



Determinants and impacts of rural crime victimization: Evidence from a case study in Southeast Asia

Ulrike Grote^{a,*}, Thanh-Tung Nguyen^{b,a}, Trung Thanh Nguyen^a, Frank Neubacher^c

^a Institute for Environmental Economics and World Trade, Leibniz University Hannover, Germany

^b Center for Development Research, University of Bonn, Germany

^c Institute of Criminology, University of Cologne, Germany

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ABSTRACT

We use a panel dataset of around 3500 rural households from Southeast Asia and investigate evidence on crime victimization. More concretely, we ask (1) to what extent are rural people affected by crime? (2) What factors determine rural crime victimization? And (3) what are the impacts of crime victimization on welfare of rural households? We use the routine activity approach as the theoretical framework and apply different logit models to identify determinants of crime victimization. We find that 5.46% of the rural households have been victimized, mainly by theft, over the last 12 months, some of them even more than once. Living in a rural region with higher levels of inequality is positively correlated with the likelihood of theft victimization. Households with higher levels of crop commercialization are associated with a higher victimization risk, while households with more livestock and being more specialized in specific livestock species are associated with a lower risk. Moreover, past victimization and exposure to weather shocks are positively associated with the likelihood of being affected by crime. With respect to the impacts, we use the heteroscedasticity-based instrumental variable approach to account for endogeneity and find highly significant negative effects of agricultural theft victimization on food consumption and child health outcomes. We conclude that rural crime requires attention although overall incidence is low in rural Thailand and Vietnam. Guardianship should be promoted, especially in times of weather shocks. Finally, reducing inequality helps preventing theft.

1. Introduction

The prevention of crime is expected to generate high social and economic returns. It increases the attractiveness of rural areas as a living place and eventually reduces outmigration of young people who are urgently needed in sustaining farming and thus food security in the longer run. This is also in line with the Agenda 2030 of the United Nations which includes the Sustainable Development Goal (SDG) 16 to “promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels” (United Nations UN, 2020).

The International Crime Victims Survey (ICVS) suggests that people in developing countries are more often and more severely affected by crime than in developed countries (Zvekic & Del Frate, 1995; Del Frate, A.A., 1998; van Dijk, 2008; van Kesteren et al.,

* Correspondence to: Institute for Environmental Economics and World Trade, Leibniz University Hannover, Königsworther Platz 1, 30167 Hannover, Germany.

E-mail address: grote@iuw.uni-hannover.de (U. Grote).

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2014). However, research has mainly focused on developed countries and on urban crime so far but not on rural crime (Ceccato, 2015). Rural crimes are often property-related. They include a high percentage of theft of tools and equipment, farm inputs (e.g. fuels, pesticides, fertilizer, water) or field crops (such as maize or wheat, fruits and vegetables, timber) and livestock. But also the destruction of property (i.e. vandalism), arson, or damage from trespassers and hunters commonly happen in rural areas (Bunei et al., 2013; Anderson & McCall, 2005; Donnermeyer & Barclay, 2005; Barclay & Donnermeyer, 2011; Holmes & Jones, 2017; Mears et al., 2007a).

There are a few studies from Sub Saharan Africa that have examined crime victimization in rural areas such as Tanzania (Neubacher et al., 2019) and Kenya (Bunei et al., 2013; Bunei & Barasa, 2017). With respect to Asia, research has mainly focused on non-rural crime victimization (i.e. juvenile delinquency, homicide) finding huge regional differences in the prevailing types of crime and across the continent (Liu, 2009; Shytov & Boonchoo, 2007). In terms of rural crime, there is only some evidence on poaching and illegal wildlife trade in Southeast Asia (Ngoc & Wyatt, 2013; Rosen & Smith, 2010), but no research related to the farming sector which is still of significant importance in terms of income generation and employment in rural Thailand and Vietnam.

Against this background, we aim to answer the following three research questions: (1) To what extent are rural people in Southeast Asia affected by crime? (2) What factors determine rural crime victimization? And (3) what are the impacts of crime victimization on welfare of rural households? Our paper contributes to the given literature by adding evidence on the determinants and impacts of rural crime on household welfare in Southeast Asia. First, to identify determinants of victimization, we use the routine activity approach which provides a solid rationale for why we use certain variables and how they are functionally related to crime victimization (see, e. g., Cohen & Felson, 1979; Barslund et al., 2007; Barclay & Donnermeyer, 2011; Bunei & Barasa, 2017; Grote & Neubacher, 2016; Hollis-Peel et al., 2011; Pesch & Neubacher, 2011). Second, most studies are from Sub Saharan Africa and from single countries (see, e. g., for Kenya (Bunei et al., 2013; Bunei und Barasa 2017); Tanzania (Neubacher et al., 2019); Madagascar (Fafchamps & Moser, 2003); South Africa (Clack and Minnaar 2018); Malawi (Sidebottom, 2013)). We apply rigorous econometric analyses to a rich and unique panel dataset of original survey data from two Southeast Asian countries, Thailand and Vietnam. Third, our data allows to adequately measure the determinants and welfare impacts of rural crime from a single dataset as suggested as a welcome extension of given research by Sidebottom (2013). For this, we use different specifications of logit models and the heteroscedasticity-based instrumental variable approach to account for endogeneity. The results are expected to help rural households to prevent crime by suggesting coping or preventive strategies and policies.

The rest of the paper is structured as follows: Section two provides an overview of the theoretical and empirical literature on the routine activity approach as a basis for further analysis. Section three presents the data and the methodology. Section four shows the results and discusses them. Section five summarizes and concludes and points at limitations and further research needs.

2. Literature review

2.1. Theoretical literature

To identify the determinants of crime victimization, economic theory suggests to focus on the behavior and motivation of the offender who weighs the costs and benefits associated with a criminal act (Becker, 1968; Ehrlich, 1973). Accordingly, the costs reflect the risk of getting caught and punished, whereas the benefits derive from financial gains of victimizing a relatively rich target. However, we generally do not have reliable information on the offender due to a lack of victimization studies, particularly from developing countries. Thus, the routine activity approach – also called theory (i.e. Miró, 2014; Bunei et al., 2013) - from criminology (Cohen & Felson, 1979) has been suggested as theoretical framework to understand and prevent crime victimization (Bunei & Barasa, 2017) (Fig. 1). It can be used to study the likelihood of crimes occurring in rural areas and has been found useful in explaining why certain farm households are more likely to get victimized and which items are more likely to be stolen (Sidebottom, 2013; Mears et al., 2007a). It derives from the observation that crime is directly related to daily routines of both victims and offenders resulting in crime opportunities and contains elements (i.e. of exposure) which have been ignored in economics so far (Barslund et al., 2007). With this approach, we can find a solid rationale for why we use certain variables and how they are functionally related to crime victimization.

A *suitable target* is an object (mostly property) or a person who may be threatened by a motivated offender. It displays characteristics which make it attractive to a potential offender. *Guardianship* determines whether the offender will commit a crime. It acts as an obstacle to offenders and can be both, human (e.g. through neighbors, friends, relatives, passersby, reliability of and access to the



Fig. 1. The routine activity approach.
Source: Based on Cohen and Felson (1979).

police) and/or non-human (e.g. locks, alarms, watchdog) (Bursik & Grasmick, 1993). Finally, a *motivated offender* is somebody who is inclined to commit a crime. He or she can behave rationally by weighing the costs and benefits of committing a crime. However, emotions are likely to be involved as well, as suggested by Bouffard et al. (2000) and these can prove to be a benefit (“thrill”) when committing a crime.

For a crime to occur, a motivated offender, a suitable target and the absence of guardianship must converge in time and space. It is the interaction between these three elements, or the circumstances in which a criminal act happens, rather than the characteristics of the offenders or victims. In contrast to economic theory, Cohen and Felson (1979) focus explicitly on the criminal event, not on the offender. They combine rational choice theory with the aspect of a criminal opportunity and usually assume the presence of people who are sufficiently motivated to seize an opportunity (Pesch & Neubacher, 2011).

2.2. Determinants of victimization

Empirically, the routine activity approach has been applied to a wide variety of subjects ranging from farm crime (Neubacher et al., 2019; Bunei et al., 2013; Bunei & Barasa, 2017), cattle rustling (Sidebottom, 2013), parrot poaching (Pires, 2015), looting of archeological sites (Grove et al., 2018) to cybercrime (Yar, 2005). But first, these studies are mostly descriptive in nature (Bunei et al., 2013; Bunei & Barasa, 2017) and second, they either focus on suitable targets (Sidebottom, 2013; Mears et al., 2007b) or on guardianship (Hollis-Peel et al., 2011) but seldom on both.

Articles with a focus on the *suitable target* and its characteristics help explain risk of crime victimization. These characteristics include socio-economic as well as welfare-related characteristics. Barslund et al. (2007) relate these characteristics from the lifestyle-exposure perspective based on the assumption that victimization risk increases with indicators related to lifestyle and income (van Kesteren et al., 2014; Clinard & Abbott, 1973). In fact, crime is viewed as a by-product of development as wealthy societies provide more suitable targets (e.g. motorcycles, small valuables) and become more materialistic (Shelley, 1981; Grote & Neubacher, 2016). Cohen and Felson (1979) specify targets in terms of their value, inertia, visibility and access (VIVA) as so-called “hot” targets. Clarke (1999) then broadens the notion of property-related crime mainly to define the choice of a target according to whether it is “CRAVED” (Concealable, Removable, Available, Valuable, Enjoyable, and Disposable). Finally, the properties of suitable targets can be also affected by shocks such as health- or weather-related shocks. This may be due to the increased value of targets as availability decreases in the event of a weather shock, making them more attractive for thieves (Sidebottom, 2013). Health shocks which are generally accompanied by a loss of earnings and high medical costs are expected to reduce the attractiveness of targets. Furthermore, sick people more often stay at home which make them less suitable targets, while the use of drugs may make them more vulnerable again due to possible inhibitory effects of drugs (Chalfin et al., 2019; Azimi & Daigle, 2021).

