clarity when one recognizes the short nature of the data applied in such arguments and the very significant changes that have occurred in federal crop insurance and in the agricultural economy as a whole over these periods. Many other factors complicate formal testing of such relationships and we believe the relevant question is not as much about constant yield CV's or other such rigid assumptions but rather whether practical superior rating methods are available. We do not believe such has been revealed by the rate review or by the comments provided by outside reviewers.

Ultimately, the empirical analysis that we reported leads us to suggest that there is evidence to support the constant yield CV assumption in some major corn and soybean producing regions. However, the paper by Harri et al. finds statistical rejection of the assumption in some crops and counties. Thus, it is not our intent to argue that assumption holds everywhere. We would also add that the counter-analysis makes some interesting suggestions regarding allowing for a more flexible time-varying effect of weather. Our caution on that point is that in relatively short series there is a judgment call to be made regard how much flexibility to allow. We evaluated the suggestion in you review's addendum but find the critical difference between our work and that proposed is still the result of his using data that begins in 1980s. Our analysis which uses more than twice as many years of data has a much greater chance of getting the weather-year weights right. The weather data clearly show that weather in the 1980s was on average much worse than more recent decades. Examination of longer weather data show this quite clearly. The question that is difficult, but necessary, to assess is when will we see weather like the 1980s again and what will the crop insurance experience look like given new technology and production practices. Finally, we do not believe that our work or the work in your addendum provides the conclusive answer to the issue of how RMA should address the potential issue of evolving yield variability. Rather we believe more research is needed to provide RMA with mechanisms that will be implementable, but also sufficiently flexible to accommodate various crop/region differences. This is a weakness of the current rating system that we identify in the report and suggest research to address the issue.

The insights of the analysis provided in this review of the RMA report provide guidance to RMA regarding implementation of the recommendation by the authors that a longer time series of weather data be used to weight the historical loss-cost data. Not only should historical loss-cost data be weighted by a better estimate of the frequency distribution of growing season weather, but historical losses should also be adjusted downward to reflect the statistical evidence that supports the hypothesis that corn hybrids today are less susceptible to adverse weather.

Response: In general we take this conclusion as support for the suggested study of re-weighting experience based on weather probabilities. At this point we believe it would be premature to guess the outcome of such a study, but you may be right on this point.

Response to the comments submitted by Commenter B

We have carefully reviewed the comments from Commenter B and offer the following responses to their review.

....An important contribution of the report is that it provides one of the more compact explanations we have seen of the steps in the APH ratings process, in a single document, in a form that will continue to help others understand the workings of the program, independently of the remaining purposes the report may accomplish. As the program has evolved and grown through time, the ability to reproduce and recreate elements in the rating system has become more difficult to say the least. The report articulates and clarifies several of the steps in developing rates, and provides a useful framework for considering the implications of specific components of the ratings methodology.

Response: We are pleased that the program explanation and description were found useful.

To begin, we would characterize several related themes in the report as suggestions *to make adjustments to historic loss experiences* to reflect estimable impacts of differences between the conditions that generated the losses and conditions expected in application. The report examines weather, acreage, coverage standardization issues, differential coverage factors, etc., and to a lesser extent, possible yield risk evolution impacts; and finds some potential adjustments to be more defensible than others. We agree with this general thrust (and apologize if the authors think we have over simplified at this point), but argue to extend the implied advice significantly to include examination and inclusion of additional evidence which demonstrates differences between the data used in rate construction, and that expected in insured experience. Trends in yields and yield risk, for example, can matter considerably (a point not unrelated to the BE endorsement effect, but one we argue is much broader). Other weighting schemes for weather can be considered. The coverage normalization process can be debated and importantly could be tested against experience, and many of the conclusions may be impacted by observed differences in product shares through time as individuals react to their own situations, and to the annually changed price environments. So, while we understand and appreciate that the examination of existing methods naturally led to some suggested improvements, the greater insight provided is that the process can reflect adjustments to reflect empirical differences that occur over time to the underlying units of exposure. We wholeheartedly agree with the implications for continued adjustments to reflect recognized and demonstrable differences between exposure units and their predecessors that generated the loss rate experience on which rates are ultimately based.

Response: Commenter B correctly describes one of the thrusts of the report. We do support basing rates on adjusted loss experience and do not support a simulation-based approach. The point about yield trends and yield risk is a relevant one, but in our opinion one that has to be examined holistically. We argue that trends in yields and risk must be addressed while controlling for weather and must consider reference yields, exponents, and other factors such as the BE endorsement.

