Risk Attitudes and Returns in Rural Economics: Evidence from Thailand and Vietnam

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Abstract

Risk attitudes play an important role in the transformation process of traditional farm households to business entities in rural areas of emerging market economies. In addition, these household live in risky environments and are exposed to a myriad of adverse events. Recent empirical studies suggest that covariate shocks trigger substantial changes in poor people's risk attitudes. If shocks increase risk aversion, a negative feedback loop may result, as poor and risk-averse people are likely to invest in low-risk and low-return activities, increasing the likelihood that they will remain below the poverty line. Empirical evidence on this negative feedback loop is, however, scant. In this paper, we investigate whether and to what extent changes in risk attitudes that were caused by adverse shocks lead to changes in economic decision-making. Our analysis is based on a unique 10 years panel data set from rural Thailand and Vietnam. The data set includes information on individual risk attitudes and investment behavior of approximately 2,000 households. We combine this data set with historical rainfall data at village level. This combination allows us to empirically investigate whether variations in economic behavior can be explained by variations in risk attitudes that were triggered by rainfall shocks. Our results show that increases in risk aversion that were driven by shocks are associated with low return investments. We can also show that the negative effect is more severe among the relatively poor than among the relatively wealthy.

Key words: Risk attitudes, Returns, Rural households, Southeast Asia

JEL: D13, D81, D91, O12

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1 Introduction

Risks and returns are a major issue in the literature concerned with economic development of rural households in developing countries. Attention has been focused on measuring returns to agricultural investments (Foster and Rosenzweig 1995; Goldstein and Udry 1999; Udry and Anagol 2006; Duflo, Kremer, and Robinson 2011) or returns to capital in microenterprises (de Mel, McKenzie, and Woodruff 2008; McKenzie and Woodruff 2008; Banerjee and Duflo 2014). Results of these studies suggest that the impact of additional - especially small - investments on revenue can be high (see Banerjee and Duflo (2005) for a review).

Few studies explicitly connect returns and risks together in a developing country context. Among the few extant studies is the study by Rosenzweig and Binswanger (1993) that investigates how the composition of asset portfolios varies across different wealth levels and across different degrees of weather risk using the ICRISAT panel surveys from India. They show that the association between average profit returns to wealth and profit variability is positive. They also show that wealthier farmers living in environments with high rainfall risk produce higher returns that are less risk sensitive than returns produced by poorer farmers. Morduch (1995) uses the same data set and finds that poor farmers have limited abilities to smooth out consumption ex-post shock occurrence and choose low return production activities in order to smooth ex-ante income. Recently, Samphantharak and Townsend (2018) estimate returns on assets net of risk decomposed into covariate and idiosyncratic risk components among rural households in Thailand. They find, in contrast to previous studies, that poor households are more involved in risky activities and consequently generate higher expected, average returns. However, adjusting the returns, i.e., subtracting risk premia from expected, average returns, shows that the poor households' net returns are lower or not different from those of the wealthy. Samphantharak and Townsend (2018) conclude that the poor are hence, not credit constrained in the usual sense, but rather are excluded from activities that produce higher net returns. These activities are available to richer households, given their higher ability or willingness to tolerate especially covariate risks that are associated with relatively larger risk premia as compared to idiosyncratic risks. Lab-in-the-field experiments conducted with farmers from northern Ghana by Karlan et al. (2014) provide further evidence in this direction. They show that farmers' agricultural investment decisions are less responsive to relaxing credit constraints through cash grants, but strongly responsive to relaxing covariate risk constraints through rainfall index insurance.

Individual risk attitudes, however, just play a “bit part” in this literature on risk and return despite the abundance of studies that suggest the importance of risk attitudes in explaining economic behavior (see for example, the reviews of Haushofer and Fehr (2014) or Cardenas (2016))[1]. Rosenzweig and Binswanger (1993) point to the difficulty of considering individual risk attitudes in the analysis of risk and returns, i.e., the violation of the orthogonality condition which would lead to biased and inconsistent estimates.

What we study in this paper is motivated by recent empirical evidence that is starting to challenge the general accepted assumption of time-invariant risk attitudes. Long-term panel studies from both the developed and developing world examining the impact of idiosyncratic and covariate shocks on individual risk attitudes suggest that covariate shocks alter risk attitudes over time, whereas idiosyncratic shocks do not (see Liebenehm 2018 for a review). In a related paper, Liebenehm, Degener and Strobl (2018) utilize panel data from 4,212 representative households in rural Thailand and Vietnam, combine the household data with village-level rainfall data and investigate whether individuals become more or less risk averse in response to severe weather events. They show that abnormal weather shocks, such as severe droughts and floods, appear to increase individuals’ risk aversion. If shocks increase risk aversion, a negative feedback loop may result, as poor and risk averse people are likely to invest in low-risk and low-return activities, increasing the likelihood that they remain below the poverty line.

