The FAPRI Baseline Model of the Federal Crop Insurance Program

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THE FAPRI BASELINE MODEL OF THE FEDERAL CROP INSURANCE PROGRAM

Since 1986 the federal crop insurance program has changed in several ways. The number of covered crops has increased dramatically. Insured acres rose from 49 million acres in 1986 to a maximum of 221 million acres in 1995. Total premiums have risen from $380 million in 1986 to $1.77 billion in 1997. New styles of crop insurance policies, such as area yield insurance and revenue insurance, have been introduced. In 1986, producers paid, on average, 74 percent of the total premiums. That figure dropped to 49 percent in 1997.

Each of these changes has had a significant impact on the costs of the program. The government's total financial obligations due to crop insurance for 1995-97 have nearly doubled those for the years 1986-88. Fiscal outlays have nearly tripled over the same period. Due to the increasing importance of crop insurance to agriculture's risk management strategy and to the possible budgetary impacts any changes in crop insurance performance or activity might have, the Food and Agricultural Policy Research Institute (FAPRI) has developed a baseline model for the federal crop insurance program. This report outlines the construction of the model, previews preliminary results, and puts forth ideas for possible extensions.

Recent Changes in Crop Insurance

Many changes have occurred to the federal crop insurance program since 1990.[1] Congressional acts in 1990 and 1994 set guidelines for premium adjustment, created catastrophic coverage (CAT) policies, increased premium subsidies, made crop insurance mandatory for government program participants,[2] and limited the possibility of *ad hoc* disaster aid. More crop insurance options became available as the choice of percentages of yield guarantees and price elections was expanded. Three revenue insurance products have been introduced to the market:

[1] For a brief historical description of the program before 1990, see Hart and Smith 1996.

[2] This provision was removed the next year.

Crop Revenue Coverage (CRC) and Income Protection (IP) in 1996 and Revenue Assurance (RA) in 1997. The Standard Reinsurance Agreement (SRA)[3] has been renegotiated twice.

And such changes are occurring at an even more rapid pace, as can be seen from recent CRC expansions, illustrated in Figure 1, and the changes embedded in recently approved legislation. For example, the Agricultural Research, Extension, and Education Reform Act of 1998 will impact crop insurance in several ways, such as through administrative and operating expense reimbursements, sales commissions, and loss adjustment expense reimbursements. Research and development expenses will be capped at $3.5 million per fiscal year. Producer-paid fees will increase for both catastrophic and buy-up coverage.

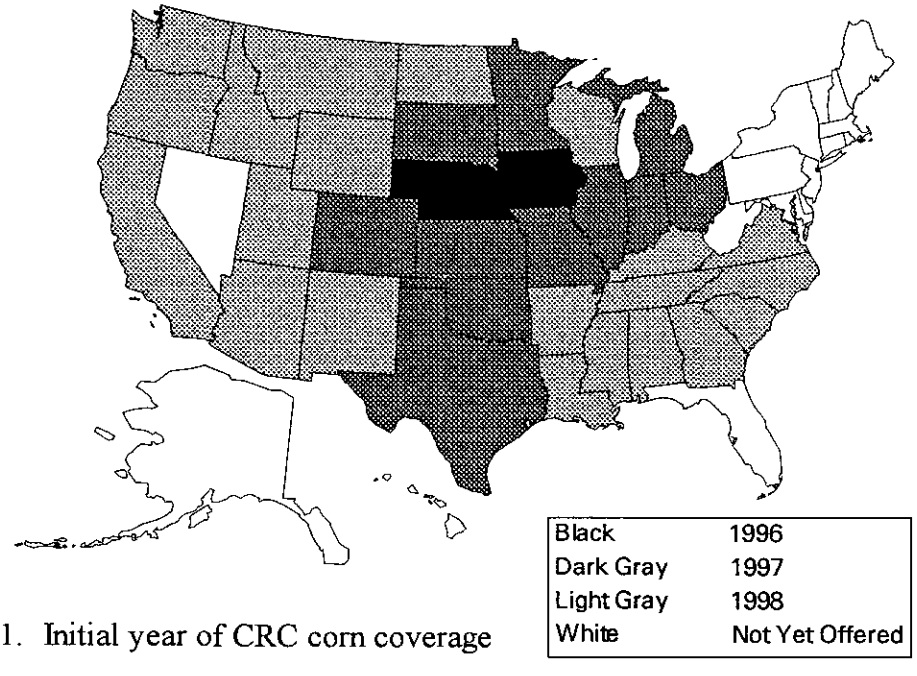

Figure 1. Initial year of CRC corn coverage

Because one of FAPRI's roles is to be a provider of government cost estimates for various agricultural programs, we have been asked to examine crop insurance. These requests have become more frequent. To answer these requests, FAPRI has built a crop insurance baseline model. A formal model is required to maintain consistency with FAPRI projections of prices, acres planted, farm income, and government costs. The primary goal of the approach taken here

