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Consumption Insurance against Unforeseen Epidemics: The Case of Avian Influenza in Vietnam*

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Abstract

We examine how households protected their livelihood against an unexpected negative shock caused by the highly pathogenic avian influenza (HPAI). We also compare HPAI with other shocks such as sickness, ceremonial events, typhoons, floods, droughts, and unemployment. We apply the augmented testing framework of the canonical consumption risk-sharing hypothesis developed by Fafchamps and Lund (2003) to our unique household panel data that was collected in two Vietnamese villages exclusively for this study. While we reject the full consumption risk-sharing hypothesis strongly, our empirical results reveal that informal credit transactions played an important role for those affected by HPAI in coping with the unforeseen negative asset shock that it created. Moreover, our result suggests that the informal and/or formal insurance network against an unforeseen event has been strengthened after awhile.

Keywords: Avian Influenza; Consumption Insurance; Risk Coping; Poverty

JEL Classification Numbers: D12, O12

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1. Introduction

Since Highly Pathogenic Avian Influenza (hereafter, HPAI) was first identified in Vietnam in 2003, it has become endemic to the country (WHO, 2006). Especially during the period from December 2003 to January 2004, the disease spread to 57 of Vietnam's 64 provinces, where it prompted the culling of 44 million birds (Samman, Son, and Trung, 2006). These losses amounted to about 1.8% of Vietnam's GDP in 2004 (MARD and MOH, 2006).[1] Since poultry is an important source of income and nutrition for small farmers in rural areas, HPAI is likely to affect the poor disproportionately (Dawkins, 2005; World Bank, 2005). While there are plenty of existing veterinary or epidemiological studies on HPAI, there has been no quantitative study on the impact of HPAI on people's livelihood. The lack of appropriate data constrained such an analysis. In order to bridge this gap in the existing literature, we employ a unique dataset that was collected in Vietnam exclusively for this study and investigate how households protected their livelihoods against an unexpected negative shock caused by HPAI.

In micro-development economics, there has been remarkable progress in the theoretical and empirical literature on risk and household behavior (Fafchamps, 2003; Dercon ed., 2005). While the social impacts of man-made disasters, such as financial crises, have been examined widely (Frankenberg, et al., 2003; Friedman and Levinsohn, 2002; Ravallion and Lokshin, 2005; Kang and Sawada, 2008, 2009; McKenzie, 2003, 2004, 2006), shocks generated by natural disasters have rarely been investigated or utilized, mainly due to data constraints (Skoufias, 2003; Sawada, 2007; Ichimura, Sawada, and Shimizutani, 2007; Sawada and Shimizutani, 2008, Yang, 2008; Shoji, 2009). As an unexpected, exogenous event, HPAI provides an unusual, clean experimental situation under which we are able to investigate the functioning of markets and the way in which households respond to exogenous shocks. In other

[1] There has been a concern that the virus appears to be mutating in a way that facilitates its transmission. As such, in addition to its direct impact on the poultry sector, HPAI poses an increasing threat to human health. The highest number of human deaths was recorded in Vietnam until the middle of 2006.

words, we exploited this event, which households are unable to influence, as an exogenous instrumental variable to identify the effectiveness of formal and informal insurance on households' livelihood. Such an economic study on HPAI is important in order to uncover human behavior against epidemics and to develop effective insurance policies, because most of the existing studies on HPAI have been conducted from an epidemiological perspective.

In this paper, we use unique data collected exclusively for this project to investigate two issues on the impact of HPAI: first, we compare consumption smoothing patterns between the affected and the non-affected families using the framework of full consumption risk sharing (Cochrane, 1991; Mace, 1991; Townsend, 1994); and second, we investigate household risk-coping behavior against the shocks generated by HPAI and other events.

As an unexpected, exogenous event, HPAI provides an unusual & clean experimental situation under which we can test the complete consumption insurance hypothesis. We apply the canonical empirical strategy of consumption risk sharing following Cochrane (1991), Mace (1991), Townsend (1994), Altonji et al (1997), Ogaki and Zang (2001), and Ligon (2008) to our unique data on HPAI in Vietnam. These existing studies typically use income changes as their shock variables. However those variables are not necessarily exogenous to a household, resulting in possible estimation biases arising from endogeneity, measurement error, and/or private information problems (Cochrane, 1991; Mace, 1991; Ravallion and Chaudhuri, 1997; Dubois, Jullien, and Magnac, 2008). Our findings are less susceptible to econometric problems since we tested consumption reaction to direct shocks caused by an unexpected, large, and verifiable event that cannot be affected by households.

The rest of this paper is organized as follows: Section 2 presents the theoretical and empirical framework for our analysis; Section 3 contains data and descriptive statistics, which is followed by empirical results in Section 4. The final section summarizes concluding remarks.

2. The Model

We follow Cochrane (1991), Mace (1991), Ligon (2001), and Townsend (1994) to formulate a canonical model of full consumption insurance in a pure exchange economy without storage. We consider an insurance network economy composed of N infinitely-lived households, each facing serially independent income draws. The Pareto-optimal consumption allocation problem of a hypothetical social planner becomes the Negishi-weighted utility maximization subject to the economy's goods market equilibrium condition. The optimal condition implies that under full insurance, idiosyncratic household income changes should be absorbed by all other members in the same insurance network, and those shocks should not affect changes in consumption so that the expected value of weighted marginal utility is equalized across households.

We postulate several further assumptions. First, we assume that durable and non-durable consumption goods are additive and separable. Second, we suppose that all households can observe uncertainty realizations exactly. In other words, there is no private information and thus information structure is symmetric. This assumption may not be as bad as it looks because the damages due to HPAI are largely observable in the insurance network. Third, we impose a technical assumption that the contingent securities span the state space and thus markets are complete. Finally, we assume that the probability distribution of state realization and subjective discount rate are identical across households, i.e., households have identical beliefs and preferences about the future. Under these assumptions, the Pareto efficient allocation should satisfy that $\lambda^i \partial u / \partial c_{it} = \lambda^j \partial u / \partial c_{jt}$ for all states where λ is the Negishi-weight of a social welfare function, u (•) is the concave instantaneous utility of a household, c is the household's non-durable consumption, and i and j denote i-th and j-th households, respectively.

We postulate the CARA utility, i.e., $u(c, c^d)$=-$(1/\sigma)exp[-\sigma(c)]$ -$(1/\sigma^d)exp[-\sigma^d(c^d)]$, where c^d is durable consumption. Then, we have

$$c_{it} = \frac{1}{N}\sum_{j=1}^{N} c_{jt} + \frac{1}{\sigma}\left(\ln\lambda^{i} - \frac{1}{N}\sum_{j=1}^{N} \ln\lambda^{j}\right). \tag{1}$$

This equation (1) shows that the change in consumption should be constant across households, since individual idiosyncratic income risk can be completely absorbed by the rest of the population under the full risk-sharing regime (Cochrane, 1991; Mace, 1991; and Townsend, 1994).