In this paper, we empirically investigate the feedback loop between shocks, risk attitudes and returns. We utilize the same panel data set as Liebenehm et al. (2018), add information on investments and profits and examine whether and to what extent changes in risk attitudes that were caused by severe weather shocks lead to changes in the composition and profitability of investments. In particular, we first, calculate returns on productive assets and their allocation across activities of rural households that are engaged in agriculture and/or in small-scale

[1] For example, DeMel et al. 2008 use risk attitudes as a further explanatory variable to explain heterogeneity, while Rosenzweig and Binswanger (1993) refer risk preferences to inter-farmer variation in preference mappings.

businesses following Samphantharak and Townsend (2012, 2018). Second, we estimate the effect of temporal changes in risk attitudes on temporal changes in returns. Finally, we investigate how the influence of risk attitudes on returns varies with households' wealth.

To comply with the orthogonality condition requires an instrumental variable that is correlated with changes in risk attitudes, but is otherwise unrelated to returns. The variable applied in this paper is rainfall shocks lagged by two time periods before the respective survey period. We argue that lagged rainfall shocks will be related to returns only through its impact on risk attitudes. Three pieces of evidence support our claim. First, the majority of our sampled households from rural Thailand and Vietnam depend on agricultural activities, in particular on growing non-permanent crops, such as rice, with up to three growing cycles per year. Consequently, the returns generated within a particular growing year are unaffected by rainfall shocks that occurred two years ago. Second, tests of overidentifying restrictions are consistent with the exogeneity of the instruments across all specifications. Third, future shocks are unrelated to current returns, which suggests exogeneity of the instruments.

The results obtained in this paper suggest the existence of a negative feedback loop between adverse shocks, risk aversion and low returns. Increasing risk aversion appears to decrease returns on assets. The estimates suggest that each marginal increase in risk aversion as a result of a severe weather shock is associated with a decrease in the annualized average return on assets by approximately 6%. Furthermore, the negative feedback loop is more severe among the relatively poor than among the relatively wealthy.

The paper proceeds as follows. In the next section, we describe the data and the measurement of the main variables of interest. In Section three, we establish a positive relation between rainfall shocks and risk aversion and demonstrate a negative reduced-form relation between shocks and returns. In Section four, we estimate the correlation between risk attitudes and returns, using shocks as instruments. We also test how effects change with wealth, and we finally draw conclusions in Section five.

2 Data and Measurement of Main Variables

The data used in this study is a combination of household panel data and historical rainfall data. The household panel data are from the Thailand Vietnam Socio Economic Panel (TVSEP) survey, a comprehensive survey initiated in 2007 in three provinces of Thailand and three provinces of Vietnam. The provinces are rather rural and located in the peripheral regions by the border of Cambodia and Laos. The Thai provinces are Buriram, Nakhon Phanom and Ubon Ratchathani. They are located in the less developed northeastern region of Thailand and are relatively homogenous in their agro-ecological characteristics. In contrast, the provinces in Vietnam are more heterogeneous. Ha Tinh and Thua Thien Hue stretch across Vietnam's Northern Central Coast, while Dak Lak is part of the landlocked Central Highlands. The sampling procedure consists of a three-stage cluster sampling design that takes country specific differences in heterogeneity into account[2]. The initial sample of 4,400 households is representative of the rural and vulnerable population in the selected provinces and areas with similar conditions.

The analysis presented in this paper is based on five survey waves in 2007, 2008, 2010, 2013 and 2016. We include only the households that were present in the survey throughout the five survey waves. In addition, we drop the households whose agricultural activities do not mainly depend on cultivating non-permanent crops in order to comply with the exclusion restriction. In the end, our sample consists of 2,092 households: 1,138 from Thailand and 954 from Vietnam. Table 1 shows the descriptive statistics of household characteristics across the six provinces. The median household, as defined as a nucleus household that includes all members that are residing more than 180 days, consists of four members with equal shares between males and females. The average age of all household members is a bit higher in Thailand than in Vietnam, however, maximum years of education are higher in Vietnam than in Thailand. Furthermore, Thai households are wealthier than Vietnamese households, especially in terms of assets. Hereby, the largest contribution comes from productive assets such as tractors or machines used in agricultural production, productive land and large livestock. In both countries, financial assets such as savings and loans are relatively small, whereas liabilities amount to up to 34% of total assets.

[2] For details on the sampling procedure, see Hardeweg, Klasen and Waibel (2013).