Next, we note that the report repeatedly emphasizes key phrases in the Federal Crop Insurance Act and related documents that are taken to require the examination of equity and geographic patterns of performance. We again agree, but did not view the empirical evidence about historic performance in the report to provide a particularly broad or complete presentation of those issues. The charge of the study may have differed, and simply may not have explicitly included those needs, but experience data are used as the foundation of the ratings methods - if there are enough data to set rates, then it seems practical to examine resulting loss experience more completely as well. The general tone in the report on issues related to reconciliation of loss rates through time seems to rely on data deficiency arguments - but to this point we again suggest that the ratings data used can be compared to the implications of the rates they produced. Observable components that remain that explain non-random performance in application deserve additional investigation as possible rating deficiencies, or at least require explanation for sustained divergences through time based on events believed to be idiosyncratic, or to changes in rates through time. As is well known, the largest program crop is corn, and its related loss experiences could fairly deserve additional attention in a report examining the performance of the rating system generating its experience. Again, the charge of the study may have been differently targeted, but the lack of empirical treatment does make it difficult to understand the generally benign conclusions of the report in light of the historic loss performance of the single biggest program crop which is also concentrated in a constant geographic area (and whose loss performance might be judged to be inequitably related to premiums by some).

Response: We are pleased to see the agreement with our review of the RMA approach maintaining fair rates across crops and regions. We hope that we have put the cross-subsidization argument to rest. What is imperative is for RMA to accurately rate policies for all crops and regions. The difficulty is that in low risk regions a small sample of actual experience can give the appearance of actuarial unsoundness when it is actuarially sound (or vice-versa). However, we believe the best chance to more accurately assess the actuarial soundness of corn is to implement the recommendations in our report. We consider those recommendations to be serious and potentially fundamental to resolving the concerns expressed about the program.

Our third main point is simply that the report's overall general endorsement of the Combo product ratings methodology proceeds with little evidence about the impact on actual premiums under sensible conditions that could be expected to be in place on a going-forward basis. It appears that the ratings are generally more similar to RA than CRC, but there are a couple of "scale" issues that remain unclear. A simple presentation of the implied premiums with a comparison to those generated under the existing RA-HP and CRC similar products would have greatly improved the understanding of the impacts of the potential ratings methods. The Combo policy uses certain parametric approaches that can be easily extended to realistic depictions of actual yield and price risks faced - and we think this approach has great merit, but that it should be tied to better evidence than that created through the existing loss rate data. Further, details about the local correlation (i.e., it is often far stronger at the local grain collection region level, not weaker than the state), and other effects with material implications need to be thoroughly tested and vetted before moving toward what appears to be the option that resulted in the higher average premiums in the areas of lowest loss experience.

Response: First we would describe the combo rating as differing in some respects from either RA or CRC. Further, it is not clear what ‘scale’ issues are of concern. As to correlations that are more localized than reported at the state level. We do make a recommendation in section 7.3 There we state, “We suggest that RMA evaluate estimate price-yield correlation at a level below the state level as there may be clear reason to allow correlation to vary across production regions in a state.”

Response to the Commenter C Comments

1. Basic Approach to APH Rating. Basic rating approach gets a thumb up, and should continue to be based on loss experience.

A shortcoming of the ratemaking study is that even though it contains a discussion of rate adequacy, it does not provide an evaluation of the rate adequacy of the program in its current state. Nor does it provide a basis for the evaluation of rate adequacy. There is no development of any actuarial measure of rate adequacy for APH or COMBO products, even at national level. Actual empirical analysis of actuarial adequacy seems to be outside the scope of the paper.

Response: Rate adequacy is a prospective, rather than a retrospective concept. A rate is reasonable and not excessive, inadequate, or unfairly discriminatory if it is an actuarially sound estimate of the expected value of all future costs associated with an individual risk transfer. (Statement of Principles Regarding Property and Casualty Insurance Ratemaking, Casualty Actuarial Society 1988)

Thus, a review such as this study – one that examines the data, methods and assumptions that are used to set rates on a prospective basis - is a better evaluation of the actuarial soundness of the rates than any retrospective study of actual outcomes can be. This is particularly true for an exposure with significant catastrophic potential, such as crop insurance. To take an extreme example, a retrospective review over any time period since 1825 would indicate that any rate over \$0 is excessive for earthquake coverage in Memphis; the potential for catastrophic losses is nevertheless present, and earthquake rates can and do reflect the potential for loss despite the lack of a history of insured events. Our paper correctly points out, however, that current RMA ratemaking procedures do not address whether the resulting rates collectively do reflect the expected value of all future costs because they do not account for the effects of capping, cupping and judgmental adjustments to the indicated rate levels.

