Impacts of income uncertainty and diversified agriculture on savings of thai agricultural households

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Abstract

This study aims at empirically testing the influences of income uncertaintyand diversified agriculture on the savings of Thai agricultural households.Using a sample of 1,904 agricultural households selected from the Thai Household Socio-Economic Panel Surveys from 2005 to 2007, decision of agricultural households to save, as well asthe amount of household savings are estimated usingthe random effect probit model and random effect regression model, respectively. A decline in income uncertainty, measured by the semi-variancehas a significantly negative influence on the likelihood to have savings but that measured by the standard deviation or the predicted standard deviation of total household income has a positive influence on the amount of savings, indicating an evidence of precautionary savings. An increase in the degree of diversified agriculture, measured bythe number of agricultural types has an insignificant influence on the likelihood to havesavings but have a negative influence on the amount of savings. However, when the share of non-farm income is used to measure the degree of diversified agriculture, it increases both the likelihood to have savings as well as the amount of savings.Government should carefully implement agricultural policy to reduce uncertainty as different types of diversified agriculture have different impacts on savings. This paper is the first that directly tests the impact of diversified agriculture on savings of Thai agricultural households using the Panel Survey data. In addition, more direct measures of income uncertainty are constructed in order to take into account all types of risks that farmers face.

1. Introduction

The household saving rate is declining in Thailand. It peaked at 14 percent in 1989 and declined to 6 percent in 2006 (National Economic and Social Development Board, 2009).The declining number of people in agriculture was one of the factors behind the decline in Thai household savings, due to the decline in the need for precautionary saving motives (Pootrakul el al, 2005). In addition, farmers and laborers who are hired on a daily basis, both of whom are engaged in riskier occupations tend to have more savings than those in other occupations, reflecting their needs for precautionary savings against the vagaries of weather and external circumstances (Pootrakul el al, 2005). Ruangthammasak (2008) found no evidence of precautionary savings for overall Thai households, high-income Thai households, and middle-income Thai households. However, she found the existence of precautionary savings in only three low-income groups: working-age households, households outside the Bangkok Metropolitan Area and households whose heads do not have salary-based income. Results from Pootrakul et al (2005) and Ruangthammasak (2008) imply the presence of precautionary savings in sub-groups of Thai households such as agricultural households whose heads do not have salary-based income and engage in riskier occupations.

Thai agricultural households face high income uncertainty due to variability in the weather, natural disasters and market risks, causing them to have high income variability. To reduce farm income variability, one of the farm policies in Thailand, particularly since the 1990s, is to promote diversified agriculture. This policy will reduce income variability as the number of activities in portfolio investments increases. According to the fundamentals of diversification, the gains in risk reduction from diversification increase as the number of investments in portfolio increases,

assuming zero correlation among investments. See Barry et al, 2000. The decline in income variability may also reduce current savings, as suggested by the theory of precautionary savings. However, the impact of the diversified agriculture on savings of Thai agricultural households has not been empirically tested yet.

According to the theory of precautionary savings, an individual who faces a higher uncertainty of future income tends to save more and accumulate more wealth. This theory emphasizes the role of savings in insuring against income shocks. The empirical studies that have investigated the existence of precautionary savings can be grouped into three sets. The first set of empirical studies examines the impact of income uncertainty on savings (Sakellis, 1985; Paxson, 1992; Kraay,2000; Guariglia & Kim, 2004; Mishra&Chang, 2009). The second set explores the impact of income uncertainty on consumption level or consumption growth (Dardadoni, 1991; Kuelwein, 1991, Chen et al, 1999; Zhou, 2003;Ruangthammasak, 2008; Jalil&Zafarullah, 2009). The last set studies the impact of income uncertainty on wealth accumulation (Caroll&Samwick,1998; Lusardi, 2000; Murata, 2003; Jensen&Pope, 2004). The results from most of these three sets of empirical studies show an existence of precautionary saving; however, the prevalence of precautionary savings differs. In particular, households who are engaged in agriculture have a higher degree of precautionary savings than others (Zhou 2003).However, a limited number of empirical studies, for example, Paxson (1992), Chen et al (1999) and Mishra and Chang (2009) have investigated precautionary savings among Thai farm households, Illinois grain farmers and US farm household, respectively. Paxson (1992) indirectly tested the impact of income uncertainty on savings, using regional rainfall variability as an estimate of transitory income, with the assumption that greater variability in rainfall leads to an increased fluctuation in income. A striking result of Paxon (1992) shows that farm households save a significantly higher proportion of transitory income. However, the limitation of Paxon's study is that a regional rainfall variability is not a good indicator for income uncertainty as Thai farm households are subjected to different types of risks such as price risks, and disease and pest risks, other than rainfall variability.As a result, a more directmeasure of income variability needs to be constructedas it takes into account all types of risks that farmers face. In addition, the impact of diversified agriculture on savings of Thai agricultural households has not yet been directly empirically tested.

