DEMAND FOR CROP INSURANCE BY ORGANIC CORN AND SOYBEAN FARMERS IN THREE MAJOR PRODUCING STATES

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Ariel Singerman, Chad Hart and Sergio H. Lence*

Abstract

A survey of organic grain and oilseed producers in Iowa, Minnesota and Wisconsin was conducted to collect information about their demographic characteristics, production and price risk management strategies, yields and losses, and crop insurance decisions. The data are analyzed using a discrete choice model to establish which variables influence organic producers' decision of whether to purchase crop insurance and also which ones affect the insurance product choice when applicable. The study describes the risk profiles of organic producers, and analyzes whether significant variations exist between organic and conventional methods of production so as to quantitatively determine the differential production risk associated with organic production. This research may contribute to the design of an organic crop insurance policy in which organic producers would be charged according to their idiosyncratic production risks, rather than the arbitrary 5% blanket premium surcharge currently in use.

Keywords: crop insurance, organic farming, organic production.

JEL Codes: Q18.

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I. Introduction

The Agricultural Risk Protection Act of 2000 recognized organic farming as a good farming practice. Thus, organic crops are covered by Federal crop insurance taking into account some of the idiosyncrasies of the organic production system. In addition to the production risks covered for conventional producers, organic farmers that sign up for coverage are compensated for production losses from damage due to insects, disease, and/or weeds (Dimitri and Greene, 2002). In total, the Risk Management Agency (RMA) provided roughly $90 billion in crop insurance protection in 2008, covering over 350 commodities across 272 million acres.

However, the incorporation of organic production into the crop insurance rating structure has been limited. Currently, the base premium rates are determined across all production practices, both conventional and organic. In choosing the organic production practice, producers are charged an arbitrary 5% premium surcharge over conventional crop insurance. No other adjustments are made to the premium rate to reflect organic production practices. In the case of crop failure, organic farmers receive compensation based on conventionally produced crop prices. Thus, price premiums that organic producers are able to obtain in the market are not compensated for under the current insurance policy structure (RMA, 2008).

During 2001 and 2002, Hanson *et al.* (2004), with RMA sponsorship, organized nationwide focus groups with organic farmers to identify and describe their risks and needs for assistance. In their study, they point out that organic farming may involve different risks than conventional farming because it does not rely on the use of pesticides and insecticides as risk management tools. Organic farmers rely instead, for example, on the use of mechanical cultivation, crop rotation and use of beneficial insect populations to manage their crops. The authors also indicate that besides weeds, pests and diseases, contamination with genetically modified organisms (GMOs), input shortage, and non-stable price premiums were mentioned by organic producers as the most relevant risks that affect their production.

In addition, at the focus group meetings organized by Hanson *et al.* (2004), organic farmers identified Federal crop insurance as a useful risk management tool. However, they also expressed their discontent with the current crop insurance policies. Farmers argued that the coverage being offered does not reflect the organic price premiums that they would receive in the market compared to their fellow non-organic producers (Hanson *et al.*, 2004). Further evidence in this regard is provided by Chen *et al.* (2007), who showed that, even though crop insurance is an important tool for apple growers to manage risk, "the low price selection and low price premium setting do not provide enough indemnity [to organic growers] when losses occur". Furthermore, Greene and Kremen (2003) also argue that limited access to crop insurance may discourage conventional farmers from switching to organic farming.

The Food, Conservation and Energy Act of 2008, which amends part of the Federal Crop Insurance Act, was written to investigate some of these claims, requiring the U.S. Department of Agriculture to examine the currently offered Federal crop insurance coverage for organic crops as described in the organic policy provisions of the 2008 Farm Bill (Title XII of the Food, Conservation and Energy Act, 2008). Such provisions establish the need to review, among others, the underwriting risk and loss experience of organic crops, determine whether significant, consistent, or variations in loss history exist between organic and non-organic production, and in accordance with the results, reduce, eliminate or increase the 5% premium surcharge for coverage of organic crops that applies to all crops and regions across the U.S.

In reviewing the scientific literature related to organic versus conventional yield comparisons, several examples can be cited. The results are mixed. Badgley *et al.* (2007) conducted the most comprehensive review of organic vs. conventional yields worldwide and found few differences between the two production systems. Delate *et al.* (2003) found that organic corn and soybean yields were equivalent to conventional yields. Pimentel *et al.* (2005) reported that, over 22 years of a long-term comparison trial, organic yields were comparable to conventional corn and soybean yields. Mäder *et al.* (2002) obtained organic yields that were between 80% and 100% of conventional yields for all crops over 21 years in an organic rotation of wheat, potatoes, and grass-clover hay. Other studies reported corn yield in an organic system reaching 91.8% of conventional corn yield (Delate and Cambardella, 2004). In the same study, organic soybean yield was 99.6% of conventional soybean yield. Porter (2003) reported organic corn yields 7 to 9% lower and organic soybean yields 16% to 19% lower than conventional crop yields. In a survey conducted by the Organic Farming Research Foundation (2001), organic corn yields across the U.S. were found to average 95% of conventional yields. In general, organic horticultural crops often yield less than conventional horticultural crops (Delate, 2002), but some exceptions exist.

Importantly, after an extensive literature review we found a noticeable lack of rigorous studies focusing on the difference in production risks of organic versus conventional crops on actual farms. The majority of the data comes from yields obtained at experimental plots. This implies that, to the best of our knowledge, currently there is no basis to quantitatively determine the differential production risk associated with organics, and therefore, whether the insurance premiums currently charged to organic producers are actuarially fair. This lack of data implies that research is needed to start filling that gap and to better understand organic farmers' demand for crop insurance (or lack of it). Thus, given the review of the organic crop insurance coverage policies mandated by the Farm Bill, the purpose of this study is to investigate the current demand for crop insurance from organic grain producers in three Midwestern states.

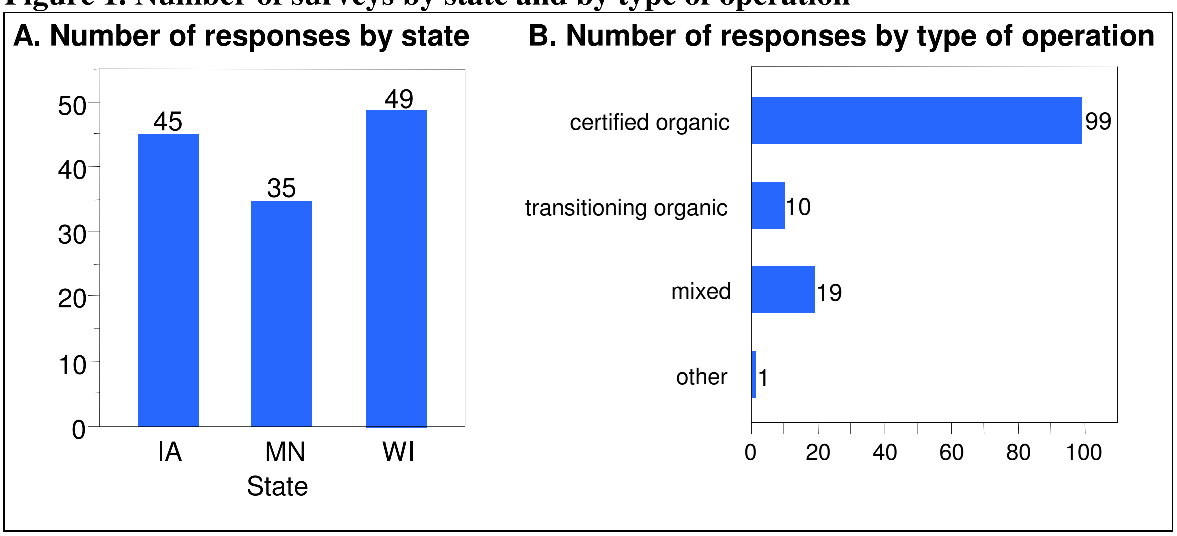
Specifically, the objectives of this study are three-fold. First, the study aims at delineating the profile characteristics of organic grain producers in Iowa, Minnesota and Wisconsin; as well as describing their production and price risk management strategies usage and comparing it to that of crop insurance. Second, the study analyzes the demand for crop insurance from organic grain producers in the aforementioned states using a discrete choice model, and attempts to determine which variables, if any, influence their decision of whether to purchase crop insurance, as well as their product choices. Finally, the third objective of the study is to determine the differential production risk associated with organic grain and oilseed production in the states under analysis.

