Distributional Impacts of the Federal Crop Insurance: Crop and Regional Differences

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Abstract: The structure of the crop insurance premium subsidies can result in the selection of particular crop insurance contracts and asymmetric distributional impacts across policyholders, private insurers and taxpayers. Given the complicated structure of the federal crop insurance program, it is not clear who benefits from certain insurance products per crop and region. The current study utilizes highly detailed crop insurance data for different States to empirically evaluate the distributional impacts stemmed from different insurance choices across the interest groups involved and assess the impact of premium subsidies on the policy incidence. Significant crop and spatial differences exist among the interest groups involved, especially after the enactment of the Agricultural Risk Protection Act of 2000.

Key words: Crop Insurance, policy incidence, regional differences.

JEL code: Q18.

Introduction

Premium subsidies play a central role in the design of the federal crop insurance program as the main policy instrument to incentivize producer participation in the available insurance coverage options. Inevitably, the structure of premium subsidies tied to crop insurance characteristics and regional differences in risk exposure, can lead to different total insured liability and generate case-specific distributional impacts among the interest groups involved (producers, private insurance providers (AIPs), and taxpayers), creating concerns about the efficiency of the crop insurance program.

Producer benefits from crop insurance can significantly vary among different contract choices and regions, resulting in spatial differences in the provision cost of the crop insurance regime. In addition to the premium subsidies and the administrative and operating subsidies (A&O) paid to AIPs by the government, the final provision cost of crop insurance is determined by the degree of risk sharing of the corresponding written crop insurance policies between the AIPs and the government. The risk sharing is stipulated by the Standard Reinsurance Agreement (SRA) through the reinsurance provision to the AIPs at the State level. The associated reinsurance underwriting gains or losses can be asymmetrically distributed between the government and AIPs. Given the complicated structure of the federal crop insurance program involving producers, AIPs, and the government, it is not always clear who gets what and what the unintended outcomes might be.

While several studies examine factors influencing producer participation in crop insurance (see for example: Goodwin (1993), Coble et al (1996), Smith and Baquet (1996), Mishra and Goodwin (2003), Sherrick et al (2003), Sherrick et al (2004), Shalik et al (2008) and O'Donoghue (2014)) little research focuses on the impact of producer choices on AIPs

underwriting outcome and the federal cost. Evaluating the effect of different insurance coverage choices and premium subsidies on every interest group involved can provide key insights that will improve our understanding of the policy incidence and the effectiveness and efficiency of the policy mechanism per crop and region. In this context, the purpose of this research is to empirically evaluate the distributional impacts, stemmed from different insurance choices, across all the interest groups involved and assess the impact of premium subsidies on the policy incidence. The study utilizes detailed producer-level insurance data for different States and major field crops that enables us to evaluate the distributional impacts of certain producer insurance choices.

In particular, our analysis identifies and evaluates (a) crop and regional differences in producer response to different insurance products and their corresponding welfare impacts; (b) spatial differences in private insurance providers underwriting outcome and taxpayer costs; and (c) the impact of premium subsidies on crop insurance participants, before and after the enactment of the Agricultural Risk Protection Act (ARPA) of 2000. The rest of the paper is structured as follows. First, we present our research methodology, estimation procedures and assumptions made, followed by the utilized data description and results. Conclusions and policy implications are provided in the final section.

Research Methodology

First, we empirically quantify the distributional impacts stemmed from different crop insurance choices across producers, private insurers, and taxpayers. The more disaggregated empirical analysis enables us to identify and quantify differences in the insured acres per insurance policy for different field crops and regions, and assess the impact of premium subsidies on the interest

groups involved (i.e., producers, private insurers, taxpayers) before and after the enactment of the Agricultural Risk Protection Act (ARPA) of 2000, which changed the structure and substantially increased the magnitude of premium subsidies.

