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Shocks, vulnerability and income generating capacity of rural households: Evidence from Southeast Asia

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Abstract

Against the background of rising weather risks this paper seeks to understand how risks impact the income generating capacity of rural households in Southeast Asia. In this study, we use assets to predict households' income generating capacity and examine the role of different shock categories on asset accumulation. In addition, we detect region, country and income group specific patterns. We use panel data from Cambodia, Laos, Thailand, and Vietnam covering 5,200 rural households. Households' income generating capacity is estimated in a fixed-effects regression based on assets owned or accessed by the household. The findings suggest that shocks decrease the asset accumulation rate of rural households by 1.4 percentage points across all four countries. While health shocks decrease households' asset accumulation rate by 1.2 to 1.4 percentage points, the effect of drought and flood shocks is twice as high. At the country level, the effect of flood shocks on asset growth are strongest in Vietnam while drought shocks disproportionately affect Laotian households. Households are largely able to anticipate the occurrence of health shocks, while droughts and floods are less predictable and thus, have a more detrimental effect on asset growth. The effects of shocks differ across income quartiles. While households in the richest quartile are able cope with weather shocks, health shocks affect their asset accumulation disproportionately. Poor households are strongest affected by drought shocks.

Keywords: Shocks, Asset-based approach, Economic development, Poverty, Regional analysis, Southeast Asia

JEL: I32, O18, Q1

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1 Introduction

Despite recent advances in poverty reduction, the income generating capacity of rural households remains volatile and adverse shocks may push households back into poverty. A non-poor household may become poor due to a shock e.g. a sick household member or an adverse weather event which both affect the household's income generating capacity and subsequently its income. While all households face shocks, rural households whose income earning activities are closely connected to agriculture and environmental resource extraction are especially at risk of experiencing frequent weather shocks (Dercon, 2002). Even though weather shocks remain a common threat to all rural households, their risks and their manifestation vary by income group.

In Southeast Asia adverse shocks are common and affect rural households frequently (Gloede et al., 2015; World Bank, 2012). Despite the overall economic growth in the region, pockets of poverty persist where households are more vulnerable to idiosyncratic shocks such as illness (World Bank, 2012). Furthermore, the frequency and impact of aggregate weather shocks, especially droughts, floods, and storms, is increasing and burden public finances in Southeast Asia (World Bank, 2012, 2013).[1] To reduce vulnerability to poverty in the region, it is vital to develop a better understanding which households move in and out of poverty, why and with what frequency. In addition, to design targeted interventions it is important to analyze how shocks affect households with different levels of income generating capacity. This study aims to fill this gap and quantifies the effect of shocks on the asset accumulation rate of households in rural Southeast Asia. Additionally, as needs may differ along the income distribution and by country, the effects of shocks are disaggregated by income group and country.

There is a large theoretical and empirical literature which looks at vulnerability to poverty (Calvo and Dercon, 2005; Klasen and Povel, 2013; Ligon and Schechter, 2004) and the influence of shocks on household income, labor supply, and well-being in Southeast Asia (Hardeweg et al., 2013; Klasen and Waibel, 2015; Klasen et al., 2015). Due to data availability, few studies are capable to compare different income groups across countries (Klasen and Povel, 2013). To date most studies primarily explore short-run effects and largely ignore heterogeneity in terms of shock incidence and shock type by different income levels (Araujo and Pabon, 2009; Heltberg et al., 2013; Wagstaff and Lindelow, 2010). Only few studies take into account the ex-ante conditions of households by taking into account the likelihood of experiencing a shock (Gloede et al., 2015).

[1] According to the World Bank (2013), the Cambodian and Laotian economies are estimated to face costs of around 18 percent or more of total public expenditures in case of a 200 year event.

The results in this paper add to the literature on asset-based income generation and examines the effects of different shocks types while controlling for the likelihood of experiencing a shock. Specifically, the three research questions are: (i) How do household with and without shocks move between income groups?, (ii) What is the impact of different shocks on households' income generating capacity? and (iii) What are general region- and country-specific patterns for households in similar income groups? In the empirical analysis, we create a transition matrix and explore how households move between income quartiles across years. Second, following Attanasio and Székely (1999), Adato et al. (2006), Carter and Barrett (2006), Bussolo and Lopez-Calva (2014), and Amare and Hohfeld (2016), we estimate the impact of shocks on households' income generating capacity based on their existing asset stock and rates of returns for productive assets. Third, we specifically quantify the effect of four distinctive shocks, namely economic, health, flood and drought shocks. Fourth, we detect general regional as well as country-specific patterns for households in similar income groups.

We use representative household-level panel data from Cambodia, Laos, Thailand and Vietnam covering 5,200 rural households for our analysis.[2] The results suggest that on average, shocks decrease the asset accumulation rate of rural households by about 1.4 percentage points. However, the effects differ by shock type, country and income quartile. While health shocks decrease households' asset growth by 1.2 to 1.4 percentage points, drought and flood shocks have a considerably larger impact as they reduce asset growth by 2 to 3 percentage points. At the country level, Vietnamese households are strongly affected by floods while Laotian households are disproportionately affected by drought shocks. Our results also suggest that health shocks have a stronger impact on households in the richest income quartile while drought shocks disproportionately affect households in the poorest income quartile.

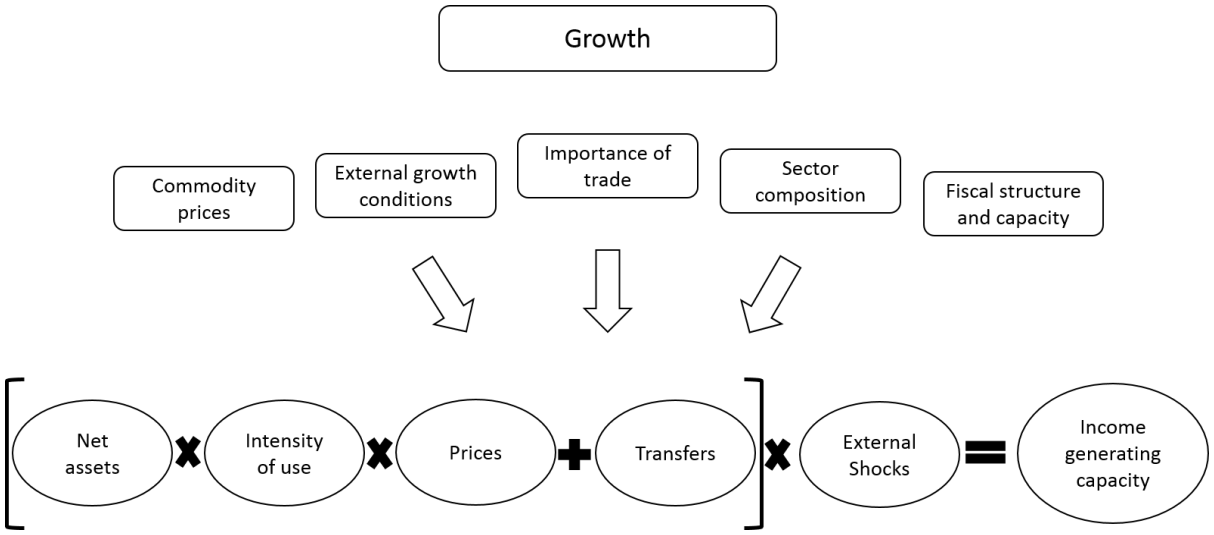
The paper is set out as follows. Section 2 introduces the conceptual framework and Section 3 presents the study area and descriptive statistics. Section 4 formulates the empirical model and the different definitions of the shock variable. Section 5 reports and discusses our main results and Section 6 presents our robustness checks. Finally, Section 7 concludes.

[2]The Thai and Vietnamese data originates from the Thailand and Vietnam Socio Economic Panel (TVSEP). Information can be found at the project webpage: https://www.tvsep.de/overview-tvsep.html. The Cambodian and Laotian data is from a related, two-year panel study.

2 Conceptual Framework

Our framework is derived from the asset-based approach (Adato et al., 2006; Amare and Hohfeld, 2016; Bussolo and Lopez-Calva, 2014; Attanasio and Székely, 1999; Carter and Barrett, 2006) which captures the households' income generating capacity in relation to macro- and micro-level factors. The macro-level, presented in the top of Figure 1, includes commodity prices, external growth conditions, importance of trade for the economy, sectoral composition of growth as well as the regional fiscal structure and capacity. At the micro-level, depicted in the lower part of Figure 1, the households' capacity to generate income depends on the households net assets and their use intensity valued at current price levels as well as transfers received. All four main determinants at the micro-level are subject to the occurrence of external shocks.

Figure 1: Asset-based approach



Adapted from: Attanasio and Székely (1999), Bussolo and Lopez-Calva (2014) and Carter and Barrett (2006).

Net assets represent the productive assets owned or accessed by a household. Given that households in the study area - rural Southeast Asia - predominantly depend on agriculture, natural capital such as land and livestock are major components of households productive assets (Vincent, 2007; Banerjee et al., 2017). Physical capital includes transportation assets and machinery owned as well as access to common pool resources such as rivers and forests (Amare and Hohfeld, 2016). In addition, assets include human and social capital of the household and entail education and skill level, labor capacity and social interactions (Bebbington, 1999). The intensity of use depends on a mix of factors including education and skill level as well as labor and land used for agricultural production (Adato et al., 2006; Carter and Barrett, 2006).

Local prices capture the economic conditions under which a household operates. Transfers are represented by additional financial capital to which the household has access to, such as remittances, social transfers, or insurance payments received (Banerjee et al., 2017). External shocks include events such as illness, bad weather or business failure that potentially decrease household income.