The literature on *guardianship* for crime prevention is a comparatively underdeveloped component of the routine activity approach (Hollis-Peel et al., 2011). It has been found that higher levels of guardianship are associated with significantly lower levels of crime (Cohen & Felson, 1979). Guardianship has been described by household or village level characteristics such as household size or male adult share. The unemployment situation in villages might also increase guardianship because jobless individuals are now at home more often (D'Alessio et al., 2012). It also depends on characteristics related to space (or geography) which is stressed as an important dimension of a criminal opportunity (Brantingham & Brantingham, 1981). Thus, farm isolation has been shown to increase farm household vulnerability to victimization due to lack of guardianship, as potential offenders are less likely to be detected by victims or witnesses (Fafchamps & Moser, 2003; Fafchamps & Minten, 2006). The distribution of smaller plots and greater distances between these plots and the homestead are also associated with higher vulnerability to victimization since offenders are less likely to be detected in case of theft of crops, livestock or machinery parts and tools (Donnermeyer et al., 2011; van Dijk, 2008; Ganpat et al., 2016).

Describing *offenders* is hardly possible and often ends in speculation and anecdotes. Because criminal offences often go unreported, crime statistics are unreliable and there is a lack of data from self-reported crime studies, particularly from the Global South. Asking victims to characterize the (often unknown) offenders, as Bunei et al. (2013) did, is not considered a sensible approach. Bunei and Barasa (2017) point out that a major limitation of the routine activity approach is that offenders' motivations can only be assumed to be the need for food, money, drugs including alcohol, or the urge to improve one's lifestyle (e.g. mobile phone theft). However, there is general criminological evidence that most crimes anywhere in the world are committed by young adult males. When youth density is high, more potential offenders become part of the society and the risk of victimization increases. In fact, delinquent youth correlate with poor education and unemployment (United Nations Office on Drugs and Crime UNODC, 2018). In pastoralist societies there are definitions of masculinity in which young men are encouraged to steal livestock and cattle (Barrett et al., 2001). Donnermeyer et al. (2011) also point out, specifically for rural crime, that farmers are not only harassed by nearby neighbors or individuals, but also by organized groups and passers-by from urban centers. It is also known from the literature that the possession of weapons and vehicles can make crime easier for offenders (Felson & Boba, 2010; Pesch & Neubacher, 2011).

2.3. Welfare impacts of victimization

Rural crime has been found to hamper development of areas in a serious way (Ceccato, 2015; Skaperdas et al., 2009). Persistent crime in rural areas is likely to result in unsustainable development, depriving people of their livelihoods and encouraging the out-migration of often younger household members to urban centers (Ganpat & Isaac, 2018). This can have serious implications for food security in some developing countries (Barclay et al., 2001; Neubacher et al., 2019). Fafchamps and Minten (2006) find for Madagascar that crime and insecurity result in a significant reduction in income and in access to public infrastructure such as health care centers and schools. Also, Ganpat and Isaac (2018) find that crime impedes income and rural livelihoods in the Caribbean. Fafchamps and

Moser (2003) point at indirect costs that arise when, for example, business and trade are diverted, investments and savings are reduced or resources are wasted on crime. Indirect costs also occur as psychological costs and lost work time when those affected by burglary or theft feel suspicious and unsafe at home (Barclay et al., 2001; Ceccato, 2015; Neubacher et al., 2019).

Also worth mentioning are studies that deal with the welfare effects of criminal victimization in the context of armed conflict. Minoiu and Shemyakina (2014) find that conflict-related household victimization is an important channel through which child health is negatively affected in Cote d'Ivoire. Also Dabalen and Paul (2014) show that conflict-related victimization lowers dietary diversity of households and individuals in that country. In addition, farm households in Nigeria are deprived of their livelihoods with severe effects on food security in cases of property crime when livestock, crops or tools are stolen from their homesteads or fields (Kaila & Azad 2019).

3. Data and methodology

3.1. Data

The paper is based on household, village and district data collected in the context of the long-term panel project "Poverty dynamics and sustainable development: A long-term project in Thailand and Vietnam", in brief the "Thailand Vietnam Socio-Economic Panel (TVSEP)"¹ funded by the German Research Foundation (DFG). This project deals with shocks and their impacts on the wellbeing of rural households. Shocks may include economic shocks, natural disasters such as floods and droughts, or health shocks but they can also occur due to crime such as theft, burglary, fraud, or vandalism. A total of 4400 rural households from Thailand and Vietnam were identified in 2007 in a three-stage sampling design with subdistrict, village and then household classifications. Of these, 3536 households from 2016 and 3573 households from 2017 have been used.

In Thailand, the surveys were conducted in the three provinces Buriram, Nakhon Phanom, and Ubon Ratchathani. All three provinces belong to the Northeastern region which is considered to be the "poverty pocket" in Thailand (Healy & Jitsuchon, 2007). In Vietnam, the surveys were conducted in the three provinces Dak Lak, Thua Thien Hue, and Ha Tinh. While the latter two are located in coastal regions, Dak Lak is a more mountainous region which is comparably better off due to the dominance of coffee production (Fig. 2).

We used two survey instruments, namely a household survey and a village survey, which were the same in both countries. The questionnaires for the household survey cover a broad set of questions regarding the socio-demographic and economic conditions of the sampled households. Quantitative information was collected with the help of computer-assisted personal interviews on the exposure to different kinds of shocks including different types of crime experience of the household members. More detailed information was collected about type, frequency and severity of victimization over the last 12 months, the reporting behavior and security measures taken by the households to prevent crime. The main focus was on different questions of everyday crime, in particular various forms of theft (accomplished and attempted), burglary, robbery, fraud, or damage to property. After the interview, each completed questionnaire was cross-checked for plausibility and consistency. The village questionnaire addressed to the village head, entails information at the village level, including the distance from the village to the nearest marketplace, the distance from the village to the nearest police station, and if unemployment is a problem in the village.

3.2. Methodology

Our empirical procedure includes the following steps. First, we conduct a descriptive analysis to identify to what extent rural people in Thailand and Vietnam are affected by different types of crime. We then focus on rural crimes as theft of farm outputs (crops, livestock), but also include theft of motorcycles or other vehicles, of mobile phones or other household items and burglary. Second, we operationalize the routine activity approach by examining the relationships between the variables representing the suitable target and guardianship with the probability for a rural household to suffer from crime. Last, we investigate the impact of victimization on rural households' welfare. The following two subsections represent the second and the last steps.

3.2.1. Model 1 to identify the determinants of victimization

To identify the factors that determine the likelihood that a household will be affected by a criminal event, model 1 is specified by three different logit models: a random-effects logit model, a Firth logit model, and a multilevel logit model (household and village levels). As conceptualized in Section 2, the probability (Y_i) that household i suffers from crime victimization can be specified as:

$$Y_i = F(T_i, G_i, O_i) \quad (1)$$

where F is the cumulative distribution function of the logistic distribution. T represents characteristics of a suitable target; G is a vector of characteristics of guardianship, whereas O denotes other control variables.

Since our data are from two years, a year dummy is also included in the model. As presented, most of these variables are at household level, but some of them are at the village level and one at the district and the provincial level. Thus, our model is further specified as:

¹ Detailed information can be found on the project website www.tvsep.de.



Fig. 2. Study areas in Southeast Asia.
Source: TVSEP.

$$Y_{ivdt} = \alpha + \beta T_{ivdt} + \delta G_{ivdt} + \tau O_{ivdt} + \omega_{ivdt} \tag{2}$$

where Y_{ivdt} denotes the probability that household i in village v of district d suffers from victimization during the last 12 months (year t). Victimization is defined as crime in general (including theft, being cheated at work/business, conflict with neighbors, robbery and vandalism), theft in general, theft of agricultural items (livestock, crops or agricultural products) or theft of personal items (transportation, other items, burglary). T is a vector of household variables; G is a vector of household and village variables; O is the vector of control variables (e.g. inequality, year, province), and ω is the error term. α is the constant and β , δ and τ are the parameters showing impacts of the independent variables on victimization. The selected vectors are further specified in the following:

$$T_{ivdt} = [age_{ivdt}; education_{ivdt}; marital\ status_{ivdt}; farmland\ p\cdot c_{ivdt}; assets\ p\cdot c_{ivdt}; assets\ p\cdot c\cdot sq_{ivdt}; TLU_{ivdt}; livestock\ species_{ivdt}; motorcycle_{ivdt}; past\ victimization_{ivdt-1}; health\ shocks_{ivdt}; weather\ shocks_{ivdt}] \tag{3}$$

With respect to the suitable target T , we include variables of household head characteristics (age, marital status and education), farmland per capita as well as asset value per capita and asset value per capita squared, the number of tropical livestock units (TLU) and the number of livestock species to represent their available, removable and disposable traits, number of motorcycles, whether the households have been victimized in the past and whether they have been affected by health and weather shocks in the last 12 months.

$$G_{ivdt} = [hhsz_{ivdt}; maleadults_{ivdt}; wage\ employment_{ivdt}; HCI_{ivdt}; mobile\ phones_{ivdt}; distance\ plots_{ivdt}; land\ plots_{ivdt}; paved\ road_{vdt}; dist_market_{vdt}; dist_police_{vdt}; unemployment_{vdt}] \tag{4}$$

Guardianship (G) is represented by a number of household variables and four village variables. Household characteristics are household size, proportion of male adults in the household, wage employment, household commercialization index (HCI), number of mobile phones, distance to plots and number of land plots. The four village variables are existence of a paved road, distance to the nearest police station, distance to the nearest market, and unemployment in villages. Other control variables (O) are consumption inequality in the district, year and province dummies.

