Original Research Article

Animal Insurance and Farmer's Behavior in Vietnam

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 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.

Key words: Moral hazard, adverse selection, Asymmetric information, risk, insurance, Vietnam

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 byadverse selection and moral hazard, derived from information asymmetry. For example, Banerjee and Duflo (2011) described cases

39 of moral hazard in India – a development of a market for cows' ears. Ascows' ears were needed to
40 provide proof of the death of livestock covered by insurance against death, fraud involving purchased
41 ears was reported. Also, Miwa and Fukui(2014)andIto and Kono(2010) reported examples of adverse
42 selection in the health insurance markets of Cambodia and India, respectively.They observeda
43 tendency among households with poor health to purchase health insurance.
44 In order to combat adverse selection and moral hazard, a new type of insurance known as index
45 based-insurance has emergedin recent years (Hill et al., 2011;Gine et al., 2007). The insurance payout
46 is based on indicators (indexes) that can be publically confirmed such as rainfall or hours of sunshine,
47 alleviating the problems of adverse selection and moral hazard.
48 Research on insurance in developing countries has frequently addressed people's health insurance
49 and crop insurance. The findings often relate to factors that influence the decision to purchase
50 insurance,focusing onpeople's tendency to avoid risk, moral hazard, the level of insurance premiums,
51 time preference, and education about insurance products. Studieson livestock insurance in developing
52 countries by the DHAN Foundation (2012) andDalal et al. (2012), focused on India and on the
53 workings of livestock insurance there,but did not analyze farmers' behavior in the context of moral
54 hazard and adverse selection,the key factors that must be considered when examining the insurance
55 in developing countries.
56 However, even if asked directly about theirbehavior, arising from moral hazardor adverse selection,
57 few farmers are likely to answer honestly. When sensitive questions are asked directly andan 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), amethod which has been applied in the field of livestock health. Randrianantoandro et al. (2015) used ICT to calculate the likelihood that pigs infected with African swine fever (ASF) were soldin Madagascar by farmers who mistakenly believed that "ASF can be passed to humans." Further,Gunarathneet al. (2016) used ICT to examinethe likelihoodthat cows infected with FMDwere 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 selectionor moral hazard regarding agricultural insurance.

Agricultural insurance was introduced in Vietnam as a pilot project in 2011–2013. Itwas 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 beenanalyzedfrom 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. Oursurvey 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 endogeneityin the farmers' attitude to risk. Further, we use ICT to present evidence of adverse selection and moral hazard at the time of farmers'

77 insurance participation.

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

84

85 **2. AGRICULTURAL INSURANCE IN VIETNAM[2]**

86 Agricultural (crop, livestock) insurance was first introduced into Vietnam between 1985 and 1987
87 (Phase 1). In Phase 1 of agricultural insurance, there was no government support. There was,
88 however,behavior pertaining to moral hazard, such as replacing dead livestock, the value of paid out
89 claims soared, and agricultural insurance, except forcrude-rubber insurance, was withdrawn in 1987.
90 Later, in 2011, aiming to stabilize agricultural production, the Vietnamese prime ministerNguyen Tan
91 Dung ordered the introduction of agricultural insurance,launchingPhase 2 of agricultural insurance as a
92 three-year trial from 2011 to 2013. This phase involved agricultural crop insurance, livestock insurance,
93 and aquaculture insurance.
94 Phase 2of agricultural insurance included government support for insurance premiums, with the very
95 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 trillionVND over the three-year period(GlobalAgRisk, 2009).

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 2agricultural insurance was conducted in 20 provinces and 5 centrallycontrolled 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 324.1billion 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 (FAO, 2015). 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 threedeath 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, 50million,or VND 60million, 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 Figure 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 (Janvry&Sadoulet, 2015).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 illegallywithout 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 illegallyis 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 inthe third hypothetical course of action, the probability of not being discovered is $(1-\beta)$, with no change to I, F, and R.