[3] The SRA is an agreement between the Federal Crop Insurance Corporation and private insurance companies that sets the rules and financial obligations for the sale, service, and reinsurance of federal crop insurance contracts.

is to maintain this consistency. The model is presented in this paper and potential enhancements are described.

A Description of the FAPRI Insurance Baseline Model

The FAPRI Insurance Baseline combines historical crop insurance data with FAPRI projections of national agricultural production and prices to project the performance and costs of the federally subsidized crop insurance program over the next decade. Projections are made for the number of acres insured, total premiums, total premium subsidies, total producer-paid premiums, total indemnities (insurance payments), the total participation rate, loss ratios (indemnities/premiums), and various costs associated with crop insurance. The models that form the insurance baseline are contained and calculated in an SAS-Excel framework using dynamic data exchange to transfer information between the programs.

To begin, we have created an historical crop insurance data set, which is updated frequently.[4] This data set tracks relevant insurance variables at several levels of aggregation (national, by state, by crop, etc.). The data include the number of insured acres, premiums, indemnities, premium subsidies, liabilities, price elections, futures prices, and various costs, such as underwriting, delivery expenses, and administrative and operating expenses. A vast majority of these data are obtained from the Risk Management Agency (RMA) web site through the Summary of Business reports, the Manager's bulletins, and the Research & Development bulletins. Other data sources include federal budget reports, commodity market yearbooks, U. S. Department of Agriculture publications, and other RMA communications. These data are combined with historical production and price data and employed to form models and assumptions about future crop insurance activity. Once the models and assumptions are set, we use the FAPRI projections of national agricultural production and prices to provide the basis for the crop insurance projections.

To track the eligibility of acres for crop insurance, we combine county crops data from the National Agricultural Statistical Service (NASS) with the listing of eligible crop-county combinations for crop insurance. Given these data, we compute the proportions of total planted

[4] Current year data are periodically revised as policy information is updated. Some insurance data from RMA are updated weekly.

acres eligible for crop insurance. These proportions are employed throughout the projection period. Under the baseline set-up, only those expansions that have been approved are included in the analysis. This follows the FAPRI baseline procedure of adhering to the current policy structure.

There are separate models for various crop-policy combinations. The crops incorporated into the analysis are the eight major crops (barley, corn, cotton, oats, rice, sorghum, soybean, and wheat) and a non-eight crops aggregate. Expanding the crop list would be one area for future extensions. The insurance policy types modeled are catastrophic coverage (CAT), traditional multiple-peril crop insurance (APH, Actual Production History), the Group Risk Plan (GRP), Crop Revenue Coverage (CRC), Income Protection (IP), and Revenue Assurance (RA). Most of the variables are modeled at the national level, but some, like underwriting costs, require a more disaggregated approach. Future expansions of the modeling structure would move the models to a regional- or state-level focus.

Price projections are based on historical ratios of FAPRI farm prices and the relevant insurance prices for the various policies. Total eligible acre changes follow the changes in the estimated planted acres for the eight major crops from the FAPRI baseline projections. Insured acres, by crop and policy, are based on historical participation and updated for insurance policy area expansions. Modeling participation would be another worthwhile extension. We assume that crop insurance participants, on average, purchase 65 percent yield/100 percent price coverage on all buy-up policies. Since the policies have different coverage areas,[5] yields are adjusted to reflect these area differences by examining historical differences in yields among coverage areas.

We state premium rates as cost per dollar of insurance liability. Projections of premium rates are calculated from the most recent year's figures, insurance price movements, and an inflationary component. The premium subsidy rates follow historical data, insurance price movements, and the APH subsidy structure for 65 percent yield/100 percent price coverage. Insurable yields are calculated as five-year averages of past yields where actual yields are used when available and trend yields are employed in projection years. Total liabilities equal the product of the insured acreage, the insurable yield, and the insurable price.

[5] For example, for corn, the APH policy can be obtained virtually throughout the nation, whereas the RA policy can only be obtained in Iowa.