The analysis utilizes observations for three major field crops, corn, soybeans, and wheat for three different States, Iowa, Nebraska, and Oklahoma. In particular, we evaluate the impact of producer insurance choices for corn and soybeans on the interest groups involved in Iowa, all the above field crops in Nebraska, and for wheat in Oklahoma. The selected field crops correspond to the major insured crops in each particular State. The examined insurance characteristics include differences in the insurance type and coverage levels. The revenue type provides a more comprehensive insurance coverage (additional price protection that may or not include the harvest price option) relative to the yield one. The available coverage levels range from 50% to 85%, with 5% increments. Catastrophic insurance coverage (CAT) policies are excluded from our analysis.[1] We merge and consider as one revenue type the different available insurance plans (e.g., Crop Revenue Coverage, Income Protection, Revenue Assurance). For simplicity and tractability, we also merge and consider two categories of coverage levels, one that represents high coverage, with coverage levels greater than 70%, and low coverage otherwise (Walters et al., 2012).

Based on the theoretical analysis of the factors affecting producer participation and the market and welfare impacts of crop insurance in Mavroutsikos, Giannakas, and Walters (2018), the main variables of interest are the insured acres and liability, producer premium paid, the total

[1] CAT policy covers losses below 50% at 55% of the crop projected price and is fully subsidized by the government by the government (producers usually pay only an administration fee). It has been historically used by producers to meet eligibility requirements for extra assistance programs.

premium, the subsidy amount, indemnity amount, the Administrative and Operating (A&O) subsidy amount, the AIPs underwriting outcome, and the government total cost. For the time period between 1995-2009, we quantify the average value (per State) of the above variables for each crop and insurance characteristics and identify regional differences. That is, we analyze the impact of particular crop insurance choices on producer welfare benefits, AIPs returns from their involvement in the crop insurance market, and the associated government cost. Similarly, we identify the effect of ARPA on the policy incidence during the period 2001-2009.

For each crop and region, we construct a weighted per year and county average of the variables of interest to facilitate the comparison between crops and regions. To examine the effect of the change in the structure of premium subsidies (ARPA) on the policy incidence, a weighted average for the same variables is constructed before and after the structural change. Similarly, a weighted average of A&O subsidy is constructed for each crop and its associated insurance types and coverage levels, for the whole time period and pre- and post-ARPA. The A&O subsidy is estimated for each type of insurance based on the specific rules of the two standard reinsurance agreements. Furthermore, we estimate the average percentage of AIPs and the federal government (represented by FCIC) share of the underwriting outcome, which is applied proportionally per crop and insurance policy enabling us to evaluate spatial differences and how the corresponding producer choices affect such differences.

Although we do not have access on insurers' reinsurance allocation decisions on each risk fund, we are able to examine allocation scenarios consistent with the fund allocation and risk sharing rules as stipulated by the two SRAs of 1998 and 2005 that were being held during the examined period. Each producer insurance choice corresponds to the approved insurance provider that was allocated. Therefore, we allocate each AIPs' net book of premium to the

reinsurance funds (at the policy level) based on a selected cutoff level of each insurance policy loss ratio and in accordance with each SRA allocation rules. The allocation includes 739,894 policy observations for Iowa, 657,223 policy observations for Nebraska, and 201,390 policy observations for Oklahoma. It should be noted that for both SRAs of 1998 and 2005, 3 sub-funds were existed for the commercial and developmental fund. One sub-fund for placing revenue policies, one sub-fund for the rest of the insurance types, and one for CAT policies. Excluding CAT policies from our data, we consider only allocation decisions to the assigned risk fund and the two sub-funds of the commercial and developmental funds. The main difference between the two SRAs lies on the maximum allocation percentage of the net book premium allowed to be placed on the assigned risk fund for the examined States (changed from 15% to 25% in 2005 SRA).

AIPs strategically allocate their obtained policies to the reinsurance funds at the State level for ensuring the maximum expected returns. The allocation decisions include the part of policies placed on each reinsurance fund subject to the constraints of maximum allocation and minimum retention levels (as percentage of premiums and associated liability) on each fund. The assigned risk fund has been designed to absorb the riskiest crop insurance policies, whereas the commercial and developmental funds have been designed for less risky policies. Several studies examine AIPs' optimal allocation decisions to the reinsurance funds (see Coble, Dismukes, and Glauber (2007), Ker and Ergun (2007), Vedenov, Miranda, Dismukes, and Glauber (2004 & 2006)). Several methodological approaches examine or predict at the county or policy level an optimal historical loss ratio cutoff level and other insurance characteristics that can explain allocation decisions to the reinsurance funds. However, with no actual observations on such decisions, different approximations might be considered. We consider as reinsurance fund

allocation decision criterion the moving average of the historical loss ratio of each crop insurance's policy. This provides a more realistic approach, since the historical loss ratio reflects the riskiness of an issued policy (through the premiums which reflect different factors (e.g., county, crop, practice, production history, etc.) and the realized over time indemnities), and enables us to estimate the underwriting outcome of the private companies and the FCIC, consistent with the risk sharing rules as stipulated by the two Standard Reinsurance Agreements.