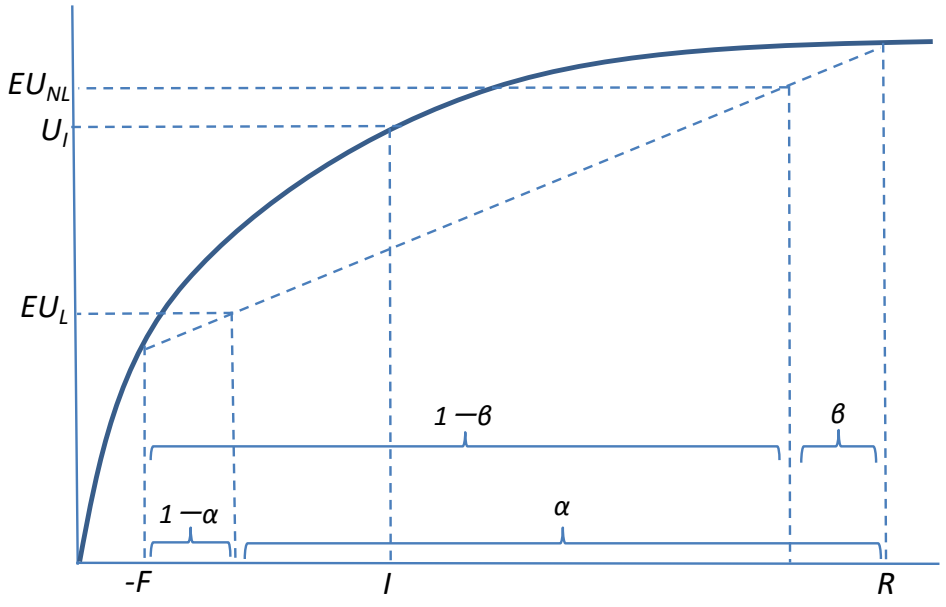

Fig.1. The relationship between expected utility and farmers' behavior

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 lowerthan $EU_{NL}$and U_I(utility of insurance payment, I). Consequentlythe possibility of moral hazard among farmers is reduced.

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 inBa 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'scomposition 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

184 cow per day) at a large advanced dairy farm (15,000 cows) run by TH true Milk in Nghe An Province,
185 their milk production represents anaverage for Vietnam's small-scale dairy farmers with a small
186 number of cows.[7]
187
188 **4.2 Methods of analysis**
189 We used two methods to analyze the behavior of farmers when taking out insurance: the instrumental
190 variable (IV) method and the item count technique (ICT).
191 In analyzing the factors affecting decision-making concerning insurance, we consider the impact of the
192 farmers' appetite for risk on insurance participation. Hence, it becomes necessary to investigate the
193 endogeneity of appetite for risk, estimated using the IV method (Rivers &Vuong, 1998; Sannabe&Saito,
194 2007).Following Miwa and Fukui (2014), we present the model below. In the first stage (Equation 2),
195 we estimate the degree of risk avoidance (Risk) and the rate of time discounting (Time) with ordinary
196 least square (OLS) method. Next, using the residual obtained from that estimation, in stage 2
197 (Equation 1), we investigated endogeneity using the probit model. Following existing research, we
198 employed severalexplanatory variables: a village dummy (Village), characteristics of the household
199 (Age,Knowledge,Off-farm), and characteristics of the farm (Cow,Disease,Calving, Labor) that were
200 made available through ourfield research.[8]Trust in Equation (2) is an instrumental variable, capturing
201 the endogeneity of the degree of avoidance of risk (Risk) and the rate of time discounting (Time) in
202 Equation (1). Details and definitions of the variables used in Equations (1) and (2) are summarized in

203 Table 1.

204

205

206 $Insurance=\alpha_0+\alpha_1 \cdot Time+\alpha_2 \cdot Risk+\alpha_3 \cdot Cow+\alpha_4 \cdot Disease+\alpha_5 \cdot Calving+\alpha_6 \cdot Labor$

207 $+\alpha_7 \cdot Knowledge+\alpha_8 \cdot Off\text{-}farm+\alpha_9 \cdot Village+\sigma$ (1)

208

209 $Riskor\ Time=\beta_0+\beta_1 \cdot Cow+\beta_2 \cdot Disease+\beta_3 \cdot Calving+\beta_4 \cdot Labor$

210 $+\beta_5 \cdot Knowledge+\beta_6 \cdot Off\text{-}farm+\beta_7 \cdot Village+\beta_8 \cdot Trust+\delta$ (2)

