Investments of Rural Households in Northeast Thailand and the Future of Small Scale Farming

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Abstract

This paper analyses investments of some 2000 farm households in rural villages in three provinces of Northeast Thailand. We use a multinomial logit model to analyse the determinants of different types of investments in agriculture as well as small scale enterprises and a hurdle model to investigate the intensity of investments in agriculture. Results show that only 30% of rural households undertake investments and most investments made are small. Only households with larger land sizes tend to invest and wealthier households are more likely to invest larger amounts. Female headed households, those with older household heads as well as households in remote areas invest less. Access to finance increases the probability of investing in small scale enterprises, but does not influence agricultural investments. Households with larger investments in agriculture tend to not invest in non-farm activities. The paper demonstrates implications for rural development and agricultural policy in Thailand and other Asian emerging market economies.

Keywords: farm investments, hurdle model, Thailand, rural development, vulnerability to poverty
JEL: Q12, R11, O13, O12

1 Introduction

A major downside to the impressive economic growth of many emerging market economies in Asia is the growing income gap between rural and urban areas. For a long time, development policy has been geared towards rapid industrialization, encouraging the transfer of cheap rural labor to urban industrial centers (PUNTASEN and PREEDASAK, 1998) and less attention was given to development in rural areas. As a result, rural households have paid less attention to agriculture and instead have diversified out of agriculture through temporary and seasonal migration of younger household members. HAYAMI (2007a) has pointed at the possible negative consequences of this process on agricultural productivity growth and food prices. Furthermore, in Thailand, the neglect of the rural class has resulted in social and political conflicts as demonstrated by the so-called "Red Shirt crisis" in 2010 (SIAMWALLA and JITSUCHON, 2012).

The continuous diversification out of agriculture by small scale farmers in Northeast Thailand poses a development challenge. In many cases, migration of household members does not automatically lead to prosperity of their natal households in the village. Migrant household members are often in low quality and vulnerable employment conditions with little social protection (AMARE et al., 2012). Therefore, rural households hold on to their land as an ex-ante coping strategy (HAYAMI, 2007a) and as a result, structural change in agriculture is slow and the development of larger and more efficient farms is impaired (LETURQUE and WIGGINS, 2011; POAPONGSAKORN, 2006). This can lead to a low supply response of small scale farmers even with significantly higher output prices during the 2008 food price hike as shown in a case study of VÖLKER et al. (2012). Hence, the conditions in the rural villages in Thailand appear not to be favorable for investment. However, so far little empirical evidence exists on the extent of small scale farmers' investments in productive assets[1] and the determinants of such investments.

Past studies that looked at agricultural investments in developing countries focus on specific investments, e.g. wells (HAYES et al., 1997), livestock (ROSENZWEIG and WOLPIN, 1993), or fruit trees (HUANG et al., 2009). Other studies concentrate on investments in certain agricultural sectors such as the dairy sector (TUBETOV et al., 2012). Also most of past studies use cross section data, which limits the conclusions with regards to longer term development impacts. This paper contributes to the existing literature by analyzing agricultural investments of small scale farm households in three provinces in Northeast Thailand. In addition we also include investments in non-agricultural activities, i.e. in small scale enterprises (SSEs) such as village shops, transport businesses or food processing enterprises. We actually include three investment options, namely agriculture, non-agriculture or a combination of both because households in Northeast Thailand may follow different livelihood strategies that may include either option in addition to not undertaking any investment.

As empirical base we use a unique panel data set from 2007 and 2010 to investigate the extent and the determinants of investments in agriculture and small scale enterprises. In this paper we ask three questions:

1. What factors encourage rural households to invest into different types of productive assets?
2. What are the constraints to such investments?
3. What factors influence the extent of investments in agricultural activities?

[1] We define productive assets as all assets that are mainly used for income generating activities.

Our main findings are that only a small share of households invests in agriculture or non-farm SSEs. Those who undertake investments are wealthier households and wealth increases the probability to invest larger amounts. Female headed households and those with older household heads as well as households located in remote areas tend to invest less. Access to finance increases the probability of investing in SSEs, but does not have an influence on agricultural investments. Households that invest in agriculture tend to be specialized. Income from off-farm employment is rather consumed and does not increase the probability to invest.

2 Theoretical Background and Literature Review

We derive our hypotheses from household theory assuming an agricultural household with the objective of maximizing utility in terms of level and stability of consumption as well as leisure (e.g. REARDON et al., 1994; ELLIS, 2000). Investments are undertaken with the purpose of increasing future utility. The choice of investment requires a dynamic framework, demanding at a minimum a two-period model. In such a model, in the first period income can be consumed or invested to generate additional income in the next period. The extent of investment depends on the household´s time preferences for consumption and its investment possibilities which determine the rate of return on investment. In perfect market conditions optimal investment is where the marginal rate of return to investment equals the marginal rate of substitution of consumption over time (HIRSHLEIFER et al., 2005). Since households in Northeast Thailand face imperfect capital markets (PAULSON and TOWNSEND, 2004), investment and consumption decisions are interdependent (ELLIS, 2000). Therefore, an analysis of investment decisions needs to take into account the households' capabilities, preferences and incentives (REARDON et al., 2000; BINSWANGER et al., 1993).