Based on the cutoff loss ratio level, individual AIP policies below that value are placed to the commercial sub-funds, while the policies above the cutoff value are placed on the developmental sub-funds and the assigned risk fund, subject to the constraints of maximum cession on each fund. We assume 100% retention level for the commercial funds, and the minimum required for the developmental and assigned risk funds (i.e., 35% and 20%, respectively). The developed STATA program ensures that the policies with the highest loss ratio are allocated to the assigned risk fund subject to the maximum cession constraints for each State. The remaining policies are accordingly placed on the developmental sub-funds. Then we calculate the average generated AIPs' returns over the examined period for the different States by applying the risk sharing rules as stipulated by the two SRAs.

Based on the selected cutoff loss ratio for each State, we also calculate the weighted average underwriting outcome of the FCIC and the final government cost for the whole time period, analyzed pre-ARPA and post-ARPA. The government cost includes the summation of the premium and A&O subsidies, increased by the FCIC underwriting loss or reduced by the FCIC underwriting gain, as needed. It should be noted that we assume that the A&O subsidy amount covers exactly AIP delivery expenses. Therefore, AIPs' returns depend on their reinsurance underwriting outcome. The type (gain or loss) and magnitude of AIPs' underwriting outcome is

affected by the type of their obtained policies, their allocation decisions and the actual loss ratio of their retained part of their book of business at the State they operate. That is, AIPs may have incentives to pursue certain types of crop insurance policies through selling agents, not only in particular States, but also in particular counties within that State. Such policies can contribute to particular outliers among AIPs with spatial differences in their underwriting outcomes. In such a case, A&O subsidies may significantly contribute to their returns.

To evaluate how the number of policies (differing in their insurance characteristics) obtained by each AIP contribute to their returns, we estimate the following equation for each State:

$$(1) \qquad R_{it} = \beta_o + \beta_1 LYC_{it} + \beta_2 HYC_{it} + \beta_3 LRC_{it} + \beta_4 HRC_{it} + \beta_5 \nu_t + \beta_6 \mu_i + \varepsilon_{it}$$

where R_{it} represents AIPs returns from crop insurance, LYC represents the obtained number of yield with low coverage level policies from each AIP, HYC represents the obtained number of yield with high coverage level policies from each AIP, LRC represents the obtained number of revenue with low coverage level policies from each AIP, HRC represents the obtained number of revenue with high coverage level policies from each AIP, ν_t captures crop year effects, μ_i denotes the unobservable AIP fixed effects, and ε_{it} denotes the error term. The unbalanced panels for each State include 193 observations for 42 AIPs in Iowa, 184 observations for 40 AIPs in Nebraska, and 160 observations for 36 AIPs in Oklahoma.

The enactment of ARPA (2000) resulted in increase for crop insurance, in general, and high coverage policies, in particular. A key question is how these producer crop insurance choices affected regional AIPs' returns. To estimate the effect of ARPA on AIPs' returns, we modify equation (1) by including a dummy variable to capture the effect of ARPA on AIPs'

returns. The inclusion of the dummy variable $ARPA$ takes the value 1 for years 2001-2009 and 0 otherwise. The interaction of $ARPA$ with the rest of the variables as previously defined, enables us to evaluate the contribution of the different policy characteristics on AIPs' returns after the ARPA enactment. The corresponding marginal effects are estimated for each State for the following equation.

$$(2) \qquad R_{it} = \gamma_o + \gamma_1 LYC_{it} + \gamma_2 HYC_{it} + \gamma_3 LRC_{it} + \gamma_4 HRC_{it} + \gamma_5 ARPA * LYC_{it} + \gamma_6 ARPA * HYC_{it} + \gamma_7 ARPA * LRC_{it} + \gamma_8 ARPA * HRC_{it} + \gamma_9 ARPA + \gamma_{10}\mu_i + \eta_{it}$$