II. Data

The lack of available data on organics crops in general, and on the demand for crop insurance by organic farmers in particular, stimulated us to collect it ourselves by using a mail survey instrument. We conducted a survey targeting organic grain producers in three Midwestern states: Iowa, Minnesota and Wisconsin. These three states were selected because they account for over 40% of the U.S. organic cropland destined for organic corn and soybeans, which in turn are among the main organic crops in the U.S. in terms of acreage. Furthermore, Iowa, Minnesota and Wisconsin are the top three states in terms of organic corn acreage, and Iowa and Minnesota are the top two states regarding organic soybean acreage (USDA-ERS, 2008a-b-c).

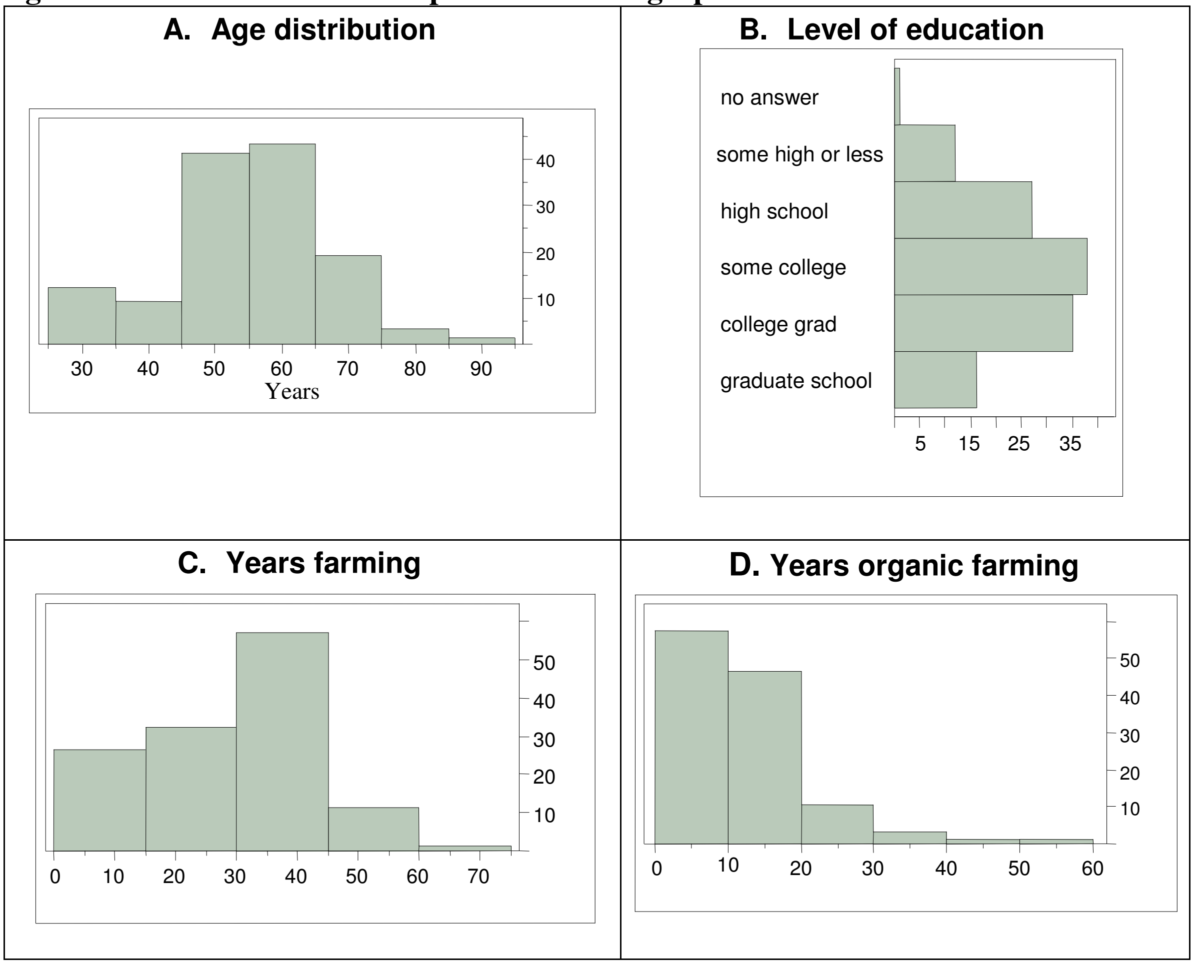
The clientele targeted by our survey were 665 producers of organic grains in Iowa, 366 in Minnesota and 550 in Wisconsin, adding up to a total of 1,581. The survey was sent out in late March 2009 to organic grain producers across Iowa, and in early May 2009 to farmers in Minnesota and Wisconsin. In both rounds, after three weeks a reminder letter was sent to increase the number of returns. A total of 212 surveys were returned giving a response rate of 13%; however, the number of surveys that effectively corresponded to organic grain producers who gave sufficiently comprehensive responses was 129. Panels A and B of figure 1 show the number of responses by state and by type of operation, respectively. Type of operation refers to whether the producer is certified organic, transitioning to organic or mixed (i.e.: conventional and organic simultaneously). We also received one survey in which the farmer stated that his production was chemical free.

Figure 1. Number of surveys by state and by type of operation



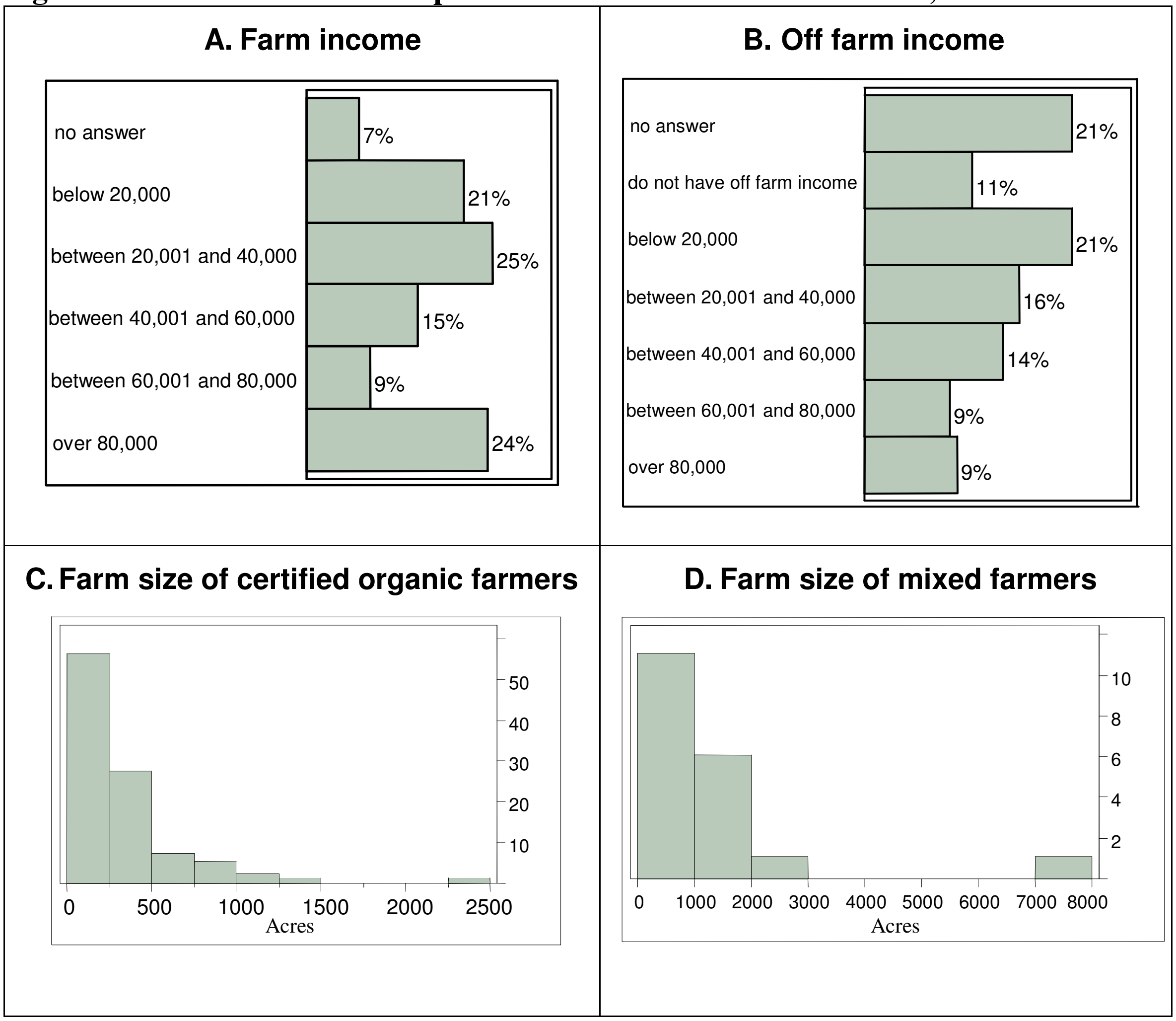
The survey's questions could be divided into three categories according to the nature of the information that they intended to gather. The first part of the survey was intended to collect information on demographic variables of organic producers so as to delineate the profile of organic grain and oilseed producers. The distributions for those variables are shown in the different panels of figures 2 and 3.