Households can protect their consumption from income shortfalls caused by HPAI and other hazards and unexpected events using a wide variety of risk-coping strategies, which are defined as *ex post* strategies, to reduce consumption fluctuations provided income fluctuations are due to these *ex-post* risks (Alderman and Paxson, 1992; Fafchamps, 2003). In general, the existing literature identified the following different ways of employing risk-coping mechanisms through self-insurance and/or mutual-insurance schemes.

Here we present five different risk-coping methods. First, households can reduce luxury or unnecessary consumption expenditure while maintaining a necessary consumption level, such as a minimum calorie or nutrition intake. Second, households can use credit to smooth consumption by reallocating future resources to today's consumption. Third, households can accumulate financial and physical assets as a precautionary device against unexpected income shortfalls. Fourth, additional adult or child labor incomes through labor market participation are often used as a risk-coping device. In other words, returns to human capital can be used as a risk-coping device. Finally, receiving emergency private and/or public transfers is a form of risk coping.

In order to incorporate these risk-coping strategies into our empirical framework, we consider the following intertemporal budget constraints of households:

$$c_{it} + c_{it}^{d} = y_{it} + p_{it}^{r} + b_{it} + p_{it}^{b} + \Delta w_{it} - \Delta d_{it} + F_{it}, \tag{2}$$

where p^r represents private transfers from relatives and friends, b is borrowing from formal and informal sources including microfinance programs, p^b represents public transfers, Δw is net dis-saving, Δd is the amount of livestock damages caused by HPAI, and F is a residual component that includes family labor income and self-production. We follow Fafchamps and Lund (2003) to combine Equations (3) and (4) to obtain:

$$(3) \quad p_{it}^r + b_{it} + p_t^b + \Delta w_{it} = -y_{it} + c_{it}^d + \Delta d_{it} - F_{it} + \frac{1}{N}\sum_{j=1}^{N} c_{jt} + (1/\sigma)\left(\ln \lambda^i - \frac{1}{N}\sum_{j=1}^{N} \ln \lambda^j \right).$$

This equation (3) indicates that households can utilize private and public transfers, borrowings, and dis-saving as risk coping strategies against livestock damages caused by HPAI, Δd.

Two Econometric Specifications

There are two sets of econometric analyses implemented in our paper. First, we test the complete consumption insurance hypothesis by employing the empirical strategy of Cochrane (1991) and Mace (1991). It should be noted that our empirical analysis does not limit us from testing the existence of formal insurance markets. Instead, we examine the validity of a wide variety of formal and informal insurance mechanisms, such as borrowing and receiving private and/or public transfers against an earthquake [Mace (1991)]. From equation (3), we have the following estimable equation:

$$(4) \qquad c_{it}^n = \alpha_0 + \alpha_1 (y_{it} - c_{it}^d) + \alpha_2 \Delta d_{it} + \alpha_v + \alpha_i + \varepsilon_{it},$$

where c^n is the money inflow represented by the left-hand side of equation (3), α_v is a village dummy variable, α_i represents household fixed effects, and ε_{it} is a well-behaved error term. We assume that the unobserved component, F, in equation (3) is captured by household fixed effects and the error term.

By comparing Equation (3) with Equation (4), it should be clear that the null hypothesis of full risk-sharing is represented by the condition that α_1= -1 and α_2= 1. The null hypothesis that α_1= -1 is also considered to be a necessary condition. The intuition behind these restrictions should be clear. In order to smooth consumption against a decrease in income, y-c^d, or an increase in the degree of livestock damage, Δd, the exact same amount should be generated by risk-coping mechanisms represented by the money inflow, c^n, in Equation (4). If coefficients α_1 and α_2 are not statistically significant or of the right magnitude, it implies that the risk-sharing mechanisms do not function effectively.

A major concern with estimating Equation (4) is in a possible correlation between the income variable, y-c^d, and error term, ε, because income and durable consumption may be a part of risk-coping strategies. Presumably, health shocks, funerals and other ceremonial events, unexpected loss of livestock, and HPAI infection variables are all exogenous, and thus can be employed as instrumental variables.

As to the second econometric framework, we follow Fafchamps and Lund (2003) and investigate possible factors that inhibit consumption insurance by comparing the effectiveness of different risk-coping strategies, i.e., dis-saving as well as borrowing and receiving private and/or public transfers. Treating the second term on the right-hand side of Equation (4), y-c^d, as an endogenous variable and using instrumental variables, we postulate the following reduced-form equation:

$$(5) \qquad p_t^r + b_t + p_t^b + \Delta w_{it} = \alpha_0^r + D_{it}\beta^r + \alpha_v^r + \varepsilon_i^r + \varepsilon_{it}^r,$$

where D is a matrix of instrumental variables such as health shocks, funerals and other ceremonial events, unexpected loss of livestock, and HPAI infection variables. Finally, we follow Fafchamps and Lund (2003) to estimate Equation (5) for each component of the left-hand-side variables.

3. Data and Descriptive Statistics

We collected a unique dataset exclusively for our analysis in the Muonglai commune of Luc Yen District of Yen Bai province with a help of an NGO, Save the Children Japan (SCJ). The commune is located in a mountainous area about 183 kilometers from Hanoi (Figure 1). According to the Vietnam Health and Living Standard Survey (VHLSS) 2004, the total number of natural disasters and the average number of animal epidemics per community, including HPAI, are comparable to the rest of the nation (Table 1).

The details of the data collection procedure in the Muonglai commune of Yen Bai province are described in Nose (2007). Fortunately, we can employ a baseline dataset collected by Gamada (2004) for the period between October 2003 and September 2004. Nose (2007) conducted a survey of the same households interviewed by Gamanda (2004). The incidence of poverty in this area was 46% in 2006, which is significantly higher than the national average of 24% (JBIC, 2006). Hence, the sampled households were drawn from one of the poorest communities in Vietnam. In the baseline survey, Gamada (2004) selected two villages randomly from 20 villages in the Muonglai commune. In these villages, complete enumeration of all the households was attempted. The final sample size was composed of 136 households, which covers 79.5% of all households in the two villages. Nose (2006) conducted a follow-up survey with the same respondents in September 2006. Since Nose (2006) includes a retrospective module for the year 2005, we obtained a balanced panel dataset of 136 households that covers three years: the first round for October 2003 – September 2004; the second round for October 2004 –September 2005; and, finally, October 2005 – September 2006.

Table 2 shows descriptive statistics for the first round of the survey. The average age of respondents was 41 years and the average household size was 4.25 persons. As to the level of educational attainments, the majority of respondents were middle school graduates or lower: the proportion of those who completed middle school but not high school was 72.8%. As a poverty index, the proportion of official poverty card holders was 16.2% until the second round. This proportion increased to 29.0% in the third round, possibly because the government changed the eligibility criteria for the poverty card. The rate of land usufruct rights ownership was approximately 94 percent.