All monetary variables are measured in 2005 purchasing power parity dollars (2005 PPP\$). Because our data are panel, we use a random effects logit model with robust standard errors to account for potential heteroscedasticity. The variance inflation factor (VIF) values are checked and do not signal any serious multicollinearity problem. Since the proportion of victimized households is less than

10%, we also carry out a Firth logit (Penalized Maximum Likelihood Estimation, see Puhrt et al., 2017) as well as a multilevel logit model to test the robustness. The results prove robust across the different models. Table 1 presents the descriptive statistics of the variables which will be used in our econometric models.

3.2.2. Model 2 to investigate impacts of victimization

To investigate the impacts of crime victimization on household consumption, we specify model 2 as follows:

$$W_{ivdt} = \alpha + \varphi Y_{ivdt} + \beta T_{ivdt} + \delta G_{ivdt} + \tau O_{ivdt} + \omega_{ivdt} \tag{5}$$

where W_{ivdt} is consumption of household i in village v of district d in year t . We use three household consumption variables (total consumption per capita, food consumption per capita, and non-food consumption per capita (all in ln form).

We also estimate the impact of crime victimization on child health and this estimation is conducted at the individual level as follows:

$$H_{jivdt} = \alpha + \varphi Y_{jivdt} + \beta T_{jivdt} + \delta G_{jivdt} + \tau O_{jivdt} + \sigma C_{jivdt} + \omega_{jivdt} \tag{6}$$

where H represents child growth standards of the World Health Organization (WHO) including standardized height-for-age and weight-for-age of child j in the age from 0 to 10 years. T, G, O are defined as in Equation 1. C represents child characteristics (gender, age, age squared, number of siblings).

Since crime victimization is the dependent variable in Equation 1, it is endogenous in the estimate of welfare as in Eq. 5 and Eq. 6. Therefore, we use the heteroscedasticity-based instrumental variable method proposed by Lewbel (2012). This method allows us to generate internal instrumental variables (IVs). These IVs for Y_i in estimating crime victimization in Eq. 5 are constructed as: $[z'_i - E(z'_i)] \xi_i$ with ξ and z being the residuals and control variables in Equation 1, respectively. In Eq. 6, the IVs are constructed in a similar way, but at the individual level (not at the household level like in Eq. 5), and control variables of child characteristics are taken into account. IVs are not correlated with ε_i in Eq. 5 and Eq. 6 because it is assumed that $Cov(z'_i, \varepsilon_i) = Cov(z'_i, \xi_i) = Cov(z'_i, \varepsilon_i \xi_i) = 0$. Due to heteroscedasticity ($Cov(z'_i, \xi_i^2) \neq 0$), IVs are correlated with Y_i through ξ_i . A series of post-estimation tests for under-identification, overidentification and weak instruments were performed and their results confirm the validity of our models (see Tables 5 and 6).

Table 1
Definition and descriptives of variables.

| Variable | Description of variable | Mean | sd |
|----------------------------------|--|--------|---------|
| Suitable Target T | | | |
| <i>age</i> | Age of household head in years | 58.61 | 12.52 |
| <i>education</i> | Highest education level of household members in school years | 9.81 | 3.89 |
| <i>marital status</i> | Household head is married (1 =yes) | 0.78 | 0.42 |
| <i>farmland p.c.</i> | farm land area per capita (hectare) | 0.33 | 0.49 |
| <i>TLU</i> | No. of tropical livestock units | 1.19 | 2.17 |
| <i>livestock species</i> | No. of different livestock species | 1.39 | 1.28 |
| <i>assets p.c.</i> | Asset value per capita in 1000 PPP (constant 2005 international \$) | 2.042 | 0.125 |
| <i>assets p.c. sq.</i> | Assets per capita squared | 19.272 | 113.244 |
| <i>motorcycle</i> | No. of motorcycles of household members | 0.86 | 0.36 |
| <i>past victimization</i> | Household victimized in the past (1 =yes) | 0.14 | 0.41 |
| <i>health shocks</i> | No. of health shocks suffered by the households during the last 12 months | 0.16 | 0.39 |
| <i>weather shocks</i> | No. of weather shocks (e.g. floods, droughts, storms) suffered by the households during the last 12 months | 0.23 | 0.46 |
| Guardianship G | | | |
| <i>hhszize</i> | No. of household members | 3.71 | 1.65 |
| <i>maleadults</i> | Share of male adults in household size | 0.31 | 0.23 |
| <i>wage employment</i> | Share of household members with main occupation being wage employment | 0.13 | 0.22 |
| <i>HCI</i> | Household Commercialization Index (crop sales to production ratio) | 0.42 | 0.38 |
| <i>mobile phones</i> | No. of mobile phones of household members | 1.31 | 0.57 |
| <i>distance plots</i> | Average distance to plots in km | 1.56 | 6.92 |
| <i>land plots</i> | No. of plots of household | 3.48 | 2.23 |
| <i>paved road</i> | Nearby road is paved (1 =yes) | 0.91 | 0.28 |
| <i>dist_market⁺</i> | Distance to the nearest market in km | 6.35 | 7.16 |
| <i>dist_police⁺</i> | Distance to the nearest police station in km | 9.37 | 8.00 |
| <i>unemployment⁺</i> | Unemployment is a problem in the village, as reported by village head (1 =yes) | 0.43 | 0.49 |
| Other Control Variables O | | | |
| <i>inequality⁺⁺</i> | Gini consumption inequality index in the district | 0.37 | 0.06 |

Note: ⁺ data at the village level; ⁺⁺ data at the district level; sd: standard deviation

4. Results and discussion

4.1. Evidence on crime victimization in rural Southeast Asia

The surveyed households were first asked an open question about their general fears about the future. Concerns about personal health and family problems ranked relatively high. Crime is not seen as the biggest fear, but on average still around 11% of the households say it is a fear of the future. It also ranks close to natural disaster fears in Thailand and Vietnam. This is interesting as both countries are often affected by natural disasters. They are among the top 5 countries in the world affected by disasters with serious injuries and fatalities.

Rural households from our sample in Thailand and Vietnam were asked to indicate whether their household had been affected by crime in the past 12 months. Table 2 shows that there are 388 victimized households (or 5.46%) in 2016–17, of which 365 households have been affected by one type of crime, 22 by two types of crimes and one household even by three types. Just over half of all crimes are related to theft, particularly of livestock, but also of crops and other agricultural produce, transportation and other items. The theft of transportation is the most heavily valued type of theft, with an average loss of nearly USD 2000 (PPP 2005) per affected household. 84 households also stated that they had been cheated at work or in business during the study period. This is consistent with ICVS findings indicating that consumer fraud is widespread in Asia (van Dijk, 2008). This type is classified by the affected households as the most serious crime. At over USD 4000 (PPP 2005), their estimated damage is on average twice as high as that of transport theft. With an average annual income of around USD 11,000, this can be quite significant for some households. Other types of crime recorded in the survey are – in a decreasing number of households – burglary, conflict with neighbors, vandalism and robbery (Table 3).

We have pooled the data because first, we want to focus on the Southeast Asian region, rather than on the individual countries. Even though Thailand is an upper-middle income country, while Vietnam is a lower-middle income country, the rural areas of the two countries are similar in several aspects (Nguyen et al., 2020). Second, if we separate the sample for Thailand and Vietnam, the number of crime cases becomes relatively small. Consequently, some models do not satisfy validation tests. Third, to nevertheless account for country differences, we include provincial dummies in our different logit regressions (Appendix Table C). These provincial dummies account for the differences among provinces and thus between the two countries.

Comparing Thailand and Vietnam, households in Thailand are less likely to be subjected to victimization than in Vietnam (Appendix A). Looking at the type and frequency of victimization separately for the two countries, we find that theft especially of livestock and crops and other agricultural products happens more often in Vietnam than in Thailand. Being cheated is at a relatively higher level in Thailand than in Vietnam, and burglary happens at similarly high levels in both countries. The mean incidence values indicate that Vietnamese households are more severely affected by theft of livestock, crops or other agricultural products and vandalism than Thai households. With respect to the level of average damage, being cheated results in both countries in the highest levels of damage. Robbery and theft of transportation result in Thailand in more severe average damages than in Vietnam which might be related to a slightly higher welfare level in Thailand as compared to Vietnam. Accordingly, Thai households are more likely to report robbery, theft of transportation and theft of crops and agricultural products to the police than Vietnamese households. However, Thai households are less likely to report work/business fraud to the police than Vietnamese households, probably because they do not trust the police, cannot provide sufficient evidence, or are ashamed or upset of having been scammed. In addition, there is a tendency for people in developing countries to manage crime and conflict with the help of informal support such as village heads or other social institutions (Neubacher et al., 2019).

