Risk, Cooperation and the Economic Origins of Social Trust: an Empirical Investigation

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Abstract

Extensive research has documented the importance of social trust for economic development, yet the origins of trust remain largely unexplored. This paper examines the historical relationship between risk, cooperation and the emergence of social trust. I hypothesize that norms of trust developed in pre-industrial times as a result of experiences of collective action and mutual insurance triggered by the need for subsistence farmers to cope with climatic risk. These norms persisted over time, even after climate had become largely unimportant for economic activity. I test this hypothesis in the context of Europe combining high-resolution climate data for the period 1500-2000 with contemporary survey data at the sub-national level. I find that regions characterized by higher year-to-year variability in precipitation and temperature display higher levels of trust. Consistent with a theory of insurance through geographic differentiation, I also find that trust is higher in regions with more spatially heterogeneous precipitation. Furthermore, variation in social trust is driven by weather patterns during the growing season and by historical rather than recent variability. These results are robust to the inclusion of country fixed-effects, a variety of geographical controls, and regional measures of early political and economic development.

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I. INTRODUCTION

There is a widespread consensus among social scientists that social trust is important for economic and institutional development because it facilitates cooperation and collective action among the members of a community.[1] Despite the multitude of intriguing results on the role of trust, only recently economists have begun to investigate the historical origins of trust and to explain the large differences in trust across and within countries (Tabellini, 2005; Guiso et al., 2008; Nunn and Wantchekon, 2009). These studies have documented how historical circumstances, particulary experiences of cooperation or conflict like the free-city state experience in medieval Italy and the slave trade in Africa, can have long lasting effects on the level of trust of a community.

This paper investigates whether other more primitive and universal factors may explain differential historical patterns in the emergence of cooperative behavior and differences in current levels of trust. In particular I examine the historical relationship between environmental risk - captured by variability in climatic conditions - and the evolution of cooperation and trust.

I propose a simple explanation of the emergence of trust based on the need of subsistence farmers to cope with weather fluctuations which, in the context of a pre-industrial rural economy, represented one of the main sources of risk. In the absence of well-functioning credit and insurance markets, farmers had to rely on a variety of strategies to shield consumption from weather-related shocks. While some of these strategies could be efficiently implemented by a single household, others involved some degree of interaction with members of the broader community. On the one hand, collective action among members of the local community was needed for large-scale investments such as the construction of collective storage and irrigation facilities. On the other hand, insurance capacity against climate-related risk could be improved by expanding economic relations to individuals living in neighboring areas, who were likely to be affected by weather fluctuations in less correlated ways. For example, cases of inter-community exchange, and geographically diversified mutual insurance arrangements are well-documented in the historical, anthropological and economic literature (Kirkby, 1974; Dean et al., 1985; Halstead and O'Shea, 1989; Platteau, 2000). However, the creation and maintenance of socio-economic connections over larger areas would have entailed higher costs since incentive and information problems would be more severe among geographically distant individuals. The degree of intra- and inter-community cooperation would depend on: a) the relative magnitude of the weather-related risk (measured by the variability of weather over time at a given location); b) the potential insurance benefit from risk-pooling (measured by the variability of weather fluctuations across neighboring locations). To the extent to which experiences of cooperation favored the emergence of a culture of trust that continues to persist today, one would expect differences in historical

[1] This argument was put forth long ago by Kenneth Arrow (1972) who argued that "virtually every commercial transaction has within itself an element of trust, certainly any transaction conducted over a period of time. It can be plausibly argued that much of the economic backwardness in the world can be explained by the lack of mutual confidence." Other influential contributions on the role of social capital and social trust are Coleman (1988), Putnam et al. (1993) and Fukuyama (1996). Social capital and trust have been associated with well-functioning institutions (Knack, 2002), economic growth (Helliwell and Putnam, 1995; Knack and Keefer, 1997; Zak and Knack, 2001), low corruption and crime (Uslaner, 2002; Buonanno et al., 2009), financial development (Guiso et al., 2004a) and trade (Guiso et al., 2004b).

climate variability to explain in part differences in current levels of trust.

I test this prediction in the context of Europe, combining high-resolution climate data for the period 1500-2000 with contemporary survey data on self-reported level of trust available from the European Social Survey for a sample of 251 regions in 24 countries. I first investigate the relationship between current trust and variability using climate data for the last century, because the finer resolution of this data allow the study of both the temporal and spatial dimensions of variability. The analysis confirms that regions with greater inter-annual fluctuations in temperature and precipitation have higher levels of interpersonal trust. This result is primarily driven by weather variability in the growing-season months, consistent with the effect of climatic risk operating primarily through agriculture. Furthermore, for a given level of temporal variability, regions with a higher degree of within-region spatial correlation in precipitation fluctuations display lower trust, a result consistent with an explanation involving insurance through geographic differentiation. These findings are robust to the inclusion of a variety of geographic controls and of country-fixed effects which capture the political and historical background common to regions of the same country.

I then replicate the analysis using climate data for the period 1500-1750. The relationship between historical climatic variability and trust is positive and significant, even after controlling for climate variability between 1900-2000, which does not appear to have an independent effect on trust. These findings support an explanation based on the historical formation and long-term persistence of trust attitudes over possible alternative arguments stressing the effect of contemporary climate variability on trust.

To further test the long-term effect of climatic risk on the emergence of cultural norms, I also look at the relationship between climate variability and the role of the family. Previous research has documented 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 (Banfield, 1958; Ermisch and Gambetta, 2008; Alesina and Giuliano, 2009). According to the argument sketched above, 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 trust outside and within the family are substitutes, then higher climate variability should be associated with weaker family ties. I test this hypothesis using individual data on the importance of the family available from the European Value Survey. The results are the mirror image of those found for trust: a) weaker family ties in regions with more temporal variability in precipitation and temperature (particularly in the growing season), b) weaker family ties in regions in which precipitation fluctuations are less spatially correlated, and c) a negative relationship between historical climate variability and the strength of family ties even after controlling for contemporary variability.

After establishing the relationship between hisorical climate variability and social trust, I explore the robustness of this result by controlling for regional measures of early political and econonomic development such as urbanization, political institutions and literacy. My results confirm the importance of early political institutions and literacy for the emergence of social trust as previously documented by Tabellini (2005). At the same time I find that historical climate variability continues to have a positive and sizeable effect on current trust. One interpretation of this result is that the demand for insurance against climatic risk may have also fostered the emergence of trust by favoring the adoption of informal collective arrangements whose long-lasting effect on trust is not captured by historical differences in formal political institutions.

