Asian Journal of Agricultural Extension, Economics & Sociology
16(2): 1-12, 2017; Article no.AJAEES.31910
ISSN: 2320-7027

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Animal Insurance and Farmer's Behavior in Vietnam

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Authors' contributions

This work was carried out in collaboration between all authors. Author HK designed the study, performed the statistical analysis and wrote the first draft of the manuscript. Authors SK, YS and TN managed the analyses of the study. Author KM performed the epidemiological study. Authors NTMH and TMH managed the field survey and the literature searches of animal insurance in Vietnam. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2017/31910
Editor(s):
(1) Jurislav Babic, Faculty of Food technology, University of Osijek, Croatia.
Reviewers:
(1) Nancy Maynes, Nipissing University, Canada.
(2) Mandla Nyathi, National University of Science and Technology, Zimbabwe.
Complete Peer review History: http://www.sciencedomain.org/review-history/18445

Original Research Article

Received 30th January 2017
Accepted 22nd March 2017
Published 31st March 2017

ABSTRACT

Most poor people in developing countries make their living from agriculture; hence, their livelihood is subject to various risks such as livestock disease, flooding, drought, and fluctuations in the price of agricultural products. One method of dealing with risk is insurance. However insurance markets in developing countries are seriously impacted by adverse selection and moral hazard, derived from information asymmetry. Livestock insurance was introduced in Vietnam as a pilot project in 2011–2013. We examine the factors behind the decision to take out insurance, from the viewpoint of moral

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hazard or adverse selection in Vietnam. The results suggest that, if there are few trustworthy people locally, the rate of time discounting is lower and farmers will purchase insurance coverage. Further, the higher the number of calvings, and therefore the older the cows owned by a farmer, the more likely he/she is to take out livestock insurance. The analysis of results also reveals a low level of existence of adverse selection and moral hazard with respect to livestock insurance in the surveyed areas. The incidence of livestock diseases covered by insurance is currently low. Many dairy farmers expressed their wish for insurance coverage to be expanded to include other diseases such as mastitis and hoof disease. Expanding the range of diseases covered by insurance would introduce an additional financial burden. As a consequence, the system of surveillance and penalties would need to be strengthened.

Keywords: Moral hazard; adverse selection; asymmetric information; risk; insurance; Vietnam.

ABBREVIATIONS

ASF : African swine feve
FAO : Food and Agricultural Organization
FMD : Foot and mouth disease
ICT : Item count technique
IV : Instrumental variable
MARD : Ministry of Agriculture and Rural Development
OLS : Ordinary Least Square
SS : Sensitive statement
VND : Vietnamese Dong

1. INTRODUCTION

Most poor people in developing countries make their living from agriculture; hence, their livelihood is subject to various risks such as livestock disease, flooding, drought, and fluctuations in the price of agricultural products. To mitigate such risks, various strategies can be adopted, such as growing produce that has a stable yield, limiting the impact of insect damage by cultivating a number of different plots, and varying planting times.

In developing countries in Asia, the expansion in the consumption of livestock products has been accompanied by an increase in the number of reared animals, and, consequently, many outbreaks of livestock diseases such as porcine reproductive and respiratory syndrome, Foot and Mouth Disease (FMD), and avian influenza. The majority of livestock producers are small-scale farmers, and the economic impact of a disease outbreak on such farmers is immense. It is therefore necessary to devise ways of dealing with the risk.

One method of dealing with risk is insurance. However, insurance systems in developing countries are by no means mature, and the proportion of farmers taking out insurance is also low. In particular, insurance markets in developing countries are seriously impacted by adverse selection and moral hazard, derived from information asymmetry. For example, Banerjee and Duflo [1] described cases of moral hazard in India – a development of a market for cows' ears. As cows' ears were needed to provide proof of the death of livestock covered by insurance against death, fraud involving purchased ears was reported. Also, Miwa and Fukui [2] and Ito and Kono [3] reported examples of adverse selection in the health insurance markets of Cambodia and India, respectively. They observed a tendency among households with poor health to purchase health insurance.

In order to combat adverse selection and moral hazard, a new type of insurance known as index based-insurance has emerged in recent years [4, 5]. The insurance payout is based on indicators (indexes) that can be publically confirmed such as rainfall or hours of sunshine, alleviating the problems of adverse selection and moral hazard.

Research on insurance in developing countries has frequently addressed people's health insurance and crop insurance. The findings often relate to factors that influence the decision to purchase insurance, focusing on people's tendency to avoid risk, moral hazard, the level of insurance premiums, time preference, and education about insurance products. Studies on livestock insurance in developing countries by [6,7], focused on India and on the workings of livestock insurance there, but did not analyze farmers' behavior in the context of moral hazard and adverse selection, the key factors that must be considered when examining the insurance in developing countries.