Data

The empirical analysis utilizes highly detailed crop insurance producer-level data obtained from the Risk Management Agency of the United States Department of Agriculture for the 15-year time period between 1995 and 2009. The data provide observations of producer insured choices for different States, field crops, the corresponding selected insurance types and coverage levels, insured acres, liability, total and producer premiums, premium subsidy and indemnity amounts. We utilize data for Iowa, Nebraska and Oklahoma for three major field crops: corn, soybeans, and wheat. The dataset for Iowa includes observations for corn and soybeans, the dataset for Oklahoma includes observations for wheat, and the dataset of Nebraska includes observations for corn, soybeans, and wheat. Each dataset includes all counties in each particular State. All observations are aggregated from the unit to the policy level before allocating them to the reinsurance funds and determining the AIPs' returns.

Results

Tables 1-4 present the distributional impacts stemmed from certain producer crop insurance choices for the States under study.[2] These include insurance choices for corn, soybeans and wheat. Regional differences are identified between Iowa and Nebraska for corn and soybeans, and between Nebraska and Oklahoma for wheat. For both Iowa and Nebraska corn constitutes the main insured field crop, while the main crop in Oklahoma is wheat. In general, producers in Iowa and Nebraska receive back in indemnities their premium paid for corn and soybeans, with indemnities exceeding the producer premia for soybeans in Iowa, and for both corn and soybeans in Nebraska. The same holds for wheat in Nebraska and Oklahoma, with significantly greater differences. Wheat producers in Nebraska receive back almost double their premium paid compared to Oklahoma producers who receive back more than three times their premium paid. Producer benefits from crop insurance increase with risk exposure, as it can be readily verified by comparing the loss ratios in the three States (loss ratio ranking: Oklahoma>Nebraska>Iowa) and by comparing the indemnity per acre across crops and States.

On the other hand, AIPs' returns typically increase with lower regional risk exposure in contrast with the government cost which typically increases with the risk exposure. However, AIPs' returns stemmed from soybean policies are less in Iowa compared to the riskier Nebraska. This can be attributed to the less (almost half) insured acres in Nebraska relative to Iowa. A&O

[2] Due to space limitations, we include the aggregate effects of crop insurance for different regions and crops, and the effects for different insurance type (revenue vs yield). However, we also discuss the key results and policy implications from the interaction of insurance type with different coverage levels. The corresponding tables are available from the authors upon request.

subsidies paid to AIPs by the federal government helped AIPs to double their returns for corn and soybeans, quadruple their returns in Nebraska for wheat, and ensure them positive returns in Oklahoma. Further disaggregation to crop insurance characteristics per region verifies the general pattern of producer benefits increasing with higher insurance coverage and risk exposure, whereas AIPs' returns appear more case-specific to crop insurance characteristics and spatial riskiness, mainly for States with similar classification of risk exposure (e.g., Iowa and Nebraska), but with the returns being increased with low risk exposure and higher insurance coverage at the expense of the government.

Tables 5-8 present the effect of the change in premium subsidies on the policy incidence, per crop, region, and different insurance characteristics. As noted earlier, the enactment of the ARPA changed the magnitude and structure of premium subsidies. Premium subsidies are now applied as a percentage of the premium (Babcock, Hart, and Hayes, 2004) to induce increased producer participation in higher insurance coverage levels. The amount of premium subsidy was almost tripled across crops and regions after the enactment of ARPA resulting in significant increase in the insured acres and two to three times increase in insured liability, indicating the shift of producer participation to high coverage crop insurance (e.g., revenue type and high coverage levels). Producer benefits were increased 2-3 times after ARPA, with benefits increasing with risk exposure. Same effect holds also for the AIPs with the exception of wheat in Oklahoma, where AIPs did not improve their returns compared to the 100-300% level of increase in other regions and field crops. The federal cost was increased 3-4 times after ARPA for all field crops and regions, although the reinsurance underwriting (with the exception of Oklahoma) of the FCIC was significantly improved. A&O subsidies constituted a significant part of this cost, with an increase of 2-3 times of their pre ARPA level. A major shift was also

observed in insurance type selection for every crop and region. Producers switched from yield to revenue crop insurance and from law to high coverage levels. Their benefits increased with the insurance coverage level and risk exposure, with benefits being crop- and region-specific. The same qualitative result holds also for the AIPs' returns and the government cost.