The objective of this paper is to develop an econometric model which directly links the income uncertainty to Thai agricultural household savings. This study generates three major contributions. First, the panel data of Thai household Socio-Economic Surveys is usedto allow for the dynamic behavior of household savings and to construct a more precise measure of income uncertainty. More direct measures of income variability are constructed in order to take into account all types of risks that farmers face. Second, a present study estimates savings from report savings in order to reduce the bias of estimated income uncertainty. Third, the effect of diversified agriculture on household savings is intitially tested empirically.

The next section presents a theoretical framework followed by a discussion of methods to measure income uncertainty, some of which are then used in empirical models. Then the empirical model and its results are discussed, before presenting the conclusion.

2. Theoretical Framework

The relationship between agricultural household savings and income uncertainty can be explained by the consumer's optimization problem. Agricultural households choose their level of consumption to maximize their expected utility over their life-time subject to a budget constraint, given that farm income is uncertain. Following Chen et al. (1999), the farm households are assumed to have a constant absolute risk aversion utility function (CARU) with a constant parameter of risk aversion of R. Equation 1 shows the utility function of farm households (U_{it}):

$$U_{it} = -\frac{1}{R}\exp(-R \times C_{it}) \quad (1)$$

where C_{it} is the consumption of agricultural households,

As farm households face uncertainty in the level of their future income, their expected life-time utility has to be maximize at time t= 0.

$$Max\, U_{it} = E[\sum_{t=0}^{T}(1+\delta)^{-t}U(C_{it}|0)] \qquad (2)$$

where$(1+\delta)$is a discount factor;$E[\cdot|0)]$ is the expectation conditional on information available at time t=0.

Consistent with Chen et al. (1999), at the beginning time t, agricultural households accumulate financial assets with a total real value of W_{it}. At the same time, agricultural households have net income from the farm ofF_{it}, which is random. The total assets and net income from the farm is distributed to consumption C_{it} and a set of assetsA_{it}

Farm household assets in the period t+1 will increase to:

$$W_{it+1} = (1+r_{it})(W_{it} + F_{it} - C_{it}) \qquad (3)$$

where $r_{it}$is the interest rate.

Agricultural households seek their highest expected utility under the budget constraint in equation (3).

For simplicity, assume that changes in net farm income are random walk with a normal distribution with a standard deviation σ and a discount rate and an interest rate that are both zero:

$$F_{it} = F_{it-1} + \varepsilon_{it}, \quad \varepsilon_t \sim N(0,\sigma^2) \qquad (4)$$

The optimal condition for the path of current and future consumption can be derived using the Euler equation from the agricultural household's utility maximization, the envelope theorem and the first order condition.

Following Banchard and Mankiew (1988), the optimal path of consumption statisfies:

$$E[C_{it+1}|I_t) = C_{it} + R\sigma^2/2 \qquad (5)$$

The optimal level of consumption can be solved using backward substitution.

Following Chen et al (1999), the optimal path of consumption is

$$C_{it} = \frac{1}{T-t}W_{it} + F_{it} - \frac{R(T-t-1)}{4}\sigma^2 \quad (6)$$

Equation (6) shows that the level of consumption is determined by net wealth, current income and income variability. The first and second terms are hypothesized by the life cycle permanent income hypothesis (LC/PIH). The third term is the impact of income uncertainty on consumption. The increase in income uncertainty will reduce current consumption and increase savings, all other things being equal.

3. Measurements of Income Uncertainty and Diversified Agriculture

The measurements of income uncertainty in previous empirical studies can be categorized into two groups. The first group involves direct measurement using the standard deviation or the variance of future income. The permanent income is estimated from the panel data and the squared residuals of the model are used as income uncertainty (Chen et al, 1999). The estimated total variance can be decomposed to permanent income variances and transitory income variances as measures of income uncertainty (Caroll&Samwick, 1998; Chen et al, 1999; Jensen&Pope, 2004). The simple variance of the income within time-series horizons of the panel is also constructed as a measure of income uncertainty (Jensen&Pope, 2004). In addition, the semi-variance can be calculated as a measure of downside risk (Chen et al, 1999). The semi-variance is defined as the expected value of the squared deviation below a target value. Semi-variance equals zero when the actual farm income is above its target value. The target income is set equal to the mean of farm income. For the cross-sectional data, the variance of income cannot be estimated directly. Dardadoni (1991) estimates the variance of income within each group of households as a measure of income uncertainty. He assumes that each group of the same occupation faces the same uncertainty. The variance of income

