Journal of Agribusiness 18,3(Fall 2000):303–317

Evaluation of Crop Insurance Premium Rates for Georgia and South Carolina Peaches

Stephen E. Miller, Kandice H. Kahl, and P. James Rathwell

We estimate actuarially fair premium rates for yield insurance for Georgia and South Carolina peaches for comparison to the premium rates established by the Risk Management Agency (RMA) for the 1999 crop. The RMA premium rates varied from county to county, but were identical for all growers in a given county. The estimated premium rates decrease with the grower's expected yield. The RMA rate structure encouraged adverse selection, as premium rates were too low for growers with low expected yields (especially at low coverage levels) and were too high for growers with high expected yields (especially at high coverage levels).

Key Words: adverse selection, crop insurance, peaches, premium rate, yield guarantee

Peach crop insurance, administered by the U.S. Department of Agriculture's Risk Management Agency (RMA), provides a guarantee against low yields for participating growers. That insurance product has been criticized for its high loss ratios (indemnities paid relative to insurance premiums) in Georgia (GA) and South Carolina (SC) in recent years,[1] and for its high premium rates in the two states. These criticisms may seem inconsistent because high loss ratios may be caused by premium rates that are too low or otherwise inaccurate. Nevertheless, grower concerns regarding the high premium rates have been reflected in congressional directives to the RMA that require review of peach crop insurance in GA and SC. In response to these directives, the RMA commissioned the authors to evaluate peach crop insurance premium rates in the two states. This article reports the results of that evaluation.

The authors are professors, all in the Department of Agricultural and Applied Economics, Clemson University. We would like to thank two anonymous reviewers for their helpful comments. This research was funded by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement No. 97-COOP-2-4545. The views expressed here are those of the authors and do not necessarily represent those of the U.S. Department of Agriculture.

[1] From 1986–1999, the loss ratios averaged 2.68 in GA and 2.48 in SC (USDA/RMA, 1999c).

Background

The peach crop insurance product is an individual yield guarantee. Under an individual yield guarantee, a participating grower receives an indemnity whenever his actual yield falls below his yield guarantee. The grower selects his yield guarantee by choosing a percentage of his historical average yield (measured here in pounds/acre), called the actual production history (APH).[2] The yield guarantee is the APH multiplied by the selected coverage level. The grower can choose from coverage levels between 50% and 75% in 5% increments. The grower's premium, before government subsidy, is computed as the product of his yield guarantee (pounds/acre), a price (measured here in dollars/pound) specified by the RMA, and the RMA premium rate.[3] If the grower's yield is less than his yield guarantee, he receives an indemnity equal to the product of the RMA price and the difference between his yield guarantee and his actual yield.

The RMA has maintained a "flat" premium rate structure for individual yield guarantee insurance for most horticultural crops, including GA and SC peaches through the 1999 crop year.[4] That is, the premium rates for a particular crop can vary by county, but are identical for all growers in a given county, and thus do not vary with individual growers' APH values. From an actuarial standpoint, a flat rate structure is consistent with a coefficient of variation (CV) of farm-level yields (100 × standard deviation of yield/mean yield) which is constant for all growers of the crop within a given county (i.e., the standard deviation of farm-level yields increases proportionally as farm-level mean yield increases).

Since 1985, the RMA premium rates for most agronomic crops have been inversely related to individual growers' APH values (Knight and Coble, 1997). Such a rating structure is consistent with a CV of farm-level yields that decreases with mean farm-level yield within a given county (i.e., the standard deviation of farm-level yields increases less than proportionally as farm-level mean yield increases).

Goodwin (1994), Knight and Coble (1997), and Skees and Reed (1986), among others, have discussed the implications of rate-making practices for adverse selection in crop insurance. According to Skees and Reed:

---

[2] The APH for peaches is calculated using the grower's actual yields for a minimum of the four and a maximum of the five preceding years. The RMA assigns proxy yields when actual yields are available for less than four years. There are limits on the extent to which the grower's APH can change from one year to the next, so the grower's APH need not equal the average of his actual yields. The RMA formerly measured peach yields per acre in 48-pound bushels, but now measures the yields in 50-pound bushels. We use pounds rather than bushels to avoid confusion over the changing bushel definition.

[3] For the 2000 crop, the government subsidy (before premium discounts financed through supplemental funding measures) is 55% for 50% coverage, 42% for 65% coverage, and 24% for 75% coverage. For the 2001 crop, the government subsidy will be 67% for 50% coverage, 59% for 65% coverage, and 55% for 75% coverage.

[4] Insurance premium rates for the 1999 and earlier peach crops were based on historical insurance loss experience. That is, the flat premium rates were adjusted upward (downward) when insurance indemnities were greater than (less than) insurance premiums.

> Adverse selection occurs when growers with higher relative risk have opportunities to purchase insurance at the same cost as farmers with lower relative risk. If farmers are able to recognize these differences and participation reflects such recognition, . . . [crop insurance] tends to attract farmers with relatively high risk. . . . Setting insurance rates to reflect relative risk of different farmers is necessary to forestall this adverse selection (1986, pp. 653–654).