211

212 **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

213 Note: Figure is average and standard deviation in parenthesis

214 Here, *Insurance*, the explained variable in Equation (1), is a dummy variable.It equals 1 ifa farmer took
215 out any livestock insurance during the three-year period from 2011 to 2013, and 0 otherwise.
216 Equation (2) expresses time and risk preference. The rate of time discounting,*Time*, which is an
217 indicator of time preference, was obtained based on answers to the following question (Kirby et al.,
218 2002) in the questionnaire: “If you won VND 500,000 on the lottery,but were offered VND 1million
219 instead if you waited a number of years, how many years would you wait?” If the time they are willing to
220 wait is longer, the rate of time discounting is lower;as the number of days decreases, the rate of time
221 discounting rises.[9]Phomtavong and Fukui (2014) demonstrated that, if the rate of time discounting is
222 low, there is a high tendency to adopt new technology, and it is conceivable that, in Equation (1),
223 farmers with a low rate of time discounting will take out livestock insurance and the expected signis
224 positive.
225 FollowingGine et al. (2008), Risk,indicates the degree of risk avoidance.Thedegree of risk avoidance
226 reflects the farmer’s selection of one of six combinations of sums of money received for “heads” and for
227 “tails” in an imagined coin-tossing game.[10]
228 In Equation (1), if a farmer is more risk-averse, the likelihood ofthe farmeropting forinsuranceincreases.
229 The expected sign is, hence, negative.All calculations were performed using STATA (STATA CORPS).
230 People usually do not provide honest answers to sensitive questions (for example, questions about the
231 use of hard drugs such as heroin or questions regarding homophobia or risky sexual
232 behavior(Randrianantoandro et al., 2015).However, the ICT method allows for an indirect estimate of

233 the proportion of people engaging in behavior that is not be reflected in people's answers. In the ICT
234 method, the surveyed farmers who have, and have not, taken out insurancewere divided into
235 subsample A and subsample B, as shown in Table 2. Each subsample was asked to say whether four
236 basic statements concerning various dairy production practices, known as the baseline list, apply to
237 them.[11] For subsample B, the sensitive statement (SS) "I have, on occasion, not sought treatment from
238 a veterinarian even though a cow has shown signs of Pasteurella infection" isadded to the baseline list,
239 making a total of five statements. The farmers beinginterviewed werenot asked to indicate directly
240 which statements appliedto them, but to use only the numbers assigned to the statements to answer
241 indirectly. $\bar{X}_{4A}$is the average answer number for the baseline list, and $\bar{X}_{5B}$is the average answer
242 number for the baseline list + SS; the difference between the two is $\hat{P}_1$ (Equation 3).
243
244 **Table 2. ICT survey structure**

Questionnaire	SubsampleA	SubsampleB
	Baseline list	Baseline list + SS
Sample size	Insurance farmer = 16	Insurance farmer = 22
	No insurance farmer = 33	No insurance farmer = 26

245
246 Meanwhile, all farmers, both in subsample A and subsample B, were asked to answer "yes" or "no" to
247 the statement "I have on occasion not sought treatment from a veterinarian even though a cow has
248 shown signs of Pasteurella infection," posed directly at the end of the questionnaire. The proportion of
249 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 frequentlyin the surveyed farmers’ farms are those not covered by insurance: 24 cases of mastitis, 17 cases of hoof disease, and 4 caseseach ofmilk fever and peritarsitis.Disorders surrounding pregnancy andcalving and disorders of the digestive system also occurred.

Table 3. Sample farmers' disease prevalence

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

Note: Figure is based on field survey. Multiple responses.

Figures in parenthesis are number farmerswhocould obtain insurance payment because theanimal hasdied 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 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.

283

284 **5.2 Analysis of factors involved in the purchase of livestock insurance**

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

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

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

301 The probit model estimation showed a high tendency for risk-averse farmers to take out insurance.

This is consistent with the findings of Ito and Kono (2010) and Harms (2011), but differs from the findings of Miwa and Fukui (2014) and Phomtavongand Fukui (2014). 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 hazardmay lead to farmers who takeout insurance and then failto manage their herds properly. These results differ from those of Miwa and Fukui (2014).

The results above 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 havesignificant impactson the taking-out of livestock insurance.

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$chi^2(1)$".

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 hazardtendencies.

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 isstatistically significant. The results suggest that behavior pertaining to moral hazard existsamong

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 Miwa and Fukui (2014), who findinsured farmers frequently engaging in behavior pertaining to moral hazard.

