

Original Research Article

Animal insurance and farmer's behavior in Vietnam

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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 adverse selection in Vietnam. The results 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

Comment [A2]: The term “time discounting” is unclear.

higher. 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

20 financial burden. As a consequence, the system of surveillance and penalties would need to be
21 strengthened.

22 *Key words: Moral hazard, adverse selection, risk, insurance, Vietnam*

23

24 1. INTRODUCTION

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

30 In developing countries in Asia, the expansion in the consumption of livestock products has been
31 accompanied by an increase in the number of reared animals, and, consequently, many outbreaks of
32 livestock diseases such as porcine reproductive and respiratory syndrome, FMD, and avian influenza.

Comment [A3]: Use full words followed by the short form in brackets on the first use.

33 The majority of livestock producers are small-scale farmers, and the economic impact of a disease
34 outbreak on such farmers is immense. It is therefore necessary to devise ways of dealing with the risk.
35 One method of dealing with risk is insurance. However, insurance systems in developing countries are
36 by no means mature, and the proportion of farmers taking out insurance is also low. In particular,
37 insurance markets in developing countries are seriously impacted by adverse selection and moral
38 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. As cows' 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); Ito and Kono(2010) reported examples of adverse
42 selection in the health insurance markets of Cambodia and India, respectively. They observed a tendency
43 among households with poor health to purchase health insurance.

Comment [A4]: spacing

44 In order to combat adverse selection and moral hazard, a new type of insurance known as index
45 insurance has emerged in recent years (Hill et al., 2011; Gine et al., 2007). The insurance payout is
46 based on indicators (indexes) that can be publicly 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 on people's tendency to avoid risk, moral hazard, the level of insurance premiums,
51 time preference, and education about insurance products. Studies on livestock insurance in developing
52 countries by the DHAN Foundation (2012) and Dalal et al. (2012), focused on India and of the workings
53 of livestock insurance there, but did not analyze farmers' behavior in the context of moral hazard and
54 adverse selection, the key factors that must be considered when examining the development of
55 insurance in developing countries.

Comment [A5]: awkward using 2 forms
of the same word so close together

56 However, even if asked directly about their behavior, arising from moral hazard or adverse selection,
57 farmers are likely to answer honestly. When sensitive questions are asked directly and an honest

58 answer cannot be expected (for instance, questions relating to homosexuality or use of hard drugs
59 as heroin), the proportion of people engaging in the relevant behavior can be indirectly estimated using
60 the item count technique (ICT), a method has been applied in the field of livestock health.
61 Randrianantoandro et al. (2015) used ICT to calculate the likelihood that pigs infected with African
62 swine fever (ASF) were sold in Madagascar by farmers who mistakenly believed that “ASF can be
63 passed to humans.” Further, Gunaratne et al. (2016) used ICT to examine the likelihood that cows
64 infected with foot and mouth disease (FMD) were sold in Sri Lanka by farmers with extensive
65 knowledge about the disease. With ICT, it is possible to provide indirect evidence of behavior
66 surrounding sensitive issues that people are reluctant to discuss. It has not, however, been applied to
67 farmer’s behaviors stemming from adverse selection or moral hazard regarding agricultural insurance.
68 Agricultural insurance was introduced in Vietnam as a pilot project in 2011–2013. It was introduced on a
69 trial basis in 20 provinces in Vietnam and featured special characteristics including limited disease
70 coverage and subsidies for poor farmers. The project has, however, never been analyzed from the point
71 of view of participating farmers’ the behavior in the context of moral hazard and adverse selection.¹
72 In this report, we examine the factors behind the decision to take out insurance, from the viewpoint of
73 moral hazard or adverse selection, with particularly focusing on dairy farm. Our survey was carried out
74 Ba Vi District, Hanoi Province, Vietnam. In particular, our analysis of the factors behind farmers’
75 insurance decisions takes account of the impact of the endogeneity in the farmers’ attitude to risk.
76 Further, we use ICT to present evidence of adverse selection and moral hazard at the time of farmers’

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77 insurance participation. The Vietnamese government has used the results of their pilot project to
78 deliberate over the future of the livestock insurance business. An analysis of farmer behavior when
79 participating in livestock insurance is likely to provide beneficial suggestions for the future
80 livestock-insurance strategy in Vietnam.