Table 1a Descriptive statistics of household characteristics - Thailand

Country	**Thailand**											
Province	**Buriram**				**Ubon Ratchathani**				**Nakhon Phanom**			
		Percentiles				Percentiles				Percentiles		
	N	25th	50th	75th	N	25th	50th	75th	N	25th	50th	75th
As of 2007												
Household size	392	3	4	5	530	3	4	5	216	3	4	5
Male	392	1	2	3	530	1	2	3	216	1	2	3
Female	392	1	2	3	530	1	2	3	216	1	2	3
Female ratio	392	0.33	0.50	0.67	530	0.33	0.50	0.67	216	0.40	0.50	0.67
Dependency ratio	392	0.20	0.50	1	530	0.25	0.50	1	216	0.25	0.50	1
Mean age	392	27.33	33.25	40.83	530	26.60	32.25	40.67	216	26.60	30.65	37.58
Max education	392	4	6	9	530	6	6	9.50	216	4	6	9
Share of non-permanent crops grown	392	1	1	1	530	1	1	1	216	1	1	1
5-waves average (2007 -2016)												
Net income	392	188.38	1557.44	4901.81	530	857.69	2643.85	5863.75	216	325.13	1235.55	3018.72
Total assets	392	2814.79	6190.67	10860.01	530	2695.13	5777.18	10690.68	216	1467.91	3819.03	6955.17
Productive assets	392	2936.16	5563.45	9230.17	530	2914.99	5373.65	8836.50	216	1759.98	3054.07	5288.46
Consumption assets	392	817.10	1386.15	2310.23	530	636.94	1033.09	1686.46	216	717.27	1277.91	2004.70
Financial assets	392	0	113.16	727.50	530	11.70	202.84	1104	216	0	58.20	496
Liabilities	392	137.74	2139.26	4417.71	530	0	1820.07	3701.52	216	0	1155.36	3121.46
Liability to asset ratio	392	0.02	0.26	0.65	530	0	0.24	0.59	216	0	0.26	0.73

Table 1b Descriptive statistics of household characteristics - Vietnam

Country	**Vietnam**											
Province	**Ha Tinh**				**Thua Thien Hue**				**Dak Lak**			
		Percentiles				Percentiles				Percentiles		
	N	25th	50th	75th	N	25th	50th	75th	N	25th	50th	75th
As of 2007												
Household size	471	3	4	5	312	4	5	6	171	4	5	6
Male	471	1	2	3	312	2	2	3	171	2	2	3
Female	471	1	2	3	312	2	2	3	171	2	2	3
Female ratio	471	0.40	0.50	0.67	312	0.40	0.50	0.60	171	0.38	0.50	0.63
Dependency ratio	471	0	0.50	1	312	0.33	0.67	1	171	0.33	0.50	1
Mean age	471	23.25	30.75	38.50	312	20.18	26.23	34.33	171	18.40	24.14	30.80
Max education	471	7	9	12	312	5	8	9	171	5	7	10
Share of non-permanent crops grown	471	1	1	1	312	0.79	1	1	171	0.67	1	1
5-waves average (2007 -2016)												
Net income	471	645.65	1754.92	3814.25	312	315.32	1296.98	3625.78	171	359.27	1754.40	5673.93
Total assets	471	738.62	2378.87	5150.42	312	1385.77	2766.05	4754.11	171	1457.85	3482.42	6834.76
Productive assets	471	882.26	1727.83	3541.41	312	788.54	1596.25	2748.18	171	1507.76	3043.89	5688.95
Consumption assets	471	653.95	1191.31	2007	312	709.79	1285.24	2103.31	171	611.14	1107.73	1890.11
Financial assets	471	0	0	92	312	0	0	90.60	171	0	0	0
Liabilities	471	0	1104	2668	312	0	567.60	1465.01	171	300.83	1395.78	2710.75
Liability to asset ratio	471	0	0.34	0.84	312	0	0.16	0.46	171	0.07	0.31	0.66

Notes: The unit of observation is household (nucleus). Mean age and maximum years of education were calculated across household members within a given nucleus household. Net income, assets and liabilities are in 2005PPP U.S. Dollars.
Source: Authors' calculations.

The main outcome variable of interest in this paper is the rate of return on assets (ROA). We follow Sampantharak and Twonsend (2018)'s measurement of ROA, which they found robust to alternative measurements in a previous study (Samphantharak and Townsend 2012). They define ROA as a household's accrued net income divided by its total assets, which takes into account the dual character inherent to agricultural households as being both an enterprise and a consumption unit (Ellis 1993). In particular, accrued net income is the difference between the enterprise total revenue and associated total costs. Total revenue considers the total value of all outputs produced for sale, own consumption or given away, and rental income from fixed assets, e.g., from renting out land. The total revenue equation explicitly excludes wages earned outside the household and received gifts or transfers, because they are outside the household's enterprise production activities. Total costs include the total value of inputs used in the production process of outputs, total labor costs (i.e., both wages paid to non-household members and compensation to the labor provided by household members), all utility expenses and depreciation of fixed assets. Furthermore, total assets include a household's portfolio of multiple asset classes such as fixed assets (depreciated), inventories and financial assets net of liabilities, regardless of their use for production or consumption activity (Samphantharak and Townsend 2018). The ROA calculation in this study is based on information provided in the survey modules of land, crop and livestock production, hunting and fishing, non-farm self-employment, borrowing and lending, expenditures and assets, where the reference period is 12 months. All values are converted from Thai Baht and Vietnamese Dong into 2005PPP U.S. Dollars. Table 2 presents descriptive statistics of the ROA[3]. The median ROA is ranging from 1.95% in Buriram, over 2.17% in Ubon Ratchathani, to 2.81% in Nakhon Phanom. ROA are generally higher in Vietnam, ranging from 2.96% in Dak Lak to 4.25% in Hue and Ha Tinh. The calculated ROA are in line to average real interest rates reported by the World Bank (2018) for the same time horizon and Samphantarak and Townsend's (2018) reported ROA for the Northeast region in Thailand.

[3] The composition of ROA components are shown in the Appendix (Figures A1 - A3).