Mathematically, the households' income generating capacity (Y) can be expressed as the product of household's productive asset endowments and the return on these assets (Barrett, 2005):

$$Y = A'R + \mu + \epsilon^M, \tag{1}$$

where A is a vector of productive assets used by the household and R is the corresponding vector of expected returns per unit of asset owned or accessed by the household. Both the assets and the rate of return are expressed in local prices. Thus, with reference to Figure 1, the vector of assets and their respective returns represent the households' asset endowments, the use intensity of these assets as well as associated prices. Social transfers and remittances, which are unrelated to the productivity of assets controlled by the household (e.g. lottery winnings, remittances, social transfers), are represented by μ. In addition, Barrett (2005) introduces a measurement error which is depicted by ϵ^M. Asset returns are stochastic, thus:

$$R = r + \nu^R, \tag{2}$$

where r denotes the expected return per asset and ν^R is an exogenous shock to asset productivity (e.g. induced by rainfall, drought, illness, or a change in economic conditions such as prices). Following Barrett (2005) the underlying assumption is that all shocks, namely the exogenous transitory income (μ), the measurement error (ϵ^M), and the exogenous shock to asset productivity have a zero mean, constant variance, and are serially independent. Thus, the mean asset-based expected income, i.e. the households' income generating capacity, is given by $E(Y) = A'r$. Substituting equation (2) into (1) and totally differentiating yields an expression for the change in household's income generating capacity as a function of changes in the asset stock, expected returns to assets and various shocks:

$$\Delta Y = \Delta A'R + A'\Delta r + A\Delta\epsilon^R + \Delta\mu + \Delta\epsilon^M \tag{3}$$

Given that all errors are expected to have a mean of zero and are serially independent the expected income generating capacity reduces to:

$$E(\Delta Y) = \Delta A' R + A' \Delta r. \tag{4}$$

Equation (3) indicates that the households' income generating capacity, i.e. its asset-based expected income, changes either through variations in the household's productive asset holdings, the rate of return or external shocks. In our empirical analysis we focus on how the occurrence of external shocks influences the households' income generating capacity and whether the effect of shocks differs along the income distribution.

3 Background and data description

Our study uses data from four Southeast Asian countries, Cambodia, Laos, Thailand, and Vietnam. In this section we briefly introduce the institutional setting and the data. In addition, we provide descriptive statistics on poverty and asset holdings and describe the frequency and nature of shocks reported by households in the study region.

3.1 Country profiles

In terms of economic development the four countries differ substantially (see Appendix, Table 6). According to their Gross Domestic Product (GDP) per capita, Cambodia, Laos, and Vietnam belong to the lower-middle-income economies, while Thailand is classified as an upper-middle-income country (World Bank, 2018b). Thailand also has the highest inequality based on the Gini index. Referring to the poverty headcount ratios at national poverty lines, the poverty incidence is highest in Laos (23% in 2012) followed by Cambodia (17% in 2012), Vietnam (17% in 2012) and Thailand (12.6% in 2012). Despite recent growth and increases in overall household wealth in Thailand and Vietnam, pockets of poverty persist in rural areas (Hardeweg et al., 2013). Life expectancy at birth, infant mortality rate, share of population with access to basic sanitation facilities, and share of population with access to electricity all support the conclusion that households in Thailand and Vietnam are better off compared to those in Cambodia and Laos.

The cultural and institutional background across the four countries is quite diverse. Thailand and Cambodia are both constitutional monarchies which operate under relatively free, market-driven policies. Laos and Vietnam belong to the four remaining countries worldwide which are

governed by a one-party socialist system openly advocating communism (Gloede et al., 2015).[3] Overall, the study allows us to compare dynamics of rural households in four rather diverse countries both in terms of the economic as well as political conditions.

3.2 Data

The micro-economic data used in this study stems from rural household surveys conducted in Cambodia, Laos, Thailand, and Vietnam (see Figure 5 in Appendix A). The Thai and Vietnamese data originates from the Thailand and Vietnam Socio Economic Panel (TVSEP) and covers 4,000 rural households in the Thai provinces Buriram, Nakhon Panom and Ubon and the Vietnamese provinces Thua Thien Hue, Ha Tinh and Dak Lak. The Cambodian and Laotian data was collected in 2013 and 2014 by an add-on project financed by the Hannover University. It covers 1,200 rural households in the Northern province Stung Treng, Cambodia and the central province Savannakhet, Laos. To align the time frame, we restrict the Vietnamese and Thai sample to match the years of the Cambodian and Laotian survey.

Together, the data set covers about 5,200 rural households living in around 500 villages. The household sample in each province was randomly drawn based on a stratification process considering the heterogeneous agro-ecological conditions within the regions (Hardeweg et al., 2013). In Cambodia and Thailand each household in the survey region had an equal probability to be included in the survey, while poor households were oversampled in Laos and Vietnam (Hardeweg et al., 2013). We correct for this by applying sampling weights throughout our analysis. The data is representative for rural households in all four countries (Liebenehm et al., 2018). All monetary variables were converted to 2005 Purchasing Power Parity USD equivalents.

Across all countries an almost identical household survey was applied. It consists of nine sections covering individual information on household members (e.g. age, education, health, and employment) as well as household-level information on expenditures, shocks, risks, income earning activities such as farming, livestock raising and fishing, household financial situation, housing conditions, transfers received, and assets owned. In addition to the household survey, a village-level survey was administered to the village chief collecting information on the village location, population, infrastructure, employment, agriculture, and economic conditions.

Given the structure of the household surveys, we observe household-level income, consumption and asset holdings at two points in time, which are subsequently denoted as baseline and follow-

[3] The other two countries are China and Cuba.

up. The shock section is retrospective and refers to shocks that happened in the past 1 year (up to the period when the survey started). Thus, the shock section covers the time-period between the two household surveys as well as the shocks that happened in the year before the baseline survey took place. The risk section is forward-looking and asks for the shocks the household expects to face in the coming year (up to one year after the survey period). In our empirical specification we use (i) the household-level characteristics observes at baseline and the follow-up, (ii) the information about shocks that occurred between the two survey waves, (iii) the information about future risks households reported in the baseline survey.

3.3 Poverty and asset holdings in the sample

Our final household sample is balanced and consists of 4,686 households which are observed at baseline and the follow-up survey. The household characteristics differ significantly by country (see Table 1).[4] With an average income of $722 per capita households in Laos are comparatively poor. At baseline, 41% of households in Laos are considered to be poor according to the international poverty line of $1.90. Cambodian and Vietnamese households earn about $922 and $854 per capita per year, respectively. In both countries roughly every third household is classified as poor. Thai households are on average the richest with $1,820 per capita per year. This is also reflected in the the low share of poor households (17%).

These differences are confirmed by financial and human capital holdings. With average remittances received between $72 and $164 per capita and an insurance coverage rate of 3% to 46%, financial capital in Cambodia and Laos is substantially lower compared to Thailand and Vietnam. Furthermore, households in Cambodia and Laos are considerably larger and include more dependent members, especially children. Education levels are low and almost half of the average education level in Vietnam (3.5 versus 6.8 years).

Asset holdings for natural and physical capital are rather diverse. With 0.96 hectare, land holdings are smallest in Vietnam. However, in Vietnam land is centrally distributed to farmers and each household is granted a similar amount of land for farming (Do et al., 2017; Markussen et al., 2011). The value of agricultural production assets varies between $31 per capita in Laos and $45 in Cambodia. With $1,798 and $3,162 transportation assets in Cambodia and Laos are higher than in Vietnam. However, transportation assets include not only vehicles but also boats. Given that households in Cambodia and Lao are engaged in fishing and logging this

[4] In relation to the initial sample size this is equivalent to an attrition rate of almost 10%

Table 1: Descriptive statistics at baseline by country

	Cambodia		Laos		Thailand		Vietnam	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Financial Capital								
Remittances^{+}	72.20	320.89	164.39	418.36	568.80	1034.80	361.89	923.24
Access to insurance (1=yes)	0.03	0.17	0.46	0.50	0.99	0.08	0.88	0.33
Human Capital								
Household size	5.12	1.91	5.93	2.50	4.06	1.70	4.27	1.71
Number of children	1.91	1.39	2.21	1.71	1.20	1.07	1.35	1.25
Number of elderly	0.31	0.59	0.34	0.60	0.68	0.81	0.51	0.77
Education hh head (years)	3.48	3.24	3.43	3.78	4.39	3.04	6.83	4.46
Age hh head (years)	44.89	13.81	49.80	13.39	57.17	12.49	50.40	13.34
Gender hh head (1=female)	0.12	0.33	0.15	0.35	0.27	0.44	0.16	0.37
Natural Capital								
Land size in ha	2.71	2.80	2.16	1.98	3.39	3.55	0.96	3.21
Livestock in TLU	0.13	0.26	0.08	0.21	0.25	0.64	0.27	0.52
Distance to forest$^{\#}$	3.65	3.69	2.63	1.73	3.41	4.31	2.56	6.61
Distance to water-body$^{\#}$	2.28	3.09	1.24	1.53	1.97	3.40	0.24	1.68
Physical Capital								
Transportation assets^{+}	363.91	555.42	643.44	1159.45	1255.74	2410.34	294.59	618.75
Agricultural assets^{+}	45.76	82.57	30.68	118.28	40.21	102.04	38.33	95.93
Household appliances^{+}	69.03	245.71	141.44	313.13	239.85	297.67	205.36	237.10
Size house in m^2	56.90	29.76	71.17	35.40	81.68	43.96	64.64	35.92
Social Capital								
Communication assets^{+}	6.14	8.98	12.40	20.14	26.26	50.06	31.96	71.51
Ethnicity	0.81	0.39	0.48	0.50	0.94	0.24	0.79	0.40
Membership political party	0.61	0.49	0.00	0.00	0.11	0.31	0.90	0.30
Income & Poverty								
Income gen. capacity^{+}	922.24	144.56	722.05	119.39	1820.50	261.72	854.56	126.62
Income per day^{+}	2.53	0.40	1.98	0.33	4.99	0.72	2.34	0.35
Poverty (regional)$^{\circ}$	0.34	0.47	0.29	0.46	0.60	0.49	0.36	0.48
Poverty (international)$^{\varnothing}$	0.33	0.47	0.41	0.49	0.17	0.37	0.36	0.48
Shocks								
Number of shocks	3.86	2.83	2.54	2.22	2.00	2.06	2.79	2.32
Number of economic shocks	0.08	0.32	0.07	0.26	0.08	0.29	0.14	0.36
Loss from economic shocks^{+}	0.00	0.00	0.00	0.00	0.79	9.68	4.52	37.03
Number of health shocks	0.69	0.76	0.38	0.52	0.22	0.44	0.27	0.53
Loss from health shocks^{+}	9.03	67.12	15.16	74.11	0.77	12.18	0.95	18.46
Number of weather shocks	0.43	0.57	0.39	0.59	0.32	0.52	0.27	0.49
Loss from weather shocks^{+}	29.11	84.04	43.49	89.34	32.80	141.95	2.71	33.39
N	484		470		1,872		1,860	

