Journal of Agricultural and Resource Economics 33(2):137–153

Get a GRIP: Should Area Revenue Coverage Be Offered Through the Farm Bill or as a Crop Insurance Program?

Nicholas D. Paulson and Bruce A. Babcock

The successful expansion of the U.S. crop insurance program has not eliminated ad hoc disaster assistance. An alternative currently being explored by Congress in preparation of the 2008 farm bill is a standing disaster relief program. One form such a program could take can be found in the area insurance programs currently offered by the U.S. crop insurance program. Total per acre taxpayer costs of offering Group Risk Income Protection (GRIP) in Indiana, Illinois, and Iowa for corn and soybeans are estimated to have the ability to fund a county target revenue program at the 93% coverage level.

Key words: area insurance, commodity programs, crop insurance, farm bill, Group Risk Income Protection

Introduction

A common justification given for the continued funding of U.S. crop insurance program subsidies is that it will eliminate the need for ad hoc disaster programs. For example, part of President Clinton's statement upon signing the Agricultural Risk Protection Act (ARPA) of 2000 was as follows: "I have heard many farmers say that the crop insurance program was simply not a good value for them, providing too little coverage for too much money. My FY 2001 budget proposal and this bill directly address that problem by making higher insurance coverage more affordable, which should also mitigate the need for ad hoc crop loss disaster assistance such as we have seen for the last three years." In 2006, testimony before the House Subcommittee on Agriculture, Rural Development, Food and Drug Administration, and Related Agencies, former USDA under-secretary J. B. Penn said, "One of the overarching goals of the crop insurance program has been the reduction or elimination of ad hoc disaster assistance."

By almost any measure, the drive to induce farmers to increase their purchase of crop insurance through increased premium subsidies and support for the crop insurance industry has been a resounding success. Over 80% of insurable crop acreage was enrolled in the program in 2005, and more than half of those acres were insured at coverage levels of 70% or higher. Total liability for the 2006 crop year was approximately $50 billion. Despite this success, a multi-billion dollar disaster assistance package is included in the 2008 farm bill currently pending in Congress.

Nicholas D. Paulson is assistant professor, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign; Bruce A. Babcock is professor, Department of Economics, and Director of the Center for Agricultural and Rural Development (CARD) at Iowa State University. The authors would like to thank the editor and two anonymous reviewers for their helpful comments and suggestions.
Review coordinated by David K. Lambert.

Given that Congress has largely succeeded in its effort to expand the crop insurance program, one can only conclude that crop insurance does not substitute for disaster assistance programs. Policy makers are then left with a choice of either continuing to live with the overlapping coverage offered by crop insurance and disaster programs or designing a new approach to the problem of providing farmers with an efficient financial safety net.

One problem with continuing the current crop insurance program is that it represents a relatively inefficient way of providing coverage to farmers. Glauber (2007) calculates that the average marginal cost of inducing farmers to purchase insurance coverage is approximately $26 per covered acre.[1] This high marginal cost is reflected in the average cost of supporting farmers' incomes through the crop insurance program. Over the first five crop years under ARPA (2001 to 2005), the net transfer to producers (indemnities paid less producer premiums) totaled $8.8 billion. However, the cost to taxpayers of delivering these funds totaled $15.5 billion (Babcock and Hart, 2006).

It is well recognized that crop insurance plans based on area yields rather than individual farm yields offer many advantages, including lower delivery costs relative to individual based plans. Halcrow (1949) first promoted area yield insurance as a way around the problems inherent in basing guarantees and premium rates on individual farm yields, noting that yield variability is largely driven by systemic factors in many areas. Miranda (1991) notes that area yield insurance offers a solution to the adverse selection and moral hazard problems that plague crop insurance products which are based on individual yields. Miranda models farm yields as a decomposition of systemic and poolable components and demonstrates that an area yield product can offer better protection against yield losses than does individual yield insurance. Barnett et al. (2005) also show that the Group Risk Plan (GRP), introduced in 1993 as the first area yield plan of insurance in the United States, outperforms individual yield insurance for some crops and regions. Skees, Black, and Barnett (1997) document the development of the GRP program.

An often overlooked advantage of an area insurance product is that it could automatically provide disaster aid to farmers faced with unexpectedly low prices or who reside in areas with low yields. Miranda and Glauber (1991) proposed an area revenue program that would indemnify producers whenever area revenue fell below a target revenue program. The program would protect producers against systemic price or yield drops.

In this paper we examine how provision of an area revenue program could be implemented as the basis for a safety net for agriculture. We use the Group Risk Income Protection (GRIP) program as the area revenue plan that would be provided to farmers for disaster assistance. We compare expected program costs under two different delivery mechanisms for GRIP. The first is delivery as a crop insurance product in the current crop insurance program. The second is as a program in the commodity title of the farm bill that would replace marketing loan and countercyclical programs. Specifically, we estimate and compare the expected costs of (*a*) the current GRIP insurance program, and (*b*) payments that would flow from an area revenue disaster program based on the GRIP program. An additional contribution is the documentation of the procedures used in the development of the GRIP insurance program.

---

[1] Glauber's measure of marginal cost to increase insurance participation includes the full subsidy cost of newly enrolled acres as well as the incremental subsidy cost incurred on all previously enrolled acreage due to the increased subsidy rate.

Background

Two area crop insurance products, GRP and GRIP, are currently eligible for federal reinsurance, premium subsidy, and administrative and operating (A&O) expense reimbursement as part of the U.S. crop insurance program. GRP is an area plan of insurance that pays all insured farmers in a county an indemnity when the county average yield falls below a trigger yield. The trigger yield is chosen by the insured as a percentage (up to 90%) of the expected (trend) county yield. GRIP is an area revenue plan that pays an indemnity when county average revenue falls below a trigger revenue level. The trigger revenue is chosen by the insured as a percentage of expected county revenue, which is the product of the GRP trend yield and the expected price as measured by futures markets. GRIP was developed by IGF Insurance Company and first sold in 1999. In 2004, NAU Companies developed and introduced an optional endorsement to GRIP called the Harvest Revenue Option (HRO).[2] The HRO endorsement turns GRIP into a GRP policy when the harvest price is greater than the expected price. Any production losses under the resulting GRP policy are valued at the harvest price.