The soundness of APH rating using the loss cost ratio method depends on certain assumptions on the mean and variability of yields over time. On page 57, near the bottom of page, it is stated that “Ultimately, the question of proportional heteroskedasticity and RMA assumptions is an empirical one.” This points out a need for a comprehensive econometric study of yields controlling for the weather information. The analysis provided on page 56 is not comprehensive enough to address this issue (see also Lobell and Asner, 2003; Zuba, Vergara, and Doggett, 2005; and McCarl, Villavicencio, and Wu, 2008). The time period covered in the analysis is from 1950 to 2008. This is a state level study including Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, North Dakota, Ohio, and Wisconsin for both corn and soybeans, and additionally the state of South Dakota for corn. The August Palmer Drought Index (PDI) is used as a control for the weather. Extreme negative and extreme positive values of PDI may adversely affect yields, so a squared term for PDI should have been included in equation 5.3 on page 56 (as a way to get a single peaked concave curve). Other concerns include: PDI in other months, and the temperature and rainfall data were not used. The study could be done for geographic regions within states, as PDI could be available for those regions. The estimates of the coefficients and their significance were not reported. Also, if the variable PDI is statistically significant in equation 5.3, then the model in equation 5.2 should not be used to test the heteroskedasticity.

Response: We appreciate the opportunity to clarify our point in the report. You have correctly identified one of our most relevant points. Trends in yield variability are an empirical issue and are important to actuarially fair rates. The analysis in the report was meant to be illustrative of a point and not exhaustive. However, it generally supports the more exhaustive work of Harri et al. We used a simple trend estimator, state level data, and crude measure for weather. Our point remains that the selected time period for analysis can drive the conclusions drawn. In general, we believe observations on weather in the Cornbelt since 1980 paint a myopic picture of crop yield risk. The available weather and yield data should be used to the fullest extent possible. Ultimately, it is our opinion that more geographically disaggregated work and refined methods should be used in a follow up. We believe your suggestions are relevant to that recommended work.

2. Reference Rate, Reference Yield, and Exponent. *Rework the reference yield to match up better with reference rate and exponent.*

There are issues adjusting county level target rates to individual rates as discussed on pages 35 to 38. A 2008 RMA internal memo recommends an alternative method (non-linear least squares) to fix the shortcomings of a commissioned 2007 study. The 2008 memo finds smaller exponent estimates and notes that this may be due to many zero loss cost ratios in the data (censoring). The individual risk heterogeneity will be better accounted as the rates are more accurately adjusted. That would in turn help mitigate the adverse selection issue, long recognized in the crop insurance industry (Somwaru, Makki, and Coble, 1998; Just, Calvin and Quiggin, 1999; Makki and Somwaru, 2001).

On pages 33 and 64, the yield ratio (APH yield divided by Reference yield) is used as an indicator of a producer's risk relative to their county. The yield ratio is equal to one when the unit has the same APH yield as the county. This is apparently interpreted as the unit having the same variability as the county. However, if an optional unit has more variability than a basic unit, then a basic unit similarly may not have the same variability as its county. While yield ratio may explain some fraction of variability, it is possible that inclusion of yield correlation between a unit and the county would explain even more variability (Goodwin, 1994). We suspect that yield ratio alone can not provide sufficient information regarding producer's risk and may cause biases in APH basic unit rates.

Response: We do not interpret a yield ratio of 1.0 as indicating that the unit has the same yield variability as the county (assuming that this means the same variability as the county-level yield). Rather, it means that, all else equal, all basic units in the county with a yield ratio of 1.0 are assumed to have the same yield variability. Similarly, all else equal, all optional units in a county with a yield ratio of 1.0 are assumed to have the same yield variability. Differences in variability among unit formats (for example basic versus optional units) are addressed in the discussion of Unit Division Factors in Section 4.6. Conceptually, inclusion of additional information like the correlation between unit and county yields might improve the rating process. However, current program data requirements provide a maximum of 10 unit-level yields and a large proportion of units have six or fewer actual yields available. Given the short time series of actual yields available for computing unit-to-county correlations we do not consider it likely that incorporating such correlations into the rates would result in significant rate improvements.

3. Type and Practice Factors: *Move practice and type into the CAT load in addition to where they are now.*

It is unclear whether the adjustment proposed by the ratemaking study is simply a correction to a rate formula to ensure that the premiums are consistent with the selected type/practice factors, or whether the contractor is proposing to have the fixed portion of the rate vary by type and practice. CAT load currently is computed from data excluding information such as crop practice and crop type. The current method is to take the worst 20% of loss and redistribute it within the state. It is not made clear where the 20% mark originated (arbitrary or computed). Maybe a number like 10% is more appropriate in some sense (this 10% number was raised during the teleconference). Many options are possible, including a liability-based credibility formula to drive the choice of CAT percentage, with an upper cap at 20%. If the catastrophic loss were accumulated by practice and type, it could be redistributed by practice and type, subject to credibility. If a practice/type is not credible, its rate might get raised because of removal of a credible low risk practice/type.