However, even if asked directly about their behavior, arising from moral hazard or adverse selection, few farmers are likely to answer

honestly. When sensitive questions are asked directly and an honest answer cannot be expected (for instance, questions relating to homosexuality or use of hard drugs such as heroin), the proportion of people engaging in the relevant behavior can be indirectly estimated using the item count technique (ICT), a method which has been applied in the field of livestock health. Randrianantoandro et al. [8] used ICT to calculate the likelihood that pigs infected with African swine fever (ASF) were sold in Madagascar by farmers who mistakenly believed that "ASF can be passed to humans." Further, Gunarathne et al. [9] used ICT to examine the likelihood that cows infected with FMD were sold in Sri Lanka by farmers with extensive knowledge about the disease. With ICT, it is possible to provide indirect evidence of behavior surrounding sensitive issues that people are reluctant to discuss. It has not, however, been applied to farmers' behaviors stemming from adverse selection or moral hazard regarding agricultural insurance.

Agricultural insurance was introduced in Vietnam as a pilot project in 2011–2013. It was introduced on a trial basis in 20 provinces in Vietnam and featured special characteristics including limited disease coverage and subsidies for poor farmers. The project has, however, never been analyzed from the point of view of participating farmers' behaviors in the context of moral hazard and adverse selection[1].

In this report, we examine the factors behind the decision to take out insurance, from the viewpoint of moral hazard or adverse selection, particularly focusing on dairy farms. Our survey was carried out in Ba Vi District, Hanoi Province, Vietnam. In particular, our analysis of the factors behind farmers' insurance decisions takes account of the impact of the endogeneity in the farmers' attitude to risk. Further, we use ICT to present evidence of adverse selection and moral hazard at the time of farmers' insurance participation.

We emphasize the possibility of government role on livestock insurance to mitigate the problems associated with asymmetric information, not depending on index-based insurance which has elicited considerable attention recently. The Vietnamese government has used the results of their pilot project to deliberate over the future of the livestock insurance business. An analysis of farmer behavior when participating in livestock insurance is likely to provide beneficial suggestions for the future livestock-insurance strategy in Vietnam.

2. AGRICULTURAL INSURANCE IN VIETNAM[2]

Agricultural (crop, livestock) insurance was first introduced into Vietnam between 1985 and 1987 (Phase 1). In Phase 1 of agricultural insurance, there was no government support. There was, however, behavior pertaining to moral hazard, such as replacing dead livestock, the value of paid out claims soared, and agricultural insurance, except for crude-rubber insurance, was withdrawn in 1987.

Later, in 2011, aiming to stabilize agricultural production, the Vietnamese prime minister Nguyen Tan Dung ordered the introduction of agricultural insurance, launching Phase 2 of agricultural insurance as a three-year trial from 2011 to 2013. This phase involved agricultural crop insurance, livestock insurance, and aquaculture insurance.

Phase 2 of agricultural insurance included government support for insurance premiums, with the very poorest farmers receiving a subsidy of 100%, the next tier of poor farmers, 90%, ordinary farmers, 60%, and agricultural groups, 20%. Such subsidies cost the government 3 trillion VND over the three-year period [10].

Policy design and underwriting were carried out by two large local insurers, Boa Viet and Boa Minh. Reinsurance was carried out by a local reinsurance company, Vietnam National Reinsurance Corporation, and reinsurance giant Swiss Re provided technical support, centering on premium calculation using actuarial methods[3].

With the support of the Ministry of Agriculture and Rural Development (MARD), the insurance was marketed to, and claims were paid out to, whole communes as a means to reach small-scale farmers in rural areas. A trial of Phase 2 agricultural insurance was conducted in 20

[1] *GlobalAgRisk [10] produced a report explaining agricultural insurance in Vietnam. However, it focuses on the basic insurance mechanism and contains no analysis of the behavior of farmers choosing agricultural insurance.*

[2] *These comments on agricultural insurance are based on the results from field research and studies by [11].*

[3] *Agricultural insurance in Vietnam has also attracted attention as a public-private risk-management system [12].*

provinces and 5 centrally controlled municipalities. As of June 2013, a total of 315,341 policies had been taken out, the majority of which (257,110) related to agricultural crops; 42,607 were livestock policies, and 15,624 cultivation policies. Direct premiums were 324.1 billion VND. The loss ratio was low for agricultural produce and livestock insurance, but, at 315%, high for cultivation insurance, hence, the underwriting of cultivation insurance was suspended in the first half of 2013.

The subject of our research is livestock insurance, with a particular focus on dairy cattle. With the economic development of Vietnam in recent years, the consumption of cow's milk has increased. In line with this, cow's milk production has expanded sharply, from 63,400 tons in 1993 to 487,400 tons in 2013 [13]. There are some large farms owned by major Vietnamese milk producers such as Vinamilk and TH True milk, but most dairy farmers are small-scale farmers with a small number of cows. Meanwhile, there are frequent outbreaks of infectious diseases such as FMD, and the small-scale dairy farmers had to take action against this risk.