Skees and Reed estimated models in which the yield standard deviation and yield coefficient of variation were alternatively regressed on mean yield using farm-level yield data for corn and soybeans in Illinois and Kentucky. They were unable to reject the null hypothesis that the yield standard deviation is independent of the mean yield, but were able to reject the null hypothesis that the yield CV is independent of mean yield. Their research provided support for the 1985 change in rate-making practices for agronomic crops to allow for lower rates for farmers with higher mean yields.

Goodwin (1994) estimated regression models in which mean yields were used to explain yield standard deviations using farm-level yield data for Kansas dryland and irrigated wheat, corn, sorghum, and soybeans. Regarding the low explanatory power of his regression models, Goodwin notes:

> This result implies that any assumed relationship between the average and standard deviation of yields is precarious since considerable variation exists in the relationship between average yields and yield variation across farms. The important implication of these results is that rate-setting practices that examine only average yields likely will introduce adverse selection into the insurance pool since average yields are an imperfect indicator of relative yield variability (p. 387).

Goodwin also estimated models in which the farm-level yield CVs were regressed on farm-level mean yields and selected farm characteristics (e.g., acreage, a diversification index, net farm income, etc.). He found that the coefficients for mean farm yields were negative and significant at the 5% level for each crop, but the coefficients for the other farm characteristic variables were not consistently significant across crops. He interpreted his results as providing support for crop insurance rate discounts for farms with higher average yields, but cautioned that "even in the best of cases, this relationship is imperfect, and thus basing risk measures solely on average yield may induce adverse selection" (p. 393).

Although the results of Skees and Reed (1986) and Goodwin (1994) report an inverse relationship between the CV of farm-level yields and mean farm-level yields for agronomic crops, whether such a relationship holds for peaches is an empirical question. If there is an inverse relationship between the farm-level yield CV and the mean farm-level yield for peaches, a flat rate structure would benefit growers with low yields relative to those with high yields, thus encouraging adverse selection in peach crop insurance.

Procedures

Estimates of actuarially fair or pure premium rates are required to evaluate the RMA premium rates. Actuarial fairness occurs when the expected indemnity (loss) equals the insurance premium. Let y denote farm yield, E(y) the expected farm yield, and Y_g be the yield guarantee. For example, for 50% coverage, $Y_g = 0.50 \times \mathrm{E}(y)$. Then the expected loss measured in commodity terms, E(L), for an individual yield guarantee product is given by

$$\mathrm{E}(L) = \mathrm{prob}(y < Y_g) \times [Y_g - \mathrm{E}(y \mid y < Y_g)]. \tag{1}$$

The pure premium rate, R, is calculated as the ratio of the expected loss to the maximum loss:

$$R = \mathrm{E}(L)/Y_g. \tag{2}$$

The actual premium rate differs from the pure premium rate for various reasons (e.g., to include reserves for catastrophic events).

Farm-level distributions of peach yields must be estimated in order to evaluate equations (1) and (2). Farm-level peach yield data for both GA and SC are available for all farms participating in the crop insurance program from 1986 onward (USDA/RMA, 1999b). Only farms with four or more years of reported actual yields are used in this analysis.[5] For GA, these data are available for 60 farms (including eight farms in the North region, 24 farms in the Central region, and 28 farms in the South region). For SC, the data are available for 149 farms in 10 counties (with 94 farms in the Upper State region, 51 farms in the Ridge region, and four farms in the Coastal Plain region).[6] The available observed farm yield data are limited, with an average of 5.8 years for GA farms and 6.4 years for SC farms.

Researchers have used several approaches to estimate farm yield distributions. Some have assumed a specific parametric distribution and used farm-level data to estimate the parameters of that distribution. While the normal and beta have been popular choices for the distribution of y, both distributions have been criticized because they are unimodal and county yield distributions for some crops have been found to be bimodal (Goodwin and Ker, 1998). Others have estimated the empirical distribution from farm-level data (Skees and Reed, 1986). However, yield data for a large number of years are required to obtain accurate empirical premium rates unless smoothing methods are used to estimate a continuous distribution from the discontinuous empirical distribution (Goodwin and Ker, 1998). Goodwin and Ker

---

[5] Farm-level peach yield data are not available for growers who do not participate in the peach crop insurance program. Goodwin (1994) found that average farm-level yields for agronomic crops did not differ between participating and nonparticipating farms in Kansas. However, on average, the mean yield CV for participating farms was 3% higher than for nonparticipating farms. Whether peach yield risks are higher for participants than for nonparticipants is a question we cannot answer with the available data.

[6] The GA and SC regions are defined by the USDA/Agricultural Statistics Services in the respective states.

recommend the kernel function smoothing method for this purpose, but point out their sample size of 32 annual yields is relatively small for application of that method. The use of empirical distributions (with or without smoothing) seems inappropriate when applied to the small samples of farm-level peach yields. State-wide freezes in GA and SC can wipe out the entire peach crop, as was the case in 1955. Empirical rates based on yield data for only subsequent years would not reflect this possibility.