81 In Section 2 of this report, we outline the current situation in agricultural insurance in Vietnam. In
82 3, we summarize theoretically the relationship between farmer's behavior and livestock insurance. In
83 Section 4, we explain the methods of analysis used in our research. In Section 5, we first provide an
84 overview of the situation with regard to outbreaks of livestock disease in the area we study; next, we
85 explain the results of the ICT analysis and factors affecting the purchase of livestock insurance. We
86 conclude with a summary of policy recommendations.

Comment [A8]: Remove...this is the role of an abstract.

87

88 **2. AGRICULTURAL INSURANCE IN VIETNAM²**

89 Agricultural (crop, livestock) insurance was first introduced into Vietnam between 1985 and 1987
90 (Phase 1). In Phase 1 of agricultural insurance, there was no government support. There was,
91 however, behavior pertaining to moral hazard, such as replacing dead livestock, the value of paid out
92 claims soared, and agricultural insurance, except for crude-rubber insurance, was withdrawn in 1987.
93 Later, in 2011, aiming to stabilize agricultural production, the Vietnamese prime minister Nguyen Tan
94 Dung ordered the introduction of agricultural insurance, launching Phase 2 of agricultural insurance as a
95 three-year trial from 2011 to 2013. This phase involved agricultural crop insurance, livestock insurance,

96 and aquaculture insurance.

97 Phase 2 of agricultural insurance included government support for insurance premiums, with the very

98 poorest farmers receiving a subsidy of 100%, the next tier of poor farmers, 90%, ordinary farmers, 60%,

99 and agricultural groups, 20%. Such subsidies cost the government VND3 trillion over the

100 three-year period.

Comment [A9]: Unclear what this means

Comment [A10]: What's your source for this claim?

101 Policy design and underwriting were carried out by two large local insurers, Boa Viet and Boa Minh.

102 Reinsurance was carried out by a local reinsurance company, Vietnam National Reinsurance

103 Corporation, and reinsurance giant Swiss Re provided technical support, centering on premium

104 calculation using actuarial methods³.

105 With the support of the Ministry of Agriculture and Rural Development (MARD), the insurance was

106 marketed to, and claims were paid out to, whole communes as a means to reach small-scale farmers

107 rural areas. A trial of Phase 2 agricultural insurance was conducted in 20 provinces and 5

108 centrally controlled municipalities. As of June 2013, a total of 315,341 policies had been taken out, the

109 majority of which (257,110) related to agricultural crops, 42,607 were livestock policies, and 15,624

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110 cultivation policies. Direct premiums were VND 324.1 billion. The loss ratio was low for agricultural

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111 produce and livestock insurance, but, at 315%, high for cultivation insurance, hence, the underwriting of

112 cultivation insurance was suspended in the first half of 2013.

113 The subject of our research is livestock insurance, with a particular focus on dairy cattle. With the

114 economic development of Vietnam in recent years, the consumption of cow's milk has increased. In line

115 with this, cow's milk production has expanded sharply, from 63,400 tons in 1993 to 487,400 tons in
116 (FAO, 2015). There are some large farms owned by major Vietnamese milk producers such as
117 and TH True milk, but most dairy farmers are small-scale farmers with a small number of cows.
118 Meanwhile, there are frequent outbreaks of infectious diseases such as FMD, and the small-scale
119 farmers must take action against this risk.

Comment [A13]: This should be in past tense.

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

Comment [A14]: causes???

