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INTRODUCTION

Agriculture is perceived as a very risky occupation. Whenever weather plays a role in the production of a commodity, the uncertainty increases. As Goodwin and Smith observed, agricultural production is subject to unpredictable, random shocks caused by weather events, pest damages and other natural disasters. The randomness of supply as well as the inelasticity of demand creates peril for farmers. Historically, policy makers have justified a wide range of government programs directed towards the support and stabilization of agricultural prices and incomes. In 1938, legislative efforts to provide protection against crop losses from multiple risks resulted in the establishment of a federal crop insurance program through the Crop Insurance Act. The program was discontinued briefly between 1943 and 1945, but has generally maintained many of its original features for approximately forty years. The Federal Crop Insurance Act of 1980 expanded the crop insurance program by offering several premium subsidies to producers to encourage participation.

The major objective of the Federal Crop Insurance program is to create an actuarially sound, subsidized insurance that will eliminate the need for other disaster assistance. Attainment of this goal had been questioned by Williams et al. who observed: " Although the 1980 act expanded the scope of crop insurance and made it more available, Congress continued to provide disaster assistance to farmers via emergency loans and direct payments because the number of acres covered by crop insurance remained below the 50% goal established for the program in 1980…As a likely result of adverse selection and rigid premiums, indemnities paid to farmers in each year from 1980-88 exceeded premiums collected. The loss ratio from 1981 to 1988 was

1.56 and exceeded Congress's mandate of 1.0." A loss ratio (indemnity/premium) of 1.56 means that indemnities paid out exceed premiums collected by 56%. Goodwin (1993) reported an average participation elasticity of –0.32 and an aggregate demand elasticity of –0.73. He devised an interaction term between premium rate and a loss-risk variable (constructed as the average of the county's ten-year loss ratio divided by the state average loss ratio for the year) to examine whether premium response was conditional on a farmers' risk level. The resulting elasticity suggested that counties with low risks have more elastic demand responses than counties with high risk. The importance of this result, as suggested by Goodwin, is that raising the premium rates for all producers would result in cancellations by low-risk producers thereby increasing the industry loss ratios by even more. Thus, Goodwin's results do not support the use of secular premium rate increases as a solution to the problem of high program loss ratios.

Adverse selection and moral hazard are considered to be the primary factors in the high crop insurance loss ratios. Moral hazard occurs not only in the crop-insurance, but in general insurance markets too. Primarily, two factors cause moral hazard. As Knight and Coble observed, " 1) Insureds must take less care to prevent losses than they would if uninsured, thus increasing there expected losses or indemnities. 2) Insurers must be unable to observe and incorporate the insureds' reduced care into their premiums, such that premiums are inadequate to cover expected indemnities plus administrative costs." Miranda has argued that adverse selection is the primary cause of actuarial unsoundness (loss ratio > 1.0) in the crop insurance programs. Adverse selection arises if producers are better able to ascertain their likelihood of suffering losses than are insurers. Skees and Reed and Goodwin have examined the potential for adverse selection created through possible misclassification of producer riskiness based on historical mean yields for the insured unit. Skees and Reed also examined the appropriateness of equal premiums for farms with different mean yields. Their results support the FCIC practice of charging lower rates to farms with higher mean yields. Goodwin investigating along the same lines found that rate-setting practices with only average yield considerations would introduce adverse selection into the pool of insureds.

Knight and Coble (1999) examined a second potential cause of adverse selection relating to a controversial crop insurance contract provision which allows farms to be optionally subdivided into separate insured units based on production parameters. Insured units are divided into two types: basic and optional. A basic unit is all of a farmer's acreage of a crop, owned or leased. A landlord who leases out his land to different farmers owns different basic units. Optional units are sub-divided basic units. Location and crop production practices define these. Different farming practices, like dryland versus irrigated production also define different optional units too.

