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REFEREED ARTICLE

INSURANCE DECISIONS BY DUTCH DAIRY AND ARABLE FARMERS

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This paper analyses the impact of farm characteristics on the adoption of an all-risk insurance package and underlying specific categories of insurance coverage for Dutch dairy farmers compared to arable farmers. Major farm characteristics considered are structural, operational and liquidity variables. The specific insurance categories reviewed are damage, disability, legal and liability insurance. The results suggest that there are common and insurance-specific factors that explain adoption of insurance coverage.

Keywords: arable farm, dairy farm, farm characteristics, insurance, risk.

Introduction

In agriculture farmers often face risky situations. 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. In contrast, 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 of activities, insurance, or spot and futures marketing contracts (Hardaker *et al*., 2004).

Insurance is frequently used to cover the financial consequences of many risks (Pritchet *et al*., 1996). Many agricultural studies, for example focusing on crop insurance, have been done to derive the variables influencing a farmer's actual (objective) insurance purchase decisions on the example of crop insurance (e.g. Coble *et al*., 1996; Goodwin *et al*., 2004; Mishra *et al*., 2005; Mishra and Goodwin, 2003; Sherrick *et al*., 2004), or to predict a farmer's demand for insurance by a subjective source of data (Van Asseldonk *et al*., 2002). In agricultural studies, the variables were divided into farm characteristics and farmers' personal characteristics (e.g. Mishra and Goodwin, 2003; Sherrick *et al*., 2004). The farm characteristics analysed referred to structural, operational and liquidity variables. Farmer-specific characteristics analysed in insurance purchases were risk perception, risk attitude, age, education, tenure, previous exposure to risk and the farmer's experience level. The impact of personal characteristics on the amount of insurance purchased was extensively examined in non-agricultural studies regarding health insurance, optimal long-term care insurance and car insurance (e.g. Gupta and Li, 2004; Ma and Schmit, 2000; Polsky *et al*., 2005; Zweifel and Struwe, 1998). Similar to agricultural studies, the personal characteristics, such as age, marital status, risk aversion, education and income, were considered for the current analysis.

In agriculture, many of the studies were conducted as to specific risks and focused on perils such as hail, frost, drought, precipitation, storm and flood (e.g. Ganderton et al., 2000; Kunreuther and Pauly, 2004; Van Asseldonk *et al*., 2002).

Farmers, on the other hand, are faced with the whole set of risks, and they should opt for an integrated risk-management strategy, in which all business and financial risks are evaluated in a portfolio context. Published examples within a whole-farm perspective to analyse farmers' decisions about the purchase of all-risk insurance package and its underlying coverages are rare.

It is also important to analyse the effect of diversification in insurance decisions (Hardaker *et al*., 2004; Harrington and Niehaus, 1999). For instance, arable farmers usually have several crops (activities), and their selection of the optimal plan (set of crops) can be seen as an appropriate risk management strategy to cope with many risks. Alternatively, dairy farmers are more specialised compared to arable farmers, and have, next to milk production, only one additional activity: rearing calves. The potential for diversification is much lower than in arable farming.

The goal of this paper was to conduct an empirical analysis of actual (objective) insurance purchase decisions by Dutch dairy and arable farmers based on a set of specific risks. The analysis focuses on gaining a perspective as to the purchase of an all-risk insurance package within a whole-farm context and also within a partial context for the separate underlying insurance categories to cope with specific risks. All models are analysed by the generic set of variables.

The paper is organised as follows. First the conceptual model with the main definitions, estimation procedure, data and variables used for the empirical models are introduced. Then the results of the different models analysing the actual purchase of insurance by Dutch dairy and arable farmers are described. The paper finishes with conclusions and recommendations for insurance policy-makers.

Conceptual model, data and estimation

Conceptual model and definitions

The conceptual model is based on previous studies and available data for the current analysis. The purchases of the following insurance types are examined: all-risk insurance, damage, disability, legal and liability insurance. The *all-risk insurance package* is the summation of total premiums paid for all insurance types. *Damage insurance* protects in case of fire, storm or flooding causing property damage. *Disability insurance* covers the costs when a person is unable to perform work, due to serious injury or illness (Pritchet et al., 1996). *Legal insurance* provides coverage for losses incurred due to court actions (but excluding criminal matters). *Liability insurance* protects against loss arising if a farmer injures other persons or damages their property (a good example is mandatory insurance of driver's liabilities in car insurance).