The approach used in this analysis adapts procedures from Atwood, Baquet, and Watts (1996) to augment the limited individual farm yield data with the yield variability information from aggregated yield data, which are available for longer periods. Peach yield data for GA and SC are reported by the National Agricultural Statistics Service (USDA/NASS, 1956–98). State-level yield data for 1955–1998 are used here. County-level yield data are available for SC for 1958–1997 from the South Carolina Agricultural Statistics Service (1959–98) and region-level yield data are available for GA for 1988–1997 from the Georgia Agricultural Statistics Service (1993–98). Specifically, we model state yields, county (region) yields conditional on state yields, and farm yields conditional on county (region) yields.

We simulate 10,000 yields for each state, 10,000 yields for each county (region) in the state conditional on the simulated state yields, and 10,000 yields for each farm in the county (region) conditional on the simulated county (region) yields.[7] The simulated variables are computed as yield forecasts plus simulated yield forecast errors. The yield forecasts are based on the point estimates of the parameters of the state, county (region), and farm yield equations. The simulated forecast errors are computed from simulated sampling errors in estimation of the parameters of the yield equations and bootstrapped estimates of the parameters (Efron and Tibshirani, 1993), and from simulated disturbance terms based on the residuals from estimating the yield equations. The resulting cumulative farm-level yield distributions incorporate the state-level yield variability over the 44-year period, the extra yield variability at the county (region) level, and the extra yield variability at the farm level. These farm-level yield distributions are used to estimate actuarially fair premium rates. For details of the simulation methodology, refer to Miller, Kahl, and Rathwell (2000).

In the way of notation, $y_{k,i}$ represents the ith simulated yield ($i = 1, 2, \ldots, 10{,}000$) for farm k. The probability associated with the ith simulated yield is $\text{prob}(y_{k,i}) = 1/10{,}000$ for all i, and the mean of the simulated yields for farm k is specified as

$$\text{(3)} \qquad \bar{y}_k = \text{E}(y_{k,i}) = \sum\nolimits_i^{10{,}000} \text{prob}(y_{k,i}) \times y_{k,i}\,.$$

We consider each coverage level from 50% to 75% that is offered in the current peach crop insurance program, and use c_j to denote the jth coverage level (which is a percentage) written in decimal form. The yield guarantee with a jth coverage level for farm k is given by

[7] The choice of 10,000 simulated yields is arbitrary on our part.

$$Y_{j,k} = c_j \times \bar{y}_k. \tag{4}$$

The *i*th loss for farm *k* with a *j*th coverage level is

$$L_{j,k,i} = \max\left[Y_{j,k} - y_{k,i},\ 0\right], \tag{5}$$

with mean

$$\bar{L}_{j,k} = \sum_i^{10,000} \text{prob}(y_{k,i}) \times L_{j,k,i}. \tag{6}$$

The premium rate for farm *k* with a *j*th coverage level is

$$R_{j,k} = \frac{\bar{L}_{j,k}}{Y_{j,k}}. \tag{7}$$

We calculate the premium rates for each of the GA and SC farms for each coverage level.

Results and Discussion

A plot of the observed mean of the farm yields against the observed farm yield CV for each farm in the two states (figure 1) indicates the farm yield CV tends to decrease at a decreasing rate as mean yield increases. A plot of the simulated mean of farm yields against the simulated farm yield CV (not shown) exhibits a similar pattern. Table 1 provides summary statistics for the farm yield CVs and mean farm yields, and the results of fitting log-log models in which mean yield is used to explain yield CV using both actual and simulated farm yield data.

We are not aware of published farm-level yield CVs for horticultural crops, and so we cannot make comparisons in that regard. However, the highest farm yield CV for Kansas field crops reported by Goodwin (1994) is 40% (for dryland soybeans). The mean farm yield CVs for GA and SC peaches are 77% or higher, indicating that peaches in those states have much higher relative yield risks than do Kansas field crops. The models based on the simulated yield data result in higher squared correlations between the fitted and observed CV values than do the models based on actual farm yield data.[8] Nevertheless, regardless of whether actual or simulated farm-level data are used in estimation, there is a significant negative relationship between the farm yield CV and the farm mean yield for both GA and SC. This finding raises questions about the implicit assumption of constant CVs across farms in a county used by the RMA until 1999 in determining insurance premium rates for GA and SC peaches.

---

[8] The R^2 values from the models based on the actual yield data are in line with R^2 values from the multiple regressions (0.25 to 0.63) used by Goodwin (1994) in explaining farm yield CVs for Kansas field crops.