This paper examines the appropriateness and adequacy of several adjustments that are incorporated into crop insurance rates to correct for the heterogeneity of risks among insureds. Specifically, the factors are optional subdivision, farming practice (irrigated or dryland), mean yield, reported acres, coverage level, and penalties imposed for having less than a required amount of historical yields for establishment of the insured yield. The plan of the paper is as follows. First I outline the aspects of Federal Actual Production History Program (APHP) premium rate structure. Next I explain the data and estimation procedures. This is followed by results of the analysis. Finally, suggestions for improvement are offered.

PREMIUM RATE STRUCTURE OF APHP

The APHP contract is tailored to reflect differences in riskiness across counties and among individual insureds within a county. Driscoll (1988, pp. 28-30) observed that there are three approaches to ratemaking. There are the pure premium approach, loss ratio approach and judgement. The basic ratemaking procedure used by the FCIC is an empirical application of the pure premium approach, which is similar to the experience rating suggested by Driscoll, but with several added adjustments that are based on analysis of underlying relationships for different crops and geographical location. Milliman & Robertson (M&R) have said, " For long term efficiency, it is imperative that the procedure for determining rates be responsive to changing conditions and distribute costs equitably among producers. Failure to do so will result in rates not representative of current conditions and less than optimal levels of participation of low cost producers."

Millman & Robertson identify three general steps in a producer's rate calculation. They were

1) Compilation of experience data.
2) Development of county rates
3) Calculation of producers rates.

The producer data for the most recent twenty years are compiled at the county level. These include acres insured, acres indemnified, liability, premium, indemnity, number of policies indemnified, number of units indemnified and average coverage levels. Producers whose loss experience exceeds certain criteria are segregated into a separate high-risk pool. The remaining data are summarized at the county level and the liability, premium and indemnity data are adjusted to a common coverage level.

Milliman & Robertson explain the calculation of coverage levels to a common ground. The county level experience is based on a number of producers with different coverage levels. To achieve an appropriate balance of responsiveness and stability in the rates, it is necessary to consider both the lengths of the experience period and the weighing assigned to the individual years in the experience period. They recommended that the FCIC practice of equally weighing the most recent twenty years of experience be retained. They continue by explaining a formula to convert indemnity at a given coverage level for a county to the 65% coverage level

It is as follows

$$I_{65\%} = I_c + (L_{65\%} - L_c) \times \frac{A_{ind}}{A_{ins}} \left(\frac{I_c}{\left(4.4 - 0.14431c + 0.001415c^2\right)} - I_c \right) \times \frac{1 - A_{ind}}{A_{ins}} \times \left(0.65 - c\right)$$

C = Average coverage level

I_c = Indemnity at coverage level C

L_c = Liability at coverage level C

A_{ind} = Acres Indemnified

A_{ins} = Acres insured

Milliman & Robertson explain the development of county rates from the experience data. There are 3 steps. First there is the development of target rates. Target rates are those rates that have not yet been adjusted for maximum allowable annual increase or decrease. The second step is the “smoothing” of target rates to reduce differences in the surrounding counties. The smoothed rates are known as “unloaded” rates. Third is adding of loads in the rate formula. Loads are added for practice type, unit division, disaster reserve and catastrophic losses.

County unloaded rates are calculated using the smoothed county unloaded target rates. There is a pre-determined annual maximum percentage increases or decreases specified by Congress in comparison to the prior years’ rates. The rates are loaded for the disaster reserve, catastrophe provision, unit division and practice type. To determine a producers' 65% base coverage rate, two rate expansion factors are considered: yield span exponentials and coverage level differentials.

The ratemaking formula is:

$$BaseRate = \left[CF(\delta)\right] \times \left[\frac{\dfrac{CountyUnloadedRate \times (YieldSpanRatio)^{Exponential}}{reservefactor} + CatastropheRate}{UnitDivisionFactor} \right]$$

Yield Span ratio is the ratio of the producers' historical average yield to the county average yield. This can be illustrated with a simple example. Here, I assume there is no catastrophic rate. If the average yield of a county is 40 bushels, a producer with an expected yield of 30 would have a yield span ratio of 30/40 = 0.75. There are nine categories of yield spans based on the yield span ratio: mean yields below 0.5 of the county yield, seven evenly spaced yield spans between 0.5 and 1.5 of the county yield and yield span 9 for mean yields greater than 150% of the county yield.