The results of this research complement the literature on the long-term persistence of cultural norms (Bisin and Verdier, 2001; Guiso et al., 2007; Tabellini, 2008) by documenting that historical patterns of cooperation in response to risk continue to influence how individuals relate to each other today, both within and outside the family. The evidence presented here also dovetails nicely with the few existing studies on the historical determinants of differences in social capital and trust (Tabellini, 2005; Guiso et al., 2008; Nunn and Wantchekon, 2009), and with previous research on the relationship between trust and the importance of the family (Banfield, 1958; Ermisch and Gambetta, 2008; Alesina and Giuliano, 2009).

My findings can also be interpreted in the context of the debate on the effects of geography on economic development. Previous research has documented that the environment can influence economic performance directly, through its effect on health and agricultural productivity (Landes, 1998; Sachs and Malaney, 2002), and indirectly, by setting the conditions in which sociopolitical institutions have formed (Sokoloff and Engerman, 2000; Acemoglu et al., 2001; Easterly and Levine, 2003) or by defining environmental constraints to population growth (Galor and Weil, 2000).[2] The evidence presented here suggests that geography may also have influenced the emergence of particular cultural traits which, in turn, continue to have an effect on economic outcomes.

The rest of the paper is organized as follows. Section 2 discusses evidence on the relationship between climatic risk and cooperation, describes the conceptual framework and illustrates its predictions. Section 3 describes the data. Section 4 illustrates the empirical strategy and presents the results obtained using both contemporary and historical climate data. Finally, section 5 summarizes the key findings and concludes.

II. Background and conceptual framework

I. On climate, risk and cooperation

An extensive literature has investigated the impact of climate on various aspects of human activity including agricultural productivity (Adams et al., 1990; Mendelsohn et al., 1994; Schlenker et al., 2005), health (Curriero et al., 2002; Deschenes and Moretti, 2007; Gallup and Sachs, 2001) and conflict (Miguel et al., 2004).[3] Most contributions have looked at the effect of mean climatic conditions, seasonality, or extreme events. However, other dimensions of climate are also relevant. In particular, year-to-year variability in climatic conditions has traditionally represented an important source of

[2] Other examples of how biogeographical factors can have long-lasting effects on different aspects of human development are discussed in Diamond (1997); Michalopoulos (2008); Nunn et al. (2009); Ashraf et al. (2009)

[3] For a comprehensive survey of the literature on the effect of climate on human activity see the Intergovernmental Panel on Climate Change 4th Assessment Report (IPCC 2007)

risk for agriculture and other natural resource-dependent activities.[4] Even today, interannual fluctuations in precipitation and temperature account for a large fraction of the year-to-year variations in crop yields (Lobell and Field, 2007) and crop failure rates (Mendelsohn, 2007); this despite the widespread availability of irrigation, chemical fertilizers, and new crop varieties which reduce yield sensitivity to weather conditions. Rural populations were even more vulnerable to erratic weather in past centuries when the availability of these instruments was limited, and there was a greater dependence on natural resources for survival (Solomou and Wu, 1999; Le Roy Ladurie, 2004; Brunt, 2004).

In the absence of well-functioning credit and insurance markets, subsistence farmers in pre-industrial societies adopted a variety of strategies to cope with climate-related risk, as documented by historical evidence and corroborated by findings from today's developing countries.[5] Some of these strategies could be efficiently implemented at the household level. For example, farmers could have mitigated the economic impact of climate fluctuations by extending the set of livelihood activities to include foraging and fishing (Kates et al., 1985), by diversifying crops (Halstead and O'Shea, 1989), by selecting crops varieties that were less sensitive to weather realizations (Morduch, 1995), or by scattering their plots over larger and varied areas in order to reduce the risk of crop failure due to highly localized weather events (McCloskey, 1976).

Another range of risk-coping strategies involved interaction and collective action with members of the broader rural community. Farmers could self-insure against adverse climatic events by storing grains or other assets in good years for bad years. Although storage could be carried out by single households in isolation, since storage technologies are characterized by significant economies of scale, collective action among members of the local community to build communal storage facilities entailed large efficiency gains and was often practiced.(Stead, 2004) An example of the role of collective storage facilities in coping with weather and price volatility is analyzed by Berg (2007) in his recent work on the grain banks *(magasins)* in 18th and 19th century Swedish parishes. Intra-community collective action was crucial for the realization of other large-scale investments aimed at reducing vulnerability to weather shocks. For example, village-level irrigation and water management systems (e.g. wells, tanks, dikes) could increase the stability of the farming system in the face of erratic rainfall, particularly in drought-prone zones. Examples of farmer-managed irrigation systems are discussed by Bardhan (2000) and Meinzen-Dick et al. (2002) for contemporary India, and by Lam (1998) and Ostrom (2000) for Nepal. Finally, in his work on adaptation to environmental risks in Vietnam, Adger (2000) emphasizes the importance of collective action for the management

[4] Variability is the product of both low and high-frequency climatic processes. While low-frequency processes have long cycles (longer than a human generation) and are responsible for major phenomena such as fluctuations in groundwater levels, erosion, etc., high frequency processes exhibit shorter cycles and are responsible for seasonal and year-to-year fluctuations. While low-frequency variability is usually not apparent to humans, high-frequency and particularly year-to-year variability represents a major determinant of fluctuations in natural resource productivity and an important source of risk for economic activity.

[5] The issue of adaptation to climate variability has attracted the interest of different disciplines, particularly in the context of the effect of anthropogenic climate change on socio-economic development. Many definitions of adaptation and different categorization of adaptive strategies have been proposed in the literature (see among others Smithers and Smit (1997)). Rennie and Singh (1996) for example, define adaptive strategies as "those ways in which local individuals, households and communities change their mix of productive activities, and modified their community rules and institutions in response to vulnerabilities, in order to meet their livelihood needs".

of local-level coastal defense against hazards associated with flooding and typhoons.

Other risk-coping strategies were based on the possibility of pooling risk with other individuals, through exchange or mutual insurance relations. A rich literature in economics, anthropology and history has documented the importance of risk-sharing mechanisms to cope with idiosyncratic agricultural risks (see among others Townsend, 1994).[6] Research on the use of these mechanism to buffer covariant (weather-related) risk is more sparse (Scott, 1976; Kimball, 1988; Platteau, 1991). Family- and kin-related connections are generally particularly effective in providing partial insurance against idiosyncratic shocks due to the lower cost of enforcing promises and monitoring deviance among family members. However, these networks are generally too small and spatially concentrated to provide insurance against weather-related risks. Insurance capacity against weather shocks can be improved by expanding the radius of socio-economic relations to individuals living in distinct locations who are likely to be affected by shocks in less correlated ways. However, the creation and maintenance of geographically dispersed socio-economic connections would have entailed higher communication and monitoring costs. Platteau (1991) describes this "insurance dilemma" in the following terms: "the larger and geographically less concentrated the social group concerned in the insurance scheme, the lower the covariance of their income and contingencies is likely to be, but the more serious the moral hazard problem".