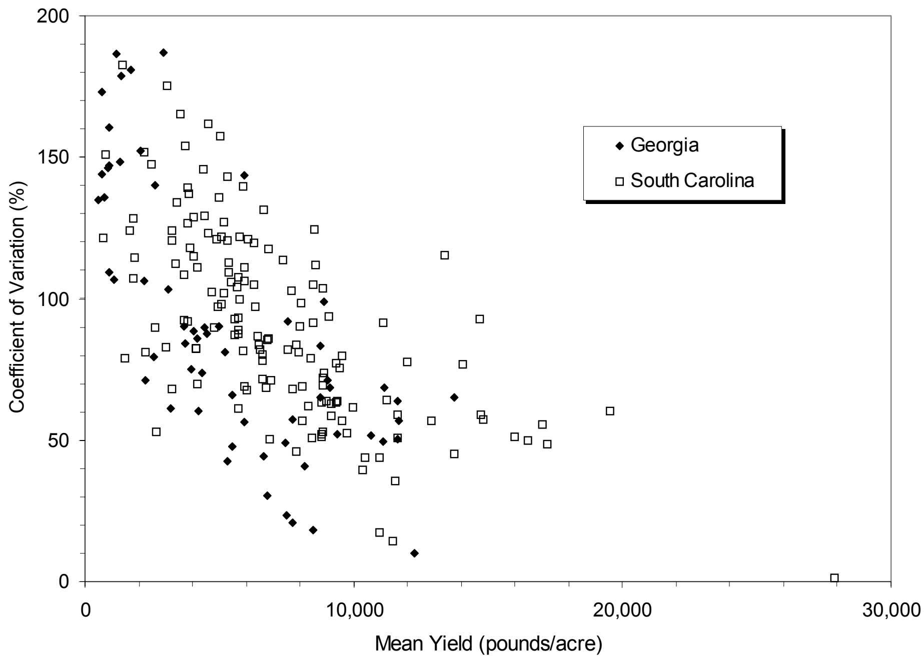

Figure 1. Scatter plot of coefficient of variation of observed peach yields vs. mean of observed peach yields for GA and SC farms

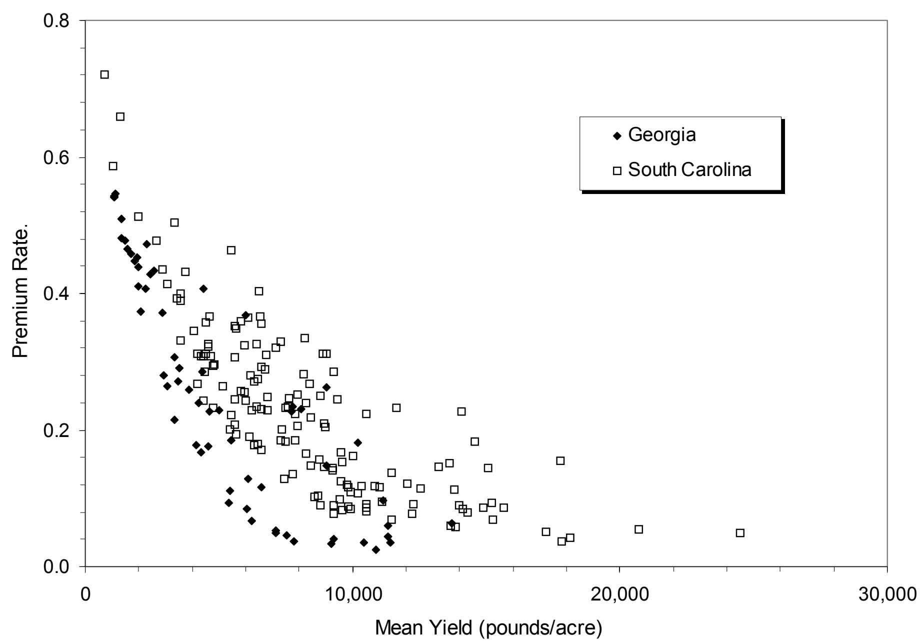

Figure 2. Scatter plot of premium rate for 50% coverage computed from simulated peach yields vs. mean of simulated peach yields for GA and SC farms

Table 1. Regression Results for Log-Log Functional Form Models Explaining Coefficients of Variation of Actual and Simulated Farm-Level Peach Yields for 60 Georgia Farms and 149 South Carolina Farms

	Data Type	
Statistic	Actual	Simulated
GEORGIA:		
Mean of C (%)	89.131	81.203
Mean of $\bar{y}$ (pounds/acre)	5,411	5,329
$\hat{\gamma}_0$	8.167*	9.085*
$\hat{\gamma}_1$	−0.463*	−0.573*
$\hat{\sigma}^2$	0.187	0.055
R^2 [a]	0.557	0.807
SOUTH CAROLINA:		
Mean of C (%)	91.288	76.997
Mean of $\bar{y}$ (pounds/acre)	7,167	8,371
$\hat{\gamma}_0$	8.901*	8.883*
$\hat{\gamma}_1$	−0.514*	−0.515*
$\hat{\sigma}^2$	0.186	0.030
R^2 [a]	0.317	0.762

Notes: An asterisk (*) denotes significance at the 1% level.
The estimated models are $\hat{C}_k = \exp(\hat{\gamma}_0 + \hat{\gamma}_1 \ln(\bar{y}_k) + 0.5\hat{\sigma}^2)$, where $\hat{C}_k$ is the fitted coefficient of variation of yield for farm k, $\bar{y}_k$ is the mean yield (pounds/acre) for farm k, $\hat{\sigma}^2$ is the mean squared error of the log-log regression, and ln(·) denotes the natural log. The term $0.5\hat{\sigma}^2$ is used to correct for the bias in estimating the intercept terms in log-log models (Kmenta, 1986, p. 511).
[a] The R^2 statistic is the squared correlation between the fitted and observed (actual or simulated) coefficient of variation values.