The only insured events under livestock (dairy cattle) insurance in Vietnam are three death causes, such as a result of FMD, Anthrax, or Pasteurella infection. Diseases associated with milk production such as mastitis and hoof disease are not covered. The market price of a dairy cattle insurance policy of one-year duration is VND 30 million, VND 40 million, VND, 50 million, or VND 60 million, depending on which of the four available packages is chosen. The cost of insurance is equivalent to 3.6% of the market price of milk. However, for the poorest farmers who receive the aforementioned 100% insurance premium subsidy, the cost of insurance is zero.

3. THEORETICAL FRAMEWORK OF FARMER'S BEHAVIOR TOWARD LIVESTOCK INSURANCE

The relationship between farmer's behavior and livestock insurance is illustrated in Fig. 1, using expected utility theory[4]. We hypothesis the utility curve for farmers taking out livestock insurance are risk-averse, that is, farmers are trying to reduce their overall risk. Small-scale farmers in developing countries are particularly risk averse as exposure to an uninsured shock can have devastating consequences on survival [15]. When there is an outbreak of disease that the insured farmer thinks is covered, the farmer has three hypothetical courses of action. The first is to report the outbreak to the government veterinarian and set an insurance claim in motion, with the insurance payout to be received denoted as I (net sum received after deduction of premiums paid). The second hypothetical course of action is to attempt to sell the animal illegally without reporting the outbreak to the government veterinarian, with the probability α of discovery by the authorities. In this case, the fines and the cost of social sanctions are denoted as F. The third hypothetical course of action is not to report the outbreak to the government veterinarian and manage to sell the animal without being discovered by the authorities, with a probability of $(1-\alpha)$. The revenue for the sale of the animal illegally is denoted R and we assume R is greater than I ($R > I$).[5] If we assume that more than the three diseases are covered by the livestock insurance, the probability of discovery of the disease animal by the authorities in the second hypothetical course of action is β and in the third hypothetical course of action, the probability of not being discovered is $(1-\beta)$, with no change to I, F, and R.

Under these circumstances, the expected utility for the farmer from being insured if there is an incidence of livestock disease is denoted EU_{NL}. Where the insured diseases are not limited within three diseases (numerous), the probability $(1-\beta)$ of being able to sell the animal and obtain R without being discovered by the authorities led by one specified local official (the government veterinarian) rises. As a result, the farmers' expected utility EU_{NL} is likely to grow.

However, when the insurance coverage disease is limited, the probability $(1-\alpha)$ of being able to sell the animal without being discovered by the authorities is likely to be lower. As a result, the expected utility EU_L in this situation is lower than EU_{NL} and U_I (utility of insurance payment, I). Consequently the possibility of moral hazard among farmers is reduced.

[4] *Here, we present an expected-utility analysis following [14].*

[5] *In our survey, there were farmers who did not receive a payout for an animal that died from an uninsured disease even farmers joined insurance. Also there were farmers that were dissatisfied by the fact that the payout was lower than the contracted sum. The assumption $R > I$ is, thus, rather realistic.*

