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Cooperation Makes Beliefs: Climate Variation and Sources of Social Trust in Vietnam

Anh Duc Dang

AUTHOR AFFILIATION: Research School of Economics, College of Economics and Business, Australian National University

CONTACT: dang.ducanh@anu.edu.au

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Anh Duc Dang
Research School of Economics
College of Economics and Business
Australian National University
Email: dang.ducanh@anu.edu.au

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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 are 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 are transmitted through strengthening the cooperation among village peasants in coping with risk and uncertainty. The results also show that households with higher proportion of agricultural incomes tend to trust people more. However, the increased village relationship does not erode family ties.

JEL classification: O13, O53, Z13, Q54
Keywords: Climate variation, social trust, Vietnam

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]. 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, network connections, mutual monitoring 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, 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.

Although this cross-country study is suggestive and stimulating, it may provide limited evidence of causal effects since too many things alter across countries (Alesina, 2010). In addition, it is

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

difficult to exclude the possibility of other factors, such as religion, ethnicity or geography of the region, may relate to both changing in the social trust and climate variables, especially, for long time period and then bias the results[3]. 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 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 have to be built to ease the impacts of hazard environment, they require cooperative action

[3] It is also difficult to control for movement of people around and migration into Europe, particularly over several hundred years.

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 inter-annual fluctuations in rainfall and extreme events such as heavy 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 natural climate variation 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 the results indicate that more variability in rainfall does not weaken family ties in regions. One explanation is that in a Confucian country people consider families as the most important factors and this perception is 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 substituted 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. It also that climate variation makes households more equality in income, which creates incentives for them to cooperate. In addition, I realized that households who rely more on agricultural incomes tend to trust other people. There is also evidence that climate variation makes village people more equal and strengthens their cooperation and 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 East 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 East Sea and

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

hence can occur several times throughout years. Consequently, as rainfall is immediately 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 (Marsh et al, 2007).

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.

Although Southern villages originally share the same form of social organization as their northern ancestors, they have 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 is 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 are different from the northern ones. In fact, they are not villages in the conventional senses. There is no bamboo hedge to physically define the boundaries of the village, no gate and control on entry. Individual households are widely scattered along the banks of the canals that cross the delta. Although these settlements are organized by the state into villages and hamlets, these administrative units are not true communities. Households often had closer social relations with neighbors living directly across canals; even they are 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 several 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 authors 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. In addition, as natural shocks happen frequently, peasants increase in the perceived probability that a similar event might occur in the future. They can improve insurance capacity against natural risks by expanding relationship to other members in same communes, who are likely to be affected by weather fluctuations in the same ways. It causes people to be more trustworthy (Cassar et al, 2011). In addition, as argued by Alesina and LaFerrara (2002), after the disaster, the community has a lower degree of income disparity, then trust may increase due to greater equality.

Rambo (1979) demonstrates 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 other 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. This view is coherent with empirical findings on the 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 residents of the original country (Guiso et al., 2006; Algan and Cahuc, 2007).

3. Data Sources and Description

Social Trust

I employ the third round of Vietnam Access to Resources Household Survey (VARHS)[5] in 2008 to inspect the impacts of climate volatility on social trust in different parts of the empirical analysis.

The VARHSs are uniquely representative surveys which are based on interviews of a random sample of 3,223 households in rural regions. Of which, 1,364 rural households in 2004 Vietnam Household Living Standards Survey (VHLSS)[6] have been resurveyed. In addition to the 1,364 resurveyed VHLSS-2004 households, the survey contains two other main groups of households. First, 820 rural households are resurveyed from the 2002 VHLSS in Ha Tay, Phu Tho, Quang Nam and Long An provinces. Second, the sample includes 945 additional households from the five provinces covered by the Agricultural and Development Program (ARD-SPS), namely Lao Cai, Dien Bien, Lai Chau, Dak Lak and Dak Nong.

In total, the survey covers 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 special feature of this survey is that these provinces are located in different geographical regions that reflect various climate conditions and then nationally representing different living environment.

The survey provides 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

[5] The survey data 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/

[6] The VHLSS is a nationally representative, socio-economic survey, carried out biennially by the General Statistics Office (GSO).

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 41 percent of them are minority.

The survey asks two standard questions 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 statements: Most people are generally honest and can be trusted* and *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 3,156 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 shown in Appendix, the estimates are qualitatively identical if I pursue this alternative strategy.

Two questions seem to ask about generalized trust at different levels with the first asking about social trust for a broader community. However, respondents are likely to apply their behavior instead to trust in narrow community such as village and commune. Therefore, these two questions are likely to reflect the impacts of climate adaptation on trust among village/commune members.