Table 3 shows the distribution of ownership of different livestock, i.e., water buffalo, mother pig, hog, chicken and duck, during the first round of the survey. A majority of households own water buffaloes, pigs, chickens and/or ducks. Such a livestock portfolio is consistent with the pattern commonly found in Vietnam (Jonsen, 2002). More than 90 percent of households engage in chicken farming, indicating a prevalence of chicken farming in the area. While the average number of chickens has decreased since the HPAI incident occurred, still more than 90 percent of households continue to raise about 30 chickens on average. These chickens seem to be raised for own consumption purposes as well as for sale in the market.

Table 4 summarizes a variety of shocks affecting households. In the first year, October 2003- September 2004,19 households encountered the AI. There is a significant number of households that were subsequently affected by the AI again in the second and third rounds. Funerals and other ceremonial events can be regarded as negative shocks that cause sharp increases in expenditure. An average expenditure amounts to two million VND. Damage caused by typhoons, floods, and droughts can be found in these two villages. Typhoons and floods generate two types of shocks: negative income shocks and damage to land and other assets. The estimated damage to farmland and housing ranges from 0.5 million to 2 million VND. Sickness is a negative health shock that increases medical expenditure for necessary medication and treatments. The amount of such expenditure can be 2 million to 15 million VND.

In Vietnam, the first case of HPAI was discovered in December 2003. In our sample, there were 19, 16, and 11 incidents of HPAI in the first, second, and third rounds, respectively

(Table 5). Our data also reveals multiple damages. Table 5 shows estimated damages caused by HPAI that were computed as a product of the number of dead chickens and the unit market price. The damage amounted to around 20 percent of the total farm income.

Next, we asked questions about potential sources of household risk-coping behavior against these damages (Table 6). First, households extensively utilized credits from two public financial institutions - Vietnam Bank for Agriculture and Rural Development (VBARD) and Vietnam Bank for Social Policy (VBSP). The average loan size was about 6.3 million VND conditional on the land usufruct rights being used as collateral. Secondly, informal credits from relatives, friends, and neighbors were also used. Third, microfinance programs were introduced in 2003 by NGOs (Save the Children Japan in Vietnam, 2003; Save the Children Japan, 2004). In our sample, 36 households received loans of around 1.3 million VND, which were significantly smaller than loans from public sources. Fourth, casual labor participation was also used by around 40 percent of the households. Finally, cash or in-kind transfers from relatives and friends as well as governments were also important. The government has also been providing chicken immunization and land cleansing since 2004, but around 30 percent of the households in our sample that were affected by AI never received such benefits. Moreover, no household in our sample has ever received compensation for the loss of chickens, although ESARD (2004) indicates direct compensation for the AI victims.

In Table 7, we compare risk-coping strategies between HPAI-affected and non-affected households. The affected households are less likely to receive formal credit and informal transfers, and more likely to borrow from informal sources, to participate in casual labor, to sell livestock, to participate in microfinance programs, and to receive public transfers.

Is HPAI Shock Really Exogenous?

In our econometric framework, we have treated the damages caused by HPAI as exogenous. Yet, it is not necessarily warranted that the use of HPAI variables gives a clean experimental dataset. Indeed, Martin (2004) implied that the commune level HPAI infection is determined by factors such as farmland size, poverty ratio, farm production level, and number of hogs. In order to test the validity of the exogeneity assumption of HPAI, we utilize the household-level information on HPAI infections. Our test strategy is simple: we regress an HPAI shock variable on a variety of observable variables such as household, asset, and livestock variables. As for dependent variables, we employ three variables: (1) a dummy variable that takes the value of one when a household encounters HPAI; (2) the number of dead chickens due to HPAI; and (3) the value of losses caused by HPAI.

Table 8 shows the estimation results. Most coefficients are statistically insignificant. In fact, according to the joint test results, we cannot reject the null hypothesis that the coefficients are jointly zero. Admittedly, there are some statistically significant coefficients, such as the poverty card dummy and ownership of a color TV. In order to mitigate the possibility of estimation bias arising from these remaining effects, we included household-level variables and fixed effects in the risk-sharing tests and risk-coping equations. Hence, we believe that the exogeneity assumption of HPAI does not cause serious bias.

4. A Test of Full Consumption Risk-Sharing and the Determinants of Risk-Coping Strategies

Table 9 shows the estimation results of equation (4) using OLS, household fixed effects, and fixed effects IV methods. In all specifications from (1) to (6), the necessary condition of full consumption risk sharing, which is represented by the null hypothesis that α_1= -1, is rejected. Another joint hypothesis of full risk sharing is represented by the condition that α_1= -1 and α_2= 1. This joint hypothesis is also rejected, as we can see from specifications (2), (4), and (6). In sum, these estimation results suggest that the full consumption risk-sharing hypothesis does not hold.

It should be noted, however, the results are driven by the "unforeseen" nature of the damages caused by HPAI. Initially, HPAI was a totally unknown event to the households and thus it was natural to face it with a lack of formal or informal insurance mechanisms. Yet after a while, some insurance mechanism might have emerged. In order to examine such a possibility, we ran a IV-fixed effects model with only the sample of the second and third years. The result is shown in specification (7) of Table 9. Indeed the result indicates that the consumption risk-sharing hypothesis holds because the null hypothesis of α_1= -1 and α_2= 1 cannot be rejected statistically.[2]

Credit Market Accessibility

In order to explore the reasons behind the rejection of the full consumption risk-sharing hypothesis, we employed the direct information on credit constraints. Following Scott (2000), we carefully designed the questionnaire so that the credit constraints can be identified directly from the dataset. In identifying credit constraints, household heads were asked about experiences of borrowing from informal sources such as relatives, friends, and neighbors during the past twelve months. We defined two indicator variables of credit constraints that were weak and strict versions of indicators.

We first asked whether a household attempted to obtain a loan. Then, for those who tried to borrow money, we asked whether the household could borrow the total amount requested. If the answer was yes, we identified the household as being non-constrained. On the other hand, we identified those households whose loan requests were rejected or accepted on a partial-amount basis as being credit constrained. Second, for those who did not attempt to borrow, we asked the respondents about the reason for not availing themselves of the bank loans. Among the answer choices, those who selected "no need for credit" were considered as being unconstrained with regard to informal sources. This is the weak version of the credit constraint

[2] However, we should also note that the fitness of the first-stage regression is not necessarily sufficient. Hence, the result should be treated as suggestive, not conclusive.

indicator.

In the second criteria of the strict constraint indicator, we defined credit unconstrained households simply as those who answered that they could borrow as much as they requested. According to our data, among 408 observations from 136 households, 229 (350) cases were identified to be credit-constrained and 179 (58) to be unconstrained in the weak (strict) sense, indicating that a significant portion of households are credit-constrained.