Table 9 reports State differences in AIPs' returns stemmed from the number of policies with certain insurance characteristics that form AIPs' net book of premiums. AIPs allocate policies to the reinsurance funds that differ in the insurance type and coverage level. Serving high coverage revenue or low coverage yield policies in the low-risk State of Iowa, significantly contributes to the increase in AIPs' returns compared to high coverage yield policies that decrease their level of returns. In contrast, AIPs seem to benefit from serving low coverage yield and revenue policies in the riskier (compared to Iowa) Nebraska, while no statistically significant findings obtained regarding Oklahoma. The same pattern follows regarding the ARPA effect on underwriting particular types of policies. Table 10 reports significant positive marginal effects for low coverage yield and low coverage revenue policies and significant negative marginal effects for the rest types of policies in Nebraska. The enactment of ARPA had positive effect on AIPs' returns in Nebraska. Significant positive marginal effects exist in Iowa for high coverage revenue policies and Oklahoma for low coverage yield policies.

Table 1: Distributional Impacts of Crop Insurance and Regional Differences

Corn										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
IA	89,355	28,009,329	1,012,862	995,797	2,008,659	877,570	426,449	599,477	531,612	-890,634
NE	73,318	20,628,220	818,401	916,846	1,735,248	896,512	366,467	505,758	332,978	-950,335
Soybeans										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
IA	70,734	15,410,753	499,169	478,980	978,150	632,529	208,709	183,179	162,442	-525,247
NE	42,436	8,637,601	355,365	389,842	745,208	385,751	157,775	216,753	142,704	-404,913
Wheat										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
NE	18,885	2,017,078	126,185	141,298	267,484	208,381	57,538	35,639	23,464	-175,372
OK	55,632	4,531,199	332,129	423,810	755,939	1,060,587	163,178	-50,876	-253,772	-840,760

Table 2: Distributional Impacts of Insurance Type Selection for Corn and Spatial Differences

Corn: Revenue Insurance										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
IA	65,796	22,772,167	874,417	893,011	1,767,429	778,388	364,053	524,192	464,849	-792,215
NE	52,045	16,107,622	705,609	808,666	1,514,275	773,687	310,468	446,575	294,013	-825,121
Corn: Yield Insurance										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
IA	23,559	5,237,161	138,445	102,785	241,230	99,182	62,397	75,285	66,763	-98,419
NE	21,273	4,520,599	112,793	108,180	220,973	122,825	55,999	59,183	38,965	-125,214

Table 3: Distributional Impacts of Insurance Type Selection for Soybeans and Spatial Differences

Soybeans: Revenue Insurance										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
IA	46,102	11,078,938	407,077	406,231	813,308	530,352	165,838	149,967	132,989	-439,080
NE	28,649	6,349,374	292,698	328,865	621,563	307,324	126,269	189,486	124,753	-330,381
Soybeans: Yield Insurance										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
IA	24,632	4,331,815	92,093	72,749	164,842	102,176	42,871	33,213	29,453	-86,167
NE	13,787	2,288,227	62,667	60,977	123,644	78,427	31,506	27,266	17,951	-74,532

Table 4: Distributional Impacts of Insurance Type Selection for Wheat and Spatial Differences

Wheat: Revenue Insurance										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
NE	11,938	1,456,901	98,034	117,693	215,727	166,974	44,073	29,398	19,355	-142,411
OK	28,398	2,744,648	221,342	314,037	535,379	781,777	107,045	-41,148	-205,250	-626,332
Wheat: Yield Insurance										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
NE	6,947	560,178	28,152	23,605	51,757	41,407	13,465	6,241	4,109	-32,961
OK	27,235	1,786,551	110,787	109,773	220,561	278,810	56,133	-9,728	-48,521	-214,427