A plot of the simulated premium rates for 50% coverage against the simulated mean yields for GA and SC farms (figure 2) indicates the following:

- For both states, the premium rates decrease as mean yields increase.
- For both states, the premium rates decrease at a decreasing rate as mean yields increase (i.e., the premium rate decreases more from a unit increase in mean yield when mean yield is low than when mean yield is high).
- For a given mean yield, the premium rates for GA farms tend to be lower than the premium rates for SC farms.[9]

Because the premium rates are bounded by zero and one, we use the logistic functional form to estimate the relationship between the simulated mean yield and the

[9] Plots for higher coverage levels (not shown) exhibit similar patterns. These plots are available from the authors upon request.

Table 2. Regression Results for Logistic Functional Form Models Explaining Premium Rates for Individual Yield Guarantee Crop Insurance for Peaches for 60 Georgia Farms and 149 South Carolina Farms, by Coverage Level

	Coverage Level		
Statistic	50%	65%	75%
GEORGIA:			
$\hat{\alpha}_0$	0.145	0.155	0.159
$\hat{\alpha}_1$	−1.008***	−0.878***	−0.788***
$\hat{\alpha}_2 \times 100$	−0.021***	−0.019***	−0.017***
R^2 [a]	0.859	0.857	0.853
RMSE [b]	0.063	0.063	0.063
SOUTH CAROLINA:			
$\hat{\beta}_0$	0.130	0.163	0.172*
$\hat{\beta}_1$	−0.524*	−0.531**	−0.525**
$\hat{\beta}_2 \times 100$	−0.019***	−0.017***	−0.016***
$\hat{\beta}_3 \times 100$	0.006**	0.006***	0.006***
R^2 [a]	0.748	0.739	0.732
RMSE [b]	0.065	0.064	0.063

Notes: Single, double, and triple asterisks (*) denote significance at the 10%, 5%, and 1% levels, respectively. The estimated models are

$$\hat{R}_{j,k} = \frac{1}{1 + \exp(-(\hat{\alpha}_0 + \hat{\alpha}_1 D_{Central,k} + \hat{\alpha}_2 \bar{y}_k))}$$

and

$$\hat{R}_{j,k} = \frac{1}{1 + \exp(-(\hat{\beta}_0 + \hat{\beta}_1 D_{Ridge,k} + \hat{\beta}_2 \bar{y}_k + \hat{\beta}_3 (D_{Ridge,k} \times \bar{y}_k)))}$$

for GA and SC, respectively, where $\hat{R}_{j,k}$ is the fitted premium rate for coverage level j for farm k; $\bar{y}_k$ is the mean of the simulated yields (pounds/acre) for farm k; $D_{Central,k}$ equals 1 if farm k is located in Central GA, 0 otherwise; and $D_{Ridge,k}$ equals 1 if farm k is located in the SC Ridge, 0 otherwise.

[a] The R^2 statistic is the squared correlation between the simulated and fitted premium rates.

[b] RMSE is the root mean squared error, computed from the squared differences between the simulated and fitted premium rates.

simulated premium rate for each coverage level for each state (Greene, 1997, pp. 227–228). Preliminary analyses indicate the models for GA should allow for an intercept shift for Central farms relative to North and South farms, but should maintain a common mean yield coefficient across the three regions; and the models for SC should allow for intercept and mean yield coefficient shifts for Ridge farms relative to Upper State and Coastal Plain farms.

The final regression results provided in table 2 and a plot of the fitted regressions (figure 3) preserve the findings obtained from the scatter diagram (figure 2), except that the fitted premium rates for North and South GA exceed those for SC at low mean yield levels.[10] However, additional conclusions are obtained. The premium rates for Central GA are lower than the rates for the other locations at all mean yield levels. The Ridge of SC has the second lowest premium rates for low mean yield levels, but the highest premium rates for high mean yield levels. The lower relative yield risk for peaches in Central GA as reflected in the estimated premium rates for that region may be due to differences in climatic factors and/or differences in grower behavior across regions. Davis et al. (1997) have studied the use of spatial scattering of peach orchards as a means of reducing yield risks by large commercial growers in Central GA. Spatial scattering may be more common in Central GA than in other regions of GA and SC. The RMA farm yield database used in our analysis does not include a measure of spatial scattering, so this hypothesis cannot be tested.

The estimated pure premium rates are compared to the RMA premium rates for the 1999 crop year (USDA/RMA, 1999a) after adjusting the RMA rates to make them pure rates.[11] Table 3 provides comparisons for 50%, 65%, and 75% coverage levels for the regions in GA and SC. Given that the regressions are identical for the North and South regions of GA, and for the Upper State and Coastal Plain regions of SC, the comparisons are made for these combined regions. In each case, the lowest county-adjusted RMA premium rate, the highest county-adjusted RMA premium rate, and the simple average of the adjusted RMA premium rates for counties within the region(s) are reported.[12] The following conclusions can be drawn from the results:

- At low average yield levels, the estimated premium rates exceed the highest RMA county rates at all coverage levels for each location, except at the 75% coverage level for Central GA and the Ridge of SC. Thus, in general, our results indicate that the 1999 premium rates for growers with low yields were too low, and the expected indemnities exceeded the premiums (net of reserves for catastrophic events but gross of government subsidy) for these growers.
- At high average yield levels, all estimated premium rates are less than the lowest county rates. Thus, the 1999 premium rates for high-yielding growers were too high, and the expected indemnities were less than the premiums (net of reserves for catastrophic events but gross of government subsidy) for these growers.
- At the median of the average yield levels, the estimated premium rates are higher than the highest RMA county rates for all coverage levels in North and South GA, and so the 1999 RMA rates were too low for the majority of growers in those two regions. The 1999 RMA premium rates for 75% coverage were too high for the majority of growers in Central GA and in the Ridge of SC. The majority of growers in the Upper State and Coastal Plain of SC faced 1999 RMA rates for 50% and 65% coverage levels that were too low.