Note: $^{+}$monetary values are all given in per capita Purchasing Power Parity 2005 $US; $^{\#}$in km, measured at village-level; $^{\circ}$regional poverty lines apply - for details see Table 7; $^{\varnothing}$international poverty line of $US 1.90. ^{s}Shock group definitions: The economic shocks include the categories strong decrease of prices for output, strong increase of prices for input, could not afford to buy food to increasing prices, lack of food availability on the market. The health shocks include illness, death, or accidents of household members. The weather shocks include drought and flood shocks.
Source: Authors' calculations.

might explain the rather high amount of transportation assets. Household appliances, which include furniture, kitchen and entertainment equipment, are higher in Thailand and Vietnam.

While all households in the area are prone to shocks, the occurrence and frequency of shocks differs across regions (see Table 1). With 3.9 shocks Cambodian households experience comparatively more adverse events, while Thai households experience only about 2 shocks per year. In line with previous research on this data set (Do et al., 2017; Gloede et al., 2015), health and weather shocks make up the majority of shocks. However, while health shocks appear rather frequent, their impact on household assets is moderate. Still the average losses from health shocks in Cambodia and Laos exceed the losses in Thailand and Vietnam. This is partly due to the relatively high share of 'out-of-pocket' health expenditures and the poor health system which means households turn to private clinics (if they can afford it) or traditional healers (Kenjiro, 2005; Levine et al., 2016; Ros et al., 2015). The impact of weather shocks on assets is more detrimental in all four countries.

4 Empirical model

In this section we introduce the empirical model which we use to predict the households' income generating capacity. First, we specify the econometric model to derive the asset-based expected income as established in the literature (Amare and Hohfeld, 2016; Carter and Barrett, 2006). Second, we present our asset accumulation model in which we allow for the occurrence of different shocks. Third, we introduce the shock indicators used in this study and present the robustness tests applied to prove the validity of our results.

4.1 Household income generating capacity

Following Amare and Hohfeld (2016) and Carter and Barrett (2006), we predict households' income generating capacity based on net assets, intensity of use, prices and transfers. The household-level fixed-effects regression is specified as:

$$Y_{it} = \alpha + \beta_i(A_{it}) + \sum_j \beta_{jt}(A_{it})A_{ijt} + \gamma G_t + \delta_{pt} + \eta_i + \epsilon_{it}, \tag{5}$$

where Y_{it} is the income generating capacity of a household which we approximate by expenditures of household i at time t divided by the rural poverty line (Amare and Hohfeld, 2016).[5] Thus, Y_{it} takes on values below one for households with expenditures below the poverty line and values above one for households that are non-poor. A_{it} is a vector of net assets owned or accessed by the household (i) at time t. Based on the literature (Banerjee et al., 2017; Bebbington, 1999; Do et al., 2017; Nguyen et al., 2017), we form subcategories for financial, human, natural, physical, and social capital (see Table 1 for overview of variables).

Since the return per asset depends also on the level of other assets owned or accessed by the household the vector $(A_{it})A_{ijt}$ interacts all assets (i) with all other assets (j) owned or accessed by the household. Macro-level influences such as prices, the general economic condition, and potential public transfers are captured by province fixed-effects (δ_{pt}) and open access to resources at the village level (G_t). Household fixed-effects (η_i) capture differences between households that are time invariant.

Subsequently we calculate the fitted values to estimate the asset-based expected income:

$$\Lambda_{it} = \sum_j \hat{\beta}_{jt}(A_{it})A_{ijt}, \tag{6}$$

where Λ_{it} represent our index in which assets are weighted according to their marginal contribution to households' income generating capacity given by the estimated coefficient $\hat{\beta}_{jt}$. For our analysis we use the asset-based income generating capacity Λ_{it} to distinguish between poor and non-poor households. In addition, we also disaggregate effects by consumption quartiles.

4.2 Asset accumulation

Based on the conceptual framework we estimate two models to examine the impact of different shocks on asset accumulation. In both cases the dependent variable is the asset-based income generating capacity.

First we estimate the impact of household level shocks on asset growth using the following regression equation:

$$\Delta\Lambda_i = \alpha + \psi_1 S_i + \gamma_1 HH_i + \gamma_2 A_v + \gamma_3 G_v + \pi_i \tag{7}$$

[5] We use rural poverty lines published by the respective country, see Appendix Table 7.

where $\Delta\Lambda_i$ refers to the accumulation of assets between *t-1* and *t*. The variables of interest are captured by S_i which is a vector of shock indicators. Throughout the specifications we use two different types of shock indicators: (a) an aggregate shock indicator which takes on the value of one if the household reported any shock between the baseline and the follow-up and is zero otherwise, and (b) specific shock indicators for flood, drought, health, and economic shocks to differentiate the effects by shock type. HH_i is a vector of household characteristics which controls for household size, education, gender and age of the household head, off-farm and self-employment activities, and access to sanitation, drinking water and electricity. Further, we control for the village mean of initial asset-based expected income (A_v) and initial village-level assets (G_v) including topography, social problems within the village, infrastructure, and access to basic public goods.

Second, the effects of shocks on households' income generating capacity may differ by their initial economic status i.e. asset base or income generating capacity. To allow for differential effects by economic group we employ a quartile regression. The specification is analogue to equation 7.

4.3 Definition of shock variable

In our main regressions we use two different ways to capture shocks. First, we use a simple shock indicator which is equal to one if the household reported any shock in the reference period and zero otherwise. Second, we disaggregate the shock indicator into four shock categories to capture the major types of shocks observed in our sample, namely economic, health, drought and flood shocks. In line with previous studies (Bühler et al., 2015; Do et al., 2017; Gloede et al., 2015) we use the following shock group definitions: (i) Economic shocks include the categories 'price fluctuations' and 'product availability on the market'; (ii) health shocks include 'illness', 'death', or 'accidents of household members'; and weather shocks which are separated into (iii) drought and (iv) flood shocks.

While the shocks themselves are exogenous, the probability to experience and report a shock might differ across the sample due to regional differences and/or income inequality which leads to a different level of being affected (Dercon and Krishnan, 2000; Gertler et al., 2000; Hoddinott and Quisumbing, 2003). Therefore, we perform a series of robustness checks throughout our estimations to verify the validity of our shock indicator.

One main concern in relation to shocks and their effect on household's asset accumulation is that the probability of experiencing and reporting a shock may be correlated to the household's

location or welfare. We test for this bias using a simple OLS regression which uses income quartiles to predict the probability of reporting a shock. The results (see Table 8 in Appendix B) reveal that households in the richest quartile are significantly less likely to experience a shock compared to households in the other quartiles. However, while the coefficient is significant at the 1 percent level, the magnitude is small i.e. households in the richest quartile are 4.7 percent less likely to experience a shock compared to households in the other quartiles.

Throughout the empirical analysis we address the concern in three ways. First, we control for the shock probability at the village level expressed as the share of households per village who experienced a shock divided by the total number of households in the village. Therewith, we account for the likelihood of shocks at the village-level and control for any regional differences that potentially drive our results. The results are reported in the main regression tables.

Second, we address the concern that households form expectations regarding the realization of shocks. We follow the approach described by Gloede et al. (2015) and define a surprise shock indicator as the mean difference between reported shocks and anticipated risks for each shock type. Basically, shocks are weighted against the household's expectation of shocks and shocks that the household does not anticipate are assigned a higher weight. This measure allows us control for the expectation formation at the household-level. Results are reported in Section 6.

Third, we employ an instrumental variables (IV) approach to address the endogeneity related to the household's location choice and potential differences in shock reporting. Following Bartik (1991) and Altonji and Card (1991), we combine average village-level assets at baseline with the geographic distribution of shocks at the sub-district-level to instrument the shock indicator. While the household's shock reporting is likely biased due to unobservables the share of households at the sub-district-level which experience a shock and the average village-level asset-base at baseline are exogenous to the household. For the regression specification please refer to Appendix B. Results are reported in Section 6.

5 Results

In this section we present the results of our analysis. First, we present descriptive results regarding the economic mobility of households across the two waves. Second, we analyze asset growth in the presence of shocks for the whole sample. Third, we present results for the heterogeneous effects of shocks across different income quartiles.

5.1 Welfare dynamics

In order to assess welfare dynamics, we examine the economic mobility of households between asset-based income quartiles over time (Table 2). Households are grouped into quartiles in both time periods and we determine the percentage of households who stayed in the same quartile or moved to a different quartile in the follow-up. Furthermore, we perform two sided t-tests for households with versus households without shocks.

Table 2: Economic mobility of households between quartiles

		Follow-up			
		Bottom 25%	Quartile 2	Quartile 3	Top 25%
Baseline	Bottom 25%	67%	21%	10%	3%
	Quartile 2	24%	44%	22%	10%
	Quartile 3	7%	27%	42%	24%
	Top 25%	2%	8%	27%	63%

Source: Authors' calculations.

