Do Direct Payments Influence Farmers' Hail Insurance Decisions?

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Abstract

We analyze determinants of hail insurance use of Swiss farmers, covering the period 1990-2009 using FADN panel data. Mixed effect logistic regression models are estimated to identify the most important farm and farmer characteristics that determine insurance use. In addition, information on local hail risk is taken into account in these models. It shows that larger farms, with specialization on crop production, and with larger local hail risks are more likely to adopt the hail insurance. Moreover, insurance users are usually older and better educated. Since the early 1990s, Swiss agricultural policy has reduced price support and introduced general and ecological direct payments. This has led to a much higher importance of direct payments for farmers' incomes. We find that this development has contributed to decreasing hail adoption rates in Switzerland in the considered period, due to the insurance and wealth effects of direct payments. Our results indicate that the larger the share of direct payments for total farm revenue, the more subsidies would be required to induce hail insurance adoption. Thus, agricultural policy should explicitly consider this interdependency.

Introduction

Risk management is expected to gain importance in European agriculture (e.g. Musshoff et al., 2009, Bielza Diaz-Caneja et al., 2008), in particular due to increasing production risks caused by changes in climatic conditions (e.g. Torriani et al., 2008) as well as due to increasing price volatility caused by market liberalization (e.g. Mahul, 2003). In order to cope with these risks, insurances may become a valuable risk management tool for farmers. Unlike in North-America, no widespread use of different insurance options such as farm-revenue, farm-yield or index based insurances can be currently observed in Europe at large (Bielza Diaz-Caneja et al., 2008). In contrast, hail insurances have a long tradition in European agriculture[1] and are still the most used insurance scheme in Europe. Thus, farmers' current decisions with respect to the use of hail insurance may be a good indicator for problems, potentials and pitfalls of other agricultural insurance schemes. More specifically, factors that influence insurance use are important to project the potential use of other agricultural risk management instruments in the future. Furthermore, an analysis of current insurance decisions of farmers can reveal potential policy measures to support farm-level risk management strategies.

The adoption of agricultural insurances is usually determined by a wide range of factors[2]. Among these factors that influence farmers' use of insurances are farm and farmer characteristics (such as farm size, farmers' education and age), the composition of farm income (e.g. the importance of off-farm income), production risks (e.g. local climate conditions), the monetary value of farm production (e.g. expected

[1] For instance, the agricultural hail insurance in Switzerland was established in 1880.
[2] See e.g. Sherrick et al., 2004, Medina et al., 2010, Rydant, 1979, Enjolras and Sentis, 2008, Jung et al., 2005, Cabas et al., 2008, Ogurtsov et al., 2006, for literature overviews and case studies.

yield and output price levels) as well as the price of the insurance premium and governmental insurance support (e.g. subsidies for insurance premiums).

In this paper, we analyze the determinants of hail insurance use in Swiss agriculture. Particular emphasis is given to the role of direct payments and off-farm employment on the use of hail insurance. This is motivated by the fact that both direct payments and off-farm income have become more important for agricultural income in Swiss agriculture in the last decades (El Benni et al., 2011). Moreover, both income components are expected to strongly influence farmers' risk management behavior. First, such non-volatile income sources reduce the variability of total farm income, i.e. they have an insurance effect. Thus, these income sources decrease the probability that farmers' face very low income levels and are thereby substitutes for agricultural insurances. Second, direct payments and off-farm income increase farmers' wealth[3]. If farmers are risk-averse, such increase in their wealth level is expected to decrease their level of risk aversion (wealth effect). Lower risk aversion reduces farmers' demand for insurances. These wealth and insurance effects are defined and discussed in Hennessy (1998) and Femenia et al. (2010). In summary, we expect that the increasing relevance of both direct payments and off-farm income, i.e. weather and hail independent income sources, decreases farmers' incentives to use the hail insurance.

The goal of this paper is to identify determinants of hail insurance adoption in Swiss agriculture. To this end, different logistic regression analyses are conducted using FADN panel data that is combined with information on local hail risks and takes the effects of direct payments and off-farm income on insurance adoption into account.