127

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

129 INSURANCE

130 The relationship between farmer's behavior and livestock insurance is illustrated in Figure 1, using
131 expected utility theory⁴. The utility curve for farmers taking out livestock insurance and farmers are
132 risk-averse. When there is an outbreak of disease that the insured farmer thinks is covered, the farmer

Comment [A15]: This sentence is unclear/

133 has three hypothetical courses of action. The first is to report the outbreak to the government

134 veterinarian and set an insurance claim in motion, with the insurance payout to be received denoted as
135 I (net sum received after deduction of premiums paid). The second hypothetical course of action is to
136 attempt to sell the animal without reporting the outbreak to the government veterinarian, with the
137 probability α of discovery by the authorities. In this case, the fines and the cost of social sanctions are
138 denoted as F . The third hypothetical course of action is not to report the outbreak to the government
139 veterinarian and manage to sell the animal without being discovered by the authorities, with a
140 probability of $(1 - \alpha)$. The revenue for the sale of the animal is denoted R ($R > I$).⁵ If we assume that
141 more than the three diseases are covered by the livestock insurance, the probability of discovery of the
142 disease animal by the authorities in the second hypothetical course of action is β and in the third
143 hypothetical course of action, the probability of not being discovered is $(1 - \beta)$, with no change to I , F ,
144 and R .

145

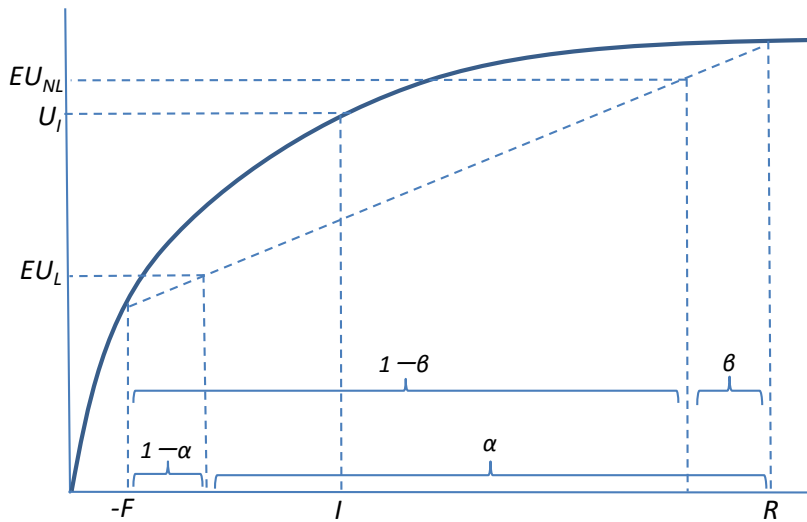


Fig.1. The relationship between expected utility and farmer's behavior

Comment [A16]: farmers'

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.

158 4. METHODS

159 4.1 Research methods

160 We carried out field research using a questionnaire in Ba Vi District in North-West Hanoi in January
161 2015. Having received dairy-related technical support from Japan in recent years, Ba Vi District has
162 some of Vietnam's most advanced dairy production. Of the 19 villages in Ba Vi, dairy production is
163 prevalent in Tan Linh, Van Hoa, and Yen Bai, and about 80% of the approximately 7,500 dairy cows
164 in Ba Vi are in dairy farms in those 3 villages, which have 2,264, 2,472, and 1,259 dairy cows,
165 respectively. We carried out our field research in Van Hoa and Yen Bai, where farmers' cooperation
166 was high. In Ba Vi District, as of October 2013, 260 farmers had taken out livestock insurance, 54 in Van Hoa and
167 60 in Yen Bai. We surveyed 97 farmers chosen randomly from the farmers' registration book, 38 of
168 whom were insured and 59 uninsured. Of the 38 insured farmers, 22 were in Van Hoa and 16 in Yen
169 Bai. Of the 59 uninsured farmers, 26 were in Van Hoa and 33 in Yen Bai. Of the 97 farmers surveyed,
170 48 were in Van Hoa and 49 in Yen Bai.