The majority of household (67%) which are classified as Bottom 25% at baseline remain in the poorest quartile in the follow-up. However, a substantial share (34%) move into higher income quartiles in the follow-up. 21% move into the second lowest income quartile, 10% into the second highest, and 3% into the Top 25%. Still, this indicates that extreme poverty is quite persistent for households in our sample and the majority of households in this groups remains poor over time. Similarly, the majority of households (63%) which are classified as Top 25% at baseline remain in the richest quartile. While 27% of households which leave the top quartile move into the second highest quartile, about 2% move into the poorest quartile. Thus, even households which appear economically more secure are at risk of sliding back into poverty between years indicating that households are not able to keep the standard over time. However, this concerns only a small share of households.

The mobility patterns differ by country (see Appendix, Figure 6). In Cambodia and Laos none of the households in the Bottom 25% managed to climb out of poverty between the baseline survey and the follow-up. Likewise, none of the households from the Top 25% fell back into complete poverty in the follow-up. In Thailand and Vietnam economic mobility is more dynamic. While poverty appears to be more transient in Thailand (only 36% remain in extreme poverty in both waves), it is still persistent in Vietnam (58% of extremely poor households remain poor). On the other hand, even households which are categorized as Top 25% at baseline face a 12 to 13% chance to fall back into poverty.

Results from a two-sided t-tests (see Table 9) show that households who do not experience shocks receive on average more remittances and are more likely to have access to insurance.

In addition, households with shocks have significantly more household members and a higher number of children. While education and natural capital do not differ, households who do not experience shocks have significantly larger physical and social capital holdings. Lastly, household income is larger for households without shocks and they are less likely to be poor.

Overall, poverty appears to be more persistent in Cambodia and Laos compared to Thailand and Vietnam. Yet, in Thailand and Vietnam richer households are more likely to fall back into poverty while it is still rather unlikely for households from the Bottom 25% to exit poverty in the short-term. Across all four countries, the mean comparison shows that shocks reduce households asset holdings and increase the probability to remain in poverty.

5.2 Asset growth in the presence of shocks

In this section we explore the relation between shocks and asset accumulation. The analysis is split in three parts. First, we consider the aggregate effect of any type of shock on asset growth. Second, we disaggregate into the major four shock types: economic, drought, flood, and health shocks. Finally, we disaggregate by shock type and country to shed light on different impacts at the country level. The first step results for the fixed-effects household estimation to predict households' income generating capacity based on assets are reported in the Appendix, Table 10.

Our main results are presented in Table 3 and Figure 6. The overall influence of shocks on asset growth is significant and negative, see columns (1) and (2). The point estimate (-0.018) shows that shocks reduce growth of households' income generating capacity (or asset growth) by 1.4 percentage points.[6] In monetary terms, the income generating capacity of households with a shock reduces by $17 per capita which is equivalent to between 3 (Thailand) and 9 days (Laos) of per capita daily income (see Table 1). The results are robust to the inclusion of all control variables as well as controlling for the village-level shock probability (columns 2 and 4). Thus, regional differences in shock probability do not drive the results.

The results, reported in columns (3) and (4), show that the overall negative effect is mainly driven by health shocks. Drought and flood shocks, on the other hand, appear to be significant

[6]The average increase in the income generating capacity is $0.244 per capita per day. In relation to the asset-based predicted income of $1.298 per capita per day at baseline this suggests an increase in income generating capacity by 19 percent. The shock coefficient suggests that the income generating capacity decreases by $0.0178 per capita per day which means households' income generating capacity grows only by 17.7 percent. In relation to the average household income generating capacity of $1,234 for the baseline year households without a shock increase their income generating capacity by $236 per capita per year whereas households with a shock only increase their income generating capacity by $219 per capita per year.

Table 3: Household income generating capacity and shocks

Variables	(1) Asset growth	(2) Asset growth	(3) Asset growth	(4) Asset growth
Shock	-0.0178***	-0.0110**		
	(0.0054)	(0.0050)		
Economic shock			0.0020	0.0029
			(0.0075)	(0.0070)
Drought shock			-0.0102*	-0.0051
			(0.0053)	(0.0051)
Flood shock			-0.0136*	-0.0110
			(0.00712)	(0.0068)
Health shock			-0.0174***	-0.0107**
			(0.0049)	(0.0046)
Country fixed effects	x	x	x	x
Shock probability		x		x
Household controls		x		x
Observations	4,686	4,686	4,686	4,686
Adjusted R^2	0.0409	0.179	0.0418	0.179
F-value	57.42	38.92	34.82	34.57
Root mean square error	0.151	0.140	0.151	0.140

Note: Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1. Household controls: household size, number of children, number of elderly, average education, membership political party, age household head, gender household head, self-employment, off-farm employment, access to sanitation, access to drinking water, access to electricity; village characteristics: paved road, violence, epidemics, irrigation, village-level average asset stock at baseline.
Source: Authors' calculations.

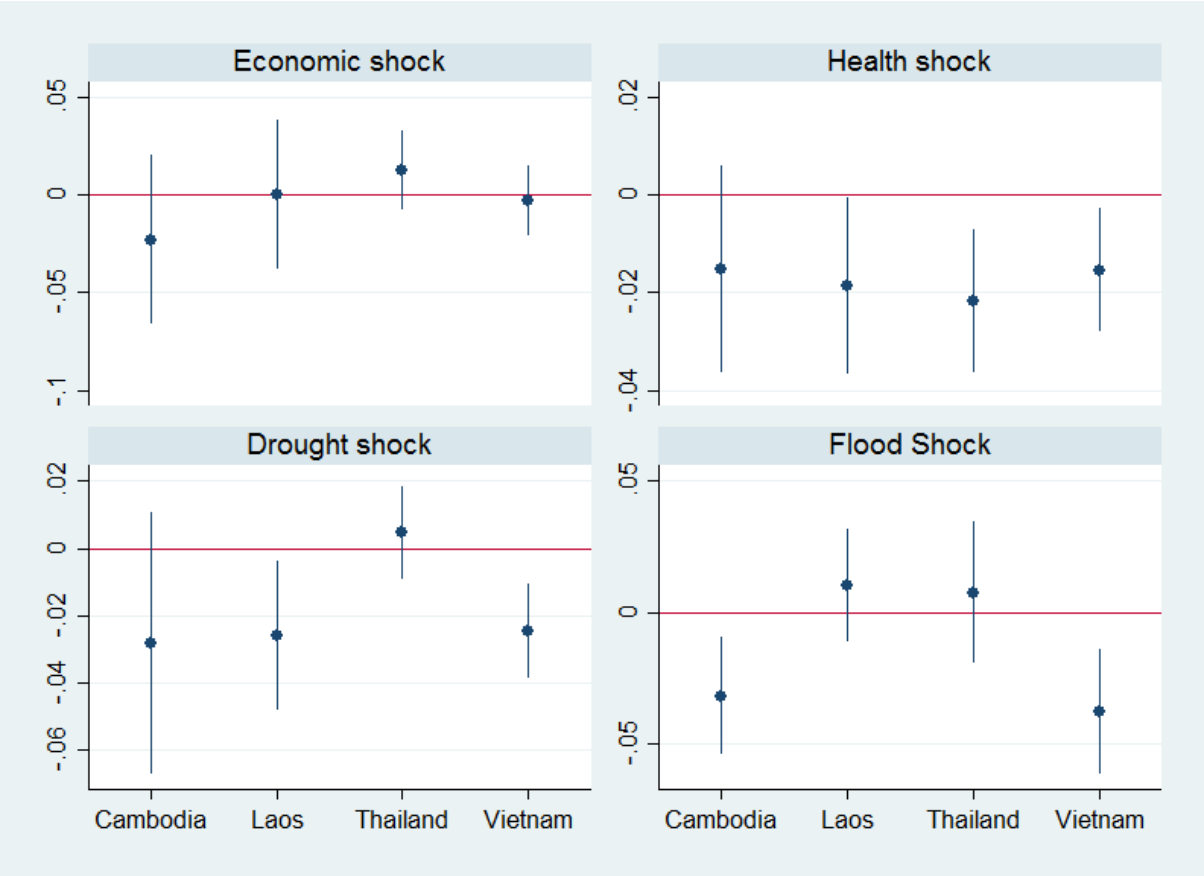
at the 10% level but become insignificant once the household controls are included (column 6). Economic shocks are overall insignificant in both specifications. From an economic point of view, the income generating capacity of households which experience a health shock decreases between $10 to $17 per capita compared to households without any health shocks. This roughly corresponds to the losses from health shocks reported by households in Laos and Cambodia (see Table 1). Similarly, households' income generating capacity reduces by $10 for households which experience a drought shock and by $13 for households which experience a flood shock. This is in line with earlier research by Kenjiro (2005) who shows that illness causes more economic damage than crop failure in Cambodia.

In a second step we separate effects by shock type and country. The results, shown as marginal effects in Figure 6 (and Table 11 in Appendix C), confirm that economic shocks are not significant. This is related to both the estimation as well as the sample. Covariate shocks are partly captured in the geographic controls included in the first stage regression. In addition, our sample includes mainly marginalized households who are not engaged in medium or large scale business and consequently report only very few incidences of economic shocks (between 0.08 to 0.14 economic shocks on average, see Table 1). The majority of households is engaged in agriculture where weather related shocks are common and more destructive which is confirmed by previous research using the same data set (Do et al., 2017; Gloede et al., 2015) as well as the descriptive statistics (see Table 1).

Similar to the overall results, the country-level results confirm that health shocks decrease the income generating capacity of households in all four countries. However, the effect is only statistically significant in Laos, Thailand and Vietnam. With a decrease of 1.2 to 1.4 percentage points the change in the growth rate is quite similar across the three countries. Given the different income levels, the monetary impact in Laos and Vietnam ($10 per capita per year) is smaller compared to Thailand ($31 per capita per year).