is calculated by groups of households whose household heads belong to the same industry, or have the same economic position orskill level. However, there might be some variations' in income among the same group if the group is not homogenous; for example, Zhou (2003) improves Dardadoni's approach by selecting households within each group as homogenous with respect to levels of labor income, assets, social security insurance, and variance of income. Determinants of household earnings that significantly affect both the labor income of the household head and the household income variance are selected as criteria when grouping the data. The drawback of the direct measurement using the standard deviation or variance from the estimated income is that "this approach is sensitive to the presence of measurement error of income, to the choice of the income process used in the empirical estimation, and to how much the consumer knows that the econometrician does not" (Lusardi, 2000:4).

The second group uses a proxy for income uncertainty such as climatic conditions (Sakellis,1985), specifically rainfall variability (Paxon, 1992; Mishra&Chang, 2009) or measures of labor earning variability based on the subjective measures or self-reported measures (Lusardi, 2000; Murata, 2003; Guariglia&Kim, 2004). The subjective measures remove the problems with estimated income processes. Lusardi (2000) uses the subjective probabilities of job losses in the next year to construct a measure of the earning variances. Murata (2003) develops two subjective measures─ labor earnings (based on economic prospect) and public pension benefits. Guariglia&Kim (2004) measure earnings variability based on the subjective probability of primary job loss of household heads.

To construct a better measure of income uncertainty, four direct measures are constructed, which are (1) simple standard deviation (S.D.) of total income within 3-year of the panel, (2) semi-variance of total income, defined as the expected value of the squared deviation below a target value, which is the mean of total income, (3) the coefficiation of variation (C.V.) of total incomeand (4) predicted S.D. of total income within 3-year of the panel. The predicted S.D. of total income is estimated from OLS regression, assuming that the standard deviation is determined by share of non-farm income to total income, number of agricultural types, share of working members to total household members. The simple SD, semi-variance and C.V. measurements are calculated at the village level and the predicted S.D. is calculated at the household level so that they vary across households and are exogenous.

Agricultural diversification can be conceptualized into three categories: crop diversification, diversification of agricultural production toward more diversified activities (including different crops, livestock, aquacultures and other agricultural activities), inter-sectoral diversification into non-agricultural activities. Due to the limitation of the data, the latter two have been focused. The number of agricultural types is constructed in order to measure the diversification of agricultural production. The share of non-farm income is constructed in order to measure the inter-sectoral diversification.

4. Empirical Model

Agricultural households have 2 decisions to make in order to maximize their utility. These are the decision to save or not save and the amount of savings. This study estimates factors determining decision of agricultural households to participate in savings as well as the amount of money saved for savers using the random effect probit model and random effect regression model, respectively. Both models use the same set of independent variables. Comparing with Mishra and Chang (2009) who uses Double-Hurdle procedures, these two separate models are more unrestricted.

According to equation 6, savings are determined by net wealth, current income and income variability. The independent variables in both models include net wealth which excludes land, income variability or diversified agriculture, land ownership, farm size, health insurance and other control variables that represent household attributes. The current income is excluded as it could be

endogenous to net wealth, income uncertainty and other control variables. The effect of health insurance on savings is tested as households whose members receiving health insurance reduce savings as they do not have precautionary saving motives for illness. Other control variables are household size, numbers of working members and education level of household heads. Hypothesizes are as follows. More household members can help share the financial burden and thus reducing savings. More working members have positive influences on savings according to the life-cycle theory. The influences of education of household heads are uncertain. The household heads with higher education might have higher level of financial literacy, and increasing savings. On the other hand, they might have higher capabilities in managing farm risks and reduce uncertainty, and reducing savings. The age of household head is excluded as a control independent variable in this study as it affects individual savings rather than household savings. In addition, farmers in Thailand can work even after normal retirement age (over 60 years old).