Projected yields are computed, by crop and policy, as the product of the national projected yield from the FAPRI baseline and the yield adjustment factor explained above. To compute indemnities, we find trigger yields, yield figures that represent the upper bound at which indemnities would be collected. The calculation of the trigger yields is dependent on the policy (i.e., the formula to compute the trigger yield for APH policies differs from the formula for CRC policies).

The indemnity structure is implemented by assuming that yields in a given year across an insurance region are normally distributed. This outlook differs from the typical way yields are viewed. Most yield studies look at the distribution of yields over time and usually arrive at a skewed distribution (for example, a beta distribution is often used to describe yields over time). Since we have found no studies that have examined yields in the way we need, a normal distribution, as a first approximation, should be the most palatable choice we can make at this time. Another future extension would examine other possible choices for the yield distributions.

Given the normality assumption, we only need to concentrate on two parameters, the mean and standard deviation of the distributions. The means of the normally distributed yields are represented by the projected yields. To obtain standard deviations for the distributions, we examine NASS county yield data and compute yield standard deviations across the insurance policy areas. Adjustments are made to these standard deviations to reflect farm- or unit-level yields and to calibrate the system to an overall loss ratio near one. Given these parameters and the trigger yields, we calculate the proportion of insured acres that would receive an indemnity and the average indemnity level. The product of these is the amount of total indemnities paid out.

The non-eight crops category uses historical proportions once we have figures for the eight major crops. Costs for delivery expenses, administrative and operating expenses, and sales commissions are computed from the most recent SRA. Due to the insurance fund structure under which underwriting costs are determined,[6] we take a dynamic approach to modeling underwriting costs. We attempt to emulate how insurance companies divide their premiums among the three insurance funds (Commercial, Developmental, and Assigned Risk) through an historical evaluation of how the various state-crop-policy combinations would have performed as far as

[6] The SRA explains the procedures employed to calculate underwriting costs. Insurance companies gain or lose money depending on the state-crop loss ratio of their insurance contracts and the company's allocation of its policies among three insurance funds. The rates of gain or loss differ among these funds.

underwriting costs under the current SRA. Combinations that provide an underwriting gain are placed in the Commercial Fund, while those that show an underwriting loss are placed in the Assigned Risk Fund with overflows going to the Developmental Fund. These fund designations are then used in the projections. National projections for premiums and indemnities are broken down to the state level by historical proportions. These state-level figures are then employed to calculate projected underwriting costs.

Once the models have been run, overall crop insurance totals are formed and reported on an insurance year basis. Also, government costs and obligations for crop insurance are reported on a fiscal year basis. The government's total obligations equal the sums of premium subsidies, indemnities, delivery expenses, other expenses, and agent commissions. The government's net outlays equal the total obligations and underwriting costs less total premiums. The projections also include the provisions of the Agricultural Research, Extension, and Education Reform Act of 1998 (referred to later as the 1998 Act).

Preliminary Results

Table 1 presents 1986-96 historical figures for crop insurance costs and performance. The drought of 1988 and the floods of 1993 are reflected in the indemnity payments for those years. Participation increased after these events partially because of the requirement that farmers who had received disaster payments must sign up for crop insurance the next year. The biggest changes occurred in 1995 when crop insurance was mandatory for participants in federal agricultural programs. As was stated earlier, this provision was rescinded the next year in the 1996 Farm Bill. However, with the significant changes in federal farm programs, crop insurance participation remained very high. Over the period, the number of insured acres and total premiums quadrupled. The overall loss ratio was 1.21, implying that for every premium dollar, $1.21 was paid out in indemnities. Only in 1994 and 1996 was the overall loss ratio below 1.0. The government's total financial obligations due to crop insurance averaged $1.57 billion per fiscal year, while net budgetary outlays averaged $0.84 billion.

Table 2 presents last year's figures and annual projections through 2007. Sales commissions have been broken out in this table since the Congress handled these separately for the 1998 insurance year. The number of insured acres increases from 182 million in 1997 to a

projected 196 million in 2007. The rise in total premiums in 1998 followed by the drop in 1999 is due to the increases in price elections for 1998 that are followed by decreases in 1999. After that, price elections remain steady. The government's total financial obligations for crop insurance rise from $1.59 billion in 1997 to $2.86 billion in 1998 and $3.64 billion in 2007. Net budgetary outlays increase from $1.03 billion in 1997 to $1.24 billion in 1998 and $1.71 billion in 2007. Sales commissions decrease from $188 million in 1998 to $160 million in 1999 then rise back to $190 million in 2007. This pattern originates from the change in the administrative and operating expense subsidy (from 27 percent in 1998 to 24.5 percent in 1999) mandated in the 1998 Act.