Response: *The proposal in the ratemaking study corrects the formula to be consistent with the method of calculation for the type/practice factors. The proposed change would result in varying fixed portions by type and practice because it would apply the type/practice factor to the CAT load. We agree with the comment that separate CAT load calculations by type/practice would likely result in insufficient data for credible calculations for some practices/types. We also note that the ratemaking study points out that RMA has previously commissioned a study looking at the calculation of CAT loads that suggested a higher threshold than the 80th percentile.*

4. Unit Factor: *Rework unit factor to match up better with historically observed unit sizes.*

We agree with the recommendation in general, but we also believe that unintended consequences are likely. In pages 71 and 72, the report demonstrates shortcomings of current unit discount factor application and recommends a modification. The modification mitigates the problem to a large extent, provided that the proportion of enterprise units in a county is also taken into account. However, the practical implications (the cost of record keeping and reporting) of variable discounts for enterprise units must be evaluated carefully. The same concern holds for the adoption of variable unit discount factor for basic vis-à-vis optional units, which is approved but not yet implemented by the FCIC (see the bottom two lines in p. 43).

Response: *The adjustment we are proposing would take into account variable rate differentials for enterprise units as well as basic units. We will defer to the RMA on balancing of costs and benefits of rate refinements. We also note that, should RMA switch from a pure premium method to a loss ratio method to calculate the indicated change in rates, many of the referenced record keeping issues would be mitigated.*

5. Coverage Level Adjustments: *Eliminate the coverage approximation procedure, and rate at the 50% level in any location where low level is the historically dominant choice.*

Currently rate relativities and rates are estimated separately. There are two issues related to the experience data adjustment. Downward data conversion from high to low coverage level (e.g., 65% to 50%) results in censoring of loss information from reported claims. This would reduce the number of claims as well as the indemnity on each claim, which reduces the credibility of the loss experience used in the rate analysis. Upward data conversion requires restatement of reported claims to reflect the change in deductible plus an estimate of additional indemnities for claims not reported at the lower coverage level that would have been reported at the higher coverage level. The study does not make clear how the estimate of indemnities for additional claims is developed. Even though this would be an estimate, the uncertainty of the estimate may be relatively low. In addition, if the magnitude of the estimated indemnities on claims no longer eliminated by the deductible is relatively small, use of the estimate may have a limited impact on the loss cost estimate.

In choosing between the two data conversion methods, RMA should keep in mind that the standard actuarial practice for combining experience at different deductible levels is to convert all of the claims to the lowest deductible level or even to full coverage as if no deductible applied. This assumes that the experience at different coverage levels is generated by exposures with similar risk characteristics. If the populations differ, combining the experience at different coverage levels may be problematic, regardless of the method being used. If the populations at different coverage levels are similar, and assuming that rate relativities are accurately estimated, it may not matter that the rate is computed at any “nearby” coverage level; the rating results should be virtually the same. The authors say that their recommendation would place even greater reliance on the coverage level relativities, but they believe the relativities can be estimated effectively (see p. 75). Whether or not this is the case, avoiding data conversion is better where there is plenty of the experience data available.

Response: Standard actuarial practice for combining experience at different deductible levels is to convert all claims to the highest commonly reported deductible level. We are not aware of any commonly used ratemaking procedures, other than RMA’s procedure, that converts data to a lower deductible level by estimating the missing claims. . [Casualty Actuarial Society: Basic Ratemaking (v3 January 2010), chapter 11] Any conversion from one deductible level to another presumes that insured behavior is not affected by the deductible selection. Ideally, if there is sufficient credibility at a single deductible, the base rate can be calculated using the data from a single deductible, followed by calculation of relativities for the other deductibles without any type of conversion. In the absence of credible data at a single deductible, conversion to the highest common deductible avoids the manufacture of data to fill in missing elements while providing a credible base. The data removed for the base rate calculation can still be taken into account in calculating deductible relativities.

6. Catastrophic Loading. *Back off CAT load in low risk areas by revising the usual state by crop granularity.*

RMA currently caps county indemnities at the 80% percentile of the empirical distribution. On its face, an event that occurs one year out of five would appear to be a normal event rather than a catastrophic occurrence. We agree that RMA should investigate whether the current capping method is reasonable or not. In concept, the losses eliminated by the procedure should be replaced with a loading that represents the expected losses for the excess layer. In practice, the

county losses eliminated by the procedure should be redistributed in an equal amount to a broader group of counties. One concern with the redistribution method is that if the true pure premiums vary widely across a state, a statewide loading may be a biased estimator for the excess layer, particularly in low risk areas. However, any decision regarding the redistribution method will also need to consider the sparseness of the available data in certain locations.