Table 2 Descriptive statistics of return on assets

Country	Thailand											
Province	Buriram				Ubon Ratchathani				Nakhon Phanom			
		Percentiles				Percentiles				Percentiles		
	N	25th	50th	75th	N	25th	50th	75th	N	25th	50th	75th
Mean	392	1.34	1.95	2.81	530	1.55	2.17	3.17	216	2.05	2.81	3.74
Standard deviation	392	0.54	0.96	1.7	530	0.62	1.07	1.95	216	0.79	1.28	2.17
Coefficient of variation	392	0.36	0.53	0.71	530	0.39	0.52	0.67	216	0.32	0.51	0.65
Country	Vietnam											
Province	Ha Tinh				Thua Thien Hue				Dak Lak			
Mean	471	3.28	4.25	5.47	312	3.16	4.26	5.94	171	2.02	2.96	4.21
Standard deviation	471	1.5	2.3	3.61	312	1.09	1.87	3.49	171	0.8	1.34	2.15
Coefficient of variation	471	0.42	0.57	0.73	312	0.33	0.45	0.67	171	0.34	0.45	0.58

Notes: The unit of observation is household (nucleus). ROA is computed by a household's net income divided by the household's average total assets over the reference period, i.e., 12 months between May and April. ROA is in real terms adjusted to 2005PPP U.S. Dollars. ROAs' mean, standard deviation and coefficient of variation are computed from the annual ROA for each household over five survey waves (2007-2016).
Source: Authors' calculations.

The main explanatory variable in this paper is the survey-based measure of risk attitudes, originally suggested by Dohmen et al. (2011). In this measure respondents are asked to classify themselves on an eleven-point Likert scale, where zero denotes being "unwilling to take risks" and ten denotes being "fully prepared to take risks". Recent studies tested the validity of the survey-based measure in different countries and contexts and generally suggest its usefulness especially in larger-scale surveys (Wölbert and Riedl 2013; Guiso, Sapienza, and Zingales 2013; Chuang and Schechter 2015; Lönnqvist et al. 2015). Furthermore, Hardeweg, Menkhoff and Waibel (2013) validated the survey-based measure in an incentive-compatible experiment using a sub-sample of the current paper's sample. We proceed interpreting this variable as the household's willingness to take risk (WTR)[4].

The instrumental variables used in this paper come from the Tropical Rainfall Measuring Mission (TRMM), a joint mission between NASA and the Japanese space agency JAXA that provided precipitation measurements in the tropical and subtropical regions from 1997 to 2015. We follow the World Meteorological Organization that recommends the Standardized Precipitation Index (SPI) for monitoring severe abnormal weather events. More specifically, the SPI measures the number of standard deviations from the long-term precipitation average after the long-term precipitation has been normalized. To calculate the SPI, we use the TRMM data series – containing 3 hourly precipitation estimates for the period from 1998 to 2014 at village coordinates – to which we fitted a two-parameter gamma distribution (Edwards and McKee 1997; Trennberth et al. 2014)[5]. We define two types of rainfall shocks, i.e., (i) a severe shortage when the SPI value is below -1.0 and (ii) a severe excess when the SPI value is above +1.0 (Hayes 2000).

[4] The survey-based measure of risk attitudes has been incorporated in the questionnaire since the 2008 survey wave.

[5] More precisely, we use the TRMM-adjusted merged-infrared precipitation (3B42 V7) product, which provides daily rainfall data for the period 1998 to 2014 for every village. These 3 hourly precipitation estimates were generated by first using the TRMM VIRS and TMI orbit data (TRMM products 1B01 and 2A12) and the TMI/TRMM Combined Instrument (TCI) calibration parameters (from TRMM product 3B31) to produce IR calibration parameters. The derived IR calibration parameters were then employed to adjust the merged-IR precipitation data, which consists of GMS, GOES-E, GOES-W, Meteosat-7, Meteosat-5, and NOAA-12 data. The final gridded, adjusted merged-IR precipitation (mm/hr) have a 3 hourly temporal resolution and a 0.25-degree by 0.25-degree spatial resolution and extend from 50 degrees south to 50 degrees north latitude.

3 Correlations between Rainfall Shocks, Risk Attitudes and Returns

Having described in the previous section the main variables of interest, we proceed in this section with the establishment of their relationships to each other. Since the survey-based measure of risk attitudes was introduced in the 2008 survey wave, the following analyses reduce the observations to the survey waves 2008 to 2016. Table 3 presents growth rates in households' willingness to take risk as a function of severe rainfall shocks. We calculate a household's WTR-growth rate as its deviation from provincial averages in order to control for provincial trends in risk attitudes. For the most part the expected pattern of coefficients emerges from Table 3, i.e., there is a negative relation between rainfall shocks and households' willingness to take risk. However, the timing of the shock event matters. Households' WTR-growth rates fell below 85% and 170% of the provincial averages in Dak Lak and Ha Tinh provinces when exposed to shocks one year ago and below 100% and 144% in Ubon Ratchathani and Buriram provinces when exposed to shocks two years ago. In contrast, the effects of rainfall shocks that occurred in the same year do not show any significant effects on risk attitudes.

