Cooperation makes beliefs: climate variation and sources of social trust in Vietnam

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CLIMATE VARIATION AND SOURCES OF SOCIAL TRUST IN VIETNAM

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Abstract

I investigate the origins of social trust within Vietnam. Combining a unique contemporary survey of households with historical data on climate variation, I show that individuals who were heavily threatened by negative climate fluctuation exhibit more trust in neighbors and other people in close group. The evidence indicates that the effects of climate variation on social trust transmitted through strengthening the cooperation among village peasants in coping with risk and uncertainty. The results also indicate that households with higher proportion of agricultural incomes tend to rely more on village members in the case of emergency. However, the increased village relationship does not erode family ties.

JEL classification: O13, O53, Z13, Q54
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1. Introduction

The past decade has seen a rapidly increasing consensus among economists that institutions is one of the most important sources of economic growth and holds the key to prevailing patterns of prosperity around the world[1]. This literature usually cites North's (1991) definition of institutions as being 'the rules of the game in a society or, more formally, [they] are the humanly devised constraints that shape human interaction'. Along with expanding research on formal institutions, economists also pay more attention on the role of informal institutions and its interaction with formal institutions as key determinants contributing to economic development (Jutting et al, 2007; Helmke and Levitsky, 2004). Substantial studies have found that informal institutions, such as social trust, play crucial roles on economic and institutional development through its facilitation of cooperation and collective action among the members of a community[2].

However, far too little attention has been paid to find out the origin of social trust. Only recently some studies have begun to investigate the source of social trust and to explain the large differences in trust across and within countries. Several studies have revealed that historical circumstances, particularly experiences of cooperation or conflict such as the free-city state experience in medieval Italy and the missionary activities and slave trade in Africa, can have long lasting effects on the level of trust of a community (Tabellini, 2010; Guiso et al., 2008; Nunn, 2010; Nunn and Wantchekon, 2011).

In another interesting paper, Durante (2009) examines the long term impacts of climate volatility on social trust and showing that historical variability in climatic conditions affects the evolution of trust and family ties in Europe. He finds that norms of trust developed as a result of collective action and mutual insurance resulted from farmers coping with dramatic climate variation. While most of these regions have now become industrialized, these medieval norms still exist.

[1] See for example Knack and Keefer, 1995; Mauro, 1995; Alesina et al., 1996; Hall and Jones, 1999; Acemoglu Johnson and Robinson, 2001, 2002; Rodirk, 2000a; Rodrik, 2000b; Rodrik, Subramanian and Trebbi, 2004; Easterly and Levine, 2003; La Porta et al., 1999, 2004; Acemoglu and Johnson, 2005; Acemoglu, 2009.

[2] Some important studies include Knack, 2002; Helliwell and Putnam, 1995; Knack and Keefer, 1997; Zak and Knack, 2001; Guiso, Sapienza and Zingales, 2004, 2006; Tabellini, 2010.

Although the study is suggestive and stimulating, it may provide limited evidence since too many things alter across countries (Alesina, 2010). In addition, it is difficult to exclude the possibility of other factors, such as religion, ethnicity or geography of the region, relate to both changing in the social trust and climate variables and then bias the results. Therefore, investigation within country to see how different individuals behave, by holding the other characteristics and institutions of a country constant, can provide a good comparison and supplement for cross-country studies.

The primary objective of this paper is to complement recent studies that try to understand and explain trust origins. Particularly, the paper tries to fill gaps in our knowledge of origins of social trust in the context of developing and non-Western societies. Specifically, I examine empirical relationships between climate variation and social capital in the context of Vietnam. Vietnam offers an attractive setting to study social trust. Unlike many other developing countries and transitional economies, Vietnam has experienced exceptional per capita income growth in the last two decades, accompanied by fundamental but gradual social changes without large-scale social or political upheavals. However, the high economic growth cannot explain by the quality of formal institutions as Vietnam is ranked at low level in international ranking tables such as Polity IV and Governance Indicator. One explanation is weak formal institutions are likely to be supplemented by informal institutions. For instance, the World Value Surveys show that the Vietnamese national level of social trust appears higher than some other East Asian nations at Vietnam's stage of economic development (Dalton and Ngoc, 2005).

I try to examine empirically the hypothesis that development of trust is based on the demand of cooperation between peasants to cope with natural climate[3] fluctuations, which are considered as the main risks for agricultural activities (Durante, 2009; Tran, 1997; Rambo, 1979). Durante (2009) proposes that peasants in rural and remote regions, in which well-functioning credit and insurance markets do not exit, have to rely on different strategies to protect themselves from natural shocks. Of which, some strategies are only effective if there are some degree of collective

[3] According to World Meteorological Organization, climate in a narrow sense "can be defined as the statistical description in terms of the mean and variability of relevant quantities over a period of time".

effort and involvements of the broader community. For example, as large-scale constructions, such as dykes and irrigation systems, have to be built to ease the impacts of hazard environment, they require cooperative action among members of the local community. In addition, peasants can improve insurance capacity against natural risks by expanding relationship to other member in same communes, who are likely to be affected by weather fluctuations in the same ways.

To test our hypothesis, I use data from 2008 Vietnam Access to Resources Household Survey to investigate whether households living in regions that were heavily affected by climate variability in the past are more trusting others people today. Through combining historical climate data for the period 1927-1985 with a contemporary survey data on social capital available from different provinces across the country, the analysis confirms that regions with greater intra-annual fluctuations in temperature and rainfall have higher levels of interpersonal trust among village peasants. This study also indicate that although some can argue that other factors, such as genetics or education, play a much larger role in the development of culture, the relationship of climate variability and social trust in Vietnam can no longer be ignored. In other words, Vietnam's climate has played a crucial role in the development of Vietnamese agricultural culture and will continue to influence Vietnam's in the future.

I also examine whether a more variable environment should increase an individual's propensity to interact with non-family members and reduce her dependency on the family for insurance purposes. If it does, then higher climate variability may make family ties weaker. Numerous studies have attempted to explain the existence of a negative relationship between social trust and the strength of family ties: the greater the importance of the family to the individual, the less their sense of community and civic engagement (for example, Banfield, 1958; Ermisch and Gambetta, 2008; Alesina and Giuliano, 2009; Durante, 2009).

Contrary to other studies, such as Durante (2009), the results indicate that more variability in rainfall and temperature does not weaken family ties in regions. One explanation is in a Confucian country most people consider families as the most important factors and persistent. Therefore, this norm is expected to be maintained even people receive less support from their

relatives. Another alternative explanation for my finding is that family ties and general trust are not necessarily substitutes but rather unrelated (or complemented) in Confucian countries.

I then turned to specific mechanisms and examined two explanations for the relationship between the climate variation and trust. I found that people living in more climate variation tend to ask for the help from their neighbors in the case of emergency, which enhance mutual trust among them. In addition, I realized that households who rely more on agricultural incomes tend to trust other people. One possible interpretation is that the living that heavily relies on natural environment resulted in continuing cooperation and promoting social networks, and higher trust

The paper has been organized in the following way. I begin in section 2 by describing historical background, discussing evidence on the interaction between natural environment and cooperation. In this section, I also illustrate the conceptual framework and its predictions. Section 3 describes the data. Section 4 explains the empirical strategy and presents the results obtained using historical climate data. Finally, section 5 summarizes the key findings and concludes.

2. Environmental Adaptation, Cooperation and Trust in Rural Regions of Vietnam

A. Historical Background

Vietnam lies between roughly eight and twenty-three degrees north latitudes, which places it within the tropical monsoon belt. Due to differences in latitude and uneven topography, Vietnam's climate conditions are far from uniform with two distinct climatic zones, North and South Vietnam (Mark and Nguyen, 2001). North of Vietnam encompasses the mountainous provinces, Red River Delta and a part of central regions of the country. Gourou (1936) divided the Red River Delta into eight sub-regions, three of which are the foothills marginal to the plain and five of which are within the Delta. Each of these sub-regions represents a variety of relief and drainage. The quality of soil is low and varies in structure and type across the region and even from village to village. In addition, the Red River Delta is also exposed to high risk of

being flooded. The coastal central regions can experience heavier rainfall than other areas because of typhoons that develop in the South China Sea and move northeast along the coast. The typhoons are generally worse along the southern coast, which experiences the most severe winds and heaviest rainfall. Vietnam's typhoons are most common in July through October. Large portions of the coast can experience heavy rainfall throughout the entire year. South climate is dominated by dry seasons and wet monsoons and lies in the northern temperate zone; therefore, these regions would have been most productive for agriculture purposes.

Being a typical agricultural country, people's lives depend much on natural conditions. Resident areas are organized into hamlets and villages. Village people have liked to live in big families. Compassion and assistance among people are the representation of kin's strength. In a kin, everybody is responsible for protecting and assisting each other both material and spirit, guiding each others to promote their position in society. Moreover, since the wet rice cultivation requires a big labor force, Vietnamese farmers not only bear much but also assist to each others. In order to cope with the social environment, it is necessary to cooperate to make effect. The organization basing on this habitat creates democracy and equality between man and man. This is regarded to be primary democratic form - village democracy (Rambo, 1979; 2005). However, there are fundamental differences in the characteristics of villages and village peasants between the North and South[4]. The differences in natural environment help to explain the diversity of social organization between northern and southern peasants. While the environment in Mekong Delta is homogonous through its surface, the Red River Delta shows a natural diversification.