The estimated equation of decision to save

The estimated equation of decision to save (D_{it}^{*})which is unobservable is shown in equation 7:

$$D_{it}^{*} = \alpha_0 + z_i\alpha + x_{it}\beta + v_{it} \qquad (7)$$

whereD_{it} =1 if households report having savings, which is observable and occurred only if D_{it}^{*}> 0 and D_{it} =0 if households report no savings;$z_i$is an observed independent variable and do not change over time, which is an education level of household head; x_{it} are observed independent variables and change over time, which are net wealth, income uncertainty or diversified agriculture, land ownership, land size, health insurance, household size, and numbers of working members; v_i is the error term, consisting of unobserved household effect (u_i) and random error (ε_{it}), shown in equation 8:

$$v_{it} = u_i + \varepsilon_{it} \qquad (8)$$

$\varepsilon_{it}$is assumed to have a normal distribution $\varepsilon_{it} \sim N(0, \sigma_\varepsilon^2)$, $u_i$also has a normal distribution$u_i \sim N(0, \sigma_u^2)$, and u_i is independent toz_i andx_{it}:

The probability of agricultural household to have savings is conditioned on $u_i z_i$ andx_{it}, shown in equation 9:

$$Prob\left(D_{it} = 1 \mid u_i, z_i, x_{it}\right) = \Phi\left(A_{it}\right) \qquad (9)$$

where$A_{it} = -\frac{(\alpha_0 + z_i\alpha + x_{it}\beta)}{\sigma_u^2}$ and$\Phi$is a cumulative normal distribution.

Equation 9 is estimated using the random effect probit model based on the maximum likelihood Estimation.

The empirical model of level of savings for savers

The estimated equation of level of savings for savers(S_{it}) is shown in equation 10:

$$S_{it} = \lambda_0 + z_i\gamma + x_{it}\psi + \eta_{it} \qquad (10)$$

where$S_{it}$is the amount of household savings;z_i is an observed independent variables and do not change over time which is and education level of household head;x_{it} are observed independent variables and change over time, which are net wealth, income uncertainty or diversified agriculture, land ownership, land size, health insurance, household size, and numbers of working members;η_{it} is the error term, consisting of unobserved household effect (μ_i) and random error (ϵ_{it}), shown in equation 11:

$$\eta_{it} = \mu_i + \epsilon_{it} \qquad (11)$$

Equation 10 and 11 are estimated using random effect regression with the assumption thatu_i is independent to z_i andx_{it}.The dependent and independent variables are in the form of logarithm so that the coefficients of independent variables represent elasticities of savings.

Data

A sample of 1,904 agricultural households is selected from the Thai Household Socio-Economic Panel Surveys (THPS) of 2005 to 2007. The THPS contains panel data for 6,000 general households in Thailand for the year 2005 to 2007. Unfortunately, this panel survey was discontinued in 2007.

Definition of Data

Savings

The panel of Thai household surveys asked questions regarding individual savings: "Do you have savings? Please specify your average monthly savings". Decision to save (D_{it}^{*})equals one if households reported having savings. The amount of household savings (S_{it}) are the sum of reported individual savings in the household.

Net Wealth

Net wealth is calculated as total household assets minus total household debts. Total household assets are the sum of the estimated value (in present time) of physical assets such as motorcycle, bicycle, car, mini-truck, truck, van, farm-truck, tractor, boat, and housing. Total household debts are the sum of the amount of loan that household members borrow.

Income Uncertainty

Measures of income uncertainty are (1) simple standard deviation (S.D.) of total income within 3-year of the panel, (2) semi-variance of total income, defined as the expected value of the squared deviation below a target value, which is the mean of total income, (3) the coefficiation of variation (C.V.) of total income and (4) predicted S.D. of total income within 3-year of the panel. The predicted S.D. of total income is estimated from OLS regression.

Total household income includes net farm income, wage and salaries, remittance income, business income, government assistances, property income, interest and dividends, and other income. Net farm income equals income from agriculture (from selling agricultural products and renting of agricultural assets) minus agricultural expenses. Other income includes lottery winings, inheritance, commission.

Diversified Agriculture

This study uses a number of agricultural types and a share of non-farm income to total income as measures of diversified agriculture. In the panel of Thai household survey, the question is what types of agriculture you engaged in are: crops, livestock, aquaculture, fishery, hunting and gathering? Multiple choices can be selected. Non-farm income is total household income minus net farm income.

Land ownership

Agricultural households in Thailand hold different degree of land ownership. The dummy variable representing land ownership equals one if agricultural households owned more than half of the farm sizes and equals zero otherwise.

Farm size

The area of agriculture land per household (Rai)

Health insurance

Health insurance is the dummy variable representing whether members have health insurance. It equals one if at least one member received health insurance (from government/pension/state enterprises/employers/social security/universal card/
Private insurance company) and equals zero otherwise.

Education of household head

Education of household head is the dummy variable representing level of education of household head. It equals one if a household head has a high-school education upwards and zero otherwise.