The exponential takes three alternative values for different crops: -1, -1.2 and –1.5. With no catastrophic load, an exponential of –1.0 results in a constant premium per acre. If a producer's expected yield is one-half the county average expected yield, the producer's *yield* *span ratio* would be 0.5. Combined with an exponential of -1.0, the county unloaded rate would be multiplied by a factor 2($2 = 0.5^{-1}$) which offsets the impact of lower expected yield on the premium, maintaining a constant premium per acre.

An exponential less than –1.0 produces a premium per acre that is higher for producers with lower expected yields. If we multiply the example above with an exponential of –1.5, it would multiply the county unloaded rate by a factor of 2.8($2.8 = 0.5^{-1.5}$). This will create higher loss cost for producers with lower yields (M&R).

The exponents of –1.0, -1.2 and –1.5 represent the slope of the curve graphing the base rate % as a percent of liability against the *yield span ratio*. The yield span ratio is $R_y = Y_i / Y_c$, where Y_i is the APH yield for the insured unit and Y_c is the RMA (formerly FCIC but now Risk Management Agency) established mean yield for the production practice in the country. An illustration of the curve graphing the yield spans with the base rate is given in figure 1. The base rate differential is steep at the lower yield spans, but becomes much more flat at higher yield spans. Also, for higher absolute values of exponential, the rate differential is steeper. The unit division factor is usually equal to 0.9. It is an incentive offered to the farmers for insuring as a basic unit rather than as an optional unit. $CF(\delta)$ is the coverage factor which adjusts for different coverage levels of the insured units. If the coverage level of the insured unit is 75%, the coverage factor is 1.0. If the coverage level of the insured unit is 65%, the coverage factor is 0.65. If the coverage level is 50%, the coverage factor is 0.47. *Reserve factor* is a measure of the systemic risk that cannot be eliminated through pooling. It is a multiplicative load factor of 0.88.

DATA AND ANALYSIS

The APHP *liability* is the product of APH yield, coverage level, price election and acreage. The APHP *indemnity* is equal to zero if the realized yield is greater than or equal to the insured yield. If the realized yield is less than the insured yield, then the indemnity is equal to the shortfall times acreage and price election. The *loss ratio* is a ratio of indemnity to the total premium of the unit. It is a measure of the unit-level losses in my analysis.

The *loss ratio* may be used as a measure of the effectiveness of corrections made to the rate structure, such as those for mean yield discussed by Skees and Reed and Goodwin and for optional unit subdivision as examined by Knight and Coble (1999). It measures whether the corrections made are consistent with differences in loss experience.

Coverage levels from 35% to 75% of the APH yield were offered during the study period. More than 95% of the liability insured under the APHP is under the two coverage levels, 65% and 75%. In my analysis, I represent coverage level as a dummy variable that equals zero when the unit is insured at 65% and equals one when the unit is insured at 75%. If the coverage level of the insured was not equal to either of these, I eliminated them from the analysis.

Actual Production History yields and indemnity records from 1992 through 1996 were obtained from the FCIC. County yields were obtained from National Agricultural Statistical Service. County dummy variables were incorporated for the counties defined, to capture the variability of riskness across counties. Year dummy variables were incorporated to explain the effects of year-specific program factors that might affect the loss. The other variables that are included are *optional, 75% coverage level, % irrigated, yield span ratio, 35% penalty, 20% penalty, 10% penalty, yield ratio, ownership share, acreage*. These variables are defined in Table 1.

