DO AGRICULTURAL HOUSEHOLDS SHARE RISKS IN THAILAND? EVIDENCE FROM THAI SOCIO-ECONOMIC PANEL SURVEY DATA

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For this paper, three waves of the Thai Socio-Economic Panel Survey data which cover the years 2005-2007, are used for the first time to examine risk sharing through many specifications. The findings show that the null hypothesis of full insurance against income shock is rejected for the whole country case together with a group consisting of a sample from the Central, Eastern and Western regions. This rejection, nevertheless, is supported by the existence of evidence of partial insurance for the whole country case. Unlike income shock, a specific adverse shock, which uses the illness of the household head as a proxy, is fully insured by households for all region groups except a group consisting of a sample from the Central, Eastern and Western regions.

JEL Classification: O12, Q12, R20.

Key words: Income shock, risk sharing, consumption smoothing, Thai household panel data.

I. INTRODUCTION

Risk is an inevitable fact of life for people in most developing countries. In Thailand, a large number of households, mainly agricultural households, often face various risks similar to the ones prevalent in other developing countries. Consequently, their lives are vulnerable to risk.[1] However, even with the absence of a complete credit and insurance market as a result of the well known problem of asymmetric information (Stiglitz and Weiss, 1981), these agricultural households have been using a variety of alternative mechanisms to protect their lives from adverse risks in ways that similarly done in most developing countries.

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[1] Vulnerability is the likelihood that at a given time in the future, an individual will have a level of welfare below some norm or benchmark (Hoddinott and Quisumbing, 2003).

Alderman and Paxson (1992) categorize alternative mechanisms into two main mechanisms. The first is risk management, which includes crop and field diversification, income source diversification, sharecropper tenancy and migration of family members. The second is risk coping, which can be classified as those that smooth consumption intertemporally through borrowing, selling assets, savings and remittances, and those that smooth consumption across space (households), through risk sharing. In addition to those two mechanisms, because most developing countries might face both the incompleteness of formal insurance and the limitations of informal insurance mechanisms, governments may also take action in terms of public safety net programmes, such as crop and unemployment insurance and microcredit programmes, to improve people's welfare.

Among the variety of mechanisms, the focus of this paper is on risk sharing due to six reasons. First, there is still the incompleteness of a credit and insurance market in Thailand, especially in rural areas (see the details in Siamwalla and others, 1990; Kaboski and Townsend, 2005). Second, consumption smoothing (over time) may be very costly in circumstances characterized by the difficulty in borrowing (Kinsey, Burger and Gunning, 1998). Third, most risk management options (ex ante actions) might also be costly, so that the households would be sacrificing income, on average, in order to assume a less risky stream of income (Bardham and Udry, 1999). Fourth, public safety nets are very costly and may crowd out other informal mechanisms (Cox and Jimenez, 1995; Jensen, 2004). Fifth, some households are often too poor and weak to use both risk management mechanisms and consumption smoothing over time strategies. Finally, with the acceptance of *The Moral Economy of the Peasant*, a book written by James Scott in 1976, together with well known Thai cultural traits, such as generosity and charitableness, especially in rural society, it is interesting to examine these abstracts through risk-sharing behavior. The study of Ravallion and Dearden (1988) indicates that as developing economics become more urbanized, there is a decline in the distributional significance of the moral economy. Therefore, if this statement is true, risk-sharing behavior in Thai agricultural households may decline.

Excluding the original study of Mace (1991) and Cochrane (1991), which uses data from the United States of America, in most studies, the full insurance model is tested by using data from developing countries. Among them are the following: Townsend (1994), Ravallion and Chaudhuri (1997) and Morduch (2002) for India; Jalan and Ravallion (1999) for China; Gertler and Gruber (2002) for Indonesia; Fafchamps and Lund (2003) for the Philippines; and Weerdt and Dercon (2006) for Tanzania. Despite different methodologies and data sources, full insurance is rejected in these studies. This includes the study of Townsend (1995), which also uses data from Thailand.

However, even though a fully Poreto-efficient allocation of risk within communities is rarely achieved[2] (Bardhan and Udry, 1999), partial risk sharing could still possibly be an important method of consumption smoothing (Alderman and Paxson, 1992). The existence of some level of risk sharing at least implies that idiosyncratic risks are shared at some level among community members.

Motivated by the existence of at least partial risk sharing, a study conducted by Townsend in Thailand (Townsend, 1995) is reexamined with a stronger technique and more insight. This paper, nevertheless, is different from the study of Townsend in several specifications. First of all, three waves of Thai Socio-Economic Panel Survey data that cover the years 2005-2007 are used for the first time, and thus allow a look at behavior of the households over time as well as control for unobserved household heterogeneity. Secondly, instead of using an amphoe (district) unit as an observation unit, as is the case with most risk-sharing studies, household units are used in this paper. Thirdly, as were earlier noted in the prospect of the existence of the moral economy, including well known Thai cultural traits, Thai agricultural households that mostly dwell in rural areas and thus are expected to have the greatest possibility of risk-sharing behavior (Ravallion and Dearden, 1988) are specified in this paper. Fourthly, since perfect risk sharing or full consumption insurance is rarely found, testing for partial consumption insurance within the same community is carried out. Finally, with concern for the problem of endogeneity and measurement errors in income variable, the instrument variable technique is applied the test.