We estimate the model of equation (4) for credit-constrained and unconstrained groups separately. We postulate an indicator function of credit constraints as $cc=1[Z\gamma>u]$, where Z is a vector of determinants of credit constraints. Assuming that credit constraint is endogenous, the model is reduced to a Type II Tobit model applied to each group separately. We estimate the model using Heckman's two step procedure with sample selection correction terms, $\varphi(Z\gamma)/\Phi(Z\gamma)$ and $\varphi(Z\gamma)/[1-\Phi(Z\gamma)]$ for the constrained and non-constrained groups, respectively, where $\varphi(\cdot)$ and $\Phi(\cdot)$ are the density and cumulative density functions, respectively, of the standard normal distribution.[3]

The estimation results are shown in Table 10. In the weak criteria of the credit constraint, the consumption risk-sharing hypotheses are rejected in the cases of both constrained and non-constrained groups. On the contrary, as can be seen from specifications (6) and (7) in Table 10, for the unconstrained group in the strict criteria of credit constraint, the two null hypotheses, H_0: $\alpha_1= -1$ and H_0: $\alpha_1= -1$ and $\alpha_2= 1$, cannot be rejected. These results indicate that the credit-unconstrained group effectively faces the full consumption insurance. In other words, these results suggest that violation of full consumption risk-sharing against HPAI may arise from credit market imperfections.

Risk-Coping Strategies

Even though overall consumption risk-sharing is not necessarily effective, to some

[3] We also corrected for the biases of variance-covariance matrices.

extent households are capable of adopting a wide variety of risk-coping devices against negative shocks created by HPAI. We then investigated the relative effectiveness of households' risk-coping mechanisms against different shocks. By doing so, we were able to identify the sources of incomplete risk sharing. Specifically, based on the reduced form of Equation (5) we applied the empirical model of Fafchamps and Lund (2003) to investigate how each household's risk-coping behavior responded against different negative shocks, such as health shocks, funerals and other ceremonial events, unexpected loss of livestock, and HPAI infection.

Table 11 represents the estimation results of each risk-coping equation. With respect to funeral and other ceremonial events, formal borrowings as well as private transfers were utilized significantly. Yet for the damages caused by HPAI, informal borrowings seemed to play an important role - sensitivity of the death of one chicken due to HPAI led to loan of 34,000 VND.[4] However, other risk-coping strategies were largely ineffective against a variety of negative shocks. This may be seen as being consistent with the finding of the overall lack of full consumption risk-sharing in the dataset.

5. Concluding Remarks

Our empirical results imply a serious lack of formal and informal insurance mechanisms for damages caused by a wide variety of shocks. These findings are not surprising if we consider the low level of insurance market development in Vietnam. Moreover, there is no formal insurance mechanism available for unexpected events, such as HPAI and other natural disasters. Without effective *ex ante* measures, the actual welfare losses caused by disasters as enormous as HPAI prove to be extremely large for the government to support effectively.

Our analysis contains two policy implications for preparing well-designed social safety nets against future natural disasters: first, when governments attempt to provide *ex post*

[4] We also estimate an econometric model with year-specific coefficients for the HPAI damage variable. The result, however, rejects the heterogeneous response of informal borrowings for the later years.

public support in the event of a natural disaster, they may create a moral hazard problem by encouraging people to expose themselves to greater risks than necessary. In this respect, we should also note that according to our results, the credit market imperfection is a possible source of violation of full consumption insurance. Hence, our empirical results suggest that providing victims with subsidized loans, rather than direct transfers, can be a good example of facilitating risk-coping behavior because such interventions are less likely to create serious moral hazard problems.

Second, it is imperative to design *ex ante* risk-management policies against disasters including HPAI (Nakata and Sawada, 2008). The development of markets for index-type HPAI insurance, for example, would lead to the efficient pricing of insurance premiums. This development would generate proper incentives to invest in *ex ante* risk mitigations which are known to be very cost effective. Policy issues such as these will be important research topics in the future. A large, nationally representative dataset should be employed to investigate these issues.

References

Altonji, J.G., F. Hayashi and L.J. Kotlikoff (1992), "Is the Extended Family Altruistically Linked? Direct Tests Using Micro Data," *American Economic Review*, Vol.82, No.5, pp.1177-1198.

Attanasio, O.P. and M. Székely (2004), "Wage Shocks and Consumption Variability in Mexico during the 1990s," *Journal of Development Economics*, Vol. 73, No. 1, pp. 1–25.

Cochrane, J.H. (1991), "A Simple Test of Consumption Insurance." *Journal of Political Economy*, Vol.99, No.5, pp.957-976.

Dawkins, Z. (2005), "Needs Assessment: Vietnam, Poultry Disease in Village Chickens, Final Report," KYEEMA Foundation., International Rural Poultry Centre, and Vietnam Women's Union. Hanoi.

Dercon, S. (2004), *Insurance Against Poverty*, Oxford University Press.

Dubois, Pierre, Bruno Jullien and Thierry Magnac (2008), "Formal and Informal Risk Sharing in LDCs: Theory and Empirical Evidence," *Econometrica* Vol.76, No.4, 679-725.

EASRD (2005), "Compensation and Related Financial Support Policy Strategy for Avian Influenza: Emergency Recovery and Rehabilitation of the Poultry Sector in Vietnam," World Bank East Asia and Pacific Region. Washington, D.C.

Fafchamps, M. (2003), *Rural Poverty Risk and Management*, Edward Elgar Publishing.

Fafchamps, M. and S. Lund (2003), "Risk-sharing and Endogenous Network in Rural Philippines," *Journal of Development Economics*, Vol.71, No.2, pp. 261-287.

Fallon, P.R. and E.B. Robert (2002), "The Impact of Financial Crises on Labor Market, Household Incomes, and Poverty: A Review of Evidence," *World Bank Research Observer*, Vol.17, No.1, pp.21–45.

FAO, VFS-CICDA, DAH (2005), "A Guide for Veterinary Paraprofessionals in Vietnam; Prevention and Control of Avian Flu in Small Scale Poultry," Food for Agriculture Organization (FAO), Agronomes & Veterinaires Sans Frontieres (VFS-CICDA), Department of Animal Health, Socialist Republic of Vietnam (DAH), Vietnam.

Frankenberg, Elizabeth, James P. Smith and Duncan Thomas (2003), "Economic Shocks, Wealth, and Welfare," *Journal of Human Resources,* 38 (2), 280-321.

Friedman Jed and James Levinsohn (2002), "The Distributional Impacts of Indonesia's Financial Crisis on Household Welfare: A "Rapid Response" Methodology," *World Bank Economic Review* 16 (3), 397-423.