Table 3 Effect of rainfall shocks on households' willingness to take risk (annual deviation from provincial average)

		Timing of rainfall shocks		
	N	**Same year**	**Previous year**	**Two years ago**
Thailand				
Buriram	392	0.089 (0.365)	-	-1.44** (0.713)
Ubon Ratchathani	530	0.568 (0.556)	0.514 (0.449)	-1.007* (0.522)
Nakhon Phanom	216	-0.663 (0.937)	0.828 (0.741)	-0.888 (1.121)
Average across all provinces		-0.046 (0.196)	0.823** (0.348)	-0.393* (0.124)
Vietnam				
Ha Tinh	471	-	-1.702*** (0.358)	0.581 (0.362)
Thua Thien Hue	312	0.387 (0.236)	-0.052 (0.32)	0.842* (0.484)
Dak Lak	171	-0.002 (0.757)	-0.848* (0.506)	0.055 (0.519)
Average across all provinces		0.235 (0.216)	-0.889*** (0.174)	0.403** (0.203)

Notes: The unit of observation is household (nucleus). Values in the table reflect the average annual deviation in a household's WTR from the provincial average across four survey waves (2008-2016) due to the unavailability of WTR in 2007. Single, double, and triple asterisks (*, **, ***) denote $p < 0.10$, 0.05, and 0.01, respectively. Robust standard errors are reported in parentheses.
Source: Authors' calculations.

A comparison of the patterns of changes in risk attitudes and changes in returns under the different timings of shocks provides further insights on the interlinkages between shocks, risk attitudes and returns. We, therefore, estimate the effects of rainfall shocks on households' risk attitudes and returns, adding a wide range of covariates including year dummies and household characteristics. Table 4 reports similar patterns on the effect of rainfall shocks on individual risk attitudes as Table 3. The significant negative effects of shocks on risk attitudes continue to emerge from lagged shocks by one and two years. These shocks, however, are not significantly associated with changes in households' returns. One can, therefore, conclude that lagged rainfall shocks are an appropriate instrument since it is correlated with risk attitudes, but unrelated to returns. Furthermore, the coefficient of future shocks on returns in the first row of Table 4 is substantially small and statistically insignificant, which is also consistent with the claim that the timing of shocks is orthogonal to changes in returns. Finally, the shock indicators are jointly significant at the 1% level, which suggests that the shock classification in this manner fits well to the data.

Table 4 Response of households' WTR and ROA to rainfall shocks

	Δ WTR		**Δ ln ROA**	
	Coefficient	Standard error	Coefficient	Standard error
Future shocks	-0.249	0.166	-0.006	0.009
Shocks in the same year	-0.201	0.128	0.0335***	0.012
Shocks in the previous year	-0.438***	0.096	-0.004	0.01
Shocks two years ago	-0.254**	0.127	-0.0006	0.007
Δ Household size	-0.02	0.059	0.001	0.003
Δ Female ratio	0.116	0.454	0.017	0.02
Δ Dependency ratio	-0.087	0.111	-0.005	0.036
Δ Mean age	-0.018*	0.011	0.0001	0.001
Δ Max education	0.029	0.023	0.0001	0.001
Year controls	Yes		Yes	
R^2	0.0217		0.02	
P-value: all shocks	<0.001		<0.001	
Number of observations	2,018		2,021	

Notes: The dependent variables are ΔWillingness to Take Risk and Δln Return on Assets. Single, double, and triple asterisks (*, **, ***) denote p < 0.10, 0.05, and 0.01, respectively. Standard errors are clustered at the household level and reported in parentheses.
Source: Authors' calculations.

4 Estimates of the Effects of Risk Attitudes on Returns

Having demonstrated in the previous section a negative relationship between rainfall shocks and risk attitudes and a reduced-form relation between shocks and changes in returns, we apply in this section an instrumental variable approach to estimate the effect of risk attitudes on returns.

We assume that changes in returns and risk attitudes are determined according to:

$$(1) \quad \Delta \ln(ROA_{it}) = \beta\Delta(WTR_{it}) + X'_{it}\theta + \gamma_t + c_i + \varepsilon_{it},$$

where ROA_{it} and WTR_{it} are the relevant rate of return on assets and risk attitudes of household *i* in year *t*, respectively. X_{it} is a vector of covariates, γ_t is a vector of year dummies. Differencing the data neutralizes time-invariant unobserved heterogeneity c_i. However, unobserved time-variant effects ε_{it} may still simultaneously affect both sides of the equation. For example, the effect of an increase in risk attitudes on returns is likely to depend on idiosyncratic shocks that affect the total level of household wealth. We, therefore, follow Rosenzweig and Binswanger's (1993) suggestion and include inherited wealth (i.e., mostly inherited land) as one among other covariate variables in vector X that is arguably less endogenous than a household's current wealth. In some specifications we also include village-fixed effects in order to control for historical developments. The coefficient of interest is β, which will be consistently estimated using the two-stage least squares approach with lagged rainfall shocks as instruments if the exclusion restriction of rainfall shocks from the return equation holds. A priori, we expect β to be positive, i.e., increases in willingness to take risks increases returns on assets, whereas decreases in risk-taking attitudes decreases returns.