171 The research was carried out with a questionnaire covering several topics: details of the farm
172 environment such as the number of dairy cows reared by the farmer, milk volume, occurrence of
173 disease, and welfare management; details on the household's composition such as age, duration of
174 education, and scale of the family labor force; risk avoidance; and the situation regarding insurance.
175 To provide an overview of the surveyed farmers' details, the average age of the main farmer was 47.2
176 years in Van Hoa and 43.0 years in Yen Bai; the average household size was 4.3 people in Van Hoa

Comment [A17]: This seems a bit odd as the measure was given in tons earlier in the paper and tons is not a measure of volume.

177 4.1 people in Yen Bai; and the average education level of the main farmer was 3.2 in Van Hoa and 3.3
178 Yen Bai.⁶ Thus, there was no significant difference between the two villages. The average number of
179 dairy cows was 4.8 in Van Hoa and 5.5 in Yen Bai, with both villages having small-scale farmers with
180 around five cows. The average number of dairy-cow calvings was 3.0 in Yen Bai and 2.6 in Van Hoa,
181 reflecting a slightly older herd age. Productivity was a little higher in Yen Bai, with daily milk production
182 volume per cow of 20.3 liters, compared to 18.5 liters in Van Hoa. Although milk production in the two
183 villages is at a low level when compared to the average milk production (around 27 liters per cow per
184 day) at a large advanced dairy farm (15,000 cows) run by TH true Milk in Nghe An Province, their milk
185 production represents an average for Vietnam's small-scale dairy farmers with a small number of
186

187 4.2 Methods of analysis

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

190 In analyzing the factors affecting decision-making concerning insurance, we consider the impact of the
191 farmer's appetite for risk on insurance participation. Hence, it becomes necessary to investigate the
192 endogeneity of appetite for risk, estimated using the IV method (Rivers and Vuong, 1998; Sannaband
193 Saito, 2007). Following Miwa and Fukui (2014), we present the model below. In the first stage (Equation
194 2), we estimate the degree of risk avoidance (Risk) and the rate of time discounting (Time) with OLS.

195 Next, using the residual obtained from that estimation, in stage 2 (Equation 1), we

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investigate endogeneity using the probit model. Following existing research, we employ 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.

Comment [A21]: investigated

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

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

Table 1. Definition of variables for IV and Probit method

Variables	Definition	All sample		VanHoa		YenBai	
Cow	Total number of cattle	5.15	(1.89)	4.84	(1.89)	5.49	(1.84)
	Ratio (%) of disease						
Disease	prevalence to total cattle	0.17	(0.20)	0.16	(0.19)	0.18	(0.21)
	Average parity number of						
Parity	dairy cattle per farm	2.84	(1.46)	2.62	(0.99)	3.04	(1.82)

Comment [A23]: remove space gaps between stats for each column that are outside of brackets and those inside brackets. For example, this should be 5.49 (1.84).

<i>Labour</i>	Number of family labor	2.54	(1.03)	2.50	(1.09)	2.57	(0.98)
<i>Age</i>	Age of head farmer	45.07	(9.91)	47.22	(10.28)	42.96	(9.15)
	Number of Non-agri. worker						
<i>Non-agri</i>	in family member	0.35	(0.58)	0.49	(0.65)	0.27	(0.46)
<i>Knowledge</i>	Knowledge of animal disease	1.31	(1.15)	1.40	(1.27)	1.22	(1.03)
<i>Time</i>	Time preference	0.21	(0.40)	0.26	(0.43)	0.17	(0.37)
<i>Risk</i>	Risk preference	2.57	(2.06)	2.67	(2.13)	2.47	(2.01)
<i>Trust</i>	Number of trustworthy person	30.28	(48.98)	41.43	(59.12)	18.56	(33.05)
	Village dummy (VanHoa=1,						
<i>Village</i>	YenBai=0)	-	-	1.00	-	0.00	-

Comment [A24]: persons

212 Note: Figure is average and standard deviation in parenthesis

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

215 Equation (2) expresses time and risk preference. The rate of time discounting, *Time*, which is an
216 indicator of time preference, was obtained based on answers to the following question (Kirby et al.,
217 2002) in the questionnaire: "If you won VND 500,000 on the lottery, but were offered VND 1 million
218 instead if you waited a number of years, how many years would you wait?" If the time they are willing to
219 wait is longer, the rate of time discounting is lower; as the number of days decreases, the rate of time
220 discounting rises.⁹ Phomtavong and Fukui (2014) demonstrated that, if the rate of time discounting is
221 low, there is a high tendency to adopt new technology, and it is conceivable that, in Equation (1),
222 farmers with a low rate of time discounting will take out livestock insurance and the expected sign is
223 positive.