The Red River with about 1,200 kilometers long has high water volume, which averages 500 million cubic meters per second, but may increase by more than 60 times at the peak of the rainy season. The entire delta region is no more than three meters above sea level, and much of it is one meter or less. Moreover, this delta area is subject to erratic but heavy rainfall (Rambo, 1979). Such heavy rains are usually associated with the movement of typhoons in the South China Sea and hence can occur several times throughout years. Consequently, as rainfall is immediately

[4] The southern Vietnamese peasants originated from the north and gradually migrated southward in the process of advancing to the south.

poured in the river regime, the red River can rise to flood levels up to dozen times in a single season (Dumong, 1935). Under a natural river regime, almost all the Delta would be subject to annual flooding and hence would not be usable for rice cultivation (Gourou, 1936). Therefore, large-scale constructions, such as dykes and irrigation systems, have to be built and maintained to ease the impacts of hazard environment and to irrigate the rich rice-growing delta. Each village takes its responsibility of the supervision of the dykes within its territory and all village members were liable to perform unpaid labor to repair the dykes (Cima, 1987; Rambo, 2005).

The threat of losses of crop to natural disasters and disease contribute to the adaptive values of various risk spreading social institutions which characterize Northern peasant society. Village communal granaries provide a reserve food supply in case of serious loss. The division of fields into tiny plots and the custom of family owning several widely dispersed fields would also tend to reduce the risk of a household losing its entire crop to any particular pest or disease.

The northern peasants live in densely settled villages that surrounded by thick bamboo hedges. Outsiders were not permitted to stay in the village after nightfall. Villages were largely endogamous and in-migration rare. Outsiders who were allowed to settle in a village had to wait three generations before becoming full members of the community. Each village was an autonomous self-governing community.

Subject to irregular weather patterns with their typhoons, floods and drought and a distressing frequency of emergencies, the early settlers of the Red River Delta developed a distinctive social attitude that became an intrinsic part of their culture. There are many solutions to the problems of making a living and dealing with natural disasters and other misfortunes which require a collective effort that individual interests became subordinate to those of the group. Rather than rugged individualism and self-reliance, the emerging culture placed high value on cultivating relationship within the group, particularly the village, the extended kin group and the family (James, 2005).

Although Southern villages had originally shared the same form of social organization as their northern ancestors, they had evolved their open settlement pattern in the Mekong Delta with its much more benign natural and social environment. Contrary to Northern environment, the average annual rainfall in Mekong Delta is just adequate to satisfy the requirements for rice growing. Unlike the case of Read River Delta, there is relatively little variation from year to year in the quantity of rainfall in the South and consequently crops rather suffer there for lack of water (Great Britain, 1943). The habitat was essentially benign, offering no major hazard to peasant cultivation and thus requiring no corporately organized protective responses such as the flood control dykes of the North (Rambo, 2005). Therefore, the peasant settlements in the South were very different from the northern ones. In fact, they were not villages in the conventional senses. There was no bamboo hedge to physically define the boundaries of the village, no gate and control on entry. Individual households were widely dispersed along the banks of the canals that cross the delta. Although these settlements were organized by the state into villages and hamlets, these administrative units were not true communities. Households often had closer social relations with neighbors living directly across canals, even they were actually residents of different villages than they did with people living far down the canal in their own village (Rambo, 2005). Southern peasant society does not appear to have become adapted to the threat of crop loss at the village level of integration although the share cropping system which predominates in the Mekong Delta provides a certain amount of protection to the tenant farmers against crop losses, both because it is customary for the landowner to reduce rents in the event of a poor harvest (Hendry, 1964).

B. Conceptual Framework

There are two mechanisms that climate variation is likely to impact on trust. The first mechanism is that the difficult natural environment creates favorable conditions for cooperation. Some author seek to explain development of trust based on the demand of cooperation between peasants to cope with natural weather fluctuations, which are considered as the main risks for agricultural activities (Durante, 2009; Tran, 1997; Rambo, 1979). Durante (2009) proposes that peasants in rural and remote regions, in which well-functioning credit and insurance markets do

not exit, have to rely on different strategies to protect themselves from natural shocks. Of which, some strategies are only effective if there are some degree of collective effort and involvements of the broader community. For example, as large-scale constructions, such as dykes and irrigation systems, have to be built to ease the impacts of hazard environment, they require cooperative action among members of the local community. In addition, peasants can improve insurance capacity against natural risks by expanding relationship to other member in same communes, who are likely to be affected by weather fluctuations in the same ways[5].

Rambo (1979) demonstrate that the peasant society in the high risk environment has evolved a series of institutions which serve to reduce individual insecurity by spreading risk-taking over group larger than the nuclear family such as extended family, the lineage and the corporate community. As village members select to cooperate with other members, it makes them taking more risks in trusting other members. As Ermisch and Gambetta (2010) suggest, interacting more with other peoples can lead to more "outward exposure", and improve their ability to trust other people by (1) estimating more accurately the probability of trustworthiness; or (2) reading the signs of untrustworthiness more precisely. Therefore, peasants cooperate and interact less with other people will exhibit a lower level of trust in members in villages.

The second potential channel of trust is from cultural norms. Although natural uncertainty is becoming less profound impacts on agricultural activities, the cooperative and trustworthy culture is expected to be maintained. A number of recent papers show that trust attitudes, like other cultural traits, can persist for surprisingly long periods of time and are transmitted from generation to generation (for example, Bisin and Verdier, 2001, Guiso et al., 2008, Tabellini, 2008; Alesina and Fuchs-Schundeln, 2007; Nunn, 2010; Nunn and Wantchekon, 2011). A recent study by Guiso et al. (2008) shows that parents can transmit their prior trustworthiness to their children. In another cross- and within-country study, Bjørnskov (2007) finds that trust scores are remarkably stable over several decades. At the individual level, this persistence is generally attributed to intergenerational transmission operating through genetics, imitation, or deliberate inculcation by parents. This view is consistent with recent empirical findings documenting the

[5] A formal model has been presented in Appendix III

existence of a strong correlation in the propensity to trust between parents and children (Katz and Rotter, 1969; Dohmen et al., 2008) and between second-generation immigrants and current inhabitants of the country of origin (Guiso et al., 2006; Algan and Cahuc, 2007).

3. Data Sources and Description

Social Trust

I employ Vietnam Access to Resources Household Survey (VARHS)[6] in 2008 to inspect the impacts of climate volatility on social trust in different parts of the empirical analysis.

VARHSs are uniquely representative surveys which are based on interviews of a random sample of 3,223 households in rural regions. The surveys cover rural areas of 12 provinces in Vietnam, including: Ha Tay, Lao Cai, Phu Tho, Dien Bien and Lai Chau in the North; Nghe An in the North central Coast; Quang Nam and Khanh Hoa in the South Central Coast; Dak Lak, Dak Nong and Lam Dong in the Central Highland and Long An in the Mekong River Delta. The surveys provide rich information on a broad range of topics, such as rural employment, on- and off-farm income generating activities, rural enterprises, property rights, savings, investment, insurance and participation in formal and informal social networks. The visual location distribution of current respondents has been represented in Figure 1. The summary statistics of our analysis sample are presented in Table 1. As shown by the Figure 1, a lot respondents live in remote and mountainous areas, with about 17 percent of them are minority.

The survey asks a standard question about self-reported trust. The exact wording of the question is as follows: "*Please tell me whether in general you agree or disagree with the following*

[6] The survey data used in this analysis is taken from the third round of the VARHS, which was conducted in 2008 by Institute of Labour Science and Social Affairs (ILSSA) of the Ministry of Labour, Invalids and Social Affairs (MOLISA) under the technical support from Department of Economics (DoE) at the University of Copenhagen. All rural households in 12 provinces interviewed for the 2004 Vietnam Household Living Standards Survey has been resurveyed. The data are publicly available and can be downloaded at: http://www.econ.ku.dk/derg/links/vietnam/

statements: Most people are generally honest and can be trusted or In this commune one has to be careful, there are people you cannot trust?" Respondents could either agree or disagree. They also had the option of answering that they "do not know". Removing respondents with no answer leaves us with 2219 and 1845 potential observations for the two questions.

Since respondents' answers to the trust questions are binary, there are a number of possible estimation strategies. The first is constructing a measure of trust that takes on the binary value of 0 and 1: 0 corresponds to the response "Disagree"; and 1 to the response "Agree" then using OLS to estimate linear probability model. Another strategy is to instead estimate a logit model. As we shown in Appendix, the estimates are qualitatively identical if we pursue this alternative strategy.

People suspect that this kind of question is unlikely to capture individual trust attitudes (Durante, 2009). For example, some have argued that this question is a relatively ambiguous in that it does not explicitly specify the object of the respondent's trust. Moreover, the question does not provide an exact answer whether this is generalized or particular trust.

Particular trust refers to those cases in which individuals trust members of a narrow circle of family members or close friends, but do not trust (and do not expect to be trusted by) people outside of it. In contrast, generalized trust is the trust that a given person has toward a member of a broader community. The first question basically asks about general trust. However, since a lot people in same village or commune have close relationship, such as kin or relatives, respondents are likely to apply instead to particular trust. Therefore, this dataset is likely to reflect the impacts of climate adaptation on trust among village members (or particular trust).