The distributions of responses for question on social trust are summarized in Table 4[7]. 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* nearly 90 percent. The results are consistent with those reported in Dalton et. al. (2002), which show that the

[7] The statistical summary is based on the number of rural households who have head and/or spouse were born in the same place where they are living.

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

Family and Village Ties

The importance of family is a historical 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 extended 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 money 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) by counting the number of people in the asking lists who are relatives. Relatives can be people who live outside villages. Therefore, the number of helpers who are relatives ranges from 0 to 3. The same strategy is applied to calculate the number of helpers who are in the same village. Table 5 shows that 68 percent of the helpers mentioned are relatives of the respondents. The number of households who ask for the help from other members in the same village is even bigger with 78 per cent.

The results on the share of helpers who are relatives are interesting. They show that households in the more developed provinces such as 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 deteriorated by more modern types of social relations (CIEM et at, 2007).

Climate Variables

A. Rainfall

To measure climate variation, I restrict my attention to daily extreme rainfall and rainfall deviation. 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 centuries.

Data on climate variability from 45 climate stations comes from Institute of Meteorology and Hydrology and prolongs 35 – 70 years from 1927 to 2006[8]. 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* .

[8] For the period 1975 – 2006, the data is taken from the Thomas et al, "Natural Disasters and Household Welfare: Evidence from Vietnam", Policy Research Working Paper, 2010, Worldbank.

To compute the climate variation, I follow Durante (2009) by first calculating standard deviation of rainfall in each station for each month over 30 years (month-specific variability) from 1975 to 2006. After that, I obtain the average of rainfall deviation of each station over twelve months to investigate year-to-year rainfall fluctuations. For extreme rainfall events, I take the highest daily rainfall in each station over 35 to 50 years from 1927 to 1985.

For districts without stations, the climate condition is assumed to be similar to that of 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 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 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 plot dummy variable to measure of agricultural 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, more than 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 households do not have any plots that suffer any above problems and 0 otherwise. Only two percent of households report high quantity of land without any above problems.

C. Migration

Normally, we would 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.

The survey provides useful information about migration based on questions on how long households have lived in the commune and location that people were born. I follow a strategy to take only households with head, spouse or both of them for whom where they live are also where they were born. The argument here is the more time those people have been exposed in this environment, the more their norms adapt to this natural condition. In addition, if we expect that culture is resistant and transmitted through generations, people were born there also are likely to inherit trust form their ancestors who used to live in those settings. In Table 1, the average age of household heads who were born locally is 50 years old. It implies that climate has long-lasting and profound effects on their living and behavior.

In addition, other reasons that make migration less likely to be major issues. Since most of provinces are poor and underdeveloped, it first provides less incentive to people from one province in the sample migrate to others and second, 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 equation[9]:

[9]Because the distribution of the extreme rainfall and rainfall variation 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.

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

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 among stations. β is our coefficient of interest which estimates the relationship between the climate variation in a station 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 $\mathrm{X}_{i,d,p}^{'}$ 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 rainfall, land terrain and quality, number of groups attending, 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 station level. For example, climate variation will have the similar effects for people living the same station. The household survey also uses stratified cluster sampling, there is a potential for within-group correlation of the residuals. Therefore, I adjust all standard errors for potentially arbitrary correlation between households in the same station.

Table 6 and 7 report the results using for log of extreme rainfall and rainfall variation. In baseline models, I find substantial evidence that climate variation, particularly extreme rainfall, is correlated with two self-reported trust indicators. In the most case, with and without provincial fixed effects, the estimated coefficient for extreme rainfall, β, is 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 climate variation positively affects individuals' trust of those around them.

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 log of average rainfall, land area, land terrain and quality. When the geographical controls are included, the point estimates of the coefficients of interest increase substantially and 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 0.23 increase in probability of trust other people (approximately 21 percent of standard deviation in trust)[10].

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

[10] The effect is calculated as (0.23 x 0.3)/0.33=0.21 or 21%

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[11]. To take into account of these factors, I control for hours of watching TV, the number of social and religious groups that people belong to and a dummy variable to indicate how frequent they attend meetings. The results suggest that social network variables 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 both female and male subsamples. I find that climate variation (in Table 10 and 11) has higher impacts on female. Particularly, the effects are two times higher for the female. One possibility is that climate volatility promotes female's social relationship and then increasing their social trust. 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.

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 and endogeneity. However, it is important to admit that I cannot definitively exclude the

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

possibility that some unobserved district characteristic affects both climate variation and social trust, leading to spurious results. In addition, other problems also may create biased estimation.

The first is OLS estimator would yield biased estimates since our measurement error from measure of climate variation, i.e. extreme rainfall and rainfall variation, 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.