224 Following Gine et al. (2008), *Risk* indicates the degree of risk avoidance. The degree of risk
225 avoidance reflects the farmer's selection of one of six combinations of sums of money received for

226 “heads” and for “tails” in an imagined coin-tossing game.¹⁰

227 In Equation (1), if a farmer is more risk-averse, the likelihood of the farmer opting for insurance increases.

228 The expected sign is, hence, negative. All calculations were performed using STATA (STATA CORPS).

229 People usually do not provide honest answers to sensitive questions (for example, questions about the

230 use of hard drugs such as heroin or questions regarding sexual preferences). However, the ICT method

231 allows for an indirect estimate of the proportion of people engaging in behavior that is not reflected

232 in people's answers. In the ICT method, the surveyed farmers who have, and have not, taken out

233 insurance were divided into subsample A and subsample B, as shown in Table 2. Each subsample was

234 asked to say whether four basic statements concerning various dairy production practices, known as

235 the baseline list, apply to them.¹¹ For subsample B, the sensitive statement (SS) “I have, on occasion,

236 not sought treatment from a veterinarian even though a cow has shown signs of Pasteurella infection”

237 is added to the baseline list, making a total of five statements. The farmers being interviewed are not

238 asked to directly indicate which statements apply to them, but to use only the numbers assigned to the

239 statements to answer indirectly. $\bar{X}_{4A}$ is the average answer number for the baseline list, and $\bar{X}_{5B}$ is the

240 average answer number for the baseline list + SS. The difference between the two is $\hat{P}_1$ (Equation 3).

241

242 **Table 2. ICT survey structure**

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

Comment [A25]: This very strong and central assertion needs a source to support it.

Comment [A26]: were

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

Comment [A29]: were

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

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

255 5. RESULTS AND DISCUSSION

256 5.1 The occurrence of livestock disease and the use of insurance

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

Comment [A30]: each of

262 digestive system also occurred.

263

264 **Table 3. Disease prevalence in sample farmers**

	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

Comment [A31]: Be consistent about where you locate table and figure titles...some are above, some are below.

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

266 Figure in parenthesis are number farms that could obtain insurance payment because the animal
267 was died after the occurrence of a disease covered by insurance.

Comment [A32]: who

268

269 Only two farmers (for three cows) were able to obtain an insurance payout after the occurrence of a
270 disease covered by insurance; hence, the number of cows for which a payout could be obtained was
271 extremely low when compared to the 13 cows suffering from the insured diseases. This is because,
272 even when there is an incidence of an insured disease, there is no payout unless the animal dies. If the
273 animal recovers following treatment (and does not die), it is not covered by the insurance.

274

275 5.2 Analysis of factors involved in the purchase of livestock insurance

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

281 A Wald test of the exogeneity of the discount rate is significantat the 1% (for the null hypothesis of the
282 discount rate (Time) being an exogenous variable). We reject the null hypothesis. Hence, we may view
283 the discount rate as an endogenous variable and demonstrate the validity of the estimation using the
284 IV method.

Comment [A33]: Try to simplify the wording here so it's more accessible to readers.

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

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

294 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 Phomtavong and 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 hazard, that is, farmers taking out insurance and then failing to 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 have a significant impact on the taking-out of livestock insurance.

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Comment [A35]: reword....may lead to farmers who take out insurance and then fail to...

Comment [A36]: significant impacts

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 **
Exogeneity 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.

Exogeneity test indicate the result of "Wald test of exogeneity $\chi^2(1)$ ".

5.3 ICT

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), 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.

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.

Comment [A37]: Use full words for titles.