The conceptual model is based on previous studies and available data for the current analysis. Purchase of insurance is 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 run, operational variables that can change in the short run and liquidity variables. The impact directions of variables influencing the amount

of premiums purchased is shown in Figure 1.

Figure 1. Variables explaining the amount of insurance purchased

Farm characteristics			Farmer's personal characteristics
Structural	**Operational**	**Liquidity**	
Balance sheet value (+) Rented land (+) Region	Net-farm result (-) McSharry (-) Off-farm income (-) Operational expenses	Leverage (+)	Age (+)

As structural variables, the size of the farm, proportion of rented land and regional variable were taken. The impact of farm size had previously been tested by Goodwin *et al.* (2004) and Sherrick *et al*. (2004), where a positive relationship between farm size and insurance purchase was found. In our model the balance sheet value of the farm is used as a size indicator. The proportion of rented land was previously examined in the study by Sherrick *et al*. (2004). It was found that farmers having relatively more rented land purchased more insurance. Additionally, it is expected that there are regional differences between farmers concerning insurance purchase. That is why a region variable was constructed, dividing the farmers into a southern and a northern part (1= South, 0 = North).

As operational variables, the net-farm result, McSharry compensations, off-farm income and operational results were taken for the models. The variables net-farm result, off-farm income and McSharry compensations are variables characterising incomes. A negative impact of these variables on the amount of insurance purchased was expected, because farmers would prefer more money to less accumulating wealth than spending income sources on insurance, as was shown in the studies by Ganderton *et al*. (2000), Mishra and Goodwin (2003), Sherrick *et al*. (2004), Smith and Goodwin (1996), and Watt *et al*. (2001).

As operational variables, the effect of chemical use on crop insurance purchase was analysed in the study by Mishra *et al*. (2005), but no clear relationship was found. Smith and Goodwin (1996) found a negative relationship between purchase of crop insurance and use of chemical inputs. In our analysis, the effect of fertilisers and feed costs on the amount of premium paid is tested (Ganderton *et al*., 2000; Kunreuther and Pauly, 2004; Van Asseldonk *et al*., 2002).

The impact of liquidity variables on the amount of insurance purchased was tested by Ganderton *et al*. (2000), Mishra and Goodwin (2003), Mishra *et al*. (2005) and Sherrick *et al*. (2004). They found that more indebted farmers purchase more insurance. In this study the impact of debt-to-equity ratio (leverage) on insurance purchased is examined.

Of farmer-specific variables, only the variable age was available in the

database analysed. In farm research the positive impact of age on insurance

Table 1. Descriptive statistics of the model variables for dairy and arable farms.

Characteristics	**Units**	**Dairy farms (n=240, N=24400)**			**Arable farms (n=117, N=9060)**		
Characteristics	**Units**	**Mean**	**%**	**CV**	**Mean**	**%**	CV
Insurance							
All-risk insurance	Euro	6251	-	54	7667	-	96
Damage insurance	Euro/participation (%)	1666	94	69	2336	99	71
Disability insurance	Euro/participation (%)	1317	69	129	1391	68	128
Legal insurance	Euro/participation (%)	152	55	134	195	62	147
Liability insurance	Euro/participation (%)	886	90	87	1293	97	96
Structural							
European size units (ESU)	units	112		28	87		36
Balance sheet value	Euro	2230571		39	1445175		70
Number of cows	units	60		31	-		
Rented land	% in total area		0.34			0.49	
Region	(1=South; 0=North)		0.55			0.47	
Operational							
McSharry	Euro	3752		99	2935		215
Net-farm result (excl. insurance)	Euro	-22648		-179	1410		-806
Feed costs	Euro	33552		56	-		
Fertiliser costs	Euro	-			6917		60
Financial variables							
Family-farm income	Euro	53421		64	54871		114
Liquid capital	Euro	46210		304	91140		240
Long-term loans	Euro	371497		74	269964		104
Off-farm income	Euro	6506		181	5633		681
Leverage	%		26			31	
Farmer specific							
Age	years	51		22	53		23

purchased was obtained by Mishra *et al*. (2005) and Sherrick *et al*. (2004). Non-agricultural studies, such as by Gupta and Li (2004) and Polsky *et al*. (2005), also reported that insurance users are relatively older.