Response: This comment does not appear to reflect significant disagreement with our recommendations.

7. Use of Expert Judgment. *Override historical observations of yield with expert opinion, in cases of rapid change in local conditions. Also document this and make it reviewable by outside parties.*

Given the diversity of crops and regions along with the development of new programs, it is conceivable that some form of expert judgment would be used in the rate development process. Following the review team's recommendation, as long as the use of judgment is documented and reasonably transparent, then judgment rating will and should have a necessary role in limited situations in RMA's overall rating process. In these situations, RMA should attempt to involve the relevant stakeholders as best it can, recognizing that certain decisions will, on occasion, negatively impact certain program participants. At the same time, the actuarial development process must have some degree of autonomy in order to be effective.

Response: We agree that there may be instances where some level of interaction with stakeholders could prove beneficial. However, we strongly recommend that any consultation of this nature should be conducted in a way that does not undermine the autonomy and integrity of the rating process.

8. Additional Rating Variables. *Add soil data and more practices and types.*

We believe there is a need to analyze the economic costs and benefits associated with introduction of new rating variables. For example, it may be that soil type is a good thing to have, but it may also be prohibitively expensive to collect the information. In that case, an external stockpile of soil information can be used such as the National Resources Inventory (<http://www.nrcs.usda.gov/technical/NRI/>), which may further require some additional funding for conceptual integration. As a conclusion, no new data collection requirements should be imposed until some preliminary studies have been conducted to confirm that the rating variable provides a meaningful benefit in terms of accuracy.

There is a design issue regarding adding more rating variables versus other alternatives. The risk classification based on category or group is a practical way of measuring or predicting individual risk. It usually works well in a system with mutually exclusive categories. However, for multiple dependent rating variables (e.g., soil class, slope and salinity), it may make ratemaking more complex, costly, inconsistent and difficult to justify. This is because the yield effects from different climate, soil or other site specific factors may not be all additive or all multiplicative. A complex category-based agricultural model is often beset with low predictability and generality. A factor that limits yield in one location may not limit yield in another location. The complex

relationship and integration of various climate factors, crop variety and farming practice make crop insurance very different from property/casualty insurance. Furthermore, there are always some limitations on risk measurement using categories, due to the use of a low predictability model. A statistical prediction based on category may not fully represent the risk level for some individuals. Some individuals may require an additional adjustment for their own unique characteristics or their prior loss experience.

The use of performance based discounts or weighting rates by small zones can be alternatives to the use of additional rating variables. A small geographical zone could contain a single soil type, a single microclimate, a single crop practice, and so on. A performance based discount combined with rating weighted by zone could help avoid a large number of rating variables. Finally, the implications of additional rating variables should be considered in the simulation process for COMBO rating.

Response: We would not argue against performance based discounts but would observe that such discounts have been considered in the past and rejected in part due to industry concerns about data requirements. We also recognize the need to carefully assess costs and benefits of incorporating additional rating variables. However, this does not change our recommendation that investigation of such rating refinements could improve program performance.

9. Statewide Rate Level Adequacy. *Determine the circumstances in which caps are resulting in actuarially inadequate rates statewide or in which the catastrophe minimum load is resulting in excessive rates.*

Traditional ratemaking methods involve a balance between the two contending factors of rate adequacy and rate accuracy. Generally, insurers are willing to accept a certain degree of inaccuracy in the rates in order to obtain an overall rate level that achieves the insurer's overall profit objectives. The use of the legislated upper limit of 20% on rate increases creates the possibility of inadequate rates for individual counties and for the state as a whole. This can be addressed by applying an off-balance factor to ensure that the statewide rate level is adequate even if rates in certain counties are not. This issue deserves further investigation to evaluate the magnitude of any rate shortfall. However, we are concerned over the SRA implications of this and RMA should make available any information regarding the overall rate level adequacy and the actions being taken to reduce or eliminate it. RMA designated four state groups in the proposed SRA but did not provide any rationale or research basis in doing so. In line with these concerns, the ratemaking study (see p. 76) points out that "There is no mechanism in the rating process **to test** whether the actual premiums collected meet the mandate that premium shall be sufficient to cover the anticipated losses and a reasonable reserve." The contractor's report also addresses the issue of the minimum catastrophe load of 0.0065 (at the 65% coverage level). The report notes that this could result in a statewide premium that is in excess of the mandated level. In addition, the minimum catastrophe loading could lead to an overestimation of the rates in low risk areas as discussed in the response to item 6 above. While the use of a minimum could theoretically lead to an overstatement of the rates, RMA would again need to consider the issue of the sparseness of the available data and whether the rates would be reasonable and sufficient in the absence of a minimum loading.