Examples of spatially diversified risk-pooling arrangements and of their usefulness in mitigating the effects of covariant shocks have been discussed by scholars from various disciplines working on very different geographical and historical contexts. Some of these arrangements involved exchange and trade relations. For example, in their study on the behavioral and cultural responses to environmental variability of the Anasazi civilization in the American Southwest, Dean et al. (1985) emphasize the importance of trade alliances among communities located in environmentally heterogeneous zones to cope with the frequent local subsistence shocks. Similarly, King (1976) emphasizes the importance of the elaborate inter-village exchange system used by the native population of the Chumash in coping with the considerable temporal and spatial variability of the Southern Californian environment. Other accounts refer to informal mutual assistance arrangements. In his study of the Kwakiutl native population of the Northwestern coast of America, Piddocke (1965) analyzes the *pot-latch*, a system based on delayed gift exchange among different groups (*numaym*) and used to "counter the effect of varying resources productivity by promoting exchanges of food from groups enjoying a temporary surplus to groups suffering a temporary deficit". Another example is the *hxaro* system used by the Kung San hunter-gatherers in contemporary Botswana and described by Cashdan (1985) as a system of mutual reciprocity based on delayed gift exchange connecting members of different bands living in distinct locations over distances of up to 400 km. Analogous evidence is available for subsistence farmers in contemporary developing countries. In his investigation on the Ivory Coast, Grimard (1997) finds evidence of partial insurance against locally covariant risk taking place within spatially differentiated networks formed around ethnic bonds. Similarly, in his study

[6] Solidarity mechanisms are generally organized around delayed reciprocity contingent upon need and affordability, with contingent transfers taking the form of gifts, food, labor assistance, or loans. For a comprehensive discussion of the role and functioning of solidarity networks in pre-industrial societies see Fafchamps (1992).

on the effect of risk and social connections on livestock asset dynamic in northern Ethiopia, Mogues (2006) finds that being part of a geographically dispersed network reduces the degree to which an household's livestock wealth is eroded following an adverse climatic shocks. Finally, in the context of pre-industrial Europe, Richardson (2005) emphasizes the role of rural fraternities as risk pooling institutions and their importance in coping with both weather- and non-weather related agricultural risk in medieval England. Similar evidence is available from Baker (1999) who investigates the role of regional voluntary associations as collective means used by XVIII century french peasants to defend themselves against climatic shocks.

These examples illustrate the extent to which the ability of a society to adapt to climate variability depends on the capacity of its members to act collectively. Furthermore, the above discussion suggests the importance of both the temporal and spatial dimension of climate variability for the emergence of intra- and inter-community cooperation. On the one hand, cooperation would be more valuable in areas characterized by more erratic weather (higher *temporal* variability), since exposure to greater climatic risk would result in greater demand for insurance and would increase the incentive to forge social connections within both the local and neighboring communities. On the other hand, cooperation would be more beneficial in areas in which weather fluctuations are more unsynchronized across neighbors (higher *spatial* variability) since this would increase the potential insurance benefit from pooling risk with neighbors.[7]

II. Emergence and persistence of trust

Previous research in evolutionary anthropology on social learning (Boyd and Richerson, 1985, 1995) provides a good theoretical framework to study the emergence of mutual trust. In this literature, cultural norms are modeled as behavioral heuristics that simplify decision-making. In a context in which acquiring and processing information necessary to behaving optimally is costly, using general "rules-of-thumb" about the right thing to do can be optimal. Since different behavioral norms are available *a priori*, which norms are adopted is determined through an evolutionary process based on which ones yield the highest payoff in terms of survival probabilities. This, in turn depends on the external constraints faced by each society. Over time, through a process of social learning, rules-of-thumb that favor adaptability to the external environment will become more prevalent in the population. For example, in situations in which large-scale cooperation increase fitness, norms that facilitate fruitful interaction (such as norms of mutual trust) will be particularly valuable and will

[7] An illuminating discussion of this aspect is offered by Dean et al. (1985) who argument that "spatial variability in climate facilitates or inhibits certain responses to local subsistence stresses. During periods of high spatial variability, interaction and exchange with other populations are viable means of offsetting local production inadequacies because different groups are likely to be experiencing different degrees and kinds of subsistence stress. Conversely, when similar conditions prevail across the region, all areas are affected uniformly, and interaction and exchange become far less useful ways of alleviating local population-resource imbalances."

become prevalent.[8]

Based on this conceptual framework, the hypothesis advanced in this paper is that norms of trust developed because they facilitated collective action and risk-sharing among subsistence farmers exposed to weather-related risk in pre-industrial times. In particular, a culture of greater trust should have emerged in areas characterized by more variable and spatially heterogeneous weather patterns, in which extra-familial cooperation would have been particularly beneficial to coping with risk. This paper investigates the empirical validity of this argument by testing whether higher trust is observed today in regions historically characterized by: *i*) higher inter annual weather variability, and *ii*) lower spatial correlation in weather fluctuations.

These predictions are based on the assumption that differences in trust have persisted over time, even after weather patterns became less important for economic activity. Growing evidence suggest that in fact trust attitudes, like other cultural traits, can persist for surprisingly long periods of time. At the national and sub-national levels, for example, trust scores are remarkably stable over several decades (Bjørnskov, 2007). 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 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 (Uslaner, 2002; Guiso et al., 2006; Algan and Cahuc, 2007).

Additional insights into the persistence of cultural norms are offered by recent empirical contributions on the historical determinants of trust. In a recent study on the effect of culture on economic development across European regions Tabellini (2005) finds that early political institutions have a significant impact on current trust attitudes: regions that centuries ago had more checks and balances on the executive are characterized by higher levels of trust. Guiso et al. (2008) trace current differences in social capital between the North and South of Italy to the culture of independence fostered by the experience of the free city-states in the Middle Ages, and conclude that "at least 50% of the North-South gap in social capital is due to the lack of a free city state experience in the South"[9]. Finally, Nunn and Wantchekon (2009) investigate the impact of the transatlantic slave trade on mistrust in contemporary Africa, finding robust evidence that "individuals whose ancestors were heavily raided during the slave trade today exhibit less trust in neighbors, relatives, and their local government".

Another stream of literature relevant to this research concerns the relationship between social trust and family values. The trust literature typically distinguishes between "generalized" trust and "particularized" trust. Particularized 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

[8] In the context of a large cross-cultural study, Henrich et al. (2001) conducted ultimatum, public good, and dictator game experiments with subjects from fifteen small-scale societies exhibiting a wide variety of economic and cultural conditions. They find that, in societies where payoff from extra-familial cooperation in economic activity is higher, subjects display significantly higher levels of cooperation in the experimental games. The authors argue that one interpretation of this result is that subjects' behavior in the experiments reflect different norms of conduct with regard to sharing and cooperation, which, in turn, are shaped by the structures of social interaction and modes of livelihood of the community daily life.