As with most empirical studies, the null hypothesis of full insurance against income risk is rejected for the whole country and most regions in this paper. This rejection, nevertheless, is complemented by the existence of evidence of partial insurance and community risk sharing. In the next section, the theoretical framework of modeling consumption across space is outlined. Section III contains a description of the empirical specifications and data used, and section IV contains a discussion on the empirical results. In section V, the conclusion and the policy implications are set forth.

[2] In a Pareto-efficient allocation of risk within community, households face only aggregate risk. Idiosyncratic income shocks are completely insured within the community.

II. BACKGROUND

General derivations of risk-sharing models can be found in Mace (1991), Cochrane (1991), and Townsend (1994). Here only a brief derivation is provided. Let $i = 1,..., N$ index the households that live in the village. There are T periods, indexed by t. The state of nature S is indexed by s, and π_s is the probability of occurrence in each state of nature. Suppose that the utility function, which is presumed to be additively separable across time and states, for each household i is

$$\sum_{t=1}^{T} \delta^t \sum_{s=1}^{S} \pi_s U_i(C_{ist}, Z_{ist}) \tag{1}$$

where δ^t is the discount factor, and C_{ist} and Z_{ist} are the consumption and preference shock respectively of household i if state s occurs in period t.

A Pareto-efficient allocation of risk within the village can be found when a social planner efficiently allocates consumption across households. It is done by maximizing the weighted sum of the utilities of each of the N households, where the weight of household i in the Pareto programme is $\omega_1, 0 < \omega_i < 1, \sum \omega_1 = 1$:

$$\max_{C_{ist}} \sum_{i=1}^{N} \omega_i \sum_{t=1}^{T} \delta^t \sum_{s=1}^{S} \pi_s U_i(C_{ist}, Z_{ist}) \tag{2}$$

subject to the resources available in the village at each point in time in each state of nature:

$$\sum_{i=1}^{N} C_{ist} = \sum_{i=1}^{N} y_{ist} \forall_s, t \tag{3}$$

$$C_{ist} \geq 0 \ \forall_i, s, t \tag{4}$$

equation (3) is the set of village resource constraints. Equation (4) represents the non-negative constraints, which will not bind if the village has any resources in each period along each possible point in history (Bardhan and Udry, 1999). In addition, it is assumed that Y_{ist}, which is the income of the household i in state s at time t, consists of an individual-specific fixed effect μ_i, an aggregate shock μ_{st} and an idiosyncratic shock ν_{ist}:

$$Y_{ist} = \mu_i + \mu_{st} + \nu_{ist} \tag{5}$$

If a derivative with respect to C_{ist} and C_{jst} is taken, the first order conditions for the problem maximize (2) subject to (3) and (4) yield:

$$\omega_i U'_i(C_{ist}, Z_{ist}) = \omega_j U'_j(C_{jst}, Z_{jst}) = \lambda_t \quad \forall_{i,j,st} \tag{6}$$

where λ_t is the Lagrange multiplier on the village resource constraint, i.e. the marginal utility of income. Equation (6) says that, with a perfect risk-sharing condition, total village resources in any period are distributed across households so as to equate the weighted marginal utility of consumption across households. Furthermore, the social planner cannot transfer resources from one household to another and improve the weighted sum of their utility; at the optimum any further transfers reduce social welfare (Morduch, 2002).

If it is assumed that a household's preference is a constant absolute risk aversion (CARA) utility function with the form:

$$U_i(C_{it}, Z_{it}) = -\frac{1}{\sigma}\exp^{-\sigma(C_{it}-Z_{it})} \tag{7}$$

where σ is the Arrow-Pratt measure of absolute risk aversion, equation (6) may be expressed, after subtracting logarithmic transformation of equation (7) with its averaging over the *N* individuals and rearranging, as

$$C_{it} = \bar{C}_t + \left[\frac{1}{\sigma}(log\omega_{it} - log\bar{\omega})\right] + (Z_{it} - \bar{Z}_t) \tag{8}$$

Equation (8) indicates that there are three important implications. First, households' consumption depends on the average consumption of the village, a time-invariant household fixed effect which depends upon the relative weight of the household in the Pareto programme and preference.[3] Second, after controlling for average consumption, change in household income (ΔY_{is}) does not affect its own consumption. Third, perfect risk sharing only protects against idiosyncratic rather than aggregate risk.

Nevertheless, it should be noted that from the second welfare theorem, it is known that the Pareto-efficient allocation of risk can be supported by a competitive equilibrium with a complete contingent market. However, the notion that such a rich set of competitive markets exits is incredible because any risk-pooling mechanism may not overcome the information and enforcement problems associated with insurance contracts. Consequently, a complete set of markets will not exist and the competitive equilibrium will not be Pareto-efficient. Therefore, to achieve efficient (or nearly efficient) risk pooling other mechanisms, such as gifts and transfers may be implemented to support it (Bardhan and Udry, 1999).

[3] Differencing can eliminate a time-invariant household fixed effect implicit in equation (9), while the preference term can also be eliminated if it is assumed that preferences do not change with time.