The distributions of responses for question on social trust are summarized in Table 4. A number of characteristics of the responses are notable. The share of respondents who agree with the statement "*most people are generally honest and can be trusted" is* more than 90 percent. The results are consistent with those reported in Dalton et. al. (2002), which show that the

Vietnamese exhibit high levels of trust, compared with other countries surveyed under the World Values Survey project.

Family ties

The importance of family is a historic aspect of Vietnamese society, as with many Confucian societies in East Asia. The family is a basis of economic organization in an agrarian economy, the role of the father and parents in general is reinforced by cultural traditions, and family relations provide a general model for authority relations (Pham, 1999). Through history and changes in political and social regimes, the centrality of the family appears to be an enduring feature of Vietnamese society (Dalton et al, 2003).

To investigate the impact of climate variation on family ties, I use information about households who reported having helpers. The survey asks respondents to provide information about people who are a source of help in case of emergency. People can list the name of up to three people from whom they asked for a help. The exact question is "*If you were in need of money in case of an emergency who outside of your household could you turn to who would be willing to provide this assistance?"* In addition, the survey includes another question about how relationship of these people with household: (1) Relative; (2) Friend; (3) Neighbor; or (4) Other. The survey also provides information whether these people in the same village or not.

I classify whether household mainly asking for help from relatives rather others (friend and neighbors) if all people in the asking lists are relatives. Relatives can be people who live outside villages. Column 2 in Table 5 shows that 59 percent of the helpers mentioned are relatives of the respondents. The results on the share of helpers who are relatives are interesting. They show that households in the more developed provinces such as Ha Tay, Phu Tho or Long An are at least as likely as households in less developed provinces (for example, Lai Chau and Dak Nong to mention relatives as their most important helpers. This similarity in level of family ties is a first indication of important trend: whereas economic development has tended to erode the relative economic importance of family ties in Western countries, this may not necessarily be happening

in Vietnam. Similar conclusions are reached by Dalton et. al. (2002), who in a sample that includes both rural and urban dwellers find that the importance of family ties does not decline with socioeconomic status. In the language of social capital theory, Vietnamese families display high levels of "bonding" social capital, and this "traditional" form of social capital does not appear to be crowded out by more modern types of social relations (CIEM et at, 2007).

Climate Variables

A. Rainfall and Temperature

With regard to climate variables, I restrict my attention to temperature and rainfall. These two variables have a considerable impact on wet-rice agriculture and other natural resource-dependent activities, are highly correlated with other important factors such as storms, typhoon, cyclones and drought. Of course, these indicators do not represent a comprehensive catalog of the physical and biotic components of the Vietnamese habitat. However, they include main factors that empirically affect the natural adaptation and livelihood strategies of Vietnamese peasants throughout the country.

Data on climate variability from 46 climate stations comes from Institute of Meteorology and Hydrology and prolongs 35 – 70 years from 1927 to 1985. These stations are allocated evenly among national geography. For each station, I have climate data, such as precipitation, at station with latitude-longitude degree point p in district i during month m of year t .

To compute the climate variation, I first calculate average of temperature and rainfall in each station for each month (month-specific average). I take average of weather over 30-50 years to reduce the effect of extreme weather condition in specific years. After that, I obtain the standard deviation of temperature and rainfall of each station over twelve months to investigate within year weather fluctuations. The idea behind this calculation is to see how the repeated weather variability within the year affects the demand for cooperation. For villages/communes with a great deal of weather variation throughout a year, farmers can predict these circumstances based

on their own experience in the past and will ask a help from their neighbors in coping with these unpleasant conditions. If everyone in the same commune faces the same condition, everyone will cooperate.

For districts without climate stations, the weather condition is assumed to be similar to other districts with the same latitude. The reason to apply this strategy is that stations are expected to gauge the significant climate variation in different regions. Therefore, climate data from one station can be used to measure neighboring districts with similar condition.

B. Other geographical variables

Other factors and geographical conditions may have impacts on the evolution of cooperation and the appearance of trust among village members. At the same time, they may correlate with climate variation.

Average climate conditions

Average climatic conditions are likely to have considerable impact on patterns of cooperative behavior. For example, even a region without much climate variation but low average rainfall or temperature within a year also makes people come up with differences of livelihood strategies. To account for these effects, I control for the average level of temperature and rainfall at the district level. These measures are constructed from the same dataset described above, taking their average over twelve months and over the entire period.

Elevation and Land Terrain

Elevation and land terrain can have both direct and indirect effects on patterns of human interaction and on economic outcomes (Nunn and Puga, 2012). Land terrain and elevation can also be expected to be correlated with climate variability. For example, the presence of a mountain can lead to different climatic condition and micro-ecosystems on each side (Durante,

2009). This requires village members to come up with different cooperative strategies. To control for the relationship between climate variability and topography, I include a regional dummy variable to measure of land terrain in regressions. The information for land terrain is withdrawn from the question to household heads on topography of household's land plot : "*In general, what is the slope of this plot? Flat, Slight Slope, Moderate Slope and Steep Slope*" The measure of land slope takes the value of 1 if plots are flat and 0 otherwise. As presented in Table 1, nearly 50 percent of land plots are in slight to steep conditions.

Land area and quality

Diversification in land quality may have significant impacts on productivity and village members' motivation to cooperate in agricultural activities (Durante, 2009). To account for this aspect, I include area of land and dummy of land quality in regressions. Information on the land quality is taken from the question: "*Do you experience problems with any of following conditions on this plot? Erosion, Dry land, Low-lying land, Sedimentation, Landslide, Stone soils/clay, other or No problem*". I construct a measure of land quality that takes on the value of 1 if plots does not suffer any above problems and 0 otherwise. Sixty percent of households report high quantity of land without any above problems.

C. Migration

Although the survey has many important advantages, the data also have some shortcomings with limited information on migration. Normally, we would ideally like to know precisely when and where an individual move (from one district to other districts). This is because our analysis exploits geographic and environment variation to study their impacts on social trust. Migration is likely to make the regression coefficient biased in the way that people could be selective to choose living in one region rather than others and these people are likely to be more (or less) trusting people.

Fortunately, the survey provides some useful information on location that people born. Therefore, I follow a strategy to take only households with head, spouse or both of them where they live are also where they were born. The argument here is the more time those people live in this environment, the more their culture adapt to this natural condition. The control of location that people were born may mitigate the possibility of selection bias.

In addition, other reasons that make migration less likely to be major issues. First, since most of provinces are poor and underdeveloped, it provides less incentive to people from one province in the sample migrate to others. Second, it also reduces the possibility that people from other provinces move to live in any provinces in the sample.

4. Empirical evidence

A. OLS estimates

I first investigate the relationship between climate variability and trust using historical climate data. To further test the robustness of the relationship between trust and historical climate variability, I extend the analysis to account for differential geographical and social network variables.

My empirical strategy can be summarized by the following estimating equation[7]:

$$Trust_{i,d,p} = \alpha_p + \beta Environ\_Var_d + \mathrm{X}'_{i,d}\Gamma + \mathrm{Z}'_{i,d}\Phi + \gamma X_c + \varepsilon_{i,d,p}$$

[7] Sampling weights are applied in all calculations to ensure unbiased estimates of population parameters. The weights for each household are, approximately, the inverse of the probability that the household was surveyed for the 2004 VHLSS. Because the distribution of the rainfall and temperature are highly left skewed, with a small number of observations taking on large values, I report estimates using the natural log of the climate measures

where α_p denotes province fixed effects, which are included to capture provinces specific factors, such as effectiveness of local regulations and norms, that may affect trust. The variable $Trust_{i,d,p}$ denotes measures of trust, which vary across households. $Environ\_Var_d$ denotes the degree of variability for climate (temperature or rainfall) among districts. β is our coefficient of interest which estimates the relationship between the climate variation in a district and the individual's current level of trust.

To assess the potential effects of climate variation on this social trust, it may necessary to examine whether these patterns vary systematically across demographic groups. For example, if there are systematic differences by income and education levels, then we might speculate that rising social status might shift patterns of social trust in predictable ways. Higher levels of income is expected to increase involvement in social networks; family activity is will be higher among the better educated, as well as participation in work and friendship networks. We also might hypothesize that younger Vietnamese might place less reliance on family ties, and be more integrated to work and friendship networks and less social trust. Occupation may be an important determinant of social trust in the sense that people who work in more competitive sectors have higher levels of trust (Francois et al, 2010). Similarly, we expect that farmers would follow more family-center patterns of social relations than urban workers.

The vector $X'_{i,d,p}$ include information on household head, such as age, age squared/100, years of education, household income, a gender variable indicator, an indicator variable that equals one if the respondent lives in an urban location, a dummy variable for people who are ethnic minorities and sixty one occupational fixed effects. The vector $Z'_{i,d}$ consists of geographical and social network variables, such as average temperature and rainfall, land terrain and quality, set of 15 group member indicators, an indicator of whether people always attend meeting. X_c is a variable designed to capture the share of the commune's population that is of the same ethnicity as the respondent.