[9] This findings support the conjecture originally formulated by Putnam et al. (1993)

by) people outside of it. Generalized trust applies instead to everyone, including agents for whom the agent has no direct information[10]. Empirical evidence suggest that these two objects are negatively correlated. Using survey data from multiple sources Alesina and Giuliano (2009) find that individuals with strong family ties display lower levels of generalized trust, civic engagement and political participation. According to their argument, "the more people rely on the family as a provider of services, insurance, transfer of resources, the lower is civic engagement and political participation. The more the family is all that matters for an individual the less she will care about the rest of society" (p.3). Similar results are found by Ermisch and Gambetta (2008) who combine experimental and survey data drawn from Great Britain. At the heart of their analysis lies the concept of "outward exposure" and the idea that trust attitudes are affected by "any factor which either constrains people within the family circle or that gives them an opportunity and a motive to interact with others, whether neighbors or strangers". If, as these findings suggest, trust and family values operate as cultural substitutes, then climate variability - by increasing the payoff to extra-familial cooperation and decreasing the dependency on the family for insurance purposes - would have favored the development of norms consistent with higher trust and weaker family values. As a way of further testing my theoretical argument in what follows I also explore the empirical relationship between climate variability and family ties.

III. Data and variable description

To test the main predictions of my theoretical argument, I look at differences across and within European countries.[11] I employ several types of data in different parts of the empirical analysis: survey data on social trust and strength of family ties; contemporary and historical climatic data on precipitation and temperature; data on a variety of regional geographical controls; historical data on political institutions, education and urbanization. In what follows I first describe the data sources and then discuss how the variables used in the empirical analysis are constructed.

i. Data

i.1. Social Trust

Measuring interpersonal trust is a problematic task. Several variables have been proposed in the literature as proxies for social trust. Some have used aggregate indicators such as the number of

[10] This distinction reflects the distinction between "generalized" and "limited" morality stressed by (Platteau, 2000)

[11] There are a number of reasons why Europe can be considered a good context to test the validity of my hypothesis. First, up until the onset of the industrial revolution, the vast majority of the European continent was rural, most of the population depended predominantly on agriculture for subsistence, and the economy was characterized by relatively low spatial mobility and considerable intergenerational persistence in occupation.Le Roy Ladurie (2004) Second, an advantage of working with European data, particularly at the sub-national level, is given by the relatively small size of European regions. Since the proposed relationship between climatic volatility and emergence of trust operates at a relatively local scale, the availability of trust data for fairly small administrative divisions is particularly valuable.
My theoretical argument is based on the hypothesis that cultural norms developed at a given location are passed on to subsequent generations, which, to a large extent, continue to live in the same area. To this regard Europe represents an appropriate context because - despite significant cross- and within-country migration - it has not experienced the massive migration movements that took place for example in North and South America over the last five centuries, and, in general, a substantial portion of individuals living in a given region had ancestors that lived in the same region. Last but not least, Europe is also the continent for which better historical climate data are readily available.

civic and non-profit organizations/associations, turnout in elections or referenda, and blood and organ donations(Guiso et al., 2004a, 2008; Buonanno et al., 2009; Putnam et al., 1993). Most contributions, however, employ measures of self-reported trust based on individual responses to survey questions (Alesina and La Ferrara, 2002; Tabellini, 2005). I follow the latter approach, using data on self-reported trust in others from the three rounds of the European Social Survey (ESS), a biennial cross-sectional survey designed to monitor attitudes and behaviors across (mostly) European countries[12], similar in many aspects to the American General Social Survey (GSS). The three rounds of the survey were conducted in 2002-03, 2004-05, and 2006-07. Overall, the ESS data cover 31 countries: the large majority of the European Union members plus Iceland, Israel, Russia, Switzerland, and Turkey. Most countries were surveyed in all three ESS rounds, some, instead, only in one or two of the rounds.

In addition to providing information on the respondent's country, the ESS surveys report the region in which the interviewee resides. This feature makes it possible to study differences in trust attitudes at the sub-national level, an approach that is consistent with my theoretical argument which links the evolution of trust to social responses to climate variability on a local scale. The ESS regions are generally defined in accordance with the administrative divisions used in each country. These, in turn, often coincide with one of the three levels of the European NUTS classification[13]. The number and size of the ESS regions vary considerably from country to country. For example, France is divided into nine large regions roughly corresponding to NUTS level 1, Italy into 20 regions corresponding to NUTS level 2, and Bulgaria into 28 regions corresponding to NUTS level 3.

Seven of the thirty-one original ESS countries were excluded from the analysis because they lie partially or totally outside the area covered by the climate data used. Overall my sample includes 251 regions in 24 countries, comprising approximately 107,000 individuals[14]. On average, 427 individuals were interviewed in each region, the median number of respondents being about 306. Table 1 reports the number of respondents in each round for the countries in the sample.

The ESS questionnaire includes a version of the standard trust question used in most surveys, commonly known as Rosenberg's question. The exact wording of the question is as follows: "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people? Please tell me on a score of 0 to 10, where 0 means you can't be too careful and

[12] The core module of the ESS questionnaire questions aimed to monitor change and continuity in a wide range of social variables, including media use, social and public trust, political interest and participation; socio-political orientations, governance and efficacy; moral, political and social values; social exclusion, national, ethnic and religious allegiances; well-being, health and security; demographics and socio-economics. The ESS data have been extensively used in previous studies on culture and social capital, by Luttmer and Singhal (2008); Alesina and Giuliano (2009); Butler et al. (2009) among others.

[13] The Nomenclature of Territorial Units for Statistics (NUTS) is a three-level hierarchical classification established by EUROSTAT in order to provide a single uniform breakdown of territorial units for the production of regional statistics for the European Union. Depending on their size countries can have only one or two levels of divisions. In the case of Luxembourg, for example, each of the three NUTS level corresponds to the entire country.

[14] The decision of pooling together responses from the three rounds of the ESS is aimed at maximizing the number of available observations, and is justified by the great stability of both national and regional trust scores over the relative short length of time between different rounds (2 years).