Availability of the HRO endorsement has corresponded to a dramatic increase in acreage insured under GRIP. Insured acreage more than doubled in 2004, doubled again in 2005, and doubled yet again in 2006, when a total of 11.7 million acres were insured.[3] For the first time, an area plan of insurance now ranks among the most widely used crop insurance products.[4] In Illinois, 37% of the insured corn acres were insured under GRIP in 2006, compared to 28% insured under Crop Revenue Coverage (CRC) and 22% insured under Revenue Assurance (RA). In 2003, the GRIP market share was less than 2% for Illinois corn.

The incentives to buy and sell GRIP are high. The average 2006 premium of a GRIP-insured corn acre in Illinois was $46.36 compared to approximately $26 per acre for RA and CRC, the next two highest-premium products. The average premium subsidy rate for GRIP in 2006 was 55%, which means that corn farmers paid less than $21 per acre of the $46/acre insurance premium. If GRIP is actuarially fair, farmers receive an expected net (of premium) gain of $25 compared to an expected net gain of about $13 under RA and CRC. Prior to 2004, the incentives to buy and sell GRIP without the HRO endorsement were much lower. The average premium in Illinois on corn acreage insured under GRIP in 2003 was $23.37, which was nearly identical to the premium collected for RA and CRC in 2003. The group insurance plans (GRP and GRIP) have also been noted to provide an attractive alternative to individual insurance plans which are potentially overpriced due to multi-year losses (Barnaby, 2006).

As demonstrated by the dramatic increase in GRIP usage, many farmers recognize that an area plan of insurance offers sufficient risk management benefits. Overall, continued adoption of GRIP should improve the actuarial performance of the crop insurance program in aggregate as adverse selection and moral hazard are reduced. But the dramatic growth in acres insured under GRIP raises important policy questions.

---

[2] As a note of disclosure, Bruce Babcock was hired as a consultant to develop and rate GRIP and GRIP-HRO.

[3] Only 18% of the increased GRIP acreage is accounted for by the 2004 expansion in the number of states eligible to offer GRIP and the 2005 expansion to coverage of grain sorghum, cotton, and wheat. Illinois, Indiana, Iowa, Michigan, and Ohio had GRIP in 2003, and account for 82% of the acreage increase.

[4] Acreage insured under GRP in 2006 totaled 34.1 million, but only 2.6 million acres of crops were insured. The remainder of the insured acreage was in forage and rangeland.

Because GRIP indemnities can be triggered by low prices, GRIP can duplicate coverage provided by marketing loans and countercyclical payments available to producers of program crops in U.S. commodity programs. Producers pay an average of only 45% of the insurance premium for GRIP, and they are given free farm bill put options under the marketing loan and countercyclical programs. This suggests reconciliation of the two programs would increase efficiency as measured by the program cost per dollar of producer risk management benefit.

This raises the more fundamental policy question of whether GRIP should be part of the crop insurance program or part of the farm bill. As noted by Miranda and Glauber (1991), an area revenue program provides cost-effective support for farmers faced with recurring low prices or low yields. Farmers who purchased GRIP before 2004 were purchasing a Miranda-Glauber area revenue program, suggesting that pre-2004 GRIP could provide an effective Miranda-Glauber farm bill safety net program.

Farm bill commodity programs and crop insurance commodity programs share the objective of giving financial support to farmers. However, Congress has mandated different mechanisms for accomplishing this objective. Farm bill commodity programs are administered through the Farm Service Agency, and they are made available to farmers at minimal administrative cost. Crop insurance commodity programs are administered through a public-private partnership between the Risk Management Agency, crop insurance companies, and crop insurance agents. Farmers are required to pay a portion of program costs.

Interest is growing in adopting a Miranda-Glauber style of area revenue plan as the basis for farm bill commodity programs. For example, Babcock and Hart (2005) showed how an area revenue plan can be designed to help the United States achieve proposed limits on commodity support as part of the Doha Round negotiations in the World Trade Organization. American Farmland Trust (2006) has proposed moving to an area revenue program as part of an overhaul of U.S. farm bill programs. The USDA (2007) proposal for what has now become the 2008 farm bill suggests changing the current price-based countercyclical program to one where payments are based on a revenue target. Additionally, the National Corn Growers Association made an area revenue plan the basis of its proposal for the 2008 farm bill. And finally, the Senate-passed farm bill includes an optional state-triggered revenue plan as an alternative to current farm programs.

A number of other issues should be considered in determining whether an area revenue plan such as GRIP should be offered as a completely public farm bill program or continue to be offered as a quasi-public crop insurance program. At a minimum, policy makers will need a comparison of the cost and effectiveness of meeting program objectives under the two alternatives. Expected program costs for GRIP in the crop insurance program include easily calculated A&O reimbursements and premium subsidies and the more difficult to calculate expected underwriting gains and expected indemnities, which require stochastic models for analysis.

The effectiveness of an area-based safety net in meeting the objectives of risk reduction to producers will almost certainly differ across crops and regions. While Miranda (1991) and Barnett et al. (2005) found that area plans can provide better protection than farm-level insurance programs based on yield, these results applied only to certain crops and regions (namely corn and soybeans in the Midwest). Geographic areas with greater variation in yield levels across farms, such as wheat production in Kansas or corn and cotton production in Texas, would be expected to realize smaller benefits from coverage based on area yields or revenues. A proper analysis of the level of risk reduction offered by an area-based plan over different geographic areas could easily expand into a study of its own. Given its importance, we leave a formal analysis of this issue as an area for future research.

Finally, offering GRIP as a fully public program may introduce the threat of crowd-out of voluntary coverage under both the quasi-public and private insurance offerings currently available to farmers. The threat of crowd-out in the market for private insurance created by public insurance offerings has been formally investigated by many authors. Brown and Finkelstein (2004) conclude that the main cause of crowd-out is the implicit tax on private coverage created by the structure of the Medicaid program. Cutler and Gruber (1996) model the crowd-out problem as one driven by budget constraints where individuals are forced to choose between the free program of lower quality and their optimal level of private insurance coverage of a higher quality at market costs.

As programs currently stand, we have crowding out of partially subsidized crop insurance products with a fully subsidized public program offering countercyclical payments (CCPs) and loan deficiency payments (LDPs). Because LDPs and CCPs cover only price risk, and crop insurance covers yield and price risk, the two do not provide identical coverage; hence, a portion of farmers choose to buy subsidized crop insurance. A publicly offered area revenue product would change the degree of overlap between crop insurance and farm bill programs, so it is likely (as is currently the case) that a portion of farmers would choose to not buy the partially subsidized product while optimal coverage levels for those farmers who do buy insurance would also likely change. However, it is unclear whether this should be referred to as crowd-out since participation in the crop insurance program would most likely see a significant decline if the crop insurance were not subsidized. The more likely source of crowding out is that of private risk management tools which would be more intensively used if crop insurance were not subsidized—such as hail insurance, weather derivatives, and price put options. As with the case of the program effectiveness, the issue of crowd-out and the interaction between subsidized and private crop insurance programs is left for future work.