Many of the explanatory variables in above equation do not vary across individuals, rather at the district level. For example, climate variation will have the similar effects for people living the same district. Given the potential for within-group correlation of the residuals, I adjust all standard errors for potentially arbitrary correlation between households in the same district.

Table 6 and 7 reports the results using for log of rainfall and temperature variation. In baseline models, I find substantial evidence that climate variation, particularly temperature variability, is correlated with two self-reported trust indicators. In the most case, with and without provincial fixed effects, the estimated coefficient for temperature, β, is positive and statistically significant (at the 5% level), indicating that climate variability positively affecting average trust score at household level. This is consistent with the hypothesis that the weather positively affected individuals' trust of those around them. However, the evidence is not quite clear for the case of rainfall variation. The significant relationships disappear as I control for provincial fixed effects.

Realizing the potential problem is that climate variation may pick up the effects of other geographical variables, in Table 8, I include the vector of geographic controls, which includes average temperature and rainfall, land area, land terrain and quality. When the geographical controls are included, the point estimates of the coefficients of interest increase substantially and become highly statistically significant. For the magnitude of the coefficient, holding other variables constant, one standard deviation increase in log of rainfall variation corresponds to a .04 increase in probability of trust other people (approximately 14 percent standard deviation increase in trust).

I perform a variety of robustness checks for the results. Alesina and La Ferrara (2002) find evidence in the US that when respondents are part of an ethnic minority they exhibit low trust. However, religious belief and ethnic origin does not affect trust. In other studies, some authors argue that religion can affect trust directly, especially within religious communities, by promoting it via ritual (Iannaccone, 1998) or indirectly through psychological effects (Tan and Vogel, 2005). They find that trustworthiness increases with religiosity and more religious trustees are trustworthier. Participation in associations is also mater because it can affect social

trust through repeated interactions. In addition, participation in social groups can enhance trust as social networks of the form created by social groups provide a mechanism to enforce agreements among network members (Kandori 1992; Mobius and Szeidl 2007). Putnam (2000) shows how changes in work, family structure, age, suburban life, television, computers and women's roles have contributed to the decline in stock of social capital. Olken (2009) also finds that the more village members spend on watching television and listening to the radio, the less they participate in social organizations and lower they self-report trust[8]. To take into account of these factors, I control for hours of watching TV and add dummy variables to indicate whether people belong to social and religious groups and how frequent they attend meetings. However, the results suggest that social network variables such as always attend meeting and hours watching TV do not show significant effects on social trust.

I undertake a number of other sensitivity checks. First, I separately investigate the impacts of climate variation for each gender group of population. The results are more robust to the male subsample. I find that temperature variation (last Column in Table 10 and 11) has higher impacts on female; however, the results are not obvious for rainfall variation. Second, I check for robustness to alternative estimation methods. Using a logit model produces estimates that are qualitatively identical to our baseline OLS estimates (Appendix II). Third, I alternatively exclude different regions to see the impacts of other potential geographical factors, such as landlocked or near big rivers can make the results change significantly. The results in Table 12 and 13 indicate that the estimates are quite stable over a range of regression, except the impact of rainfall variable after excluding Northwest and Red River Delta regions. A plausible interpretation is that the impacts of climate variation are more profound in Northern areas.

B. Possible endogeneity problems

The use of a rich set of individual characteristics and district controls, and the fact that the climate volatility measures predate the outcomes, reduce concerns about omitted variable bias

[8] To save space, I do not report the coefficient estimates of the control variables throughout the paper.

and endogeneity. However, it is important to admit that I cannot definitively exclude the possibility that some unobserved district characteristic affects both climate variation and social trust, leading to spurious results. Other problems also may create biased estimation.

First, OLS estimator would yield biased and inconsistent estimates since our proxy measure of climate variation, i.e. rainfall and temperature, would be correlated with the error term in the social trust equation. This problem results in an attenuation bias in the estimated climate variation on social trust.

Another problem that may affect the estimates is selection bias. The problem happens as a non-random subgroup of village peasants select to stay in regions even with more natural risks. The reason may be due to constrained resources that make them less opportunity to move to other regions with better natural environments. People with less ability are also likely to choose not moving out of villages. These groups of people are likely to have different patterns of social trust. I assume that these village peasants have less interaction with outside society and less trust other people, then the measurement error in self-reported trust, to whatever reasons, may correlate with the climate variation term in the right hand side. Another selection problem can be raised due to unobservable individual characteristics. Some groups of village peasants are likely to be more risk-averse or less motivation and tend to stay at the same place where they were born even those places are not favorable for living. Cameron and Shah (2011) show that people living in villages that have suffered a natural disaster behave a more risk averse than others. If risk-averse people less trust others and these factors correlate with climate variability among district, then the estimates are also to be underestimated. However, I expect this effect would be small.

C. Sensitivity Test for Unobservable Bias

As mentioned above, although I try to control for observable factors, such as individual controls and other geographical variables, the estimates reported in Table 6 and 7 may still be biased by unobservable factors correlated with selection into the climate variations and social trust.

In this part, I assess the likelihood that the estimates are biased by unobservables. I follow the approach initiated by Altonji *et al.* (2005) and Bellows and Miguel (2008) that selection on observables can be used to assess the potential bias from unobservables. Their ideas are to measure the strength of the likely bias arising from unobservables. In another word, how much higher selection on unobservables, relative to selection on observables, must be to explain away the full estimated effect (Nunn and Wantchekon, 2011). Specifically, to gauge this bias, the ratio of the estimated coefficient for the variable of interest from the unrestricted regression over the difference between the estimated coefficient for the variable of interest from the restricted and unrestricted regression is calculated. Then, the higher this ratio, the greater is the effect that needs to be explained away by selection on unobservables.

I consider two sets of restricted control variables: one with average rainfall and temperature controls and another with a group of individual controls that includes only age, age squared, and married, gender and average rainfall and temperature variables. I also consider two sets of full covariates: the baseline group of controls from equation Table 8, and a second with geographic and social network control variables in Table 9.

Given our two restricted and two unrestricted sets of covariates, there are four combinations of restricted and unrestricted controls that can be used to calculate the ratios. The ratios, for each of two measures of trust, are reported in Appendix II.3.

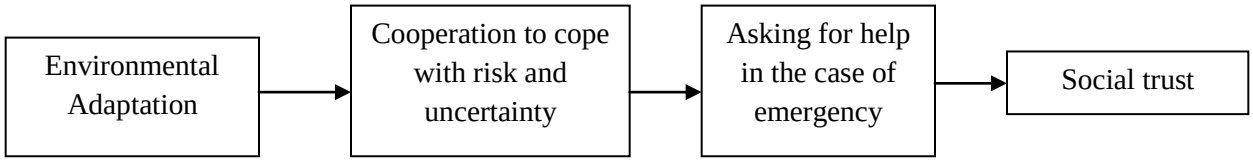
Of the sixteen ratios are reported in Appendix II.3, none are less than one. The ratios range from 9.91 to 942.8, with a median ratio of 52.41. Therefore, to make the entire OLS estimate to be from selection effects, selection on unobservables would have to be nearly nine times greater than selection on observables, and on average, over 52 times greater. In my view, these results make it less likely that the estimated effect of the rainfall variation is completely driven by unobservables.

D. Exploration of Mechanisms

To test the empirical validity of my theoretical channels, I now look at the relationship between climate volatility and the importance of the family and relationship among village members, replicating the analysis performed in the previous section.

Subsistence peasants often lack savings to self-insure themselves against adverse income shocks. In addition, they are likely to suffer credit-constrain since the high transaction costs of providing small credit prevent credit organizations from entering the market. Therefore, through social networks, they can access an important source of small credit that helps to improve efficient risk-sharing within the community.

The hypothesis here is in the process of environmental adaptation, village peasants have to cooperate with each other to deal with natural turbulences and disasters. This promotes trust and social networks among members in the village. Therefore, village peasants rely more on other members in the facing of emergency. In contrast, social networks also strengthen trust between peasants because they allow their members to get more information about each other through repeated interaction. This allows potential lenders to identify reliable borrowers. Social networks enable lenders to control the actions of borrowers to some degree and, for example, discourage excessively risky investments through a system of punishments and rewards. I will investigate a channel through which climate variation will enhance the relationship among communal members. I expect that districts with high level of weather variation make lenders more willing to provide loans to other members of the community. At the same time, borrowers also are likely to ask for more help from neighbors, regardless of whether they are close family members. This channel is described in the graph below.



In Table 14, I examine the effects of the frequency of climate varibility on enhancing cooperation and relationship among neighbours. All regressions include both provincial fixed

effects and geographical controls. In column 1, I start regressing the first village ties on variability in rainfall. The coefficient on rainfall variability is positive but statistically insignificant. Because the question about asking for help does not mention specific reasons for borrowing money, the results are likely to be contaminated by other factors beyond climate variation. To overcome this, I gradually exclude some regions in the South with less climate variation to figure out the effects more precisely. Column (2)-(5) indicate that climate variation strengthen relationship among village members.

In addition, in order to investigate the impacts of income sources on cooperation, I decompose household income into different components: incomes from agricultural and common resource activities and incomes from non-farm activities. If main source of income of village peasants from agricultural and related activities, I expect that people with higher share of agricultural incomes will ask for help from other village members more.