Table 2

Types, frequency, severity and reporting of crime (both in Thailand and Vietnam), 2016–17.

| | Number of reported cases ^a | Incidence ^b (mean) | Severity ^c (mean) | Damage (in PPP\$ 2005) | Reporting (mean, 1 =yes; 0 =no) |
|---|---------------------------------------|----------------------------------|---------------------------------|---------------------------|------------------------------------|
| Theft victimization | | | | | |
| <i>Agricultural theft</i> | | | | | |
| Theft of livestock | 107 | 1.00 | 2.74 | 152.85 | 0.35 |
| Theft of crops or agricultural products | 44 | 1.00 | 2.91 | 505.00 | 0.36 |
| <i>Personal theft</i> | | | | | |
| Theft of transportation | 28 | 1.04 | 3.18 | 1934.56 | 0.64 |
| Theft of other items | 25 | 1.00 | 2.80 | 557.36 | 0.28 |
| Burglary | 55 | 1.02 | 2.93 | 681.26 | 0.42 |
| <i>Total theft</i> | 259 | | | | |
| Other types of victimization | | | | | |
| Being cheated at work/business | 84 | 1.02 | 3.46 | 4011.44 | 0.23 |
| Conflict with neighbors | 42 | 1.02 | 2.63 | 658.83 | 0.62 |
| Robbery | 7 | 1.00 | 3.00 | 981.20 | 0.71 |
| Vandalism | 20 | 1.00 | 3.15 | 506.03 | 0.60 |
| <i>Total other types</i> | 253 | | | | |
| Total | 412 | | | | |

^a In total, 388 households (or 5.46%) have been victimized, of which 365 households have been affected by one type of crime, 22 by two types of crimes and 1 household by three types.

^b Incidence indicates repeated victimization; if mean is > 1, some households have been victimized more than once.

^c Severity of the event (1: no impact, 2: low, 3: medium, 4: high).

Table 3
Determinants of theft victimization in rural Southeast Asia (marginal effects).

| | Random-Effects Logit | | Firth Logit | | multilevel logit model (household and village levels) | |
|----------------------------------|--------------------------------|-----------------------------|--------------------------------|-----------------------------|---|-----------------------------|
| | Without past victimization (1) | With past victimization (2) | Without past victimization (3) | With past victimization (4) | Without past victimization (5) | With past victimization (6) |
| Suitable Target T | | | | | | |
| age | -0.0003 * (0.0002) | -0.0003 (0.0002) | -0.0100 * (0.0060) | -0.0091 (0.0061) | -0.0003 * (0.0002) | -0.0003 (0.0002) |
| education | -0.0012 * (0.0007) | -0.0014 * (0.0007) | -0.0333 (0.0214) | -0.0372 * (0.0218) | -0.0013 * (0.0007) | -0.0015 * * (0.0007) |
| marital status | -0.0121 * * (0.0054) | -0.0129 * * (0.0057) | -0.3573 * * (0.1650) | -0.3652 * * (0.1670) | -0.0117 * * (0.0055) | -0.0126 * * (0.0057) |
| farmland p.c. | 0.0049 (0.0042) | 0.0049 (0.0045) | 0.1508 (0.1311) | 0.1469 (0.1327) | 0.0050 (0.0045) | 0.0054 (0.0048) |
| TLU | -0.0055 * * (0.0022) | -0.0057 * * (0.0022) | -0.1599 * * * (0.0559) | -0.1582 * * * (0.0561) | -0.0054 * * (0.0022) | -0.0056 * * (0.0022) |
| livestock species | 0.0049 * * (0.0021) | 0.0048 * * (0.0022) | 0.1438 * * (0.0627) | 0.1346 * * (0.0637) | 0.0051 * * (0.0022) | 0.0050 * * (0.0023) |
| assets p.c. | 0.0019 * (0.0011) | 0.0020 * (0.0012) | 0.0451 (0.0333) | 0.0455 (0.0329) | 0.0019 (0.0012) | 0.0020 (0.0012) |
| assets p.c. sq. | -0.0001 (0.0000) | -0.0001 (0.0000) | -0.0009 (0.0010) | -0.0010 (0.0010) | -0.0001 (0.0000) | -0.0001 (0.0000) |
| motorcycle | 0.0011 (0.0074) | 0.0023 (0.0078) | 0.0209 (0.2213) | 0.0542 (0.2243) | 0.0019 (0.0072) | 0.0030 (0.0076) |
| past victimization | | 0.0104 * * (0.0041) | | 0.2999 * * (0.1253) | | 0.0097 * * (0.0041) |
| health shocks | 0.0053 (0.0050) | 0.0045 (0.0054) | 0.1606 (0.1503) | 0.1315 (0.1535) | 0.0048 (0.0051) | 0.0041 (0.0055) |
| weather shocks | 0.0141 * * * (0.0043) | 0.0149 * * * (0.0045) | 0.4252 * * * (0.1211) | 0.4297 * * * (0.1213) | 0.0135 * * * (0.0046) | 0.0144 * * * (0.0048) |
| Guardianship G | | | | | | |
| hhsz | 0.0011 (0.0017) | 0.0009 (0.0019) | 0.0320 (0.0478) | 0.0247 (0.0493) | 0.0011 (0.0018) | 0.0008 (0.0019) |
| male adults | -0.0001 (0.0108) | 0.0024 (0.0117) | -0.0176 (0.3217) | 0.0523 (0.3278) | -0.0008 (0.0109) | 0.0021 (0.0117) |
| wage employment | 0.0092 (0.0108) | 0.0104 (0.0115) | 0.2966 (0.3218) | 0.3149 (0.3258) | 0.0089 (0.0109) | 0.0097 (0.0118) |
| HCI | 0.0148 * * (0.0072) | 0.0149 * * (0.0076) | 0.4461 * * (0.2077) | 0.4284 * * (0.2094) | 0.0155 * * (0.0075) | 0.0155 * * (0.0080) |
| mobile phones | 0.0085 * (0.0045) | 0.0093 * * (0.0047) | 0.2513 * * (0.1282) | 0.2608 * * (0.1294) | 0.0092 * (0.0048) | 0.0101 * * (0.0050) |
| distance plots | 0.0001 (0.0001) | 0.0001 (0.0001) | 0.0050 (0.0043) | 0.0046 (0.0043) | 0.0001 (0.0001) | 0.0001 (0.0001) |
| land plots | 0.0001 (0.0011) | -0.0003 (0.0011) | 0.0007 (0.0354) | -0.0092 (0.0358) | 0.0001 (0.0011) | -0.0002 (0.0012) |
| paved road | 0.0008 (0.0076) | -0.0004 (0.0080) | 0.0125 (0.2250) | -0.0214 (0.2262) | 0.0007 (0.0089) | -0.0007 (0.0095) |
| distance market | 0.0000 (0.0004) | 0.0001 (0.0004) | 0.0011 (0.0106) | 0.0014 (0.0107) | 0.0001 (0.0004) | 0.0001 (0.0004) |
| distance police | -0.0004 (0.0003) | -0.0004 (0.0003) | -0.0114 (0.0089) | -0.0094 (0.0089) | -0.0004 (0.0003) | -0.0004 (0.0003) |
| unemployment | 0.0004 (0.0048) | -0.0003 (0.0050) | 0.0124 (0.1393) | -0.0095 (0.1410) | 0.0011 (0.0055) | 0.0004 (0.0059) |
| Other Control Variables O | | | | | | |
| inequality | 0.1426 * * * (0.0376) | 0.1415 * * * (0.0391) | 4.3270 * * * (1.1385) | 4.1109 * * * (1.1496) | 0.1354 * * * (0.0429) | 0.1337 * * * (0.0449) |
| year and province dummies | yes | yes | Yes | yes | yes | yes |
| N | 7109 | 6651 | 7109 | 6651 | 7109 | 6651 |
| Prob > Chi ² | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

* * * p < 0.01, * * p < 0.05, * p < 0.1; standard deviation in parentheses

The households surveyed were also asked whether they take any security and precautionary measures to avoid such crimes (Appendix B). Around 70% of all households stated that they had not taken any security measures. In Thailand, almost 90% do nothing, while in Vietnam it is only 50%. The most commonly chosen security measures are locks and watchdogs, especially in Vietnam. In addition, neighborhood watch and networks, associations or gifts to increase mutual assistance seem to play some role, particularly in Vietnam.

The surveys in Thailand and Vietnam delved into reporting behavior in more detail by asking “*Who did you report the case to?*”. Only around 40% of the 417 criminal cases were reported. When reported, victim households were more likely to report to the police (18%) than to local institutions such as the village head (12%) or a local government official (7%). The evidence is similar in both countries and comparable to the ICVS, which states that Asians report well under 40% of all conventional crimes to the police (van Dijk, 2008). Police forces in developing countries are generally underfunded and often based in cities. Furthermore, police may have no influence on the victimization rate due to unmotivated police officers and inefficient courts (Fafchamps & Moser, 2003).

4.2. Determinants of victimization

To analyze the two components suitable target and guardianship of the routine activity approach and their relationships to the likelihood that a rural household will be affected by theft, we present the results from three specifications: the random effects logit model, the Firth logit model and the multilevel logit model with two levels (household and village) in Table 3. In the first specification of each model, we do not include past victimization as one of the explanatory variables to avoid temporal autocorrelation (column 1, column 3 and column 5), while in the second specification, we include it (column 2, column 4 and column 6). We correct for location and time fixed effects and report the marginal effects. The results are robust and show the same significant factors leading to theft victimization in all six models. The same models were applied to crime in general, agricultural theft and theft of personal items, and yielded similarly robust results.

We first note from Table 3 that some suitable target characteristics appear to be associated with the likelihood of becoming a victim of theft. Thus, single household heads seem to be at a higher risk of theft. This result is statistically significant at the 5% level and could be due to poorer physical condition and lower social status (Bunei et al., 2014; Clinard & Abbott, 1973; van Kesteren et al., 2004). With respect to livestock, a lower TLU is associated with higher theft risk. This statistically significant result contradicts our expectation (Mears et al., 2007a; Sidebottom, 2013). It may indicate that households more specialized in livestock production are more concerned about livestock security so that they may use fences or keep their livestock indoors. So this variable does not reflect whether livestock is available, but whether it is guarded. In contrast, households with a higher number of different livestock species are associated with a statistically significantly higher risk of victimization. This finding is supported by Sidebottom (2013), who examines self-reported theft data for seven livestock species from 11,280 households in Malawi. He notes that chickens have been identified as the most commonly stolen farm animals as they are easier to remove and dispose of, and easier to capture and to sell. Households that have been victims of crime in the past are more likely to become crime victims again. This result is statistically highly significant, and is supported by Wittebrood and Nieuwebeerta (2000), Dolliver et al. (2022) and Neubacher et al. (2019).