III. EMPIRICAL SPECIFICATIONS AND DATA DESCRIPTION

Empirical specifications

Empirical specifications for a risk-sharing test generally depend on assumed preferences. However, if the CARA utility function is assumed as in the previous model derivation and after first differencing equation (8) to eliminate a time-invariant household fixed effect, the primary empirical specification for the CARA utility function of the form may be expressed as:

$$\Delta C_{it} = \beta_1 \Delta \bar{C}_t + \beta_2 \Delta Y_{it} + \mathrm{u}_{it} \tag{9}$$

where ΔC_{it} and ΔY_{it} are the change in household consumption and income, respectively. ΔC_t is the change in average consumption and u_{it} is the disturbance term that includes the time-varying component of both household and aggregate preference shocks and might also include measurement errors from the consumption and income data.[4]

However, to complement with the scope of three waves of Thai Socio-Economic Panel Survey data, the formal specification for equation (9), which is exploited in the paper, may be rewritten as follows:[5]

$$\Delta C_{itv} = \sum_{tv} \delta_{tv}(D_{tv}) + \beta \Delta Y_{itv} + \xi \Delta S_{itv} + \delta X_{itv} + \Delta \varepsilon_{itv} \tag{10}$$

where S_{itv} the idiosyncratic shocks (the preference shifters). D_{tv} is time-community dummies (round and community dummies interacted) which capture changes in the resource constraints faced by the community at different times. In other words, they are a proxy for the aggregate, community-level shocks to income. X_{htv} is a vector of household or household head's characteristics. $\Delta \varepsilon_{htv}$ is a household-specific error term capturing changes in the unobservable components of household preferences and δ, β are vectors of parameters to be estimated. If there is perfect risk sharing within the village then household income will have no effect on consumption after controlling for common time-community (village) effects, i.e., $\beta = 0$.

[4] Alternatively, even if in several studies, the first different approach to test as sharing is used, the data are short panel data (three wave panel data); thus in this study the fixed effect estimator, which has been used by Kazainga and Udry (2006).

[5] Several authors also utilize equation (10) for a test of risk sharing. They are: Ravallion and Chaudhuri (1997); Jalan and Ravallion (1999); Morduch (2002); Skoufias (2003); Skoufias and Quisumbing (2003); Harrower and Hoddinott (2004); and Kazianga and Udry (2006).

Additionally, concerning the problem of endogeneity and measurement error on income variable, the instrumental variable technique for equation (10) is applied. This study follows the technique used in the studies of Fafchamps, Udry and Czukas (1998), Jacoby and Skoufias (1997) and Kazianga and Udry (2006). The income equation in those studies has been set as follows:

$$Y_{irt} = \alpha_1 X_{irt} + \alpha_2 R_{rt} \otimes Q_{irt} + \gamma_{rt} + \lambda_i + u_{irt} \quad (11)$$

However, if $\gamma_{rt} = \alpha_r R_{irt} + \tilde{Y}_{rt}$ is defined and assume that $\tilde{Y}_{rt}$ is uncorrelated with X_{irt} and Q_{irt}, equation (11) can be rewritten as

$$Y_{irt} = \alpha_1 X_{irt} + \alpha_2 R_{rt} \otimes Q_{irt} + \alpha_r R_{rt} + \lambda_i + (\tilde{\gamma}_{rt} + u_{irt}) \quad (12)$$

where Y_{irt} is the farm profit, R_{rt} is the deviation of rainfall from the long-run regional mean and this deviation squared, Q_{irt} is the farm characteristics that are the determinants of income, such as the demographic structure of the household and detailed information on its landholdings and their quality (Fafchamps, Udry and Czukas, 1998). X_{irt} is a set of household characteristics. γ_{rt} is a village-years fixed effect and u_{irt} is the disturbance term. The Kronecker product ($\otimes$) generates interaction terms.

Using the estimated income from equation (12), another specification for the paper is

$$\Delta C_{itv} = \sum_{tv} \delta_{tv}(D_{tv}) + \beta \Delta \hat{Y}_{itv+} \xi \Delta S_{itv+} + \delta \Delta X_{itv} + \Delta \varepsilon_{itv} \quad (13)$$

where $\hat{Y}_{itv}$ is the estimated income.

Generally, perfect risk sharing or full consumption insurance is hardly ever found. Therefore, another specification usually may be used to test for partial consumption insurance among households within the same community. This specification is based on the idea that in a purely autarkic world, where there is no pooling of resources and risk sharing, the average community income ($\overline{Y_{vt}}$) should have no impact on consumption of any one household. Evidence that average community income has a significant role in household consumption (i.e., $\gamma \neq 0$) is consistent with the hypothesis that some risk sharing is taking place within communities (Skoufias and Quisumbing, 2003). Therefore, to test for partial consumption, the insurance equation (13) may be written as:[6]

[6] Differently with Skoufias (2003), in this study village-year dummies variables are also controlled in this equation to capture all common shock at the village level since there may be some shocks within the village which the village mean income cannot capture, such as those that are characterized as being cultural or religious.

$$\Delta C_{itv} = \alpha + \beta \Delta Y_{itv} + \gamma \Delta(\overline{\hat{Y}_{vt}}) + \xi \Delta S_{itv} + \delta X_{itv} + \Delta \varepsilon_{itv} \quad (14)$$

where $\Delta(\overline{Y_{tv}})$ is the change in average community income. Applying then the instrument variable, equation (14) may be written as:

$$\Delta C_{itv} = \alpha + \beta \Delta \hat{Y}_{itv} + \gamma \Delta(\overline{\hat{Y}_{vt}}) + \xi \Delta S_{itv} + \delta \Delta X_{itv} + \Delta \varepsilon_{itv} \quad (15)$$

Data description

The main data source for this paper comes from the Thai Household Socio-Economic Panel Survey collected by the National Statistical Office (NSO). Due to the problem of endogeneity and measurement error on income variables, as well as using crop farmers as the sample household, time series regional rainfall data gathered by the Meteorological Department in the Ministry of Information and Technology are used for estimating income.