Table 5 presents the estimates. Column 1 shows fixed-effects regression estimates, which do not control for the endogeneity of risk attitudes. In the other two columns we use the indicator variables of lagged shocks as instruments for changes in individual risk attitudes. Column 3 also includes village-fixed effects.

When risk attitudes are treated as exogenous in Column 1 the coefficient is small and statistically insignificant. Instrumenting risk attitudes in Column 2, however, shows a positive coefficient of 0.056 that is statistically significant at the 1% level. Adding village-fixed effects in Column 3 marginally decreases the estimated coefficient. According to expectations, an increase in willingness to take risk by one point on the Likert scale is associated with an increase in returns on assets by 5.6%.

The other covariates in the model generally yield imprecise coefficients. For example, changes in the number of household members are positively correlated with returns, but are only significantly different from zero in the fixed-effects specification. In contrast, changes in average age of households are positive and significant in the two IV-specifications. The only variables that are consistently statistically significant across all three specifications are the ratio of females in a household and the wealth indicator. One possible explanation for the negative coefficient on female ratio is that a higher share of female members may contribute less to agricultural production, which is likely to lead to lower revenues and hence, to lower returns.

Table 5 Effect of risk attitudes on return on assets

	Δ ln ROA					
	FE		**FDIV**		**FDIV**	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Δ WTR	0.001	0.001	0.059***	0.02	0.056***	0.015
Δ Household size	0.01**	0.005	0.007	0.006	0.006	0.005
Δ Female ratio	-0.05**	0.022	-0.067**	0.031	-0.072**	0.032
Δ Dependency ratio	-0.009	0.006	-0.017	0.011	-0.005	0.008
Δ Mean age	0.001	0.001	0.002*	0.001	0.002*	0.001
Δ Max education	-0.001	0.001	-0.001	0.002	-0.001	0.002
Δ Ln Inherited wealth	-0.035***	0.004	-0.036***	0.006	-0.036***	0.007
Year controls	Yes		Yes		Yes	
Village controls	Yes		No		Yes	
Instrument	No		Yes		Yes	
R^2	0.07					
P-value overid. restrictions			0.751		0.842	
Number of observations	2,076		2,045		2,045	

Notes: The dependent variable is Δln Return on Assets. Column 1 is a fixed effects regression, Columns 2 and 3 are First Difference IV regressions. Single, double, and triple asterisks (*, **, ***) denote p < 0.10, 0.05, and 0.01, respectively. Standard errors are clustered at the household level and reported in parentheses.
Source: Authors' calculations.

The negative coefficient on the wealth indicator suggests that increases in wealth are leading to lower returns, which is intuitively in contrast to what one would expect. We therefore, investigate this relation a bit further and introduce indicator variables of inherited wealth quintiles. Column 1 of Table 6 shows that effects of changes in lower wealth quintiles on returns are smaller than in higher wealth quintiles. Interacting the wealth quintiles with the instruments in Column 2 shows that the positive correlation of willingness to take risk and returns on assets decreases as wealth increases. One can conclude that returns are higher among the poor and that for them the effect of risk attitudes on returns, instrumented by shocks, is larger than for the non-poor.

Table 6 Wealth effects

	Δ ln ROA			
	FDIV with Wealth Quintiles		**FDIV with Wealth Quintiles interacted with instruments**	
	Coefficient	Standard error	Coefficient	Standard error
Δ WTR	0.057**	0.022	0.047**	0.019
Δ Household size	0.007	0.006	0.004	0.006
Δ Female ratio	-0.068*	0.04	-0.059*	0.034
Δ Dependency ratio	-0.018	0.011	-0.015	0.009
Δ Mean age	0.0016	0.001	0.001	0.001
Δ Max education	-0.001	0.002	-0.0001	0.002
Δ *Inherited wealth quintiles*			Δ *Inherited wealth quintiles* x Δ *WTR*	
2nd quintile	-0.022	0.015	0.047**	0.018
3rd quintile	-0.049***	0.017	0.046**	0.018
4th quintile	-0.08***	0.02	0.042**	0.019
5th quintile	-0.128***	0.021	0.042**	0.019
Year controls	Yes		Yes	
Village controls	No		No	
Instrument	Yes		Yes	
P-value overid. restrictions	0.861		0.095	
Number of observations	2,045		2,045	

Notes: The dependent variable is Δln Return on Assets. Column 1 and 2 are First Difference IV regressions. Non-linear combinations of the interaction terms are shown in Column 2. Single, double, and triple asterisks (*, **, ***) denote $p < 0.10$, 0.05, and 0.01, respectively. Standard errors are clustered at the household level and reported in parentheses.
Source: Authors' calculations.

5 Conclusions

This paper attempts to estimate the effect of increased risk aversion on returns on assets using lagged rainfall shocks as an instrument. Our analyses are based on rural households from Thailand and Vietnam that are mostly engaged in agricultural production and small-scale businesses. We first, measured households' returns on assets, estimated the effect of temporal changes in risk attitudes on temporal changes in returns and finally, investigated how the effect varies with households' wealth.