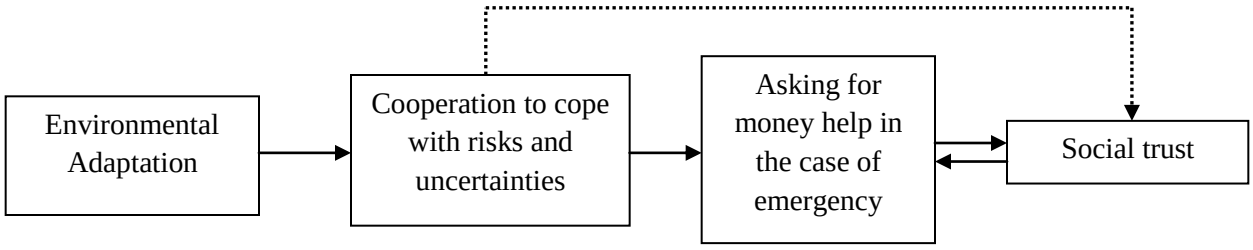
Another problem that may affect the estimates is selection bias. The problem happens as a non-random subgroup of village peasants select to stay in regions even with more natural risks. The reason may be due to constrained resources that make them less opportunity to move to other regions with better natural environments. People with less ability are also likely to choose not moving out of harmful areas. 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) and Cassar et al (2011) show that people living in villages that have suffered a natural disaster behave a more risk averse than others. If risk-averse people trust others less and these factors correlate with climate variability among district, then the estimates are also to be underestimated. If so, the results provide lower bound estimation.

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 that in the process of environmental adaptation, village peasants have to cooperate with each other to deal with natural turbulences and disasters. On the one hand, this promotes trust and social networks among members in the village. Therefore, village peasants rely more on other members in the facing of emergency. On the other hand, 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 climate 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.



Another possibility is that climate variation is likely to affect cooperation and trust through its effect on income equality. One potential explanation is hazard environment (e.g storm and flood) in every year could destroy crop and property of households and make them become more equal. It in turn creates incentives for them to cooperate and help each other to survive, which could create more trust among village farmers. This argument is consonant with findings

from Alesina and Ferrara (2002) who found that low trust associates with high degree of income disparity in the US.

In Table 14, I examine the effects of the frequency of climate varibility on enhancing cooperation and relationship among neighbours. All regressions include both occupational effects and geographical controls. I start regressing the first village ties on extreme rainfall. The coefficient on extreme rainfall is positive and statistically significant. 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 take into account of this possibility, I gradually exclude some regions in the South with less climate variation to figure out the effects more precisely. Column (2)-(4) indicate that climate variation strengthens relationship among village members. The results are less robust to the case of rainfall variation

I also test the possibility that increased relying on other people in the same villages will reduce the family ties. Empirical evidence has 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 generalized trust, civic engagement and political participation. Durante (2009) discovers 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 estimating the first family ties on extreme rainfall. The coefficient on rainfall variability is positive and statistically significant, showing that climate variation enhances family relationship. 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 4 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 empirical studies that Western family ties tend to be deteriorated as people are more generalized 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 has not been weaken due to an appearance of 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.

Lastly, I turn to the potential mechanism that climate variation results in income equality among village people, then promoting cooperation and trust. The first Column in Table 17 shows that extreme rainfall makes rural households in the same district more equal. 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 pursue a number of different strategies. First, I control for potential observable characteristics,

including geographical and social network variables, which may correlate with natural environment and affects social trust. Second, I control for provincial 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.

I further examine the relationship between climatic variability and individuals' behavior to their family. 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 results also indicate that hazard natural environment resulted in higher income equality among people, which creates incentives for 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	2370	0.87	0.33	0	1
Careful in dealing with people	2370	0.53	0.50	0	1
Log highest daily rainfall (100mm)	2370	1.04	0.49	0.06	2.06
Log rainfall deviation (100mm)	2370	4.54	0.30	3.97	5.37
Log average monthly rainfall (100mm)	2370	5.01	0.35	2.96	5.70
Age of head	2370	49.35	14.50	18	107
Age of head, squared/100	2370	26.46	15.79	3.24	114.49
Year of schooling of head	2370	8.12	3.66	1	13
Gender (Male:=1)	2370	0.84	0.37	0	1
Married	2370	0.85	0.35	0	1
Rural	2370	0.99	0.09	0	1
Minority	2370	0.42	0.49	0	1
Log Household income (mil VND)	2370	3.18	0.86	-0.12	7.02
Area of land (1000m2)	2370	8.85	20.72	0.04	830.42
Land terrain (Flat:=1)	2370	0.52	0.50	0	1
Land Quality (Good:=1)	2370	0.02	0.12	0	1
Member of social and religious groups	1461	1.15	0.43	1	4
Attend meeting frequently	1461	0.67	0.46	0	1
Hours of watching TV	2370	1.41	1.00	0	5
Share of minority by district	2370	0.38	0.46	0	1
Borrowing from same village	2084	1.46	0.98	0	3
Borrowing from relatives	2084	1.27	1.01	0	3

Note: The summary statistics are calculated based on VARHS survey data.