Data and Background

The here presented analysis is based on Swiss FADN data, i.e. farm level bookkeeping data, covering the period 1990-2009 (Agroscope FAT, 2005)[4]. Relevant for this study, this database documents expenditures on hail insurance for each farm and year. The here presented analysis focuses on the farm-level use/non-use of hail insurance. The choice of a farm-level (and not crop specific) analysis is motivated by the fact that though Swiss farmers can purchase hail insurance for single crops, the most important hail insurance scheme covers the entire farm[5].

The used FADN data sample has in total, i.e. over 20 years, 66438 observations that come from in total 9622 different farms[6]. Most observations are available for the year 1990 (N=4008) and the lowest number of observations is available for 2002 (N=2067). The low number of available observations for the early 2000s were caused by changes in the FADN data sampling methodology (see Meier, 2005, for descriptions).

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[3] This assumes that direct payments and off-farm income remain with the farmer (i.e. increase his wealth) and are not passed through to, for instance, to land owners (Femenia et al., 2010). In Switzerland, there are legal limitations on maximum land rents, though land rents exceeding these limitations may be paid in practice (see Häusler, 2010, for details).

[4] Note that the representativeness of the Swiss FADN data is limited due to the sampling methods applied (Meier, 2005).

[5] This includes the entire arable land (and/or grassland) surface of a farm, with a general (i.e. not crop specific) premium based on the total crop acreage. In this hail insurance scheme, vulnerable crops such as vegetables may require higher premiums. Note that also other elementary risks such as flooding or storm damages are covered by this insurance, see www.hagel.ch for details.

[6] Note that the length of individual farm records differs, i.e. the panel is unbalanced. More specifically, 1386 farms have only a single observation and 1253 have two observations in the sample, while 155 farms have continuous records over the entire 20 years.

Figure 1a shows the overall hail insurance adoption rates within our sample. This participation rate shows a decreasing trend over time, from 69% in 1990 to 56% in 2002, but re-increased to about 60% in 2004 and shows slight reductions over time henceforward. This study aims to link this development of decreasing hail insurance use with contrary developments in the relevance of direct payments and off-farm income that are displayed in Figures 1b and 1c. The importance of direct payments (measured as share on total farm revenue) increased continuously over time, rising from 7% in 1990 to 29% in 2009 (Figure 1b). Also the relevance of off-farm income for total farm revenue increased over time (Figure 1c): while about 9% of total farm revenue have been generated from off-farm income in 1990, this share accounts for about 14% in 2009. In contrast to the rising importance of direct payments and off-farm income, (governmental) price support has been reduced over time. Thus, the importance of income generated on agricultural markets has decreased over the last two decades (El Benni et al., 2011). This effect is captured by the here applied definition of the share of direct payment and off-farm income to total farm revenue. Therefore, both decreasing price levels and increasing direct payments simultaneously lead to the sharp increase of the importance of direct payments for total farm revenue shown in Figure 1. The same effect is evident also for the development of the relevance of off-farm income. Figure 1d shows that the total farm size increased from about 18 ha in 1990 to 22 ha (i.e. by about 22%) in 2009, while the average size of arable land increased (only) from 7.7 ha to about 8.6 ha (i.e. by about 12%) in the period 1990-2009[7].

Rydant (1979) argues that the participation in hail insurance schemes is directly linked to recent perception of hail damages. This means, a decreasing hail insurance adoption rate might be caused by low frequencies of hail events in previous years. However, this effect cannot explain decreasing adoption rates shown in Figure 1a, because Schiesser (2003) shows that the frequency of significant hail events in Switzerland increased from 1980 to 1994, but decreased till 1999. But, the frequency of hail events explains the upward jump of the adoption rate in 1995, i.e. adoption increased sharply after one of the most important 'hail years' in Switzerland in 1994 (Schiesser, 2003). In contrast, the deviations of the adoption rate from the underlying trend in the years 2002 and 2003 (Figure 1a) cannot be directly linked to hail event frequency, because in these years no exceptional frequency of significant hail events has been observed (Schiesser and Schmid, 2005). However, it might be rather caused by the limited number of available observations as well as general changes in the sampling methodology in this period that has been discussed above.

Note that only 5 out of 26 cantons currently subsidize hail insurance premiums (LID, 2005)[8]. However, the amount of premium subsidies is negligible. These subsidies covered (on average) 2% of total hail insurance premiums in the early 1990s and 0.03% in 2009 (SBV, 2010). Thus, these subsidies are not explicitly considered in our analysis.