The results show incomes from common resource activities have a significantly positive effect on villagers' relationship. The coefficients in Column 1 to 5 are significant at 1% level and quite are stable across models. The point estimate indicates that one percentage increase in agricultural income increase the probability of cooperation (asking for help) to village neighbors from 0.46 to 0.53.

I also test the possibility that increased relying on other people in the same villages will reduce the family ties. Empirical evidence have suggested that these two objects are negatively correlated. Using survey data from multiple sources Alesina and Giuliano (2010) find that individuals with strong family ties display lower levels of general trust, civic engagement and political participation. Durante (2009) discovered that climate adaptation has tended to erode the relative importance of family ties in Western countries.

Table 15 reports regression results for the effects of the frequency of climate variation on family ties. Family ties are proxied by the whether village members ask their relatives for money in case of emergency. In column 1, I start by regressing the first family ties on variability in rainfall. The

coefficient on rainfall variability is positive, showing that climate variation enhance family relationship but not statistically insignificant. Following the above strategy, I exclude regions with less climate variation, such as Mekong River Delta, to figure out more precisely the effects. The result from Column 2 to 5 indicate the same pattern, climate variation does not erode family and relative ties. In other words, this shows that people living in unfavorable conditions still rely on family and relatives in the case of assistance. These results contradict with other studies that family ties tend to be deteriorated as people are more general trust. However, this may not necessarily be happening in Vietnam. Similar conclusions are reached by Dalton et. al. (2002), who in a sample that includes both rural and urban dwellers finds that the importance of family ties does not decline with socioeconomic status. Vietnamese families display high levels of "bonding" social capital, and this "traditional" form of social capital does not appear to be crowded out by more modern types of social relations. One possible explanation of this pattern is the continued importance of Confucian values, along with living in difficult environments, which tend to strengthen family relations.

I continue the investigation of mechanism by decomposing the total income by household in farming and non-farming sources. I expect that people in household with higher share of income from farming activities will expose higher social trust to other people. Table 16 report OLS regressions for the impact of share of household incomes from farming activities. In column (1) and (3) regressions, the coefficients of share of incomes from agricultural activities are positive and significant effects on social trust. In other words, as household incomes are rely more on agricultural activities, people tend to be more cooperative and trust other people more. This is very much consistent with our story.

5. Conclusion

Despite its importance to economic development, the economic sources of social trust remain relatively unexplored. This paper adds to a new and growing literature in economics that seeks to better understand the role of climate variation on cooperation and social trust of village peasants.

I have shown that the levels of trust among village peasants can be traced back to the effects of historical climate variation. Individuals' trust in their neighbors is higher if their livings were heavily affected by the natural disasters. To check the robustness of this causal relationship, I pursued a number of different strategies. First, I controlled for potential observable characteristics that may correlate with natural environment and affects social trust. Second, I controlled for district fixed effects that are expected to wipe out confounding effect caused by invariant unobserved variables. In general, the estimates show a positive effect of social trust on mutual assistance within village members. Third, using recently developed techniques from Altonji *et al.* (2005), I showed that on average selection based on unobservable variables would have to be 33 times greater than selection on observables in order for the effect of the rainfall and temperature variation on social trust to be completely spurious.

I further examine the relationship between climatic variability and individuals' behavior to their family in the case of emergency. Contrary with recent studies documenting the existence of a negative empirical relationship between trust within and outside the family, I find that higher variability in climate does not significantly impacts on family ties.

I then turned to specific mechanisms and examined two explanations for the relationship between the climate variation and trust. I found that people living in more climate variation tend to ask for the help from their neighbors in the case of emergency, which enhance mutual trust among them. In addition, I realized that households who rely more on agricultural incomes tend to trust other people more. The explanation is that the living that heavily relies on natural environment resulted in continuing cooperation and promoting social networks, and higher trust. The findings provide another evidence for the importance of natural environment to economic development through the evolution of cultural norms.

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Appendix I

Table 1. Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Most people can be trusted	2219	0.93	0.26	0	1
Careful in dealing with people	1845	0.78	0.41	0	1
Log Rainfall variation (mm)	2316	4.85	0.17	4.57	5.71
Log Temperature variation (oC)	2316	0.58	0.49	-0.12	1.61
Average Rainfall 12 months (mm)	2316	151.96	36.78	113.24	320.07
Average Temperature 12 months (oC)	2316	24.45	2.15	18.31	27.36
Age of head	2348	50.07	14.22	16	105
Age of head, squared/100	2348	27.09	15.70	2.56	110.25
Year of schooling of head	2348	7.84	3.31	1	13
Gender (Male:=1)	2348	0.79	0.41	0	1
Married	2348	0.83	0.38	0	1
Rural	2348	0.99	0.11	0	1
Minority	2348	0.17	0.37	0	1
Log Household income (mil VND)	2348	3.35	0.88	-0.12	7.02
Area of land (1000m2)	2348	0.82	1.51	0	30
Land terrain (Flat:=1)	2348	0.48	0.50	0	1
Land Quality (Good:=1)	2348	0.60	0.49	0	1
Member of social and religious groups	1833	5.51	4.23	1	15
Attend meeting frequently	1833	0.67	0.47	0	1
Hours of watching TV	2348	1.71	0.94	0	5
Share of minority by district	2348	0.14	0.33	0	1
Borrowing from same village	2065	0.65	0.48	0	1
Borrowing from relatives	2065	0.59	0.49	0	1

Note: The summary statistics are weighted by household weight and calculated based on VARHS survey data.

Table 2. Bivariate correlation

	Most people can be trusted	Careful in dealing with people	Log Rainfall Variation	Log Temperature Variation
Most people can be trusted	1			
Careful in dealing with people	-0.166*	1		
Log Rainfall Variation	0.119*	-0.170*	1	
Log Temperature Variation	0.145*	-0.115*	0.140*	1

Note: * Statistically significant at 5 percent.

Figure 1. Map showing the current locations of respondents

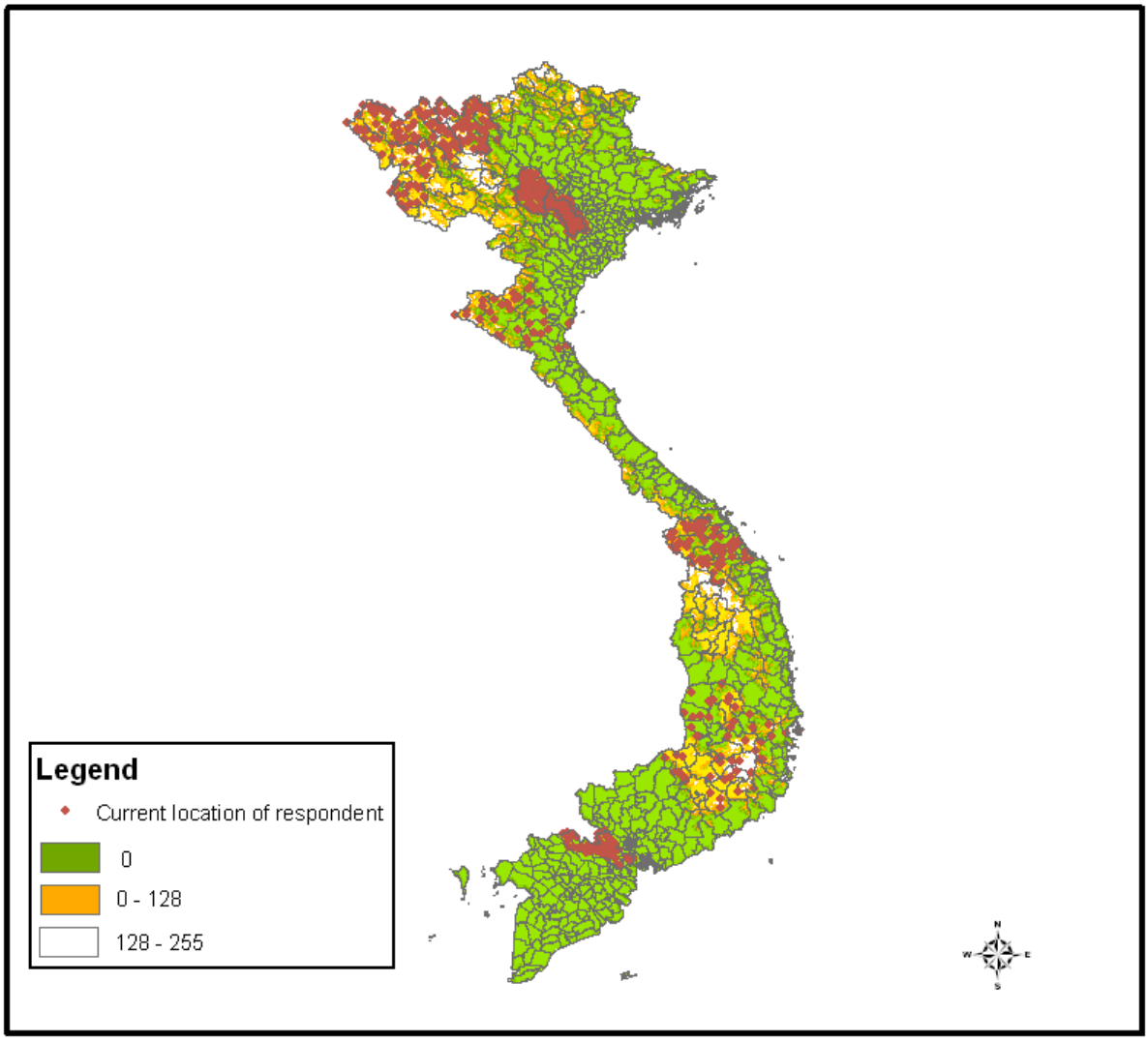

Table 3. Climate variation summary (Standard Deviation)