Finally, characteristics of suitable targets can be also influenced by shocks such as health or weather-related shocks. We find that weather shocks such as floods, storms or droughts expose households more to theft in contrast to health shocks. Also, Blakeslee and Fishman (2018) and Yu et al. (2017) find strong positive effects of weather shocks on all types of crime. This might be due to the covariate nature of weather shocks affecting several or all households in the village. Weather shocks increase the strain on individuals who may cope by committing a crime. This implies for example, that uncomfortable temperatures at times of heatwaves make people more aggressive which decreases the threshold of aggressive actions and may result in crime (Anderson et al., 2000). Furthermore, the routine activity approach suggests that in case of hot weather, routine activities alter (Cohen & Felson, 1979) because people tend to spend more time in outdoor public spaces, leaving their homes unprotected and thus reducing guardianship. Weather shocks may also weaken the formal and informal social controls. A flood for example may force people to displace temporarily from the inundated area which leads to a loss of informal social control. Similarly, formal control by the police may be weakened in such flooded areas because road access to the flooded area might be blocked. In addition, floods or droughts are likely to decrease the availability of resources such as food, fuel or water which results in their increased value and makes them more attractive targets for thieves (Nguyen et al., 2022; Sidebottom, 2013). At the same time, social conflicts may increase due to competition over scarce resources (Nguyen et al., 2023). Health shocks, in contrast, are not interrelated with victimization. This may indicate that farmers might become less attractive targets in case of illness. The offender might be more hesitant to commit a crime (Mears et al., 2007b).

Other characteristics related to the suitable target, which are statistically significant at 10% are age, education and assets. With respect to age, younger people are more and older people less likely to be victimized by theft. This may be explained by the fact that the respect for age is very pronounced in Asian cultures (Vauclair et al., 2017). In addition, it might be also possible that older household heads are more aware of risks and thus more likely to take precautionary measures. Also Kappes et al. (2013) find no age-related change in fear. Their research is grounded on the so-called “victimization-fear paradox”, implying that the elderly are more afraid of becoming victimized than the younger (Bilsky et al., 1993). It is called a paradox since the elderly have the highest fear of crime although they have statistically the lowest risk of victimization. This is mainly explained with their avoidance behavior and the preventive measures regarding crime.

Better educated household heads turn out to be less likely victims of theft. This result can be explained by the fact that more educated household heads are more likely to take precautionary measures. However, households with more assets are more likely to become victims of theft. In fact, crime is often regarded as a by-product of development with societies providing more suitable targets and becoming more materialistic (Shelley, 1981; Neubacher & Grote, 2016). The variables farmland per capita, assets per capita squared and motorcycle are not correlated with theft.

There are a number of variables which refer to guardianship. However, most variables turn out to be statistically insignificant. This might be explained by the relatively low rate of victimization in Southeast Asia which is also reflected in the observation that many people do not take any security measures at all. The significant result that a higher HCI is associated with a higher exposure to theft can be explained by the observation that first, household members have to go to markets and thus leave their farms unguarded (Omiti et al.,

Table 4
Determinants of victimization across different types (marginal effects; random-effects logit model).

| | Crime in general | | Theft in general | | Agricultural theft | | Personal theft | |
|----------------------------------|-----------------------------|--------------------------|-----------------------------|--------------------------|-----------------------------|--------------------------|-----------------------------|--------------------------|
| | Without past victim. (1) | With past victim. (2) | Without past victim. (1) | With past victim. (2) | Without past victim. (1) | With past victim. (2) | Without past victim. (1) | With past victim. (2) |
| Suitable Target T | | | | | | | | |
| age | -0.0004 (0.0003) | -0.0003 (0.0003) | -0.0003 * (0.0002) | -0.0003 (0.0002) | -0.0002 (0.0001) | -0.0002 (0.0002) | -0.0002 (0.0001) | -0.0002 (0.0001) |
| education | -0.0015 * (0.0009) | -0.0018 * (0.0009) | -0.0012 * (0.0007) | -0.0014 * (0.0007) | -0.0004 (0.0006) | -0.0005 (0.0006) | -0.0008 * (0.0004) | -0.0009 * * (0.0005) |
| marital status | -0.0150 * * (0.0072) | -0.0173 * * (0.0076) | -0.0121 * * (0.0054) | -0.0129 * * (0.0057) | -0.0065 (0.0043) | -0.0059 (0.0045) | -0.0058 * (0.0034) | -0.0074 * * (0.0035) |
| farmland p.c. | 0.0009 (0.0062) | 0.0013 (0.0065) | 0.0049 (0.0042) | 0.0049 (0.0045) | 0.0051 * (0.0029) | 0.0053 * (0.0030) | 0.0003 (0.0031) | 0.0003 (0.0032) |
| TLU | -0.0048 * (0.0025) | -0.0050 * * (0.0025) | -0.0055 * * (0.0022) | -0.0057 * * (0.0022) | -0.0033 * (0.0018) | -0.0035 * (0.0019) | -0.0020 (0.0012) | -0.0020 (0.0013) |
| livestock species | 0.0062 * * (0.0028) | 0.0068 * * (0.0029) | 0.0049 * * (0.0021) | 0.0048 * * (0.0022) | 0.0042 * * * (0.0015) | 0.0041 * * * (0.0016) | 0.0004 (0.0016) | 0.0005 (0.0017) |
| assets p.c. | 0.0033 * * * (0.0012) | 0.0037 * * * (0.0013) | 0.0019 * (0.0011) | 0.0020 * (0.0012) | -0.0000 (0.0012) | -0.0000 (0.0013) | 0.0015 * * (0.0006) | 0.0016 * * (0.0006) |
| assets p.c. sq. | -0.0001 (0.0000) | -0.0001 * (0.0000) | -0.0001 (0.0000) | -0.0001 (0.0000) | -0.0000 (0.0000) | -0.0000 (0.0000) | -0.0000 * (0.0000) | -0.0000 * * (0.0000) |
| motorcycle | 0.0075 (0.0098) | 0.0087 (0.0102) | 0.0011 (0.0074) | 0.0023 (0.0078) | 0.0019 (0.0058) | 0.0024 (0.0060) | -0.0001 (0.0044) | 0.0008 (0.0048) |
| past victimization | | 0.0218 * * * (0.0056) | | 0.0104 * * (0.0041) | | 0.0107 * * * (0.0028) | | -0.0045 (0.0042) |
| health shocks | 0.0033 (0.0063) | 0.0030 (0.0066) | 0.0053 (0.0050) | 0.0045 (0.0054) | 0.0027 (0.0036) | 0.0023 (0.0039) | 0.0022 (0.0034) | 0.0018 (0.0037) |
| weather shocks | 0.0144 * * * (0.0055) | 0.0154 * * * (0.0056) | 0.0141 * * * (0.0043) | 0.0149 * * * (0.0045) | 0.0131 * * * (0.0030) | 0.0137 * * * (0.0031) | -0.0009 (0.0035) | -0.0008 (0.0036) |
| Guardianship G | | | | | | | | |
| hhsz | 0.0025 (0.0021) | 0.0027 (0.0022) | 0.0011 (0.0017) | 0.0009 (0.0019) | 0.0005 (0.0014) | 0.0002 (0.0015) | 0.0007 (0.0011) | 0.0008 (0.0012) |
| male adults | 0.0101 (0.0135) | 0.0155 (0.0144) | -0.0001 (0.0108) | 0.0024 (0.0117) | 0.0016 (0.0090) | 0.0021 (0.0098) | -0.0007 (0.0063) | 0.0015 (0.0068) |
| wage job share | 0.0023 (0.0137) | 0.0085 (0.0143) | 0.0092 (0.0108) | 0.0104 (0.0115) | -0.0041 (0.0093) | -0.0040 (0.0099) | 0.0111 * (0.0064) | 0.0125 * (0.0068) |
| HCI | 0.0105 (0.0089) | 0.0098 (0.0093) | 0.0148 * * (0.0072) | 0.0149 * * (0.0076) | 0.0093 * (0.0056) | 0.0090 (0.0059) | 0.0059 (0.0047) | 0.0064 (0.0049) |
| mobile phones | 0.0042 (0.0054) | 0.0047 (0.0057) | 0.0085 * (0.0045) | 0.0093 * * (0.0047) | 0.0005 (0.0033) | 0.0003 (0.0035) | 0.0079 * * * (0.0031) | 0.0090 * * * (0.0033) |
| distance plots | 0.0001 (0.0002) | 0.0001 (0.0002) | 0.0001 (0.0001) | 0.0001 (0.0001) | 0.0001 (0.0001) | 0.0001 (0.0001) | 0.0000 (0.0001) | 0.0001 (0.0001) |
| land plots | 0.0016 (0.0014) | 0.0010 (0.0015) | 0.0001 (0.0011) | -0.0003 (0.0011) | -0.0003 (0.0008) | -0.0005 (0.0008) | 0.0004 (0.0007) | 0.0001 (0.0008) |
| paved road | 0.0107 (0.0103) | 0.0084 (0.0107) | 0.0008 (0.0076) | -0.0004 (0.0080) | -0.0003 (0.0054) | -0.0013 (0.0057) | 0.0021 (0.0057) | 0.0021 (0.0059) |
| distance market | -0.0001 (0.0005) | -0.0001 (0.0005) | 0.0000 (0.0004) | 0.0001 (0.0004) | -0.0001 (0.0003) | -0.0001 (0.0004) | 0.0001 (0.0002) | 0.0001 (0.0002) |
| distance police | -0.0003 (0.0003) | -0.0002 (0.0004) | -0.0004 (0.0003) | -0.0004 (0.0003) | -0.0004 * (0.0002) | -0.0004 (0.0002) | -0.0000 (0.0002) | -0.0000 (0.0002) |
| unemployment | 0.0100 * (0.0059) | 0.0086 (0.0061) | 0.0004 (0.0048) | -0.0003 (0.0050) | -0.0009 (0.0036) | -0.0021 (0.0039) | 0.0010 (0.0031) | 0.0015 (0.0033) |
| Other Control Variables O | | | | | | | | |
| inequality | 0.1545 * * * (0.0456) | 0.1558 * * * (0.0475) | 0.1426 * * * (0.0376) | 0.1415 * * * (0.0391) | 0.1088 * * * (0.0281) | 0.1012 * * * (0.0287) | 0.0284 (0.0262) | 0.0342 (0.0280) |
| year and province dummies | yes | yes | yes | yes | yes | yes | yes | yes |
| N | 7109 | 6651 | 7109 | 6651 | 7109 | 6651 | 7109 | 6651 |
| Prob > Chi ² | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