Response: This comment addresses some SRA issues that are outside the scope of our review.

On issues that were covered in our review there does not appear to be significant disagreement with our recommendations.

10. Yield Correlation and Weighting Loss Experience Data. *Add weather data to the picture.* The report suggested “two straightforward weighting approaches” (see p. 79) without any empirical modeling. Weighting of experience data using weather data requires a substantial study before its implementation. The study would model yield or loss effect due to weather data and changes in weather data patterns. On an aggregated data level, the relationship between yield (or loss cost) and weather may not be as strong as the authors expect and it may not even be linear. Nevertheless, some minor weighting on experience may be needed. The authors appear to weigh all experience regardless of cause of loss and crop growing season, which seems excessive. Because the impact of a dominant peril on yield may vary by growing season, year and location, we believe that only part of the experience could be weighted by named perils. There is also the problem of identifying pattern changes due to extreme weather. For a relatively short weather series, it is hard to determine whether the occurrence of bad weather is a purely random event (requiring no weighting) or is part of a pattern (requiring weighting). This requires long historical data and extensive research to find a cause-response model for a group of named perils and weather pattern changes over time and space. It is likely that a very long term, huge and complex study will have to be executed to intelligently weight experience this way.

Response: The statement that “Weighting of experience data using weather data requires a substantial study before its implementation” is consistent with our recommendations. In the course of conducting such a study it might be useful to consider whether all or part of the experience should be weighted. However, we are skeptical as to whether the loss history data provide adequate and reliable information to support named-peril based weighting.

11. Study of Loss Ratio System *Use the loss ratio method as proposed by Milliman in their unviewable 2008 paper titled “Fixed Rate Load Review”.* It appears worthwhile that RMA explore the use of loss ratio methods in their overall actuarial development. Loss ratio methods are a more traditional approach that could be used to complement RMA’s existing procedures. Loss ratio methods may be useful in situations characterized by sparse data when formal statistical and credibility approaches break down. Currently, the crop-hail insurance industry employs loss ratio techniques to develop indications for minor crops. The loss ratio approach to ratemaking has certain advantages over the loss cost approach. One key benefit is that it allows the experience for different segments of the business to be combined into an aggregate result, such as a statewide loss ratio. This approach is commonly used to ensure statewide rate level adequacy (see item 9 above) by performing a top-down rate analysis. That is, once a statewide rate level change is determined, the next step would be to allocate the rate change to individual counties within the state. The disadvantage of the loss ratio method is that it makes it more difficult to evaluate the reliability of other rating characteristics such as type/practice factors. Implicitly, the loss ratio method assumes that the rate structure is essentially accurate and that only minor corrections are needed to respond to recent loss experience. When this is not the case, which can often occur for small segments of the business, the loss ratio approach generally fails to be effective in correcting the rating discrepancy.

Response: We agree on the identified benefits of the loss ratio method. However, we do not agree that use of the method makes development of rating factors such as type/practice factors more difficult. In our opinion the difficulty of constructing, estimating and validating such factors is essentially the same with the loss cost or loss ratio method.

12. COMBO Rating. *Basic rating approach gets a thumb up, but the theoretical foundations might need some repair to eliminate inconsistent rate relativities.*

With COMBO set on a rapid pace to dominate the market, it is surprising to see so little in terms of recommendations. The authors do propose an improvement in “conceptual soundness”, which would come from using a consistent set of yield rate relativities (rather than empirically estimated rate relativities). It appears on the surface to be a limited project just for COMBO, but it more likely spans all APH rating.

Conversion of APH indemnity to (and especially from) COMBO indemnity is still not clear. There does not appear to be a description of how the conversion is handled. Individual crop loss is variably censored (from indemnity status) by lack of a COMBO indemnity. The APH loss information for individual crops may be lost from APH rating methods in the future, even though this information is available for the duration of the policy. This may point to a gradual decrease in the quality of APH rating over time. Even so, this might be acceptable if COMBO took over completely.