10 means that most people can be trusted"[15]. Doubts have been raised about the ability of this kind of question to capture individual trust attitudes. 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. However, the impersonal framing of the question ("people") may be valuable in encouraging respondents to think about the general context in which they live rather than specific groups such as friends or relatives. Trust surveys do not display the large and random fluctuations in responses that one would expect of question of dubious reliability and meaning. On the contrary, average trust scores - both at the national and sub-national level - show a surprising deal of stability over time Uslaner (2002); Delhey and Newton (2005). Another element of reassurance is given by the fact that survey-based measures tend to be correlated with behavioral indicators of trust. For example, Knack (2000) reports the results of an experiment in which a certain number of wallets containing $50 worth of cash and the addresses and phone numbers of their putative owners were "accidentally" dropped in each of 20 cities in 14 different western European countries and 12 U.S. cities. He finds that the number of wallets returned with their contents intact - both at the national and regional level - is highly correlated with the average score in the standard trust question from the World Value Survey. Similarly, at the individual level, responses to survey-based trust questions have been shown to be good predictors of actual behavior in trust experiment (Glaeser et al., 2000; Fehr et al., 2003; Sapienza et al., 2007).[16]

1.2. Family Ties

Measuring cultural differences on the relative importance of the family and the strength of family ties is often problematic, especially since many surveys do not include questions designed to capture these aspects. This is the unfortunately the case for the European Social Survey data used to derive my trust measure. Some relevant questions are however available from another similar survey, the European Value Study (EVS). In particular, I use data from three waves of the EVS carried out respectively in the years 1989-1993, 1994-1999, and 1999-2004. Overall, the three waves of the EVS cover 39 European countries. However, for consistency with the analysis of the trust data, and due to limitations in the climate data, I restrict my attention to the same 24 countries for which data on both trust and climate are available. As with the ESS, the EVS data generally include information on the respondent's region of residence, allowing for the study of differences at the sub-national level. Overall the EVS sample for the 24 countries of interest includes almost 82,000 individuals.

[15] Unlike other similar surveys (like the World Value Survey) the ESS trust question does not offer a 0-1 choice, but rather allows respondents to choose a value on a 1-10 scale, thus allowing for a more precise assessment of the the intensity of trust.

[16] These contributions, however, have provided contrasting evidence with regard to whether responses to the trust question reflect an individual's own trustworthiness rather than his tendency to trust others. In an attempt to reconcile these apparently contrasting results, Sapienza et al. (2007) argue that the different findings might be due to differences in the composition and homogeneity of the two populations showing that an individual's trust attitude is heavily influenced by his own trustworthiness in the context of a homogeneous population (such as the Harvard undergraduates participating in Glaeser's experiment), but not in a more heterogeneous population, (such as the cross-section of the German population in Fehr's sample). Since the ESS surveys a random sample of the adult population of each country, the sample is extremely heterogeneous with respect to different individual characteristics. In light of the debate discussed above, it seems plausible that responses to the ESS trust question reflect respondents' trust attitude towards others rather than their own trustworthiness.

For some countries in certain years, however, no information on the respondent's region is available (see 2). Excluding these observations, the usable sample includes over 69,000 individuals in over 220 regions. [17]

Following Alesina and Giuliano (2007; 2009), I employ three of the EVS questions covering different aspects of the centrality of family relationships in a person's life, as well as individual beliefs about the role and obligations of parents and children. The first question (labeled as *Family important*) asks the respondent how important is family in his/her life, the possible answers ranging from "not very important" (score of 1), to very important (4). The second question (*Respect parents*) assesses the respondent's opinion on whether "children have to respect and love parents only when these have earned it by their behavior and attitudes" (1), or whether they always have this duty, regardless of parents' qualities and faults (2). Finally, the third question (*Parents responsibilities*) aims at evaluating respondents' view about parents' responsibilities to their children, particularly on whether "parents have a life of their own and should not be asked to sacrifice their own well being for the sake of their children" (1), or whether "it's parents' duty to do their best for their children even at the expense of their own well-being" (2).

I.3. Climate

With regard to climatic variables, I restrict my attention to temperature and precipitation. These two variables have a considerable impact on agriculture and other natural resource-dependent activities, are highly correlated with other important factors such as relative humidity, cloud cover, and solar radiation. I employ two kinds of climatic data covering different time periods. In the first part of my analysis I use gridded data derived from actual weather station records covering the period 1900-2000. These are high-quality data, both in terms of temporal frequency and spatial resolution, but since they only cover the last century they can only be used as a proxy for historical climate. I then extend the analysis to look directly at historical climate variability using reconstructed paleoclimatic data for the period 1500-1900. The obvious benefit of these data is that they cover a much longer period, however, their temporal and spatial resolution is much more coarse. On the one hand, the high resolution of the 20th century data allows us to analyze both temporal and spatial dimensions of climate variability. On the other, the use of the historical data in combination with the 20th century data further allows us to confirm that historical variability, rather than current variability, is correlated with trust.

1900-2000 Climate data for the last century come from the TS 1.2 data set constructed by the Climatic Research Unit (CRU) of the University of East Anglia (Mitchell and Jones, 2005). The CRU TS 1.2 data are in grid format and cover most of the European surface at a 10-minute spatial resolution Mitchell and Jones (2005). The grid includes 258 columns and 228 rows. Only data for land grid cells (overall 31,143) are available. For each cell the data set provides monthly observations

[17] The difference between the number of regions in the ESS sample (251) and the number of regions in the EVS sample is due to the fact that, in some cases, especially for the early waves, the EVS regions coincide with larger administrative divisions than those used for the ESS.

on air temperature and precipitation for the period 1901-2000 (1200 data points per cell). The data are constructed from actual climatic records collected at a number of weather stations throughout Europe, and generalized at the grid cell level using a particular interpolation technique [18]. The cells in the CRU grid have width of 10 minutes, approximately 10 miles. Each region in my sample comprises a number of grid cells, which varies considerably depending on the region's size. To give a sense of the size of the cells, Figure a1 shows the example of Sicily, a mid-size region in southern Italy, the surface of which is divided into 85 cells.

1500-1900 Climatic data for past centuries are available from paleoclimatic studies. These kind of data are not based on actual weather station records, but are rather derived, through a sophisticated process of "reconstruction", from a multiplicity of indirect proxies such as tree rings, ice cores, corals, ocean and lake sediments, and documental evidence [19]. One of the most recent and advanced reconstructions of European climate over the last 500 years is the European Seasonal Temperature and Precipitation Reconstruction (ESTPR henceforth), a product of the work of a group of paleoclimatologists at the University of Berne, Switzerland (Luterbacher et al., 2004; Pauling et al., 2006) [20].

The ESTPR data are in grid format and cover roughly the same area as the CRU data described above, although at a much lower spatial resolution. The cells in the ESTPR grid have width of 0.5º, approximately 35 miles. Using the example of Sicily, Figure 2 provides a visual sense of the difference in cell size between the CRU and the ESTPR. Overall, the ESTPR grid for the precipitation data includes 72 rows and 132 columns for a total of 5117 land cells. The temperature data set covers a slightly smaller area including 70 rows and 130 columns, for a total of 4961 land cells. For each cell the data include seasonal observations for the period 1500-2000 (2000 data points per cell)[21]. Measurement error is likely to be more severe in the case of the ESTPR data than for the CRU data for two orders of reasons: 1) climatic records are derived not from observed data but from proxy variables through an indirect process of reconstruction; 2) they are interpolated over larger areas. Despite these limitations, these data, which have not been previously used by social scientists, are among the best data available on European climate for past centuries.