Households' capabilities to invest are influenced by external conditioning variables, such as the institutional environment (land and capital markets), technology and location-specific variables as demonstrated for example for China by FEDER et al. (1992). Landownership reduces risk and therefore provides incentives for long term investments (e.g. FENSKE, 2011; PLACE, 2009). Small farms face less favorable conditions for investments than larger farms who tend to achieve higher levels of investment efficiency (HAYAMI, 2007b) and have better access to credit markets (FAN and CHAN-KANG, 2005).

Household demographics have an influence on household preferences. In the literature, female headed households and households with older and less educated heads have been found to be more risk averse and therefore have a lower probability to invest (BRYANT and GRAY, 2005; HARDEWEG et al., 2013).

Imperfect credit markets influence households' liquidity position; therefore household wealth increases the financial capacity to invest (REARDON et al., 2000). One possibility to overcome liquidity limitations for financing farm investments is off-farm income (DAVIS et al., 2009; HERTZ, 2009). However, off-farm employment and non-farm investment possibilities can compete with agriculture for labor and capital (HUANG et al., 2009; REARDON et al., 2000). As KILIC et al. (2009) emphasize, the net impact of off-farm income on agriculture is complex and difficult to assess a priori, especially, because it might differ depending on farm household types and their activities as well as the agricultural potential and institutions of the area.

By including different investment alternatives, namely farm investments small scale enterprise investments (SSEs) and a combination of the two, we include a wide range of investment options which may differ in their rates of return and risk, and therefore offer different incentives to the households.

Combining situation analysis, household theory and review of literature we develop the following four hypotheses regarding investment decisions of rural households:

1. Households with better endowments are more likely to invest.
2. Household demographics and location factors are important determinants for investments.
3. Access to finance facilitates larger investments.
4. Labor allocation is a determinant for investments.

In our analysis, we differentiate investments in agricultural activities (e.g. tractors, irrigation equipment, and livestock) from those in SSEs, which include small retail shops, processing facilities or transportation businesses. We define investments as items with a service life of more than one year. We also defined a threshold of 5,000 THB (275 PPP-$) excluding any item below this value. To meet the realities of investments in rural villages in Thailand, we also included those items which are used for both, productive and consumptive purposes. For example, a motorbike is used to transport rice bags to the market but also to take children to school.

3 Empirical Model

To answer the research questions we applied two empirical models. First, to estimate the influence of determinants on the decision to invest in agriculture and non-agriculture productive activities, we use a multinomial logit model. In a second step, we apply a hurdle model to analyze agricultural investments in more detail and identify the determinants for an investment decision as well as the amount of investment.

Both models are reduced forms of the conceptual household model outlined in the theory section. The dynamic element is incorporated by drawing upon the panel data base including two periods. For the explanatory variables we use the baseline of 2007 as lagged variables and we take the cumulative number of investments asked in 2010 for the last four years. With including investments from a longer period, we are in a better situation to measure the investment behavior of rural households, since investments are lumpy and infrequent, i.e. households will not invest every year. A shorter period would therefore reduce the number of investment observations and would classify households as non-investors that actually follow an investment strategy (ELHORST, 1993).

In model 1, we analyze households who undertake: (1) farm investments, (2) investments in small scale enterprise (SSE) and (3) both type of investments in comparison to households with no investment. We add SSE as a separate investment alternative to reflect the ongoing commercialization and diversification process in Thailand. These investment decisions can be demonstrated by a nominal (unordered) choice model (LONG, 1997). We use a multinomial logit model to estimates the probability that a certain investment alternative is chosen. In this model, individual i can choose alternative m which maximizes her utility, consisting of average utility μ and error ε (MCFADDEN, 1974).

$$u_{im} = \mu_{im} + \varepsilon_{im} \quad (1)$$

The probability of choosing alternative m is therefore the probability of the utility of alternative m being higher than the utility of all other alternatives. The average utility thereby is a linear combination of an individual's characteristics:

$$\mu_{im} = x_i \beta_m \quad (2)$$

Important for the correct specification of the model is the assumption of independent errors ε, which results in the independence of irrelevant alternatives (IIA) assumption. The model should therefore only be applied if alternatives are distinct, which we think is given in our case (LONG and FREESE, 2006; MCFADDEN, 1974). To support our view, we conducted available tests, the Hausman test, generalized Hausman (suest) test and the Small-Hsiao test[2], which indicated that the IIA assumption holds for our data.