Seventy five percent coverage level is a dummy variable that equals 1 when insured at 75% and 0 if insured at 65%. Percent irrigated is the percentage of liability that is on irrigated acreage. *Yield span ratio* is the ratio of the yield of unit to the estimated county yield. *35% penalty* is the dummy variable that is equal to 1 if a 35% penalty on t-yields was applied to APH calculation due to provision of no actual yields in years 1994-96. *20% penalty* is a dummy variable equal to 1 if a 20% penalty was applied to APH calculation due to provision of a year of actual yield in years 1994-96. *10% penalty* is a penalty on t-yields applied in the APH calculation due to provision of only 2 years of actual yields in years 1994-96. *Yield ratio* is the ratio of actual to predicted county yield in the year. It is included in the model to account for general production conditions in each year, at the county level. *Ownership share* is the percentage share of the crop that is owned by the insured. This is included in the model to reflect the differences in loss-reporting incentives for owners of a large interest in production from a unit versus those whose ownership interest is small. *Acreage* is the total acres in the insured unit. This variable is included to account for the differences in losses that may occur due to size differences among insured units. *Optional* is included to account for the difference in loss ratios due to optional subdivision. A 10% discount is offered for the units that are not optionally subdivided. *Yield span ratio* is incorporated to examine the appropriateness of the yield span ratio adjustment as represented in figure 1.

DATA

Wheat insurance data for the period 1992-96 are used in my analysis. The states on which the modeling was done were Colorado, Minnesota, Montana, Oklahoma, Missouri, Washington, Nebraska, South Dakota, Texas, Kansas, and North Dakota. The number of observations and the mean values of the variables are given in Table 2. The number of observations range from 16,000 for Washington to 513,000 for North Dakota. Average insured acreage varies from 44.5 in Missouri to 133 acres in Texas. The average size of an insured unit is higher for Washington (321 acres). The percentage of units insured at coverage level of 75% ranges from 1% for Colorado, South Dakota and Texas to a very high 84% for Washington. Averages for the o*wnership share* was between 50% for Washington to 82% for Minnesota. Means of y*ield span ratio* ranged from 0.83 for Washington to 1.48 for Texas. The *35% penalty* is applied to 5% of insured units in Kansas and North Dakota to 14% of the insured units in Missouri. The *20% penalty* is applicable to 4% in Colorado, Minnesota, Washington and North Dakota up to 10% in Missouri. The *10% penalty* was imposed on less than 7% of insured units in all states. The values were 4% for Colorado, Minnesota, Montana, Washington, Kansas and North Dakota. The *10% penalty* was applicable to 6% of the farmers in Nebraska and Texas and 7% of the farmers insured in Missouri and Oklahoma. *Yield ratio*, which takes a value of 1 when the realized county yield is equal to predicted county yield for the year, took values in 0.9's for most of the states except Oklahoma (0.84). Its' high was 1.19 for Montana, indicating a very favorable production year.

ESTIMATION PROCEDURE

The estimation method used is a Tobit procedure. The left-hand side variable, loss ratio, is left censored at zero. A zero value is obtained when there is no indemnity and since it was left censored, there were no values below that. Loss ratios up to five or six have been observed. Tobit modeling is generally used when there is an activity observed if a variable attains a value beyond certain threshold level. According to Kennedy, " Tobit contains elements of regression

(Here the regression of loss ratios that occur when the indemnity is above a certain limit) and probit (the chance of indemnity being above a certain level)".

Tobit modeling is generally used when the dependent variable is censored. The general formulation of the tobit is usually given by an index function (Greene, 1993) as follows;

$$Y_i^* = \beta' X_i + \varepsilon_i$$

$$Y_i = 0 \qquad \text{if } Y_i^* \leq 0,$$

$$Y_i = Y_I^* \qquad \text{if } Y_i^* > 0.$$

For an observation randomly drawn from the population,

$$E[y_i|x_i] = \varphi\left(\frac{\beta' x_i}{\sigma}\right)(\beta' x_i + \sigma\lambda_i) where$$

$$\lambda_i = \frac{\phi(\beta' x_i|\sigma)}{\varphi(\beta' x_i|\sigma)}$$

The right-hand side variables include county dummy variables, numbering one less than the number of counties in the state. Other dummy variables are year dummies for crop years between 1993 and 1996, *35% penalty*, *20% penalty*, *10% penalty* and *75% coverage level*. The other variables are *yield span ratio*, *yield ratio*, *ownership share* and *acreage*.