Gamada, Ryohei (2005), "On the Economic Impact of Micro-credit in a poor area: The Case of a Village in Northern Vietnam [in Japanese]," unpublished Master's thesis submitted to

Department of Agricultural and Resource Economics, University of Tokyo.
Ichimura, H., Y. Sawada and S. Shimizutani (2006), "Risk Sharing Against An Earthquake: A Case of Village Yamakoshi," The Faculty of Economics at the University of Tokyo, mimeo.
JBIC (2006), "JBIC Provides FY2005 ODA Loan Package for Vietnam - Supporting Economic and Social Development through Improvements in Urban Environment, Education, and Medical Care, as well as through Economic Infrastructure Development," Japan Bank for International Cooperation (JBIC), Tokyo.
http://www.jbic.go.jp/autocontents/english/news/2006/000044/index.htm
Jonsen, L.U. (2002), "Intra Household Decision-making and Livestock Investment Patterns in Thanh Hoa Province, Vietnam." Master thesis, The Royal Veterinary and Agricultural University Department of Economics and Natural Resources Unit of Economics, Denmark.
Kang, Sung Jin and Yasuyuki Sawada (2009), "Did Public Transfers Crowd Out Private Transfers in Korea During the Financial Crisis?" *Journal of Development Studies* 45(2), 276-294.
Kang, Sung Jin and Yasuyuki Sawada (2008), "Credit Crunch and Household Welfare: The Korean Financial Crisis," *Japanese Economic Review* 59(4), 438-458.
Ligon, Ethan (2008), "Risk sharing," In *New Palgrave Dictionary of Economics*, Palgrave Macmillan, 2nd edition.
Mace, B. (1991), "Full Insurance in the Presence of Aggregate Uncertainly," *Journal of Political Economy*, Vol.99, No.5, pp.928-956.
MARD, MOH. (2006), "Vietnam; Integrated National Operational Program For Avian and Human Influenza (OPI) 2006-2010," Socialist Republic of Vietnam, Ministry of Agriculture and Rural Development (MARD), Ministry of Health (MOH), Vietnam.
Martin, V. (2005), "Epidemiology of Avian Influenza EMPRES Activities." Food for Agriculture Organization (FAO), Rome.
McKenzie, D.J. (2006), "The Consumer Response to the Mexican Peso Crisis," *Economic Development and Cultural Change*, Vol.55, No.1, pp.139-72.
——— (2004), "Aggregate Shocks and Urban Labor Market Responses: Evidence from Argentina's Financial Crisis," *Economic Development and Cultural Change*, Vol.52, No.4, pp.719-758.
——— (2003), "How Do Households Cope with Aggregate Shocks? Evidence from the Mexican Peso Crisis," *World Development*, Vol.31, No.7, pp.1179–99.

MOH, MARD. (2006), "Vietnam; Integrated National Plan for Avian Influenza Control and Human Pandemic Influenza Preparedness and Response," Socialist Republic of Vietnam, Ministry of Agriculture and Rural Development (MARD), Ministry of Health (MOH), Vietnam.

Nakata, H. and S. Sawada (2008), "Willingness to Pay for Insurance against Disasters: The Case of HPAI, Floods, Typhoons, and Droughts in Vietnam," in progress, Research Institute for Economy, Trade, and Industry (RIETI), Tokyo, Japan.

Nose, Sakuya (2007), "How Did Vietnamese Farmers Cope with Damages Caused by HPAI [in Japanese]?" unpublished MA thesis submitted to Faculty of Economics, the University of Tokyo.

Ogaki, M. and Q. Zhang (2001), "Decreasing Relative Risk Aversion and Tests of Risk Sharing," *Econometrica*, Vol.69, pp.515-526

Pfiffer, D. (2005), "Assistance in the Geospatial Analysis of HPAI Outbreaks in Vietnam," Country Mission OSRO/RAS/401/JPN report. United Kingdom

Ravallion, M. and S. Chaudhuri (1997), "Risk and Insurance in Village India: Comment," *Econometrica*, Vol.65, pp.171-184.

Ravallion, Martin and Michael Lokshin (2005), "Lasting Local Impacts of an Economywide Crisis," World Bank Policy Research Working Paper 3503.

Rosenweig, M. and K.I. Wolpin (1993), "Credit Market Constraints, Consumption Smoothing and the Accumulation of Durable Production Assets in Low-Income Countries," *Journal of Political Economy*, Vol.101, pp. 223-244.

Samman, Emma, Ton That Son, and Pham Quang Trung (2006), "The Impact of Avian Influenza on Poultry Sector Restructuring and its Socio-economic Effects," Agrifood Consulting International.

Save the Children Japan (2004), "Review report: Credit and savings project," Save the Children Japan

Save the Children Japan in Vietnam (2003), Research on Non-governmental Organisations' Microfinance Programmes in Vietnam, Save the Children Japan in Vietnam.

Sawada, Y. (2007), "The Impact of Natural and Man-made Disasters on Household Welfare," *Agricultural Economics* 37 (s1), 59-73.

Sawada, Y., and S. Shimizutani (2008), "How Do People Cope With Natural Disasters? Evidence from the Great Hanshin-Awaji Earthquake," *Journal of Money, Credit, and Banking* 40 (2-3), 463-488, 2008.

Sawada, Y. and S. Shimizutani (2007), "Consumption insurance and risk-coping strategies under non-separable utility: Evidence from the Kobe earthquake," CIRJE Discussion Paper Series F-512, Graduate School of Economics, the University of Tokyo.

Scott, K. (2000) "Credit," in M. Grosh and P. Glewwe (eds), Designing Household Survey Questionnaires for Developing Countries: Lessons from Ten Years of LSMS Experience, Washington, DC: World Bank .

Shoji, Masahiro (2009), "Does Contingent Repayment in Microfinance Help the Poor During Natural Disasters?" *Journal of Development Studies*, forthcoming

Skoufias, Emmanuel (2003), "Economic Crises and Natural Disasters: Coping Strategies and Policy Implications," World Development 31 (7), pp. 1087-1102.

Smith, J.P., D. Thomas, E. Frankenberg, K. Beegle and G. Teruel (2002), "Wages, Employment and Economic Shocks: Evidence from Indonesia," *Journal of Population Economics*, Vol.15, No.1, pp.161–93.

Strauss, J., K. Beegle, A. Dwiyanto, Y. Herawati, D. Pattinasarany, E. Satriawan, B. Sikoki, Sukamdi and F. Witoelar (2004), "Indonesian Living Standards before and after the Financial Crisis: Evidence from the Indonesia Family Life Survey," Rand Corporation and ISEAS.

The Centre for Research on the Epidemiology of Disasters (2008), The International Disaster Database.

Townsend, R.M. (1999), "Removing Financial Bottlenecks to Labor Productivity in Thailand," in W. C. Hunter, G. G. Kaufman, and T. H. Krueger, eds., *The Asian Fiancial Crisis: Origins, Implications, and Solutions*, Klewer Academic Publishers.

Townsend, R.M. (1994), "Risk and Insurance in Village India." *Econometrica*, Vol.62, pp.539-591.

Townsend, R.M. (1995), "Financial Systems in Northern Thai Villages," *Quarterly Journal of Economics*, Vol.110, pp.1011-1046.

World Bank (2006), World Development Indicator 2006. World Bank, Washington DC. http://devdata.worldbank.org/external/CPProfile.asp?CCODE=VNM&PTYPE=CP

WHO (2006), "Avian Influenza," http://www.who.int/csr/disease/avian_influenza/en/ World Health Organization (WHO).