I.4. Regional environmental controls

Other bio-geographic conditions may have influenced the evolution of cooperation and the emergence of trust over the course of history. At the same time, some of these factors may be correlated with climate variability. To test whether climate variability has an independent effect on trust and is not

[18] Further information on the characteristics of the CRU data sets is available at http://www.cru.uea.ac.uk/~timm/grid/CRU_TS_1_2.html. For a detailed description of the primary data sources and of the methods employed in the construction of the TS 1.2 data set see www.tyndall.ac.uk/publications/working_papers/wp55.pdf.

[19] For more info...

[20] Extensive information on these data, as well as on other climate reconstructions data sets, is available on the website of the National Oceanic and Atmospheric Administration's National Climatic Data Center at http://www.ncdc.noaa.gov/paleo/recons.html.

[21] While the data for the period 1500-1900 are reconstructed, those for the years 1900-2000 are derived from the CRU data set described above.

merely proxying for other geographical characteristics, in addition to the region's area, I control for a range of variables that the literature has traditionally identified as important determinants of socio-economic development.

Average climatic conditions are likely to have had considerable impact on livelihood strategies and patterns of cooperative behavior. To account for the effect of average climate in estimating my regressions I control for the average level of temperature and precipitation at the regional level. These measures are constructed from the same data described above (CRU data for the period 1900-2000, and ESTPR data for the period 1500-2000), taking the average over the entire period of interest.

Both average land quality in a region and differences in land quality within a region can have important implications for productivity, mobility, and exchange at the local level.[22] To account for this aspect, measures of both average land quality and variability in land quality at the regional level are included in all the regressions. High-resolution data on soil suitability are available from the Food and Agriculture Organization Global Agro-Ecological Zones project (FAO-GAEZ).[23,24] The FAO-GAEZ data are constructed to measure soil suitability for rain-fed crops assuming the absence of irrigation. This feature make these sort of data particularly suited for the historical analysis of pre-industrial societies. The FAO-GAEZ database include a variety of measures of soil suitability. Since I separately control for mean climatic conditions in the regressions, I employ a measure that captures all those soil characteristics that affect land suitability for rain-fed crops, abstracting from average local climate.[25] The data are in grid format, have very high resolution (1'), and assign to each grid cell a score from 0 (totally unsuitable), to 7 (very suitable). As regional measures of average land quality and variability in land quality I use the mean and the standard deviation of the suitability index over all cells in a region.

Terrain ruggedness can have both direct and indirect effects on patterns of human interaction and on economic outcomes (Nunn et al., 2009). To some extent, ruggedness and elevation can also be expected to be correlated with climate variability, especially with regard to its spatial dimension. The presence of a mountain can cause very different microecosystems to manifest over relatively small distances; as a consequence, climatic realization on the one side of the mountain can be very different from those of the other side. To control for the relationship between climate variability and topography, I include a regional measure of terrain ruggedness in my regressions constructed from the Global Land One-km Base Elevation Project (GLOBE), a global gridded digital elevation data set

[22] In his recent study on the environmental origins of ethnolinguistic diversity, Michalopoulos (2008) argues that, by favoring the accumulation of region-specific human capital, differences in land endowments limited population mobility and lead to the formation of localized ethnolinguistic groups.

[23] More information on the FAO-GAEZ project can be found at http://www.fao.org/ag/agl/agll/gaez/index.htm

[24] Data from FAO-GAEZ were used by Michalopoulos (2008), and by Nunn and Qian (2008) who investigate the effect of the introduction of potato on modern European economic and demographic growth.

[25] The FAO-GAEZ measure of combined soil constraints considers the following factors: slope constraints, terrain fertility constraints, drainage constraints, texture constraints, and chemical constraints. A more detail and comprehensive description of the criteria is available at: http://www.fao.org/ag/agl/agll/gaez/index.htm

covering the Earth's surface at a 10-minute spatial resolution (approximately 1km).[26,27]

Access to waterways may potentially be correlated with both climate variability and the historical emergence of interpersonal trust. On the one hand, in coastal areas, climate fluctuations can be less extreme than in interior areas, due to the mitigating influence of the sea. On the other hand, one could expect individuals living in regions with no access to the sea to have been historically less exposed to other populations, and as a consequence, to be less inclined to relate to, interact with, and trust strangers. A similar argument can be made for access to rivers which have historically represented important ways of communication particularly in areas with limited access to the sea. To control for proximity to the sea in my cross-regional regressions I include two variables: a dummy for the region being landlocked, and the distance of the region's centroid from the coast line. To account for access to rivers I control for the number of large rivers - longer than 200 km - passing through each region. Data on the geographic distribution of major European rivers are available from the Water Information System for Europe (WISE) project of the European Environment Agency.[28]

Finally, in all regression I control for the latitude of the region's centroid, which, to some extent, should capture differences in geographic conditions other than those discussed above.

I.5. HISTORICAL BACKGROUND

Historical data on political and economic development at the sub-national level are not available for all regions in my original sample. However, reliable measures are available from Tabellini (2005) for a sample of 69 regions in eight western European countries including Belgium, France, Italy, Netherlands, Portugal, Spain, Germany, and the United Kingdom. Tabellini's data include historical regional measures of political institutions, urbanization and educational attainment.[29] With regard to early political institutions the data include a measure of constraints on the executive between 1600 and 1850. This variable, analogous to the one included in the POLITY IV dataset (Eckstein and Gurr, 1975), is designed to capture "institutionalized constraints on the decision making powers of chief executives". According to this criterion, a region had better political institutions if the executive branch was accountable to assemblies of elected representatives, and if the power of the executive was constrained by the existence of checks and balances and by the rule of law. The measure of constraints on the executive was coded for different 40-year windows around the years 1600, 1700, 1750, 1800, and 1850, and takes values from 1 (unconstrained authority) to 7 (maximum accountability and constraints). With regard to education, Tabellini's data include regional measures of literacy around the year 1880, the earliest date for which systematic information on education could be found. Finally,

[26] The GLOBE data set has superseded the GTOP30 which, before the introduction of GLOBE, was considered the most accurate digital elevation data set and had been used, among others, by **?** in the above mentioned contribution.

[27] For every cell i and neighboring cell j I calculate the absolute value of the difference in elevation between i's center and j's center, and then divide it by the sea level distance between the two points to obtain the uphill slope ($h_{i,j}$). I repeat the same calculation for each of i's neighbors (at most eight), and then average these slopes to calculate cell i's mean uphill slope (h_i). Finally, to obtain the average uphill slope of the region's land area (h_r), I average h_i across all cells in region r.

[28] More information about the WISE project are available at http://water.europa.eu/

[29] A detailed description of the procedure and sources used in the construction of this variable is provided in the Appendix of Tabellini's paper (2005)

the data include a measure of urbanization around 1850, measured as the share of regional population living in cities of population 30,000 or more.