---

[10] Although only the regression results for 50%, 65%, and 75% coverage levels are shown in table 2, the results for the other coverage levels are similar (and are available from the authors upon request).

[11] The adjusted premium rate is computed as 79.2% of the published RMA rate (Driscoll, 1998). For example, if the published gross premium rate is 0.226, the adjusted premium rate is 0.179 (calculated as 0.792×0.226). This adjustment removes the reserves for catastrophic events, etc.

[12] The adjusted RMA premium rates are reported only for those counties for which there was at least one grower with four or more years of reported actual yields in the RMA's yield experience database.

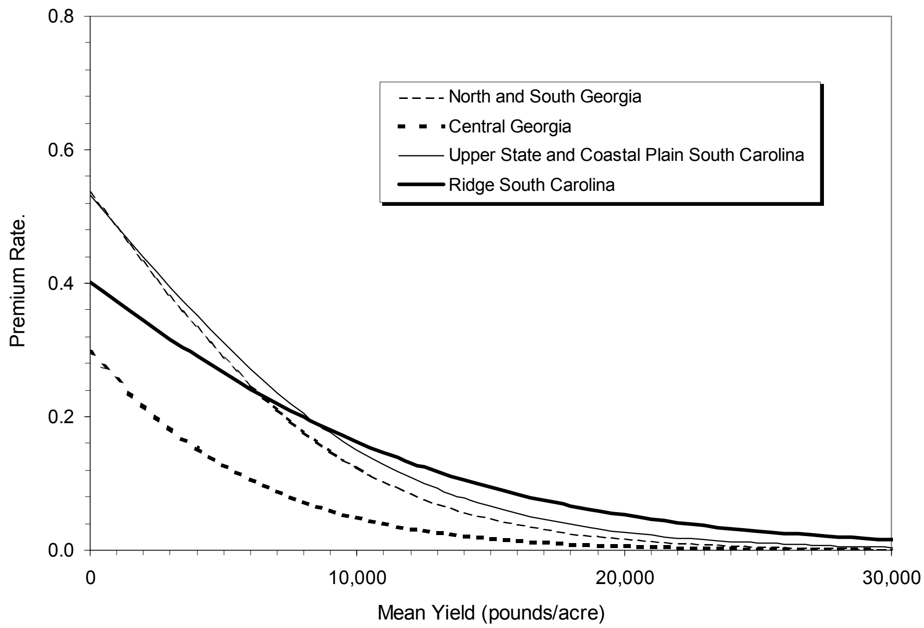

Figure 3. Fitted peach crop insurance premium rate for 50% coverage vs. mean of simulated peach yields for GA and SC farms, by region

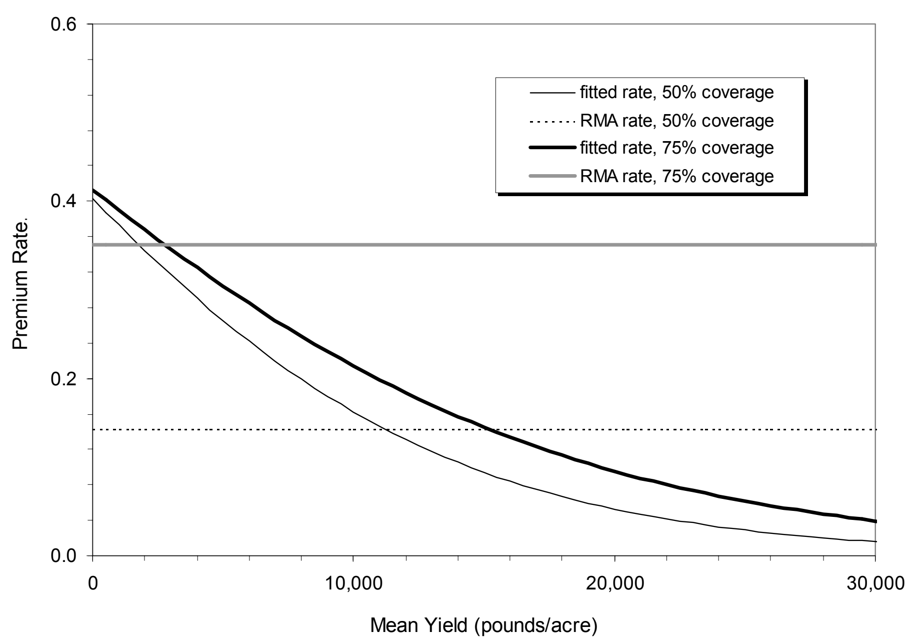

Figure 4. Fitted and 1999 RMA premium rates for peach crop insurance vs. mean of simulated peach yields for farms in the Ridge region of SC, 50% and 75% coverage levels