Data

The Farm Accountancy Data Network (FADN), containing a cross-sectional dataset, was used for our analysis. The FADN dataset is an official European Union dataset. Farm-specific accounting data that are available in the FADN dataset include detailed information about all agricultural sectors. The sample of FADN data was corrected by a weighted factor to represent the whole population of Dutch dairy and arable farmers. The data corrected were compared with national statistics and were not different. In total, a sample of 240 from 24400 dairy farms and 117 from a total number of 9060 arable farms are analysed (see Table 1).

FADN data are not very detailed with respect to insurance related variables. They comprise only the premiums of underlying specific insurance categories. The descriptive statistics of farm characteristics and variables used in the models are presented in Table 1.

Descriptive statistics

As can be seen from Table 1, arable farmers pay more premiums in total than dairy farmers. With respect to underlying categories, most dairy and arable farmers have damage, disability, legal and liability insurance. On average, arable farmers participating in those insurance types pay higher premiums than dairy farmers.

From ESU and balance sheet value it can be observed that dairy farms are larger. On average, arable farmers have almost 50% of rented land, which is substantially more than dairy farmers have. The dairy and arable farmers sampled are more or less equally located.

Arable farmers had a positive net farm result in 2001, while the average dairy farm was not so profitable, despite the fact that dairy farmers received higher McSharry (price) compensations. On average, total family-farm income is a bit higher for arable farmers, whereas the off-farm income of dairy farmers is larger. From the balance sheet value and debt-to-equity ratio (leverage), it can be concluded that dairy farmers are less indebted than arable farmers, and are also wealthier. As to age the average arable farmer is a bit older than the average dairy farmer.

Data estimation

Linear regression analysis was carried out to estimate the impact of variables on the amount of premium paid, thus including only farmers who purchased insurance. In total 5 models for dairy farms and 5 models for arable farms were estimated. The models estimating the purchase of an all-risk insurance package had total premium paid as dependent variable. The other models estimated the purchases of insurance coverages related to agricultural

Table 2. Main variables explaining insurance purchase by dairy farmers.

Variables	Damage			Disability			Legal			Liability			All-risk		
Variables	Parameter value	St. error	VIF	Parameter value	St. error	VIF	Parameter value	St. error	VIF	Parameter value	St. error	VIF	Parameter value	St. error	VIF
1st set of models															
Balance sheet value	5.6E-04***	5.6E-05	2.8	5.0E-04***	1.0E-04	3.0	9.1E-05***	1.3E-05	4.1	2.7E-04***	3.3E-05	2.8	1.3E-03***	1.7E-04	3.0
Region (1 = South; 0 = North)	593.7***	137.5	2.0	494.6**	212.3	2.0	97.6***	21.2	2.0	300.2***	92.1	2.0	408.8	598.8	2.0
Off-farm income	1.4E-02***	6.0E-03	1.3	-1.7E-03	1.1E-02	1.2	2.5E-03*	1.3E-03	1.3	1.8E-02***	3.9E-03	1.3	6.2E-02***	1.8E-02	1.2
Leverage	4.4	2.7	2.0	17.6***	6.4	2.6	0.6	0.7	2.4	4.0**	1.8	2.0	25.7***	8.0	2.0
Adjusted R-square		0.76			0.56			0.70			0.66			0.78	
Sample size		225			165			231			215			240	
2nd set of models															
Net-farm result	-6.1E-03***	0.002	1.4	-6.8E-03*	0.003	1.2	-2.4E-04*	4.6E-04	1.3	-6.3E-03***	1.2E-03	1.4	-9.6E-03	6.0E-03	1.3
Age	29.6***	1.7	1.4	32.7***	11.1	1.1	2.0***	0.4	1.3	17.5***	1.1	1.4	11.3***	5.3	1.3
Adjusted R-square		0.73			0.55			[illegible]			[illegible]			[illegible]	
Sample size		225			165			231			215			240	

*, **, *** - significant at 10%, 5% or 1% level.

activities and had damage, disability, legal and liability insurance as dependent variables. For those insurance categories, farmer participation was the highest, and farmers paid the highest premiums (see Table 1).

Most of the data referred to the farm data; the only variable characterising a farmer as a person was age. The variables analysed were balance sheet value, the regional variable, net-farm result, McSharry compensations and off-farm incomes as additional farmer's resources, leverage (debt-to-equity ratio) and farmers's age.