Table 2. Bivariate correlation

	Most people can be trusted	Careful in dealing with people	Log Highest Daily Rainfall	Log Rainfall Variation
Most people can be trusted	1			
Careful in dealing with people	-0.041*	1		
Log Highest Daily Rainfall	0.108*	-0.014	1	
Log Rainfall Variation	0.156*	-0.062*	0.253*	1

Note: * Statistically significant at 5 percent.

Figure 1. Map showing the current locations of respondents

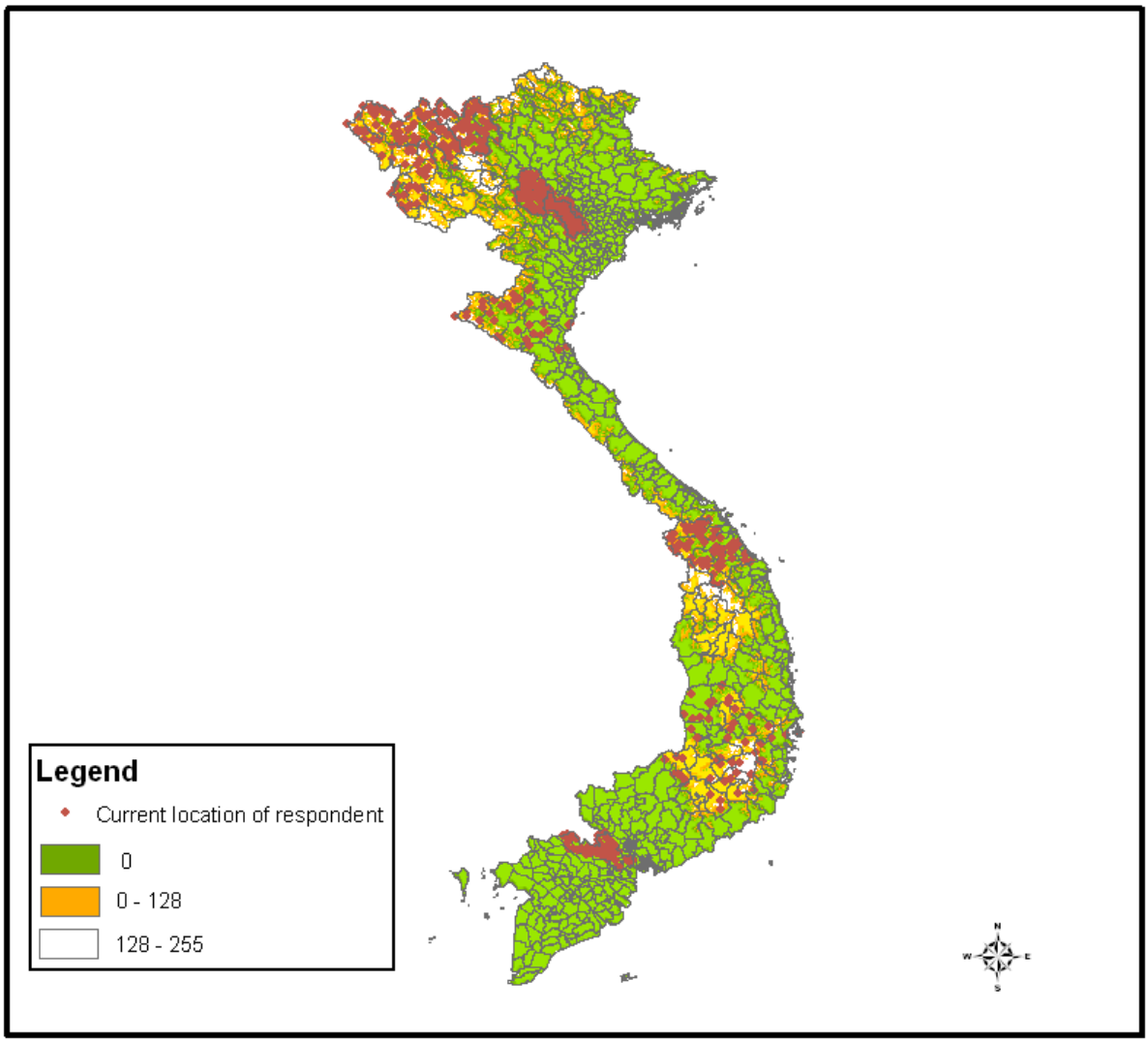

Table 3. Climate variation summary (Highest daily rainfall and Standard Deviation)