[2] We confirmed our assumption using three different tests. First, applying the generalized Hausman suest test we could not reject the null hypothesis of independent alternatives. Second, since the Small-Hsiao test randomly divides the sample into subsamples, we repeated this test several times to strengthen our results. In the majority of cases the null hypothesis was not rejected. Third, we applied the Hausman test, which did not reject the null hypothesis for some alternatives, for the remaining alternatives it resulted in negative chi2 statistics, which can be interpreted as non-violation of the IIA assumption following HAUSMAN and MCFADDEN (1984).

In model 2 we look at agricultural investments in more detail. The majority of households did not undertake investments; this distribution of investment with the typical pileup at the endpoint of zero is a corner solution response. Hurdle models take this situation into account and model the outcome as result of two different decisions, here the *investment decision* (y=0 versus y=1) and the *amount decision* (magnitude of y if y > 1). The hurdle model assumes the dependent variable y to be generated by a binary variable s and a latent variable w* (WOOLDRIDGE, 2010),

(3) $$y = s \cdot w^*$$

While the binary variable s can be observed, since it equals the indicator y > 0, w* can only be observed if s= 1. In the hurdle model s and w* are assumed to be independent conditional on explanatory variables (conditional independence assumption, CIA), so that the mechanisms determining the investment and amount decision are independent.

A widely used version of the hurdle model assuming a lognormal distribution and therefore a model suitable for our investment data is Cragg`s (CRAGG, 1971) lognormal hurdle model.[3] It was developed for the analysis of expenditure for certain goods characterized by an excess of zeros and has also been used for investments (ARAMYAN et al., 2007; ELHORST, 1993). The model estimates s with a logit-model, and assumes w* to follow a lognormal distribution,

(4) $$y = s \cdot w^* = 1[x\gamma + v > 0] \exp(x\beta + u)$$
$$u|x \sim Normal(0, \sigma^2)$$

The observed amount of investment is y; s and w^* are the latent variables describing the *decision to invest* and the *amount of investment decision*. γ and β are vectors of parameters and v and u are error terms. x is a set of explanatory variables, containing household and village characteristics which are the same variables as those used in model 1.

Referring to the conceptual household model as a theoretical basis, we can specify the explanatory variables (X) of models 1 and 2. Broadly, these can be categorized in household characteristics (H), village characteristics (V), and province variables (P). Household characteristics (H) include demographics (Z), labor capacity and labor allocation (L), endowment with capital and land (K) as well as capital market

[3] The hurdle model is in our case preferred to the Exponential Type II Tobit model (ET2TM), a variant of the Heckman model for corner solution responses relaxing the conditional independence assumption, since no exclusion restrictions are available. Under this condition, the ET2TM might result in poor identification of parameters (SMITH, 2003; WOOLDRIDGE, 2010). The error covariance was tested to be not significant from zero, which supports the choice of the model.

participation of the household (F), i.e. whether the household uses loans or experienced credit rationing.

$$X = [H, V, P] = [(Z, L, K, F), V, P] \quad (5)$$

Regarding demographics (Z) we include household size, female headship, age and education of the household head. These variables tend to influence risk attitudes and therefore preferences for investments. Smaller households with female, older and less educated heads are thereby expected to invest less (BRYANT and GRAY, 2005; HARDEWEG et al., 2013).

Labor availability and allocation (L) influence the capability of the household to invest (BINSWANGER et al., 1993; DAVIS et al., 2009). In our models we include two sets of variables that capture labor allocation effects. First, we include dummy variables for commercial crop farming, livestock farming and perennial crop farming, as well as for off-farm and self-employment income. These measure the income structure and agricultural intensity. Second, we include variables on the number of household members with their main occupation in agriculture, off-farm and self-employment, as well as the number of migrants to urban centers. Off-farm employment and migration can positive influence investment due to the additional income, or can reduce the likelihood of investment because of labor scarcity. The result depends on the type of the household and regional conditions, such as agricultural potential or access to markets (KILIC et al., 2009).

To measure capital endowment (K) as a part of households' capabilities, we included size of own land, asset value, household income and savings. Ownership of land and land size have been found to positively influence investments, since they reduce investment risk, improve access to loans and improve investment efficiency (e.g. FENSKE, 2011; HAYAMI, 2007b). Asset value, income and savings positively influence the household's capabilities to invest (REARDON et al., 2000). Shocks, e.g. health shocks, can reduce household capability to invest by reducing capital endowment and labor availability (DERCON and KRISHNAN, 2000; GERTLER and GRUBER, 2002). To measure the effects of different negative shocks, we included the occurrence of severe agricultural, economic and demographic shocks. Agricultural shocks mainly consist of weather shocks, which can reduce agricultural outputs and destroy assets. Economic shocks include negative price and market developments and job losses. Demographic shocks include health shocks, death and negative effects of migration or changes in the family structure.