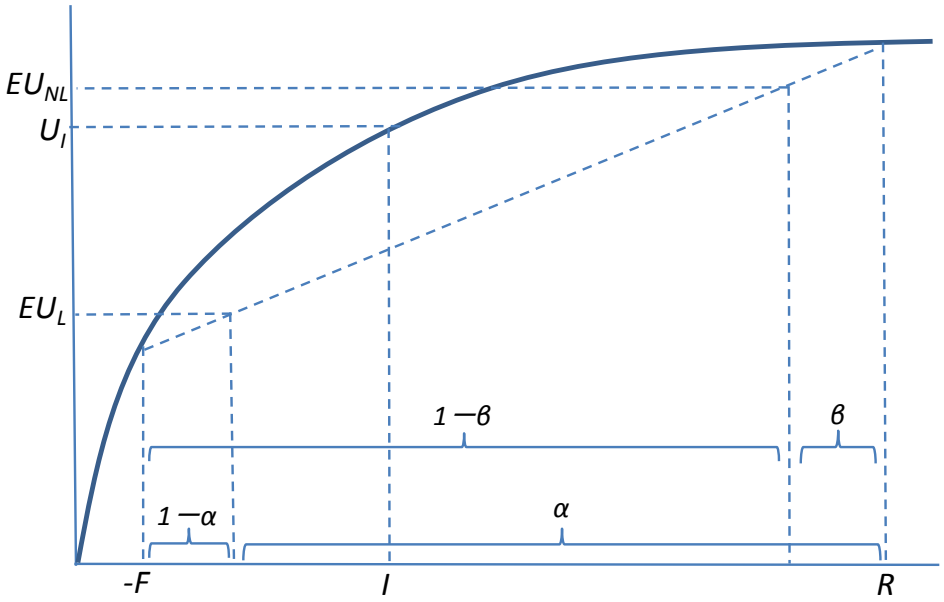

Fig. 1. The relationship between expected utility and farmers' behavior

4. METHODS

4.1 Research Methods

We carried out field research using a questionnaire in Ba Vi District in North-West Hanoi in January 2015. Having received dairy-related technical support from Japan in recent years, Ba Vi District has some of Vietnam's most advanced dairy production. Of the 19 villages in Ba Vi, dairy production is prevalent in Tan Linh, Van Hoa, and Yen Bai, and about 80% of the approximately 7,500 dairy cows in Ba Vi are in dairy farms in those 3 villages, which have 2,264, 2,472, and 1,259 dairy cows, respectively. We carried out our field research in Van Hoa and Yen Bai, where farmers' cooperation was forthcoming.

In Ba Vi District, as of October 2013, 260 farmers had taken out livestock insurance, 54 in Van Hoa and 60 in Yen Bai. We surveyed 97 farmers chosen randomly from the farmers' registration book, 38 of whom were insured and 59 uninsured. Of the 38 insured farmers, 22 were in Van Hoa and 16 in Yen Bai. Of the 59 uninsured farmers, 26 were in Van Hoa and 33 in Yen Bai. Of the 97 farmers surveyed, 48 were in Van Hoa and 49 in Yen Bai.

The research was carried out with a questionnaire covering several topics: details of the farm environment such as the number of dairy cows reared by the farmer, milk production, occurrence of disease, and welfare management; details on the household's composition such as age, duration of education, and scale of the family labor force; risk avoidance; and the situation regarding insurance.

To provide an overview of the surveyed farmers' details, the average age of the main farmer was 47.2 years in Van Hoa and 43.0 years in Yen Bai; the average household size was 4.3 people in Van Hoa and 4.1 people in Yen Bai; and the average education level of the main farmer was 3.2 in Van Hoa and 3.3 in Yen Bai.[6] Thus, there was no significant difference between the two villages. The average number of dairy cows was 4.8 in Van Hoa and 5.5 in Yen Bai, with both villages having small-scale farmers with around five cows. The average number of dairy-cow calvings was 3.0 in Yen Bai and 2.6 in Van Hoa, reflecting a slightly older herd age. Productivity was a little higher in Yen Bai, with daily milk production volume per cow of 20.3 liters, compared to 18.5 liters in Van Hoa. Although milk production in the two villages is at a low level when compared to the average milk production (around 27 liters per cow per day) at a large advanced dairy farm (15,000 cows) run by TH true Milk in Nghe An Province, their milk

[6] *Education level is the education level of each main farmer measured against five levels (no education, finished elementary school, finished middle- school, graduated from high school, graduated from university or higher). The average education level is the average value of these.*

production represents an average for Vietnam's small-scale dairy farmers with a small number of cows[7].

4.2 Methods of Analysis

We used two methods to analyze the behavior of farmers when taking out insurance: the instrumental variable (IV) method and the item count technique (ICT).

In analyzing the factors affecting decision-making concerning insurance, we consider the impact of the farmers' appetite for risk on insurance participation. Hence, it becomes necessary to investigate the endogeneity of appetite for risk, estimated using the IV method [16,17]. Following [2], we present the model below. In the first stage (Equation 2), we estimate the degree of risk avoidance (Risk) and the rate of time discounting (Time) with ordinary least square (OLS) method. Next, using the residual obtained from that estimation, in stage 2 (Equation 1), we investigated endogeneity using the probit model. Following existing research, we employed several explanatory variables: a village dummy (Village), characteristics of the household (Age, Knowledge, Off-farm), and characteristics of the farm (Cow, Disease, Calving, Labor) that were made available through our field research[8]. Trust in Equation (2) is an instrumental variable, capturing the endogeneity of the degree of avoidance of risk (Risk) and the rate of time discounting (Time) in Equation (1). Details and definitions of the variables used in Equations (1) and (2) are summarized in Table 1.

$$Insurance = \alpha_0 + \alpha_1 \cdot Time + \alpha_2 \cdot Risk + \alpha_3 \cdot Cow + \alpha_4 \cdot Disease + \alpha_5 \cdot Calving + \alpha_6 \cdot Labor + \alpha_7 \cdot Knowledge + \alpha_8 \cdot Off\text{-}farm + \alpha_9 \cdot Village + \sigma \quad (1)$$

$$Risk\ or\ Time = \beta_0 + \beta_1 \cdot Cow + \beta_2 \cdot Disease + \beta_3 \cdot Calving + \beta_4 \cdot Labor + \beta_5 \cdot Knowledge + \beta_6 \cdot Off\text{-}farm + \beta_7 \cdot Village + \beta_8 \cdot Trust + \delta \quad (2)$$

Here, *Insurance*, the explained variable in Equation (1), is a dummy variable. It equals 1 if a farmer took out any livestock insurance during the three-year period from 2011 to 2013, and 0 otherwise.

