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Abstract

This paper analyzed the impact of farm and farmer characteristics on the acceptability to dairy farmers in the Netherlands of an all-risk insurance package and underlying specific categories of insurance coverage. The major farm characteristics considered were structural, operational and financial variables, while farmer age was the major farmer-specific characteristic analyzed. The specific insurance categories reviewed were damage, legal, disability, liability and health insurance. The results suggest that there are common and insurance-specific factors that can improve the design of insurance policies for dairy farmers.

Keywords: insurance, farm characteristics, risk, dairy farm

1. Introduction

Farmers often face risky situations in agriculture. A risk means the possibility of a loss of income or property (Pritchet et al., 1996). Farm risks can be divided into business and financial risks. Business risk is related to production, price, institutional and personal risk. Financial risk results from the method of financing and is related to the debts and equity of the farm (Hardaker et al., 2004). To cope with risks, farmers may apply risk management strategies, such as farm financing, diversification, insurance, or spot and futures marketing contracts (Hardaker et al., 2004). **Insurance** is frequently used to cover against the financial consequences of many risks (Pritchet et al., 1996). Many studies have been done to describe farmer's actual insurance purchase factors (e.g. Mishra and Goodwin, 2003; Sherrick et al., 2004; Mishra et al., 2005), or to predict a farmers' demand for insurance (Van Asseldonk et al., 2002). In these studies the factors were divided into farm and farmers' personal characteristics. The farm characteristics analyzed referred to financial, structural and operational variables. Farmer-specific characteristics were risk perception, risk attitude, farmer age, education, tenure, previous risk exposure and the experience level of the farmer.

Previous studies were of high importance for describing the impact of variables affecting the purchase of insurance. Studies of specific risks (e.g. Ganderton et al., 2000; Van Asseldonk et al., 2002; Kunreuther and Pauly, 2004) have focused on perils like hail, storm and flood, while those devoted to specific types of insurance on farms have mostly dealt with the purchase of crop insurance (e.g. Mishra and Goodwin, 2003; Sherrick et al., 2004; Mishra et al., 2005;

Goodwin et al., 2004). Those studies were conducted using the subjective data from decision makers obtained either from real experiments or questionnaires. Due to subjective source of data the results could be different from the data obtained from observed economic behaviour.
That studies are of high importance for insurance policies about specific risks. The variables may be significant for one type of insurance, but may have a different impact or be not significant for the other. That makes problematic to make insurance policy, which is often based on general guideline for different insurance types. Farmer is insured from many risks at the same time with different insurance policies. Using the data from observed economic behaviour is possible to analyze the actual purchase of different insurance types in order to improve insurance policy-making.
By analyzing all insurance policies that a farmer follows it is possible to come to the aggregated measure of insurance. The farmer is faced with the whole set of risks, and he should opt for an integrated risk-management strategy in which all business and financial risks are evaluated in a portfolio context and related to the farmer's risk attitude. No published examples have been found of a whole-farm perspective used to analyze a farmer's decisions about the purchase of all-risk insurance package.
The goal of this paper was to make an empirical analysis of actual insurance purchase from observed economic behaviour to improve the policy-making of insurers. The impacts of variables described in the previously mentioned studies were estimated empirically in a whole-farm context to gain a perspective on the purchase of all-risk insurance package consisting of accident, damage, disability, liability, legal, life, health and combined insurance categories. The models with the same set of variables used for the all-risk insurance were also estimated in a partial context for the separate insurance categories. On the basis of similarities and differences between purchases of insurance types the recommendations to improve insurance policies will be made.
The paper is organized as follows. First the conceptual model, estimation procedure, available data and variables used for the empirical models are introduced. Then the results of the models will be described. The paper finishes with the main conclusions.

2. Conceptual model, data and estimation

Conceptual model

The conceptual model is presented on the basis of previous studies and available data (see Figure 1). Purchase of insurance was assumed to be influenced by both farm characteristics and the farmer's personal characteristics. Farm characteristics were divided into structural variables that usually can change only in the long-term, operational variables that can change in the short term, and financial variables that have both long- and short-term characteristics. The expected sign of the impact of these variables on the amount of premium paid is shown in brackets.