To measure capital market participation of the households (F), we include the amount of loans and a zero-one variable that accounts for a direct credit constraint of the household and equals one if the household applied for a loan and did not receive it. Credit constraints were shown to be a limiting factor for smallholder investment (REARDON et al., 2000; FAN and CHAN-KANG, 2005).

As BINSWANGER et al. (1993) show, village infrastructure influences households' capabilities and incentives to invest. To account for the effects of village characteristics (V), distance to the district town and village size (number of households) are included. Additionally and similar to clusters in rural small-scale industries (PORTER, 2000), other households in the village investing in agriculture might encourage farmers to invest due to available knowledge and the demonstration of positive outcomes. To account for this effect, the amount of investments by other households in the village is included. Dummy variables for the respective provinces control for unobserved spatial differences in the level of development. An overview of the variables included in the empirical models is shown in appendix 1.

4 Data

This paper is based on a unique and rich three year household panel data set of three provinces in Northeastern Thailand, which was collected under the DFG FOR 756 project on vulnerability to poverty. The survey was conducted in 2007, 2008[4] and 2010 and contains data of some 2,200 households in 220 villages.[5] The three provinces included in the survey, namely Ubon Ratchathani, Buriram and Nakhon Phanom were purposely selected on the basis of a low per capita income, the importance of agriculture, low agricultural potential and remoteness in some and high potential in other districts, differing agro-ecological conditions and variation in development potential (HARDEWEG et al., 2012). Within the provinces, a three-stage cluster sampling procedure on sub-district, village and household level was employed, resulting in a household sample representative for the rural areas of the three provinces. The survey instrument was a comprehensive questionnaire covering detailed information on household members, composition of income, as well as shock experience. In 2010, the questionnaire was complemented by an investment module, which asked recall data on farm and business investment activities for the last 5 years. In 2007 and 2010 a village survey was additionally conducted.

[4] The 2008 data was not used in this analysis.

[5] www.vulnerability-asia.uni-hannover.de, for the sampling procedure see HARDEWEG et al. (2012).

5 Descriptive Statistics

In the 2010 survey, households were asked about the investments they undertook during the last four years. The share of households that reported investments during this time period is small (Table 1). The majority of households did not invest; households who only undertake farm investments account for one fourth while less than 7% invested in SSEs, and 65 households (3%) in both.

Table 1. Households´ participation in different investment types (2007-2010)

HHs with	Freq.	Percent
Farm investments	524	24.89
Enterprise investments	142	6.75
Farm and business investments	65	3.09
No investments	1,374	65.27
Total	2,105	100

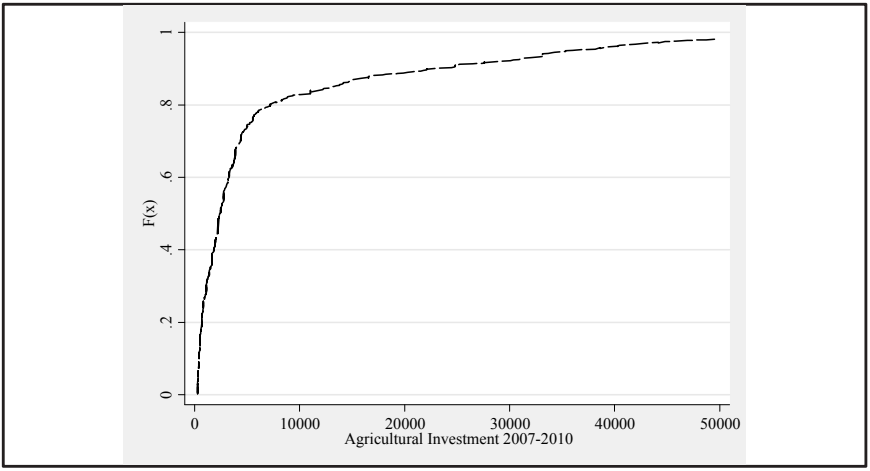
Source: own calculations based on household survey

In total, 1,091 investments for productive activities have been reported for the time period 05/2007-04/2010, with most of the investments reported in 2010. The majority of households (67%) reported one investment in the period observed and 20% of the households reported two items. Only about 15% reported more than two investments.

Most agricultural investments are small investments, resulting in a positively skewed distribution with a mean of 6,165 PPP-$ and a median of 2,042 PPP-$ although we find a few cases with over 100,000 PPP-$. The overall distribution of investment amount is described in Figure 1.