The effects of weather related shocks differ across countries. While drought shocks have a significant negative effect on asset growth in Laos and Vietnam, we find a positive, yet insignificant, effect of drought shocks on asset growth in Thailand. Flood shocks, on the other hand, have no significant effect on asset growth for households in Laos and Thailand but a significant negative effect in Cambodia and Vietnam. This is in line with previous research (Gloede et al., 2015) and reflects the different geographic and local climatic conditions. Both, drought and flood shocks, have a stronger effect on asset growth compared to health shocks. Drought shocks decrease income growth by about 2 percentage points which is equivalent to $14 to $17 per capita per year. The influence of flood shocks is even stronger as affected households have a 2.4 to

Figure 2: Marginal effects of shocks by country



Note: Controls for shock probability are included.
Source: Authors' calculations.

3 percentage point lower income growth equivalent to $22 per capita per year for Cambodian households and $26 per capita per year for Vietnamese households.

Overall, our results suggest that health, drought and flood shocks significantly decrease the income generating capacity of rural households in Southeast Asia. While the impact of health shocks is strongest in Thailand, drought and especially flood shocks significantly decrease income growth for households in Cambodia, Laos and Vietnam.

5.3 Heterogeneous effects along the income distribution

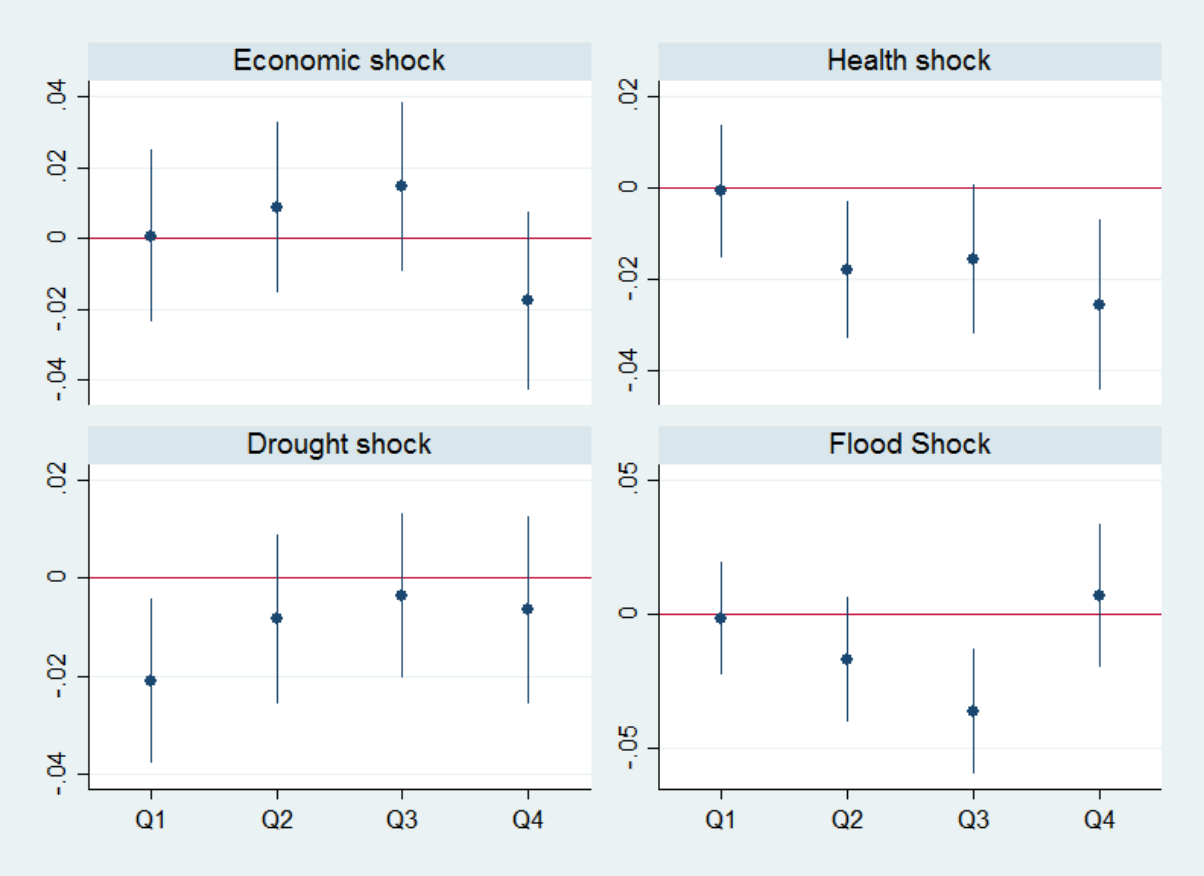
In this section we examine the differential impact of shocks per income quartile. Given that the influence of shocks on asset accumulation differs significantly across countries, we expect that they have differential effects along the income distribution. First, we present the marginal effects of shocks for each income quartile. Second, we distinguish the effect per quartile by country.

The marginal effects by shock types and income quartile are presented in Figure 3 (and Table 12 in Appendix C). The results suggest that the income generating capacity of households differs substantially by quartile. Health shocks significantly reduce income growth for households in the upper three quartiles. The effect on the growth rate varies between 1.2 for households in quartile 3 to 2 percentage points for households in the richest quartile. While poor households are not less likely to experience health shocks compared to households in the richer quartiles, health shocks do not seem to reduce the income growth of poorer households. However, this does not mean poorer households are not affected by health shocks but rather indicates that we find no significant effect of health shocks on their income generating capacity. There are two possible explanations for this finding. First, since poor households are mainly engaged in agriculture, illness of one particular member might not reduce the overall income generating capacity of the household. Second, richer households might use their asset base to pay for medical treatment and thus, through the sale of assets, reduce their income generating capacity (Kenjiro, 2005; Levine et al., 2016; Ros et al., 2015).

Drought and flood shocks appear to be more harmful for households in particular income quartiles. While drought shocks appear to be most detrimental for poor households, flood shocks have a strong negative effect for households in quartile 3. On average, drought shocks decrease the income growth of poor households by 1.6 percentage points, which is equivalent to a decrease of the income generating capacity by $17 per capita per year. Similar to the country-level results from Section 5.2 the magnitude of flood shocks exceeds those of the other shock events. Income

growth of households in quartile 3 reduces by almost 3 percentage points which is equivalent to $36 per capita per year or up to 19 days of daily income (see Table 1).

Figure 3: Marginal effects of shocks by income quartile



Note: Country fixed-effects and control for shock probability are included. Q1 to Q4 refers to the income quartiles.
Source: Authors' calculations.

6 Validity of results

In this section we address potential validity concerns related to the shock indicator and the arbitrariness of the welfare quartiles presented before. First, we present evidence that if anything the shock indicator we use for our main results gives lower bound estimates in terms of the decrease in asset growth. Second, we address how meaningful our quartile regression is for policy makers and show that our results are similar when applying cross-validated cut-offs.

6.1 Robustness of shock indicator

One major concern is the potential endogeneity of the shock indicator. We address this reporting bias in two ways: (i) we construct a surprise shock indicator to account for the expectation formation regarding shocks at the household level and (ii) we implement a two-stage-least-squares estimation and use a Bartik-type instrument to predict household-level shocks to overcome the potential endogeneity.

The results for the surprise shock indicator, displayed in Table 4, suggest that indeed the effect of unexpected shocks is about two thirds higher compared to the main results from Section 5. Accordingly, household asset growth decreases by 2.4 percentage points which is equivalent to $31 per capita per year. However, once all the control variables are included, the coefficient is insignificant. At the country level, the results confirm the importance of drought and flood shocks for Vietnam and Cambodia (see Table 13 in Appendix D). While the main results show that health shocks matter for households' income generating capacity, the results from Table 4 and 13 suggest that health shocks have no significant effect when controlling for households' expectations. Thus, households are aware of the risk associated to health shocks. However, as the main results show, households' income generating capacity still reduces if health shocks occur despite the fact that households are aware of the risk. Therefore, it is important to strengthen the health systems and to provide access to health care for rural households in the region.

Second, we present the results from our IV estimation which addresses the potential downward bias of the shock effect due to the reporting bias. The first stage results (see Table 14 in Appendix D) show that the instrument is meaningful and fulfills Stock and Watson's rule of thumb.[7] The second stage results, displayed in Table 5 suggest that the true effect of shocks on household income growth is indeed higher than the results presented in Section 5. Accordingly, household asset growth decreases by 12 to 29 percentage points which is equivalent to $156 to $359 per capita per year or 82 to 190 days of income.[8] However, while the regression in Section 5 gives the average treatment effect (ATE) i.e. the effect of a shock for all households, the instrumental variables regression estimates the local average treatment effect (LATE) which is the average effect for households who experience a shock as projected by the instrument.

[7] An instrument is relevant if the first-stage F-value exceeds the value of 10 (Stock, 2011).

[8] The coefficient suggests that asset growth decreases by $0.427 pc/day which means the income generating capacity grows only by 7 percent versus 19 percent for households without shocks. This translates into a reduction of the income generating capacity by $156 to $359 per capita per year.

Table 4: Asset growth and unexpected shocks

Variables	(1) Asset growth	(2) Asset growth	(3) Asset growth	(4) Asset growth
Unexpected shock index (USI)	-0.0324**	0.00344		
	(0.0149)	(0.0142)		
Unexpected economic shock index (UESI)			-0.00831	0.0231
			(0.0180)	(0.0171)
Unexpected health shock index (UHSI)			-0.0144	-0.00672
			(0.00892)	(0.00807)
Unexpected drought shock index (UDSI)			0.00244	0.000255
			(0.00408)	(0.00384)
Unexpected flood shock index (UFSI)			-0.0149***	0.000556
			(0.00499)	(0.00486)
Country fixed-effects		x		x
Household controls		x		x
Observations	4,682	4,682	4,682	4,682
Adjusted R squared	0.000692	0.177	0.00161	0.177
F-value	4.714	40.48	3.205	35.60
Root mean square error	0.154	0.140	0.154	0.140

Note: Marginal effects per country and shock type * quartile are displayed. Standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1. Household controls: household size, number of children and elderly, education, membership political party, self-employment, off-farm employment, access to sanitation, drinking water and electricity; household head characteristics: age and gender; village characteristics: paved road, violence, epidemics, irrigation, average asset stock at baseline.
Source: Authors' calculations.