The equation is as follows:

$$LR_{it} = \alpha + \beta_1 75\% \, coveragelevel_{it} + \beta_2 \% irrigated_{it} + \beta_3 optional_{it} + + \beta_4 yieldspanratio_{it} + \beta_5 35\% \, penalty_{it}$$
$$+ \beta_6 20\% \, penalty_{it} + \beta_7 10\% \, penalty_{it} + \beta_8 acreage_{it} + \beta_9 share_{it} + \beta_{10} yieldratio_{it} + \sum_{t=1}^{4} \delta_t year_{it}$$
$$+ \sum_{c=1}^{C-1} \beta_c county_{ci} + \varepsilon_{it}$$

where LR_{it} is the loss ratio for insured unit *i* in time *t*; $county_{ci}$ is the vector of dummy variables for *C-1* of the *C* counties in the state. If a county had less than 50 observations, it was eliminated. $Year_{it}$ is the dummy variable vector depicting the years 1993-96. The rest of the dummy variables and the continuous variables are consistent with earlier definitions. Finally, α is the intercept term and ε_{it} is a random disturbance.

RESULTS

My objective is to examine whether the corrections made to the premium rates adequately reflect differences in the loss ratios among insured units. Table 3 gives the parameter estimates and significance of the variables included in the models. Examining these results , we observe that the 75% coverage level variable is not statistically significant at the 10% level in seven states. This means that the rate differencial for the coverage of 75% and 65% are adequate for the seven states. Parameter estimates are positive and significant for Montana, Nebraska, Kansas and North Dakota. This means that, in these states, units insured at the 75% coverage level have higher loss ratios than those insured at the 65% coverage level. The rates in these states are too low for 75% coverage level compared to 65% coverage level.

Results for irrigated versus dryland production are very mixed. The rate differential for irrigated units results in a loss ratio that is not significantly different than that for dryland units in only three of eleven states. Among the other states, irrigated units have higher loss ratios in Montana, Nebraska and North Dakota and lower loss ratios in Colorado, Minnesota, Oklahoma, Washington, Texas and Kansas. These mixed results support the conclusion that the corrections for irrigated versus dryland production are generally inadequate, offering only state-specific guidelines as to the nature of the inadequacy. This suggests a need for additional analysis to further explore underlying relationships which give rise to difference in riskiness of irrigated and dryland production.

Optional is not significant for seven out of the eleven states. The states in which *optional* is significant are Minnesota, South Dakota, Texas and Kansas. In all these states except one, Minnesota, the sign on the significant parameter estimate is positive. In general, this supports the conclusion that a null hypothesis that the current 10% differential for optional subdivision is appropriate cannot be rejected at the 10% level of significance in majority of the states. Estimated loss ratios are higher for optional than the basic units in three states: South Dakota, Texas and Kansas. These results suggest that the surcharge of 10% for optional subdivision imposed in 1988 is considered generally appropriate, but is inadequate to correct for higher losses in three states.

The corrections applied for *yield span ratio* are adequate for only three states. This means that the risk across each yield span is not correctly captured by the premium rate structure of the APHP. The parameter estimates are positive and significant for seven states. This finding of higher loss ratios for units having higher yield span ratiosindicate that the premium rate discounts offered for units with higher yield span ratios are too large. Refering to Figure 1, my results indicate that the current yield span exponential for wheat of –1.5 results in rates that decline too steeply with yield span rates. This is an important result which supports results obtaind by Knight and Coble which indicated a need for corrections to the central element of the APHP rate structure.

Parameter estimates of the penalty imposed, for not providing any actual yield history, *35%penalty*, were negative and significant for nine states. This means that the penalty imposed was too large for producers in Minnesota. The variable was not significant in Minnesota and was positive and significant in Montana.

Parameter estimates for the penalty imposed for providing only one year of actual yield history, *20% penalty*, were negative and significant for 9 states. Here the implication is same as above: loss ratios do not warrant premium penaltiesas large as currently imposed.