Table 3 displays the projections with the 1998 Act's provisions removed. The portion of the 1998 Act that impacted crop insurance focused on administrative fees and reimbursements from the federal government to private insurance companies. Thus, the changes from the original projections are only in the total obligations, net outlays, and sales commissions. For the years affected by the 1998 Act, annual total obligations are reduced by $50 million, net outlays fall by $70 million, and sales commissions shrink by $20 million.

Table 4 presents a scenario run with the model. The scenario imposes 1988 type droughts in years 2001 and 2006 through the use of yield ratios (actual yield/trend yield). All other aspects of the model remain the same. The loss ratios in those years jump to more than 1.90, indicating $1.90 of indemnity is paid out for every premium dollar. But this rate is well below the 1988 loss ratio of 2.45, showing crop insurance improved its handling of extreme conditions. In comparing Tables 2 and 3, we find several changes in the intermediate years (2002-2005). These result from changes in the insured yield. The drought yields lower the insurable yield for the scenario and this follows through to lower premiums and indemnities. Each of the drought years has the same general effect on total obligations and net outlays, increasing them in the years of and following the drought.

Summary

This paper presents the FAPRI Insurance Baseline Model. The model serves to formally link crop insurance analysis to the FAPRI baseline. The construction of the model maintains consistency with projections of prices, acres planted, farm income, and government costs from the overall FAPRI baseline. We have outlined the model construction procedures, displayed

preliminary results and a scenario example, and sketched out areas for future work on the model. The model projects crop insurance expenditures and performance over the next decade based on historical data and FAPRI projections for the global agricultural economy. The results from the model depend on the assumptions and implied distributions employed in the model.

The projections show crop insurance participation as remaining approximately 70 percent of eligible acres. Total premiums will reach above $2 billion, with producers paying nearly half. The financial obligations of the federal government for crop insurance will increase to nearly $3.65 billion, while actual outlays rise to $1.7 billion. The effects of the 1998 Act are shown. Federal net outlays for crop insurance are reduced by $70 million per year due to the provisions of the Act. A scenario run placing 1988 type droughts in 2001 and 2006 is also shown. As expected, the scenario indicates significant increases in federal outlays in the years of and following droughts. The overall loss ratios for the drought years, however, are much improved over the 1988 figure.

Table 1. Historical crop insurance figures

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
						(Million Acres)					
Eligible Acres	248.32	224.40	226.86	254.27	253.39	249.56	259.70	257.61	263.41	256.85	273.10
Net Acres Insured	48.67	49.14	55.58	101.71	101.36	82.35	83.10	83.72	99.57	220.64	205.01
						(Percent)					
Crop Insurance Participation Rate	19.60	21.90	24.50	40.00	40.00	33.00	32.00	32.50	37.80	85.90	75.07
						($ Billion)					
Total Premiums	0.38	0.37	0.44	0.82	0.84	0.74	0.76	0.76	0.95	1.54	1.84
Producer-Paid Premiums	0.28	0.28	0.33	0.62	0.62	0.55	0.57	0.56	0.71	0.65	0.86
Premium Subsidies	0.10	0.09	0.11	0.20	0.21	0.19	0.19	0.19	0.24	0.89	0.98
Total Indemnities	0.62	0.37	1.07	1.22	0.97	0.95	0.92	1.66	0.60	1.57	1.49
Loss Ratio	1.62	1.01	2.45	1.48	1.16	1.30	1.21	2.19	0.63	1.01	0.81
						($ Billion, Fiscal Year)					
Total Obligations	1.28	0.74	1.66	1.67	1.36	1.30	1.43	1.41	1.08	2.92	2.39
Net Outlays	0.52	0.40	0.41	1.10	0.98	0.77	0.95	0.46	1.32	0.57	1.77