Province	Station	Period	Highest	Deviation	Province	Station	Period	Highest	Deviation
HaTay	Son Tay	1958-85	508	89.05	**DienBien**	Tua Chua	1968-85	412.5	
	Ba Vi	1970-85	554.6	93.37		Tuan Giao	1961-85	232	64.88
	Ha Dong	1973-85	318.7	81.38		Pha Din	1964-85	252.7	65.24
LaoCai	Pho Rang	1975-06		70.06		Dien Bien	1967-85	229.3	67.98
	Bac Ha	1961-85	272.3	74.71	**Nghe An**	Quy Chau	1962-85	290	77.40
	Lao Cai	1989-1950; 56-78	190.9	90.68		Quy Hop	1968-85	208.4	74.87
	Sa Pa	1929-45; 57-85	350	114.22		Tay Hieu	1960-85	279.5	87.38
Phu Tho	Phu Ho	1928-43; 62-85	701.2	79.66		Tuong Duong	1961-85	192	63.93
	Viet Tri	1961-85	508.3	77.93		Quynh Luu	1961-85	473	99.78
	Thanh Son	1971-81	554.6			Con Cuong	1961-85	449.5	92.11
	Minh Dai	1972-85	238.9	77.75		Do Luong	1961-85	788.4	104.39
Lai Chau	Than Uyen	1961-78	192.4	69.83		Hon Ngu	1961-85	362	112.04
	Tam Duong	1973-85	160.1	86.87		Vinh	1904-46; 56-85	484	121.89
	Muong Te	1961-85	573	81.38	**Khanh Hoa**	Nha Trang	1907-44; 47-85	334.1	83.15
	Sin Ho	1961-85	188.3	88.61		Cam Ranh	1978-85	263	80.15
	Binh Lu	1968-81	223.1			Truong Sa	1977-85	250.2	130.63
	Lai Chau	1928-44;55-85	312.6	81.82	**Dac Lac**	Buon Ho	1982-1985	107.1	76.51
Dac Nong	Dac Nong	1978-85	105.9	112.45		Buon Ma Thuot	1828-44; 54-74; 78-85	178	86.68
	Dac Min	1975-06		78.97		M Drack	1977-85	320	105.83
Lam Dong	Da Lat	1928-44; 60-69; 78-85	307.4	91.55		Eahleo	1975-06		53.23
	Bao Loc	1962-85	254	145.16		Eakmart	1975-06		97.78
	Lien Khuong	1975-06	121.3	81.99		Lak	1975-06		89.84
Quang Nam	Tam Ky	1979-85	374.4	163.93	**Long An**	Moc Hoa	1973-85	134.2	83.66
	Tra My	1974; 78-85	403.4	214.08					

Note: The inter-annual standard variation of rainfall is calculated based on the data in each station from 1975 – 2006.

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

Provinces	Most people can be trusted		Careful in dealing with people	
	Yes	No	Yes	No
Ha Tay	86.5	13.5	59.5	40.5
Lao Cai	96.86	3.14	36.08	63.92
Phu Tho	91.43	8.57	82.5	17.5
Lai Chau	86.12	13.88	12.81	87.19
Dien Bien	70.68	29.32	57.83	42.17
Nghe An	91.5	8.50	39.22	60.78
Quang Nam	94.19	5.81	53.49	46.51
Khanh Hoa	90.38	9.62	15.38	84.62
Dac Lac	90	10	71.25	28.75
Dac Nong	92	8	60	40
Lam Dong	92.59	7.41	66.67	33.33
Long An	79.82	20.18	77.13	22.87
Total	87.47	12.53	53.21	46.79

Note: The summary statistics are calculated based on VARHS survey data

Table 5. Overview of the asking for money help in the case of emergency

Provinces	Share of helpers who are relatives	Share of helpers who are village members
Ha Tay	0.80	0.80
Lao Cai	0.67	0.89
Phu Tho	0.65	0.76
Lai Chau	0.67	0.92
Dien Bien	0.82	0.81
Nghe An	0.69	0.65
Quang Nam	0.56	0.78
Khanh Hoa	0.86	0.72
Dac Lac	0.47	0.74
Dac Nong	0.60	0.72
Lam Dong	0.44	0.75
Long An	0.62	0.65
Total	68	78