In converting the experience from revenue plans into APH history rates on pages 18 to 19, the procedure misses those cases of production loss without revenue loss due to price increase, that is, those cases where the units that are not indemnified under revenue insurance plans despite production losses. In the COMBO methodology, a constant yield-price correlation is imposed at the state level for all producers (on p. 96, the end of second full paragraph). This appears to be a strong assumption and needs to be justified by econometric testing. It appears that accounting the price-yield correlation at least at the county level could help with the accuracy of ratings. The report makes similar recommendation on page 109. Another issue with estimating the price-yield correlations is the choice of data period from 1990 to 2005 based on the reason that significant policy changes occurred before 1990. Yet, there were significant changes since 2000 in crop prices based on market conditions which would also cause structural change in price-and yield correlations. Finally, there are alternative approaches to estimating the price-yield correlations (see Vedenov and Power, 2008) which could be investigated. One other aspect of COMBO rating that needs further review is the use of the Monte Carlo simulation method for evaluating the revenue add-on rate. Based on the sample data released by RMA as part of the COMBO evaluation process, the revenue add-on rate appears to be reasonable at first glance but the results are problematic when considered at a finer level of detail. Despite appearances, the revenue add-on rate is not a smooth and decreasing function of the COMBO lookup rate. For small changes in the lookup rate, the revenue add-on rate can either increase or decrease. RMA should investigate whether the revenue add-on rate can be smoothed using a simple function with a small number of parameters. We recognize that RMA chose to adopt the simulation method in order to eliminate the inaccuracies of the RA rating approach. However, the problems with RA arose from attempting to fit a smooth surface to the entire rating function. For COMBO, only the revenue add-on portion of the rate needs to be smoothed. The ideal solution would be for RMA to fit a sufficiently accurate functional form to all of the revenue add-on rate functions. If that is not

feasible, RMA should investigate whether the use of separate functions for different segments of the program would accomplish the goal of eliminating the simulation procedure.

Response: *The proposed rating of the Combo policy is based upon a coherent, comprehensive, and conceptually grounded approach to product design which builds a revenue distribution from well-established parametric methods. This approach utilizes market-based measures of price volatility, which provide more accurate and timely measures of overall revenue risk. Concerns regarding increases in prices should be tempered by the recognition that premiums that recognize the relevant volatility of the market, such as those proposed for the Combo, will realize much lower costs as the Combo is introduced by virtue of lower market volatilities (as compared to 2008 and 2009). It is our understanding that RMA will be discussing these issues independently of the present report. In any case, the Combo rating methods, which largely follow those already established for RA and RA-HPO, are technically correct whereas alternatives, such as the methods used to determine CRC rates, are not correct and are not based upon a coherent, statistically-sound methodology.*

The comments also note the possibility of state-dependence to exist within price and yield correlation relationships. This is certainly possible and is an issue that has received considerable attention in the literature (see, for example, Goodwin's August 2001 AJAE paper). However, quantifying such state-dependence and incorporating it into a rating engine that serves the entire program is a complicated assignment that would need to draw upon work that is still at the frontiers of actuarial science. Ongoing research involving copula models allowing for departures from constant, linear correlation is developing and we agree should be followed carefully with an eye toward implications for tangible improvements to current rating methods.

Finally, the review notes minor implementation issues pertaining to the use of simulations in the rating software. We agree that the use of simulations and the maintenance of the "nearly uniform" random draws in the rate look-up software may be suboptimal and that direct application of smooth estimation methods in the look-up software may offer advantages. This is an implementation issue rather than a criticism of the underlying rating methodology and we assume that RMA will continue to monitor such issues as the Combo plan is introduced.

Other Comments:

Quality Loss: The report briefly mentions quality loss on pages 35 and 53 but does not provide an assessment of the rate adjustments due to quality loss. The Agricultural Risk Protection Act had required a review of the quality loss adjustment procedures and to this end an independent actuarial review of quality adjustment was done in 2002 and the associated report is available in the RMA's website (Milliman USA, 2002). No reference is made to that study in this report.

Response: *We were aware of the earlier study but did not have any specific recommendations on quality loss.*

Minority Crops: In the report, we could not find a discussion of the actuarial soundness of the rates for small (minority) crops. It is not clear if they are factored off from big crops such as

corn.

Response: *The only situation in which historical loss data (and associated rates) for one crop are used in deriving rates for another crop is for new crops that have no substantial insurance history. Otherwise, the rates for a crop, whether major or minor, are derived from experience for that crop.*

Biotech Endorsement: The evidence behind discounts for certain biotech hybrids is unfounded. If there is a decrease in yield risk and/or increase in yield performance as a result of these traits, that should have been reflected in the loss cost ratio statistic and would be taken into account in the premiums. Adjusting the premium rates for certain biotech traits beyond the loss cost ratio statistic is an ad-hoc approach to ratemaking. This is one way of decreasing the rates in corn belt given that these states are the main adopters of biotech traits as reported on page 81 in the report. The report also does not address the issue of how RMA will adjust the ad hoc discount as the loss cost data are collected over time.