Our measure of the median annualized average return on assets ranges between 2%-3% in rural Thailand and 3%-4% in rural Vietnam, which corresponds to real interest rates reported for the two countries by the World Bank (2018). The estimated effect of increases in risk aversion on returns is negative, i.e., an increase in risk aversion by one unit decreases annualized average returns on assets by approximately 6%. The estimate is robust across different specifications. Finally, the examination of wealth effects shows that the negative effect of risk aversion on returns is larger for the poor. Our results, albeit preliminary, suggest empirical evidence on the existence of a negative feedback loop between adverse shocks, risk aversion and poverty.

At this stage, results are preliminary and further robustness checks are necessary. For example, it is aimed to test the sensitivity of results with respect to alternative specifications of rainfall shocks as well as of returns and to test alternative set-ups of the sample as defined at the level of respondent or the household head. Furthermore, it is aimed to investigate the effects of shock mitigation strategies.

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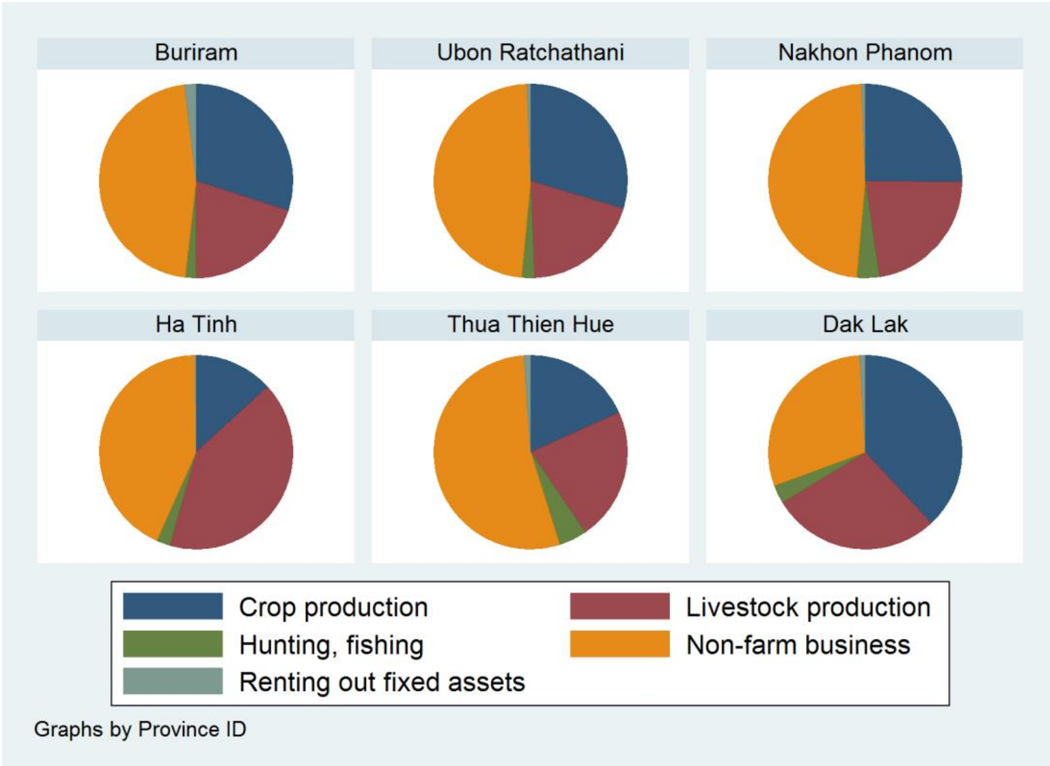

Figure A1 Composition of revenues across provinces and across 5 survey waves (2007-2016)
Source: Authors' calculation.