Figure 2. Distribution of the respondents' demographic characteristics



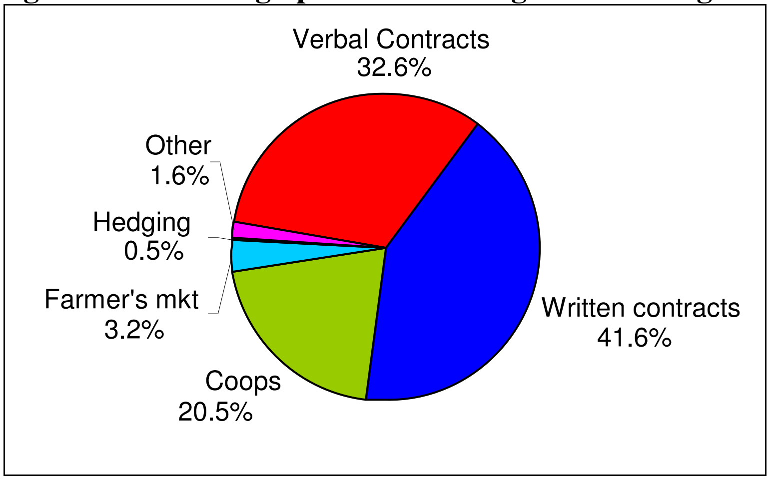
The second part of the survey was designed to collect information on producers' production and marketing risk strategies. The purpose of this section was to be able to understand what alternatives to crop insurance organic producers use to diversify their risks because organic markets are characterized by being thin; therefore, marketing is different from that of conventional crops. Born (2005) exemplifies this situation with the case of organically produced grains: "While the conventional grower can deposit a whole harvest at the elevator, organic production is usually contracted with a specific buyer ahead of planting". Born argues that this is due to the fact that in many cases organic crops do not have spot markets, and so contracts are a tool producers use to manage risk.

Figure 3. Distribution of the respondents' farm and off-farm income, and farm size



Dimitri and Oberholtzer (2008a) found evidence that contracting is the primary method for selling in the organic sector. In 2004, organic handlers procured 46% of their supply under written contracts, 24% under informal contracts and 27% through spot markets. In contrast, MacDonald *et al.* (2004) found that in conventional agriculture spot market transactions account for 60% of all purchases. Dimitri and Oberholtzer (2008b) also found that contracts in the organic sector are based on the handlers' perspective to reduce transaction costs of finding enough product, not for risk sharing. In addition to contracting, the authors found that handlers in many cases maintain close relationships with suppliers by assisting them, sometimes even recruiting them, in order to gain access to organic products. To evaluate the validity of these findings, we asked organic producers to indicate and rank in percentages the way they market their crops. The results that we obtained are displayed in figure 4.

Figure 4. Marketing / price risk management strategies



The third part of the survey was aimed at collecting information regarding organic producers' demand of crop insurance and their risk and loss experience during the last few years. Variables that measured producers' characteristics included age, education, operation, farm size, farm and off-farm income, number of years farming and number of years of organic farming. Age, farm size, number of years farming and number of years of organic farming were continuous variables, whereas education, operation, and farm and off-farm income were all ordered categorical variables. Education took values from 1 to 5 according to the number of years that the main operator attended school, where a higher number denoted more years. Operation took values from 1 to 4, where 1 indicated chemical free, 2 certified organic, 3 transitioning, and 4 mixed production. Farm and off-farm income had 5 and 6 categories respectively, and a higher income bracket translated into a higher number.

One final note on the nature of our survey is that, in contrast to the insurance data that RMA will use to develop the new crop insurance policy, the data we collected is unlikely to be biased by adverse selection. The RMA database has been gathered by having insured organic producers each year. However, adverse selection and moral hazard are to be found in agricultural insurance markets due to asymmetric information (Smith and Baquet, 1996). Hence, the RMA data may be biased by adverse selection because in most likelihood the proportion of organic producers finding the 5% organic policy premium attractive is much greater in the RMA sample than in the population of organic farmers as a whole; in other words, the database of organic farmers that have been purchasing insurance under the current insurance policy is likely to comprise the producers with greatest risk.[1] Also, given the relatively new incorporation of organic agriculture to the Federal crop insurance coverage and the lack of experience of new organic producers, adverse selection could be even greater for the pool of insured organic producers; this is due to the fact that RMA's calculation of insurance guarantees and premium rates require as few as four years of yield data available inducing large sample errors [see Carriquiry, Babcock and Hart (2008) for an analysis of such sampling errors in the estimation of farmer's mean yields and their effects on adverse selection, as well as their proposed estimator to reduce it]. Therefore, to the extent that the survey data and the RMA data differ, we might be better positioned to determine the organic risk differential and the factors that influence the demand for organic grain crop insurance in the geographic area under study.

III. Discrete Choice Model of Insurance Demand by Organic Farmers

There is a vast empirical economic literature on the demand for crop insurance, but much of it based on aggregate data (e.g., Barnett; Gardner and Kramer; Barnett, Skees and Hourigan; Goodwin; Richards). Empirical studies relying upon farm level data can be divided into two groups, namely, one group focusing on the producer's decision of whether to purchase insurance (Calvin 1992; Coble *et al.*, 1996; Just and Calvin, 1994; Vandeveer and Loehman, 1994), and another group analyzing simultaneous decisions regarding crop insurance. These simultaneous decisions were either insurance purchase and coverage-level election (Smith and Baquet, 1996) or insurance purchase and product choice (Makki and Somwaru, 2001; Mishra and Goodwin, 2003; Shaik *et al.*, 2008; Sherrick *et al.*, 2004). The present analysis follows the latter line of work.

The theoretical framework under which farmers' crop insurance purchase decision is typically examined is that of expected utility maximization subject to a set of constraints (Sherrick *et al.*, Smith and Baquet, Goodwin, Coble *et al.*, Calvin, Just and Calvin). In the theoretical model presented by Shaik *et al.* (2008), which is built upon the participation model of Coble *et al.* (1996), the authors assume that farmers have a Von Neuman-Morgenstern utility function and that they maximize their expected utility by choosing among the insurance alternatives that they have available. Mathematically, their expected utility model is given by

[1]Just, Calvin, and Quiggin (1999) analyze the effects of asymmetric information on adverse selection in crop insurance

$EU_j = \beta_j' X + \varepsilon_j$, where *j* denotes each alternative, the βs are vectors of coefficients on exogenous variables *X* and the εs are random disturbances. Shaik *et al.* empirically analyze the participation choice of producers using a multinomial logit model. Contrastingly, Sherrick *et al.* (2004) evaluate the producers' participation decision in a first stage by means of a binomial logit; and then in a second stage the authors evaluate the product choice of those farmers that purchased insurance using an unordered multinomial logit. Therefore, the main difference between the empirical models by Shaik *et al.* and Sherrick *et al.* is whether the product choice is modeled in the same stage as the participation decision.

Due to the disparity in the number of responses regarding purchase and product choice that we obtained in our survey, a model with a single step decision process would have discarded valuable information from producers that reported whether they purchased insurance but did not specify which product they bought. Thus, a two-stage empirical model similar to that of Sherrick *et al.* (2004) was more appropriate for our analysis. Given that we evaluated the purchase of only two alternative insurance products (because of the responses that we received), we ran two binomial logit regressions sequentially; the first one to evaluate the organic producers' participation decision and the second one for those who purchased insurance and decided between yield and revenue products. In the first stage (second stage), it is assumed that the probability of farmer *n* choosing alternative *j* is given by:

$$P_{jn} = \frac{\exp(\beta_j' X_n)}{\sum_{j=1}^{2} \exp(\beta_j' X_n)} \qquad j = 1, 2 \tag{1}$$

where 1 and 2 denote no insurance and insurance purchase (yield insurance and revenue insurance), respectively. Given that the probabilities add up to one, the parameter vectors of one alternative can be normalized to zero. Thus, based on equation (1), the probabilities of each alternative are given by:

$$P_{1n} = \frac{1}{1+\exp(\beta_2' X_n)} \quad \text{and} \quad P_{2n} = \frac{\exp(\beta_2' X_n)}{1+\exp(\beta_2' X_n)}.$$

The explanatory variables included in X_n are age, farm size, number of years farming, number of years of organic farming, type of operation, education, farm and off-farm income, as well as dummy variables for the state in which the farm was located. For the first stage, a priori one would expect age, number of years farming and education to have a positive sign, implying that those producers are more experienced and knowledgeable about crop insurance as a risk diversifying tool. One would also expect farm size to have a positive sign, indicating that producers with more acreage would have, to some extent, a greater need for managing their risk. With respect to type of operation and years of organic farming, one would expect them to have a negative sign, denoting organic producers' reluctance to purchase crop insurance under the current policy. Finally, one would expect farm income to have a positive sign, conveying the reliance of the household income on farm operations; contrastingly, one would expect off-farm to have a negative sign, because working off-farm is a competing risk-diversifying strategy to crop insurance.