Note: The summary statistics are calculated based on VARHS survey data

Table 6. Baseline estimations. Highest Daily Rainfall

	(1)	(2)	(3)	(4)
VARIABLES	Most people can be trusted		Careful in dealing with people	
Log Highest Daily Rainfall (mm)	0.0691*	0.111***	-0.0922	-0.239***
	(0.0344)	(0.0240)	(0.0737)	(0.0823)
Minority	-0.00359	0.0125	-0.208***	-0.0926
	(0.0423)	(0.0288)	(0.0662)	(0.0995)
Age of head	0.000549	0.00118	0.00362	0.00153
	(0.00291)	(0.00266)	(0.00561)	(0.00372)
Age of head, square/100	0.000194	-0.000126	-0.00249	-0.000404
	(0.00259)	(0.00252)	(0.00497)	(0.00343)
Rural	0.0854	0.0688	0.0289	0.0809
	(0.0573)	(0.0631)	(0.133)	(0.119)
Year of schooling of head	-3.21e-05	-0.000336	-0.000289	0.00128
	(0.00195)	(0.00181)	(0.00415)	(0.00404)
Male	0.0150	0.00976	-0.0257	-0.0201
	(0.0268)	(0.0267)	(0.0368)	(0.0429)
Married	0.0184	0.0196	-0.0199	-0.00146
	(0.0255)	(0.0236)	(0.0404)	(0.0421)
Log Household income	-0.0144	-0.0104	0.0275	0.00711
	(0.00920)	(0.00818)	(0.0187)	(0.0162)
Occupational fixed effects	No	Yes	No	Yes
Provincial fixed effects	No	Yes	No	Yes
Number of observations	2,370	2,370	2,370	2,370
Number of station clusters	45	45	45	45
R-squared	0.015	0.063	0.054	0.2

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. Rainfall variation

	(1)	(2)	(3)	(4)
VARIABLES	Most people can be trusted		Careful in dealing with people	
Log Rainfall variation (mm)	0.170***	0.282***	-0.204*	-0.108
	(0.0518)	(0.0608)	(0.106)	(0.169)
Minority	0.00329	0.00457	-0.213***	-0.0723
	(0.0310)	(0.0313)	(0.0775)	(0.107)
Age of head	0.00188	0.00146	0.00195	0.00177
	(0.00275)	(0.00273)	(0.00530)	(0.00384)
Age of head, square/100	-0.00108	-0.000340	-0.000914	-0.000723
	(0.00245)	(0.00257)	(0.00477)	(0.00353)
Rural	0.110**	0.0768	-0.00572	0.0572
	(0.0512)	(0.0654)	(0.118)	(0.128)
Year of schooling of head	0.000183	-0.000493	-0.000578	0.00100
	(0.00215)	(0.00187)	(0.00430)	(0.00422)
Male	0.00894	0.00953	-0.0179	-0.0164
	(0.0272)	(0.0255)	(0.0368)	(0.0458)
Married	0.0287	0.0211	-0.0334	-0.00499
	(0.0255)	(0.0236)	(0.0403)	(0.0435)
Household Income (mil.)	-0.00998	-0.00927	0.0228	0.00550
	(0.0104)	(0.00845)	(0.0183)	(0.0172)
Occupational fixed effects	No	Yes	No	Yes
Provincial fixed effects	No	Yes	No	Yes
Number of observations	2,370	2,370	2,370	2,370
Number of station clusters	45	45	45	45
R-squared	0.027	0.062	0.061	0.185

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 Highest Daily Rainfall		Log Rainfall Variation	
Climate variation	0.0938***	-0.281***	0.228***	-0.403
	(0.0211)	(0.0841)	(0.0732)	(0.266)
Minority	0.00871	-0.0890	0.00275	-0.0668
	(0.0299)	(0.0936)	(0.0323)	(0.101)
Age of head	0.00124	0.00151	0.00140	0.00130
	(0.00265)	(0.00366)	(0.00271)	(0.00381)
Age of head, square/100	-0.000197	-0.000458	-0.000294	-0.000398
	(0.00252)	(0.00336)	(0.00256)	(0.00348)
Rural	0.0635	0.0762	0.0735	0.0499
	(0.0621)	(0.120)	(0.0651)	(0.129)
Year of schooling of head	-0.000359	0.00105	-0.000397	0.00104
	(0.00179)	(0.00402)	(0.00186)	(0.00419)
Gender (Male:=1)	0.00843	-0.0230	0.00821	-0.0205
	(0.0263)	(0.0428)	(0.0254)	(0.0460)
Married	0.0192	-0.000481	0.0206	-0.00473
	(0.0236)	(0.0407)	(0.0237)	(0.0422)
Log Household income	-0.0114	0.00726	-0.0102	0.00457
	(0.00800)	(0.0161)	(0.00827)	(0.0170)
Log Average Rainfall (mm)	0.0654**	0.143***	0.0321	0.163*
	(0.0245)	(0.0521)	(0.0256)	(0.0827)
Area of Land (1000m2)	0.000325	-0.000201	0.000290	-9.72e-05
	(0.000318)	(0.000303)	(0.000311)	(0.000320)
Land terrain (Flat:=1)	0.0131	0.0652*	0.0109	0.0691*
	(0.0167)	(0.0339)	(0.0163)	(0.0352)
Land quality	0.00402	0.0350	0.0129	0.00969
	(0.0450)	(0.0678)	(0.0439)	(0.0722)
Occupational fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of observations	2,370	2,370	2,370	2,370
Number of station clusters	45	45	45	45
R-squared	0.07	0.21	0.06	0.19