Yang, Dean (2008), "Coping with Disaster: The Impact of Hurricanes on International Financial Flows, 1970-2002," *Advances in Economic Analysis & Policy* 8(1), 1903-1903.

Figure 1

Location of the Surveyed Villages

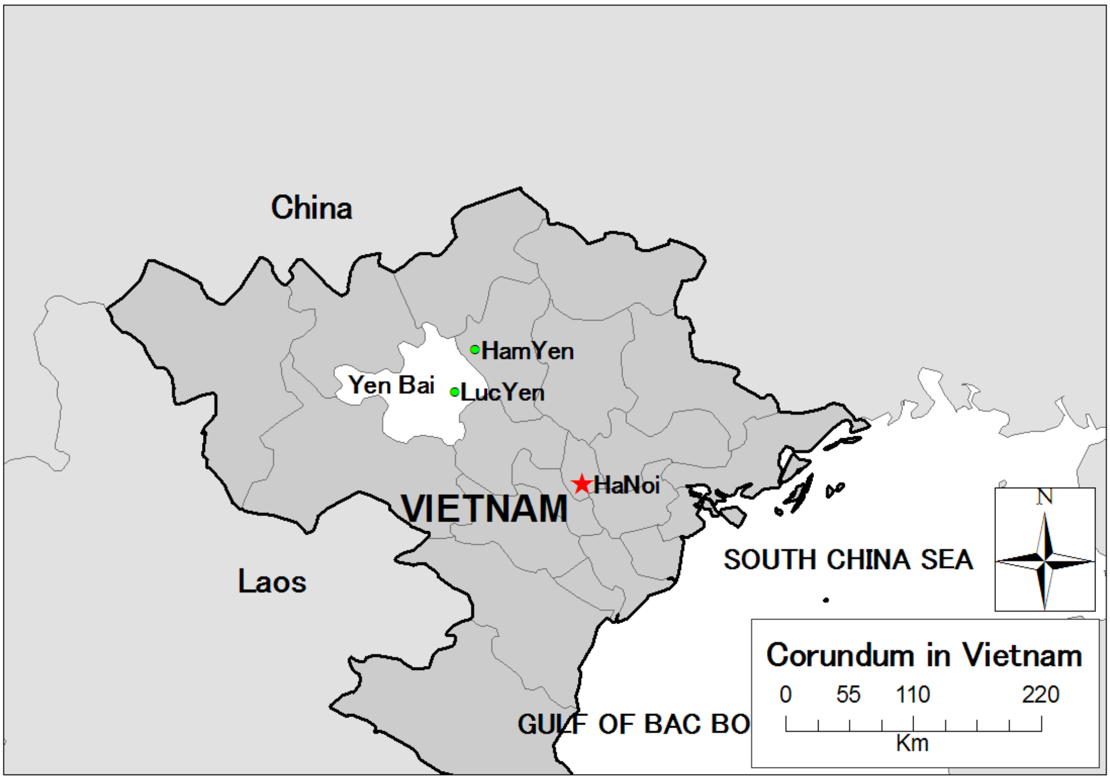

Table 1

Incidence of Natural Disasters in Vietnam by Province

(Computed by VHLSS 2004)

Province name	Average number of floods per community	Average number of typhoons per community	Average number of droughts per community	Average number of natural disasters per community (flood, typhoon, and drought)	Average number of animal epidemics per community
Ha Noi	0.091	0.000	0.136	0.227	0.909
Hai Phong	0.077	0.077	0.000	0.154	0.846
Vinh Phuc	0.455	0.227	0.091	0.773	0.773
Ha Tay	0.042	0.042	0.000	0.083	0.917
Bac Ninh	0.000	0.000	0.000	0.000	0.938
Hai Duong	0.273	0.030	0.000	0.303	0.939
Hung Yen	0.737	0.000	0.000	0.737	0.579
Ha Nam	0.000	0.063	0.000	0.063	0.875
Nam Dinh	0.658	0.158	0.026	0.842	0.605
Thai Binh	1.127	0.032	0.032	1.190	0.635
Ninh Binh	0.500	0.722	0.056	1.278	0.278
Ha Giang	0.429	0.524	0.238	1.190	0.762
Cao Bang	0.333	0.278	0.056	0.667	0.500
Lao Cai	0.111	0.333	0.000	0.444	0.333
Bac Can	0.294	0.235	0.059	0.588	0.235
Lang Son	0.263	0.316	0.368	0.947	0.579
Tuyen Quang	1.000	0.333	0.111	1.444	0.259
Yen Bai	0.524	0.190	0.095	0.810	0.619
Thai Nguyen	0.500	0.125	0.375	1.000	0.583
Phu Tho	0.333	0.667	0.111	1.111	0.333
Bac Giang	0.296	0.148	0.148	0.593	0.852
Quang Ninh	0.000	0.857	0.286	1.143	0.429
Lai Chau	0.458	0.250	0.250	0.958	0.583
Dien Bien	0.563	0.188	0.313	1.063	0.813
Son La	0.500	0.538	0.346	1.385	0.500
Hoa Binh	0.409	0.364	1.500	2.273	0.455
Thanh Hoa	0.310	0.379	0.241	0.931	0.552
Nghe An	0.533	0.111	0.378	1.022	0.444
Ha Tinh	0.536	0.071	0.429	1.036	0.357
Quang Binh	0.542	0.167	0.583	1.292	0.292
Quang Tri	0.211	0.263	0.526	1.000	0.789
Hue	0.333	0.111	0.111	0.556	0.778
Da Nang	0.000	0.167	0.167	0.333	0.833
Quang Nam	0.500	0.143	0.393	1.036	0.714
Quang Ngai	0.895	0.421	0.263	1.579	0.632
Binh Dinh	1.244	0.707	0.244	2.195	0.488
Phu Yen	0.636	0.545	0.227	1.409	0.409
Khanh Hoa	0.526	0.316	0.316	1.158	0.789
Kon Tum	0.643	0.357	1.571	2.571	0.786

Data) VHLSS 2004.

Table 1

Incidence of Natural Disasters in Vietnam by Province (continued)

(Computed by VHLSS 2004)