II. Variable description

II.1. Social trust

As basic measure of social trust at the regional level I use the average individual score on the trust question for all individuals interviewed in a region over the three ESS rounds (*trust*). The regional average conceals very large variation among individuals within a region and is hence likely to be an imperfect measure of regional trust attitudes. Besides measurement error, another concern is that, given the relatively small number of respondents in some of the regions, the ESS samples may not be fully representative of the regional population, and that differences in the average trust score might be due to differences in the composition of the regional sample with regard to certain individual characteristics that might be correlated with trust. To address this concern, in addition to the unconditional average, I compute a conditional regional measure of social trust that accounts for differences in some observable features of the individual respondents (*trust_cond*). Following Tabellini's approach (2005), in the comprehensive dataset of individual responses, I regress individual trust score on a vector of regional dummy variables, three ESS round dummies, and a set of individual controls including a dummy for the respondent gender, the respondent's age and age squared, marital status, and educational attainment. Education in particular, is intended to serve as proxy measures for individual income, which has been shown to be highly correlated with trust attitudes. The regional measure of conditional trust is taken to be the estimated coefficient on the regional dummy variables.[30] The conditional and unconditional regional measure of trust are very highly correlated (0.992); this suggests that regional differences in average trust score are not driven by differences in the composition of the respective samples, but are rather related to more fundamental cultural differences. In what follows I will report the results obtained using the unconditional means. The conditional trust measure is used for robustness checks. Figure 1 represents the distribution of the unconditional regional trust measure, while the map in Figure A.1 displays its geographic distribution across the regions in the sample, with darker values corresponding to higher levels of trust.[31] It is immediately apparent that there is general pattern of higher trust in the north and less in the south of Europe, and also that there are important within-differences.

II.2. Family ties

To construct a compound measure of the strength of family ties I combine the three EVS questions described above in two ways. First, in the whole data set of individual responses I extract the first principal component of the three variables and use its regional average as a summary measure of

[30] The coefficients on the individual controls in the first stage regression (Table —) are consistent with findings from previous studies (): younger, more educated and female respondents tend to reports higher level of trust in others. When regional dummies are included in the regression, almost all of them display highly significant coefficients; furthermore, the R-square rises by... compared to a rise of ... when fixed effects are included.

[31] Data are displayed in equal intervals, but the continuous measures are used in the econometric analysis.

family ties at the regional level *(family_pc)*. The principal component only captures the variation that is common to the three variables. However, these attributes may have more than one relevant dimension of variation. To address this concern, I also compute the algebraic sum of the three variables *(family_sum)*. Given the way the three variables were recoded, for both the sum and the principal component, a higher number reflects stronger family ties. Table 3 displays the correlation between the three original cultural attributes and the summary measures of culture for the whole sample of over 68,000 individuals. The correlation of three variables with each other is positive though not very high. However, all of them are highly correlated with the principal component and the sum. Also, the principal component is very highly correlated with the sum of the three variables which indicates that the principal component assigns very similar weights to the three variables. Figure 2 represents the distribution of the regional measure of family ties (principal component), and the map in Figure A.2 displays its geographic distribution across the regions in the EVS sample, with darker values corresponding to stronger family ties. As with social trust, there is a significant difference between north and south of Europe - with family ties stronger in the south (with the partial and surprising exception of Greece) and weaker in the north - as well as important within differences.

II.3. Measuring climate variability

As discussed above, both the temporal and the spatial dimension of climate variability are relevant to my theoretical argument. However, while measures of interannual climate variability can be derived from both the contemporary and historical climate data, only the higher resolution of the CRU data allows to measure spatial variability. In, fact using the ESTPR data to study the spatial variability in climate is not worthwhile since the grid-cells are much larger and hence communication across cells would have been very implausible given the transportation technology available in pre-industrial times.

Temporal variability In what follows I describe the procedure used to construct measures of interannual climate variability from the raw CRU monthly data for the period 1900-2000. Each measure of variability is computed at at the cell level first, and then aggregated at the regional level. Year-to-year climatic fluctuations coexist with both within-year fluctuations - particularly seasonal variations - and long-run trends. A good measure of interannual variability should address this and isolate interannual variation from seasonality and long-term trends. One way to control for seasonal variation is by looking at how climatic conditions in a given month vary over the years. Starting from monthly data has the added benefit of allowing us to aggregate over specific relevant periods, such as the growing season, as well as over the whole year. For each climatic variable x 1,200 observations are available for each cell (12 months $\times$ 100 years). Consider climatic variable x, cell i (part of region r), month m and year y, and define x_{imy} as the value of x in cell i in month m in year y. For each month m, I compute the standard deviation of x_{imy} over all years (denoted σ_{im}), which measures the month-specific variability of variable x in cell i.[32] To obtain a compound measure of year-to-year variability for cell i I average

[32] The use of the standard deviation (or variance) as a measure of climatic variability is common in climatology. This measure was also used by economists to measure variability in climatic conditions (see among others Paxson, 1992).

σ_{im} over the twelve months (or over other specific periods of interest). Finally, I average σ_i over all cells in region r to obtain a regional measure of variability σ_r. The regional measures of temporal variability for precipitation and temperature are labeled as *pr_var* and *tm_var* respectively. To address the concern that these measure of variability may capture long-run trends in climatic conditions in addition to interannual fluctuations, I construct complementary measures of variability following the same procedure described above but using first differences instead of the actual observations. The detrended variability measures (*pr_var_det* and *tm_var_det*) are highly correlated with the standard measures, and will be used to check the robustness of the results.

The same procedure described above is used for the ESTPR data covering the period 1500-2000. The only difference is that, in the case of the ESTPR data, seasonal and not monthly observations are available. Hence, given x_{isy}, the value of climatic variable x in cell i in season s in year y, I first compute σ_{is}, the standard deviation of x_{isy} over all years, then average it over the four seasons to obtain σ_i, and finally over all cells in region r to obtain σ_r. Following this procedure I can also construct measures of variability for the entire 500-year period, but also focus on specific sub-periods, as I will do in my empirical analysis.

Spatial variability To quantify how climate fluctuations are correlated across neighboring locations, I first need to define what I mean by neighborhood. For each cell i in the data, I identify a set J of neighbors j to cell i, composed of those cells that share with i a border or a vertex, such that each cell can have at most eight neighbors (see Figure —). The value of x_{imy} in a given year y, can be higher or lower than $\bar{x_{im}}$, the mean x for month m in cell i over the entire 100-year period. $x\_imy - x\_\bar{i}m$ represents the deviation in year y from the 100-year month m mean in cell i. For each pair i, j I compute the correlation between monthly deviations in i and j over all months and years ($\rho_{i,j}$) which measures how climate variations in cell i are correlated with variations in cell j. Finally, in order to obtain a unique measure of spatial correlation for cell i, one needs to aggregate $\rho_{i,j}$ across all neighbors j. This can be done in different ways: I can calculate the average of the mean, the median or the minimum of all ρ_i, j. Of these, the minimum best captures the local potential for insurance, since an agent willingness to cooperate depends on the benefit of cooperating with my most complementary neighbor. The mean and median may fail to fully capture this potential since the dissimilarity of my best neighbor may be diluted by other neighbors' similarity to my location. The regional measures of spatial correlation in precipitation and temperature are labeled as *pr_spcorr* and *tm_spcorr* respectively.