The trends presented in Figure 1, clearly underpin the hypothesis that the adoption of hail insurance may be related to the increasing importance of direct payments and off-farm income. However, several other factors that influence the adoption decision have to be considered before such conclusions can be drawn. In particular, factors such as farm size, local hail risk, main farm activities (crop or livestock production), age and education have to be taken into account, because these variables have been also changing over time, for instance, due to structural change in Swiss agriculture. Thus, an econometric approach is used to control for other influential hail insurance adoption factors at the farm level.

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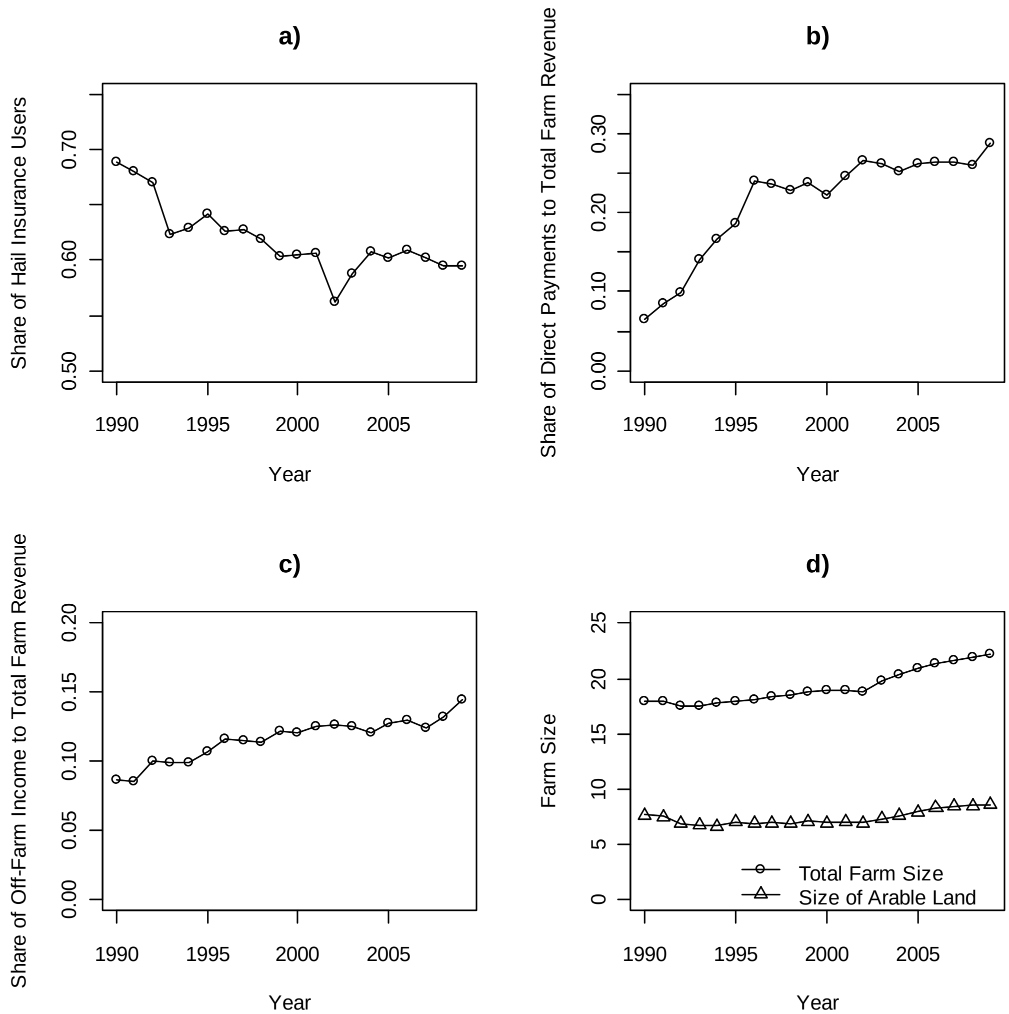
[7] The smaller growth of average arable land sizes can be explained with the fact that Swiss agricultural policy reforms gave incentives to increase grassland areas at the expense of arable land.

[8] The Swiss government has stopped premium subsidies for the hail insurance in 1967 (LID, 2005). The cantons that pay currently premium subsidies are Appenzell Innerrhoden, Basel Land, Nidwalden Schwyz and Zug.