Province name	Average number of floods per community	Average number of typhoons per community	Average number of droughts per community	Average number of natural disasters per community (flood, typhoon, and drought)	Average number of animal epidemics per community
Gia Lai	0.385	0.308	0.654	1.346	0.538
Dac Lac	0.382	0.324	1.000	1.706	0.735
Dac Nong	0.000	0.083	0.625	0.708	0.333
Lam Dong	0.476	0.429	0.571	1.476	0.476
Ho Chi Minh city	0.000	0.231	0.154	0.385	0.923
Ninh Thuan	0.857	0.095	0.429	1.381	0.619
Binh Phuoc	0.286	0.619	0.476	1.381	0.524
Tay Ninh	0.120	0.240	0.000	0.360	0.800
Binh Duong	0.000	0.091	0.000	0.091	1.000
Dong Nai	0.294	0.471	0.147	0.912	0.647
Binh Thuan	0.583	0.167	0.417	1.167	0.583
Ba Ria - Vung Tau	0.000	0.238	0.000	0.238	0.952
Long An	0.231	0.051	0.103	0.385	0.974
Dong Thap	0.738	0.405	0.167	1.310	0.833
An Giang	0.727	0.295	0.023	1.045	0.682
Tien Giang	0.408	0.224	0.041	0.673	0.959
Vinh Long	0.139	0.222	0.028	0.389	0.972
Ben Tre	0.080	0.160	0.040	0.280	0.720
Kien Giang	0.500	0.750	0.000	1.250	0.583
Can Tho	0.500	0.500	0.000	1.000	0.778
Hau Giang	0.286	0.476	0.048	0.810	0.429
Tra Vinh	0.000	0.882	0.000	0.882	0.471
Soc Trang	0.138	0.276	0.069	0.483	0.862
Bac Lieu	0.000	0.348	0.000	0.348	0.826
Ca Mau	0.000	0.367	0.000	0.367	0.800
Average in Vietnam	**0.375**	**0.292**	**0.235**	**0.902**	**0.656**

Data) VHLSS 2004.

Table 2

Descriptive Statistics

	Average	Proportion
Age of the head (1st round)	41.2	
Number of members (1st round)	4.75	
	(Number)	
Head's final education level (1st round)		
Elementary	22	16.2%
Middle	99	72.8%
High	15	11.0%
Poverty card holders (1st and 2nd rd)	21	16.2%
Poverty card holders (3nd rd)	46	29.0%
Land usufruct right holder (1st rd)	127	93.4%
Land usufruct right holder (2st rd)	115	92.7%
Land usufruct right holder (3st rd)	116	93.5%

Table 3

Livestock Portfolio

(Based on the 1st round data)

	Average number of ownership	Variance	Min	Max
Water buffalo	1.31	1.76	0	20
Cow	0.29	1.83	0	25
Mother pig	0.50	0.96	0	11
Hog	3.19	4.42	0	45
Chicken for market	14.44	15.47	0	110
Chicken for eggs	5.62	6.07	0	50
Duck for market	6.37	11.33	0	100
Duck for eggs	1.13	5.74	0	100

Table 4

Number of Shocks Households Encountered

	1st round (Oct 2003-Sep 2004)	2nd round (Oct 2004-Sep 2005)	3rd round (Oct 2005-Sep 2006)	Additional expenditure neccesiated (in 1, 000 VND; subjective assessments)
HPAI	19	16	11	800-1,000
Drought	na	67	75	
Sickness (serious)	4	3	3	2,000
Sickness (less serious)	na	21	12	500-2,000
Typhoon	na	28	25	500-
Flood	na	5	5	500-2,000
Unemployment	na	4	1	
Funeral or ceremony	2	17	5	2,000-

Table 5

Incidence of HPAI

	1st round	2nd round	3rd round
First infection	19	7	1
Second infection	0	**9**	**2**
Third infection	0	0	**8**
Total infection	19	16	11
Average estimated damages (in 1,000VND)	1020.0	849.0	850.0

Table 6

Potential Risk Coping Strategies for Shocks

	Observations for three rd	Average amount (1,000VND)	Min	Max
Borrowing from formal sources (VBARD,VBSP)	66	6399.2	100	52000
Borrowing from informal sources	23	3404.8	260	39000
Borrowing from microfinance programs	51	1311.0	400	20000
Public transfers (exclusing HPAI related)	21	366.5	6	3000
Public transfers (HPAI related)	200	257.4	3	752
Private transfers	28	3494.9	-3500	20400
Income from daily casual work and crafting	170	5272.0	48	61200
Livestock income	34	5081.0	27	16300

Table 7

Risk Coping Strategies by HPAI damage

(B)		No Damage	Damage	Total
Informal loan	No	345	40	385
	Yes	17	6	23
	% Yes	4.9%	13.0%	6.0%
	Total	362	46	408

(G)		No Damage	Damage	Total
Casual labor or crafting	No	190	18	208
	Yes	172	28	200
	% Yes	47.5%	60.9%	49.0%
	Total	362	46	408

C		No Damage	Damage	Total
Micro-finance	No	318	39	357
	Yes	44	7	51
	% Yes	13.8%	17.9%	12.5%
	Total	362	46	408

(H)		No Damage	Damage	Total
Livestock sales	No	333	41	374
	Yes	29	5	34
	% Yes	8.0%	13.9%	8.3%
	Total	362	46	408

(D)		No Damage	Damage	Total
Private transfers	No	335	45	380
	Yes	27	1	28
	% Yes	8.1%	2.2%	6.9%
	Total	362	46	408

(I)		No Damage	Damage	Total
At least one of the above	No	140	4	144
	Yes	222	42	264
	% Yes	61.3%	91.3%	64.7%
	Total	362	46	408

(E)		No Damage	Damage	Total
Public transfers (non-	No	346	41	387
	Yes	16	5	21
	% Yes	4.4%	10.9%	5.1%

Note: Numbers in cells except percentages show numbers of observations. Percentages represent the proportion of those who adopted each risk coping for each HPAI damage status.

Table 8 Determinants of HPAI damages

	Dummy=1 if experienced HPAI	Number of died chickens due to HPAI	Value of loss due to HPAI
Age	-0.004	-0.146	-4.54
	(0.005)	(0.175)	(5.39)
Number of household members	0.034	0.921	28.971
	(0.018)*	(0.686)	(21.12)
Dummy=1 if poverty card holder	0.086	2.111	63.075
	(0.045)*	(1.699)	(52.336)
Dummy=1 if Land usufruct right holder	0.041	3.432	113.836
	(0.155)	(5.822)	(179.314)
Number of motorcycles	0.064	1.119	32.548
	(0.058)	(2.196)	(67.642)
Dummy=1 if own black and white TV	0.014	-2.828	-84.175
	(0.07)	(2.654)	(81.744)
Dummy=1 if own color TV	-0.07	-4.288	-131.325
	(0.057)	(2.151)**	(66.257)**
Dummy=1 if own radio	-0.07	0.362	8.619
	(0.111)	(4.197)	(129.285)
Dummy=1 if own tractor	-0.064	-0.0005	-3.036
	(0.285)	(10.719)	(330.177)
Dummy=1 if own refrigerator	0.098	-0.338	-17.966
	(0.211)	(7.931)	(244.287)
Dummy=1 if own phone	-0.022	4.03	119.403
	(0.151)	(5.67)	(174.648)
Dummy=1 if own fan	0.056	0.926	30.363
	(0.052)	(1.953)	(60.158)
Dummy=1 if own bicycle	-0.044	-0.422	-16.452
	(0.063)	(2.367)	(72.905)
Dummy=1 if own DVD	0.072	2.959	84.541
	(0.157)	(5.895)	(181.564)
Number of buffalos	-0.004	-0.378	-10.7
	(0.012)	(0.453)	(13.959)
Number of mother pigs	0.026	0.971	29.251
	(0.018)	(0.666)	(20.511)
Number of hogs	-0.003	-0.026	-0.812
	(0.004)	(0.135)	(4.148)
Number of chickens for market	-0.001	-0.072	-2.352
	(0.001)	(0.046)	(1.413)*
Number of chickens for eggs	0.0004	-0.097	-3.057
	(0.003)	(0.124)	(3.818)
Number of ducks for market	0.00008	0.002	0.002
	(0.001)	(0.055)	(1.687)
Number of ducks for eggs	0.0005	0.011	0.299
	(0.003)	(0.097)	(3.002)
Dummy=1 if 2nd round	0.001	-1.079	-30.227
	(0.033)	(1.24)	(38.18)
Dummy=1 if 3rd round	-0.067	-3.012	-82.05
	(0.034)*	(1.277)**	(39.336)**
Constant	0.051	5.042	147.533
	(0.092)	-3.472	-106.93
F statistics for the joint hypothesis of all zero coefficients [*p*-value]	0.87 [0.6420]	1.11 [0.3329]	1.04 [0.4110]
Number of observations	408	408	408
Number of households	136	136	136
R-squared	0.07	0.09	0.09