Parameter estimates of the penalty imposed for providing only two years of actual yield history, *10% penalty*, was not significant for six states and negative and significant for the rest. This is a very mixed result. It means that the 10% penalty was adequate for six states and was too much for five states.

Reported acres is positive and significant for nine states. This means that higher loss ratios are obtained for larger units. This is counter-intuitive to the expectation that larger units are composed of more heterogeneous soils and will have less highly-correlated yields than small units. A possible explaination may be that the higher the acreage, higher will be the incentive for reporting a loss.

Ownership share is positive and significant in 10 states. This means that the larger the share that an individual holds in an insured unit, the larger will be his loss ratio. This is intutive, because large ownership share provides greater incentive to incur the cash and oppurtunity costs of time and effort to report and validate a loss.

Yield ratio is negative and significant in nine out of the eleven states analysed. This means that the loss ratio in a county would be higher in a year where the county yield is higher than the normal and vice-versa. The inclusion of this variable is justfied because it is the best available measure of production conditions of the county in that year.

SUMMARY AND CONCLUDING STATEMENTS

My results show that the various loads imposed in the premium rate structure is adequate only for optional subdivision and *75% coverage level*. This is an important result especially because I find that *yield span ratio*, which is in the base rate calculation is not correctly capturing the risk differencial between the different yield spans. The penalties imposed for not providing three years of yield history are found to be generally higher than warranted. *Ownership share* and *acreage* indicate that higher the *acreage* or *ownership share*, the higher the incentive for reporting a loss.

Since the beginning of the crop insurance program, the FCIC has been trying to reduce the losses they incur. My analysis examined a part of the puzzle, i.e., whether premium adjustments correctly account for differences in loss experience among individual insureds. The results are important because it poses the challenge for further analysis into why some adjustments are not well calibrated. With the availabilty of so much data from the RMA(former FCIC), one could estimate similar procedure for other crops as corn, sorghum, soybeans, cotton and tobacco.

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Table 1: Number of Significant and Non-Significant Variables in the Models of Wheat Loss Ratios

STATE	**POSITIVE & SIGNIFICANT**	**NEGATIVE & SIGNIFICANT**	**NON-SIGNIFICANT**
COLORADO	**2**	**4**	**4**
MISSOURI	**3**	**4**	**3**
MINNESOTA	**3**	**3**	**4**
MONTANA	**5**	**1**	**4**
OKLAHOMA	**2**	**4**	**4**
WASHINGTON	**3**	**4**	**3**
NEBRASKA	**4**	**3**	**3**
SOUTH DAKOTA	**4**	**4**	**2**
TEXAS	**4**	**4**	**2**
NORTH DAKOTA	**3**	**4**	**3**
KANSAS	**4**	**6**	**0**

Table 2: Number of Observations and Means of Variables Included in Models of Wheat Loss Ratios

VARIABLE/ STATISTIC	CO	MO	MN	OK	MT	WA	NE	SD	TX	KS	ND
Number Obs(1000's)	46	20	77	125	77	16	140	88	69	503	513
75%Coverage Level	0.01	0.10	0.06	0.06	0.39	0.84	0.09	0.01	0.01	0.05	0.09
Irrigated	0.09	0.00	0.00	0.03	0.39	0.04	0.03	0.00	0.29	0.03	0.00
Optional Dummy	0.68	0.27	0.77	0.64	0.74	0.36	0.53	0.71	0.49	0.53	0.82
Yield span ratio	0.99	1.02	1.10	1.20	1.03	0.83	1.00	0.87	1.48	1.05	0.92
35% Penalty	0.06	0.14	0.07	0.09	0.08	0.07	0.08	0.09	0.08	0.05	0.05
20% Penalty	0.04	0.10	0.04	0.06	0.05	0.04	0.06	0.06	0.06	0.05	0.04
10% Penalty	0.04	0.07	0.04	0.07	0.04	0.04	0.06	0.05	0.06	0.04	0.04
Reported Acres	129	44.5	109	110	170	321	69.0	101	133	82	111
Ownership Share	0.65	0.68	0.82	0.67	0.70	0.50	0.64	0.75	0.64	0.59	0.73
Yield Ratio	0.93	0.98	0.98	0.84	1.19	1.03	0.99	1.00	1.00	0.96	1.05