To deal with multicollinearity the variance inflation factor (VIF) was calculated for each variable. The rule of thumb was that it had to be lower than 4 (Garson, 2007), while Hair *et al.* (1998) and other researchers used the maximal cutoff value of 5 or even 10 (Hair *et al.*, 1998). Beside the VIF, the multicollinearity can be inspected on the basis of the condition index with cut-off values in the range of 15-30 (for details see Garson, 2007; Hair *et al.*, 1998). For values higher than 15, multicollinearity is a problem if the proportion of variance for two or more variables is higher than 50% (Garson, 2007). Hair *et al.* (1998) stated that if the proportion of variance is higher than 90%, there is a suspicion of multicollinearity.

In our models the values of VIF were lower than 4 (see Table 2 and 3), conditional indexes were much lower than 15, and proportion of variance of two or more variables was not higher than 50%. The variables net-farm result, McSharry compensations operational costs (fertilisers and feeds), proportion of rented land and farmer's age were the source of the multicollinearity. Therefore these five variables were excluded from the main set of models that consisted of the variables balance sheet value, regional differences, off-farm income and leverage. Moreover, operational costs very highly correlated with net-farm result, and proportion of rented land was correlated with leverage and farmer's age. McSharry compensations were highly positively correlated with balance sheet value of the farm. For the second set of models, the variables operational expenses, McSharry compensations and proportion of rented land were excluded, and the choice was made in favour of net-farm result and farmer's age.

The regressions were made by OLS estimation in SPSS 12.0. The models were estimated without a constant parameter, taking into account the limited set of variables to explain the purchases of insurance.

Results and discussion

For both dairy and arable farms, the *balance sheet value* was positively significant at the 1% level for the all-risk insurance package and also the specific underlying insurance categories (see Tables 2 and 3). This finding was according to expectations 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 accepts more risk due to growth (Goodwin *et al.*, 2004; Sherrick *et al.*, 2004). The other reason to purchase more is related to insuring more property (Harrington and Niehaus, 1999). The *regional variable* was a Dutch specific variable differentiating farmers in the South from farmers in the North. For dairy farms, it had a positive impact on the amount of premium paid for damage, disability, legal and liability insurance. That shows

Table 3. Main variables explaining insurance purchase by arable farmers.

Variables	Damage			Disability			Legal			Liability			All-risk		
Variables	**Parameter value**	**St. error**	**VIF**	**Parameter value**	**St. error**	**VIF**	**Parameter value**	**St. error**	**VIF**	**Parameter value**	**St. error**	**VIF**	**Parameter value**	**St. error**	**VIF**
1st set of models															
Balance sheet value	1.2E-03***	9.5E-05	1.7	9.0E-04***	1.6E-04	1.8	1.4E-04***	2.8E-04	1.9	7.6E-04***	7.5E-05	1.7	4.3E-03***	4.9E-04	1.7
Region (1-South; 0 - North)	-155.2	229.7	1.5	578.9	382.8	1.5	77.4	71.4	1.5	163.9	183.5	1.5	-411.4	1178.7	1.5
Off-farm income	7.6E-03**	3.5E-03	1.1	7.2E-03	5.0E-3	1.1	1.3E-03	8.5E-04	1.2	2.9E-03	2.7E-03	1.1	-3.4E-03	1.8E-02	1.1
Leverage	10.6***	2.1	1.3	4.5	3.3	1.3	0.8	0.6	1.3	2.4	1.7	1.3	18.6*	10.9	1.3
Adjusted R-square		0.77			0.54			0.48			0.65			0.55	
Sample size		116			79			72			113			117	
2nd set of models															
Net-farm result	3.1E-03	3.1E-03	1.0	-4.9E-03	4.1E-03	1.0	-7.7E-04	6.9E-04	1.0	4.9E-04	2.3E-03	1.0	2.7E-02**	1.3-02	1.0
Age	42.4***	2.9	1.0	37.0***	4.0	1.0	5.7***	0.7	1.0	24.7***	2.1	1.0	142.8***	12.3	1.0
Adjusted R-square		0.77			0.54			0.49			0.54			0.54	
Sample size		116			79			72			113			117	

*, **, *** - significant at 10%, 5% or 1% level

that there are differences in insurance behaviour: a dairy farmer in the South purchases more insurance coverage than a dairy farmer in the North. In arable farming the regional differences were not relevant concerning insurance purchase.