Province	Station	Period	Rainfall	Temperature	Province	Station	Period	Rainfall	Temperature
HaTay	Son Tay	1958-85	123.72	4.80	**DienBien**	Tua Chua	1968-85	134.40	3.59
	Ba Vi	1970-85	147.43	4.89		Tuan Giao	1961-85	111.30	4.06
	Ha Dong	1973-85	97.54	4.99		Pha Din	1964-85	126.44	3.35
	Xuan Mai	1961-85	130.51			Dien Bien	1967-85	120.76	3.91
	My Duc	1962-85	126.82	4.73	**Nghe An**	Quy Chau	1962-85	122.17	4.24
LaoCai	Muong Khuong	1961-78	128.85	4.78		Quy Hop	1968-85	111.23	4.35
	Bac Ha	1961-85	122.96	4.83		Tay Hieu	1960-85	116.39	4.48
	Lao Cai	1989-1950; 56-78	112.28	4.49		Tuong Duong	1961-85	84.73	4.00
	Sa Pa	1929-45; 57-85	158.27	4.21		Quynh Luu	1961-85	137.96	4.60
Phu Tho	Phu Ho	1928-43; 62-85	122.68	4.75		Con Cuong	1961-85	116.69	4.33
	Viet Tri	1961-85	109.81	4.83		Do Luong	1961-85	121.01	4.37
	Thanh Son	1971-81	109.79	4.64		Hon Ngu	1961-85	170.76	4.67
	Minh Dai	1972-85	105.61	4.75		Vinh	1904-46; 56-85	148.36	4.53
Lai Chau	Phong Tho	1961-78	152.11	4.15	**Quang Nam**	Tam Ky	1979-85	236.43	2.85
	Tam Duong	1973-85	178.01	3.79		Tra My	1974; 78-85	303.17	2.55
	Muong Te	1961-85	208.08	3.80	**Khanh Hoa**	Nha Trang	1907-44; 47-85	120.87	1.79
	Sin Ho	1961-85	200.84	3.84		Cam Ranh	1978-85	117.12	1.76
	Binh Lu	1968-81	180.89	4.04		Truong Sa	1977-85	135.54	0.96
	Lai Chau	1928-44;55-85	159.77	3.73	**Dac Lac**	Buon Ho	1982-1985	101.70	1.92
Dac Nong	Dac Nong	1978-85	164.84	1.27		Buon Ma Thuot	1828-44; 54-74; 78-85	118.17	1.61
Lam Dong	Da Lat	1928-44; 60-69; 78-85	99.98	1.06		M Drack	1977-85	157.39	2.26
	Bao Loc	1962-85	135.32	1.06	**Long An**	Moc Hoa	1973-85	96.80	0.88

Table 4. Overview of the responses to trust question (percentage)

Provinces	Most people can be trusted		Careful in dealing with people	
	Yes	No	Yes	No
Ha Tay	91.76	8.24	79.51	20.49
Lao Cai	97.69	2.31	39.9	60.1
Phu Tho	95.20	4.80	97.66	2.34
Lai Chau	95.72	4.28	12.89	87.11
Dien Bien	81.36	18.64	90.91	9.09
Nghe An	96.52	3.48	80.17	19.83
Quang Nam	97.72	2.28	76.61	23.39
Lam Dong	93.72	6.28	16.09	83.91
Dac Lac	92.27	7.73	84.39	15.61
Dac Nong	95.30	4.70	61.53	38.47
Khanh Hoa	87.42	12.58	89.24	10.76
Long An	83.36	16.64	83.58	16.42
Total	92.56	7.44	78.44	21.56

Note: The summary statistics are weighted by household weight and calculated based on VARHS survey data

Table 5. Overview of the asking for help in the case of emergency (percentage)

Provinces	Borrowing from relatives		Borrowing from village members	
	Yes	No	Yes	No
Ha Tay	68.26	31.74	70.79	29.21
Lao Cai	58.21	41.79	82.57	17.43
Phu Tho	57.36	42.64	66.75	33.25
Lai Chau	62.71	37.29	90.35	9.65
Dien Bien	78.19	21.81	74.86	25.14
Nghe An	54.53	45.47	48.58	51.42
Quang Nam	43.93	56.07	66.27	33.73
Lam Dong	83.74	16.26	65.95	34.05
Dac Lac	39.23	60.77	60.62	39.38
Dac Nong	63.3	36.7	67.23	32.77
Khanh Hoa	37.71	62.29	61.49	38.51
Long An	58.98	41.02	58.48	41.52
Total	58.83	41.17	65.43	34.57

Note: The summary statistics are weighted by household weight and calculated based on VARHS survey data

Table 6. Baseline estimations. Rainfall variation

	(1)	(2)	(3)	(4)
VARIABLES	Most people can be trusted		Careful in dealing with people	
Log Rainfall variation (100mm)	0.123*	-0.000937	-0.178	-0.302
	(0.0635)	(0.0705)	(0.188)	(0.239)
Minority	-0.0295	-0.0407	-0.117*	-0.0543
	(0.0278)	(0.0309)	(0.0681)	(0.0526)
Age of head	-0.000769	-0.00172	0.00873	0.00354
	(0.00346)	(0.00332)	(0.00646)	(0.00547)
Age of head, square/100	0.00139	0.00197	-0.00790	-0.00303
	(0.00293)	(0.00290)	(0.00550)	(0.00452)
Rural	0.174***	0.129*	0.123	0.0992
	(0.0540)	(0.0663)	(0.0776)	(0.104)
Year of schooling of head	0.000887	0.00101	0.00592	0.00427
	(0.00165)	(0.00158)	(0.00467)	(0.00452)
Male	-0.00456	-0.00740	-0.0188	-0.0428
	(0.0238)	(0.0234)	(0.0400)	(0.0383)
Married	0.0440*	0.0313	0.000710	0.0168
	(0.0258)	(0.0250)	(0.0362)	(0.0339)
Log Household income	-0.0245**	-0.0167	0.0142	0.0154
	(0.00944)	(0.0105)	(0.0157)	(0.0169)
Occupational fixed effects	No	Yes	No	Yes
Provincial fixed effects	No	Yes	No	Yes
Number of observations	2,188	2,188	1,819	1,819
Number of district clusters	126	126	123	123
R-squared	0.026	0.102	0.028	0.259

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

Table 7. Baseline estimations. Temperature variation

	(1)	(2)	(3)	(4)
VARIABLES	Most people can be trusted		Careful in dealing with people	
Log Temperature variation (oC)	0.0722***	0.0561***	-0.0650	-0.129***
	(0.0171)	(0.0173)	(0.0527)	(0.0446)
Minority	-0.0353	-0.0264	-0.112*	-0.0771
	(0.0277)	(0.0322)	(0.0659)	(0.0471)
Age of head	-0.000665	-0.00148	0.00841	0.00319
	(0.00349)	(0.00333)	(0.00666)	(0.00537)
Age of head, square/100	0.00120	0.00170	-0.00750	-0.00235
	(0.00294)	(0.00288)	(0.00572)	(0.00448)
Rural	0.165***	0.135**	0.120	0.0942
	(0.0512)	(0.0675)	(0.0824)	(0.104)
Year of schooling of head	3.06e-05	0.000746	0.00700	0.00586
	(0.00170)	(0.00160)	(0.00496)	(0.00512)
Male	0.00963	0.00146	-0.0319	-0.0702*
	(0.0233)	(0.0240)	(0.0401)	(0.0365)
Married	0.0332	0.0256	0.00888	0.0354
	(0.0252)	(0.0250)	(0.0368)	(0.0338)
Household Income (mil.)	-0.0251**	-0.0170	0.0163	0.0178
	(0.0102)	(0.0105)	(0.0159)	(0.0173)
Occupational fixed effects	No	Yes	No	Yes
Provincial fixed effects	No	Yes	No	Yes
Number of observations	2,188	2,188	1,819	1,819
Number of district clusters	126	126	123	123
R-squared	0.038	0.11	0.028	0.264