Results

The results for the two sequential logit regressions for corn and soybean are shown in Tables 1 and 2 respectively.[2] The panels denoted as first stages correspond to the logit analysis of the question of whether producers had bought crop insurance in the year 2008; whereas the second stage panels denote the logit analysis of which insurance product they purchased for that year. In the first stages the base case was no insurance purchase and in the second ones it was the purchase of a yield product.

The results of the first stage for corn shown in Table 1 suggest that insurance purchasers are characterized by being older, having more (fewer) years of farming (organic farming), and higher (lower) farm income (off-farm income). The signs of the corresponding estimated coefficients are consistent with the a-priori expected relationships, but none of them turned out to be statistically significant. Instead, farm size and education were significant at the 10 and 5% level respectively; thus, organic farmers with larger farms and more formal education were more likely to purchase crop insurance. Also the type of operation influenced corn producers' insurance purchasing decision. Not surprisingly, mixed farmers were found to be more likely to purchase crop insurance, most likely due to the fact that they purchase it for their conventional crops and just extend the coverage to the organic ones.

[2] We also ran the models including an additional variable; namely, the actual production history (APH) premium rate that we calculated for each farmer based on their yields and county information. Thus, such variable represented the premium rate that each farmer would have had to pay had he chosen APH coverage at the 65% coverage in 2008. However, the variable was not statistically significant and the rest of the results did not change considerably.

Table 1. Econometric results for insurance participation and product choice of organic corn producers

	Stage 1: No purchase / Purchase				Stage 2: APH / CRC			
	Coefficient	t-stat	p-value		Coefficient	t-stat	p-value	
Constant	-4.441	-2.37	0.018	**	-0.646	-0.28	0.782	
Age	0.023	0.98	0.329		-0.235	-2.46	0.014	**
Farm size	0.002	1.80	0.071	*	0.000	0.32	0.750	
Yrs. Farming	0.021	0.82	0.411		-0.001	-0.01	0.992	
Yrs.Org. farm	-0.001	-0.02	0.981		0.124	1.63	0.103	
Operation	0.818	2.20	0.028	**	0.701	1.23	0.218	
Education	0.462	2.20	0.028	**	1.130	2.09	0.037	**
Farm income	0.034	0.19	0.850		-0.101	-0.33	0.743	
Off farm inc.	-0.062	-0.55	0.581		-0.231	-1.04	0.296	
Minnesota	-0.293	-0.49	0.628		-0.677	-0.57	0.569	
Wisconsin	-0.995	-1.85	0.064	*	-0.131	-0.12	0.907	
Nobs	109				Nobs	47		
Log. Likelihood	-58.07				Log. Likelihood	-18.66		
AIC	138.15				AIC	65.13		

*** (**, *) Denotes significantly different from zero at the 1% (5%, 10%) level, based on the two-sided *t* statistic.

In addition, the dummy variable for organic farmers in Wisconsin shows that producers in that state are significantly less likely to purchase insurance than farmers in Iowa, which is the base case. Contrastingly, the results of the first binomial logit stage for soybean producers shown in Table 2 indicate that type of operation is the only variable statistically significant at the 5% level. Although the variable years of organic farming is not significant, it has a negative coefficient in this case as well.

In the second stage for corn (soybean) the number of observations dropped to 47 (49) because the sample only included those organic farmers that stated which crop insurance product they purchased for the year 2008. The results for corn suggest that producers who are younger, have larger farms, fewer (more) years of (organic) farming, more education and lower farm and off-farm income are more likely to purchase Crop Revenue Coverage (CRC) products than yield products like Actual Production History (APH). Nevertheless, only age and education were significant at the 5% level. In the second stage for soybean, age and off farm income have a negative coefficient and they are significant at the 5% level, whereas years of organic farming and education have positive coefficients and are significant at the 10% level; implying that organic producers who are younger, with less off farm income, more organic farming experience and more years of formal education are more likely to buy CRC.

Table 2. Econometric results for insurance participation and product choice of organic soybean producers

	Stage 1: No purchase / Purchase				Stage 2: APH / CRC			
	Coefficient	t-stat	p-value		Coefficient	t-stat	p-value	
Constant	-3.474	-2.21	0.027	**	-0.937	-0.41	0.681	
Age	0.037	1.11	0.269		-0.147	-2.39	0.017	**
Farm size	0.001	1.40	0.162		0.000	0.57	0.569	
Yrs. Farming	0.032	1.05	0.293		0.018	0.38	0.705	
Yrs.Org. farm	-0.002	-0.06	0.949		0.136	1.87	0.062	*
Operation	0.950	2.08	0.038	**	0.243	0.51	0.610	
Education	0.323	1.36	0.175		0.705	1.72	0.086	*
Farm income	-0.061	-0.31	0.755		-0.109	-0.45	0.655	
Off farm inc.	-0.012	-0.09	0.929		-0.434	-1.99	0.046	**
Minnesota	-0.056	-0.08	0.934		0.070	0.07	0.948	
Wisconsin	0.136	0.20	0.842		-0.434	-0.46	0.649	
Nobs	78				Nobs	49		
Log. Likelihood	-42.86				Log. Likelihood	-22.47		
AIC	107.73				AIC	66.95		

*** (**, *) Denotes significantly different from zero at the 1% (5%, 10%) level, based on the two-sided *t* statistic.

The survey data contain additional information that complement the above discrete choice model results and may help to better understand organic farmers' demand for crop insurance. To this end, figure 5 displays the farmers' participation decision in percentages by state. Interestingly, the percentage of organic surveyed farmers in Wisconsin who purchased crop insurance (34.7%) was about the same as the one for those in Iowa who did not purchase it (36.4%). Meanwhile, in Minnesota the percentage of buyers (45.7%) and non-buyers (51.4%) was divided more evenly. The reasons for this difference in participation among states are not clear, but they might be related to a similar behavior in the commodity cases.