Table 5. Result of ICT

	$\hat{P}_1$(%)	$\hat{P}_2$(%)	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 whodo 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 Phomtavong and Fukui (2014).

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 fewerpeople farmersare 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 Tanaka, Colin and Nguyen (2010), 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 (Armendariz & Morduch, 2007).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 (Janvry&Sadoulet, 2015). These resultsin Vietnam suggestthe problem associated with asymmetric information can mitigate under the condition ofcooperation between government and privatesector.

The fact that insurance coverage is limited to fatal outbreaks of three diseases couldalso be seen as working against behavior originating from moral hazard. We explain this point using Figure 1. Where the insured diseases are limited (numerous), even if a farmer anticipating that $R > I$engages in moral hazard, the probability $(1-\beta)$ 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

386 insurance coverage is limited, even if we assume that a farmer who expects $R > I$ engages in moral
387 hazard, as mentioned earlier, there is an insurance payout for only three diseases and the probability
388 $(1-\alpha)$ of being able to sell the animal without being discovered by the authorities is likely to be lower.
389 In other words, limiting the diseases covered reduces expected utility and, as shown by the results of
390 our ICT analysis, we expect that the possibility of moral hazard among farmers is also reduced.
391 In Vietnam's system of livestock insurance, the poorest farmers receive a 100% subsidy of their
392 premiums when taking out insurance; the poorest farmers do not make any payment, raising the value
393 of I, the net payout figure after deduction of premiums. It is conceivable that raising the value of I will
394 have the effect of preventing moral hazard.The inequality $U_I > EU_L$ in Figure 1 reflects positive utility and
395 the inequality $U_I < EU_{NL}$ reflects negative utility. This suggests that the system of subsidies in
396 Vietnamese government livestock insurance has a significant impact on whether farmers opt for
397 insurance.
398

399 **6. CONCLUSIONS**

400 In this paper, we have studied the factors behind the decision to take out insurance, from the viewpoint
401 of moral hazard or adverse selection.We summarize the contributions of this article into three ways
402 First,the analysis reveals a low level of existence of adverse selection and moral hazard with respect to
403 livestock insurance in the surveyed areas. It is conceivable that the fact that farmers suffering high
404 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 thefarmer is to take out livestock insurance; the lower a farmer's rate of time discounting the more likely thefarmer 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 thefarmer 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 probabilityof farmersbeing able to sell an animal without the authorities knowing and it is likely that farmers' expected utility of insurance claims willrise. Expanding the range of diseases covered by insurancewould introduce an additional financial burden. As a consequence,

424 the system of surveillance and penaltieswould need to be strengthened.

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

431

432 **ENDNOTES**

433 [1]GlobalAgRisk (2009) produced a report explaining agricultural insurance in Vietnam. However, it
434 focuses on the basic insurance mechanism and contains no analysis of the behavior of farmers
435 choosing agricultural insurance.

436 [2]These comments on agricultural insurance are based on the results from field research and studies
437 by Kada (2014).

438 [3]Agricultural insurance in Vietnam has also attracted attention as a public-private risk-management
439 system (ENESA-CEIGRAM-Agroseguro, 2015).

440 [4]Here, we present an expected-utility analysis following Kono (2011).

441 [5]In our survey, there were farmers who did not receive a payout for an animal that died from an
442 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.

[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.

[7]Average milk production volume in NgheAn 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

462 risk, and those who select option 6 have a strong tendency to seek risk.

463 [11]The following four statements were included: 1) “I use only artificial insemination.” 2) “For

464 fertilization, I use only stud bulls.” 3) “I sell raw milk to local restaurants.” 4) “I give vitamins to my

465 cows.”

466 [12]For details, see Randrianantoandro et al. (2015).

467 [13] For moredetails, see Gujarati (2015).

468

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520

521 **ABBREVIATION**

522 ASF: African swine fever;

523 FAO: Food and Agricultural Organization;

524 FMD: foot and mouth disease;

525 ICT: Item count technique;

526 IV: Instrumental variable;

527 MARD: Ministry of Agriculture and Rural Development;

528 OLS: Ordinary Least Square;

529 SS: Sensitive statement;

530 VND: Vietnamese Dong;