Table 5: Instrumental variables regression

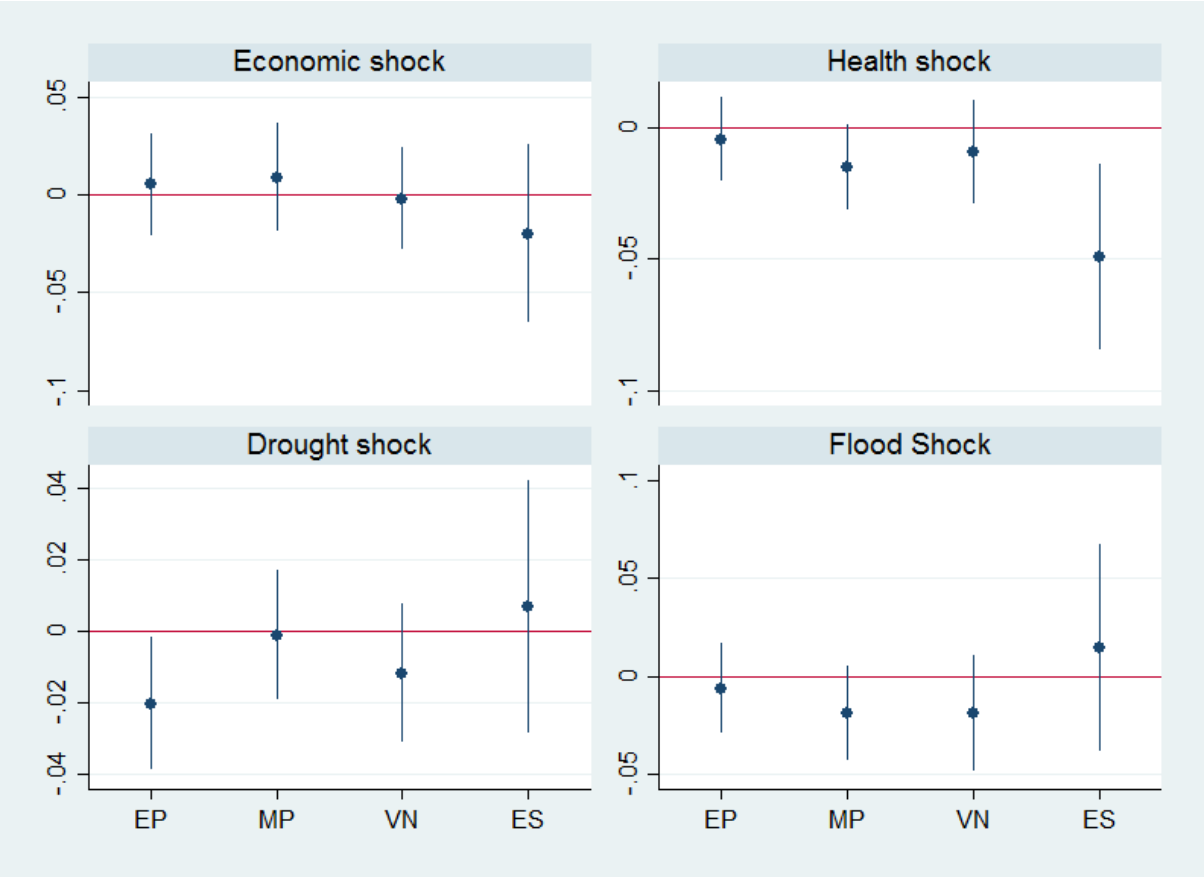
Variables	(1) Asset growth	(2) Asset growth	(3) Asset growth
Shock	-0.427**	-0.485*	-0.438
	(0.209)	(0.256)	(0.284)
Country fixed effects		x	x
Household controls			x
Observations	4,686	4,686	4,686
F-value first stage	107.16	57.24	17.11
Root mean square error	0.226	0.244	0.225

Note: Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1. Household controls: household size, number of children, number of elderly, average education, membership political party, age household head, gender household head, self-employment, off farm employment, access to sanitation, access to drinking water, access to electricity; village characteristics: paved road, violence, epidemics, irrigation, average village-level asset stock at baseline.
Source: Authors' calculations.

6.2 Policy relevant economic classes

From a policy perspective the simple income quartiles used in this study may not be the most informative. Previous research in the region has identified five economic classes in terms of households' economic prosperity (Cunningham and Huertas, 2018; World Bank, 2018a). In an effort to inform policy makers about the needs across different economic groups we replicate our analysis to include these previously identified groups instead of the quartiles.[9] Since our sample covers rural households we drop the richest group.

Figure 4: Marginal effects of shocks by economic class



Note: EP - Extremely Poor, MP - Moderately Poor, VN - Vulnerable, ES - Economically Secure.
Source: Authors' calculations.

The results for the economic groups, reported in Figure 4, are largely in line with the findings from the quartiles. Health shocks have a significant and negative impact on asset growth of the relatively wealthier households (the group of economically secure households). Drought shocks,

[9]The economic classes from the regional World Bank study are defined as follows: (i) extreme poor - less than $1.90 PPP per day, (ii) moderately poor - between $1.90 to $3.10 PPP per day, (iii) vulnerable - between $3.10 to $5.50 PPP per day, (iv) economically secure - between $5.50 to $15 PPP per day, and (v) global middle class - $15 to $50 PPP per day.

on the other hand have a significant negative effect for extremely poor households. The effects of economic or flood shocks are not statistically significant.

7 Conclusion

In this paper we use data from rural households across four countries in Southeast Asia to analyze the effect of shocks on households' income generating capacity. Using the asset-based approach, we specifically investigate the effects of droughts, floods, economic, and health shocks on rural households. In addition, we disaggregate the effects by country and income group to detect regional as well as distributional differences.

Our findings suggest that even though rural households in Cambodia, Laos, Thailand, and Vietnam face a similar probability of shocks, the type and effect of the shocks varies across countries and income quartiles. Economic shocks do not play a major role for households' income generating capacity in our sample. Health and weather related shocks show a strong and significant effect on household asset growth. While health shocks reduce the growth rate of households in all countries by 1.2 to 1.4 percentage points, the effect of drought and flood shocks is stronger but differs across countries. Drought shocks decrease households' income generating capacity by 2 percentage points in Laos and Vietnam. With a decrease of 2.4 to 3 percentage points flood shocks hit households in Cambodia and Vietnam even harder. In monetary terms, the effect of shocks reduces households' income generating capacity by $17 to $36 per capita per year which is equivalent to as much as 19 days of income in Laos.

The income quartile regression reveals that in addition to country-level differences the effect of shocks varies by income group. Households in the poorest income quartile disproportionately suffer from drought shocks, while health shocks significantly reduce the income generating capacity of households in all but the poorest income quartile. Flood shocks reduce income growth for households in quartile one to three, yet, the effect is only significant for households in the third quartile. The effects are robust to changing the group cut-offs to the economic groups defined in a broader regional study by the World Bank (Cunningham and Huertas, 2018; World Bank, 2018a).

The results from our robustness tests show that households in the region form expectations about the likelihood with which shocks occur in the future. While health shocks are largely anticipated by households, weather related shocks, such as droughts and floods, remain unpredictable to a certain extent and their effect on households' income generating capacity is more

detrimental. However, while households are able to anticipate health shocks, these shocks still reduce household's asset accumulation. Furthermore, the results from the IV regression suggest that the true effect of shocks is likely higher than the effect predicted by the OLS regression.

Against the background of higher frequency extreme weather events, policy makers should not just count on the expectation formation of rural households but rather support collective actions and community responses at the local level. Policies aiming at poverty reduction in rural areas need to take into account the situation of different economic groups. Therefore, better-targeted programs are needed which support asset accumulation, improve their use, and offer protection or immediate support in case of weather shocks. Furthermore, there is a need to strengthen access to affordable health care to enable households to cope with the anticipated, yet uninsured, health risks. Given that even richer households' are not able to deal with foreseeable health issues, improved worker protection that is affordable would be one way to reduce the pressure on rural households.

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9 Appendix A

Figure 5: Study Area

Table 6: Development indicators by country

	Cambodia	Laos	Thailand	Vietnam
Access to electricity (% of population)	49.7	87.1	100	100
Access to basic sanitation service (% of population)	48.8	72.6	78.2	95.0
Life expectancy at birth (in years)	68.98	66.68	75.30	76.25
Mortality rate, infants (per 1,00 live births)	27.5	48.9	10.5	17.6

Source: World Bank (2018b).

Table 7: Rural poverty lines per capita per day

Country	Year	Local currency	PPP USD 2005
Cambodia[a]	2009	3503.00	1.93
Laos[b]	2009	6315.79	1.48
Thailand[c]	2010	66.83	3.69
	2013	75.77	3.76
Vietnam[d]	2010	13333.33	1.89
	2013	19000.00	1.90

[a] Source: Ministry of Planning (2013); [b] Source: Asian Development Bank (2014); [c] Source: National Statistical Office (2016); [d] Source: General Statistics Office (2017).

10 Appendix B

Table 8: Probability to experience a shock by quartile

Variables	(1) Shock likelihood	(2) Shock likelihood	(3) Shock likelihood
2^{nd} Quartile	-0.0291*	-0.0189	-0.000935
	(0.0168)	(0.0167)	(0.0176)
3^{rd} Quartile	-0.0536***	-0.0329*	-0.0190
	(0.0171)	(0.0173)	(0.0191)
4^{th} Quartile	-0.115***	-0.0763***	-0.0470**
	(0.0178)	(0.0186)	(0.0204)
Constant	0.805***	0.873***	0.886***
	(0.0116)	(0.0185)	(0.0820)
Country fixed effects		x	x
Village fixed effects			x
Observations	4,733	4,733	4,733
R^2	0.010	0.027	0.204
F-value	14.69	23.18	.
Root mean square error	0.428	0.424	0.406

Notes: Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1
Source: Authors' calculations.