The Thai Household Socio-Economic Panel Survey is similar to Thai Socio-Economic Surveys (SES). It reports socioeconomic data of sample households who were interviewed repeatedly from 76 provinces throughout the country both inside and outside municipal areas over the three-year period 2005-2007. Approximately 6,000 households were chosen in the first round and those households contributed a response rate of about 96.2 per cent and 93.1 per cent in the second and third rounds, respectively. This panel data set thus yields about 18,000 sample households over the three-year period 2005-2007. However, because risk sharing among crop farmers is tested in the paper, about 5,650 crop farmer households were selected from the three survey years. These households were matched to the nearest weather station, which reported regional rainfall data during the period 1988-2007. Therefore, only 83 weather stations from the 115 stations were selected.

The main variables used in this paper are summarized in table 1. Consumption is total expenditures, which includes expenditure on all goods and services. Total income is the summation of farm profit and nonfarm income in terms of wages, salaries and benefits while village income is the average income of households who dwell in the same subdistrict. All of those income and expenditure variables were obtained by asking households in the year before the survey. Additionally, all money variables are also adjusted by the provincial consumer price index (PCPI) provided by the Internal Commercial Department in the Ministry of Commercial in each year of panel data.

Table 1. Means and standard deviations of main variables for the entire samples

Variables	Variable description	Means	Std. dev.
Income	Farm profit and nonfarm income	133 383.800	168 439.600
Consumption	Total expenditures	94 651.400	81 884.530
Nonmember_transfer	Transfer receipts from nonmember households	15 848.870	52 011.080
Owned_land	Land of households which is not rented land, public land or conserved forest	16.396	48.790
Unowned_land	Rented land and public land including conserved forest	4.550	42.231
Dev_rain	The deviation of rainfall	45.570	226.972
Dev_rain_squared	Squared of the deviation of rainfall	53 583.950	108 914.200
Head_illness	Illness of household's head	0.018	0.136
Head_age	Age of household's head	52.276	13.059
Head_age_squared	Squares of age of household's head	2 903.380	1 431.461
Members 0_5	Number of household's members under 6-years-old	0.317	0.549
Males 6_11	Number of household's males members aged between 6 and 11 years	0.235	0.478
Females 6_11	Number of household's females members aged between 6 and 11 years	0.208	0.453
Males 12_17	Number of household's males members aged between 12 and 17 years	0.217	0.458
Females 12_17	Number of household's females members aged between 12 and 17 years	0.211	0.453
Males_primary	Number of household's males members aged between 18 and 64 years and have a primary level of education	0.804	0.629
Females_primary	Number of household's females members aged between 18 to 64 years and have a primary level of education	0.913	0.567
Males_secondary	Number of household's males members aged between 18 to 64 years and have a secondary level of education	0.297	0.524
Females_secondary	Number of household's females members aged between 18 to 64 years and have a secondary level of education	0.219	0.446

Table 1. *(continued)*

Variables	Variable description	Means	Std. dev.
Males_postsecondary	Number of household's males members aged between 18 to 64 years and have a postsecondary level of education	0.088	0.303
Females_postsecondary	Number of household's males members aged between 18 to 64 years and have a postsecondary level of education	0.142	0.378
Members_65up	Number of household's members who are older than 64 years	0.336	0.619

Sources: The three wave Thai household panel data, 2005-2007 were collected by the National Statistical Office (NSO). Time series regional rainfall data were gathered by the Meteorological Department in the Ministry of Information and Technology.

Notes: 1. Data used in this study are annual data.
2. Unit of all money variables is baht and unit of land variable is rai (1 rai: 1,600 square meters).

Owned land, unowned land and soil's quality are included in the income equation to construct the instrument variable. Unowned land includes rented land, public land, conserved forest and other land while soil's quality are the dummy variable and was set to be 1 if the household's residence is located in the North-Eastern or Southern regions which have low quality of soil (Kanchanakul, Puthavatarat and Hultrakul, 2000). Illness and experience of the household head are also included in the income equation to control household head's characteristics. Age of household head is used as a proxy variable of household head's experience. The number of household members classified by gender, age and educational level are control variables in income equation. However, these household member's characteristic variables as well as illness of household head (which is equivalent to an idiosyncratic shock) were also included in consumption equation for testing on risk sharing.[7] The deviation of rainfall from its long-term average and its squared are also included in the model in conjunction with the panel data on household income to estimate income of crop farmer households. These rainfall variables are constructed by annual regional rainfall data obtained by summing monthly regional rainfall data that is reported by each regional weather station.

[7] A specified adverse shock is used to be an alternative test of complete risk sharing because it can account for a measurement error in income. However, due to data limitations, only illness of household head is included in model 8.

IV. EMPIRICAL RESULTS

By following specifications, an estimate of income to be used as an instrument variable was made. It was then used to test the risk-sharing model in the next stage.