5. Results and Discussions

Summary statistics of the variables used in this study are presented in Table 1. On average, 71 percent of agricultural households had savings during 2005-2007. The amount of savings for savers continually increased from 2005 to 2007, averaged at 2,890 Baht per month. Saver households were associated with higher level of wealth, lower levels of income uncertainty, measured by semi-variance, the C.V. and predicted S.D., less number of types of agriculture. Higher proportion of savers were found with households owning land, those with higher farm size, higher working members, and those whose heads have at least a high-school education (Table 1).

Variables	2007			2008			2009			Total		
	Save	Not Save	Total	Save	Not Save	Total	Save	Not Save	Total	Save	Not Save	Total
Save	1.00 (0.0)	0.00 (0.0)	0.65 (0.5)	1.00 (0.0)	0.00 (0.0)	0.74 (0.4)	1.00 (0.0)	0.00 (0.0)	0.73 (0.4)	1.00 (0.0)	0.00 (0.0)	0.71 (0.5)
Savings level (1,000 Baht)	2.46 (4.6)	0.00 (0.0)	1.59 (3.9)	2.86 (7.1)	0.00 (0.0)	2.13 (6.3)	3.28 (16)	0.00 (0.0)	2.41 (14)	2.89 (11)	0.00 0.0	2.04 (8.9)
Net wealth (1,000 Baht)	149 (422	101 (205)	132 (361)	172 (515)	105 (217)	155 (458)	159 (409)	103 (190)	144 (364)	160 (453)	103 (204)	144 (397)
S.D. (1,000 Baht)	19 (12)	18 (11)	18 (11)	18 (11)	19 (11)	18 (11)	18 (11)	19 (12)	18 (11)	18 (11)	18 (11)	18 (11)
Semi-variance (1,000,000 Baht)	44 (68)	65 (86)	51 (75)	44 (71)	71 (90)	51 (77)	36 (65)	62 (80)	43 (70)	41 (68)	66 (85)	48 (74)
C.V.	1.27 (0.5)	1.27 (0.5)	1.27 (0.5)	1.26 (0.5)	1.28 (0.5)	1.27 (0.5)	1.25 (0.5)	1.31 (0.5)	1.27 (0.5)	1.26 (0.5)	1.29 (0.5)	1.27 (0.5)
Predicted S.D.	7.02 (1.5)	7.05 (1.6)	7.03 (1.6)	7.21 (1.7)	7.31 (2.1)	7.24 (1.8)	7.25 (1.7)	7.04 (1.7)	7.19 (1.7)	7.17 (1.7)	7.12 (1.8)	7.15 (1.7)
Agricultural Types	1.56 (0.8)	1.68 (0.9)	1.60 (0.8)	1.60 (0.7)	1.51 (0.6)	1.58 (0.7)	1.67 (0.7)	1.58 (0.7)	1.64 (0.7)	1.61 (0.7)	1.60 (0.7)	1.61 (0.7)
Share non farm Income	0.53 (0.3)	0.53 (0.3)	0.53 (0.3)	0.60 (0.4)	0.62 (0.6)	0.61 (0.5)	0.64 (0.4)	0.56 (0.4)	0.62 (0.4)	0.59 (0.4)	0.56 (0.4)	0.59 (0.4)
Land ownership	0.83 (0.4)	0.81 (0.4)	0.82 (0.4)	0.85 (0.4)	0.80 (0.4)	0.84 (0.4)	0.87 (0.3)	0.80 (0.4)	0.85 (0.4)	0.85 (0.4)	0.80 (0.4)	0.84 (0.4)
Farm size	21 (28)	18 (48)	20 (36)	21 (30)	15 (14)	20 (27)	49 (1069)	17 (21)	41 (916)	31 (629)	17 33	27 (530)
Health Insurance	0.21 (0.4)	0.20 (0.4)	0.21 (0.4)	0.94 (0.2)	0.97 (0.2)	0.94 (0.2)	0.20 (0.4)	0.16 (0.4)	0.19 (0.4)	0.46 (0.5)	0.41 (0.5)	0.45 (0.5)
Household Size	3.96 (1.6)	3.95 (1.6)	3.95 (1.6)	3.97 (1.5)	3.98 (1.6)	3.97 (1.6)	3.09 (1.2)	2.98 (1.2)	3.06 (1.2)	3.66 (1.5)	3.66 (1.5)	3.66 (1.5)
Working members	2.31 (1.0)	2.22 (0.9)	2.28 (0.9)	2.41 (1.0)	2.26 (1.0)	2.37 (1.0)	2.45 (1.0)	2.31 (1.0)	2.41 (1.0)	2.39 (1.0)	2.26 (0.9)	2.35 (1.0)
Education Level	0.18 (0.4)	0.14 (0.3)	0.17 (0.4)	0.18 (0.4)	0.12 (0.3)	0.17 (0.4)	0.17 (0.4)	0.14 (0.3)	0.16 (0.4)	0.18 (0.4)	0.13 (0.3)	0.17 (0.4)

Table 1: Summary statistics of variables used in the empirical model.