* * * p < 0.01, * * p < 0.05, * p < 0.1; standard deviation in parentheses

2006). Second, they often follow very predictable routines when going to markets thus lowering guardianship at specific times. Third, commercialization may also increase the exposure to targets e.g. on markets. Finally, commercialized farms are also more likely to have a larger number of workers with some of them being potential offenders, especially if poorly or unfrequently paid as theorized by Bunei and Barasa (2017). In addition, the number of mobile phones in the household is associated with a slightly higher theft risk. It was hypothesized that mobile phones are related to guardianship because owning a mobile phone will enable a household to call

Table 5
Impact of theft victimization on household consumption.

| | Heteroscedasticity-based Instruments | | |
|---|--------------------------------------|----------------------------------|-------------------------------------|
| | total consumption per capita (ln) | food consumption per capita (ln) | nonfood consumption per capita (ln) |
| Panel A | | | |
| theft victimization | -0.035 (0.055) | -0.089 * (0.053) | 0.051 (0.066) |
| control variables | yes | yes | yes |
| no. of observations | 7109 | 7109 | 7109 |
| underidentification | 0.000 | 0.000 | 0.000 |
| weak identification | 110.833 | 110.833 | 110.833 |
| overidentification | 0.516 | 0.212 | 0.499 |
| p-value | 0.000 | 0.000 | 0.000 |
| Panel B | | | |
| agricultural theft victimization | -0.081 * (0.047) | -0.176 * ** (0.049) | 0.016 (0.057) |
| control variables | yes | yes | yes |
| no. of observations | 7109 | 7109 | 7109 |
| underidentification | 0.000 | 0.000 | 0.000 |
| weak identification | 255.338 | 255.338 | 255.338 |
| overidentification | 0.573 | 0.124 | 0.707 |
| p-value | 0.000 | 0.000 | 0.000 |
| Panel C | | | |
| personal theft victimization | 0.069 (0.077) | 0.016 (0.066) | 0.182 * (0.099) |
| control variables | yes | yes | yes |
| no. of observations | 7109 | 7109 | 7109 |
| underidentification | 0.083 | 0.083 | 0.083 |
| weak identification | 144.103 | 144.103 | 144.103 |
| overidentification | 0.745 | 0.939 | 0.512 |
| p-value | 0.000 | 0.000 | 0.000 |

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust standard errors in parentheses; the underidentification test is an LM test based on Kleibergen and Paap (2006) rk LM statistics with the null hypothesis that the model is underidentified; the overidentification test is based on the Hansen J test with the null hypothesis being that all instruments are valid. For weak identification, a Cragg-Donald Wald F statistic is reported.

friends, neighbors or police for help (Bhavnani et al., 2008). However, the positive association indicates that mobile phones are rather perceived as suitable targets and as an indicator of wealth. All other guardianship characteristics do not show any statistically significant sign in our case study. We also run once all regressions with *trust* as an additional guardianship variable (Appendix C). It turns out to be highly statistically significant for crime victimization in general and slightly significant for personal theft victimization, while the overall results remain robust. This supports the hypothesis that a higher level of trust in neighbors in the village increases the guardianship by neighbors who watch during absence of the owners and lowers the crime rate (Bursik & Grasmick, 1993; Wilcox et al., 2007). However, it might indicate as well that environmental factors lead to lower victimization because this part of the village is generally inhabited by households that are better protected or more alert. Furthermore, it is also possible that the low victimization rate is not the consequence but the cause of the trust measured (reverse effect). Due to these and the endogeneity concern, we decided to delete the variable from the main results' Tables 4 and 5.

Lastly, we control for inequality in the living region which is statistically and significantly positively correlated with theft. This result is confirmed for example by Demombynes and Özler (2005) and Burdett et al. (2003). The variable "unemployment" is not significantly correlated with theft victimization (Table 3), but there is a slightly statistically significant positive correlation with crime victimization in general (Table 4). This suggests that the hypothesis that unemployment increases guardianship, as the unemployed are now more likely to be at home and keeping an eye on potential targets, does not hold. Rather, it suggests that unemployment contributes to crime victimization. However, we acknowledge that the result may be biased because our unemployment variable reflects the perception of the village heads and is therefore not an objective measure. In villages where there is more criminal activity, people are more likely to worry about unemployment and to share their concerns about unemployment-related crime with others. As a result, the village head is also more likely to label it as a problem, which can lead to bias.

Table 4 compares the determinants of different types of victimization in Thailand and Vietnam. A more differentiated look at theft of agricultural goods (livestock, crops) and personal goods (i.e. transport) provides some interesting context-specific findings. For agricultural theft, significant determinants are related to farming (livestock variables, farmland per capita, weather shocks, commercialization index). However, with respect to personal theft, assets per capita are more important as a determinant of victimization, as well as owning a mobile phone.

More in detail on agricultural theft, households with a higher number of different livestock species are also associated with a statistically significantly higher risk of victimization. It can be assumed that this is related to chickens, the most commonly stolen farm animals as they are very suitable targets (Sidebottom, 2013). This positive correlation also holds for the variables past victimization and farmland per capita. Weather shocks are statistically and significantly correlated with agricultural theft, but not with personal

Table 6
Impact of theft victimization on child health.

| | Heteroscedasticity-based Instruments | |
|---|--------------------------------------|-----------------------------|
| | standardized height for age | standardized weight for age |
| Panel A | | |
| theft victimization | 0.005 (0.439) | -0.597 * ** (0.190) |
| control variables | yes | yes |
| no. of observations | 3281 | 3281 |
| underidentification | 0.001 | 0.001 |
| weak identification | 105.523 | 105.523 |
| overidentification | 0.096 | 0.291 |
| p-value | 0.000 | 0.000 |
| Panel B | | |
| agricultural theft victimization | 0.575 (0.401) | -0.436 * ** (0.157) |
| control variables | yes | yes |
| no. of observations | 3281 | 3281 |
| underidentification | 0.008 | 0.008 |
| weak identification | 406.235 | 406.235 |
| overidentification | 0.234 | 0.678 |
| p-value | 0.000 | 0.000 |
| Panel C | | |
| personal theft victimization | 0.154 (0.312) | -0.288 * (0.165) |
| control variables | yes | yes |
| no. of observations | 3281 | 3281 |
| underidentification | 0.161 | 0.161 |
| weak identification | 665.351 | 665.351 |
| overidentification | 0.673 | 0.182 |
| p-value | 0.000 | 0.000 |

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust standard errors in parentheses; the underidentification test is an LM test based on Kleibergen and Paap (2006) rk LM statistics with the null hypothesis that the model is underidentified; the overidentification test is based on the Hansen J test with the null hypothesis being that all instruments are valid. For weak identification, a Cragg-Donald Wald F statistic is reported.

theft. This might reflect that they increase the strain in times of crisis and food insecurity (Agnew, 2012). Personal theft is less likely because personal items are more difficult to sell during such times. This can be explained by the observation that crops can be more easily stolen i.e. from remote fields and that they are more attractive targets. Finally, also inequality is highly correlated with agricultural theft but not with personal theft. This might indicate that people steal food and livestock products out of need. In fact, De Courson and Nettle (2021) show that individuals who are close to the desperation threshold behave optimally if they exploit others.

With respect to personal theft (i.e. transport), there is a stronger association with the variables education, marital status, assets per capita, the share of household members with wage employment and mobile phones. These variables indicate that especially better-off households are more likely to be affected.

For crime in general, it is interesting to note that the assets per capita and assets per capita squared turn out to be both statistically significant. This suggests that there exists a non-linear relationship between assets and crime victimization which means that the likelihood of victimization increases with increasing assets but at a diminishing rate. The result is consistent with findings from Barslund et al. (2007).

4.3. Welfare impacts of victimization

Table 5 shows the results of the heteroscedasticity-based instrumental variable method on the impacts of theft victimization on household consumption per capita (column 1), food consumption per capita (column 2), and non-food consumption per capita (column 3). Panel A shows the effects of theft victimization (including all types of theft), whereas the effects of agricultural theft and personal theft are shown in panels B and C, respectively. The models' summary statistics and diagnostics parameters, reported in the lower section of the respective panel, show that all tests for overidentification, underidentification and weak instruments meet the statistical requirements, thus confirming the validity and relevance of our models.