Figure 5. Insurance purchase by state

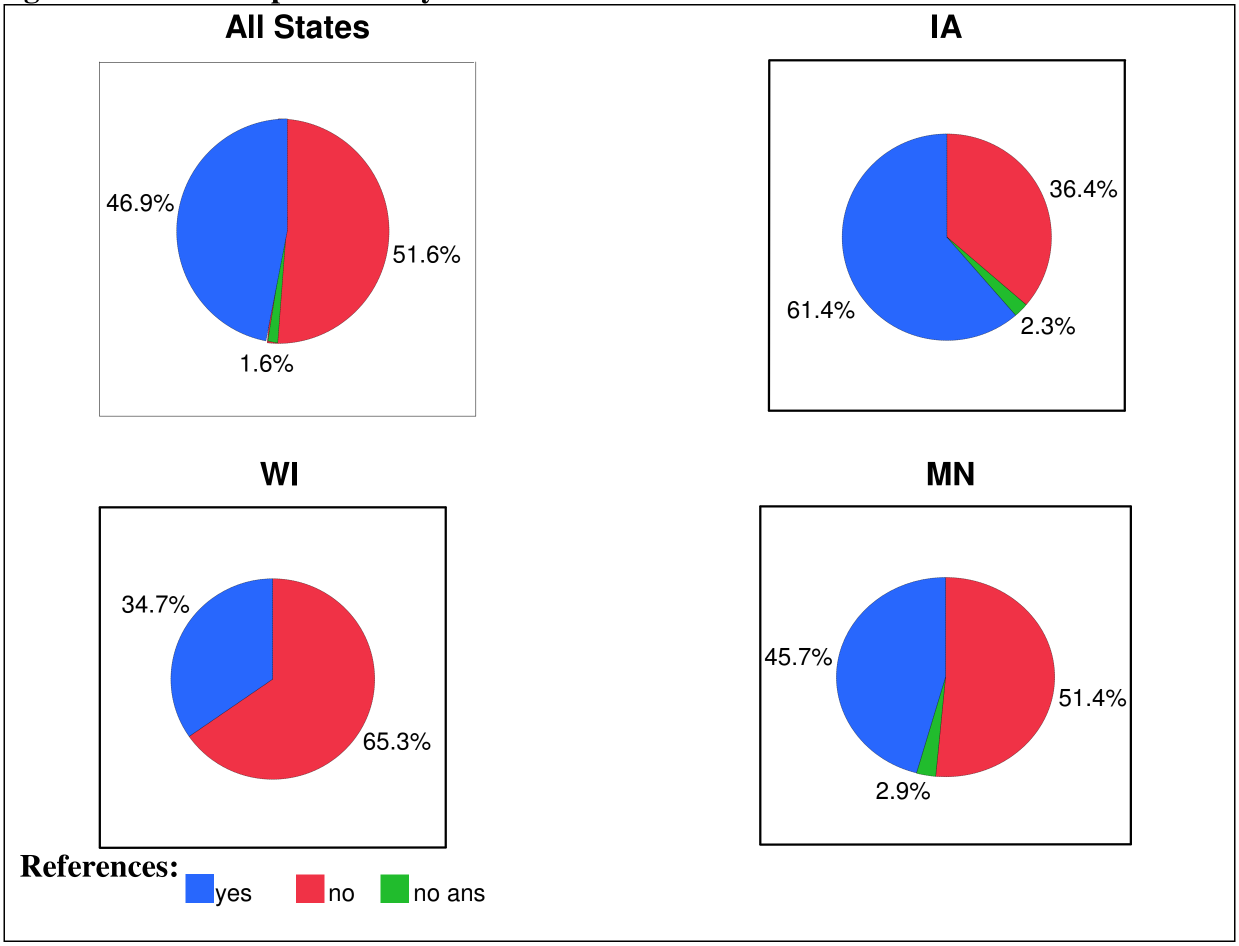
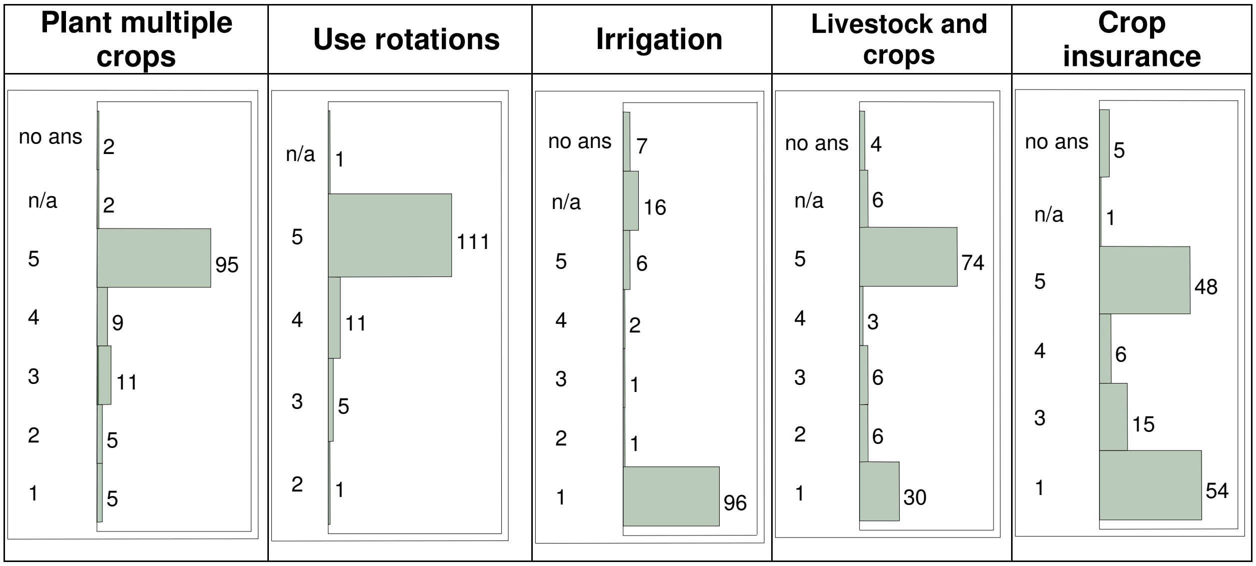


Figure 6 shows the distribution of the surveyed farmers' responses regarding their usage of alternative strategies to diversify production risk, including crop insurance. It can be seen that planting multiple crops and employing rotations is a standard practice (and a mandatory one if a producer wants to become certified organic). The results also show that having livestock in an organic farm is a widespread practice, whereas irrigating is not. From figure 6 it can also be seen that the waters are divided among organic farmers when it comes to crop insurance, since about half of them purchase it and the other half does not.

If organic producers responded that they had never bought crop insurance, they were asked to indicate in a Likert scale their motivation for not buying it among a list of preponderant reasons found in the literature as the result of focus groups. The usefulness of the information provided by the responses to this question should be evident, since it would give policymakers valuable knowledge regarding organic grain producers' demand (or lack of it) for crop insurance.

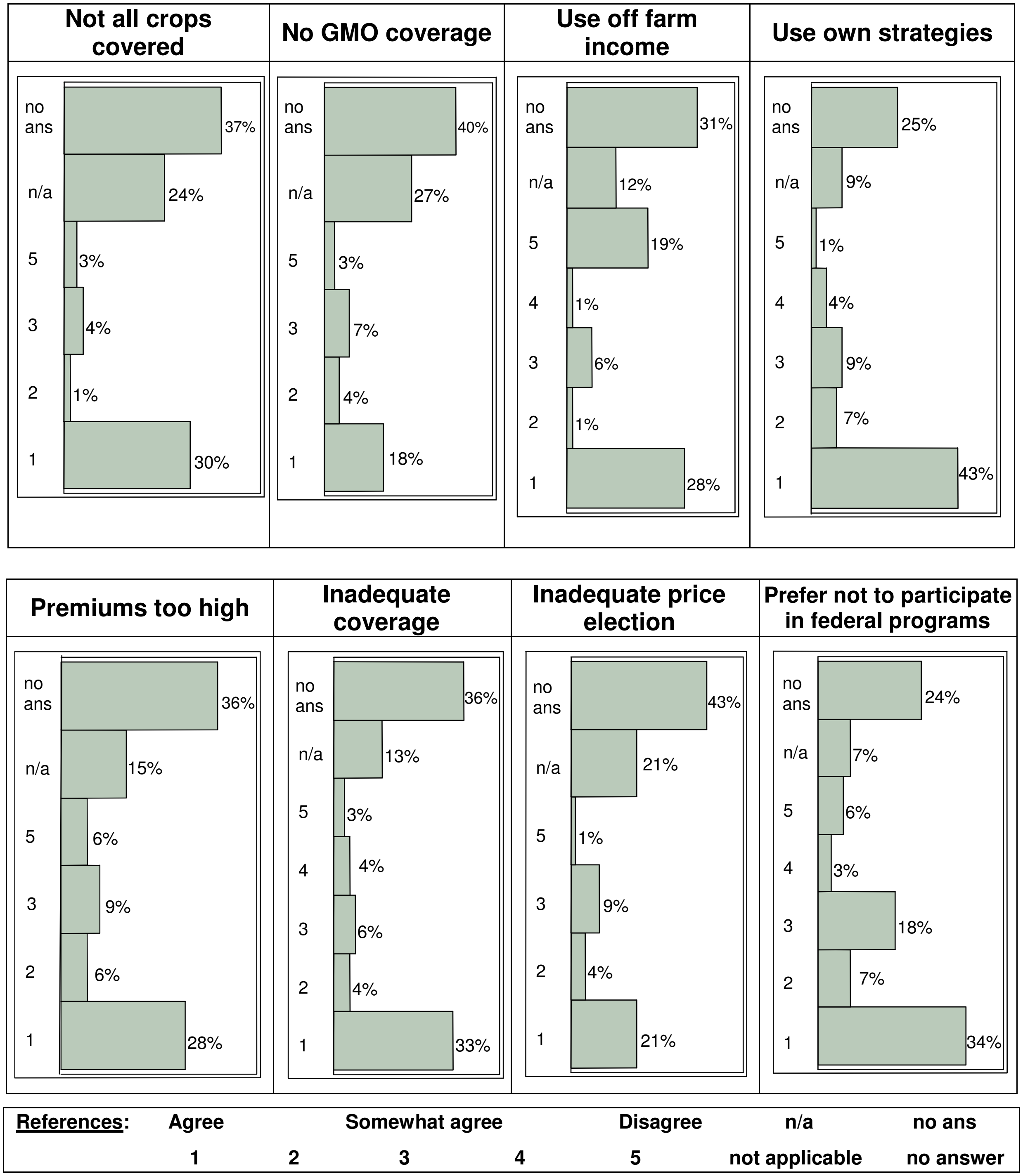
Figure 6. Production risk diversifying strategies and usage comparison relative to crop insurance



References:	Not at all		Somewhat		Definitely	n/a	no ans
	1	2	3	4	5	not applicable	no answer

The distribution of such responses is summarized in figure 7. An important result is that the top reason organic farmers indicated for not buying crop insurance is that they use their own strategies to diversify risk (43% of the respondents agreed with that statement). An even more important result from figure 7 is that 34% of the farmers responded that they have never purchased crop insurance because they prefer not to participate in federal programs, implying that they would not buy it regardless of any improvement to the insurance policy to make it more actuarially fair.