Table 3: Parameter Estimates and Significance of the Variables included in the Wheat Loss Ratio Models

Variable/ Statistic	CO	MO	MN	OK	MT	WA	NE	SD	TX	KS	ND
75% Coverage	0.5680	-0.3762	-0.1184	0.5680	1.1284*	-0.3762	0.7305*	-0.0555	-0.1842	1.0093*	1.6855*
Irrigated	-0.4796*	-2.6301	-4.4895*	-0.4796*	3.4746*	-2.6301	1.8263*	0.3949	-3.0021*	-0.5697*	5.6359*
Optional Dummy	0.0790	-0.2215	-0.4680*	0.07900	-0.2161	-0.2215	-0.1377	0.1835*	0.2251*	0.08567*	0.0966
Yield Span Ratio	0.8356	1.769*	3.6580*	0.8356	0.3084*	1.7686*	1.7209*	2.0913	0.6171*	1.4628*	-4.525*
35% Penalty	-0.1927*	-0.9863*	0.01162	-0.1927*	0.4240*	-0.9863*	-1.1317*	-1.5170*	-0.6834*	-1.5127*	-1.0751*
20% Penalty	-0.6229*	-1.2167*	-0.1706	-0.6229*	0.3398	-1.2167*	-0.7990*	-0.9613*	-0.4944*	-1.2478*	-1.2345*
10% Penalty	-0.3669	-0.5787*	0.0037	-0.3669	-0.0153	-0.5787*	-0.3786*	-0.4883*	-0.1114	-0.4646*	-0.1978
Reported Acres	0.0014*	0.0029*	0.0023*	0.0014*	0.0008*	0.0029*	0.0003	0.0013*	0.0020*	-0.0013*	-0.0003
Ownership Share	0.5227	1.4912*	0.4302*	0.5227*	0.9410*	1.4912*	0.9489*	0.8509*	1.0296*	1.0681*	1.2858*
Yield Ratio	-12.178	-14.835	-10.486*	-12.176*	-14.736*	-14.831*	-21.515*	-16.627*	-5.7408*	-21.6707*	-28.586*

* An asterisk represents the significance of the parameter estimate at 10% level.

Table 4:Definition of Variables included in Models of Loss Ratios

Variable	Definition
75% Coverage level	Dummy variable Equal to 1 if the unit is insured at 75% level and 0 if insured at 65% level
% Irrigated	Continuous variable indicating % of liability in the insured unit that is on the irrigated acreage
Optional Dummy	Dummy variable equal to 1 if the unit is insured as an optional unit and 0 if insured as a basic unit
Yield Span Ratio	Continuous variable equal to the ratio of the unit APH yield to the estimated county yield for the year
35% Penalty	Dummy variable equal to 1 if a 35% penalty on t-yields was applied in the APH calculation due to provision of no actual yields in years 1994-96
20% Penalty	Dummy variable equal to 1 if a 20% penalty on t-yields was applied in the APH calculation due to provision of only 1-year of actual yields in years 1994-96
10% Penalty	Dummy variable equal to 1 if a 10% penalty on t-yields was applied in the APH calculation due to provision of only 2-years of actual yields in years 1994-96
Reported Acres	Total Acreage in the insured unit
Ownership Share	Percentage share of crop on the unit that is owned by the insured
Yield Ratio	Ratio of actual to predicted county yield in the year
Price Election	Price at which any insured yield loss is indemnified. During the study period, price elections from 50% to 100% of an estimated harvest-period price were available to the insureds.