Figure 1. Development of Hail Insurance Adoption, the Share of Direct Payments and Off-Farm Income to Total Farm Revenue as well as of Farm Size and Arable Land 1990-2009.



Methodology

In order to identify the most important factors that influenced the hail insurance adoption decision, we use logistic regression analyses taking different explanatory variables into account. These explanatory variables as well as associated hypotheses with regard to their influence on insurance adoption are presented in Table 1. Variables and hypotheses are based on a review of empirical and theoretical insurance adoption literature. For the logistic regression analyses, two strategies are applied: First, group comparisons and logistic regressions are conducted for several years independently. This will identify differences between adopters and non-adopters for specific years, and can show their development over time. Second, the panel structure of the data is used – i.e. the development of a specific farm is taken into account – using a generalized linear mixed model specification.

Table 1. Definition of Variables and Associated Hypotheses.

Dependent Variable		
Use of Hail Insurance	A_j=1 if farm i used hail insurance in year j, else A=0	
Explanatory Variables		**Hypothesis**
Farm Size	Total size of agricultural land (in ha)	Users have a larger farm size, more arable land and a larger share of arable land (e.g. Rydant, 1979, Sherrick et al., 2004)
Arable Land	Size of the arable land (in ha)	
Share of Arable Land	Share of arable land to total farm size in %	
Age	Age of farm-head in years	Users are older (e.g. Sherrick et al., 2004)
Land Tenure	Share of owned to total farm land in %	Users are less tenured, i.e. have more rented land (e.g. Sherrick et al., 2004)
Share of Direct Payments	Share of direct payments to total farm revenue in %	Non-Users have a higher share of direct payments (based on e.g. Hennessy, 1998)
Specialization on Crop Production	Share of revenue from crop production to total farm revenue in %	Users are more specialized on crop production (in contrast to animal or grassland production)
Share of Off-Farm Income	Share of off-farm income to total farm revenue in %	Non-Users have a higher share of off-farm income (e.g. Sherrick et al., 2004)
Share of Special Crops	Share of revenue from special crops (e.g. for vine, fruits, vegetables, berries) to total farm revenue in %	Users have more special crops that have a higher per area revenue (e.g. van Asseldonk et al., 2002, Lemons, 1942)
Education	Is only reported since 2003. The used levels range from 1 (no agricultural education) to 7 (university degree)	Users are better educated (e.g. Sherrick et al., 2004)
Dummy 1995	Dummy for the year 1995, the year after the main hail event in 1994 (Schiesser, 2003)	Adoption rates are higher after a major hail event (Rydant, 1979)
Hail Risk	The hail risk is measured by the Swiss hail insurance as the number of hail years for each municipality in the period 1961-2004[9]. The FADN data and the hail risk data are matched over municipalities	Users (or the municipalities they live in) have faced a higher hail risk in the past (e.g. Rydant, 1979)

In a first step, adopter and non-adopter of the hail insurance are compared with each other for specific years. In this comparison, the variables that are summarized in Table 1, are taken into account and the Mann-Whitney test is used to assess the significance of differences between the two groups. Subsequently, a logistic regression is employed. In the binary logistic regression, let *A* be the binary

[9] This information is available from the Swiss hail insurance at http://www.hagel.ch/fileadmin/hagel/dat/3052a.pdf (assessed January 7 2011).

response variable of hail insurance use, i.e. $A_i \epsilon \{0,1\}$, for i=1,…,n farms, with π_i being the expectation that $A_i = 1$ (i.e. that farm i is an adopter) given X_i. In binary logistic regression this response probability is modeled as follows:

$$log\left(\frac{\pi_i}{1-\pi_i}\right) = \alpha + \beta X_i + \epsilon_i \qquad (1)$$

$\frac{\pi}{1-\pi}$ represents the odds of response A=1 given X, α is the vector of model intercept, β is the vector of regression coefficients and ε the vector of error terms.

For these (simple) logistic regressions, three years have been chosen: 1990, 1999, and 2008. These years represent pre-reform (1990), post-reform (1999) and recent (2008) observations. In the pre-reform period, mainly price support was used as agricultural policy measure. In subsequent policy changes during the 1990s, decoupled direct payments schemes have been introduced and price support was reduced. Direct payments are currently the most important policy measure in Switzerland to support farmers and to achieve specific goals. These direct payments are divided in general direct payments (based on cross-compliance measures) and ecological direct payments (i.e. for specific ecologic measures taken by the farmer). For overviews and descriptions of agricultural policy reform steps in the last decades in Switzerland, see El Benni and Lehmann (2010), El Benni et al. (2011) and Mann (2003).