It is our understanding that the biotech endorsement was based upon a very extensive analysis of commercial field trials data. It was subjected to extensive reviews within RMA, by the FCIC Board, and by a large number of expert reviewers. To say that evidence is “unfounded” is incorrect and ignores the review process that these endorsements were subjected to. The argument that the loss-cost experience should reflect the effects of changing technology is valid on the surface. However, a simple consideration of the underlying rating process as it is outlined in the review points out that loss-cost data dating from 1975 is used in establishing APH rates. The relevant biotech hybrids addressed by this endorsement were introduced in the last few years (largely since 2005). They have been rapidly adopted but still are only modestly represented in APH yield histories and can only have had a very modest effect on the long-run loss-costs. That said, we agree that RMA faces challenging decisions about how to treat the BE program as such biotech varieties become even more widely adopted.

Miscellaneous: The censored normal and truncated normal are used interchangeably even though these are different concepts (censored normal p. 113 versus truncated normal on p. 106).

Response: *Although the review comments are correct in stating that these terms are closely related but different concepts, the Combo rating methodology involves the simultaneous treatment of both censored and truncated normal distributions in order to reconcile the calibrated distribution to the reference rate and APH yield.*

Missing References: Some references were not transparent, or could not be found in the references. We searched for those with titles provided in the text but could not find online.

- Page 37, first full paragraph, “RMA commissioned a study completed in 2006, ...”
- Page 37, fourth full paragraph, “Based on an internal 2008 memo referring to a commissioned study about the exponents...”
- Page 38, top line, “2007 RMA-contracted study.”

- Page 95, footnote 17, “...RMA Revenue Rating An Analysis of the COMBO Rating Method”. The description of COMBO rating in Chapter 7 refers to one document not available electronically, but available on a limited basis in paper form “RMA Revenue Rating: An Analysis of the COMBO Rating Method”.
- Page 99, end of the first half paragraph: “...this is the Ag Risk, LLC document mentioned in section 8.1.1 above” This study covered RA, which preceded COMBO. (Yield distribution assumptions were adopted from RA for use in COMBO.
- Page 106, top line, “The document entitled “Development of a New Rating Method for MPCl ”...”
- Some descriptions come from internal RMA working documents, most importantly the “Rate Methodology Handbook: APH”. The Handbook is not available for public viewing. The authors state in Chapter 3 that their descriptions cover 75% of the Handbook, while suppressing technical and operational details that would be unnecessary for an overview of APH rating.
- Another elusive document is the “Fixed Rate Load Review” by Milliman, 2008.

Response: We believe we have correctly cited all publically available publications. Also it is made transparent that we also draw from internal RMA documents that are not publically available.

Response to Commenter D

...First of all I would like to state that we remain in support of the launching and integration of the Combo product. We do however have concerns in regards to the rating methodology to be used. For the sake of Illinois farmers we would like to request that the rating methodology used be similar to the methodology used in CRC as much as possible, and not the RA rating methodology. It is fairly obvious that if RA rating methodology is used it will increase premiums paid by Illinois producers significantly. A simple look at expected premiums for 2010 easily illustrates this concern. At the 75% coverage level corn Illinois producers could expect to pay \$25.24/acre on average for RA coverage while average CRC premiums would be \$20.14. At the 85% coverage level the difference is even more pronounced; \$60.45/acre for RA coverage as compared to \$47.04 for CRC. We understand that this example is only for corn and that the RMA must look at all crops in all states. We see similar expected results for the main cornbelt states including Iowa, Indiana, Missouri, Minnesota, and Nebraska.

If the RA methodology is used, it could have a severe detrimental impact on Illinois producers ability to adequately insure their production. A look at the 2009 Summary of Business indicates how much more popular CRC was over RA. In Illinois 68% of corn acres insured used CRC as compared to only 7% for RA. Large discrepancies also show up for the states listed in the preceding paragraph as well as the entire U.S. where 60% of the corn acres insured used CRC as compared to only 18% for RA. From a producer's viewpoint these two policies are very similar and the only remaining determining factor in deciding between the two each year is the premium cost.

Given the fact that Illinois routinely exhibits a very low loss ratio, the biggest complaint we hear from Illinois farmers regarding crop insurance is that they pay too much premium given the low likelihood of collecting enough claims over time to regain their premium, especially when compared to other states with significantly higher loss ratios. For these reasons we sincerely request that these factors be kept in mind when determining the rating methodology to be used for the new Combo product.

Response: It is our opinion that the new COMBO rating procedure differs from either RA or CRC. Our review assessed whether we believe the COMBO procedures result in accurate and actuarially sound rates. We understand your concern for your membership but do not find a justification for why the proposed COMBO rates are inaccurate.