Figure 7. Non buyers' reasons for not purchasing crop insurance: Likert scale responses' distribution



IV. Yields and Prices Associated with Organic Grains and Oilseeds

The results from the discrete choice model presented in the previous section offer only a partial analysis of the crop insurance demand by the surveyed organic producers. As mentioned earlier, the incorporation of organic production into the crop insurance rating structure has been limited, thereby negatively influencing producers' crop insurance purchase decisions. First, because RMA assumes that organic production has the same yield level as conventional production with 5% more yield risk. The evidence shown next suggests that although organic oats attain equivalent yields to that of its conventional counterpart, that is not the case for organic corn and soybean. Second, because RMA in the current crop insurance policy also assumes that the prices that organic and conventional producers obtain in the market are the same. But Singerman and Lence (2010) have shown that organic corn and soybean prices are consistently and significantly higher than the prices of conventional corn and soybean, with about the same risk. As explained below, in our survey we also found evidence regarding this issue. In addition, and perhaps more importantly, Singerman and Lence (2010) found that organic crop prices do not follow conventional crop prices.

Table 3 shows the average yield, price and revenue obtained by the organic producers we surveyed for corn, soybean and oats. As a way of comparing such results to those of conventional producers, we used National Agriculture Statistics Service (NASS) data; the results are also included in table 3. In that table there is also a column called 4-year APH (Actual Production History), which denotes the 4-year yield average calculation. In the three Midwestern states surveyed, organic corn and soybean yields are about 70% of conventional yields. However, organic oat yields are about the same as conventional ones.

The finding of a lower yield level for organic corn and soybean on its own does not allow one to infer that organic crops are riskier. Instead, it indicates that when insuring their crops under the current policy, organic corn and soybean farmers are being misrated twice. The first time when charged a 5% surcharge over their conventional fellows, the second time because under the Multiple Peril Crop Insurance calculations the Base Premium Rate is computed taking into account a reference yield that is determined at the county level, and it is irrespective of the farmers' production practices. Thus, based on our results when having a lower yield level and being compared to conventional yields, organic producers are subject to premium rates that are not tied to their idiosyncratic yield distributions.

Table 3. Comparison of average yield, price and revenue obtained by organic (survey) and conventional (NASS) producers from 2005 to 2008 in the selected states

Corn

			2008				2007				2006				2005			
		4-year APH	avg yield	avg price	avg revenue	# obs	avg yield	avg price	avg revenue	# obs	avg yield	avg price	avg revenue	# obs	avg yield	avg price	avg revenue	# obs
IA	survey	118	113	9.02	1,017	35	125	8.97	1,120	30	123	6.54	805	26	112	5.22	583	21
	NASS	170	171	3.95	675	n/a	171	4.29	734	n/a	166	3.03	503	n/a	173	1.94	336	n/a
MN	survey	106	107	8.09	864	13	115	9.41	1,081	9	102	7.66	784	9	101	6.47	655	7
	NASS	161	164	3.80	623	n/a	146	4.13	603	n/a	161	2.89	465	n/a	174	1.86	324	n/a
WI	survey	99	102	9.39	953	20	94	8.27	778	15	102	8.58	879	10	99	8.15	803	7
	NASS	141	137	3.50	480	n/a	135	4.11	555	n/a	143	3.04	435	n/a	148	1.94	287	n/a

Soybean

			2008				2007				2006				2005			
		4-year APH	avg yield	avg price	avg revenue	# obs	avg yield	avg price	avg revenue	# obs	avg yield	avg price	avg revenue	# obs	avg yield	avg price	avg revenue	# obs
IA	survey	31	26	21.69	574	27	31	20.80	648	23	35	16.69	577	20	33	14.89	494	21
	NASS	50	46	9.65	444	n/a	52	10.50	546	n/a	51	6.58	332	n/a	53	5.54	291	n/a
MN	survey	29	28	25.11	709	9	28	17.51	496	12	29	15.77	453	11	31	16.42	509	10
	NASS	43	38	9.60	365	n/a	43	10.20	434	n/a	45	6.26	279	n/a	46	5.53	252	n/a
WI	survey	29	29	21.67	618	8	27	20.60	564	8	32	13.67	437	5	29	15.31	450	5
	NASS	41	35	9.20	322	n/a	41	9.83	398	n/a	44	6.04	266	n/a	44	5.64	248	n/a

Oats

			2008				2007				2006				2005			
		4-year APH	avg yield	avg price	avg revenue	# obs	avg yield	avg price	avg revenue	# obs	avg yield	avg price	avg revenue	# obs	avg yield	avg price	avg revenue	# obs
IA	survey	67	59	5.33	312	11	59	4.29	254	11	73	4.21	306	9	78	3.83	299	9
	NASS	73	65	3.20	208	n/a	71	2.74	195	n/a	76	1.94	147	n/a	79	1.69	134	n/a
MN	survey	69	71	5.27	372	9	65	3.95	257	9	68	3.55	241	8	72	3.27	236	8
	NASS	62	68	2.65	180	n/a	60	2.49	149	n/a	56	1.93	108	n/a	62	1.47	91	n/a
WI	survey	63	59	3.58	210	7	64	4.28	273	9	66	2.11	139	3	63	n/a	n/a	2
	NASS	64	62	2.70	167	n/a	67	2.46	165	n/a	63	1.78	112	n/a	64	1.54	99	n/a

Table 4. Comparison of average yield, standard deviation and average price obtained by insured and non-insured (denoted non) organic producers from 2005 to 2008 in the selected states

Corn

			2008				2007				2006				2005			
		4-year APH	avg yield	std dev	avg price	# obs	avg yield	std dev	avg price	# obs	avg yield	std dev	avg price	# obs	avg yield	std dev	avg price	# obs
IA	insurers	121	114	40	9	20	126	23	9	20	123	38	6	18	120	30	5	15
	non	110	105	20	9	14	122	19	9	10	124	26	7	8	90	25	5	6
MN	insurers	73	122	15	8	3	87	37	10	3	43	23	11	2	40	n/a	12	1
	non	121	120	21	9	8	129	24	9	6	122	32	6	7	114	10	5	6
WI	insurers	103	100	35	9	9	85	41	9	6	115	35	6	4	110	39	5	5
	non	93	103	19	10	11	100	31	8	9	94	46	10	6	75	45	13	2

Soybeans

			2008				2007				2006				2005			
		4-year APH	avg yield	std dev	avg price	# obs	avg yield	std dev	avg price	# obs	avg yield	std dev	avg price	# obs	avg yield	std dev	avg price	# obs
IA	insurers	30	25	10	22.20	17	28	11	20.10	14	33	13	16.63	13	33	12	15.20	15
	non	33	28	8	22.32	9	36	11	22.11	9	37	12	16.85	7	34	9	14.18	6
MN	insurers	25	24	6	24.88	4	25	4	17.40	5	24	7	14.10	5	27	6	15.00	4
	non	32	32	10	25.30	5	31	13	17.59	7	33	13	17.16	6	34	14	17.55	6
WI	insurers	28	24	9	21.25	5	25	10	19.80	5	34	11	14.75	4	30	10	14.42	4
	non	30	36	5	22.50	3	31	6	21.67	3	26	n/a	11.50	1	29	n/a	18.00	1

Oats

			2008				2007				2006				2005			
		4-year APH	avg yield	std dev	avg price	# obs	avg yield	std dev	avg price	# obs	avg yield	std dev	avg price	# obs	avg yield	std dev	avg price	# obs
IA	insurers	74	66	20	5.88	7	64	27	4.38	8	84	24	4.31	6	81	23	4.38	6
	non	54	48	11	4.59	4	47	2	4.00	3	51	11	4.00	3	71	21	2.75	3
MN	insurers	60	62	21	5.03	4	58	32	4.05	3	58	39	3.52	3	62	30	3.42	3
	non	75	76	15	5.50	5	69	26	3.88	6	75	20	3.60	5	80	11	3.12	5
WI	insurers	67	75	15	n/a	2	69	2	3.00	3	65	n/a	n/a	1	60	n/a	n/a	1
	non	61	52	21	3.58	5	61	18	4.53	6	67	3	2.11	2	65	n/a	n/a	1

Table 3 also shows that as a consequence of receiving higher prices for their crops, organic corn and oats producers obtained an average revenue per acre about 80% higher than that of their conventional counterparts; while for soybean it was about 60% more. The differential yield and price level for organic soybean that we found is very similar to the ones that McBride and Greene (2008) reported using a nationwide on-farm survey. Yet such price difference is not reflected in the crop insurance coverage that organic producers can obtain.