Table 3. Fitted Premium Rates and Risk Management Agency (RMA) Premium Rates for 1999 for Georgia and South Carolina Peaches, by Coverage Level

Location	Coverage Level 50%	65%	75%
NORTH AND SOUTH GEORGIA:			
Estimated premium rate for an average yield (lbs./acre) of:			
‣ 504 (lowest observed average yield)	0.507	0.515	0.518
‣ 2,854 (median observed average yield)	0.388	0.406	0.417
‣ 3,950 (mean observed average yield)	0.335	0.357	0.372
‣ 10,000	*0.124*	*0.151*	*0.172*
‣ 12,240 (highest observed average yield)	*0.081*	*0.104*	*0.124*
1999 RMA premium rates for:			
‣ Butts County (lowest county rates)	0.086	0.146	0.208
‣ Average for 10 counties [a]	0.134	0.230	0.327
‣ Hall County (highest county rates)	0.172	0.291	0.415
CENTRAL GEORGIA:			
Estimated premium rate for an average yield (lbs./acre) of:			
‣ 2,928 (lowest observed average yield)	0.186	0.219	0.243
‣ 7,483 (median observed average yield)	0.081	*0.106*	*0.128*
‣ 7,601 (mean observed average yield)	*0.079*	*0.104*	*0.125*
‣ 10,000	*0.049*	*0.069*	*0.087*
‣ 13,747 (highest observed average yield)	*0.023*	*0.035*	*0.047*
1999 RMA premium rates for:			
‣ Houston County (lowest county rates)	0.062	0.105	0.151
‣ Average for 7 counties [b]	0.080	0.136	0.195
‣ Macon County (highest county rates)	0.123	0.211	0.301
UPPER STATE AND COASTAL PLAIN SOUTH CAROLINA:			
Estimated premium rate for an average yield (lbs./acre) of:			
‣ 684 (lowest observed average yield)	0.501	0.512	0.516
‣ 6,055 (median observed average yield)	0.270	0.297	*0.316*
‣ 6,809 (mean observed average yield)	0.243	0.271	*0.291*
‣ 10,000	0.151	*0.178*	*0.200*
‣ 20,000	*0.027*	*0.038*	*0.050*
‣ 27,876 (highest observed average yield)	*0.006*	*0.010*	*0.015*
1999 RMA premium rates for:			
‣ Orangeburg County (lowest county rates)	0.116	0.199	0.284
‣ Average for 6 counties [c]	0.146	0.249	0.357
‣ Four Upper State counties [d] (highest county rates)	0.157	0.267	0.382

(continued . . .)

Table 3. Continued

	Coverage Level		
Location	50%	65%	75%
RIDGE SOUTH CAROLINA:			
Estimated premium rate for an average yield (lbs./acre) of:			
‣ 761 (lowest observed average yield)	0.380	0.390	0.395
‣ 6,813 (median observed average yield)	0.224	0.251	*0.269*
‣ 7,836 (mean observed average yield)	0.202	*0.231*	*0.251*
‣ 10,000	0.162	*0.192*	*0.214*
‣ 19,520 (highest observed average yield)	*0.056*	*0.079*	*0.099*
1999 RMA premium rates for:			
‣ Lexington County (lowest county rates)	0.114	0.195	0.278
‣ Average for 4 counties [e]	0.144	0.246	0.351
‣ Aiken County (highest county rates)	0.169	0.289	0.413

Notes: The fitted premium rates are obtained from the logistic functional form regressions reported in table 2. Fitted premium rates printed in italics are less than or equal to the corresponding RMA county premium rate averages.

[a] The counties are Banks, Butts, Hall, Morgan, Oconee, Spalding, and Upson in North Georgia, and Brooks, Colquitt, and Pierce in South Georgia.

[b] The counties are Bleckly, Crawford, Houston, Macon, Monroe, Peach, and Taylor in Central Georgia.

[c] The counties are Cherokee, Chesterfield, Greenville, Spartanburg, and York in the Upper State region of South Carolina, and Orangeburg in the Coastal Plain of South Carolina.

[d] Cherokee, Greenville, Spartanburg, and York counties in the Upper State region of South Carolina have common premium rates.

[e] The counties are Aiken, Edgefield, Lexington, and Saluda in the Ridge of South Carolina.

The empirical results show large differences between the estimated premium rates and the 1999 RMA rates. Similar results have been found for agronomic crops (Goodwin, 1994; Goodwin and Ker, 1998).

The fitted and RMA premium rates for the 50% and 75% coverage levels are graphed for the Ridge region of SC (figure 4).[13] In general, the estimated premium rates are higher than the 1999 RMA premium rates for low-yielding growers, and lower than 1999 RMA rates for high-yielding growers. Thus, the graph provides visual substantiation of the earlier conclusion. The graph provides additional insights about the procedures for rate determination for alternative coverage levels. Under the RMA rate-making practices for the 1999 and earlier peach crops in GA and SC, the county premium rates for alternative coverage levels were fixed proportions of the county premium rates for the 75% coverage level. The fixed proportions were 0.41 for 50% coverage, 0.48 for 55% coverage, 0.58 for 60% coverage, 0.70 for

[13] Graphs for the other coverage levels and the other regions are similar. These graphs are available from the authors upon request.