In this paper, we focus on comparing program costs under the two program alternatives by estimating the costs for the current GRIP insurance program for corn and soybeans in the three states where GRIP was first introduced: Illinois, Indiana, and Iowa. In estimating these costs, we also make a contribution by documenting the rating procedures that were used to originally rate the GRIP insurance program. These procedures are directly conducive to estimating expected underwriting gains under the current Standard Reinsurance Agreement (SRA).

Expected program costs of GRIP as a farm bill program are assumed to equal expected payments plus administration costs. We also assume the resources currently used to administer the countercyclical and marketing loan programs could likewise administer the example area revenue-based farm bill program. Because much of the information needed to determine GRIP payments (national prices, county-level yields, and farm-level acreage reports) is currently collected to administer the existing programs, this assumption is not believed to be overly restrictive. On average, we find the per acre taxpayer cost of supporting GRIP in its current form as a crop insurance product is equivalent to the expected payments which would be generated by a Miranda-Glauber area revenue farm bill program that guarantees county revenue at a coverage level of 93%.

Data and Methodology

The data used in the analysis include GRP corn and soybean trend yield data for Iowa, Illinois, and Indiana counties from 1957–2004 provided by the Risk Management Agency (RMA).[5] National Agricultural Statistics Service (NASS) yield data for corn and soybeans over the same time period were also collected for each county in these three states as well as at the national level. Actual premium rates used in the third scenario were the 2005 GRIP-HRO premium rates for corn and soybean coverage for each county in the included states, provided to RMA by NAU Companies.[6]

The GRIP insurance program uses the average settlement price in February for the December (November) futures contract to determine the price component of the revenue guarantee for corn (soybeans). The price levels used as the price component of the revenue index used to indemnify GRIP policies is the average settlement price in November (October) for the same harvest futures contract for corn (soybeans). Chicago Board of Trade (CBOT) corn and soybean settlement price data from 1975–2004 were also used in the analysis. This historical data series was used to define the correlation structure between prices and yields as outlined in the following section. Futures settlement quotes for the harvest contracts for corn and soybeans in December 2006 were taken as the expected price levels used in our analysis, while the assumed price volatility levels were taken as the implied volatilities from at-the-money option premiums for the harvest contracts in December 2006.

Imposing Correlation

Using the yield and price deviates[7] for U.S. corn and soybean yields and CBOT corn and soybean price data, the historical correlation structure of the deviates was examined over three different time periods. The correlation structures calculated from 1975–2005 and 1980–2005 showed a lower level of (negative) own-price correlation than did the same measure from 1990–2005. The Pearson correlation coefficient between the percentage deviation in U.S. corn yield from trend and the percentage change in the December futures price from spring to fall is −0.66 for the period 1975–2005, −0.76 for the period 1980–2005, and −0.81 for the period 1990–2005. The stronger relationship between yield and price levels can be explained by changes in farm policy starting with the 1995 farm bill, which increased price responsiveness by reducing the role of government in stockholding activities (Lence and Hayes, 2002). The more recent correlation structure from 1990–2005 was chosen for use in the analysis assuming it would more accurately reflect both current and future price-yield relationships.

The U.S. corn and soybean yield deviates from trend from 1957–2004 were vertically concatenated 500 times, yielding 24,000 empirical yield deviates (Goodwin and Ker,

---

[5] GRP trend yields are calculated by the RMA. The trend yield is the level used for the yield guarantee portion for area yield and revenue coverage policies (i.e., GRP, GRIP, and GRIP-HRO).

[6] This paper focuses on GRIP-HRO as a crop insurance program instead of GRIP because the HRO option is selected by most farmers. In addition, we assume farmers choose the maximum liability and coverage level because this reflects current program preferences. For example, in McLean County, Illinois, 96% of corn farmers who purchased GRIP did so at the 90% coverage level, and of these, approximately 90% purchased the HRO option. The average percentage of maximum liability selected was 90% (135% liability factor). These estimates were calculated using RMA's Summary of Business data.

[7] The yield deviates were calculated as the percentage deviation from trend. The price deviates were calculated as the percentage change in price from the spring to the fall for the December futures contract.

1998; Ker and Coble, 2003; Vedenov et al., 2004). The empirical distribution naturally maintains the actual historical correlation structure between U.S. corn and soybean yields for a large number of yield realizations without relying on a potentially misspecified parametric form for the marginal yield distributions (i.e., the Beta or Weibull distributions).

Using a re-sorting method outlined by Iman and Conover (1982),[8] the empirical yield draws were correlated with two random standard uniform draws to match the historical rank correlation matrix from 1990–2004. The corn and soybean yield deviate draws were not re-sorted in the process to preserve the year-to-year realizations for the corn and soybean yield deviates. The standard uniform draws were then transformed to harvest price draws assuming lognormality, a mean corn price of \$3.75, a mean soybean price of \$7.00, a corn price volatility of 27%, and a soybean price volatility of 20%.[9] Thus, while the county yield distributions used in our analysis are simply the stacked 48-year yield histories, the price distributions were randomly generated. Each of the 48 unique yield observations are paired with 500 unique price draws resulting in county-level revenue distributions which are based on the random price draws and the empirical yield distributions.

Tables 1 and 2 report the historical rank correlation matrix for U.S. corn and soybean yields and prices, and the rank correlation matrix for the corn and soybean yield deviates and price draws, respectively. The re-sorting method (Iman and Conover, 1982) does an excellent job of replicating the historical correlation structure. The correlation matrix of the yield and price draws and the target historical correlation matrix differ by a maximum of 0.02.[10]

Empirical Yield Distributions

The NASS county-level yield data for corn and soybeans were detrended to 2004 equivalents (y_t^{det}) following Vedenov et al. (2004). This was done by dividing each county yield observation (y_t) by the corresponding GRP trend yield (y_t^{tr}) for the same year and county. The yield ratio was then multiplied by the 2004 trend yield level (y_{2004}^{tr}) for that county:

$$(1) \qquad y_t^{det} = \frac{y_t}{y_t^{tr}} y_{2004}^{tr}, \quad \text{for } t = 1957, \ldots, 2004.$$

The detrended county-level yield data were then vertically concatenated 500 times, giving 24,000 yield realizations from the 48-year empirical yield distribution for each county in Iowa, Illinois, and Indiana. Each row (year) of the detrended corn and soybean

[8] The Iman and Conover approach imposes correlation on independent draws based on the Cholesky decomposition of the target correlation matrix. The procedure is easy to implement, can be used with any distribution function and sampling scheme, and maintains the properties of the individual marginal distributions. Furthermore, the method is based on rank correlation rather than simple correlation which can be misleading when the underlying data are nonnormal or contain outliers (Iman and Conover, 1982).