Table 5: ARPA Effect on Crop Insurance Policy Incidence

Corn										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
Pre ARPA										
IA	72,805	15,467,893	644,473	235,309	879,781	385,516	227,345	304,962	189,303	-273,351
NE	58,644	11,605,364	440,369	203,615	643,985	427,450	166,829	134,685	81,850	-288,594
Post ARPA										
IA	100,389	36,370,285	1,258,455	1,502,789	2,761,244	1,205,606	559,186	791,820	763,818.26	-1,298,157
NE	83,119	26,654,981	1,070,905	1,393,245	2,464,150	1,209,819	499,814	753,853	500,478	-1,392,581
Soybeans										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
Pre ARPA										
IA	58,004	9,770,699	295,359	114,996	410,356	189,837	106,449	136,060	84,459	-136,986
NE	29,653	4,404,981	171,225	74,309	245,535	197,118	63,573	30,115	18,302	-119,580
Post ARPA										
IA	79,220	19,170,789	635,043	721,636	1,356,679	927,656	276,882	218,373	210,650.29	-787,868
NE	50,563	11,328,380	472,428	590,434	1,062,862	505,669	217,661	334,873	222,320	-585,775
Wheat										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
Pre ARPA										
NE	17,318	1,359,581	80,473	47,343	127,816	104,629	33,815	14,422	8,765	-72,393
OK	42,490	2,606,615	171,724	113,907	285,630	354,231	76,675	-14,338	-54,263	-244,845
Post ARPA										
NE	19,877	2,433,144	155,112	200,753	355,865	274,035	72,551	49,180	32,650.17	-240,654
OK	65,249	5,939,430	449,499	650,569	1,100,067	1,577,432	226,472	-68,263	-409,102	-1,286,143

Table 6: ARPA Effect on Corn Insurance Type Selection

Corn: Revenue Insurance										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
Pre ARPA										
IA	33,677	7,788,696	403,478	106,318	509,795	208,783	127,449	185,724	115,288	-118,479
NE	24,530	5,294,364	268,138	84,193	352,331	250,232	88,083	63,506	38,593	-133,683
Post ARPA										
IA	87,209	32,761,148	1,188,377	1,417,474	2,605,851	1,158,124	521,788	736,893	710,833.96	-1,228,428
NE	70,423	23,330,270	997,815	1,292,574	2,290,388	1,123,325	459,009	701,405	465,658	-1,285,925
Corn: Yield Insurance										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
Pre ARPA										
IA	39,128	7,679,197	240,995	128,991	369,986	176,733	99,896	119,237	74,015.90	-154,871
NE	34,114	6,311,000	172,231	119,423	291,654	177,218	78,747	71,179	43,257	-154,913
Post ARPA										
IA	13,180	3,609,137	70,078	85,315	155,393	47,482	37,397	54,927	52,984.30	-69,728
NE	12,696	3,324,711	73,091	100,671	173,762	86,494	40,805	52,448	34,820	-106,656

Table 7: ARPA Effect on Soybeans Insurance Type Selection

Soybeans: Revenue Insurance										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
Pre ARPA										
IA	24,551	4,303,276	168,586	48,771	217,356	116,425	54,339	62,274	38,657	-64,453
NE	13,494	2,086,202	102,476	33,584	136,060	113,527	34,015	14,016	8,517	-59,082
Post ARPA										
IA	60,469	15,596,046	566,071	644,538	1,210,609	806,304	240,171	205,791	198,513.76	-686,195
NE	38,283	9,059,576	413,627	516,582	930,209	430,525	184,917	300,310	199,374	-502,125
Soybeans: Yield Insurance										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
Pre ARPA										
IA	33,452	5,467,423	126,774	66,226	193,000	73,412	52,110	73,786	45,802	-72,534
NE	16,158	2,318,780	68,749	40,725	109,474	83,591	29,558	16,099	9,784	-60,499
Post ARPA										
IA	18,751	3,574,743	68,972	77,098	146,070	121,352	36,711	12,581	12,136.54	-101,672
NE	12,280	2,268,804	58,800	73,853	132,653	75,143	32,744	34,564	22,946	-83,651