Table 2 shows the share of different investment types. The most frequent type of investment are transportation vehicles. This is also where households spend the highest amount on average. In exceptional cases the amount invested reached 120,000 PPP-$ for example, a household with a trading business reported the purchase of a truck for agricultural crops and another households one worth 90,000 PPP-$ for transporting livestock. Investments in farm machinery and agricultural buildings make up for almost another third of investments. This category also includes tractors and other farm equipment. 22% of investments go into land and land improvement (e.g. irrigation and establishment of perennial crops such as rubber). Livestock investments (10.8%) show are of lower value with a mean of 2,552 PPP-$, but a wide range with establishing a cattle herd (around 10,000 PPP-$) and a large scale chicken farm with 149,000 PPP-$.

Figure 1. Density function of investment value per household (up to 50,000 PPP-$), 2007-2010



Source: own calculations based on household survey

The purposes of investments are several but most households stated that they invest to make their work easier (49%), or to increase (30%) and diversify income (10%). Reducing income risks (7%) and improving food security (3%) are less frequent motives.

Table 2. Number of investments per asset type

Investment type	Percent	Mean	Std. Dev.	Min.	Max.
Transportation equipment	32	8,907	14,841	276	126,408
Farm equipment, machines & buildings	27.21	6,240	11,192	276	66,240
Land and land improvements	21.87	4,794	9,190	276	62,100
Livestock	10.77	2,558	12,871	276	149,040
Non-farm equipment	8.14	3,592	9,194	276	63,480
Total	100	6,165	12,334	276	149,040

Source: own calculations based on household survey

6 Model Results

6.1 Determinants of Different Investment Types

Our multinomial logit model allows us to assess the probability of rural households to undertake different types of investments, namely in agriculture, in small-scale enterprises (SSEs) and in both. The base group is all households that do not invest hence independent variables indicate the relative importance of a particular factor to influence either type of investment. Direction and strength of influence of the explanatory variables can be compared across the three types of investments.

Results show (Table 3) that household size significantly increases the probability of investing in all three investment alternatives. As expected, age of household head discourages investments. This reflects role of the demographic conditions in rural villages in Thailand where often only children and the elderly stay behind. Similarly, female headed households significantly reduce the likelihood of agricultural investments.

Labor allocation corresponds with type of investment, i.e. households who have most of their labor in agriculture tend to invest in agriculture only. This suggests that households may follow different development paths with a focus on either agriculture or SSE. Households with off-farm wage employment are less likely to invest at all, which hints towards the existence of the "lost labor effect" of off-farm employment, as found by HUANG et al. (2009) and REARDON et al. (2000). Households with more persons working in SSEs tend to invest less in agriculture and but tend to expand their non-farm business. These households are pursuing an exit strategy out of agriculture, suggesting that some rural based industry development is taking place in some villages.

Households with higher income in 2007 invested more in agriculture while asset endowments positively influence all types of investments. The effect is strongest for households that undertake combined investments, i.e. in agriculture and SSEs, which suggests that wealthier households diversify more. The positive coefficient of the variable "land owned" for agricultural investments and its negative sign for SSEs once again suggest that households differ in terms of their livelihood strategy. Agricultural shocks do not affect either investment type, but seem to be relevant for those households that undertake both investments. It is possible that households may forego either type of investment as a coping strategy if such events occur.

Access to finance is not a factor for agricultural investments but is significant for SSE investments. Perhaps, rural lending institutions favor business investments over agriculture. Households investing in agriculture tend to be better endowed with land and have higher incomes and rely on own financial sources.

Table 3. Determinants of different investment decision types: multinomial logit model

	Agricultural investments	Enterprise investments	Farm and enterprise investments
HHsize	0.150*** (0.041)	0.078 (0.078)	0.223** (0.108)
AgeHHH	-0.011** (0.005)	-0.030*** (0.009)	-0.020 (0.013)
FemHHH	-0.297** (0.131)	-0.005 (0.213)	-0.309 (0.371)
EduHHH	0.018 (0.022)	-0.017 (0.035)	0.079* (0.043)
Crop	0.331** (0.133)	0.139 (0.226)	1.016*** (0.369)
Livestock	0.322*** (0.115)	0.125 (0.215)	0.505* (0.298)
Perennial	0.064 (0.208)	-0.180 (0.396)	-0.667 (0.490)
Migrant	-0.023 (0.030)	0.021 (0.050)	-0.126 (0.085)
Enterprise	-0.296* (0.156)	0.649*** (0.228)	0.877*** (0.301)
WageEmpl	-0.303** (0.121)	-0.414* (0.213)	0.077 (0.301)
NumberAgri	0.027 (0.061)	0.019 (0.110)	0.126 (0.170)
NumberSSE	-0.264* (0.136)	0.247 (0.158)	0.168 (0.193)
NumberWage	-0.048 (0.061)	-0.057 (0.102)	-0.078 (0.157)
IncomePC (log)	0.442** (0.223)	0.637 (0.418)	0.054 (0.322)
Savings (log)	0.020 (0.021)	0.011 (0.038)	-0.041 (0.054)
LandsizePC	0.118* (0.063)	-0.372** (0.171)	0.028 (0.110)
AssetValuePC (log)	0.177*** (0.061)	0.187* (0.102)	0.592*** (0.143)
AgriShock	-0.213 (0.133)	0.201 (0.220)	-1.347*** (0.415)
EconomShock	0.048 (0.173)	-0.543 (0.378)	0.079 (0.443)
DemogrShock	-0.154 (0.149)	-0.212 (0.268)	-0.300 (0.393)
Loan	-0.003 (0.022)	0.125*** (0.048)	0.093 (0.061)
CreditRationing	-0.069 (0.185)	-1.134** (0.447)	0.039 (0.445)
InvestmentVill[1]	0.000** (0.000)	0.000 (0.000)	0.000*** (0.000)
VillageSize	-0.000 (0.001)	-0.003** (0.002)	-0.005** (0.003)
DistanceTown	-0.016** (0.007)	-0.012 (0.011)	0.013 (0.016)
Buriram	-0.527*** (0.128)	-0.552** (0.254)	-1.432*** (0.426)
NakhonPhanom	0.644*** (0.153)	0.998*** (0.252)	1.344*** (0.329)
_cons	-4.758*** (1.369)	-6.493*** (2.482)	-9.185*** (2.137)
N	2050		
Log likelihood	-1643.24		