[9] The corn and soybean price levels and volatilities were based on the settlement of the December 2007 corn and November 2007 soybean futures and options contracts on December 21, 2006.

[10] An exception is the correlation between corn and soybean yields. To ensure the yield deviates were not re-sorted (i.e., to preserve the true empirical distribution) in the process, the target correlation between corn and soybean yields was set to the actual rank correlation of the 24,000 yield deviates (0.50). This differed from the rank correlation between corn and soybean yields from 1990–2004 (0.65).

Table 1. Rank Correlation Matrix for U.S. Corn and Soybean Yields and Prices, 1990–2004

	Corn Yield	Soybean Yield	Corn Price	Soybean Price
Corn Yield	1			
Soybean Yield	0.65	1		
Corn Price	-0.87	-0.72	1	
Soybean Price	-0.74	-0.69	0.81	1

Table 2. Rank Correlation Matrix for U.S. Corn and Soybean Yield Deviates and Price Draws, 1990–2004

	Corn Yield	Soybean Yield	Corn Price	Soybean Price
Corn Yield	1			
Soybean Yield	0.50	1		
Corn Price	-0.86	-0.70	1	
Soybean Price	-0.72	-0.67	0.79	1

realizations corresponds to the analogous row of the empirical distribution for U.S. corn and soybean yield deviates used to generate the correlated price draws. Thus, the rank correlation between corn and soybean yield deviates and prices at the national level is preserved, while the relationships between county yields and prices are carried through by means of the relationship between county and national yield levels. Retention of the cross-county and cross-crop yield correlations is crucial for conducting valid reinsurance analysis.

GRIP-HRO Policy Distributions

County-level distributions of GRIP-HRO indemnities were then calculated using the empirical county yield distributions and correlated price draws. GRIP-HRO indemnities in any year t are based on a trigger revenue ($TrigRev_t^{HRO}$) which is equal to the product of the producer-elected coverage level (C), the GRP trend yield for the county, and the maximum of the expected harvest price level taken from CBOT futures ($E[P_t]$) and the actual price realization at harvest (P_t). The standard GRIP policy uses a similar trigger revenue structure ($TrigRev_t^{GRIP}$), except the price component is equal to the expected harvest price level:

$$(2a)\qquad TrigRev_t^{HRO} = C * y_t^{tr} * \max\left[E[P_t], P_t\right],$$

$$(2b)\qquad TrigRev_t^{GRIP} = C * y_t^{tr} * E[P_t].$$

An indemnity ($Indem_t$) is paid if actual revenue at harvest ($ActRev_t$), defined by the product of actual yield (y_t) and actual harvest price, falls below the trigger revenue. Indemnities ($Indem_t$) are calculated based on a percentage loss ($\%loss_t$) multiplied by the liability level ($Liab_t$). The liability level is the product of the county trend yield, the expected harvest price, and a producer-elected liability factor (L).[11] The percentage loss is equal to the maximum of zero and the difference between the trigger and actual revenue levels divided by the trigger:

$$ActRev_t = y_t * P_t, \tag{3}$$

$$Liab_t = L * y_t^{tr} * E[P_t], \tag{4}$$

$$\%loss_t = \max\left[\frac{TrigRev_t - ActRev_t}{TrigRev_t}, 0\right], \tag{5}$$

$$Indem_t = \%loss_t * Liab_t. \tag{6}$$

County premium levels ($Prem_t$) were calculated by the GRIP-HRO rates ($HROrate_t^{90\%}$) at a 90% coverage level by the liability levels for the corresponding counties for both corn and soybean coverage. Distributions of gross underwriting gains ($GrossGain_t$) at the county level were calculated as the difference between the indemnity realizations and premium levels for each county. Loss ratio distributions (LR_t) were also calculated as the ratio of indemnities to premium:

$$Prem_t = HROrate_t^{90\%} * Liab_t, \tag{7}$$

$$GrossGain_t = Prem_t - Indem_t, \tag{8}$$

$$LR_t = \frac{Indem_t}{Prem_t}. \tag{9}$$

The county-level distributions for gross underwriting gains, indemnities, and loss ratios were then aggregated across counties and crops for each state to define a single distribution for each variable at the state level, which is the level used to calculate underwriting gains and losses under the SRA. Corn and soybean premium levels were also aggregated to define a state-level premium for each of the three states in the analysis. The aggregation was done with a weighted average using 2005 NASS data on planted acres for corn and soybeans.

The state-level premiums and each realization from the indemnity and loss ratio distributions were then run through the SRA to determine their effect on the underwriting gains of private crop insurance providers. The GRIP-HRO policies for each state were allocated to the Commercial Fund within the SRA. Net underwriting gains ($NetGain_t$) and net loss ratios ($NetLR_t$) are defined as the underwriting gains and loss ratios resulting from reinsuring the GRIP-HRO policies under the SRA through the Commercial Fund.[12] Reinsuring under the SRA effectively transfers the premium and a share of total liability from the insurance company to the Federal Crop Insurance

---

[11] Producers are able to choose a liability factor up to 1.5 when purchasing GRIP policies (150% liability factor). This is because the average county revenue, by definition, is less volatile than revenue at the farm level. Liability factors exceeding one allow producers to scale their coverage to better match losses at the farm level.

[12] Refer to the 2005 Standard Reinsurance Agreement (FCIC, 2005) for an explanation of how underwriting gains are calculated. The quota share requirement whereby 5% of total underwriting gains and losses are ceded back to the USDA were not accounted for in this analysis because national aggregate gains and losses from a company's entire book of business would need to be calculated.