The above described logistic regressions for separated years focus on the differences between farms. For instance, these analyses assume that observed differences in insurance use are caused by differences in the explanatory variables (e.g. the farm size, age and education) across farms. Therefore, this approach does not account for changes of explanatory variables over time at a specific farm. Furthermore, many unobserved (farm-level) factors that trigger adoption are not considered. This contrasts the use of a generalized linear mixed model, which takes the within farm effects as well as the between farm effects into account. Thus, the panel structure of the data is used[10]. In contrast to the simple logistic regression presented in equation 1, we now consider observations from i=1,…,n farms and for t=1,…,T years. The generalized linear mixed model can be formulated as follows:

$$log\left(\frac{\pi_{it}}{1-\pi_{it}}\right) = \alpha + a_i + \beta X_{it} + \epsilon_{it} \qquad (2)$$

Most importantly, the term a_i captures all (observed and unobserved) time invariant characteristics of farm i (individual effects for each farm), while coefficients (β) are assumed to be equal over all farms.

Results

Table 2 shows variable means for the years 1990, 1999 and 2008. In all years, users are characterized by larger farms, a larger size (and share) of arable land as well as a higher specialization on crops and special crops. The results for land tenure show that users tend to have less rented land (i.e. are more tenured), which contrasts the hypothesis presented in Table 1. Furthermore, hail insurance users are older and better educated. We also find the expected effect of hail risks on insurance adoption: users (or

[10] Note that ignoring the panel structure of the dataset by using normal logistic regression over the entire set of observations would understate standard errors (Johnston and DiNardo, 1997).

better their municipalities) faced more often hail occurrence in the period 1961-2004. Moreover, users generated, as expected, less revenue from off-farm income and direct payments.

Table 2. Mean of Farm and Farmer Characteristics of Insurance Users and Non-Users in 1990, 1999 and 2008.

Variable	1990		1999		2008	
	Users	**Non-Users**	**Users**	**Non-Users**	**Users**	**Non-Users**
Total Farm Size (in ha)	18.23***	17.09	19.54***	17.65	23.06***	20.25
Arable Land (in ha)	8.48***	4.66	7.75***	4.63	9.38***	5.03
Share of Arable Land (in %)	44.24***	26.09	38.53***	24.06	37.58***	22.35
Specialization on Crop Production (in %)	23.34***	9.93	16.34***	5.92	15.14***	5.41
Share of Off-Farm Income (in %)	7.96***	10.23	10.83***	14.36	11.61***	15.67
Share of Direct Payments (in %)	5.01***	10.11	20.12***	29.46	22.08***	31.71
Land Tenure (in %)	55.12***	49.90	58.30***	55.28	60.08***	54.78
Age (in years)	42.43***	41.50	44.46**	43.52	46.71*	46.11
Share of Special Crops (in %)	4.82***	3.72	3.32***	2.01	3.58***	1.96
Hail Risk [0-44]	26.54 (n.s.)	25.55	27.08***	24.78	26.26**	24.70
Education [1-7]	---	---	---	---	3.34***	3.03
Number of Observations	2763	1245	1854	1220	2010	1366

*, ** and *** denote significance at the 10%, 5% and 1% level of the Mann-Whitney test. See Table 1 for definitions of the variables.

Multicollinearity problems prevent a logistic regression analysis based on the (full) set of variables presented in Table 2. In particular, the variables arable land, share of arable land and farm size are significantly correlated with each other. Thus, the variables arable land and share of arable land have been omitted from the regression analyses. Moreover, the variable share of special crops has been removed due to high positive correlation with the (general) specialization on crop production. Several model specifications have been tested, which did not affect the qualitative interpretation of the results (not shown).

Table 3. Results from the Logistic Regressions for the Years 1990, 1999 and 2008.