Variables explaining the amount of insurance purchased			
Structural variables		***Financial variables***	***Farmer's personal***
- ESU (+) - Share of rented land (+) - Balance sheet value (?)	- Productivity (+) - Compensations (+) - Operational expenses (?)	- Off-farm income (+) - Debt use (+) - Liquid capital (-)	- Farmer's age (+)

* positive (+) and negative (-) signs mean positive or negative impact on the amount of premium paid; ** a question mark (?) means the sign of the variable is not given in the literature or inconclusive

Figure 1. **Conceptual model**

From the structural variables the analysis was conducted with size variables ESU[1] - (European size units),total balance sheet value of the farm, revenue, proportion of rented land to total area and a regional dummy variable (1- South, 0 – North).
The analyzed operational variables were productivity, operational expenses, proportion of grassland, McSharry[2] compensation from European Union and net-farm result.
The financial variables that might have an impact on insurance purchase were off-farm income, debt-to-equity ratio, long- and short-term debt and the amount of available liquid capital. The analyzed farmer characteristic was the age of a farmer.

Data

The Farm Accountancy Data Network (FADN) cross-sectional dataset from Landbouw Economisch Instituut (LEI) for 2001 on 240 specialized dairy farms was used.
The FADN data is an official European Union dataset consisting of information per farm. This dataset includes detailed information about all agricultural sectors. The limitation is that the insurance data is not that much detailed as the rest data about production and results. The descriptive statistics of variables is presented in Table 1.

1. A European Size Unit (ESU) is a measure of the economic size of a farm business based on the gross margin calculated from standard coefficients for each commodity on the farm. 1 ESU roughly corresponds to 1.3 hectares/ha of cereals or 1 dairy cow (see http://statistics.defra.gov.uk/esg/asd/fbs/sub/europe_size.htm).
2. A form of price compensations to agricultural products in European Union and UK (for details see ''McSharry'' reform of the Common Agricultural Policy (CAP) in 1992).

Table 1. Descriptive statistics of the model variables for dairy sector

Variables	Variable description	Mean	%	SD
Insurance variables				
prem	Total premium paid, Euro	6251		3342
accident	Premium paid, Euro/participation (in %)	51	30.3	175
combi	Premium paid, Euro/participation (in %)	375	25.7	969
damage	Premium paid, Euro/participation (in %)	1666	93.8	1150
disability	Premium paid, Euro/participation (in %)	1317	68.9	1699
legal	Premium paid, Euro/participation (in %)	152	54.8	203
liability	Premium paid, Euro/participation (in %)	886	90.0	768
life	Premium paid, Euro/participation (in %)	888	65.1	1379
health	Premium paid, Euro/participation (in %)	916	88.8	945
Structural variables				
ESU	Number of European size units	112		32
balsh	Total assets value, Euro	2023571		794927
grinused	Share of grassland in used area	0.76		
cows	Number of cows per 1 ha of grassland	60		18
rev	Total revenues, Euro	199358		68182
arusintot	Share of used area in total area	0.34		
Province	(1-South; 0-North)		22	
Operational variables				
mcsh	McSharry compensation, Euro	3752		3710
nfr	Net farm result excl. insurance, Euro	-22648		40488
feed	Feed cost, Euro	33552		18853
Financial variables				
ffi	Family farm income, Euro	53421		34087
liq	Liquid capital, Euro	46210		140392
ltd	Long-term debt, Euro	371497		273547
std	Short-term debt, Euro	5954		38780
ofi	Off-farm income, Euro	6506		11804
Leverage	Debt-to-equity ratio, %	81		36
Farmer specific variables				
age	Age of a farmer, years	51		11

The data was corrected by weighted factor to represent the whole population of Dutch dairy farmers.