Instrumental variables approach

The idea of using regional shares and weighting them by a baseline composition is widely used in the labor and trade economics literature. Initially the instrument was proposed by Bartik (1991) and since then has been used in numerous publications to isolate labor market shocks (see Jaeger et al. (2018) for an overview).

Formally the two-stages-least-squares procedure takes the following from:

$$\hat{S}_{it-1} = \alpha + \beta_1 A_{vt-1} + \beta_2 \frac{1}{N-1} \sum_{n \neq i}^{N} (S_{st-1}) + \beta_3 A_{vt-1} * \frac{1}{N-1} \sum_{n \neq i}^{N} (S_{st-1}) + \gamma_1 HH_{it-1} + \gamma_3 G_{vt-1} + \pi_{it} \tag{8}$$

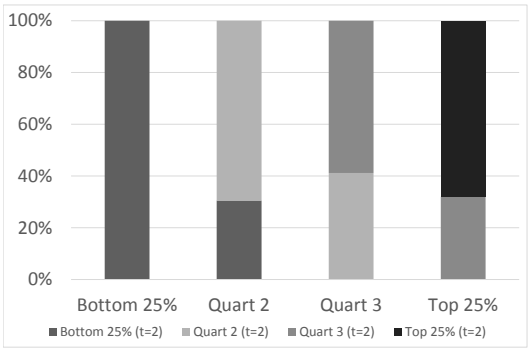
and

$$\Delta \Lambda_{it} = \alpha + \psi_1 \hat{S}_{it-1} + \psi_2 W_{it-1} + \gamma_1 HH_{it-1} + \gamma_2 A_{vt-1} + \gamma_3 G_{vt-1} + \pi_{it} \tag{9}$$

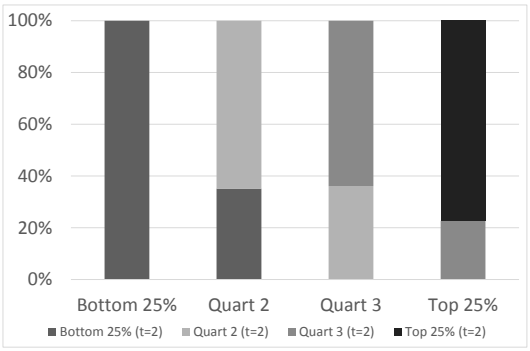
Where the household-level (i) shock indicator S_{it-1} is instrumented by the share of other households at the subdistrict level (s) which had a shock weighted by the average village-level asset-based expected income at baseline (A_{vt-1}). Household controls (HH_{it-1}) and other village-level controls (G_{vt-1}) remain the same as in equation 7 (see main text).

11 Appendix C

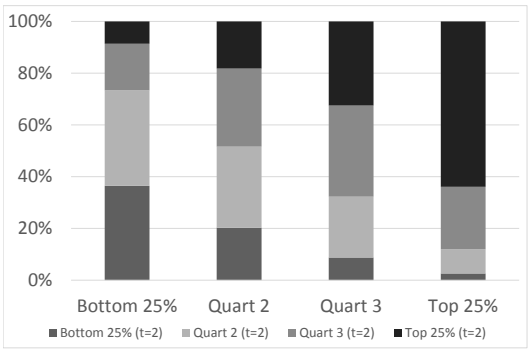
Figure 6: Transition matrix by country



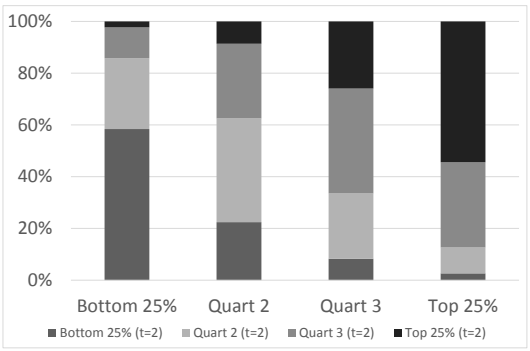
(a) Cambodia



(b) Laos



(c) Thailand



(d) Vietnam

Table 9: Descriptive statistics of households with and without shocks

Variables	Households without shock	Households with shock	Difference
Financial Capital			
Remittances in $US^{+}	1472.66	1224.26	248.4**
Access to insurance (1=yes)	0.85	0.78	0.0704***
Human Capital			
Household size	4.24	4.50	-0.258***
Number of children	1.31	1.47	-0.161***
Number of elderly	0.54	0.54	0.00411
Education household head (years)	5.33	5.11	0.220
Age household head (years)	53.12	52.26	0.852
Gender household head (1=female)	0.22	0.19	0.0328*
Natural Capital			
Land size in ha	2.26	2.23	0.0353
Livestock in TLU	0.21	0.24	-0.0241
Distance to forest in km$^{\#}$	2.99	3.03	-0.0362
Distance to water-body in km$^{\#}$	1.16	1.27	-0.103
Physical Capital			
Transportation assets in $US^{+}	3349.96	2727.78	622.2**
Agricultural assets in $US^{+}	140.49	159.45	-18.95
Household appliances in $US^{+}	800.63	684.91	115.7***
Size house in m^3	75.48	69.94	5.544***
Social Capital			
Communication assets in $US^{+}	113.49	89.19	24.30***
Ethnicity	0.83	0.82	0.0155
Membership political party	0.38	0.49	-0.107***
Income & Poverty			
Yearly income in $US^{+}	7658.77	6432.12	1226.7***
Poverty (regional)$^{\alpha}$	0.43	0.45	-0.0227
Poverty (international)$^{\beta}$	0.23	31	-0.0750***
N	1161	3575	

Note: $^{+}$monetary values are all given in Purchasing Power Parity 2005 $US; $^{\#}$measured at village-level; $^{\alpha}$regional poverty lines apply - for details see Table 7; $^{\beta}$international poverty line of $US 1.90.
Source: Authors' calculations.

Table 10: Fixed effects regression of household income generating capacity

	(1)	(2)
Variables	Coef	Se
Log transportation assets	0.132***	(0.0390)
Log agricultural assets	-0.0794	(0.0550)
Log communication assets	0.00775	(0.0563)
Log household appliances	-0.0360	(0.0855)
Log land size	0.0300	(0.0737)
Log house size	-0.0944	(0.185)
Log Tropical livestock units	0.00440	(0.0480)
Log remittances	0.00426	(0.0301)
Education (years)	0.0789	(0.0579)
Squared log transportation assets	0.000511	(0.00166)
Squared log agricultural assets	0.00233	(0.00348)
Squared log communication assets	0.000968	(0.00413)
Squared log household appliances	0.00531	(0.00516)
Squared log land size	0.00806	(0.00621)
Squared log house size	0.0201	(0.0212)
Squared log Tropical Livestock Unit	-0.00330	(0.00355)
Squared log remittances	-0.00119	(0.00176)
Squared years of education	-0.00261	(0.00223)
Log transportation assets * log agricultural assets	3.70e-05	(0.00346)
Log transportation assets * log communication assets	-0.00206	(0.00293)
Log transportation assets * log household appliances	0.00125	(0.00396)
Log transportation assets * log land size	0.00180	(0.00391)
Log transportation assets * log house size	-0.0311***	(0.0106)
Log transportation assets * log TLU	0.00708***	(0.00228)
Log transportation assets * year of education	0.000418	(0.00230)
Log transportation assets * log remittances	-0.00293*	(0.00156)
Log agricultural assets * log communication assets	-0.00131	(0.00465)
Log agricultural assets * log household appliances	-0.00916*	(0.00519)
Log agricultural assets * log land size	-0.00286	(0.00586)
Log agricultural assets * log house size	0.0273**	(0.0134)
Log agricultural assets * log TLU	0.00342	(0.00350)
Log agricultural assets * year of education	0.00185	(0.00223)
Log agricultural assets * log remittances	0.00101	(0.00285)
Log communication assets * log household appliances	0.00509	(0.00608)
Log communication assets * log land size	0.00181	(0.00541)
Log communication assets * log house size	-0.000331	(0.0144)
Log communication assets * log TLU	-0.00441	(0.00401)
Log communication assets * log remittances	-0.00253	(0.00222)
Log communication assets * years of education	-0.00551*	(0.00308)
Log household appliances * log land size	0.00714	(0.00778)
Log household appliances * log house size	0.00255	(0.0201)
Log household appliances * log TLU	-0.00624	(0.00523)
Log household appliances * log remittances	0.000358	(0.00316)
Log household appliances * years of education	-0.00413	(0.00523)
Log land size * log house size	-0.0140	(0.0150)
Log land size * log TLU	0.00744	(0.00478)
Log land size * log remittances	0.00207	(0.00278)
Log land size * years of education	-7.13e-05	(0.00427)
Log house size * TLU	-0.00795	(0.0109)

Table 10 – continued from previous page

	(1)	(2)
Variables	coef	se
Log house size * log remittances	0.00523	(0.00666)
Log house size * years of education	-0.00412	(0.00997)
Log TLU * log remittances	-0.00233	(0.00192)
Log TLU * years of education	0.00335	(0.00339)
Log remittances * years of education	-0.000649	(0.00133)
Paved road	0.0211	(0.0407)
Violence	-0.0190	(0.0297)
Epidemics	0.137***	(0.0304)
Irrigation	-0.00320	(0.0252)
Share of households with access to electricity	0.0856**	(0.0427)
Wave	0.223***	(0.0180)
Constant	0.0146	(0.644)
Household fixed-effects	x	x
Observations	9,577	9,577
R^2	0.090	0.090
Number of households	4,881	4,881
Adjusted R^2	0.0827	0.0827
F-value	6.050	6.050
Root mean square error	0.466	0.466

Note: Robust standard errors in parenthesis. Significance levels *** p<0.01, ** p<0.05, * p<0.1. Household controls: household size, number of children and elderly, education, membership political party, self-employment, off-farm employment, access to sanitation, drinking water and electricity; household head characteristics: age and gender; village characteristics: paved road, violence, epidemics, irrigation, average asset stock at baseline.
Source: Authors' calculations.