Variable	1990	1999	2008
Intercept	0.371***	0.262***	0.297***
Farm Size	1.029***	1.033***	1.035***
Specialization on Crop Production	1.043***	1.058***	1.045***
Off-Farm Income	1.000 (n.s.)	1.001 (n.s.)	1.003 (n.s.)
Direct Payments	0.960***	0.972***	0.969***
Land Tenure	1.003**	1.001 (n.s.)	1.005***
Age	1.004 (n.s.)	1.017***	1.007 (n.s.)
Hail Risk	1.025***	1.023***	1.015***
Education	---	---	1.128**
Number of Observations	3260	2416	2677
Pseudo R^2 (AIC)	0.12 (3418)	0.14 (2710)	0.12 (3077)

The results of the logistic regressions are presented in Table 3. Coefficient estimates presented throughout this paper represent the estimated changes in the odds of insurance adoption that is caused by a one unit increase in the respective explanatory variable and holding all other variables fixed at their mean values. For instance, an increase of the farm size by 1 ha in the 1990 model, would increase the odds that a farm uses the hail insurance by 2.9%. In contrast, a 1% increase of the share of direct payments on total farm revenue decreases these odds by about 4.2% (1/0.960-1) in the 1990 model.

Unlike to the group comparisons (Table 2), the logistic regression results presented in Table 3 show that off-farm income does not significantly contribute to the explanation of the adoption decision in any of the three models. The variable age is significant only in the 1999 model, showing that insurance users tend to be older. Land tenure is significant in the models for 1990 and 2008, showing that land tenure increases the adoption probabilities. The variables farm size, hail risk, specialization on crop production as well as the share of direct payments significantly explain the adoption behavior in all three models. More specifically, larger farms, farms that are more specialized on crop production and those farms that face higher hail risks are more likely to use hail insurance. In contrast, a higher dependency on direct payments for total farm revenue decreases the probability that a farm uses hail insurance. Furthermore, we find a positive effect of education on the adoption probability for the 2008 model[11].

For the estimation of the panel-data (mixed effect) logistic regression model we used the same set of variables presented above. However, some modifications in the set of explanatory variables have been necessary: Education is not included in the panel regression because it is not available before 2003. Moreover, farmer's age is usually linearly increasing over time. Thus, this variable does not contain the desired variability over time and is excluded from the regression analysis. In addition, multicollinearity

[11] Note that the variable education is not available before 2003.

problems motivated the estimation of three different models where either the variable farm size, specialization on crop production or no variable is omitted.

Due to missing values, the variable land tenure reduces the sample size by 7988 observations (852 farms). The regression has been conducted with and without the variable land tenure. In no model, land tenure is significant and the qualitative interpretation of the other coefficient estimates remains unaffected by the inclusion of this variable. To ensure clarity, only model specifications without land tenure are displayed in Table 4. Note that the logistic regression based on panel data includes a dummy variable for the year 1995, i.e. the year after a major hail event which has increased subsequent hail insurance adoption rates.

Table 4. Results from the Logistic Regression Using Panel Data 1990-2009.

Variable	Model 1	Model 2	Model 3
Intercept	0.524***	1.327***	1.633 ***
Farm Size	1.065***	---	1.066***
Specialization on Crop Production	1.071***	1.016 ***	---
Off-Farm Income	0.996***	1.000 (n.s.)	0.999**
Direct Payments	0.961***	0.992***	0.952***
Hail Risk	1.041***	1.014***	1.030***
Dummy: 1995	1.434 ***	1.065***	1.348***
Number of Observations	60810 from 8804 farms[1]	60810 from 8804 farms[1]	60810 from 8804 farms[1]
Percentage of correct predictions[12]	90.28%	92.90%	92.10%

1) Note that the total number of observations (and farms) has been reduced due to missing values.

The results of the mixed effect logistic regression that considers all farms over the period 1990-2009 are shown in Table 4. As indicated by the previous analyses, an increasing farm size as well as an increasing specialization on crop production leads to a higher probability that a farm uses hail insurance. Moreover, the observed hail frequency determines the adoption of hail insurance. Thus, the higher the observed 'risk' of hail damages, the higher is the hail insurance adoption probability. The shares of off-farm income and direct payments to total farm revenue show the expected effect, i.e. reduced the probability of insurance adoption. The larger the share of farmers' income that is generated from non-agricultural (and hail independent) sources, the lower is the incentive to use hail insurance as a risk management strategy. The dummy for the year 1995 is positive and significant in all 3 models. Thus, adoption rates significantly increase if severe hail damages have been observed in the previous year.