Income equation

Fixed effect income regression is tested by separating results for the whole country and each region as shown in table 2. Owned land has a positive significant impact on a household's income in most regions. The impact of most individual rainfall variables and its interaction is highly significant for the whole country even though the impact of these variables on household income is different for each region. The impact of rainfall deviation on household income in the whole country and its square is significant in the North-Eastern region and in a group consisting of a sample from the Central, Eastern and Western regions whereas this has not been found to be evident in other regions. Rainfall deviation and its interaction with owned land and unowned land yields a negative significant impact at the 1 per cent and 5 per cent levels only in the North-Eastern and Northern regions, respectively, while the interaction term between rainfall deviation and age of household head provides a negative low significance on household income in the Southern region. This means that rainfall may not only affect income directly but also affect it through household characteristics. More specifically, income of household with household characteristic is a negative sensitivity to rainfall variations.

Consequently, with this evidence, the hypothesis that these individual rainfall variables are jointly insignificant is rejected at the 1 per cent level for the whole country, North-Eastern and a group consisting of a sample from the Central, Eastern and Western regions. These results thus still support the claim that rainfall variation may be one of the determinants of agricultural household's income in most regions.

Table 2. Fixed effect income regressions

Variables	Regions				
	(1)	(2)	(3)	(4)	(5)
Owned_land	204.656 (74.979)***	418.871 (543.859)	585.647 (676.505)	101.010 (33.367)***	2 390.422 (835.398)**
Unowned_land	-20.984 (65.944)	-787.761 (677.432)	-742.239 (2 505.049)	40.671 (75.935)	14.369 (1 048.843)
Dev_rain	485.024 (159.392)***	-100.016 (130.162)	-1 200.979 (1 064.290)	132.9676 (86.838)	-127.245 (133.151)
Dev_rain_squared	-0.345 (0.106)***	0.073 (0.160)	-1.720 (1.805)	0.722 (0.214)***	-0.438 (0.171)***
Owned land_xi_dev	-1.007 (0.334)***	-1.104 (1.193)	-1.166 (2.176)	-0.566 (0.143)***	-2.738 (1.904)
Unowned land_xi_dev	-0.191 (0.983)	-1.742 (0.954)**	0.056 (5.046)	-1.052 (1.194)	0.108 (3.406)
Head_age_ xi_dev	-0.576 (0.674)	0.202 (1.486)	-2.267 (1.331)*	-1.038 (0.935)	2.427 (2.521)
Soil fertility_xi_dev	-458.516 (177.354)***	-	-	-	-
Cons	12 996.530 (68 567.570)	85 769.9 (134 714.000)	438 502.100 (294 323.300)	-40 978.240 (74 975.200)	-219 212.200 (211 614.500)
Number of observations	5 648	1 325	745	2 819	759
R-squared	0.053	0.053	0.001	0.126	0.310
F-tests	2.9e+07***	2.0e+04***	3 338.881***	1.4e+04***	2.3e+04***
Test 1	5.460***	1.250	1.230	8.410***	5.000***
Test 2	10 602.580***	2.1e+07***	61 410.870***	486.430***	230.560***

Source: Author's estimation from three wave Thai household panel data, 2005-2007.

Notes: 1. All regions = (1), Northern region = (2), Southern region = (3), North-Eastern region = (4), and Central, Eastern and Western regions (this group consists of a sample from the Central, Eastern and Western regions) = (5).

2. Robust standard errors in brackets under coefficients.

3. * significant at 10%; ** significant at 5%; *** significant at 1%.

4. Test 1: rainfall variables jointly insignificant. Test 2: subdistrict-year dummies jointly insignificant.

5. Regressions also include demographic variables (household head's illness, age of household head, age of household head square, boys, girls, adult males with different education levels, adult females with different education levels and elders) but coefficients are not reported.

6. The interaction term between soil fertility and deviation of rainfall is dropped in each regional regression because there is a perfect multicollinearity problem.

Test of full insurance

The estimates of equation (13) for household consumption are separately shown between the whole country and each region in table 3. Similar to most empirical studies, including, among them, Cochrane (1991), Townsend (1994), Jalan and Ravallion (1999), Morduch (2002), Skoufias (2003), Harrower and Hoddinott (2004) and Kazianga and Udry (2006), the null hypothesis of full insurance against income risk is rejected in the whole country and in a group consisting of a sample from the Central, Eastern and Western regions. Consequently, the regression result indicates that there may be partial insurance in those two groups of samples. This partial insurance implies that there is either village- (tambon or subdistrict) level insurance in some part, or some self-insurance by households, (Morduch, 2002). For the whole country, the results show household consumption is quite well insured because the coefficient of household income is close to zero. In comparing the whole country with the group results from the Central, Eastern and Western regions, which hypothesized that there is partial insurance, it has been found that household consumption appears to be better insured in the group from the Central, Eastern and Western regions than the whole country. This may be explained by the hypothesis that the poor are less likely to be insured and they tend to have limited access to credit and insurance (Jalan and Ravillion,1999). In the case of Thailand, household income in the group of sample from the Eastern and Western regions is much higher than in other regions on average. Thus, it is very possible the households in the group of sample from the Eastern and Western regions are likely to better insured. Surprisingly, it has been found that household consumption appears to be completely insulated for income shock in the Northern, Southern and North-Eastern regions.[8] This is consistent with Skoufias and Quisumbing (2003) and Weerdt and Dercon (2006) in some specifications.