Note: Base outcome: no investment. * p<0.1, ** p<0.05, *** p<0.01. Standard errors in parentheses are robust. Model is robust to the exclusion of income and loan. Data is of 2007 if not remarked otherwise. [1]investment data, 2007-2010

Source: own calculations based on household survey

The overall investment intensity in the village and the socio-economic conditions of the province significantly influence all investment types. Relative to the base province Ubon Ratchathani, investment is stronger in the province of Nakhon Phanom, which is the poorest among the three provinces in terms of income per capita. This may suggest that some "catching up" takes place in poorer provinces. Village remoteness, measured by the distance to town, has a negative effect on agricultural investments, suggesting the growing market orientation of agriculture.

In summary, the results from model 1 allow to extract some important messages. First, household wealth positively influences investments. Second, agricultural investments tend to be undertaken by larger households with higher labor capacity and comparatively larger landholdings. Third, for small scale business investments, access to credit is an important factor, while this does not play a role for agricultural investments. Fourth, households engaged in off-farm wage employment are less likely to invest in either option. These tend to be the poorer households which do not generate enough capacity to invest and may have to reduce consumption in case of severe shocks. Fifth, shocks are not a significant factor for investments, which can be explained by the fact that only wealthier households invest who are in a better position to cope with shocks. Sixth, there is a geographic dimension to investments; the remoteness of a village is a constraint for investments in agriculture. This shows that connectivity to markets is a key factor for agricultural development. In the next section we undertake a more in-depth analysis of agricultural investments.

6.2 Determinants of Investment in Agriculture

We use a hurdle model for our in-depth analysis of investments in agriculture. The purpose of this analysis is to explore the agricultural development potential of rural households in Northeast Thailand, which belongs to the less favorable environments but which may become important for future supply of agricultural commodities in the course of a growing global demand for food. The dependent variables of our model 2 are a binary variable for the investment decision and a continuous variable for the amount invested covering the period between 2007 and 2010. Independent variables are based on the 2007 observations with exception of the level of investment in the village and a dummy controlling for SSE investments, which are measured from 2007 to 2010.

Column 1 in Table 4 shows the results of the agricultural investment decision using a logit regression (part 1 of the hurdle model). The counterfactual are households that do not invest in agriculture but who may invest in non-farm productive activities. In column 2 results of part 2 of the hurdle model are shown, where the dependent variable is the amount of the investment. Here, only households that had invested in agriculture between 2007 and 2010 are included.

Table 4. Determinants of investment and amount decision for agricultural investments 2007-2010: lognormal hurdle model