The all-risk insurance package consists of premiums paid for accident, damage, disability, legal, liability, life, health and combined insurance. The description of these categories is presented further (see Pritchet et al., 1996). **Accident insurance** provides coverage in case of an unplanned, unexpected and underwritten event which occurs suddenly and at a definite place. **Damage insurance** protects in case of fire, storm or flooding resulting in property damage. **Disability insurance** covers when a person is unable to perform one or more work because of serious injury or illness. **Legal insurance** provides coverage for losses incurred due to court actions (but excluding criminal matters). **Liability insurance** protects against loss arising from legal liability for injuries to other persons or damage to their property. **Life insurance** provides payment of a specified amount at the insured person's/beneficiary's death, or at a specified date. **Health insurance** is insurance against loss due to sickness or bodily injury. **Combined ("combi") insurance** is a combination of the above policies (issued by one of the insurers, without further information from the FADN database on the amount of coverage per category). As can be seen from Table 1, 30.3% of dairy farmers have accident insurance, while most

farmers have damage, disability, liability and health insurance (neglecting the impact of the combi insurance). Farmers also pay the highest premiums for these insurance types. The lowest premiums farmers pay for combi and accident insurance. Combi insurance is issued only by one insurance company and comprises a number of different insurance categories.

Data estimation

As dependent variable, the total premium paid for an all-risk insurance package (total premium paid) was used and also the amount of premium paid for below mentioned categories. The total premium paid was calculated as the sum of premiums paid for accident, damage, disability, legal, liability, life, health and combined insurance.
The estimation of the regression coefficients covered the following steps. To solve a potential dependency problem, the variables were checked for multicollinearity. The variables operating expenses and dairy productivity were omitted due to high correlation with net farm result. The number of cows and milk quota were highly correlated with ESU and therefore eliminated from the analysis in favour of ESU as the size variable. The regressions were made by OLS estimation in Stata 8 SE. All models initially had a constant, but subsequently constants were excluded because they were not significant in all models. Then the regressions for specific insurance types and the total premium paid for all-risk insurance were estimated.

3. Results and discussion

The results are presented for the models analyzing all-risk insurance package and five main insurance categories – damage, legal, disability, liability and health insurance. The models for these categories fitted the data well (see Table 2). For those insurance categories farmer participation was the highest, and the farmers paid the highest premiums. The results for the other categories are not presented due to a poor model fit, which also corresponded to lower participation of farmers in those insurance policies.
The size variable **ESU** was significant at the 1% level for the all-risk insurance package and the rest insurance categories and had a positive impact on buying insurance. The positive impact was also observed for other size variables, such as a number of cows, revenue and balance sheet value of the farm. This was according to expectation and the results of Goodwin et al. (2004) and Sherrick et al. (2004). Increased **farm size** is a cause of purchasing more insurance because a farmer takes more risk due to growth (Goodwin et al., 2004; Sherrick et al., 2004). The proportion of **rented land** was expected to have a positive relation the amount of insurance premium paid as in a study of Sherrick et al. (2004), where they interpreted it as that farmers who have relatively more rented land can be expected to rely more on commercial insurance than self-insurance (Sherrick et al., 2004). In our models this variable was not significant.