Notes: Standard errors are in parentheses.

Factors affecting probability of agricultural household to have savings

Table 2 reports the estimated results of factors affecting decision to save of agricultural households using the random effect probit model. Model 1-4 test the influences of income uncertainty on the likelihood of having savings. The measures of income uncertainty are the S.D. of total household income(Model 1), the semi variance of total household income (Model 2), the C.V.of the total household income (Model 3), and the predicted S.D. of total household income, (Model 4). Model 5 tests the influence of the degree of diversified agriculture, measured by the number of agricultural type and share of non-farm income, on the likelihood to save. All measurements are calculated at village levels except those in model 4 that are calculated at the household level.

Overall, the estimated model can explain the decision to save as the Wald Chi Square statistics is significant at the 99 percent level of confidence. The unobserved household heterogeneity (Rho) of the total variance of the error term accounts for 42-43 percent for the estimated decision to save.

The signs of income uncertainty coefficients in almost all measures show negative influences on the likelihood of agricultural household to save. A possible explanation is that farm households with higher income variability have lower degree of income stability. Thus, they might have higher debts to smooth consumption, lowering probabilities to have savings. However, only the income uncertainty, measured by the semi-variances of total income are statistically significantly in explaining the decision to save. If the semi-variance increases from the mean of 49 Million Baht (equivalent to the semi-standard deviation of 7,000 Baht) to 54 Million Baht (increases by 10 percent), the likelihood to save reduces by 0.015, holding the other independent variables at their mean levels. Thenumber of agricultural types is positively insignificant in explaining the likelihood to save. The share of non-farm income has a positively significant influence on the likelihood to save.

Other independent variables are statistically significant in influencing the probability of a household to save in all models and are not sensitive to different measurements in income certainty. Using the model 2 as the base line, if net wealth increases by 10 percent (from the mean of 143,720 Baht to 158,092 Baht), the probability of agricultural household to have savings increases by 0.004, holding the other independent variables at their mean levels. Land ownership has a positive influence on the likelihood of agricultural household to have savings as expected. Table 3 shows the marginal effects of independent variables to the probability of agricultural household to have savings.The probability of having savings for farm household that owned land is 0.17 higher than that with rented land. In addition, agricultural households with higher farm sizes are more likely to save. The probability of agricultural household to have savings increases by 0.006 as the farm size increases from 27 Rai (4.32 Hectare) to 30 Rai (4.8 Hectare). Health insurance has an unexpected positive coefficient, indicating that an agricultural household whose members have health insurance has higher probability to have savings than that whose members do not have health insurance. Changing from a household member having no health insurance to a household member having health insurance, the probability of having savings increases by 0.225. This contradicts the study's hypothesis that heath insurance reduces the need for precautionary motive for sickness. This might be because medical expenses can be significant components of farm household consumptions once occurred; thus being savers. In addition, the increase in working members increases the probability of agricultural household to have saving, following the life-cycle hypothesis. The probability of agricultural household to have savings increases by 0.128 as the working members increase from 1 member to 2 members. On the other hand, the probability of agricultural household to have savings declines as household size increases. The probability reduces by 0.0989 as the household sizes increase from 1 members to 2 members. This shows that more household members can help share the financial burden and reduce savings Education level of the household head has a significant effect on probability to have savings. The probability of having savings by a farm head with at least high-school education is 0.215 higher than that with lower than high-school education. This might be due to the fact that household head with higher education has higher level of financial literacy, and increasing savings.

Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
	S.D.	Semivariance	C.V.	Predicted S.D.	Diversification
Net wealth	2.76e-07*** (7.39e-08)	2.59e-07*** (7.35e-08)	2.73e-07*** (7.38e-08)	2.72e-07*** (7.38e-08)	2.79e-07*** (7.39e-08)
Income Uncertainty	-1.49e-06 (2.57e-06)	-3.06e-09*** (3.45e-10)	-0.0807 (0.0534)	2.43e-05 (1.56e-05)	
Agricultural Types					0.041 (0.033)
Share non farm income					0.209*** (0.0623)
Land ownership	0.182*** (0.0654)	0.168*** (0.0650)	0.185*** (0.0654)	0.187*** (0.0653)	0.189*** (0.0654)
Farm size	0.00255*** (0.000827)	0.00197** (0.000821)	0.00256*** (0.000826)	0.00264*** (0.000830)	0.00296*** (0.000837)
Health Insurance	0.208*** (0.0441)	0.225*** (0.0443)	0.208*** (0.0442)	0.204*** (0.0441)	0.199*** (0.0442)
Household Size	-0.0880*** (0.0201)	-0.0989*** (0.0200)	-0.0879*** (0.0201)	-0.0888*** (0.0201)	-0.0881*** (0.0200)
Working members	0.162*** (0.0307)	0.128*** (0.0306)	0.161*** (0.0307)	0.159*** (0.0305)	0.151** (0.0307)
Education Level	0.247*** (0.0738)	0.215*** (0.0734)	0.248*** (0.0737)	0.237*** (0.0737)	0.241*** (0.0737)
Constant	0.331*** (0.106)	0.598*** (0.102)	0.406*** (0.117)	0.139 (0.145)	0.135 (0.112)
Rho	0.4357*** (0.0238)	0.4238*** (0.0241)	0.4355* (0.0239)	0.4346 (0.0239)	0.436 (0.0238)
Log-likelihood	-3261.098	-3181.567	-3215.121	3220.390	-3215.229
Wald test	91.36***	N.A.	93.23***	92.05***	101.48***
Observations	5,704	5,712	5,704	5,712	5,712
Number of households	1,904	1,904	1,904	1,904	1,904

Table 2: Factors affecting decision to save of agricultural households using Random Effect Probit model

Notes: ***, ** and * denote 1, 5, and 10% significance levels, respectively. Standard errors are in parentheses. Rho represents the proportion of the total error variance due to unobserved household effect.

dY/dX	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
	S.D.	Semivariance	C.V.	Predicted S.D.	Diversification
Net wealth	2.76e-07*** (7.39e-08)	2.59e-07*** (7.35e-08)	2.73e-07*** (7.38e-08)	2.72e-07*** (7.38e-08)	2.79e-07*** (0.0000)
Income Uncertainty	-1.49e-06 (2.57e-06)	-3.06e-09*** (3.45e-10)	-0.0807 (0.0534)	2.43e-05 (1.56e-05)	
Agricultural Types					0.041 (0.033)
Share non farm income					0.209*** (0.062)
Land ownership	0.183*** (0.0654)	0.168*** (0.0650)	0.185*** (0.0654)	0.187*** (0.0653)	0.189*** (0.0654)
Farm size	0.00256*** (0.000826)	0.00197** (0.000821)	0.00256*** (0.000826)	0.00264*** (0.000830)	0.00296*** (0.00084)
Health Insurance	0.208*** (0.0441)	0.225*** (0.0443)	0.208*** (0.0442)	0.204*** (0.0441)	0.199*** (0.0442)
Household Size	-0.0880*** (0.0201)	-0.0989*** (0.0200)	-0.0879*** (0.0201)	-0.0888*** (0.0201)	-0.0880*** (0.0200)
Working members	0.162*** (0.0307)	0.128*** (0.0306)	0.161*** (0.0307)	0.159*** (0.0305)	0.151*** (0.0307)
Education	0.248*** (0.0737)	0.215*** (0.0734)	0.248*** (0.0737)	0.237*** (0.0737)	0.241*** (0.078)

Table 3: Marginal effects of factors affecting decision to save of agricultural households

Notes: ***, ** and * denote 1, 5, and 10% significance levels, respectively. Standard errors are in parentheses.

Table 4reports the estimated results of factors affecting level of agricultural household savings for savers. Overall, the estimated model can explain the amount of savings as the Wald Chi Square statistics is significant at the 99 percent level of confidence. The unobserved household heterogeneity (Rho) of the total variance of the error term accounts for about 40 percent.

According to table 4, the income uncertainty, measured by S.D. or predicted S.D. of total income is significantly in explaining the amount of savings at 99% level. The signs of income uncertainty coefficients show posititve influences on level of savings. The increases in income variability on level of savings are more pronounced. A one percent increases in total income variability, measured by the S.D. will increase level of savings by 0.18 percent and those measured by the prediceted S.D. will increase level of savings by 0.5 percent. The sign of income uncertainty coefficient measured by semivariance of total income indicates a negatively significant influence. However, the coefficient is very small.