Equation (2) expresses time and risk preference. The rate of time discounting, *Time*, which is an indicator of time preference, was obtained based on answers to the following question [18] in the questionnaire: "If you won VND 500,000 on the lottery, but were offered VND 1 million instead if you waited a number of years, how many years would you wait?" If the time they are willing to wait is longer, the rate of time discounting is lower; as the number of days decreases, the rate of time discounting rises[9]. Phomtavong and Fukui [19] demonstrated that, if the rate of time discounting is low, there is a high tendency to adopt new technology, and it is conceivable that, in Equation (1), farmers with a low rate of time discounting will take out livestock insurance and the expected sign is positive.

Following [20], Risk, indicates the degree of risk avoidance. The degree of risk avoidance reflects the farmer's selection of one of six combinations of sums of money received for "heads" and for "tails" in an imagined coin-tossing game[10].

In Equation (1), if a farmer is more risk-averse, the likelihood of the farmer opting for insurance increases. The expected sign is, hence, negative. All calculations were performed using STATA (STATA CORPS).

People usually do not provide honest answers to sensitive questions (for example, questions about the use of hard drugs such as heroin or questions regarding homophobia or risky sexual behavior [8]). However, the ICT method allows for an indirect estimate of the proportion of people engaging in behavior that is not be reflected in people's answers. In the ICT method, the surveyed farmers who have, and have not, taken out insurance were divided into subsample

[7] *Average milk production volume in Nghe An province was taken from the JICA page below (accessed Aug 31, 2015). http://www.jica.go.jp/project/Vietnam/0601775/news/news/20100922.html*

[8] *Knowledge quantifies the level of knowledge about livestock disease based on the accuracy of yes/no answers to the following four questions: 1) "Chickens can be infected with FMD." 2) "Pigs can be infected with the mastitis virus." 3) "Cows can be infected with avian influenza." 4) "Cows become blind when infected with pasteurellosis."*

[9] *We calculate the rate of time discounting using the formula X=Y/(1+kT). In this formula, X is the current value of the winning lottery ticket (VND 500,000), Y is the value of the delayed ticket paying out after T days (VND 1,000,000), and k is the rate of time discounting.*

[10] *The following six combinations are listed in the questionnaire. 1) Heads: VND 100,000; Tails VND 100,000. 2) Heads: VND 80,000; Tails VND 200,000. 3) Heads: VND 60,000; Tails VND 260,000. 4) Heads: VND 40,000; Tails VND 320,000. 5) Heads: VND 20,000; Tails VND 380,000. 6) Heads: VND 0; Tails VND 400,000. Farmers who select option 1 are considered to have a strong tendency to avoid risk, and those who select option 6 have a strong tendency to seek risk.*

Table 1. Definition of variables for IV and pobit method

Variables	Definition	All sample	VanHoa	YenBai
Cow	Total number of cattle	5.15 (1.89)	4.84 (1.89)	5.49 (1.84)
Disease	Ratio (%) of disease prevalence to total cattle	0.17 (0.20)	0.16 (0.19)	0.18 (0.21)
Parity	Average parity number of dairy cattle per farm	2.84 (1.46)	2.62 (0.99)	3.04 (1.82)
Labour	Number of family labor	2.54 (1.03)	2.50 (1.09)	2.57 (0.98)
Age	Age of head farmer	45.07 (9.91)	47.22 (10.28)	42.96 (9.15)
Non-agri	Number of Non-agri. worker in family member	0.35 (0.58)	0.49 (0.65)	0.27 (0.46)
Knowledge	Knowledge of animal disease	1.31 (1.15)	1.40 (1.27)	1.22 (1.03)
Time	Rate of time discounting	0.21 (0.40)	0.26 (0.43)	0.17 (0.37)
Risk	Risk preference	2.57 (2.06)	2.67 (2.13)	2.47 (2.01)
Trust	Number of trustworthy persons	30.28(48.98)	41.43 (59.12)	18.56 (33.05)
Village	Village dummy (VanHoa=1、YenBai=0)	-	1.00	0.00

Note: Figure is average and standard deviation in parenthesis

A and subsample B, as shown in Table 2. Each subsample was asked to say whether four basic statements concerning various dairy production practices, known as the baseline list, apply to them[11]. For subsample B, the sensitive statement (SS) "I have, on occasion, not sought treatment from a veterinarian even though a cow has shown signs of Pasteurella infection" is added to the baseline list, making a total of five statements. The farmers being interviewed were not asked to indicate directly which statements applied to them, but to use only the numbers assigned to the statements to answer indirectly. $\bar{X}_{4A}$ is the average answer number for the baseline list, and $\bar{X}_{5B}$ is the average answer number for the baseline list + SS; the difference between the two is $\hat{P}_1$ (Equation 3).