In addition to testing for full insurance through the investigation of the co-movement between household consumption and household income, also examined is the impact of a specified adverse shock, which is proxied by illness of household head on household consumption as an alternative test of complete risk sharing. The result shows that this type of shock appears to be fully insured against for households in the whole country and in the Northern, North-Eastern and Southern regions. Illness of household head has a negative significant effect on household consumption at the 1 per cent level only in a group consisting of a sample from the Central, Eastern and Western regions. This indicates that households in this region are unable to insulate their consumption from this type of shock. The different impacts of illness of household head on household consumption in the study are consistent

[8] There is the possibility that the independence between the consumption of Thai agricultural households and their income may be a result of the use of other forms of insurance, such as saving withdrawal, borrowing or remittances. The study of Paxson is one which indicates that Thai farmers use a high amount of savings to smooth their consumption when they face income shock (Paxson, 1992), However, based on the risk-sharing model, this empirical evidence may be a result from the sharing of risk across households in terms of transfer money and gift exchange. This leaves the key issue for a further study.

Table 3. Fixed effect regressions: test of full insurance
Dependent variable: household consumption

Variables	Regions				
	(1)	(2)	(3)	(4)	(5)
Household income	0.309	-0.133	-0.100	0.109	0.284
	(0.129)***	(0.118)	(0.182)	(0.092)	(0.088)***
Head_illness	4 570.283	3 749.926	-10 560.470	11 354.540	-43 595.890
	(6 483.751)	(13 222.160)	(26 744.620)	(7 912.934)	(17 267.96)***
Head_age	159.658	2 547.191	2 712.594	776.8065	153.505
	(958.024)	(2 422.168)	(4 008.304)	(1 179.998)	(5 881.397)
Head_age_squared	-9.384	-33.101	-28.744	-18.203	-9.154
	(9.055)	(23.480)	(29.105)	(14.515)	(50.866)
Members 0 to 5 years	6 399.187	8 719.286	4 678.814	5 268.024	-1 840.715
	(3 820.598)*	(10 283.230)	(11 572.510)	(4 728.101)	(9 883.996)
Males 6 to 11 years	13 720.150	13 606.770	14 974.900	16 558.610	2 443.156
	(4 822.269)***	(9 573.259)	(20 730.450)	(5 892.327)***	(12 028.510)
Females 6 to 11 years	5 803.340	20 894.120	2 484.927	4 640.645	1 718.453
	(4 642.818)	(12 401.630)*	(14 636.510)	(5 073.987)	(17 234.550)
Males 12 to 17 years	20 058.610	28 864.630	695.848	21 033.150	40 028.240
	(4 708.957)***	(10 568.010)***	(22 525.600)	(5 982.711)***	(878.116)***
Females 12 to 17 years	11 690.080	24 275.540	20 647.870	17 239.420	2 699.685
	(5 582.994)***	(12 618.000)**	(14 667.380)	(6 270.551)***	(15 029.970)
Males_primary	8 833.406	16 803.090	14 494.680	11 318.990	25 315.320
	(4 121.504)***	(7 108.349)***	(15 444.910)	(4 367.579)***	(9 047.579)***
Females_primary	22 073.310	37 188.350	13 413.670	26 020.910	4 053.710
	(5 422.586)***	(9 875.146)***	(20 144.050)	(6 766.872)***	(10 718.710)
Males_secondary	12 761.280	28 227.160	23 507.570	17 074.640	20 308.220
	(5 227.232)***	(8 937.611)***	(16 788.930)	(5 693.220)***	(9 401.300)***
Females_secondary	18 701.060	28 667.570	7 647.770	33 561.760	-17 649.570
	(1 073.1230)***	(12 000.780)***	(17 325.440)	(9 407.552)***	(14 783.910)
Males_ postsecondary	22 316.830	18 193.470	26 551.280	24 311.480	20 527.880
	(6 627.638)***	(8 209.834)***	(19 069.290)	(9 440.335)***	(16 487.380)
Females_ postsecondary	29 665.210	39 971.180	62 397.060	31 107.360	26 409.400
	(6 148.652)***	(10 050.610)***	(21 222.680)***	(8 291.428)***	(13 196.05)***
Members_more than 65 years	13 462.990	26 519.530	15 835.310	15 032.900	18 816.390
	(6 666.089)***	(9 363.561)***	(17 385.230)	(9 947.209)	(14 441.190)
Cons	8 204.477	-8 301.896	54 919.420	959.0695	44 763.890
	(30 502.610)	(69 477.300)	(143 304.400)	(8 620.4970)	(166 923.700)
Number of observations	5 648	1 325	745	2 819	759
R-squared	0.134	0.173	0.139	0.231	0.263
Sargent and Hansen test	9.5e+06***	7 516.057***	2.3e+04***	1.6e+04***	1.5e+05***
F-test (subdistrict-year dummies-jointly insignificant)	169.520***	309.690***	1 316.470***	67.500***	640.440***

Source: Author's estimation from three wave Thai household panel data, 2005-2007.

Notes: 1. All regions = (1), Northern region = (2), Southern region = (3), North-Eastern region = (4), and Central, Eastern and Western region (this group consists of a sample from the Central, Eastern and Western regions) = (5).

2. Robust standard errors in brackets under coefficients.

3.* significant at 10%; ** significant at 5% ; *** significant at 1%.

with several studies, such as Skoufias and Quisumbing (2003), Harrower and Hoddinott (2004) and Weerdt and Dercon (2006). Contrary to both income shock and a specific adverse shock, it is important to note that the F-statistic on the village (tambon or subdistrict)-years dummy variables all lead to a rejection of the null hypothesis that aggregate shocks do not matter. These indicate that illness of household head, which is only one type of our specific adverse shocks, has little significant impact on household consumption in Thailand, while aggregate shock appears to be very important in explaining fluctuations in consumption.