Table 11: Income growth and shock type by country, marginal effect of interaction terms

Variables	(1) Asset growth	(2) Asset growth	(3) Asset growth	(4) Asset growth
Shock * Cambodia	-0.0323*	-0.0168		
	(0.0188)	(0.0162)		
Shock * Laos	-0.0110	-0.00438		
	(0.0124)	(0.0132)		
Shock * Thailand	-0.0196**	-0.00910		
	(0.00815)	(0.00754)		
Shock * Vietnam	-0.0156	-0.0147*		
	(0.00971)	(0.00862)		
Economic * Cambodia			-0.0224	-0.0117
			(0.0262)	(0.0231)
Economic * Laos			0.000676	0.00924
			(0.0234)	(0.0273)
Economic * Thailand			0.0125	0.00653
			(0.0124)	(0.0123)
Economic * Vietnam			-0.00301	-2.43e-05
			(0.0109)	(0.00950)
Health * Cambodia			-0.0148	-0.00433
			(0.0128)	(0.0117)
Health * Laos			-0.0190*	-0.0126
			(0.0110)	(0.0121)
Health * Thailand			-0.0213**	-0.0167**
			(0.00892)	(0.00841)
Health * Vietnam			-0.0156**	-0.00743
			(0.00769)	(0.00697)
Drought * Cambodia			-0.0278	-0.0195
			(0.0236)	(0.0228)
Drought * Laos			-0.0259*	-0.0201
			(0.0133)	(0.0158)
Drought * Thailand			0.00534	0.0123
			(0.00817)	(0.00773)
Drought * Vietnam			-0.0249***	-0.0212***
			(0.00855)	(0.00801)
Flood * Cambodia			-0.0308**	-0.0192
			(0.0133)	(0.0124)
Flood * Laos			0.00989	0.0104
			(0.0129)	(0.0141)
Flood * Thailand			0.00752	0.00997
			(0.0164)	(0.0135)
Flood * Vietnam			-0.0379***	-0.0431***
			(0.0144)	(0.0137)
Country fixed-effects	x	x	x	x
Shock probability	x	x	x	x
Household controls		x		x
Observations	4,686	4,686	4,686	4,686

Note: Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1. Household controls: household size, number of children and elderly, education, membership political party, self-employment, off-farm employment, access to sanitation, drinking water and electricity; household head characteristics: age and gender; village characteristics: paved road, violence, epidemics, irrigation, average asset stock at baseline.
Source: Authors' calculations.

Table 12: Income growth by shock type and income quartile at country level, marginal effects

Variables	(1) Cambodia	(2) Lao	(3) Thailand	(4) Vietnam
Economic shock * Quart 1	0.00678	0.0365	0.00322	-0.00646
	(0.0346)	(0.0291)	(0.0345)	(0.0194)
Economic shock * Quart 2	0.0358	0.00213	-0.00512	0.0169
	(0.0354)	(0.0859)	(0.0308)	(0.0167)
Economic shock * Quart 3	-0.000560	-0.0207	0.0388*	-0.0182
	(0.0369)	(0.0479)	(0.0225)	(0.0152)
Economic shock * Quart 4	-0.121***	-0.00742	-0.0110	0.0148
	(0.0457)	(0.0335)	(0.0200)	(0.0250)
Health shock * Quart 1	-0.0270	-0.0254	-0.0172	8.74e-05
	(0.0191)	(0.0163)	(0.0216)	(0.0123)
Health shock * Quart 2	0.00640	-0.0121	0.0145	0.00906
	(0.0181)	(0.0266)	(0.0170)	(0.0128)
Health shock * Quart 3	0.00570	-0.00538	-0.00958	-0.00516
	(0.0255)	(0.0279)	(0.0150)	(0.0128)
Health shock * Quart 4	-0.00877	-0.0117	-0.0375**	-0.0339
	(0.0345)	(0.0267)	(0.0151)	(0.0209)
Drought shock * Quart 1	-0.0493	-0.0501**	0.0190	-0.00524
	(0.0335)	(0.0244)	(0.0212)	(0.0134)
Drought shock * Quart 2	-0.0420	-0.0216	0.0150	-0.0257
	(0.0319)	(0.0291)	(0.0153)	(0.0156)
Drought shock * Quart 3	-0.0660	0.00729	0.0222	-0.00908
	(0.0559)	(0.0324)	(0.0137)	(0.0147)
Drought shock * Quart 4	-0.103***	0.0156	-0.0111	-0.00662
	(0.0320)	(0.0294)	(0.0137)	(0.0194)
Flood shock * Quart 1	-0.0205	0.0142	-0.00678	-0.0351
	(0.0199)	(0.0189)	(0.0441)	(0.0246)
Flood shock * Quart 2	-0.0434**	-0.00857	-0.00949	-0.00508
	(0.0210)	(0.0286)	(0.0295)	(0.0309)
Flood shock * Quart 3	-0.0452	0.0110	0.0355	-0.0519**
	(0.0309)	(0.0256)	(0.0218)	(0.0242)
Flood shock * Quart 4	-0.0834**	0.00279	0.0101	-0.0703***
	(0.0369)	(0.0430)	(0.0223)	(0.0227)
Country fixed-effects	x	x	x	x
Shock probability	x	x	x	x
Household controls	x	x	x	x
Observations	484	470	1,872	1,860

Note: Marginal effects per country and shock type * quartile are displayed. Standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1. Household controls: household size, number of children and elderly, education, membership political party, self-employment, off-farm employment, access to sanitation, drinking water and electricity; household head characteristics: age and gender; village characteristics: paved road, violence, epidemics, irrigation, average asset stock at baseline.
Source: Authors' calculations.

12 Appendix D

Table 13: Income growth and unexpected shocks by country

Variables	(1) Asset growth	(2) Asset growth	(3) Asset growth	(4) Asset growth
USI * Cambodia	-0.0486	-0.0244		
	(0.0359)	(0.0361)		
USI * Lao	-0.0352	-0.000751		
	(0.0433)	(0.0469)		
USI * Thailand	0.0476*	0.0467**		
	(0.0245)	(0.0235)		
USI * Vietnam	-0.0552**	-0.0328		
	(0.0251)	(0.0226)		
EUSI * Cambodia			0.128	0.120
			(0.0920)	(0.0878)
EUSI * Lao			0.159*	0.200*
			(0.0964)	(0.110)
EUSI * Thailand			0.0312	0.0315
			(0.0245)	(0.0233)
EUSI * Vietnam			-0.0475	-0.0164
			(0.0302)	(0.0269)
HUSI * Cambodia			-0.00850	-0.00348
			(0.0169)	(0.0195)
HUSI * Lao			-0.0195	-0.00292
			(0.0225)	(0.0158)
HUSI * Thailand			-0.00248	-0.00684
			(0.0163)	(0.0244)
HUSI * Vietnam			-0.00923	-0.00678
			(0.0147)	(0.0154)
DUSI * Cambodia			-0.0101	-0.00328
			(0.0159)	(0.0155)
DUSI * Lao			-0.0114	-0.0130
			(0.00903)	(0.0110)
DUSI * Thailand			0.00900	0.00987
			(0.00653)	(0.00611)
DUSI * Vietnam			-0.0144**	-0.00603
			(0.00650)	(0.00585)
FUSI * Cambodia			-0.0337**	-0.0256**
			(0.0134)	(0.0126)
FUSI * Lao			0.00517	0.0118
			(0.0111)	(0.0131)
FUSI * Thailand			0.00928	0.0112
			(0.0107)	(0.00975)
FUSI * Vietnam			0.00784	-0.000258
			(0.00774)	(0.00715)
Country fixed-effects		x		x
Household controls		x		x
Observations	4,682	4,682	4,682	4,682

Note: Marginal effects per country and shock type * quartile are displayed. Standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1. Household controls: household size, number of children and elderly, education, membership political party, self-employment, off-farm employment, access to sanitation, drinking water and electricity; household head characteristics: age and gender; village characteristics: paved road, violence, epidemics, irrigation, average asset stock at baseline.
Source: Authors' calculations.

Table 14: First stage results

VARIABLES	Shock	Economic	Illness	Drought	Flood
Mean assets (village level)	0.684***	0.140**	-0.0202	0.133*	0.00466
	(0.265)	(0.0615)	(0.132)	(0.0787)	(0.0531)
Share households with shock (subdistrict-level)	1.520***				
	(0.446)				
Mean assets * Share households with shock	-0.726**				
	(0.342)				
Share households with economic shock		1.373**			
		(0.583)			
Mean assets * Share households with economic shock		-0.850*			
		(0.455)			
Share households with health shock			-0.185		
			(0.514)		
Mean assets * Share households with health shock			0.372		
			(0.392)		
Share households with drought shock				1.184***	
				(0.331)	
Mean assets * Share households with drought shock				-0.308	
				(0.255)	
Share households with flood shock					0.837**
					(0.408)
Mean assets * Share households with health shock					-0.251
					(0.309)
Constant	-0.538	-0.135*	0.395**	-0.154	0.129*
	(0.345)	(0.0803)	(0.174)	(0.105)	(0.0705)
Country fixed-effects	x	x	x	x	x
Observations	4,887	4,887	4,887	4,887	4,887
Adjusted R^2	0.0650	0.0181	0.0563	0.151	0.106
F-value	57.57	16.00	49.60	146.4	97.15
Root mean square error	0.420	0.289	0.433	0.372	0.260

Note: Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' calculations.