Corporation (FCIC). The net loss ratio is defined as the ratio of gross premium less net underwriting gains to the gross premium:

$$(10) \qquad NetLR_t = \frac{Prem_t - NetGain_t}{Prem_t}.$$

The expected net subsidy ($NetSub_t$) paid by the FCIC (taxpayer cost) was then calculated as the sum of premium subsidy (*PremSub*), administrative and operating costs (*A&O*),[13] and the expected net underwriting gains transferred to the crop insurance companies:

$$(11) \qquad NetSub_t = (PremSub + A\&O) * Prem_t + NetGain_t.$$

Next, the yield and price distributions were used with equations (2b) and (3)–(6) to calculate the coverage level for a GRIP policy that, when offered to farmers for free as part of a farm bill program, would result in expected taxpayer costs equivalent to those implied by the net premium subsidy and gross underwriting gains for the current GRIP-HRO program. This was done by finding the GRIP coverage level at which the average indemnity is equal to the expected taxpayer cost of GRIP-HRO at 90% coverage. The taxpayer cost ($TPCost_t$) was calculated as the net premium subsidy less the gross underwriting gains for GRIP-HRO as a result of FCIC providing reinsurance through the SRA. Taxpayer costs were also calculated as a percentage of gross premium for reporting purposes:

$$(12) \qquad TPCost_t = \frac{NetSub_t - GrossGain_t}{Prem_t}.$$

Note that the expected value of gross underwriting gains is equal to zero for an actuarially fair policy. However, we use a larger level of negative own-price correlation for corn and soybeans than was used to originally rate GRIP and GRIP-HRO. Thus, the actual GRIP-HRO rates were not actuarially fair in our analysis.[14]

Results

We report our results for three different scenarios in table 3. The first scenario uses the actuarially fair rates implied by the simulation model (premium set equal to the average indemnity payment for each county); the second scenario uses the fair rates multiplied by the actual loading factors used by RMA;[15] and the third scenario uses actual GRIP-HRO rates for the 2005 crop year. The county-level distributions are aggregated to state-level results by taking a weighted average using 2005 NASS planted acres for corn and soybeans within each state. The state-level results are then aggregated using planted acres for corn and soybeans by state.

---

[13] The premium subsidy and A&O costs for 90% GRIP policies are 55% and 19.1% of gross premium, respectively.

[14] Furthermore, if the variability of county average yields when measured as a percentage of trend yield is now lower than in the past, GRIP is overrated. Overrating means that expected underwriting gains will be higher than calculated in this analysis.

[15] RMA uses load rates of 15% and 12% for corn and soybean policies, respectively.

Table 3. Estimated Premiums, Loss Ratios, Underwriting Gains, and Taxpayer Costs for 90% GRIP-HRO

Description	SCENARIO 1: Fair Premiums	SCENARIO 2: Loaded Premiums	SCENARIO 3: Actual Premiums
Premium	47.05	53.79	61.49
Gross Loss Ratio	1.00	0.87	0.77
Net Loss Ratio	0.90	0.86	0.81
Gross Gain	0 (0%)	6.74 (12.5%)	14.43 (23.4%)
Net Gain	4.58 (9.7%)	7.76 (14.4%)	11.55 (18.8%)
Taxpayer Cost	39.45 (84.0%)	40.88 (76.0%)	42.68 (69.4%)

Note: Premiums, underwriting gains, and taxpayer costs are reported in $/acre (% of premium).

Scenario 1: Implied Fair Rates

The first column in table 3 reports the model results when premiums are set equal to the average indemnities over the simulations. The premium reported in the first row represents an aggregated premium across the three states.[16] Note that the expected net loss ratio for the aggregated book of business is reduced from one to 0.90, while the expected underwriting gains increase from zero to $4.58 per acre, or 9.7% of premium, under the SRA. The expected cost borne by taxpayers, assuming fair premiums, is estimated to be $39.45 per acre, or 84% of gross premium.

Figure 1 illustrates the distribution of aggregate gross and net loss ratios, respectively, for the fair premium scenario.[17] Gross loss ratios are truncated from below at zero, by definition, and follow a right-skewed distribution with a maximum of 7.52. The loss-ratio spikes in figure 1 represent the large losses that occur in particular years over the study period. For example, the spike of realizations with loss ratios between 4.4 and 4.8 corresponds to the 1988 Corn Belt drought. The peaks at loss ratios between 2.5 and 3.2 correspond to the 1974, 1979, 1983, and 1993 crop years.

Gross underwriting gains, which equal one minus the loss ratio, also follow a skewed distribution which is truncated from above at 100% of gross premium.[18] The SRA tightens the distribution of underwriting gains by capping net underwriting losses at just over 100% of the gross premium and net underwriting gains at roughly 50% of gross premium. With fair premiums, gross underwriting losses have an expected value of $50.33 per acre (107% of premium) and are estimated to occur one out of every three years. Gross underwriting gains are realized roughly two out of every three years, with an expected gain equal to $28.32 per acre (60% of premium). A net underwriting loss

[16] Results are reported for the aggregate book of business for the three states used in the analysis. State-level results are available from the authors upon request.

[17] Figures displaying the distributions of gross and net loss ratios, underwriting gains, and taxpayer costs at the state level for all three scenarios are available from the authors upon request.

[18] While the theoretical maximum underwriting gain is 100% of the gross premium, there are no realizations when no indemnities are paid in the aggregated book of business. The maximum realization in our simulation model was a 99.8% gross underwriting gain.