Table 2. ICT survey structure

Questionnaire	Subsample A	Subsample B
	Baseline list	Baseline list + SS
Sample size	Insurance farmer = 16 No insurance farmer = 33	Insurance farmer = 22 No insurance farmer = 26

Meanwhile, all farmers, both in subsample A and subsample B, were asked to answer "yes" or "no" to the statement "I have on occasion not sought treatment from a veterinarian even though a cow has shown signs of Pasteurella infection," posed directly at the end of the questionnaire. The proportion of farmers who answered "yes" to the directly posed statement is $\hat{P}_2$. If Equation (4) is true, this suggests that some farmers "have on occasion not sought treatment from a veterinarian even though a cow has shown signs of Pasteurella infection." In particular, if the proportion of these farmers among insured farmers is high, it is likely that moral hazard exists among insured farmers[12].

$$\hat{P}_1 = \bar{X}_{5B} - \bar{X}_{4A} \quad (3)$$

$$\hat{P}_1 = \hat{P}_2 \quad (4)$$

5. RESULTS AND DISCUSSION

5.1 The Occurrence of Livestock Disease and the Use of Insurance

Table 3 presents the occurrence of different livestock diseases. Looking at diseases covered by insurance, there are a total of 13 cases, comprising seven cases of Pasteurella infection, 4 cases of FMD, and 2 cases of anthrax. Meanwhile, the diseases occurring frequently in the surveyed farmers' farms are those not covered by insurance: 24 cases of mastitis, 17 cases of hoof disease, and 4 cases each of milk fever and peritarsitis. Disorders surrounding pregnancy and calving and disorders of the digestive system also occurred.

Figures in parenthesis are number farmers who could obtain insurance payment because the animal has died after the occurrence of a disease covered by insurance.

Only two farmers (for three cows) were able to obtain an insurance payout after the occurrence of a disease covered by insurance; hence, the number of cows for which a payout could be

[11] *The following four statements were included: 1) "I use only artificial insemination." 2) "For fertilization, I use only stud bulls." 3) "I sell raw milk to local restaurants." 4) "I give vitamins to my cows."*

[12] *For details, see.[8].*

obtained was extremely low when compared to the 13 cows suffering from the insured diseases. This is because, even when there is an incidence of an insured disease, there is no payout unless the animal dies. If the animal recovers following treatment (and does not die), it is not covered by the insurance.

5.2 Analysis of Factors Involved in the Purchase of Livestock Insurance

Table 4 shows the results from estimation using Equations (1) and (2). When using Equation (2), the instrumental variable (trust) could not adequately explain *Risk*. Hence, when using Formula (1), we took the risk-aversion and time-discounting variables separately as explanatory variables, and estimated the impact of risk avoidance (Risk) on the taking-out of insurance (Insurance) using a probit model.

A Wald test of the exogeneity of the discount rate is significant at the 1%. Hence, we may view the discount rate as an endogenous variable and demonstrate the validity of the estimation using the IV method[13].

The results from the first stage of the estimation using the IV method suggest that, if there are few trustworthy people locally, the rate of time discounting is low and, if there are many trustworthy people, the rate of time discounting is higher. The results from the second-stage estimation show that the higher a farmer's rate of time discounting, the less likely he/she is to take out livestock insurance; the lower a farmer's rate of time discounting the more likely he/she is to take out livestock insurance. Further, the higher the number of calvings, and therefore the older the cows owned by a farmer, the more likely he/she is to take out livestock insurance. The village dummy was also significant, reflecting a higher tendency to take out livestock insurance in Yen Bai.

The probit model estimation showed a high tendency for risk-averse farmers to take out insurance. This is consistent with the findings of [22,3], but differs from the findings of [2,19]. In addition, knowledge is also significant: farmers with a high level of knowledge about livestock diseases opt for livestock insurance. Farmers with off-farm revenue opportunities also showed a tendency to take out livestock insurance. This suggests that farmers with the opportunity to earn money off the farm perceive the new system of livestock insurance positively.

Disease showed no statistical significance. This suggests low likelihood for the existence of adverse selection; that is, farmers with a high incidence of livestock diseases taking out insurance and low likelihood for the existence of moral hazard may lead to farmers who take out insurance and then fail to manage their herds properly. These results differ from those of [2].

The results show that it is not only the characteristics of the farmers and their farms, but the main farmer's perception of time discounting and of risk that have significant impacts on the taking-out of livestock insurance.