65% coverage, and 0.84 for 70% coverage. However, the estimated premium rates for alternative coverage levels are not fixed proportions of the rate for 75% coverage across regions or across average yields. In all regions, the estimated premium rates for coverage levels less than 75% are larger proportions of the 75% rate than the RMA fixed proportions.

As revealed by these results, the RMA fixed proportions were too small for all regions and all average yield levels. In addition, the actual differences in the estimated premium rates are smaller than the RMA differences. Therefore, these results indicate that the differences between the premium rates for different coverage levels should be smaller, both in percentage and absolute terms.

Conclusions

Our research findings suggest that the crop insurance rating structure for GA and SC peaches should allow premium rates to decrease with the grower's expected yield. Under the flat premium rate structure for the 1999 and earlier crops, the premium rates were too low for growers with low yields, especially for low coverage levels, and too high for growers with high yields, especially for high coverage levels. The expected losses have exceeded the premiums for growers with low yields, and have been less than the premiums for growers with high yields. The flat rates have encouraged participation by growers with low yields and discouraged participation by growers with high yields. To the extent that participation by growers with low yields has exceeded participation by growers with high yields, the loss ratios have exceeded unity. Our results explain both the high loss ratios for peach crop insurance in GA and SC and complaints from some GA and SC growers that the premium rates for their peach crop insurance have been too high.

Based on this research, the RMA has revised its rate structure for GA and SC peaches effective with the 2000 crop year. Under the new rate structure, premiums decline as the grower's APH increases.[14] This should encourage participation by growers with high yields (and relatively low yield risks) relative to growers with low yields (and relatively high yield risks). The revised rate structure cannot be expected to eliminate adverse selection in peach crop insurance because the relationship between relative yield risk and yield averages is not perfect. However, the revised rate structure should reduce its incidence.

[14] The grower's actual production history (APH) is indexed relative to the yield of the county (or region) in which the grower is located.

References

Atwood, J. A., A. E. Baquet, and M. J. Watts. (1996, September). "Rating procedures for IP expansion to fall seeded wheat." Unpub. staff paper, Department of Agricultural Economics and Economics, Montana State University, Bozeman.

Davis, S. B., T. J. Price, M. E. Wetzstein, and M. W. Rieger. (1997, November). "Reducing yield variation in peach orchards by geographic scattering." *American Journal of Agricultural Economics* 79(4), 1119–1126.

Driscoll, J. (1998, May). Senior Actuary. Personal communication, Risk Management Agency, Kansas City, MO.

Efron, B., and R. J. Tibshirani. (1993). *An Introduction to the Bootstrap.* New York: Chapman and Hall.

Georgia Agricultural Statistics Service. (1993-98). *Georgia Agricultural Facts* (various issues). Georgia Agricultural Statistics Service, Athens, GA.

Goodwin, B. K. (1994, December). "Premium rate determination in the Federal Crop Insurance Program: What do averages have to say about risk?" *Journal of Agricultural and Resource Economics* 19(2), 382–395.

Goodwin, B. K., and A. Ker. (1998, February). "Nonparametric estimation of crop yield distributions: Implications for rating group-risk crop insurance contracts." *American Journal of Agricultural Economics* 80(1), 139–153.

Greene, W. (1997). *Econometric Analysis*, 3rd ed. Upper Saddle River, NJ: Prentice-Hall, Inc.

Kmenta, J. (1986). *Elements of Econometrics*, 2nd ed. New York: Macmillan.

Knight, T. O., and K. H. Coble. (1997, Spring/Summer). "Survey of U.S. Multiple Peril Crop Insurance since 1980." *Review of Agricultural Economics* 19(1), 128–156.

Miller, S. E., K. H. Kahl, and P. J. Rathwell. (2000, April). "Revenue insurance for Georgia and South Carolina peaches." *Journal of Agricultural and Applied Economics* 32(1), 123–132.

Skees, J., and M. Reed. (1986, August). "Rate making for farm-level crop insurance: Implications for adverse selection." *American Journal of Agricultural Economics* 68(3), 653–659.

South Carolina Agricultural Statistics Service. (1959–98). *South Carolina Agricultural Statistics* (various issues). South Carolina Agricultural Statistics Service, Columbia, SC.

U.S. Department of Agriculture, National Agricultural Statistics Service. (1956–98). *Noncitrus Fruits and Nuts* (various issues). USDA/NASS, Washington, DC.

U.S. Department of Agriculture, Risk Management Agency. (1999a). County actuarial tables for Georgia and South Carolina peaches. Online. Available at http://www.rma.usda.gov/tools/. [Retrieved June 1999.]

———. (1999b). Farm yield data for Georgia and South Carolina peaches. USDA/RMA, Kansas City, MO.

———. (1999c). Loss ratio data for Georgia and South Carolina peaches. USDA/RMA, Kansas City, MO.