	Part 1: Investment Decision	Part 2: Amount of Investment Decision
SSEINVD 1	-0.080 (0.107)	-0.131 (0.182)
HHsize	0.086*** (0.023)	0.109** (0.046)
AgeHHH	-0.005* (0.003)	-0.002 (0.005)
FemHHH	-0.169** (0.073)	-0.061 (0.131)
EduHHH	0.017 (0.012)	0.060*** (0.023)
Crop	0.222*** (0.073)	-0.168 (0.122)
Livestock	0.203*** (0.064)	0.001 (0.111)
Perennial	0.021 (0.117)	0.172 (0.202)
Migrant	-0.020 (0.017)	-0.036 (0.026)
Enterprise	-0.149* (0.082)	-0.026 (0.150)
WageEmpl	-0.136** (0.067)	0.032 (0.117)
NumberAgri	0.023 (0.034)	0.112* (0.060)
NumberSSE	-0.121** (0.061)	0.003 (0.125)
NumberWage	-0.021 (0.034)	0.093 (0.061)
IncomePC (log)	0.179* (0.106)	-0.032 (0.227)
Savings (log)	0.009 (0.012)	0.044** (0.021)
LandsizePC	0.074** (0.034)	0.193*** (0.044)
AssetValuePC (log)	0.117*** (0.034)	0.195*** (0.061)
AgriShock	-0.179** (0.075)	0.071 (0.130)
EconomShock	0.052 (0.098)	-0.002 (0.180)
DemogrShock	-0.077 (0.082)	-0.146 (0.140)
Loan	-0.005 (0.012)	0.017 (0.021)
CreditRationing	-0.004 (0.104)	-0.013 (0.180)
InvestmentVillage[1]	0.000** (0.000)	0.000 (0.000)
VillageSize	-0.000 (0.000)	-0.001** (0.000)
DistanceTown	-0.007* (0.004)	0.002 (0.006)
Buriram	-0.327*** (0.072)	-0.036 (0.139)
NakhonPhanom	0.343*** (0.086)	0.041 (0.126)
_cons	-2.596*** (0.670)	5.428*** (1.378)
sigma: _cons		1.266*** (0.033)
n	2050	
Log likelihood		-2081.69

Note: * p<0.1, ** p<0.05, *** p<0.01. Standard errors in parentheses are robust. Data is of 2007 if not marked otherwise. [1]investment data, 2007-2010. Model is robust to the exclusion of income and loan. A reduced model showed robust results. All models have been checked for multicollinearity.

Source: own calculations based on household survey

Household characteristics show a significant influence on both decisions. First, consistent with model 1, larger households are more likely to invest in agriculture, and second, the amount which they invest rises with their household size. Additionally, age of the household head and female headship are negatively related to investments while education has a significant and positive sign.

Labor allocation variables have a significant influence on investments. Households with commercial crop or livestock enterprises are more likely to be agricultural investors. At the same time, being in off-farm employment or being engaged in non-farm self-employment reduces the probability to invest in agriculture. The same effect can be observed for households that have a high number of persons engaged in non-farm businesses. The number of household members working in agriculture positively influences the amount of investment. Wealthier households with a higher income in 2007, with larger landholdings and a higher asset value invest in agriculture, and the amount of investment rises with land size, asset value and savings.

Agricultural shocks negatively influence the decision to invest, but do not have a significant effect on the amount invested. One reason might be that larger investments are undertaken by wealthier households, which are better able to cope with shocks. Investment intensity in the village positively, and remoteness of the village negatively, influence the decision to invest in agriculture. A provincial effect can only be observed for the decision to invest in agriculture but not for the invested amount.

To summarize the results of model 2 we can derive that households which undertake small investments are different from those which invest large amounts. First, potentially marginalized households with female and older household heads have a lower probability to invest agriculture, while larger investments are undertaken by households where the household head has higher education levels. Second, land ownership and wealth are important for both, the decision for and the amount of investment in agriculture. Third, labor availability in agriculture facilitates larger investments, while at the same time off-farm employment in general has a negative effect on the decision to invest. Fourth, external finance does not play a role for farm investments, instead higher income positively influences the decision to invest and higher savings favor larger investments. Fifth, regarding a more regional perspective, at least for smaller investments a cluster effect can be observed. This suggests that the village conditions can favor or discourage agricultural investment.

7 Summary and Conclusions

This paper analyzes the factors influencing the decision of rural households to invest in agriculture and non-agricultural activities and the amount of their investments in agriculture. Two models were used explore the three questions posed in section 1 and the four hypotheses established in section 2 of the paper. First, a multinomial logit model was used to analyze households' behavior with regards to different investment options namely in agriculture, non-farm enterprises or both. Second a hurdle model was used for a more in-depth analysis of agricultural investments.

We have four hypotheses regarding the decision for and amount of rural households' investments: (1) households with better endowments are more likely to invest, (2) household demographics and location factors are important determinants of investments, (3) access to finance facilitates especially the larger investments, (4) labor diversification influences investments of rural households.

Our results supported the first hypothesis: wealth and assets influence both, the probability to invest in all types of productive assets and the amount invested in agriculture. Also, the second hypothesis on the influence of household characteristics and location factors can be confirmed. Potentially marginalized households with female and older household heads, as well as households in remote areas, invest less. Results regarding the third hypothesis on access to finance are mixed. While loans and credit rationing do not have significant effects on either the decision or the amount of agricultural investments, they increase the probability to invest in SSEs. Large agricultural investments on the contrary are favored by high savings. For the last hypothesis, the influence of labor diversification on investments, we found a lost labor effect of off-farm employment.

Returning to our initial research questions, we find, that wealth and a specialization on agriculture favor investments in general, while remoteness, age of the household head and female headship hinder them. Large agricultural investments are additionally favored by land and labor availability in agriculture, savings and education.