Comment [A38]: while 12.88%

Comment [A39]: moral hazard tendencies???

325 However, there is no statistical difference between the insured and the uninsured farmers with regard
 326 to indirect acknowledgement. This implies that there is no particular tendency for moral hazard among
 327 insured farmers. This is consistent with the results obtained using the IV method. The results differ
 328 from the findings of Miwa and Fukui (2014), who find insured farmers frequently engaging in behavior
 329 pertaining to moral hazard.

330 **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 who not join insurance (n=59)	14.22	1.69	0.011**

Comment [A40]: who do not

331

332 5.4 Discussion

333 With respect to time preference and the taking-out of livestock insurance, it is possible to interpret the
 334 findings as the higher a farmer's rate of time discounting (that is, the more impatient the farmer), the
 335 less likely he/she is to respond to a future earnings opportunity that may arise under the new system.

Comment [A41]: unclear if you're talking about the insurance "new system".

336 Conversely, it is conceivable that farmers with a low rate of time discounting are able to consider the
 337 dairy business from a long-term perspective and, hence, respond to the new system positively. These
 338 findings are similar to those of Phomtavong and Fukui (2014).

339 However, there was a tendency for farmers to have a lower rate of time discounting and be more likely
 340 to adopt the new system (livestock insurance), if there were less trustworthy people around them. Why

341 is the rate of time discounting high when there are many trustworthy people around? Taking into
342 account the number of cattle owned, as a variable showing ownership of assets by people who were
343 surrounded by many trustworthy people (at least 100), farmers able to trust at least 100 people owned,
344 on average, 5.26 cows. Farmers able to trust fewer than 100 people owned, on average, 4.73 cows.

345 Thus, the more people farmers are able to trust, the more cows they own (though the difference is not
346 statistically significant). In addition, the correlation between a farmer's earnings opportunities off the

Comment [A42]: If it's not significant, isn't this then a false claim?

347 farm and he or she being able to trust at least 100 people is 0.32, whereas that between a farmer's
348 earnings opportunities off the farm and he or she being able to trust fewer than 100 people is 0.009,
349 which is a difference of statistical significance.

350 In other words, because farmers able to trust a small number of people are relatively poor, as shown
351 by Tanaka, Colin and Nguyen (2010), the rate of time discounting among people with low incomes
352 tends to be high (and, conversely, the rate tends to be low among people with high incomes). The
353 findings thus suggest that farmers take out insurance because there are few acquaintances to turn to
354 in hard times, such as when natural disasters occur. Conversely, it is conceivable that farmers able to
355 trust a large number of people have many acquaintances to turn to in times of trouble and have little
356 need to take out insurance. Further research is needed to examine the relationship between the
357 number of people farmers are able to trust and their rate of time discounting.

358 The analysis of results also reveals a low level of existence of adverse selection and moral hazard with
359 respect to livestock insurance in the surveyed areas. It is conceivable that the fact that farmers

360 suffering high incidence of livestock disease are unlikely to engage in adverse selection and take out
361 insurance is attributable to the proper cooperation between Boa Vet, the company implementing
362 livestock insurance in Vietnam, and the local administrative bodies (local government veterinarian and
363 ministry committees). This allows the insurance company to obtain information about the farmers and
364 eliminate the problems associated with information asymmetry. Tackling the problem of asymmetric
365 information by making full use of regional institutions with a great deal of information about the villages,
366 resembles the set-up at micro-credit providers operating in Bangladesh and elsewhere
367 (Armendariz and Morduch, 2007).