Table 4 shows a comparison between the insured and non-insured organic producers that we surveyed regarding average yield, yield variability across farmers and average price. Yields were sometimes lower for non-insurers for corn and oats, but were higher in all cases (but one) for soybean. A relevant finding is that for all three crops and states, in most instances the standard deviation of yields across farmers was higher for insurers than for non-insurers, suggesting that insurers' distribution is less uniform (has more variability) than that of non-insurers. In terms of price differential between insurers and non insurers, there seems to be none.

V. Yield Density Function Comparison between Organic and Conventional Corn and Soybean Producers in Iowa

Given the significant difference in yield levels between organic and conventional corn and soybean producers described in the previous section, it seems useful to compare the extent to which their density functions differ. To perform such comparison, we estimated the nonparametric density function of their yields. Since we were able to obtain farm-level data for conventional producers for Iowa only (from the Iowa Farm Business Association (IFBA)), the density function comparison is for that state. Therefore, we used the survey panel data of corn and soybean yields for those organic producers that provided us with four successive years of their APHs,[3] and we used the IFBA data similarly. One caveat of constructing the 4-year complete APH is that we had a limited number of observations available for organic farmers that reported at least a 4 years of their historic yields; they were 17 and 14 for corn and soybean, respectively. Consequently, the analysis described below is valid as a case study; once more data become available, future research could confirm our results.

[3]We did not use the RMA's transition or T-Yield procedure, by which the missing data are replaced by a percentage of the county average yield according to the number of years missing. For a complete description of APH rules and T-Yields definitions, see http://www.rma.usda.gov/FTP/Publications/directives/18000/pdf/05_18010.pdf

To estimate the yield density functions, we used the kernel density estimator with kernel *K* defined as:

$$\hat{f}(x) = \frac{1}{Nh}\sum_{i=1}^{N} K\left(\frac{x - X_i}{h}\right) \tag{2}$$

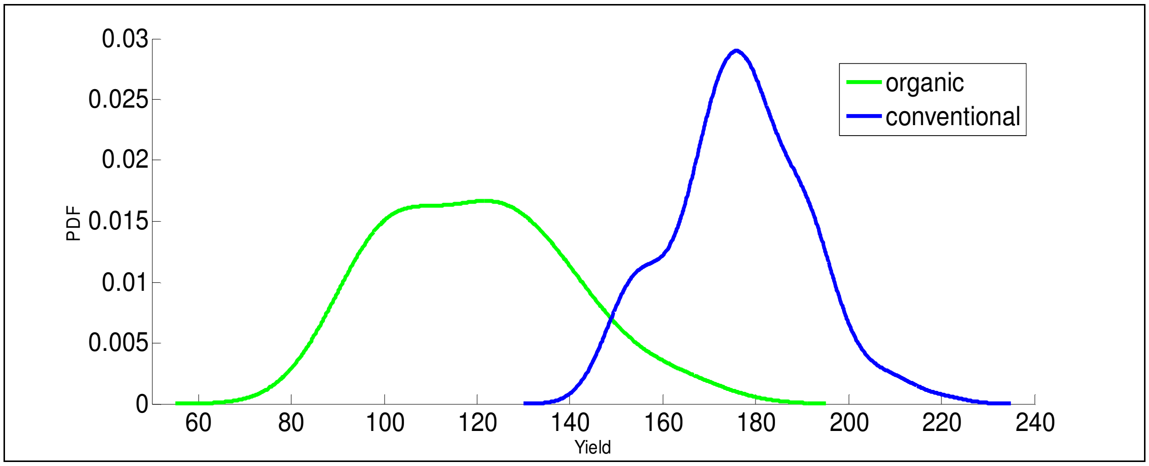
where *N* is the number of observations and *h* is the bandwidth or smoothing parameter. Regarding the choice of function $K(\cdot)$, Dinardo and Tobias (2001, p.9) explain that "…the particular kernel employed imposes nothing on the shape of the probability density function we estimate", and then they continue arguing that the choice of bandwidth is more important; but they add that "despite a huge literature […] bandwidth choice remains largely an art". As Silverman (1986) suggests, the choice of the bandwidth hinges on the purpose for which the density estimate will be used, and he further adds that in some cases a subjective choice could be sufficient and even desirable. Hence, in our estimates we chose the smallest *h* that would make the yield densities smooth.

We estimated the yield density functions for organic and conventional corn and soybean using the 4-year APH farm-level data, and drawing 1,000 estimates from them to construct their respective *pdf*s. The estimated densities for corn and soybean are shown in panels A and B of figure 8, respectively. The underlying assumption behind the 5% surcharge to organic farmers is that, when comparing the distributions of organic and conventional crop yields, the only difference between them is that organic crops should exhibit 5% more risk than conventional ones. Such clear-cut result cannot be inferred from figure 8; nevertheless, both panels of that figure clearly show that the yield distributions for organic and conventional corn and soybean are different because the mean of the organic *pdf*s are to the left of the conventional ones, denoting their lower mean yields.

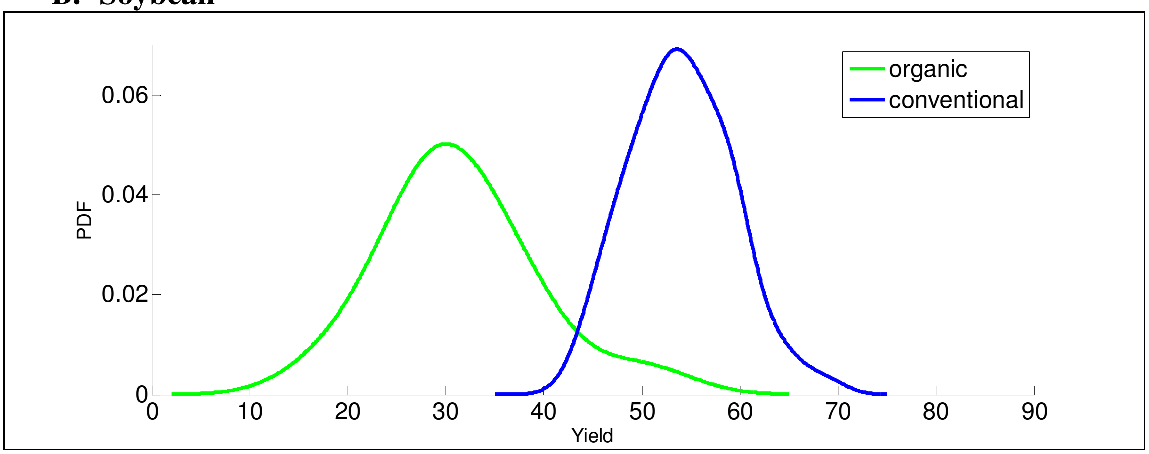
Thus, the empirical evidence indicates that organic yields of both crops do not come from the same distribution as that of their conventional counterparts, as implied by the current crop insurance policy. Consequently, if our results extended to larger (organic) data analyses and other crops, this evidence should be used by RMA to provide crop insurance for organic producers based on their idiosyncratic yield curves, rather than extrapolating the ones used for conventional farmers.

Figure 8. Iowa organic and conventional producers' 4-year yield APH kernel

A. Corn



B. Soybean



VI. Conclusions

In recent years there has been a steady and significant growth of the organic sector (OTA, 2008). However, little economic research has been performed on the subject, likely due to the lack of data availability. Also likely because of it, the creation of the current crop insurance policy for organic farmers has been ad hoc and not based on the idiosyncratic characteristics of the organic sector. The present study aimed at starting filling this gap; in particular at analyzing the demand for crop insurance and differential production risk of organic farmers in three states where acreage for organic production is among the greatest in the U.S. for the crops that we studied.

In this manuscript we analyzed organic producers' demand for crop insurance using a discrete choice model that showed the impact of demographic variables on their purchasing and product choice decisions. But perhaps more importantly, we complemented those results with additional crop insurance usage information, as well as yield, price and revenue comparisons between organic and conventional producers. Although some authors have reported that organic and conventional yields are equivalent, in this study we found that corn and soybean under organic management attain about 70% of the yield of that of conventional crops. The dissimilarity of the results could be due to the fact that many of those authors performed the experiments on (smaller) experimental plots that are more easily controlled for weeds than entire farms are. However, those experiments reveal the potential for organic farming of achieving yields equivalent to those of conventional crops, something exemplified by the yield level for organic oats achieved by producers in our sample. The present study provides further evidence that organic producers obtain higher prices than their conventional fellows. In fact, in our sample the higher prices received for the organic crops more than offset their lower yields, resulting in higher revenues per acre compared to their conventional counterparts.