Table 2. Main variables explaining insurance purchase by dairy farmers

Variables	Damage		Legal		Disability		Liability		Health		All-risk	
	Parameter value	St. error	Parameter value	St. error	Parameter value	St. error	Parameter value	St. error	Parameter value	St. error	Parameter value	St. error
Structural variables												
ESU	11.6***	1.8	1.0***	0.31	13.2***	3.6	3.6***	1.2	4.6***	1.5	(+)***	
Number of cows	(+)***				(+)***				(+)***		(+)***	
Revenue	(+)***										(+)***	
Balance sheet value	(+)***								(+)***		(+)***	
Proportion of rented land	(+)***											
Region (1-South; 0 - North)	456.4***	161.9			718**	303					1184**	465
Operational variables												
Net farm result (excl insur.)	(-)***		0.0001	0.0005			(-)***					
Revenue-cost ratio												
McSharry compensation	0.04**	0.02									0.14***	0.05
Feed costs	(+)***										(+)***	
Proportion of grassland									337.6	269.4		
Financial variables												
Off-farm income			0.001	0.001			0.01***	0.004			0.05***	0.02
Liquid capital												
Long-term debt	(+)***										(+)***	
Short-term debt												
Debt-equity-ratio	7.8***	1.8	2.2***	0.50	12.3***	3.6	2.7**	1.3	3.5**	1.7	(+)***	
Farmer personal variables												
Age	-8.6**	4.1			-15.0*	8.1	5.8**	3.0			-6.7	11.0
Adjusted R-square	0.78		0.74		0.59		0.67		0.58		0.83	
Sample size	225		131		165		215		213		240	
*, **, *** - significant at 10%, 5% or 1% level												
Asterix without coefficient is related to significant variables not included in the model due to multicollinearity;												
(+) - positive impact on dependent variable												
(-) - negative impact on dependent variable												

The **regional variable** was a Dutch specific variable differentiating farmers on the North from farmers on the South. It was significant at 1% and had a positive impact on the amount of premium paid for damage, disability and all-risk insurance package. That confirms the expectations about differences in insurance behaviour: farmer on the South purchases more insurance coverage than a farmer on the North.

Net farm result was eliminated from the models due to multicollinearity. From correlation matrixes net farm result was highly negatively correlated with amount of premium paid for damage and liability insurance while for the other insurance categories and all-risk insurance package at whole it was not significant. The negative impact on the mentioned insurance categories could be explained by behavioural terms: farmers who earn more from core activities should have less demand for insurance. In order to explore relationship of the money got by farmers from non-core activities the focus will be on off-farm income and McSharry compensation variables. From operational expenses variables used in previous studies the feed costs were analyzed, but the clear relationship was not found by Mishra et al. (2005). In our models, as net-farm result, **feed costs** were omitted due to multicollinearity, but in correlation matrixes they were highly positively correlated with purchase of damage insurance and all-risk insurance package. The result confirmed our expectations that farmers that have more operational expenses due to higher specialization and size are needed to be insured more because it is more risky than for diversified farmers. As a form of compensations got from the government (through EU) McSharry compensations were analyzed. We did not analyzed deficiency, disaster or conservation reserve **payments** for their participation in government programs as Mishra and Goodwin (2003). The assumption was that if a farmer gets additional compensations from the government in implicit or explicit form he would be more willing to spend that money for insurance. The available data was concerned to existing in European Union form of **McSharry compensation**. The results confirmed that expectations with respect to purchase of damage

insurance and all-risk insurance package as a whole as well. Farmers receiving more insurance subsidies have an incentive to buy more insurance (Mishra and Goodwin, 2003).

Again, due to multicollinearity, the **proportion of grassland** was not added in the models, but from correlation tables it had a highly positive correlation with amount of total premium paid. This confirmed the expectation that farmers insure more if they have higher production due to greater use of grassland.