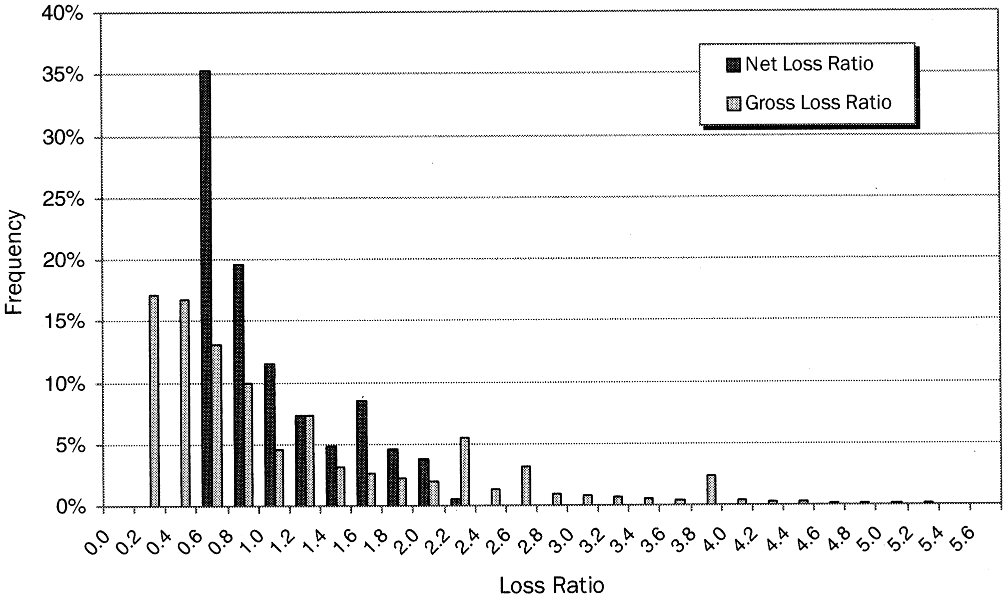

Figure 1. Distribution of loss ratios, fair premiums

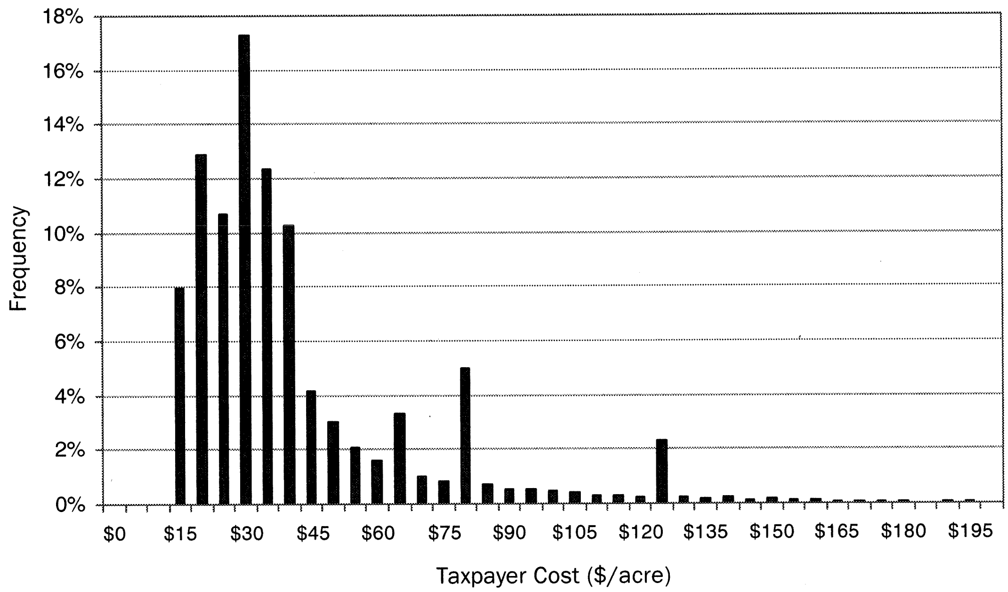

Figure 2. Distribution of taxpayer costs per acre, fair premiums

occurs with a 31% probability and an expected value of $21.94 per acre. Net underwriting gains average $16.40 per acre and are estimated to occur with a 69% probability.

Figure 2 illustrates the distribution of the cost to taxpayers of a fairly rated GRIP-HRO program. Taxpayer costs range from $10.90 to $290.87 per acre, or 23% to 620% of gross premium. The simulation results imply that the GRIP-HRO program costs taxpayers more than 100% of gross premium ($47.05 per acre) one out of every four years.

Scenario 2: Loaded Fair Rates

In practice, RMA loads GRIP rates above their actuarially fair levels. The justification for these loads is to account for unforeseen risks that have not been considered in the formal rating model and to help insurance companies build a reserve load to cover large loss years. The second column in table 3 reports the results of the model using the fair premiums implied by the simulation model with the actual loading factors applied. Under this scenario, private insurers are estimated to reduce their expected loss ratio from 0.87 to 0.86 and to increase their expected underwriting gains from $6.73 to $7.76 per acre, or 12.5% to 14.4% of total premium, by reinsuring under the SRA. Estimated taxpayer costs average $40.88 per acre, or 76% of gross premium. Because of higher premium rates, premiums and underwriting gains are larger than in the first scenario, which, in turn, increases expected taxpayer costs.

The shapes of the distributions (not reported) of underwriting gains, loss ratios, and taxpayer costs with loaded fair premiums follow those of scenario 1. Gross underwriting gains and losses with loaded rates range from a maximum loss of $299.94 per acre (558% of premium) to a maximum gain of $53.70 per acre (99.8% of premium), while the distribution of net underwriting gains is truncated between a 100% loss and a 50% gain under the provisions of the Commercial Fund of the SRA. Gross underwriting losses average $54.44 per acre and occur with a probability of 29%. Gross underwriting gains occur 71% of the time with an expected gain of $32.18 per acre. Reinsurance reduces the probability and expected value of underwriting losses to 28% and $22.64 per acre, respectively. Net underwriting gains are estimated to occur more than three out of four years with an average value of $19.66 per acre (37% of premium). Estimated taxpayer costs range from 23% to 524% of gross premium ($12.45 to $281.92 per acre) with costs exceeding 100% of premium in 20% of the simulations, or once every five years.

Scenario 3: Actual 2005 GRIP-HRO Rates

The third column in table 3 reports the results of the simulation model when the actual 2005 GRIP-HRO rates were used for premium calculation and loss adjustment. This scenario would be expected to replicate actual GRIP performance within the current crop insurance program. Using actual rates, the aggregated per acre premium for 90% GRIP-HRO coverage was equal to $61.49, while the expected gross loss ratio and underwriting gains equal 0.77 and 23.4% respectively. Our simulation model implies that the actual GRIP-HRO rates may be, on average, 30% higher than actuarially fair rates and 14% higher than loaded fair rates. By reinsuring, private insurers are estimated to achieve an expected net loss ratio and underwriting gain of 0.81 and 18.8% ($11.55 per acre), respectively, for the sample aggregated book of business. Estimated taxpayer costs average approximately 69.4% of gross premium, or $42.68 per acre.