Unlike the impact of adverse shocks, there is overwhelming evidence of the relationship between household consumption and a set of household characteristic variables in most regions. For the whole country, most household characteristic variables, except a household member who is female and aged 6 to 11, is significant at the 1 per cent level, while this evidence is also found in Northern and North-Eastern regions even though there is a slight difference for the case of a household who is under the age of 12. On the contrary, there is a little evidence of the relationship between household consumption and a set of household characteristic variables in the Southern region, while this relationship appears moderately in a group consisting of a sample from the Central, Eastern and Western regions.

Test of partial insurance

Consequently, with the test of full insurance, it is hypothesized that there may be partial insurance in the whole country together with a group consisting of a sample from the Central, Eastern and Western regions. This is issue is investigated further. The estimated coefficients of an average village (tambon or subdistrict) income, which is the focus of this section, are reported in table 4. As expected, the estimates provide evidence that favours partial insurance and community risk sharing in household consumption in the whole country except the Southern region. An average village income has a positive statistically significant relationship with household consumption at the 1 per cent level at the whole country level. This is consistent with the hypothesis that some risk sharing is taking place within villages in the whole country, or in the other words, an income shock is shared among village members. Most of the studies which have tested under conditions of both full insurance and partial insurance found this consistency between these two tests, such as Skoufias (2003), Skoufias and Quisumbing (2003) and Harrower and Hoddinott (2004). Moreover, it should be noted that there is clearly consistency between the test of full insurance and test of partial insurance in the whole country. Regarding the test of full insurance, it has been found that household consumption appears to have some level of insurance, and thus it is implied that there may be some form of village-level insurance. The result on test of partial insurance in this section fully supports this evidence in which the coefficient of average village income is large and statistically significant at the 1 per cent level for households in the case of the whole country. This reaffirms that income shock is evidently shared among village members at the country level.

Table 4. Fixed effect regressions: test of partial insurance
Dependent variable: household consumption

Variables	Regions				
	(1)	(2)	(3)	(4)	(5)
Household income	0.063	-0.133	-0.197	0.111	0.219
	(0.049)	(0.118)	(0.198)	(0.092)	(0.116)**
Village income	0.746	-0.639	0.465	-1.062	0.311
	(0.094)***	(0.475)	(0.296)	(0.532)***	(0.189)
Head_illness	2 710.283	4 007.476	-15 206.470	11 296.870	-37 907.580
	(6 332.196)	(13 202.340)	(27 042.000)	(7 907.665)	(18 695.480)***
Head_age	820.001	2 455.669	2 825.185	492.290	1 208.402
	(932.555)	(2 394.856)	(3 999.444)	(1 228.063)	(5 815.170)
Head_age_squared	-14.620	-31.972	-32.173	-15.447	-16.384
	(8.919)	(23.241)	(29.141)	(15.067)	(50.094)
Members 0 to 5 years	6 015.335	8 731.267	433.592	5 320.903	-1 036.266
	(3 802.687)	(10 169.380)	(12 324.110)	(4 734.428)	(9 883.974)
Males 6 to 11 years	16 064.230	13 379.310	12 331.860	16 615.710	5 337.735
	(4 734.467)***	(9 486.657)	(20 972.710)	(5 896.787)***	(12 600.650)
Females 6 to 11 years	7 216.988	20 857.640	-461.695	4 890.910	3 452.751
	(4 608.834)	(12 364.400)*	(14 964.490)	(5 087.448)	(17 163.610)
Males 12 to 17 years	21 173.290	28 736.850	1 028.411	21 338.160	38 444.740
	(4 669.328)***	(10 553.670)***	(22 190.660)	(5 974.286)***	(8 569.041)***
Females 12 to 17 years	18 006.700	24 226.760	22 335.440	17 124.850	5 678.464
	(4 734.245)***	(12 603.250)**	(14 777.080)	(6 284.119)***	(15 667.400)
Males_primary	14 709.740	16 941.490	14 430.750	11 489.950	25 317.770
	(3 241.850)***	(7 104.540)***	(15 316.440)	(4 384.011)***	(8 721.746)***
Females_primary	27 811.780	37 216.230	15 401.310	26 202.280	8 318.381
	(4 735.693)***	(9 867.953)***	(20 288.940)	(6 791.092)***	(11 963.310)
Males_secondary	19 521.880	28 312.260	19 311.820	17 115.870	19 415.430
	(3 841.777)***	(8 929.856)***	(18 092.360)	(5 693.713)***	(9 431.872)***
Females_secondary	28 282.280	28 643.570	12 575.680	33 636.520	-10 391.090
	(6 459.481)***	(12 001.660)***	(17 640.700)	(9 415.484)***	(17 403.400)
Males_postsecondary	25 397.870	18 091.830	16 141.010	23 735.890	22 362.160
	(6 183.559)***	(8 192.295)***	(22 618.480)	(9 500.940)***	(16 732.120)
Females_postsecondary	35 366.230	39 922.970	68 511.120	31 103.910	26 683.330
	(5 605.895)***	(10 048.450)***	(21 966.420)***	(8 284.478)***	(13 016.050)***
Members_more than 65 years	17 496.280	26 771.430	17 312.710	13 984.500	20 339.190
	(6 331.307)***	(9 342.133)***	(17 415.600)	(10 088.570)	(14 665.660)
Cons	-89 371.530	77 978.820	-12 561.970	116 632.900	-39 150.430
	(33 233.400)***	(94 858.410)	(136 998.800)	(72 004.350)	(171 916.000)
Number of observations	5 648	1 325	745	2 819	759
R-squared	0.018	0.141	0.010	0.114	0.227
Sargent and Hansen test	7.0e+06***	1.2e+04***	5.2e+04***	1.7e+04***	1.6e+05
F-test (subdistrict-year dummies-jointly insignificant)	11 975.090***	309.970***	16 567.950***	58.900***	573.290***