Results show that theft victimization is negatively and significantly correlated with food consumption per capita. For specific types of theft, it is shown that agricultural theft is negatively and significantly correlated with food consumption per capita and total consumption per capita. This result is expected as most sampled households are small-scale farmers and their food consumption is mainly covered from home-produced products. This is in line with Khoabane and Black (2012) showing that theft of livestock forces households to reduce their own consumption. Isaac et al. (2021) also argue that farm theft is considered a major threat to food security in the Caribbean Region. Kaila and Azad (2019) show that food security of Nigerian households is severely affected by theft of livestock, crops or tools.

The correlation between personal theft victimization and nonfood consumption is also slightly significant at the 10% level. This could be explained by the fact that in case of personal theft victimization (e.g. theft of more valuable assets such as appliances or

jewelry), the affected household might spend more on communication and transportation to find the stolen assets, or to replace the stolen good, or the household might also increase expenditure for improving home security.

Table 6 depicts impacts of theft victimization on the child health status with column 1 showing the impacts on the standardized height-for-age and column 2 the impacts on the standardized weight-for-age. Results from panel A show that theft victimization is negatively and significantly correlated with the standardized weight-for-age, whereas the impacts on the standardized height-for-age are not significant. The significant impact of theft victimization on the standardized weight-for-age can be explained by the fact that this indicator is a kind of short-term health indicator since changes in current dietary intake, in the living environment or an infection could immediately affect child weight. In contrast, the standardized height-for-age is rather a long-term indicator. For specific types of theft, panel B shows that agricultural theft has negative and significant impacts on the standardized weight-for-age, whereas panel C shows that the correlation between personal theft victimization and nonfood consumption is slightly significant at the 10% level (equivalent to Table 5).

The significant impacts of agricultural theft victimization on child health in Table 6 could be explained via the following underlying mechanism: First, households suffering from crime might have to significantly reduce their food consumption. Consequently, children might experience hunger or have inadequate dietary intake which are commonly considered the main causes of child malnutrition (Ijarotimi, 2013). Kaila and Azad (2019) also show that suffering from theft of livestock, crops or tools have severe impacts on food security of households in Nigeria. Dabalen and Paul (2014) confirm that conflict-related victimization lowers dietary diversity of households and individuals in the Ivory Coast. Second, suffering from crime might affect mental health of members in households. Fox and Johnson-Agbakwu (2020) show that crime victims more likely suffer from trauma, depression and other health problems. Harpham et al. (2005) show that maternal mental disorders are significantly correlated with child undernutrition. Third, to cope with shocks, parents might have less time to spend caring for their children (Debebe & Raju, 2020). In response to crime, adult members might need to spend more time on legal issues, enhancing guardianship or working more to compensate economic and asset losses. Without adequate caring from parents, the physical, mental, and social needs of the growing children are not satisfied; consequently, they can be more prone to malnutrition (Ijarotimi, 2013). Kulwa et al. (2006) also show that the number of hours, mothers work outside home is significantly and negatively associated with the child health status.

5. Summary and conclusion

We have raised the following three research questions in our paper: (1) To what extent are rural people in Southeast Asia affected by crime? (2) What factors determine rural crime victimization? And (3) what are the impacts of crime victimization on welfare of rural households? In order to answer these questions, we have used a panel dataset of around 3500 households from 2016 and 2017 from a case study in Southeast Asia, namely from Thailand and Vietnam. With respect to the first question, we find that 5.46% of the rural households have been victimized over 12 months, some of them even more than once. Most crimes relate to theft. Nevertheless, a large share of households does not take any security measures.

With respect to the second research question, we have applied the routine activity approach and estimated different logit models. We find that living in a rural region with higher levels of inequality increases the likelihood of victimization. Households with higher levels of crop commercialization are more likely to suffer from crime in general. Households with less livestock but a higher number of livestock species are more likely to suffer from agricultural theft. Being a young and single household head also increases the danger of crime victimization. Moreover, past victimization and exposure to weather shocks are positively associated with the likelihood of suffering from theft. We conclude that the routine activity approach helps to identify variables which increase the suitability of targets and decrease guardianship and thus determine the opportunity of crime. It provides a solid rationale for why we use certain variables and how they are functionally related to crime victimization. However, this approach is also not free from ambiguities, since certain determinants may be associated not just with one dimension of the routine activity approach. For example, age, education of the household head or mobile phones can be linked to the characteristics of suitable targets but also to guardianship.

With respect to the third research question, we have used the heteroscedasticity-based instrumental variable approach and find that crime and theft affect household consumption and child health in rural Thailand and Vietnam. In particular, there is a highly significant negative effect of agricultural theft victimization on the outcome variables. This finding confirms that affected households in the rural areas are prone to food insecurity and that crime is an important determinant of welfare that comes with enormous costs.

Due to the multiple negative effects of crime victimization on the rural population, preventing crime is important. Our research leads to some concrete policy recommendations in this respect: First, in times of weather shocks, more guardianship needs to be taken by owners or the police. Second, creating more equal chances in the villages and targeted programs to reduce inequality and ensure food security help to avoid crime. Third, preventing insecurity and crime is a means to increase sustainable development and important investments in public infrastructure and services such as schooling and health care in the rural regions.

Further research is needed to determine whether more security measures would be effective in reducing crime in this particular study setting, to identify the most effective measures, and should ask why respondents are not already using them. These can vary depending on the specific type of crime. Also Ceccato and Abraham (2022) and Aransiola and Ceccato (2020) note that crime prevention in rural areas is an underresearched topic in developing countries. Research is also suggested to clarify whether unemployment in the villages is a driver of crime. This could be done by using an objective measure for unemployment. Finally, more research is suggested on the role of social networks in avoiding crime since the direction of the relationship is far from clear.

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CRedit authorship contribution statement

Grote Ulrike: Conceptualization, Funding acquisition, Project administration, Supervision, Visualization, Writing – original draft, Writing – review & editing, Methodology. **Nguyen Trung Thanh:** Data curation, Formal analysis, Methodology, Supervision, Writing – review & editing. **Nguyen Thanh-Tung:** Data curation, Formal analysis, Methodology, Writing – review & editing. **Neubacher Frank:** Conceptualization, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

None.

Data availability

Data will be made available on request.

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Appendix A. Type and Frequency of Victimization (Thailand and Vietnam), 2016-17

| | No. of reported cases | | Incidence (mean) | | Severity* (mean) | | Damage (in PPP\$ 2005) | | Reporting (mean, 1 =yes, 0 =no) | |
|----------------------------------|-----------------------|-----|------------------|------|------------------|------|------------------------|--------|---------------------------------|------|
| | TH | VN | TH | VN | TH | VN | TH | VN | TH | VN |
| Theft of livestock | 31 | 76 | 1.00 | 1.00 | 2.55 | 2.82 | 156 | 152 | 0.35 | 0.34 |
| Theft of crops or agri. products | 12 | 32 | 1.00 | 1.00 | 2.33 | 3.13 | 264 | 595 | 0.58 | 0.28 |
| Theft of transportation | 13 | 15 | 1.00 | 1.07 | 3.15 | 3.20 | 2258 | 1654 | 0.85 | 0.47 |
| Theft other items | 13 | 12 | 1.00 | 1.00 | 2.46 | 3.17 | 333 | 800 | 0.31 | 0.25 |
| Burglary | 29 | 26 | 1.03 | 1.00 | 3.00 | 2.85 | 644 | 723 | 0.41 | 0.42 |
| Being cheated at work/business | 47 | 37 | 1.00 | 1.05 | 3.49 | 3.42 | 3073 | 5203 | 0.13 | 0.35 |
| Conflict with neighbors | 16 | 26 | 1.00 | 1.04 | 2.38 | 2.79 | 782 | 583 | 0.56 | 0.65 |
| Robbery | 5 | 2 | 1.00 | 1.00 | 2.80 | 3.50 | 1250 | 310 | 0.80 | 0.50 |
| Vandalism | 0 | 20 | - | 1.00 | - | 3.15 | - | 506.03 | - | 0.60 |
| | 166 | 246 | | | | | | | | |

Note: *Severity of the event (1: no impact, 2: low, 3: medium, 4: high); TH = Thailand; VN = Vietnam

Appendix B. Security measures taken up by rural households, 2016 and 2017

| | Whole sample | Thailand | Vietnam |
|--|--------------|----------|---------|
| Do nothing (%) | 70.07 | 89.71 | 49.33 |
| Investment in security of homestead (%) | 3.74 | 0.53 | 7.37 |
| Lighting (%) | 0.25 | 0.08 | 0.45 |
| Locks (%) | 13.80 | 5.20 | 23.51 |
| Alarm system (%) | 0.52 | 0.21 | 0.87 |
| Guard (%) | 2.56 | 0.05 | 5.39 |
| Watchdog (%) | 7.03 | 2.79 | 11.83 |
| Investment in social capital (networks, associations, gifts) (%) | 9.62 | 0.08 | 20.40 |
| Neighborhood watch (%) | 3.50 | 1.64 | 5.60 |
| No. of observations | 7109 | 3770 | 3339 |

Note: Sum of the share of prevention strategies is not equal to 100% as some households use multiple preventive strategies against multiple types of crimes.