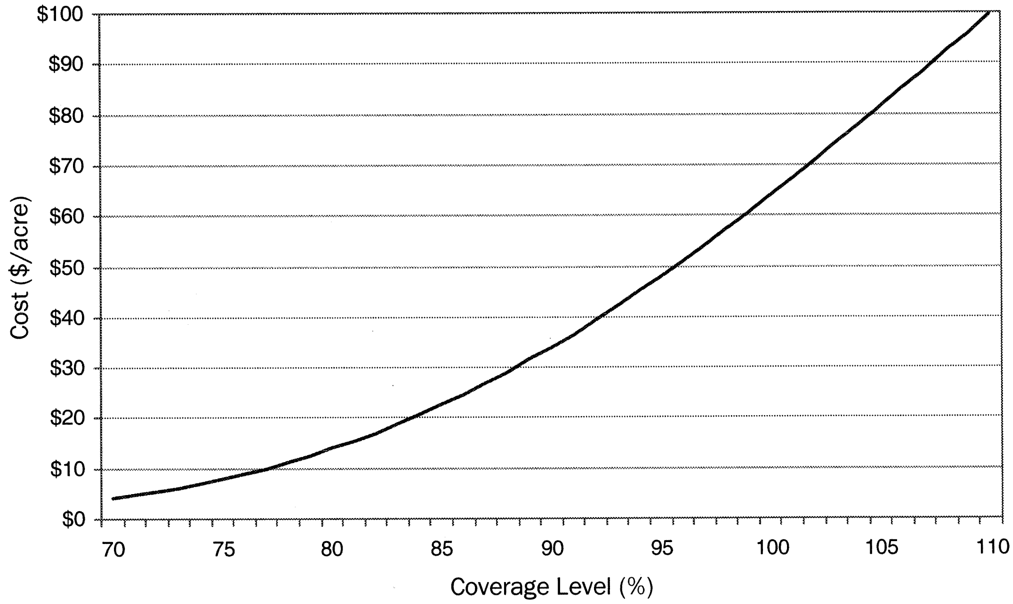

Figure 3. Expected GRIP indemnities at various coverage levels, 100% liability factor

Again, the shapes of the distributions of underwriting gains, loss ratios, and taxpayer costs follow those outlined in the scenario with fair premiums and are not reported. Gross underwriting gains range from a maximum loss of $292.26 (475%) to a maximum gain of $61.40 (99.8%) per acre. Gross underwriting losses occur with a probability of 27% with an expected loss of $52.19 per acre. Gross gains average $38.48 per acre, or 63% of gross premium. Reinsurance reduces the probability of a loss by 2%, and reduces the expected size of a loss to $23.02 per acre. Net underwriting gains average $23.37 per acre (38% of premium) and are estimated to occur three out of every four years. Simulated taxpayer costs range from $14.22 to $272 per acre, or 23% to 442% of gross premium. Consistent with the other scenarios analyzed, taxpayer costs are estimated to exceed total premium roughly once every five years.

Cost Equivalent GRIP Coverage

The cost of administering GRIP as a Miranda-Glauber disaster relief program is equal to the GRIP indemnity because there are minimal loss adjustment costs. Using equations (2b) and (3)–(6), indemnities for a standard GRIP policy were calculated over a range of coverage levels from 70% to 110%. Figure 3 plots the expected indemnity payment for each GRIP coverage level. The current GRIP-HRO program at a 90% coverage level and a 150% liability factor was estimated to cost taxpayers $39.45, $40.88, and $42.68 in scenarios 1, 2, and 3, respectively. Given the expected indemnities in figure 3, a GRIP program at a coverage level of approximately 93% and a liability factor of 100% would result in the same expected per acre cost to taxpayers. This program could be offered to farmers in the form of a Miranda-Glauber disaster relief farm program at an equivalent taxpayer cost to insuring the same acreage under GRIP-HRO at a 90% coverage level and 150% liability factor.

However, there would be important distributional impacts of providing GRIP as a farm bill program. Offering GRIP-HRO coverage to farmers as a crop insurance program provides farmers with a significantly smaller net benefit than providing GRIP in the farm bill because producers must pay a portion of the premium in the crop insurance program. As shown in table 3, producers are estimated to pay $27.67 (45% of $61.49) to obtain an expected indemnity of $47.05. Thus, producers' net benefit is $19.38. However, if GRIP were part of the farm bill, producers would obtain the full net benefit of $42.68 per acre, an increase of 120%. The difference between $42.68 and $19.38 is what flows to the crop insurance industry in the form of expected underwriting gains and A&O. That is, under the crop insurance program, there is a 55/45 split in taxpayer support, with 55% going to the crop insurance industry and 45% going to producers. If GRIP were moved to the farm bill, all the taxpayer support would flow to producers.

The second distributional impact involves taxpayers. Although taxpayer costs would be the same, by definition, the variability of costs is higher when GRIP is in the farm bill rather than in the crop insurance program. The standard deviations (coefficients of variation) of estimated taxpayer costs in scenarios 1, 2, and 3 were estimated to be $28.24 (72%), $26.81 (66%), and $25.44 (60%) per acre, respectively. The standard deviation (CV) of indemnities for a 93% GRIP farm program was estimated to be $47.55 (113%). Therefore, while a GRIP disaster program providing 93% coverage at a 100% liability factor is estimated to be cost equivalent to the 90% GRIP-HRO insurance program with a 150% liability factor, costs would also be more volatile.

The decrease in the volatility of taxpayer costs from providing GRIP as a crop insurance program rather than as a farm bill program is the crop insurance industry's primary justification for the subsidies it receives in the crop insurance program. Industry administrators argue it is fair for them to share in the gains if they are required to share in the losses. The question then becomes—At what cost to taxpayers? Using the scenario 3 results, with a 25% probability, taxpayers gain an average of $23 per acre from the SRA's risk-sharing provisions. However, taxpayers pay for this benefit 75% of the time through positive underwriting gains paid to insurance companies. The average payment from taxpayers to companies in these years is just over $23 per acre.

Putting these gains and losses into insurance terms, taxpayers essentially receive an insurance payout from the SRA 25% of the time. The average payout in these years is $23 per acre. Multiplying the probability by the average size of the payout in the years in which a payout occurs results in the overall expected indemnity (taxpayer benefit) from the SRA. This multiplication produces an expected indemnity of $5.75 per acre. The "premium" paid by taxpayers for this "insurance" is the overall average underwriting gain paid to crop insurance companies, which is $11.55 per acre in scenario 3.

This insurance program has an expected loss ratio of less than 0.5 (5.75/11.55), which means that the annual expected rate of return obtained by crop insurance companies from putting their money at risk is more than 100%. Another way to look at the SRA's effect on the costs of administering GRIP is that taxpayers are effectively accepting a gamble which pays out a given amount with a 25% probability but creates a loss in the same amount 75% of the time. If taxpayers knew they were paying 100% expected rates of return on money being put at risk by crop insurance companies, one would hope they might argue that their money could be put to better use in debt reduction or offsetting other program costs.