Our findings regarding the different yield levels (and their probability distribution functions) between organic and conventional corn and soybean producers, along with the substantial price premiums that organic farmers obtain, call for RMA to perform additional analyses to evaluate the validity of our findings on a nationwide basis and, if so, modify the current organic farming insurance policy accordingly to provide a more actuarially fair coverage to organic producers.

References

Badgley C., J. Moghtader, E. Quintero, E. Zakem, M.J. Chappell, K. Avilés-Vázquez, A. Samulon and I. Perfecto. 2007. Organic agriculture and the global food supply. Renewable Agricultural Food System (22):86-108

Barnett, B .J. 1993. Explaining Participation in the Federal Multiple-Peril Crop Insurance Program. PhD dissertation, University of Kentucky

Barnett, B.J., J.R. Skees, and J.D. Hourigan. 1990 "Explaining Participation in Federal Crop Insurance. Dept. of Agricultural Economics Staff Paper 275, University of Kentucky

Born, H. 2005. Marketing Organic Grains. National Sustainable Agricultural Information Service http://attra.ncat.org/attra-pub/PDF/marketingorganicgrains.pdf

Carriquiry, M.A., B. Babcock and C. E. Hart. 2008. Using a Farmer's Beta for Imporved Estimation of Expected Yields. Journal of Agricultural and Resource Economics. 33:52-68

Calvin, L. 1992. Participation in the U.S. Federal Crop Insurance Program. Washington D.C.: U.S. Department of Agriculture, ERS Technical Bulletin 1800

Chen, X., H.H. Wang, L.D. Makus. 2007. Production risk and crop insurance effectiveness: Organic versus conventional apples. SCC-76: Economics and Management Risk in Agriculture and Natural Resources, Gulf Shores, AL

Coble, K. H., T. 0. Knight, R. D. Pope, and J. R Williams. 1996. Modeling Farm-Level Crop Insurance Demand with Panel Data. American Journal of Agicultural. Econonics 78:439-47

Delate, K.M. 2002. Using an agroecological approach to farming systems research. HortTechnology 12(3):345-354

Delate, K., M. Duffy, C. Chase, A. Holste, H. Friederich and N Wantate. 2003. An economic comparison of organic and conventional grain crops in a long-term agroecological research (LTAR) site in Iowa. American Journal of Alternative Agriculture 18(1):1-11

Delate, K., and Cambardella, C. 2004. Agroecosystem performance during transition to certified organic grain production. Agronomy Journal 96:1288-1298

Dimitri C. and C. Greene. 2002. Recent Growth Patterns in the U.S. Organic Foods Market. U.S. Department of Agriculture, Economic Research Service, Market and Trade Economics Division and Resource Economics Division. Agriculture Information Bulletin Number 777 http://www.ers.usda.gov/publications/aib777/

Dimitri, C. and L. Oberholtzer. 2008a. The U.S. Organic Handling Sector in 2004: Baseline Findings of the Nationwide Survey of Organic Manufacturers, Processors, and Distributors. U.S. Department of Agriculture, Economic Research Service, Economic Information Bulletin Number 36 http://www.ers.usda.gov/Publications/EIB36/EIB36.pdf

Dimitri, C. and L. Oberholtzer. 2008b. Using Vertically Coordinated Relationships To Overcome Tight Supply in the Organic Market. U.S. Department of Agriculture, Economic Research Service http://www.ers.usda.gov/Publications/VGS/2008/10Oct/VGS32901/VGS32901.pdf

DiNardo J. and J.L. Tobias. 2001. Nonparametric Density and Regression Estimation. The Journal of Economic Perspectives. 15 (4) 11-28

Gardner, B. L., and R. A. Kramer. 1986. Experience with Crop Insurance Programs in the United States. Crop Insurance forAgricultural Development: Issues and Experience, eds., P. Hazzell, C. Pomereda, and A. Valdez, pp. 195-222. Baltimore: Johns Hopkins University Press, 1986

Goodwin, B.J. 1993. An Empirical Analysis of the Demand for Crop Insurance. American Journal of Agicultural Econonics 75:425-34

Greene, C. and Kremen, A. 2003. U.S. Organic Farming in 2000-2001: Adoption of Certified Systems. U.S. Department of Agriculture, Economic Research Service, Resource Economics Division, Agriculture Information Bulletin No. 780. http://www.ers.usda.gov/publications/aib780/

Hanson, J., R. Dismukes, W. Chambers, C. Greene, A. Kremen. 2004. Risk and risk management in organic agriculture: Views of organic farmers. Renewable Agriculture and Food Systems 19(4):218-227

Just, R., and L. Calvin. 1994. An Empirical Analysis of U.S. Participation in Crop Insurance. Economics of Agricultural Crop Insurance: Theory and Evidence, eds., D. L. Hueth and W. H. Furtan, pp. 205-52. Boston: Kluwer Academic Publishers, 1994

Just, R.E., L. Calvin and J. Quiggin. 1999. Adverse Selection in Crop Insurance. American Journal of Agricultural Economics. 81:835-849

MacDonald, J., J. Perry, M. Ahearn, D. Banker, W. Chambers, C. Dimitri, N. Key, K. Nelson, and L. Southard. 2004. Contracts, Markets, and Prices: Organizing the Production and Use of Agricultural Commodities. U.S. Department of Agriculture, ERS, Agricultural Economic Report No. 837 http://www.ers.usda.gov/publications/aer837/aer837.pdf

Mäder, P., A. Fließach, D. Dubois, L. Gunst, P. Fried, and U. Niggli. 2002. Soil fertility and biodiversity in organic farming. Science 296:1694-1697

Makki, S.S. and A. Somwaru. 2001. Farmers' Participation in Crop Insurance Markets: Creating the Right Incentives. American Journal of Agicultural. Econonics. 83:662-667

McBride, W.D. and Greene, C. 2008. The profitability of organic soybean production. Presented at the Agricultural and Applied Economics Association Annual Meeting, Orlando, FL, July 27-29 2008

Mishra, A., and B.K. Goodwin. 2003. Adoption of Crop versus Revenue Insurance: A Farm-Level Analysis.' Agricultural Finance Review 63:143–55

Organic Farming Research Foundation (OFRF). 2001. OFRF Newsletter, Vol. 10. OFRF, Santa Cruz, CA

Pimentel, D., Hepperly, P., Hanson, J., Douds, D., Seidel, R. 2005. Environmental, energetic and economic comparisons of organic and conventional farming systems. BioScience 55 (7): 573-582

Porter, P. 2003. Organic and other management strategies with two- and four-year crop rotations in Minnesota. Agron. J. 95:233-244

Richards, T.J. 2000. A two-Stage Model of the Demand for Specialty Crop Insurance. American Journal of Agicultural Econonics . 25:177-194

Risk Management Agency (RMA), USDA. 2008 Organic Farming Practices, Insurance Fact Sheet. http://www.rma.usda.gov/pubs/2006/organics.pdf

Shaik, S. K.H.Coble, T.O. Knight, A.E. Baquet, G.F. Patrick. 2008. Crop Revenue and Yield Insurance Demand: A Subjective Probability Approach. Journal of Agricultural and Applied Economics, 40, 3:757-766

Sherrick, B.J., Barry, P.J., Ellinger, P. N. and Schnitkey, G.D. 2004. Factors Influencing Farmer's Crop Insurance Decisions. American Journal of Agricultural Economics 86(1): 103–114

Silverman, B. (1986) Density Estimation for Statistician and Data Analysis, Chapman & Hall/CRC, 1998

Singerman, A. and S. Lence. (2010). How Closely Related Are the Prices of Organic and Conventional Corn and Soybean? *Working paper*, Department of Economics, Iowa State University. Selected Poster to be presented at the Agricultural & Applied Economics Association 2010 AAEA,CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010

Smith, V.H. and A.E. Baquet. 1996. The Demand for Multiple Peril Crop Insurance: Evidence from Montana Wheat Farms . American Journal of Agricultural Economics 78(1):189-201

USDA-ERS. 2008a. Table 3. Certified organic and total U.S. acreage, selected crops and livestock, 1995-2008. Data file: http://www.ers.usda.gov/data/organic/Data/CertifiedandtotalUSacreageselectedcropslivestock.xls

USDA-ERS. 2008b. Table 6. Certified organic grains. Data file: http://www.ers.usda.gov/data/organic/Data/Grain.xls

USDA-ERS. 2008c. Table 7. Certified organic beans. Data file: http://www.ers.usda.gov/data/organic/Data/Beans.xls

Vandeveer M.L and E. T. Loehman. 1994. Farmer Response to Modified Crop Insurance: A Case Study of Corn in Indiana . American Journal of Agricultural Economics. 76: 128-140