Table 8: ARPA Effect on Wheat Insurance Type Selection

Wheat: Revenue Insurance										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
Pre ARPA										
NE	3,750	314,513	24,569	10,199	34,769	27,584	8,692	4,469	2,716	-16,175
OK	2,816	183,606	15,241	7,008	22,250	13,952	5,562	1,734	6,564	-6,006
Post ARPA										
NE	17,120	2,179,804	144,522	185,715	330,237	255,180	66,462	45,109	29,948	-222,229
OK	47,116	4,618,580	372,147	538,692	910,839	1,343,600	181,300	-61,885	-370,876	-1,090,868
Wheat: Yield Insurance										
State	**Acres**	**Liability**	**Producer Premium**	**Premium Subsidy**	**Total Premium**	**Indemnity**	**A&O Subsidy**	**AIP Returns**	**FCIC**	**GOV COST**
Pre ARPA										
NE	13,568	1,045,067	55,904	37,143	93,047	77,045	25,123	9,953	6,049	-56,217
OK	39,673	2,423,009	156,482	106,898	263,380	340,279	71,113	-16,072	-60,827	-238,838
Post ARPA										
NE	2,757	253,340	10,590	15,038	25,628	18,855	6,088	4,071	2,702	-18,424
OK	18,133	1,320,850	77,352	111,877	189,229	233,832	45,172	-6,378	-38,225	-195,274

Table 9: AIP Returns and Regional Differences

	(1)	(2)	(3)
VARIABLES	IA	NE	OK
Low Yield	2,900**	2,592**	1,600
	(1,411)	(1,087)	(1,332)
High Yield	-7,032**	-13,009	-6,357
	(2,948)	(8,621)	(11,701)
Low Revenue	-612	1,805**	-156.3
	(1,448)	(842.8)	(1,535)
High Revenue	4,431***	933.2	-31,840
	(998.9)	(1,389)	(21,784)
Constant	12,770,000***	2,435,000	-1,397,000
	(4,360,000)	(1,594,000)	(1,690,000)
Observations	193	184	160
R-squared	0.452	0.610	0.372
Number of AIPs	42	40	36

Standard errors are shown in parentheses. One asterisk (*) denotes significance at 10% level, two asterisks (**) denote significance at 5% level, and three asterisks (***) denote significance at 1% level. Crop year effects are omitted for tractability of the variables of interest.

Table 10: Significant Marginal Effect Estimates

State	Low Yield	High Yield	Low Revenue	High Revenue	ARPA
Iowa	-	-	-	3,001	-
Nebraska	23,981	-69,122	8,577	-5,717	13,700,000
Oklahoma	2,552	-	-	-	-

Concluding Remarks

This research focuses on the empirical determination and quantification of the distributional impacts of the federal crop insurance program by utilizing highly detailed data. This disaggregated analysis assesses crop and regional differences, and the role of premium subsidies in producer insurance choices and corresponding benefits, private insurers' underwriting outcomes, and taxpayer costs.

Producer benefits from crop insurance increase with the selection of high coverage policies and with regional riskiness for all the examined field crops. In particular, for wheat in Nebraska and Oklahoma producers receive back 2-3 times their premium paid. With the exception of soybeans in Iowa, AIPs' returns seem to increase with low regional riskiness. Accounting also for the A&O subsidy amount, AIPs double their returns for corn and soybeans, quadruple them for wheat in Nebraska and are able to make positive returns in Oklahoma. Underwriting policies with high coverage revenue substantially contribute to AIPs' returns in Iowa compared to policies with low coverage revenue and low coverage yield in Nebraska.

The increase in premium subsidies after the enactment of ARPA resulted in the enrollment of more acres with 2-3 times increase in the insured liability. ARPA caused also a shift to high coverage and revenue insurance policies. Producer benefits increased 2-3 times post ARPA and are positively related to spatial riskiness. AIPs increased their returns in Iowa and Nebraska due to their increase in underwriting gains, while they realized underwriting losses in Oklahoma. Underwriting high coverage revenue policies and low coverage revenue or yield policies post ARPA in Iowa and Nebraska, contributed to increased AIPs' returns. The provision cost of the federal crop insurance program increased 3-4 times post ARPA, although the

improvement of the government underwriting through the reinsurance mechanism. The post ARPA increase in the A&O subsidies played an important role in that increase.

The disaggregation of the policy incidence per crop and region enables the linkage of spatial riskiness and program's beneficiaries. A more comprehensive analysis of the system-wide effects of the policy can ignite further discussion on the design and implementation of the crop insurance program. The discussion may focus on the design and magnitude of premium subsidies, the reinsurance mechanism and the associated federal cost, and suggestions for future overhaul that will enhance the effectiveness, efficiency, and sustainability of the crop insurance regime.

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