Of course, the underwriting gains paid to crop insurance companies are part of the financing for a 93% Miranda-Glauber area revenue program in the farm bill. If taxpayers kept the underwriting gains and financed the area revenue program with only producer premium subsidies and A&O expenses, then the amount of coverage that could be offered on a cost-equivalent basis would be approximately 88%, as shown in figure 3.

Conclusions

The expected cost of running GRIP through the crop insurance program in 2007 is approximately $42.68 per acre for corn and soybeans in Iowa, Illinois, and Indiana. If every acre planted to corn and soybeans in 2006 were insured under GRIP in these three states (55.4 million acres), the expected cost would be $2.36 billion per year, making it by far the most expensive farm program of all current programs. However, farmers would only receive approximately $1.1 billion of this amount, with the remainder going to the crop insurance industry. If the purpose of the crop insurance program is to provide support to producers, it would be difficult to design a more inefficient transfer system.

Compare the cost of delivery of this system to one in which a pre-2004 GRIP policy that covered 93% of the product of expected price and expected county yield was given to farmers. The costs of administering this policy would be minimal compared to the current crop insurance program, so farmers would be receiving a higher proportion of each dollar of taxpayer cost. Moreover, many of the administrative requirements of a program based on county revenue are already carried out by county FSA offices for the current marketing loan and countercyclical programs (e.g., acreage reports and price and yield data at the national and county levels).

As noted by many, a Miranda-Glauber type of farm program, of which GRIP is simply an example, has the potential to offer farmers significant risk management benefits because it triggers payments when systemic risk strikes a crop or a region, and it provides a transparent and automatic disaster aid mechanism. Because the program targets revenue rather than price, it could cover risks not currently covered by existing marketing loan and countercyclical programs, as well as risks currently covered by crop insurance. Therefore, it could be financed from savings from current farm programs and the current crop insurance program.

These cost savings perhaps create a large obstacle to adoption of such an approach. The large and growing tax support of the crop insurance industry has created strong vested interests of some political constituencies who will act to protect these interests. While our results cannot conclude that an area plan, such as GRIP, would provide a perfect substitute for ad hoc disaster assistance, our findings do quantify the potential cost efficiencies of such a program. A formal measure of the risk reduction offered by such a program is an important area for further research.

[*Received July 2007; final revision received May 2008.*]

References

American Farmland Trust. "Agenda 2007: A New Framework and Direction for U.S. Farm Policy." Healthy Farms, Healthy Food, Healthy People: AFT's 2007 Farm Policy Campaign. American Farmland Trust, Washington, DC, 2006. Online. Available at http://www.nppc.org/public_policy/americanfarmlandtrust.pdf.

Babcock, B. A., and C. E. Hart. "How Much 'Safety' Is Available Under the U.S. Proposal to the WTO?" CARD Briefing Paper No. 05-BP 48, Center for Agricultural and Rural Development, Iowa State University, 2005.

———. "Crop Insurance: A Good Deal for Taxpayers?" *Iowa Ag Review* 12,3(2006):1–3, 10.

Barnaby, G. A. "GRIP and GRP Provide an Alternative Crop Insurance Choice to Kansas Wheat Growers Suffering with a Reduced APH." Ag Manager, Kansas State University Research and Extension, 2006. Online. Available at http://www.agmanager.info/crops/insurance/risk_mgt/rm_pdf06/ABgrpwht.pdf.

Barnett, B. J., J. R. Black, Y. Hu, and J. R. Skees. "Is Area Yield Insurance Competitive with Farm Yield Insurance?" *J. Agr. and Resour. Econ.* 30,2(August 2005):285–301.

Brown, J. R., and A. Finkelstein. "The Interaction of Public and Private Insurance: Medicaid and the Long-Term Care Insurance Market." Work. Pap. No. 10989, National Bureau of Economic Research, Cambridge, MA, 2004.

Cutler, D. M., and J. Gruber. "Does Public Insurance Crowd Out Private Insurance?" *Quart. J. Econ.* 111,2(1996):391–430.

Federal Crop Insurance Corporation (FCIC). *2005 Standard Reinsurance Agreement.* U.S. Department of Agriculture/FCIC, Washington, DC, 2005. Online. Available at http://www.rma.usda.gov/pubs/ra/05SRA_final.pdf.

Glauber, J. "Double Indemnity: Crop Insurance and the Failure of U.S. Agricultural Disaster Policy." AEI Agricultural Policy Series: The 2007 Farm Bill and Beyond. American Enterprise Institute, Washington, DC, 2007. Online. Available at http://www.aei.org/docLib/20070515_glauberfinal.pdf.

Goodwin, B. K., and A. P. Ker. "Nonparametric Estimation of Crop-Yield Distributions: Implications for Rating Group-Risk Crop Insurance Contracts." *Amer. J. Agr. Econ.* 80,1(1998):139–153.

Halcrow, H. G. "Actuarial Structures for Crop Insurance." *J. Farm Econ.* 31,3(1949):418–443.

Iman, R., and W. Conover. "A Distribution-Free Approach to Inducing Rank Correlation Among Input Variables." *Communications in Statistics—Simulation and Computation* 11,3(1982):311–334.

Ker, A. P., and K. Coble. "Modeling Conditional Yield Densities." *Amer. J. Agr. Econ.* 85,2(2003):291–304.

Lence, S. H., and D. J. Hayes. "U.S. Farm Policy and the Volatility of Commodity Prices and Farm Revenues." *Amer. J. Agr. Econ.* 84,2(2002):335–351.

Miranda, M. J. "Area-Yield Crop Insurance Reconsidered." *Amer. J. Agr. Econ.* 73,2(1991):233–242.

Miranda, M. J., and J. W. Glauber. "Providing Crop Disaster Assistance Through a Modified Deficiency Payment Program." *Amer. J. Agr. Econ.* 73,4(1991):1233–1243.

Skees, J. R., J. R. Black, and B. J. Barnett. "Designing and Rating an Area Yield Crop Insurance Contract." *Amer. J. Agr. Econ.* 79,2(1997):430–438.

U.S. Department of Agriculture. "USDA 2007 Farm Bill Proposals." USDA, Washington, DC, 2007. Online. Available at http://www.usda.gov/documents/07finalfbp.pdf.

Vedenov, D. V., M. J. Miranda, R. Dismukes, and J. W. Glauber. "Economic Analysis of the Standard Reinsurance Agreement." *Agr. Fin. Rev.* 64,2(Fall 2004):119–134.