5.3 Item Count Technique

The whole-sample (97 farms) analysis showed that 1.03% of farmers directly acknowledged that they "have on occasion not sought treatment from a veterinarian even though a cow has shown signs of Pasteurella infection," (acknowledging behavior pertaining to moral hazard), while 12.88% indirectly acknowledged such action (Table 5). There is a statistically significant difference between the two values, suggesting that farmers' behavior reflects moral hazard tendencies.

When separating these results according to farmers who have taken out livestock insurance and those who have not, no farmers with insurance directly acknowledged such behavior and 16.48% indirectly acknowledged it. The difference is statistically significant. Further, 1.69% of farmers without insurance directly acknowledged such behavior and 14.22% indirectly acknowledged it. Again, the difference is statistically significant. The results suggest that behavior pertaining to moral hazard exists among both insured and uninsured farmers.

However, there is no statistical difference between the insured and the uninsured farmers with regard to indirect acknowledgement. This implies that there is no particular tendency for moral hazard among insured farmers. This is consistent with the results obtained using the IV method. The results differ from the findings of [2], who find insured farmers frequently engaging in behavior pertaining to moral hazard.

[13] *For more details, see [21].*

Table 3. Sample farmers' disease prevalence

	Disease	Total	VanHoa	YenBai
Insurance	Pasteurella	7(0)	1(0)	6(4)
Covered	FMD	4(0)	0(0)	4(0)
	Anthrax	2(2)	0(0)	2(0)
Insurance	Mastitis	24	10	14
not covered	Foot disease	17	8	9
(Top four ranked	Milk fever	4	0	4
diseases)	Peritarsitis	4	0	4

Note: Figure is based on field survey. Multiple responses

Table 4. Result of factors affected to animal insurance

	IV method				Probit method	
	Time		Insurance		Insurance	
Cow	0.024	(0.020)	0.018	(0.055)	-0.038	(0.083)
Disease	0.097	(0.195)	-0.331	(0.666)	-0.811	(0.755)
Parity	0.019	(0.021)	0.168	(0.085) **	0.172	(0.108)
Age	0.002	(0.005)	-0.009	(0.011)	-0.024	(0.016)
Knowledge	-0.037	(0.029)	0.047	(0.114)	0.258	(0.125)**
Labour	0.027	(0.048)	-0.041	(0.125)	-0.148	(0.165)
Non-agri	0.051	(0.098)	0.382	(0.255)	0.488	(0.266)*
Village	0.054	(0.089)	0.397	(0.214)*	0.342	(0.301)
Trust	0.001	(0.001) **				
Time			-2.195	(0.326) ***		
Risk					-0.139	(0.070)**
Wald chi^2(9)	157.76	***			20.3	**
Exogenity test	9.36	***				
Pseudo R^2					0.148	

Note: Figure in parenthesis indicates robust standard errors. Sample=95.
****, ** and * are statistically significant at 1%, 5% and 10% level respectively.*
Exogenity test indicate the result of "Wald test of exogenity chi^2(1)"

Table 5. Result of ICT

	$\widehat{P}_1$(%)	$\widehat{P}_2$(%)	Binominal test (p-value)
Total sample (n=97)	12.88	1.03	0.001***
Farmers who join insurance (n=38)	16.48	0	0.007***
Farmers who do not join insurance (n=59)	14.22	1.69	0.011**

5.4 Discussion

With respect to time preference and the taking-out of livestock insurance, it is possible to interpret the findings as the higher a farmer's rate of time discounting (that is, the more impatient the farmer), the less likely he/she is to respond to a future income opportunity that may arise under livestock insurance. Conversely, it is conceivable that farmers with a low rate of time discounting are able to consider the dairy business from a long-term perspective and, hence, respond to the new system (livestock insurance) positively. These findings are similar to those of [19].

However, there was a tendency for farmers to have a lower rate of time discounting and be more likely to adopt the new system (livestock insurance), if there were less trustworthy people around them. Why is the rate of time discounting high when there are many trustworthy people around? Taking into account the number of cattle owned, as a variable showing ownership of assets by people who were surrounded by many trustworthy people (at least 100), farmers able to trust at least 100 people owned, on average, 5.26 cows. Farmers able to trust fewer than 100 people owned, on average, 4.73 cows. Thus, the fewer people farmers are able to trust, the fewer cows (assets) they own, though the difference is not statistically significant. Further the correlation between a farmer's earning opportunities off the farm and he or she being able to trust as least 100 people is 0.32, whereas that between a farmer's earnings opportunities off the farm and he or she being able to trust fewer than 100 people is 0.009, which is a difference of

statistical significance. In other words, farmers able to trust a small number of people are relatively poor. Because of that, as shown by [23], the rate of time discounting among people with low incomes tends to be high (and, conversely, the rate tends to be low among people with high incomes).