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 Highest Daily Rainfall		Log Rainfall Variation	
Climate variation	0.127***	-0.294***	0.191**	-0.451*
	(0.0213)	(0.0762)	(0.0874)	(0.232)
Minority	-0.0738	0.0691	-0.0898	0.106
	(0.0803)	(0.115)	(0.0862)	(0.121)
Age of head	0.000642	-0.00299	0.000929	-0.00368
	(0.00372)	(0.00327)	(0.00376)	(0.00356)
Age of head, square/100	0.000107	0.00275	-5.92e-05	0.00315
	(0.00359)	(0.00326)	(0.00363)	(0.00349)
Rural	0.0530	0.217	0.0552	0.212
	(0.121)	(0.196)	(0.121)	(0.195)
Year of schooling of head	0.00172	-0.000237	0.00167	-0.000104
	(0.00179)	(0.00491)	(0.00185)	(0.00503)
Gender (Male:=1)	0.0290	-0.0249	0.0297	-0.0265
	(0.0350)	(0.0595)	(0.0326)	(0.0660)
Married	0.0273	-0.000545	0.0262	0.00192
	(0.0355)	(0.0463)	(0.0350)	(0.0484)
Log Household income	-0.0208*	-0.000993	-0.0192*	-0.00485
	(0.0104)	(0.0192)	(0.0193)	(0.0206)
Log Average Rainfall (mm)	0.0415*	0.165**	0.0288	0.197***
	(0.0242)	(0.0629)	(0.0304)	(0.0689)
Area of Land (1000m2)	0.000416	-0.000239	0.000375	-0.000145
	(0.000271)	(0.000239)	(0.000252)	(0.000250)
Land terrain (Flat:=1)	0.00977	0.0620	0.00774	0.0669
	(0.0243)	(0.0416)	(0.0247)	(0.0424)
Land quality	0.0176	0.0556	0.0336	0.0182
	(0.0418)	(0.0892)	(0.0413)	(0.0949)
Always attending meeting	-0.0131	-0.00601	-0.0135	-0.00487
	(0.0112)	(0.0158)	(0.0116)	(0.0162)
Hours watching TV	0.00755	0.0380	0.00866	0.0355
	(0.0217)	(0.0530)	(0.0230)	(0.0559)
Share of minority at commune	0.0853	-0.236	0.0924	-0.252
	(0.0791)	(0.154)	(0.0873)	(0.171)
Member of groups	-0.0130	0.0625**	-0.00736	0.0494**
	(0.0237)	(0.0237)	(0.0236)	(0.0232)
Occupational fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of observations	1,461	1,461	1,461	1,461
Number of station clusters	44	44	44	44
R-squared	0.09	0.21	0.08	0.2

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 Highest Daily Rainfall		Log Rainfall variation	
Climate variation	0.21***	-0.33***	0.01	-0.72*
	(0.05)	(0.11)	(0.2)	(0.39)
Individual controls	Yes	Yes	Yes	Yes
Geographical control	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of observations	389	389	389	389
Number of station clusters	34	34	34	34
R-squared	0.11	0.18	0.08	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 11. Climate variation and social trust by male

VARIABLES	Male			
	Trust people	Careful dealing with people	Trust people	Careful dealing with people
	Log Highest Daily Rainfall		Log Rainfall variation	
Climate variation	0.08***	-0.27***	0.27***	-0.35
	(0.02)	(0.09)	(0.08)	(0.27)
Individual controls	Yes	Yes	Yes	Yes
Geographical controls	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of observations	1,981	1,981	1,981	1,981
Number of station clusters	45	45	45	45
R-squared	0.07	0.2	0.07	0.2

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 Highest Daily Rainfall					Log Rainfall variation				
Climate variation	0.1***	0.08***	0.08***	0.14**	0.11***	0.2***	0.253***	0.22**	0.17*	0.31***
	(0.02)	(0.017)	(0.02)	(0.057)	(0.025)	(0.078)	(0.077)	(0.1)	(0.084)	(0.086)
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
Provincial fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	2,112	2,095	2,188	1,500	1,585	2,112	2,095	2,188	1,500	1,585
Number of station clusters	43	40	34	29	34	43	40	34	29	34
R-square	0.06	0.07	0.07	0.09	0.04	0.06	0.07	0.07	0.09	0.04