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

Table 8. Climate variation and social trust. Adding geographic variables

VARIABLES	(1) Trust people	(2) Careful dealing with people	(3) Trust people	(4) Careful dealing with people
	Log Rainfall Variation		Log Temperature Variation	
Climate variation	0.216*	-0.906**	0.0590***	-0.173***
	(0.110)	(0.371)	(0.0188)	(0.0642)
Minority	-0.0288	-0.0944*	-0.0257	-0.0807*
	(0.0330)	(0.0565)	(0.0332)	(0.0486)
Age of head	-0.00160	0.00244	-0.00156	0.00288
	(0.00324)	(0.00552)	(0.00327)	(0.00527)
Age of head, square/100	0.00184	-0.00208	0.00175	-0.00225
	(0.00283)	(0.00456)	(0.00284)	(0.00437)
Rural	0.128*	0.105	0.134*	0.0865
	(0.0672)	(0.106)	(0.0680)	(0.118)
Year of schooling of head	0.000838	0.00490	0.000895	0.00447
	(0.00165)	(0.00453)	(0.00166)	(0.00447)
Gender (Male:=1)	-0.00796	-0.0409	-0.000107	-0.0612*
	(0.0235)	(0.0392)	(0.0239)	(0.0360)
Married	0.0304	0.0128	0.0256	0.0254
	(0.0249)	(0.0340)	(0.0249)	(0.0322)
Log Household income	-0.0177*	0.0169	-0.0176*	0.0167
	(0.0104)	(0.0173)	(0.0106)	(0.0168)
Average Rainfall (mm)	-0.00140**	0.00380*	0.000186	-0.00235
	(0.000663)	(0.00193)	(0.000429)	(0.00179)
Average Temperature (oC)	-0.0116	0.0301	0.00573	-0.0351
	(0.00989)	(0.0198)	(0.00783)	(0.0255)
Area of Land (1000m2)	0.000449	-0.000182	0.000443	-0.000145
	(0.000416)	(0.000573)	(0.000415)	(0.000609)
Land terrain (Flat:=1)	0.00742	0.0169	0.00695	0.0214
	(0.0189)	(0.0282)	(0.0191)	(0.0276)
Land quality	0.0180	-0.219*	0.0202	-0.227*
	(0.0531)	(0.118)	(0.0528)	(0.125)
Occupational fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of observations	2,188	1,819	2,188	1,819
Number of district clusters	126	123	126	123
R-squared	0.106	0.271	0.109	0.276

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

Table 9. Climate variation and social trust. Adding other social network variables

VARIABLES	(1) Trust people	(2) Careful dealing with people	(3) Trust people	(4) Careful dealing with people
	Log Rainfall Variation		Log Temperature Variation	
Climate variation	0.209*	-0.817**	0.0542***	-0.135***
	(0.120)	(0.325)	(0.0192)	(0.0442)
Minority	-0.125	-0.116	-0.124	-0.111
	(0.0844)	(0.108)	(0.0847)	(0.101)
Age of head	-0.00356	0.00492	-0.00346	0.00478
	(0.00381)	(0.00573)	(0.00385)	(0.00545)
Age of head, square/100	0.00272	-0.00473	0.00264	-0.00458
	(0.00317)	(0.00465)	(0.00320)	(0.00446)
Rural	0.119	0.125	0.126	0.110
	(0.0845)	(0.116)	(0.0854)	(0.126)
Year of schooling of head	7.36e-05	0.00244	0.000143	0.00187
	(0.00164)	(0.00457)	(0.00163)	(0.00458)
Gender (Male:=1)	-0.0256	-0.0411	-0.0147	-0.0684*
	(0.0207)	(0.0412)	(0.0210)	(0.0379)
Married	0.0541*	0.0246	0.0479*	0.0402
	(0.0278)	(0.0400)	(0.0280)	(0.0374)
Log Household income	-0.0170	0.0134	-0.0177	0.0155
	(0.0127)	(0.0168)	(0.0129)	(0.0164)
Average Rainfall (mm)	-0.00134*	0.00434**	0.000198	-0.00110
	(0.000713)	(0.00187)	(0.000464)	(0.00106)
Average Temperature (oC)	-0.0103	0.0365*	0.00655	-0.0205
	(0.00948)	(0.0185)	(0.00764)	(0.0169)
Area of Land (1000m2)	0.000758	-0.000604	0.000749	-0.000571
	(0.000556)	(0.000544)	(0.000550)	(0.000595)
Land terrain (Flat:=1)	0.0139	0.0146	0.0135	0.0197
	(0.0207)	(0.0302)	(0.0208)	(0.0304)
Land quality	-0.00810	-0.203	-0.00625	-0.213
	(0.0654)	(0.132)	(0.0656)	(0.137)
Always attending meeting	-0.0102	-0.0324	-0.00883	-0.0353
	(0.0205)	(0.0408)	(0.0202)	(0.0393)
Hours watching TV	-0.0116	0.0137	-0.0107	0.0150
	(0.0109)	(0.0157)	(0.0108)	(0.0144)
Share of minority at commune	0.124	0.0262	0.126	0.0461
	(0.0899)	(0.125)	(0.0894)	(0.127)
Occupational fixed effects	Yes	Yes	Yes	Yes
Group member fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of observations	1,738	1,431	1,738	1,431
Number of district clusters	123	120	123	120
R-squared	0.164	0.293	0.17	0.293

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

Table 10. Climate variation and social trust by female

VARIABLES	Female			
	Trust people	Careful dealing with people	Trust people	Careful dealing with people
	Log Rainfall variation (100mm)		Log Temperature variation (oC)	
Climate variation	0.242	-0.670	0.0555	-0.187***
	(0.192)	(0.543)	(0.0359)	(0.0655)
Individual controls	Yes	Yes	Yes	Yes
Geographical control	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes
Group member fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of observations	287	230	287	230
Number of district clusters	83	73	83	73
R-squared	0.35	0.41	0.355	0.43

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

Table 11. Climate variation and social trust by male

VARIABLES	Male			
	Trust people	Careful dealing with people	Trust people	Careful dealing with people
	Log Rainfall variation (100mm)		Log Temperature variation (oC)	
Climate variation	0.211*	-0.558*	0.0473**	-0.0956*
	(0.117)	(0.309)	(0.0186)	(0.0504)
Individual controls	Yes	Yes	Yes	Yes
Geographical controls	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes
Group member fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of observations	1,458	1,207	1,458	1,207
Number of district clusters	124	122	124	122
R-squared	0.152	0.37	0.153	0.37

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

Table 12. Climate variation and social trust by regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Dependent variable: Most people can be trusted									
VARIABLES	Excluded SCC	Excluded MRD	Excluded CH	Excluded RRD	Excluded NW	Excluded SCC	Excluded MRD	Excluded CH	Excluded RRD	Excluded NW
	Log Rainfall variation (100mm)					Log Temperature variation (100mm)				
Climate variation	0.308**	0.225*	0.217*	0.307	0.128	0.071***	0.0594***	0.0514**	0.0551**	0.0558***
	(0.149)	(0.121)	(0.122)	(0.191)	(0.147)	(0.0238)	(0.0179)	(0.0201)	(0.0271)	(0.0197)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Group member fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1,505	1,618	1,605	1,011	1,241	1,505	1,618	1,605	1,011	1,241
Number of district clusters	111	104	100	79	102	111	104	100	79	102
R-square	0.15	0.13	0.16	0.219	0.16	0.15	0.13	0.16	0.22	0.17

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

Table 13. Climate variation and social trust by regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Dependent variable: Careful in dealing with people									
VARIABLES	Excluded SCC	Excluded MRD	Excluded CH	Excluded RRD	Excluded NW	Excluded SCC	Excluded MRD	Excluded CH	Excluded RRD	Excluded NW
	Log Rainfall variation (100mm)					Log Temperature variation (100mm)				
Climate variation	-0.747**	-0.861***	-0.649**	-0.232	-0.441	-0.165***	-0.0661	-0.124***	-0.116*	-0.119***
	(0.364)	(0.312)	(0.322)	(0.385)	(0.385)	(0.0479)	(0.0483)	(0.0436)	(0.0647)	(0.0437)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Group member fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1,261	1,301	1,317	882	987	1,261	1,301	1,317	882	987
Number of district clusters	110	98	102	79	99	110	98	102	79	99
R-square	0.404	0.37	0.37	0.36	0.25	0.41	0.36	0.37	0.36	0.25

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

Table 14. Identifying impact channels: Village relationship

	(1)	(2)	(3)	(4)	(5)
	Dependent Variable: Borrowing from relatives				
VARIABLES	Full sample	Excluded SCC	Excluded MRD and SCC	Excluded SCC and CH	Excluded SCC, CH, MRD
Log Rainfall variation (100mm)	0.175	0.395*	0.390*	0.416*	0.408*
	(0.229)	(0.219)	(0.229)	(0.213)	(0.221)
Share of Agricultural income	0.0827	0.0730	0.0965	0.0686	0.0979
	(0.0525)	(0.0613)	(0.0646)	(0.0690)	(0.0748)
Share of income from common resources	0.519***	0.474***	0.455***	0.550***	0.530***
	(0.110)	(0.149)	(0.162)	(0.117)	(0.123)
Individual controls	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes	Yes
Group member fixed effects	Yes	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes	Yes
Number of Observations	1,613	1,365	1,228	1,239	1,102
Number of clusters	123	110	87	90	67
R-square	0.13	0.15	0.15	0.16	0.16