Source: Author's estimation from three wave Thai household panel data, 2005-2007.

Notes: 1. All regions = (1), Northern region = (2), Southern region = (3), North-Eastern region = (4), and Central,Eastern and Western regions (this group consists of a sample from the Central, Eastern and Western regions) = (5).

2. Robust standard errors in brackets under coefficients.

3. * significant at 10%; ** significant at 5%; *** significant at 1%.

On the contrary, even though the result on test of full insurance shows that there may be partial insurance in a group consisting of a sample from the Central, Eastern and Western regions, no evidence of risk sharing within villages is found in these regions. This is similar with the findings associated with the studies of Skoufias and Quisuming (2003) and Harrower and Hoddinott (2004) in which they imply that these types of households were more autarkic in their behavior, relying more on entry into other income activities than in pooling risk with other village members. It also has been found that there is significant co-movement between household consumption and average village income in the North-Eastern region even if its sign is negative and the result on a test of full insurance finds no significant relationship between household consumption and household income. This is hardly surprising considering that the studies of Skoufias (2003) and Skoufias and Quisumbing (2003), as well as Harrower and Hoddinott (2004) also found this type of evidence. If the sign is positive for the case of the North-Eastern region, Skoufias (2003) indicates that there is the possibility of some circumstances in which this type of evidence can occur, for example, in the case in which many shocks are common and everybody resorts to self-insurance.

As with the test of full insurance, an investigation of the impact of a specific adverse shock which is proxied by illness of household head on household consumption is conducted. The regression result is not different from the test of full insurance in which illness of household head has a negative significant effect on household consumption in a group consisting of a sample from the Central, Eastern and Western regions while this type of shock appears to be fully insured against households in other regions. On the other hand, since aggregate shocks cannot be insured or smoothed out by households within a village, aggregate shock captured by the village (tambon)-years dummies still appear to be very important in explaining fluctuations in consumption also in this test. At this point, therefore, it may be concluded that household consumption co-moves with the aggregate resource constraint in every region, while both income shock and the specific adverse shock have little significant impact on household consumption in Thailand. To complete this test, a set of household characteristic variables are also examined. The regression shows a similar result with the test of full insurance. A set of household characteristic variables, especially the variable of household members who are over the age of 11, appear evidently in the relationship with household consumption in most regions while there is little significant relationship between these two variables in the Southern region.

V. CONCLUSION

Most informal insurance mechanisms often provide only inadequate protection. For the mechanisms that can provide adequate protection, the cost associated with them might be overly costly for poor households. The theory of perfect risk sharing predicts, nevertheless, that if villages perfectly pool their incomes to share risks, the household's

own income realization should not affect consumption patterns and all idiosyncratic shocks should be removed. For this paper, the three waves of Thai Socio-Economic Panel Survey data during the years 2005-2007 are used to investigate the existence of risk sharing among Thai agricultural households through three tests, namely the test of full insurance, test of partial insurance and test of risk sharing through risk-sharing instruments, respectively.

The null hypothesis of full insurance against income risk is rejected in the whole country together with a group consisting of a sample from the Central, Eastern and Western regions. Household consumption appears to be better insured in a group consisting of a sample from the Central, Eastern and Western regions than in the case of the whole country. Surprisingly, it has also been found that household consumption appears to be completely insulated for income shock in the Northern, Southern and North-Eastern regions. Unlike income shock, a specific adverse shock that is proxied by illness of household head is fully insured against for households in the whole country, North, North-Eastern and Southern regions. Only households in a group consisting of a sample from the Central, Eastern and Western regions appear to be unable to insulate their consumption for this type of shock. Consequently, with the test of full insurance, the further study supports the existence of evidence of partial insurance and community risk sharing in the whole country, except for a group consisting of a sample from the Central, Eastern and Western regions. Illness of household head still has a negative effect for household consumption only in a group consisting of a sample from the Central, Eastern and Western regions in this second test.

Even if it has been found that most regions completely insure their consumption, the households in the whole country and a group consisting of a sample from the Central, Eastern and Western regions are not completely insulated from income shock. Thus, to implement the results as policy, the government should promote and support community activities, including the participation of households within the community to contribute to the community's social capital, and then to increase the level of risk sharing. Morduch (2002) indicates that economists have considered villages to be a natural insurance unit. The problems of imperfect information and costly enforcement that hinder broad-based insurance markets can be alleviated at the village level. Setting up risk sharing within communities might therefore be one of the most economical and efficient investments to create a social protection system. Nevertheless, to effectively create this system, the government should identify which households are less insured or are weak in the face of adverse shocks, as in the investigation of this study, rather than searching for only those who are poor.

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