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 Highest Daily Rainfall					Log Rainfall variation				
Climate variation	-0.282***	-0.28***	-0.29***	-0.22***	-0.3***	-0.47	-0.48	-0.2	-0.18	-0.69**
	(0.084)	(0.088)	(0.09)	(0.06)	(0.105)	(0.306)	(0.28)	(0.32)	(0.27)	(0.28)
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
Provincial fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	2,112	2,095	2,188	1,500	1,585	2,112	2,095	2,188	1,500	1,585
Number of station clusters	43	40	34	29	34	43	40	34	29	34
R-square	0.24	0.19	0.22	0.22	0.15	0.22	0.18	0.2	0.21	0.13

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)	(6)	(7)	(8)	(9)	(10)
	Dependent variable: Borrowing from village members									
VARIABLES	Full sample	Excluded SCC	Excluded MRD, SCC	Excluded MRD, SCC, CH	Full sample	Full sample	Excluded SCC	Excluded MRD, SCC	Excluded MRD, SCC, CH	Full sample
	Log Highest Daily Rainfall					Log Rainfall variation				
Climate variation	0.41*	0.39*	0.39***	0.39*	-0.12	0.19	-0.26	-0.15	-0.05	0.19
	(0.19)	(0.19)	(0.13)	(0.2)	(0.2)	(0.23)	(0.37)	(0.33)	(0.57)	(0.4)
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
Provincial fixed effects	No	No	No	No	Yes	No	No	No	No	Yes
Number of observations	532	453	377	301	532	532	453	377	301	532
Number of station clusters	42	40	36	26	42	42	40	36	26	42
R-square	0.17	0.15	0.2	0.24	0.24	0.15	0.12	0.17	0.21	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.

Table 15. Identifying impact channels: Extended family ties

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Dependent variable: Borrowing from same relatives									
VARIABLES	Full sample	Excluded SCC	Excluded MRD, SCC	Excluded MRD, SCC, CH	Full sample	Full sample	Excluded SCC	Excluded MRD, SCC	Excluded MRD, SCC, CH	Full sample
	Log Highest Daily Rainfall					Log Rainfall variation				
Climate variation	0.35***	0.36***	0.31**	0.15	-0.1	-0.27	-0.12	0.07	0.5*	-0.15
	(0.12)	(0.12)	(0.12)	(0.14)	(0.14)	(0.18)	(0.33)	(0.33)	(0.28)	(0.3)
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
Provincial fixed effects	No	No	No	No	Yes	No	No	No	No	Yes
Number of observations	2,084	1,826	1,555	1,382	2,084	2,084	1,826	1,555	1,382	2,084
Number of station clusters	45	43	38	27	45	45	43	38	27	45
R-square	0.12	0.14	0.18	0.18	0.16	0.1	0.12	0.16	0.18	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 16. Identifying impact channels: Agricultural incomes

VARIABLES	(1) Trust people	(2) Careful dealing with people	(3) Trust people	(4) Careful dealing with people
	Log Highest Daily Rainfall		Log Rainfall variation	
Climate variation	0.094***	-0.28***	0.233***	-0.405
	(0.021)	(0.085)	(0.074)	(0.27)
Share of Agricultural income	0.051**	0.02	0.05**	0.02
	(0.02)	(0.04)	(0.02)	(0.04)
Individual controls	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of observations	2,370	2,370	2,370	2,370
Number of station clusters	45	45	45	45
R-squared	0.07	0.21	0.06	0.19

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

Table 17. Identifying impact channels: Income equality

VARIABLES	(1) Income inequality	(2) Income inequality	(3) Income inequality	(4) Income inequality
	Log Highest Daily Rainfall		Log Rainfall variation	
Climate variation	-0.024*	-0.01	0.017	0.02
	(0.013)	(0.02)	(0.035)	(0.07)
Individual controls	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	No	Yes	No	Yes
Number of observations	2,370	2,370	2,370	2,370
Number of station clusters	45	45	45	45
R-squared	0.16	0.31	0.15	0.3

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. Highest Daily Rainfall and Rainfall Deviation regression

VARIABLES	(1) Trust people	(2) Careful dealing with people	(3) Trust people	(4) Careful dealing with people
	Highest Daily Rainfall		Rainfall variation	
Climate variation	0.021***	-0.071***	0.002***	-0.002
	(0.005)	(0.026)	(0.000)	(0.002)
Individual controls	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
Occupational fixed effects	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of Observations	2,370	2,370	2,370	2,370
Number of station clusters	45	45	45	45
Pseudo R-squared	0.06	0.2	0.06	0.19

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 Highest Daily Rainfall		Log Rainfall variation	
Climate variation	1.02***	-1.61***	2.65***	-1.99
	(0.27)	(0.41)	(0.81)	(1.29)
Individual controls	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
Provincial fixed effects	Yes	Yes	Yes	Yes
Number of Observations	2,370	2,370	2,370	2,370
Number of station clusters	45	45	45	45
Pseudo R-squared	0.16	0.17	0.08	0.15

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