Note: Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 9 Test of Full Consumption Risk Sharing [Equation (4)]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Estimation Method	**OLS**	**OLS**	**Fixed Effects**	**Fixed Effects**	**FE-IV**	**FE-IV**	**FE-IV For 2^{nd} and 3^{rd} years only**
The joint F-statistics of the first stage regression [*p*-value]					2.18 [0.0009]	2.00 [0.0029]	0.95 [0.5280]
Income-durable expenditure+ (y-c^d) in 1,000 VND	-0.231 (0.081)**	-0.244 (0.081)**	-0.213 (0.093)**	-0.233 (0.092)**	0.561 (0.944)	0.358 (0.657)	-0.409 (0.827)
Dummy=1 if hit by HPAI	3,569.09 (1,542.006)*		2,493.66 (2,276.65)		6,632.86 (5,633.05)		
Damage amount by HPAI (Δd) in 1,000 VND]		2.234 (1.534)		0.381 (1.923)		2.207 (2.886)	-1.234 (3.777)
F Statistics for the joint hypothesis, α_1= -1 and α_2= 1 [*p*-value]		43.15 [0.0000]		35.83 [0.0000]		6.40 [0.0407]	1.11 [0.5752]
Observations	408	408	408	408	408	408	272
Number of households	136	136	136	136	136	136	136
R-squared	0.02	0.22	0.32	0.03	0.0070	0.0088	0.0375

Note: We estimate Equation (4) and the left-side variables are in 1,000 VND. Control variables whose results are not shown include age of the head, number of household members, dummy for poverty card holders, sex dummy of the head, education level of the head, working status of the head, and occupation dummy variables; Standard errors in parentheses. + represents endogenous variable and instrumental variables are severe and moderate illness dummies, ceremonial event dummy, unexpected loss of livestock for market dummy, unexpected loss of livestock for reproduction dummy, number of died chickens due to HPAI, missing dummies for severe and moderate illness, and year dummy variables. * significant at 10%; ** significant at 5%; and *** significant at 1%.

Table 10

Test of Full Consumption Risk Sharing by Credit Constraint Status

[Equation (4)]

	Weak Constraint				Strict Constraint			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Biding credit constraint?	YES	NO	YES	NO	YES	NO	YES	NO
Income-durable expenditure[+]	-0.0316	-0.358***	-0.0343	-0.383***	0.0438	-1.134***	0.0392	-1.178***
(y-c^d) in 1,000 VND	(0.101)	(0.116)	(0.1)	(0.115)	(0.0679)	(0.249)	(0.068)	(0.242)
Dummy=1 if hit by HPAI	2242	4014*			2902**	5997		
	(1736)	(2316)			(1313)	(5211)		
Damage amount by HPAI			2.322	2.369			2.224*	4.483
(Δd) in 1,000 VND			(1.791)	(2.26)			(1.329)	(5.003)
Sample selection correction term	-3459*	-1978	-3695*	-2325	-1122	12601**	-1170	12315**
	(1926)	(2206)	(1952)	(2209)	(2375)	(5261)	(2416)	(5279)
Chi-sq. statistics for the joint hypothesis, α_1= -1 and α_2= 1			92.67	28.89			233.46	1.52
[p-value]			[0.0000]	[0.0000]			[0.0000]	[0.4682]
Observations	229	179	229	179	350	58	350	58
R-squared	0.02	0.22	0.32	0.03	0.0153	0.0429	0.0134	0.0412

Note: We estimate Equation (4) and the left-side variables are in 1,000 VND. Control variables whose results are not shown include age of the head, number of household members, dummy for poverty card holders, sex dummy of the head, education level of the head, working status of the head, and occupation dummy variables; Standard errors in parentheses. * significant at 10%; ** significant at 5%; and *** significant at 1%.

Table 11

Determinants of Risk Coping Behavior

[Equation (5)]

	Formal borrowing	Informal borrowing	Government transfers	Private transfers	Sales of assets	Sales of livestock	Non-farm income
Dummy=1 if serious illness	-707.20	69.16	-10.72	-31.40	-1.80	146.00	4.72
	(2419.33)	(1232.64)	(14.63)	(91.29)	(13.10)	(116.95)	(280.73)
Dummy=1 if moderate illness	896.46	-133.41	0.34	44.45	2.13	14.83	-58.50
	(970.24)	(494.33)	(5.87)	(36.61)	(5.25)	(46.90)	(112.58)
Dummy=1 if ceremony	2286.77	-47.51	-5.67	68.70	2.49	-39.85	80.48
	(1,015.389)**	(517.34)	(6.14)	(38.314)*	(5.50)	(49.08)	(117.82)
Dummy=1 if livestock for market was lost unexpectedly	-67.63	245.37	-8.86	3.77	0.52	13.17	93.81
	(780.80)	(397.81)	(4.720)*	(29.46)	(4.23)	(37.74)	(90.60)
Dummy=1 if livestock for reproduction was lost unexpectedly	-1553.07	-603.21	10.35	-29.48	-5.05	108.96	58.12
	(1433.73)	(730.48)	(8.67)	(54.10)	(7.76)	(69.30)	(166.37)
Number of chickens died due to HPAI	-10.05	34.20	-0.16	0.22	-0.02	-1.84	4.02
	(28.38)	(14.457)**	(0.17)	(1.07)	(0.15)	(1.37)	(3.29)
Observations	408	408	408	408	408	408	408
Number of fid	136	136	136	136	136	136	136
R-squared	0.23	0.24	0.12	0.23	0.04	0.17	0.21

Note: All the estimations include household fixed effects based on Equation (5). The left-side variables are in 1,000 VND. Control variables whose results are not shown include age of the head, number of household members, dummy for poverty card holders, sex dummy of the head, education level of the head, working status of the head, and occupation dummy variables; Standard errors in parentheses; and * significant at 10%; ** significant at 5%; and *** significant at 1%.