T-yields are proxy yields used in the APH yield calculation when actual yields for the insured unit are not available. Prior to 1994, the APH yield was the simple average of 10 years of actual and/or t-yields. In years 1994-96, a simple average of actual yields was used for insureds who provided at least four years of history. APH yields for insureds who provided less than four years of actual yields were augmented with t-yields to complete a four-year series, with penalties applied to the t-yields if fewer than three years of actual yields were provided.

Appendix
Table 1: Significant Typing of Variables Included in Models of Loss Ratios

VARIABLE	**POSITIVE AND SIGNIFICANT**	**NEGATIVE AND SIGNIFICANT**	**NON SIGNIFICANT**
75% Coverage level	4	0	7
% Irrigated	3	5	3
Optional Dummy	3	1	7
Yield span ratio	7	1	3
35% Penalty	1	9	1
20% Penalty	0	9	2
10% Penalty	0	5	6
Reported Acres	8	1	2
Ownership Share	10	0	1
Yield Ratio	0	9	2

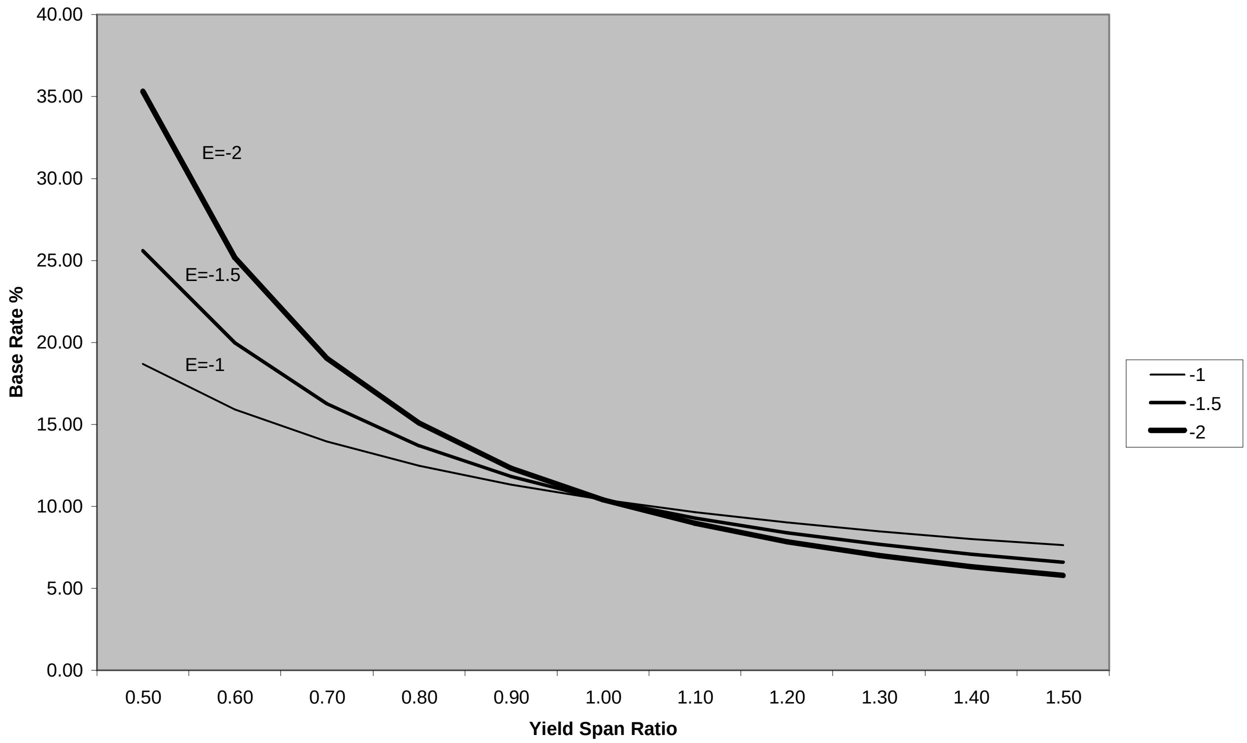

Figure 1: APH program base premium rates(stated as percent of liability insured) based on yield span ratios