[12] We also conducted a cross-validation with a randomly selected training data set of 40000 observations and a validation dataset of 26438 observations. This cross validation procedure was repeated 100 times for each model. For models 1-3 the average percentage of correct predictions for the validation dataset was 82.06%, 83.56% and 90.57%, respectively.

Discussion and Conclusion

We analyze determinants of hail insurance use in Swiss agriculture using FADN data for the period 1990-2009. In agreement with insurance adoption research in other countries, we find that larger farms that are more specialized on crop production (and the production of special crops) are more likely to use hail insurance (cp. Table 1). Farms with a specialization on crops, or even on special crops such as fruits and vegetables, have a higher vulnerability to hail damages, compared e.g. to a grassland producer. This is due to a higher monetary value per area unit of their production and due to the higher hail sensitivity of these crops itself (e.g. Wixon, 2005). Our analysis also shows that insurance users tend to be older and better educated, which is explained by a 'greater precision in risk assessment' (Sherrick et al., 2004) by these farmers. Our results show that insurance users tend to be more tenured (i.e. have less rented land). This contrasts the results of Sherrick et al. (2004) and the hypothesis that the risk management of more tenured farms relies rather on self-insurance. This unexpected effect of land tenure might be caused by a negative correlation between farm size and land tenure. Larger farms tend to rely more on rented land in Switzerland. Because the risk of hail occurrence is heterogeneous across Switzerland, our analysis also considered the risk of local hail occurrence. It shows that farms located in risky areas are more likely to adopt hail insurance, which is agreement with hypotheses developed in other studies (e.g. Rydant, 1979).

Finally, we analyze if the increasing importance of direct payments and off-farm income (both measured as share to total farm revenue) had an influence on the use of hail insurance. This hypothesis is motivated by the fact that these (weather- and hail-independent) income sources have an insurance effect (i.e. reduce the variability of total farm income) as well as a wealth effect (an increasing income reduces risk aversion) (cp. Hennessy, 1998). The importance of direct payments and off-farm income has increased remarkably in Switzerland within the last two decades, particularly due to agricultural policy reforms that reduced price support and introduced decoupled direct payments. Thus, increasing direct payments and off-farm employment as well as price reductions have contributed to these developments. Our analysis shows that the increasing share of off-farm income and in particular the increasing share of direct payments to total farm revenue contributed to the observed reduction of hail insurance use. We are aware that this relationship can be also assigned to the decrease of price levels over time, which goes hand in hand with the development of the other variables. Our analysis thus indicates that if output prices decrease further and direct payments as well as off-farm employment gain further importance, a declining participation rate in the Swiss hail insurance scheme is expected. This also means that farmers' risk management will rather rely on non-agricultural income sources and governmental support than on insurances. Thus, even though climate change and market liberalization (e.g. Torriani et al. 2008, Finger et al., 2010a,b, Mahul, 2003) will increase production and price risks in the future, the increasing importance of non-agricultural production income sources may limit the potential of agricultural insurances in Switzerland.

To address several effects that have been indicated in this paper in more detail, further research is needed. In particular, we think that changes in explanatory variables such as farm size, age and education have to be investigated. Thus, the effects of farm size expansion, e.g. due to land buying (Mann, 2005), and farm transfer to farm successors (Mann, 2007) on hail insurance decisions should be analyzed. Furthermore, the adoption of agri-environmental programs (e.g. Finger and El Benni, 2011) that implies higher (ecological) direct payments but decreases per hectare crop-revenues is expected to affect insurance demand. We thus think that, more general, the relationship between risk management strategies and the adoption of environmental farming practices is a major point for future research.

The here presented results indicate that direct payments and off-farm income seem to be valuable risk management strategies for farmers, reducing insurance demand. Thus, the increasing importance of these income components should be considered if the impacts of increasing production risks on future insurance demand are assessed. Furthermore, this relationship points out contradicting influences of agricultural policy measures. Several European countries pay decoupled direct payments to farmers but also subsidize insurances (e.g. Bielza Diaz-Caneja et al., 2008). However, these two policy measures seem to exclude each other at least partially: The higher the level of direct payments, the more subsidies will be required to induce insurance adoption by farmers. Thus, agricultural policy should explicitly consider the interdependency of these policy measures.

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