Comment [A43]: Confusing because you have two verbs here

368 The fact that insurance coverage is limited to fatal outbreaks of three diseases could also be seen as
369 working against behavior originating from moral hazard. We explain this point using Figure 1. Where
370 the insured diseases are limited (numerous), even if a farmer anticipating that $R > I$ engages in moral
371 hazard, the probability $(1 - \beta)$ of being able to sell the animal and obtain R without being discovered by
372 the authorities rises. As a result, the farmers' expected utility EU_{ML} is likely to grow. However, when the
373 insurance coverage is limited, even if we assume that a farmer who expects $R > I$ engages in moral
374 hazard, as mentioned earlier, there is an insurance payout for only three diseases and the probability
375 $(1 - \alpha)$ of being able to sell the animal without being discovered by the authorities is likely to be lower.
376 In other words, limiting the diseases covered reduces expected utility and, as shown by the results of
377 our ICT analysis, we expect that the possibility of moral hazard among farmers is also reduced.
378 In Vietnam's system of livestock insurance, the poorest farmers receive a 100% subsidy of their

Comment [A44]: &

Comment [A45]: add another sentence to explain this in a more straight forward way.

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

385 6. CONCLUSIONS

386 In this paper, we have studied the factors behind the decision to take out insurance, from the viewpoint
387 of moral hazard or adverse selection.

388 The analysis reveals a low level of existence of adverse selection and moral hazard with respect to
389 livestock insurance in the surveyed areas. It is conceivable that the fact that farmers suffering high
390 incidence of livestock disease are unlikely to engage in adverse selection and take out insurance is
391 attributable to the proper cooperation between the company implementing livestock insurance in
392 Vietnam and the local administrative bodies. This allows the insurance company to obtain information
393 about the farmers and eliminate the problems associated with information asymmetry.

394 Further the results show that the higher a farmer's rate of time discounting, the less likely farmers to
395 take out livestock insurance; the lower a farmer's rate of time discounting the more likely farmers to
396 take out livestock insurance. It is possible to interpret the findings as the higher a farmer's rate of time
397 discounting (that is, the more impatient the farmer), the less likely farmers to respond to a future

Comment [A46]: likely the farmer

Comment [A47]: likely the farmer

Comment [A48]: likely the farmer

398 earnings opportunity that may arise under the new system. Conversely, it is conceivable that farmers
399 with a low rate of time discounting are able to consider the dairy business from a long-term perspective
400 and, hence, respond to the new system positively.

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

409

410 **ENDNOTES**

411 ¹GlobalAgRisk (2009) produced a report explaining agricultural insurance in Vietnam. However, it
412 focuses on the basic insurance mechanism and contains no analysis of the behavior of farmers
413 choosing agricultural insurance.

414 ²These comments on agricultural insurance are based on the results from field research and studies
415 by Kada (2014).

416 ³Agricultural insurance in Vietnam has also attracted attention as a public-private risk-management

Comment [A49]: utility of insurance claims???

417 system (ENESA-CEIGRAM-Agroseguro, 2015).

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

419 ⁵In our survey, there were farmers who did not receive a payout for an animal that died from an
420 uninsured disease and farmers that were dissatisfied by the fact that the payout was lower than the
421 contracted sum. The assumption $R > I$ is, thus, rather realistic.

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

425 ⁷Average milk production volume in NgheAn province was taken from the JICA page below (accessed
426 Aug 31, 2015).

427 <http://www.jica.go.jp/project/Vietnam/0601775/news/news/20100922.html>

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

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

435 ¹⁰The following six combinations are listed in the questionnaire. 1) Heads: VND 100,000; Tails VND

436 100,000. 2) Heads: VND 80,000; Tails VND 200,000. 3) Heads: VND 60,000; Tails VND 260,000. 4)
437 Heads: VND 40,000; Tails VND 320,000. 5) Heads: VND 20,000; Tails VND 380,000. 6) Heads: VND
438 0; Tails VND 400,000. Farmers who select option 1 are considered to have a strong tendency to avoid
439 risk, and those who select option 6 have a strong tendency to seek risk.

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

443 ¹²For details, see Randrianantoandro et al. (2015).

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493

494 **ABBREVIATION**

495 ASF: African swine fever;

496 FAO: Food and Agricultural Organization;

497 FMD: foot and mouth disease;

498 ICT: Item count technique;

499 IV: Instrumental variable;

500 MARD: Ministry of Agriculture and Rural Development;

501 OLS: Ordinary Least Square;

502 SS: Sensitive statement;

503 VND: Vietnamese Dong;