In dairy farming, the *off-farm income* was positively significant at the 1% level for purchase of all-risk insurance package and damage, legal, liability insurance and all-risk insurance package. In arable farming, off-farm income had a positive impact on purchase of damage insurance. This finding was contrary to expectations as in the study by Smith and Goodwin (1996). The reason for that could be that a substantial part of off-farm income is presented by social security payments received from insurance companies.

The *net-farm result* of the average dairy farmer had a negative impact on the amount of premium paid for damage, disability, legal and liability insurance. Dairy farms were wealthier than arable farms, and therefore could consider self-insurance an alternative to commercial insurance. Thus having a high initial wealth position, dairy farmers could save more money from core activities to increase financial capacities for self-insurance or would be likely to insure less (Coble *et al*., 1996). In arable farming, the net-farm result was irrelevant as to the purchase of specific insurance categories, but was positively significant for purchase of all-risk insurance package.

For dairy farms, the *leverage* was significant for the purchase of disability, liability insurance and an all-risk insurance package. In arable farming, also the purchase of damage insurance and an all-risk insurance package was related with debt-to-equity ratio. In both sectors, leverage had a positive impact, according to the expectations and similar to the results by Coble *et al*. (1996), Ganderton *et al*. (2000), Mishra and Goodwin, (2003), Mishra *et al*. (2005), Sherrick *et al*. (2004), and Smith and Goodwin (1996), implying that more-indebted farmers need to purchase more insurance. Alternatively, less-indebted farmers with higher net worth are less likely to purchase insurance. In order to take more loans, it is often required from the bank to be insured to stabilise farm liquidity and avoid the risk of going bankrupt. Lenders will demand compensation for investing in farms with a 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).

The *age* was significant at 1% for purchase of an all-risk insurance package and underlying insurance categories for both dairy and arable farmers and had a positive direction of impact. This was in accordance with expectations and the results from previous studies by Gupta and Li (2004), Mishra *et al*. (2005), Polsky *et al*. (2005) and Sherrick *et al*. (2004). Insurance users are thought to be relatively older (Sherrick *et al*., 2004). Age can also be an indicator of farmer's experience, and in this respect, should have a positive impact on buying insurance (Mishra *et al*., 2005).

Conclusions

The goal of this paper was to investigate whether there are common or specific variables influencing the purchase of an all-risk insurance package and underlying insurance categories by dairy and arable farmers. In both types

of farming, for insurance categories and all-risk insurance package considered, all variables, except the net-farm result for purchase of all-risk insurance by arable farmers, had the same direction of impact.

Both dairy and arable farms showed more willingness to save money from core activities to accumulate more savings than to spend money on insurance. Both farm types were very different with respect to available finances - dairy farms are more specialised compared to arable farms having a diverse set of activities. Arable farms were expected to insure less because diversification of activities is already a form of risk management strategy. Contrary to that, the analysis showed that arable farms paid higher premiums than dairy farms. In arable farming with a diverse set of activities, the source of income is less risky than with undifferentiated commodity production as in dairy farming, but if the potential down the supply chain to cause losses is increased due to the proximity of the customer to the farmer supplier, overall risk might be increased. The other reason could be that arable farmers are less wealthy and, in general, deal with more risks than dairy farmers, and thus are more prone to paying higher premiums for insurance to avoid possible financial risks.

Despite the differences between degrees of specialisation/diversification, wealth, amount of premium paid by dairy and arable farmers, common variables were found – size and farmer's age - that influenced purchase of all insurance types and all-risk insurance package considered.

In most of the previous agricultural studies of crop insurance in the USA, it was found that insurance subsidies were one of the main reasons to purchase insurance coverage (e.g. Babcock and Hart, 2005; Mishra and Goodwin, 2003; Mishra *et al*., 2005; Sherrick *et al*. 2004; Smith and Goodwin, 1996). In the Netherlands, farmers do not receive insurance subsidies, and the analysis was conducted with a generic set of variables.

In this analysis, the off-farm income contained social security payments. If the data were less aggregated, only the impact of the ''real earned'' off-farm income on the amount of insurance coverage purchased could be tested. Due to data limitations, farmer's personal characteristics such as risk attitude, specific risk perception, marital status, education, previous exposure to risk(s) and experience level were not used in the models. As farmer's personal characteristics, the additional information on insurance contracts such as the size of deductibles could be considered for further research.

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