The findings thus suggest that farmers take out insurance because there are few acquaintances to turn to in hard times, such as when natural disasters occur. Conversely, it is conceivable that farmers able to trust a large number of people have many acquaintances to turn to in times of trouble and have little need to take out insurance. Further research is needed to examine the relationship between the number of people farmers are able to trust and their rate of time discounting.

The analysis of results also reveals a low level of existence of adverse selection and moral hazard with respect to livestock insurance in the surveyed areas. It is conceivable that farmers suffering high incidence of livestock disease are unlikely to engage in adverse selection, is attributable to the proper cooperation between Boa Vet (the private company implementing livestock insurance in Vietnam) and the local administrative bodies (local government veterinarian and ministry committees). This allows the insurance company to obtain information about the farmers and eliminate the problems associated with information asymmetry. Tackling the problem of asymmetric information by making full use of regional institutions with a great deal of information about the villages, resembles the set-up at micro-credit providers operating in Bangladesh and elsewhere [24]. The micro-credit providers normally live in community and they know who is who, what reputation each person has for hard work and honesty, and who is connected with whom. This allows them to defeat the problems of asymmetric information [15]. These results in Vietnam suggest the problem associated with asymmetric information can mitigate under the condition of cooperation between government and private sector.

The fact that insurance coverage is limited to fatal outbreaks of three diseases could also be seen as working against behavior originating from moral hazard. We explain this point using Fig. 1. Where the insured diseases are limited (numerous), even if a farmer anticipating that $R > I$ engages in moral hazard, the probability ($1-\alpha$) of being able to sell the animal and obtain R without being discovered by the authorities rises. As a result, the farmers' expected utility EU_{NL} is likely to grow. However, when the insurance coverage is limited, even if we assume that a farmer who expects $R > I$ engages in moral hazard, as mentioned earlier, there is an insurance payout for only three diseases and the probability ($1-\alpha$) of being able to sell the animal without being discovered by the authorities is likely to be lower. In other words, limiting the diseases covered reduces expected utility and, as shown by the results of our ICT analysis, we expect that the possibility of moral hazard among farmers is also reduced.

In Vietnam's system of livestock insurance, the poorest farmers receive a 100% subsidy of their premiums when taking out insurance; the poorest farmers do not make any payment, raising the value of I, the net payout figure after deduction of premiums. It is conceivable that raising the value of I will have the effect of preventing moral hazard. The inequality $U_I > EU_L$ in Fig. 1 reflects positive utility and the inequality $U_I < EU_{NL}$ reflects negative utility. This suggests that the system of subsidies in Vietnamese government livestock insurance has a significant impact on whether farmers opt for insurance.

6. CONCLUSION

In this paper, we have studied the factors behind the decision to take out insurance, from the viewpoint of moral hazard or adverse selection. We summarize the contributions of this article into three ways.

First, the analysis reveals a low level of existence of adverse selection and moral hazard with respect to livestock insurance in the surveyed areas. It is conceivable that the fact that farmers suffering high incidence of livestock disease are unlikely to engage in adverse selection and take out insurance is attributable to the proper cooperation between the company implementing livestock insurance in Vietnam and the local administrative bodies. This allows the insurance company to obtain information about the farmers and eliminate the problems associated with information asymmetry. The livestock insurance in Vietnam as a public-private risk-management is evaluated to mitigate the asymmetric information problems.

Second, the results show that the higher a farmer's rate of time discounting, the less likely

the farmer is to take out livestock insurance; the lower a farmer's rate of time discounting the more likely the farmer is to take out livestock insurance. It is possible to interpret the findings as the higher a farmer's rate of time discounting (that is, the more impatient the farmer), the less likely the farmer is to respond to a future earnings opportunity that may arise under the new system. Conversely, it is conceivable that farmers with a low rate of time discounting are able to consider the dairy business from a long-term perspective and, hence, respond to the new system positively.

Third, the fact that insurance coverage is limited to fatal outbreaks of three diseases could also be seen as working against behavior originating from moral hazard. The incidence of livestock diseases covered by insurance is currently low. Many dairy farmers expressed their wish for insurance coverage to be expanded to include other diseases such as mastitis and hoof disease. Expanding the insured diseases increases the probability of farmers being able to sell an animal without the authorities knowing and it is likely that farmers' expected utility of insurance claims will rise. Expanding the range of diseases covered by insurance would introduce an additional financial burden. As a consequence, the system of surveillance and penalties would need to be strengthened.

Many governments in developing countries have prioritized the creation and strengthening of the agricultural insurance and index-based insurance has elicited considerable attention recently, especially since it is free from information asymmetric problems. Our work showed that "conventional" insurance can mitigate the problems associated with asymmetric information under the situations we have identified, not depending on index based-insurance. It would be a meaningful implication for policy makers to enhance agricultural insurance in developing countries.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/18445