Some conclusions on the future development of agriculture and of rural villages in Northeast Thailand can be drawn from these results. First, it is remarkable that only one third of households report any investment during a three year period, which includes two post crisis years where the general conditions for growth were positive also due to higher prices for agricultural products. Consistent with other literature (GÖDECKE and WAIBEL, 2011; ROZELLE et al., 1999) many rural households rely on wage labor as the main source of income and therefore tend to pay less attention to increase their productive assets. Many households may invest in consumptive assets like house or hold other forms of savings. Resource endowments and infrastructure

play important roles for investments. Hence, from a geographic perspective productive investments tend to cluster in the villages with better conditions and among the wealthier households. Poorer households seem to rely on existing levels of resource endowments to sustain their income and consumption levels. The relatively small extent of investments has implications for the distribution of wealth in rural areas in the future. While there is already a large rural-urban income gap, a growing gap within rural areas is likely to emerge. This may have consequences for the social coherence of village societies and may lay the ground to enlarge already existing conflicts. Finally, our results point to constraints for investments that may give room for government intervention. For example, improving physical infrastructure, offering higher quality education and improving job security in the non-farm sector may facilitate structural change and allow agriculturally oriented farms to grow and modernize.

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Appendix

Appendix 1. Overview of variables included in the model: Comparison of HHs with and without agricultural investments

Variable name	Description	Unit	Non- Investing HHs		Investing HHs		Diff. of means
			Mean	Std.Dev.	Mean	Std.Dev.	
AgINV	Agricultural investments, 2007 -2010	PPP-$	0	0	7676.69	16741.47	-
SSEINVD	Household invested in SSE, 2007- 2010	1 = yes	0.09	0.29	0.11	0.31	ns
Household characteristics							
HHsize	Household size	No.	3.95	1.74	4.21	1.72	***
AgeHHH	Age household head	years	55.32	13.39	53.31	12.65	***
FemHHH	Female headed household	1 = yes	0.32	0.47	0.23	0.42	***
EduHHH	Education of household head	years	4.71	2.88	5.21	3.03	***
Labor allocation							
Crop	Crop Farmer	1 = yes	0.58	0.49	0.71	0.45	***
Livestock	Livestock Farmer	1 = yes	0.41	0.49	0.53	0.50	***
Perennial	Perennial Crop Farmer	1 = yes	0.07	0.25	0.11	0.31	***
Migrant	Migrant members in Bangkok	No.	1.41	2.38	1.15	2.11	**
Enterprise	Household has enterprise	1 = yes	0.25	0.43	0.25	0.43	ns
WageEmpl	Household has wage employment	1 = yes	0.55	0.50	0.52	0.50	ns
NumberAgri	Members with main occupation agriculture	No.	1.60	1.26	1.98	1.30	***
NumberSSE	Members with main occupation own enterprise	No.	0.26	0.69	0.19	0.57	**
NumberWage	Members with main occupation wage employment	No.	1.10	1.27	0.96	1.13	**
Capital endowment							
IncomePC	Income per capita per month	PPP-$	128.87	239.03	165.95	320.12	***
Savings	Amount of household savings	PPP-$	726.31	3499.65	1356.98	5055.92	***
LandsizePC	Land owned per capita	ha	0.64	1.06	0.91	1.47	***
AssetValuePC	Asset value per capita	PPP-$	2174.49	3907.37	2972.05	5172.92	***
AgriShock	Household experienced severe agricultural shock	1 = yes	0.24	0.43	0.22	0.42	ns
EconomShock	Household experienced severe economic shock	1 = yes	0.11	0.32	0.11	0.32	ns
DemogrShock	Household experienced severe demographic shock	1 = yes	0.20	0.40	0.16	0.37	**
Capital market participation							
Loan	Amount of loan HH received	PPP-$	2596.79	5597.00	3176.54	6256.28	***
CreditRationing	Experienced credit rationing	1 = yes	0.10	0.30	0.10	0.29	ns
Village infrastructure							
InvestmentVill	Agricultural investments of other HH in the village, 2007- 2010	PPP-$	16882.14	29676.62	23196.08	36733.53	***
VillageSize	Number of HH in the village	No.	150.72	90.03	147.53	125.51	***
DistanceTown	Distance to district town	minutes	13.55	8.02	13.32	8.64	ns
Buriram	Located in Buriram province	1 = yes	0.42	0.49	0.28	0.45	***
NakhonPh	Located in Nakhon Phanom province	1 = yes	0.15	0.36	0.25	0.44	***
n			*1516*		*589*		

Note: values are for 2007 on balanced panel, if not remarked otherwise.
Difference of means is tested with Wilcoxon rank sum test for continuous and chi-square test for dummy variables.
SSE: Small scale enterprise

Source: own calculations based on household survey