Appendix C. Determinants of victimization across different types including the variable “trust” and the results of the province dummies (in bold) (marginal effects)

| | Random-Effects Logit | | | | | | | |
|----------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | Crime in general | | Theft in general | | Agricultural theft | | Personal theft | |
| | Without past victim. (1) | With past victim. (2) | Without past victim. (1) | With past victim. (2) | Without past victim. (1) | With past victim. (2) | Without past victim. (1) | With past victim. (2) |
| <i>Suitable Target T</i> | | | | | | | | |
| age | -0.0004 (0.0003) | -0.0003 (0.0003) | -0.0003 * (0.0002) | -0.0003 (0.0002) | -0.0002 (0.0001) | -0.0002 (0.0002) | -0.0001 (0.0001) | -0.0001 (0.0001) |
| education | -0.0015 * (0.0009) | -0.0018 * * (0.0009) | -0.0012 * (0.0007) | -0.0014 * (0.0007) | -0.0004 (0.0006) | -0.0005 (0.0006) | -0.0008 * (0.0004) | -0.0009 * * (0.0004) |
| marital status | -0.0145 * * (0.0072) | -0.0169 * * (0.0076) | -0.0118 * * (0.0055) | -0.0127 * * (0.0057) | -0.0065 (0.0043) | -0.0059 (0.0045) | -0.0056 * (0.0034) | -0.0073 * * (0.0035) |
| farmland p.c. | 0.0010 (0.0062) | 0.0014 (0.0065) | 0.0050 (0.0043) | 0.0050 (0.0045) | 0.0051 * (0.0029) | 0.0053 * (0.0030) | 0.0005 (0.0031) | 0.0005 (0.0033) |
| TLU | -0.0048 * (0.0025) | -0.0049 * (0.0025) | -0.0054 * * (0.0021) | -0.0056 * * (0.0022) | -0.0033 * (0.0018) | -0.0035 * (0.0019) | -0.0020 * (0.0012) | -0.0021 * (0.0012) |
| livestock species | 0.0063 * * (0.0028) | 0.0068 * * (0.0029) | 0.0049 * * (0.0021) | 0.0048 * * (0.0022) | 0.0042 * * * (0.0015) | 0.0041 * * * (0.0016) | 0.0005 (0.0016) | 0.0006 (0.0017) |
| assets p.c. | 0.0033 * * * (0.0012) | 0.0037 * * * (0.0013) | 0.0019 * (0.0011) | 0.0020 * (0.0012) | -0.0000 (0.0012) | -0.0000 (0.0013) | 0.0015 * * (0.0006) | 0.0016 * * (0.0006) |
| assets p.c. sq. | -0.0001 (0.0000) | -0.0001 * (0.0000) | -0.0001 (0.0000) | -0.0001 (0.0000) | -0.0000 (0.0000) | -0.0000 (0.0000) | -0.0000 * (0.0000) | -0.0000 * * (0.0000) |
| motorcycle | 0.0074 (0.0097) | 0.0086 (0.0102) | 0.0010 (0.0074) | 0.0022 (0.0078) | 0.0019 (0.0058) | 0.0024 (0.0060) | -0.0001 (0.0044) | 0.0008 (0.0047) |
| past victimization | | 0.0210 * * * (0.0056) | | 0.0099 * * (0.0041) | | 0.0108 * * * (0.0028) | | -0.0050 (0.0042) |
| health shocks | 0.0032 (0.0063) | 0.0029 (0.0066) | 0.0053 (0.0050) | 0.0044 (0.0054) | 0.0027 (0.0036) | 0.0023 (0.0039) | 0.0023 (0.0034) | 0.0019 (0.0037) |
| weather shocks | 0.0141 * * (0.0055) | 0.0152 * * * (0.0056) | 0.0140 * * * (0.0043) | 0.0148 * * * (0.0045) | 0.0131 * * * (0.0030) | 0.0137 * * * (0.0031) | -0.0010 (0.0035) | -0.0009 (0.0036) |
| <i>Guardianship G</i> | | | | | | | | |
| hhszize | 0.0025 (0.0021) | 0.0027 (0.0022) | 0.0011 (0.0018) | 0.0009 (0.0019) | 0.0005 (0.0014) | 0.0002 (0.0015) | 0.0006 (0.0011) | 0.0007 (0.0012) |
| male adults | 0.0104 (0.0135) | 0.0157 (0.0145) | -0.0000 (0.0109) | 0.0025 (0.0117) | 0.0016 (0.0090) | 0.0021 (0.0098) | -0.0007 (0.0063) | 0.0015 (0.0068) |
| wage employment | 0.0033 (0.0136) | 0.0092 (0.0143) | 0.0097 (0.0108) | 0.0108 (0.0115) | -0.0041 (0.0093) | -0.0040 (0.0099) | 0.0115 * (0.0064) | 0.0128 * (0.0068) |
| trust | -0.0174 * * * (0.0068) | -0.0152 * * (0.0071) | -0.0093 * (0.0055) | -0.0087 (0.0058) | 0.0004 (0.0048) | 0.0009 (0.0050) | -0.0082 * * (0.0033) | -0.0082 * * (0.0035) |
| HCI | 0.0110 (0.0089) | 0.0101 (0.0093) | 0.0150 * * (0.0072) | 0.0151 * * (0.0076) | 0.0093 * (0.0055) | 0.0090 (0.0059) | 0.0060 (0.0047) | 0.0065 (0.0049) |
| mobile phone | 0.0040 (0.0054) | 0.0045 (0.0057) | 0.0084 * (0.0045) | 0.0092 * (0.0047) | 0.0005 (0.0033) | 0.0003 (0.0035) | 0.0078 * * (0.0031) | 0.0088 * * * (0.0033) |
| distance plots | 0.0001 (0.0002) | 0.0001 (0.0002) | 0.0001 (0.0001) | 0.0001 (0.0001) | 0.0001 (0.0001) | 0.0001 (0.0001) | 0.0000 (0.0001) | 0.0000 (0.0001) |
| land plots | 0.0016 (0.0014) | 0.0010 (0.0015) | 0.0000 (0.0011) | -0.0003 (0.0011) | -0.0003 (0.0008) | -0.0005 (0.0008) | 0.0004 (0.0007) | 0.0001 (0.0008) |
| paved road | 0.0103 (0.0103) | 0.0080 (0.0107) | 0.0005 (0.0076) | -0.0007 (0.0080) | -0.0003 (0.0054) | -0.0013 (0.0057) | 0.0017 (0.0057) | 0.0018 (0.0059) |
| distance market | -0.0001 (0.0005) | -0.0001 (0.0005) | 0.0000 (0.0004) | 0.0001 (0.0004) | -0.0001 (0.0003) | -0.0001 (0.0004) | 0.0001 (0.0002) | 0.0001 (0.0002) |
| distance police | -0.0003 (0.0003) | -0.0002 (0.0004) | -0.0004 (0.0003) | -0.0004 (0.0003) | -0.0004 * (0.0002) | -0.0004 (0.0002) | -0.0000 (0.0002) | -0.0000 (0.0002) |
| unemployment | 0.0102 * (0.0059) | 0.0088 (0.0061) | 0.0005 (0.0048) | -0.0003 (0.0050) | -0.0009 (0.0036) | -0.0021 (0.0039) | 0.0012 (0.0031) | 0.0017 (0.0033) |
| <i>Other Control Variables O</i> | | | | | | | | |
| inequality | 0.1534 * * * (0.0456) | 0.1548 * * * (0.0475) | 0.1422 * * * (0.0377) | 0.1412 * * * (0.0392) | 0.1088 * * * (0.0281) | 0.1012 * * * (0.0287) | 0.0278 (0.0263) | 0.0336 (0.0281) |
| 2016 | 0.0068 (0.0052) | 0.0081 (0.0055) | -0.0027 (0.0044) | -0.0018 (0.0046) | -0.0030 (0.0034) | -0.0029 (0.0036) | 0.0003 (0.0028) | 0.0012 (0.0029) |
| Buriram | -0.0222 * (0.0059) | -0.0201 * (0.0061) | -0.0100 (0.0048) | -0.0075 (0.0050) | -0.0118 (0.0036) | -0.0102 (0.0039) | 0.0017 (0.0031) | 0.0023 (0.0033) |

(continued on next page)

(continued)

| | Random-Effects Logit | | | | | | | |
|-------------------------|----------------------|--------------|------------------|--------------|--------------------|--------------|----------------|----------|
| | Crime in general | | Theft in general | | Agricultural theft | | Personal theft | |
| | (0.0113) | (0.0120) | (0.0089) | (0.0095) | (0.0075) | (0.0079) | (0.0054) | (0.0057) |
| Ubun Ratchathani | -0.0388 * ** | -0.0374 * ** | -0.0264 * ** | -0.0262 * ** | -0.0231 * ** | -0.0247 * ** | -0.0038 | -0.0033 |
| | (0.0103) | (0.0107) | (0.0085) | (0.0090) | (0.0075) | (0.0081) | (0.0051) | (0.0052) |
| Nakhon Phanom | -0.0220 * | -0.0182 | -0.0110 | -0.0077 | -0.0085 | -0.0064 | -0.0015 | -0.0006 |
| | (0.0129) | (0.0136) | (0.0106) | (0.0111) | (0.0085) | (0.0089) | (0.0068) | (0.0071) |
| Ha Tinh | -0.0032 | -0.0024 | 0.0048 | 0.0061 | 0.0016 | 0.0021 | 0.0036 | 0.0042 |
| | (0.0111) | (0.0115) | (0.0089) | (0.0094) | (0.0067) | (0.0071) | (0.0062) | (0.0067) |
| Hue | -0.0095 | -0.0073 | 0.0013 | 0.0038 | -0.0011 | -0.0004 | 0.0026 | 0.0037 |
| | (0.0104) | (0.0108) | (0.0079) | (0.0083) | (0.0059) | (0.0062) | (0.0055) | (0.0057) |
| N | 7109 | 6651 | 7109 | 6651 | 7109 | 6651 | 7109 | 6651 |
| Prob > Chi ² | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Note: * ** p < 0.01, * * p < 0.05, * p < 0.1; standard deviation in parentheses

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