The increase in the numbers of agricultural types results in reduction of savings amount, due to the lowered uncertainty. However, when the share of non-farm income is used to measure the degree of diversified agriculture, it increases the amount of savings. This result indicates that non-farm income playing an important role in explaining savings of Thai agricultural households. Moving-out of agriculture enhances the amount of savings. This contradicts to Pootrakul et al (2005) that moving-out of agriculture are the reason of a decline in household savings in Thailand.

Other significant factors explaining and the amount of savings in Table 3 and 4 are consistent. These are net wealth, whether households own agricultural land, farm size, number of working household members and level of education of household heads. However, health insurance and household size are not significant in explainging level of savings for savers.

Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
	S.D.	Semivariance	C.V.	Predicted S.D.	Diversification
Net wealth	0.252*** (0.0238)	0.240*** (0.0237)	0.256*** (0.0238)	0.250*** (0.0238)	0.243*** (0.0238)
Income Uncertainty	0.184*** (0.0558)	-2.80e-09*** (4.27e-10)	0.127 (0.0826)	0.503*** (0.131)	
Agricultural Types					-0.3154*** (0.065)
Share non farm income					0.2947*** (0.0821)
Land ownership	0.208*** (0.0791)	0.219*** (0.0785)	0.212*** (0.0792)	0.227*** (0.0789)	0.236*** (0.0786)
Farm size	0.0954*** (0.0267)	0.0819*** (0.0266)	0.0951*** (0.0267)	0.116*** (0.0272)	0.1303*** (0.0276)
Health Insurance	0.0275 (0.0481)	0.0430 (0.0479)	0.0269 (0.0482)	0.0267 (0.0481)	0.0214 (0.0480)
Household Size	-0.0643 (0.0802)	-0.108 (0.0799)	-0.0643 (0.0803)	-0.0858 (0.0802)	-0.0630 (0.0797)
Working Members	0.419*** (0.0836)	0.377*** (0.0834)	0.424*** (0.0837)	0.423*** (0.0834)	0.431** (0.0835)
Education Level	0.298*** (0.0793)	0.289*** (0.0788)	0.308*** (0.0794)	0.296*** (0.0792)	0.297*** (0.0835)
Constant	1.375** (0.592)	3.502*** (0.292)	3.071*** (0.286)	-1.319 (1.181)	3.071*** (0.2936)
Rho	0.3897	0.3892	0.3912	0.3890	0.3839
Wald test	236.24***	236	226.65	240.85	236.32***
Observations	3,307	3,313	3,307	3,312	3,313
Number of households	1,569	1,573	1,569	1,572	1,573

Table 4: Factors affecting the amount of agricultural household savings for savers using Random Effect Regression model.

Notes: The dependent and independent variables are in a logarithmic form, except for share of non-farm income is not in the log term

***, ** and * denote 1, 5, and 10% significance levels, respectively. Standard errors are in parentheses.

Rho represents the proportion of the total error variance due to unobserved household effect.

6. Conclusions and Recommendations

Using the panel data of Thai household Socio-Economic Surveys, this studies directly linkes the income uncertainty and diversified agriculture to Thai agricultural household savings. Several direct measures of income uncertainty variable are constructed, which are the S.D., the C.V. of total

income, the semi variance, and the predicted S.D. Key empirical finding is that income uncertainty, measured by the semi variance has a negatively significant influence on the likelihood of agricultural household to save but that measured by S.D. or predicted S.D. have positively significant influences on savings level for savers. A possible explanation is that farm households with higher income uncertainty might have higher debts to smooth consumption, decreasing the probability to have savings. The income uncertainty also plays an important role in explaining savings of Thai agricultural households for savers and indicates that Thai agricultural households have precautionary savings. Increases in the numbers of types of agriculture result in reduction of savings amount for savers, due to the lowered uncertainty. When the share of non-farm income is used to measure the degree of diversified agriculture, it increases both the likelihood to save and the amount of savings. This result indicates that moving-out of agriculture enhances savings. In addition, land ownership, land size, number of working members and education level of household heads positively affects the likelihood to save and the amount of savings. Having health insurance increases the likelihood to save, contradicts to the hypothesis that health insurance reduces the need for precautionary motive for sickness. Thus, government should carefully implement agricultural policy to promote diversified agriculture to reduce uncertainty as it will have different impacts on savings. For example, by developing programs to promote diversified agricultural activities, it will reduce the amount of savings. On the other hand, promoting moving-out of agriculture will enhance savings. The government should enhance financial literacy among farming households to increase savings.

7. Limitation of the Study and Direction for Future Research

Due to the limitation of the data of crop diversification, future research should explore the link between crop diversification and savings.

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