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

Table 15. Identifying impact channels: Family ties

	(1)	(2)	(3)	(4)	(5)
	Dependent Variable: Borrowing from same villages				
VARIABLES	Full sample	Same village	Exclude SCC	Excluded MRD and SCC	Excluded CH and SCC
Log Rainfall variation (100mm)	0.301	0.224	0.292	0.307	0.276
	(0.265)	(0.254)	(0.321)	(0.273)	(0.266)
Share of Agricultural income	-0.097	-0.0397	-0.0989	-0.0715	-0.0927
	(0.0611)	(0.0767)	(0.0647)	(0.0652)	(0.0637)
Share of income from common resources	-0.236**	-0.205	-0.177	-0.232**	-0.202**
	(0.102)	(0.137)	(0.130)	(0.112)	(0.0955)
Individual controls	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes	Yes
Group member fixed effects	Yes	Yes	Yes	Yes	
Provincial fixed effects	Yes	Yes	Yes	Yes	Yes
Number of observations	1,613	1,160	1,365	1,487	1,476
Number of district clusters	123	118	110	103	100
R-square	0.13	0.17	0.14	0.14	0.14

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

Table 16. Identifying impact channels: Agricultural incomes

	(1)	(2)	(3)	(4)
VARIABLES	Trust people	Careful dealing with people	Trust people	Careful dealing with people
	Log Rainfall variation		Log Temperature variation	
Climate variation	0.212*	-0.820**	0.0555***	-0.135***
	(0.122)	(0.327)	(0.0190)	(0.0447)
Share of Agricultural income	0.0644**	0.000462	0.0680**	-0.00909
	(0.0283)	(0.0452)	(0.0281)	(0.0470)
Individual controls	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
Group member fixed effects	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of observations	1,738	1,431	1,738	1,431
Number of district clusters	123	120	123	120
R-squared	0.17	0.29	0.17	0.29

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

Appendix II

1. Social Trust and Climate variation. Rainfall and Temperature regression

VARIABLES	(1) Trust people	(2) Careful dealing with people	(3) Trust people	(4) Careful dealing with people
	Rainfall variation		Temperature variation	
Climate variation	0.00124	-0.0047**	0.0226***	-0.0526***
	(0.000767)	(0.00213)	(0.00705)	(0.0171)
Individual controls	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
Group member fixed effects	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of Observations	1,738	1,431	1,738	1,431
Number of clusters	123	120	123	120
Pseudo R-squared	0.16	0.17	0.29	0.29

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

2. Social Trust and Climate variation. Logistic regression

VARIABLES	(1) Trust people	(2) Careful dealing with people	(3) Trust people	(4) Careful dealing with people
	Log Rainfall variation		Log Temperature variation	
Climate variation	4.027	-5.942***	1.364***	-1.004***
	(2.777)	(2.236)	(0.477)	(0.314)
Individual controls	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
Group member fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of Observations	1,659	1,424	1,659	1,424
Number of clusters	123	120	123	120
Pseudo R-squared	0.15	0.24	0.17	0.24

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Clustered standard errors are in round brackets.

3. Using selection on observables to assess the bias from unobservables

		(1)	(2)	(1)	(2)
		Log Rainfall variation		Log Temperature Variation	
Controls in the restricted regression	Controls in the full regression	Trust people	Careful dealing with people	Trust people	Careful dealing with people
Average Rainfall and Temperature	Full set of controls from Table 8	34.77	62.21	942.8	49.01
Average Rainfall and Temperature	Full set of controls from Table 9	20.46	66.1	12.73	9.91
Average Rainfall and Temp, Age, Age square/100, Gender, Married	Full set of controls from Table 8	55.81	84.96	166.7	397.4
Average Rainfall and Temp, Age, Age square/100, Gender, Married	Full set of controls from Table 9	16.15	56.5	10.77	13.66

Notes: Each cell of the table reports ratios based on the coefficient for log rainfall and temperature variation from household-level regressions. In each regression, provincial fixed effects are included. The reported ratio is calculated as: the coefficient for log climate variation in full regression/(the coefficient for climate variation in restricted regression - the coefficient for climate variation in full regression)

Appendix III. Theoretical model

To facilitate this research, I develop a simple game to demonstrate a mechanism through which climate variation is likely to change behavior of village peasants and create social trust.

Suppose a communal economy is closed, cohesive, agrarian economy consisting of small villages. Each village includes a group of mainly subsistence household-farmers. Suppose the most important factor influencing village life is the risk to crop yields resulted from climatic conditions, such as flooding or drought. As risk is prevalent and critical to village near to subsistence, much effort will be taken to mitigate uncertainty.

Large-scale constructions, such as dykes and irrigation systems, have to be built to ease the impacts of hazard environment. A group of villages are responsible to build and maintain the systems of flood control in their territory. The system of flood control is considered a public good to sustain development of villages. It is costly to provide but once it is provided it is not possible to exclude using it regardless of how much villages contributed for this good. The impossibility to exclude individual from its use encourage each individual to free-ride on the contributions of the other.

Consider a strategic game of two players – two villages. Each player has two strategies: 1) either Cooperate or 2) Don't Cooperate. I assume that none of the players has perfect information on the other's payoffs.

Figure 1 displays a normal-form representation of the game with payoff for each player in parentheses.

		Village B	
		Cooperate	Don't Cooperate
Village A	Cooperate	(a,b)	(c,d)
	Don't Cooperate	(e,f)	(g,h)

Assumption 1: High social uncertainty reduces the opportunity of cooperation among villages

I assume that society is uncertain. Peasants face informational asymmetry as they deal with other people in the village. If peasants of villages are not able to solve efficiently cooperation dilemmas because of high cost of supervision - they cannot monitor other's behavior and punish other village who 'free ride'- they choose non-cooperation.

Assumption 2: Cooperation among villages requires transaction cost

As creating social relations take time and effort, people have to invest their resources in promotion of relationship and communication with members of other villages. Transaction cost will be high if any villages refuse to cooperate.

Assumption 3: Cooperation promotes social trust

To exploit opportunities that are not satisfied by working alone, villages select to cooperate with other villages. It makes them taking more risks in trusting other members. Moreover, as Ermisch and Gambetta (2010) suggest, interacting more with other peoples can lead to more "*outward exposure",* and improve their ability to trust other people by (1) estimating more accurately the probability of trustworthiness; or (2) reading the signs of untrustworthiness more precisely. Therefore, peasants cooperate and interact less with other people will exhibit a lower level of trust in members of other villages.

The expected net benefit as peasants switching from non-cooperation to cooperation with members of other villages is:

ΔB_{switch} = {Payoff of cooperation (CV) – Social Uncertainty – Transaction cost} - Payoff of non-cooperation (CV)

where payoff of cooperation or non-cooperation is assumed as a function of climate variation (CV). Assumption is where natural environment is difficult for living, benefits of cooperation are high. Village peasants are more cooperative to cope with risks and uncertainty. Higher climate variation also reduces payoff of non-cooperation. It means:

$$\frac{\partial Payoff\_cooperation}{\partial CV} > 0 \; ; \; \frac{\partial Payoff\_non\_cooperation}{\partial CV} < 0$$

I investigate the best response strategies of both players

At first, I assume that the natural environment is hazardous that require mutual effort to cope with disasters. Then, if village A chooses to cooperate with village B, the best response of B is to cooperate with A. In term of payoff, b>d.

If member A chooses not to cooperate, the best response of B is to cooperate. In case of dangerous natural environment, B decides to work alone to protect her own benefit even she does not receive support from A ($\Delta B_{switch} > 0$)[9]. In term of payoff, f>h

Similarly, if B has the same preferences then the game that models the situation is given in Figure 2 with the best response choices of the two players are indicated by the underlined payoffs. We come up with one Nash equilibrium to the game with strategy of Cooperation is dominant.

[9] Instead of an one-shot games, suppose the games is repeatedly played (infinitely) with grim trigger strategy and villages appreciate sufficiently the benefits of future cooperation, which mean gains from cheating today is less than discounted net gain from cooperation in the future (Payoff of both Cooperate (Promise of future reward) – Payoff of both Non-cooperate (Threat of future punishment)) then B still chooses Cooperate even if f<h in the one-shot game.

		Village B	
		Cooperate	Don't Cooperate
Village A	Cooperate	(a,b)	(c,d)
	Don't Cooperate	(e,f)	(g,h)

Assumption of risky natural environment to village peasants that promote cooperation among villages (and more social trust among villages) lead to an equilibrium, which is (Cooperate, Cooperate).

Does it potentially be a stable Nash equilibrium? It depends on the benefit of cooperation.

If the natural environment is not a big concern that requires a mutual cooperation within village members, the benefit of cooperation is diminishing. If the net benefit of cooperation is not as large as gains from non-cooperation (Payoff of cooperation (CV) – Social Uncertainty – Transaction Cost < Payoff of non-cooperation (CV) or $\Delta B_{switch} < 0$), village peasants choose not to cooperate. For example, if the increment in payoff value is not worth the extra effort, B opts to not cooperate as A cooperates. In other words, the strategy to seek harmony and efficient cooperation is a good strategy insofar as opportunity costs are big enough to exceed savings from transaction cost and benefits of working alone.

If one player chooses not to cooperate, the prevailing equilibrium breaks down. In this case, the Nash equilibrium is (Don't Cooperate; Don't Cooperate)

		Village B	
		Cooperate	Don't Cooperate
Village A	Cooperate	(a,b)	(c,d)
	Don't Cooperate	(e,f)	(g,h)

A benign natural environment, which does not require much mutual efforts and cooperation to cope with, encourages villages to work alone and do not make effort to build relationship and cooperation. Therefore, it is expected that people living in regions with less dangerous environment will show lower level of social trust.