Table 2. 1997 figures and crop insurance projections

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
						(Million Acres)					
Eligible Acres	272.46	271.81	271.70	269.56	269.85	270.26	270.41	270.71	271.05	271.33	271.74
Net Acres Insured	181.94	186.94	190.91	191.55	192.41	193.25	193.64	194.14	194.66	195.15	195.72
						(Percent)					
Crop Insurance Participation Rate	66.78	68.78	70.27	71.06	71.30	71.51	71.61	71.72	71.82	71.92	72.02
						($ Billion)					
Total Premiums	1.77	1.96	1.85	1.93	1.94	2.01	2.05	2.07	2.10	2.13	2.16
Producer-Paid Premiums	0.87	0.96	0.90	0.95	0.95	0.99	1.01	1.03	1.05	1.07	1.08
Premium Subsidies	0.90	1.00	0.94	0.98	0.98	1.02	1.03	1.04	1.06	1.07	1.08
Total Indemnities	0.99	1.97	1.86	1.98	1.91	2.01	2.04	2.05	2.07	2.10	2.13
Loss Ratio	0.56	1.01	1.01	1.02	0.99	1.00	1.00	0.99	0.98	0.98	0.99
						($ Billion, Fiscal Year)					
Total Obligations	1.59	2.86	3.28	3.29	3.34	3.37	3.48	3.52	3.55	3.59	3.64
Net Outlays	1.03	1.24	1.57	1.51	1.55	1.57	1.63	1.65	1.66	1.71	1.71
(of which, Agent Commissions)		0.19	0.16	0.17	0.17	0.17	0.18	0.18	0.18	0.19	0.19

Table 3. Projections after removing the 1998 Act

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
						(Million Acres)					
Eligible Acres	272.46	271.81	271.70	269.56	269.85	270.26	270.41	270.71	271.05	271.33	271.74
Net Acres Insured	181.94	186.94	190.91	191.55	192.41	193.25	193.64	194.14	194.66	195.15	195.72
						(Percent)					
Crop Insurance Participation Rate	66.78	68.78	70.27	71.06	71.30	71.51	71.61	71.72	71.82	71.92	72.02
						($ Billion)					
Total Premiums	1.77	1.96	1.85	1.93	1.94	2.01	2.05	2.07	2.10	2.13	2.16
Producer-Paid Premiums	0.87	0.96	0.90	0.95	0.95	0.99	1.01	1.03	1.05	1.07	1.08
Premium Subsidies	0.90	1.00	0.94	0.98	0.98	1.02	1.03	1.04	1.06	1.07	1.08
Total Indemnities	0.99	1.97	1.86	1.98	1.91	2.01	2.04	2.05	2.07	2.10	2.13
Loss Ratio	0.56	1.01	1.01	1.02	0.99	1.00	1.00	0.99	0.98	0.98	0.99
						($ Billion, Fiscal Year)					
Total Obligations	1.59	2.86	3.33	3.34	3.39	3.43	3.53	3.57	3.60	3.64	3.69
Net Outlays	1.03	1.24	1.63	1.57	1.62	1.64	1.70	1.72	1.73	1.78	1.78
(of which, Agent Commissions)		0.19	0.18	0.18	0.19	0.19	0.20	0.20	0.20	0.20	0.21

Table 4. Crop insurance scenario (1988-type droughts in 2001 and 2006)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
						(Million Acres)					
Eligible Acres	272.46	271.81	271.70	269.56	269.85	270.26	270.41	270.71	271.05	271.33	271.74
Net Acres Insured	181.94	186.94	190.91	191.55	192.41	193.25	193.64	194.14	194.66	195.15	195.72
						(Percent)					
Crop Insurance Participation Rate	66.78	68.78	70.27	71.06	71.30	71.51	71.61	71.72	71.82	71.92	72.02
						($ Billion)					
Total Premiums	1.77	1.96	1.85	1.93	1.94	1.96	2.00	2.02	2.05	2.08	2.11
Producer-Paid Premiums	0.87	0.96	0.90	0.95	0.95	0.96	0.99	1.00	1.02	1.04	1.05
Premium Subsidies	0.90	1.00	0.94	0.98	0.98	0.99	1.01	1.02	1.03	1.05	1.06
Total Indemnities	0.99	1.97	1.86	1.98	3.87	1.89	1.92	1.93	1.95	3.97	2.01
Loss Ratio	0.56	1.01	1.01	1.02	2.00	0.97	0.96	0.95	0.95	1.90	0.95
						($ Billion, Fiscal Year)					
Total Obligations	1.59	2.86	3.29	3.30	4.04	4.59	3.33	3.37	3.40	4.14	4.79
Net Outlays	1.03	1.24	1.58	1.52	2.25	2.54	1.56	1.62	1.61	2.32	2.57
(of which, Agent Commissions)		0.19	0.16	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.18

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