Off-farm income was significant at the 1% level for purchase of liability insurance and all-risk insurance package. This finding was consistent to our expectations, but not consistent with previous studies. Our expectation was that farmers are more prone to spend money for insurance if they get additional incomes. When deciding to purchase an insurance, a person will consider if there are other sources of payment (Harrington and Niehaus, 1999, p.150) According to the previous studies about crop insurance, farmers having more off-farm income are likely to self-insure, so they could afford to use less commercial insurance (Ganderton et al., 2000; Mishra and Goodwin, 2003; Sherrick et al., 2004). **Liquid capital** was expected to have a negative impact as in studies of (Ganderton et al., 2000; Mishra and Goodwin, 2003; Sherrick et al., 2004), who argued that if a farmer has more liquid capital (i.e. wealth) he would be more willing to self-insure. On the other hand, the insurance literature suggest, the wealthier people (or in our case farmers) are likely to purchase higher property (i.e. accident and damage insurance) and liability insurance because the values of assets owned are likely to be higher (Harrington and Niehaus, 1999, p.159). In our model the amount of liquid capital was not significant, and also in correlation matrixes was not highly correlated with insurance variables. As debt variables, long-term, short-term debt and debt-equity ratio were analyzed. The better results were obtained by using **debt-to-equity ratio**. The variable was significant with at 1% and had a positive impact on the amount of all analyzed insurance categories and all-risk insurance package as well. That has according to our expectations and similar to the results by (Ganderton et al., 2000; Mishra and Goodwin, 2003; Mishra et al.; Sherrick et al., 2004). In order to have more lawns from the bank, it is often required from the bank to be insured to stabilize farm liquidity and avoid a risk of going bankrupt. Lenders will demand compensation for investing in firm with higher probability of financial distress. In this respect if a farmer can reduce a risk through insurance, lenders will be willing to contract the farm at better terms (Harrington and Niehaus, 1999, p.157). On the other hand, a farmer also realizes that default risk, and he has more responsibility for the money that does not belong to him.

The **age** of a farmer was significant at 5% for purchase of damage and liability insurance and at 10% for purchase disability insurance. For purchase of liability insurance the age had a positive impact. This is in accordance with expectations and the results from previous studies. Insurance users thought to be relatively older (Sherrick et al., 2004). Age can also be an indicator of the experience of the farmer, and in this respect, should have a positive impact on buying insurance (Mishra et al., 2005). For purchase of damage and disability insurance age had an opposite negative impact. In those categories dairy farmers have high insurance participation (94% for damage and 69% for disability insurance). That could be related to experience of older farmers that they pay premiums but do not use benefits of that insurance. The answer could be found in insurance literature: the payment of premium when a loss does not occur hurts individuals less than the benefit that they receive from having the insurer pay the part of the loss (Harrington and Niehaus, 1999, p.147). In this respect farmers could be willing to pay less for damage and disability insurance.

4. Conclusions

The goal of this paper was to investigate whether there are common or specific variables influencing purchase of different insurance types by Dutch dairy farmers. There were similarities and differences between variables playing a role in decisions about insurance purchase. For considered insurance categories and all-risk insurance package as well, all variables, except the age, had the same direction of impact. There were found common variables that influence purchase of all considered insurance types and all-risk insurance package as well. That concerned to the size of the farm and debt-to-equity ratio. This suggests that with respect to size and financial situation about debt the insurance policy makers should follow the general rules. The other variables were found to have a significant impact on the purchases of specific insurance types.

With respect to specific insurance implications, the following patterns were observed for specific insurance types. For the purchase of **damage** insurance that is related mainly to insurance agricultural means of production (buildings, sheds, tractors, etc.) insurance policy makers need to look almost at all analyzed farm variables – size, region, net-farm result, compensations, feed costs, debt-to-equity ratio - and age as well. In legal insurance many of non-farm objects and activities were insured, but anyway, the developers of insurance products need to focus on main farm characteristics, such as size and financial situation with respect to debt use. **Disability insurance** was related to disability risk of farm operator, and in this respect the recommendation to makers of insurance products are focused on farm (core characteristics), as size, regional location, use of debt and also to the age of a farmer. Liability insurance is related to farm and non-farm activities, so the insurance policy-makers need to consider the size, the financial results from core activities (net-farm result), non-core activities (off-farm income), use of debt and farmer's age as well. Health insurance was not mainly related to agricultural activities, but still, as also in case of legal insurance, the insurers need to look at the general variables size and use of debt. From the last model analyzing all-risk insurance package, we can conclude, if the insurer thinks generally about the factors that influence the insurance purchase by a dairy farmer he always needs to keep in mind the size of perspective or existing client (i.e. a dairy farmer) and his financial situation. In order to switch from the general view to specific insurance policies he needs consider additional farm factors, as regional location, the financial flow of farmer's compensation, his operational expenses for feed and also the potential income from non-farm activities.

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