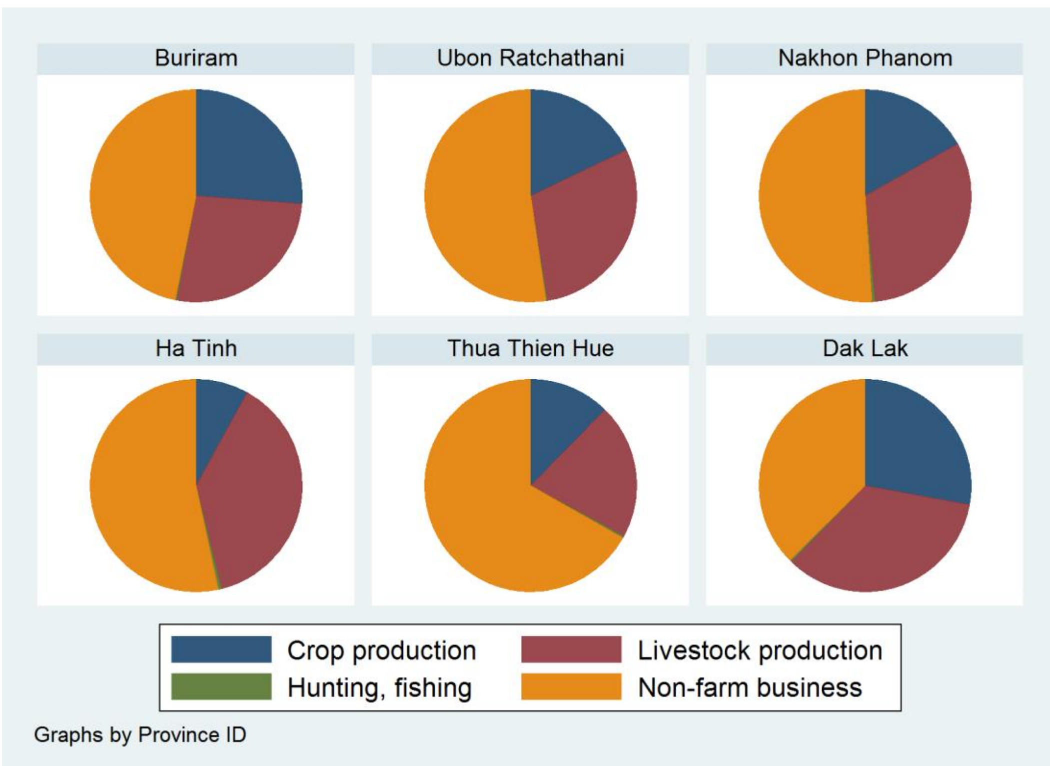

Figure A2 Composition of costs across provinces and across 5 survey waves (2007-2016)
Source: Authors' calculation.

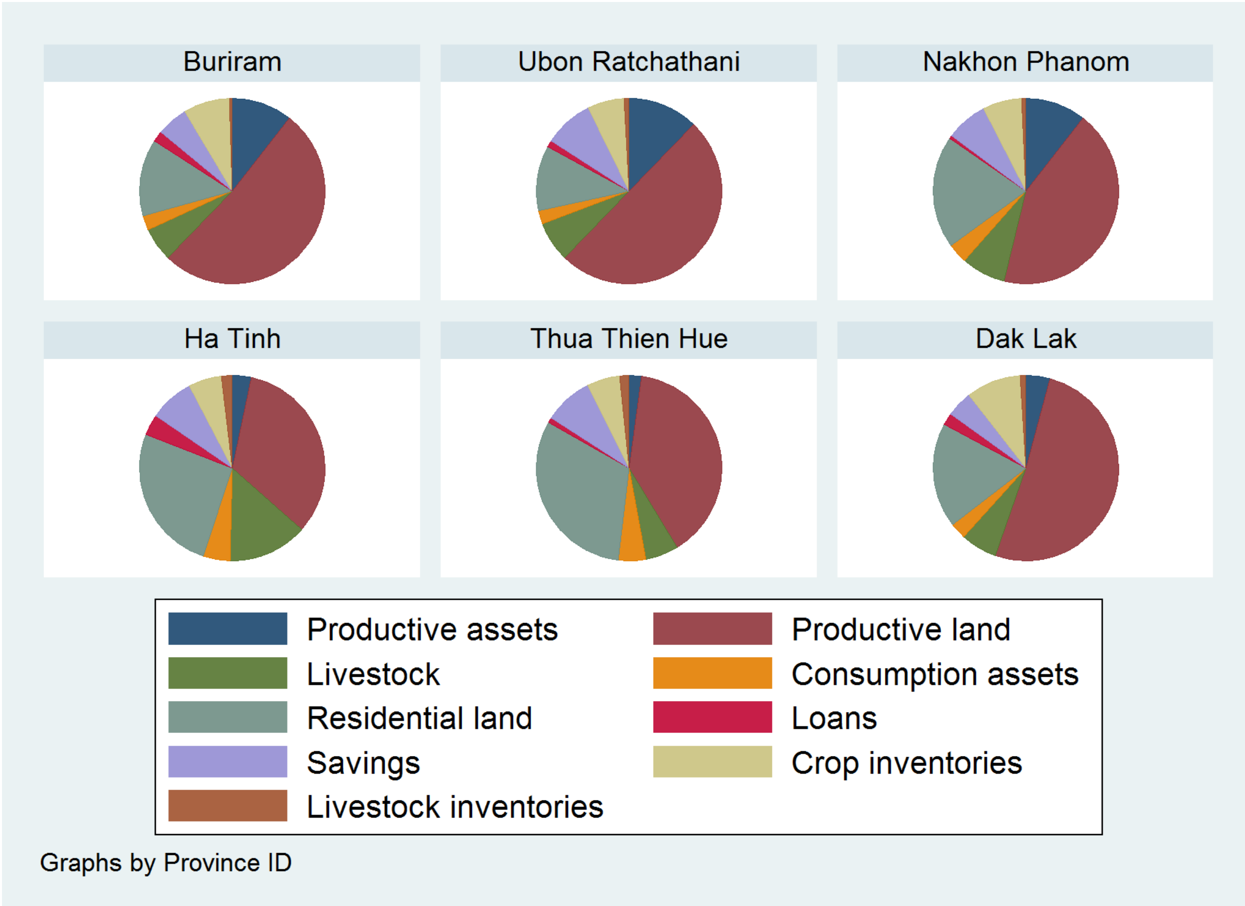

Figure A3 Composition of total assets across provinces and across 5 survey waves (2007-2016)
Source: Authors' calculation.