IV. Empirical Stategy and Results

i. Empirical strategy

To test the empirical relationship between cultural variables and climate variability I exploit differences across European regions. Using data at the sub-national level allows to control for all those country-specific factors that may potentially have an impact on citizens' trust attitudes - such as, for example, government regulation (Aghion et al., 2009) - as well as the common historical background shared by regions belonging to the same country(Tabellini, 2007). The cross-regional approach alleviates the concerns related to border and country formation inherent to cross-country analysis allowing for a more compelling test of the validity of the theory.

I first investigate the relationship between climate variability and trust using both contemporary and historical climate data. I then replicate the analysis using family ties as dependent variable. To further test the robustness of the relationship between trust and historical climate variability, I finally extend the analysis to account for differential patterns of early economic and institutional development at the regional level.

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

$$Trust_{r,c} \quad = \quad \beta x\_var_r + \gamma x\_spcorr_r + \alpha_c + \mathbf{X_r}'\delta + \varepsilon_{r,c}$$

The subscripts r and c index regions and countries respectively. The $Trust_{r,c}$ variable denotes one of my two measures of trust (unconditional and conditional), which vary across regions. $x\_var_{r,c}$ and $x\_spcorr_{r,c}$ denote respectively the degree of temporal variability and spatial correlation for climatic variable x (temperature or precipitation) in region r; the last term is only included when using contemporary climate data. α_c denotes the country fixed effects. The vector X_r' denotes a set of regional controls which can include both the geographical and historical factors discussed in the previous section.

The coefficients of interest are β, the estimated relationship between temporal variability and the regional measure of current trust, and and γ the estimated relationship between spatial correlation in climatic fluctuations and trust. In particular, the theory predicts a positive sign for β and a negative sign for γ.

An analogous equation is estimated for family ties. To allow for arbitrary patterns of correlation within countries, in all regressions robust standard errors are clustered at the country level.

II. Climate variability and social trust

II.1. Contemporary variability and social trust

I start by investigating the relationship between the level of trust in the ESS regions and climate variability measured using the climatic data for the period 1900-2000, which allow me to analyze both the temporal and spatial dimension of variability.

The underlying assumption for using contemporary data as an informative proxy for past climate is that the geographic distribution of climatic conditions in the twentieth century is similar to that in past centuries. This assumption seems reasonable in light of the fact that the spatial distribution of climatic conditions - both their average and variability - is in large part determined by differences in geographic factors which tend to remain fairly stable over long periods of time.

A partial test can be performed by looking at the relationship between climatic conditions for the periods 1900-2000 and 1500-1900. Figure A.4 provides a graphical representation of this relationship separately for average precipitation, average temperature, precipitation variability and temperature variability. The correlation between average temperature at the regional level in the last century and in the previous four is 0.999, while it is 0.987 for average precipitation; the correlation for the variability measures in different periods is lower but still large: 0.902 for precipitation, and 0.871 for temperature. These findings confirm that region characterized by more variable climate in contemporary times tended to have more volatile climate also in the past, and provide reassurance that the assumption is realistic.

Table 4 display the summary statistics for all the variables used in the trust analysis. Table 5 reports the results using the unconditional regional measure of trust, separately for precipitation and temperature. In column 1 I regress the trust variable on the annualized measure of precipitation variability. The estimated coefficient for precipitation variability is positive, and statistically significant (at the 5% level), which is consistent with climate variability positively affecting average trust score at the regional level. In column 2 I include the vector of geographic controls described above, which includes average temperature, average precipitation, terrain ruggedness, average soil quality, standard deviation in soil quality, area of the region, a dummy for the region being landlocked, the distance of the region's centroid from the coast, the number of major rivers passing through the region, and the latitude of the region's centroid. When the controls are included the point estimate of the coefficient of interest increases slightly and remains highly statistically significant (at 1% level). With regard the magnitude of the coefficient, one standard deviation increase in precipitation variability corresponds to a .17 standard deviation increase in trust. Of the other regressors, only average precipitation, latitude and number of rivers display significant coefficients, negative for the first one and positive for the other two.

The availability of monthly climatic data allow us to go a step further, and to investigate whether variability in weather conditions over different parts of the year affects trust in different ways. If patterns of mutual cooperation arose as a response to economic risk in times in which agriculture was the dominant economic activity, I would expect variability during the growing season months to have a relatively larger effect on trust than variability during other months. The term of the growing season depends on the geographic location and crops of interest. In the case of Europe, cereals like wheat, barley and rye have historically been the most important and widespread crops, representing the base of the European peasants' diet (Le Roy Ladurie, 1971), followed by sugar beet, rapeseed, sunflower seeds, and, in the South, olives and grapes. Even after the diffusion of potatoes and corn - which became widespread in Europe only from the late 18th century - cereals continued to remain preeminent.[33] In general, the growing season for these crops coincides with the spring and summer months.[34] For example, in their study on the relationship between climate and crop yield at the global level, Lobell and Field (2007)define the growing season for wheat as the months between May and October, and for barley the months between May and August. Similarly, the USDA publication "Major Crop Areas and Climatic Profiles" reports the growing season for spring and summer

[33] Even in current times, cereals continue to have a prominent role in European agriculture. According to the FAO-Agromaps statistics, over the period 1975-2000, barley rye and wheat together account for approximately —% of the European total agricultural production .

[34] This is also the case for winter grain varieties, which are usually harvested at the end of the summer.

grains for European countries to be from March-April to October-November, with the exact length depending on the specific location (longer in the South and shorter in the North). In what follows I define the growing season as the months between April and October; however, as discussed below, all the results shown are robust to alternative choices of growing season.

In column 3, I include separately variability in precipitation for growing season months (GSM henceforth) and non growing season months (NGSM). When doing so, only the coefficient on precipitation variability for the GSM is positive and highly significant, and the point estimate somewhat larger than the one found in column 2 for variability over the whole year. This result suggests that the variability in precipitation during the growing season months is accounting for most of the effect found in column 2, consistent with the effect of climatic risk operating mainly through agriculture. Since variability in the NGSM does not seem to add much to the picture, in what follows I will use variability in the GSM as the regressor of interest.

As argued in section 2, if cooperative relations are aimed at providing mutual insurance from weather related risk, I would expect the capacity to share and differentiate risk to be larger where climatic shock are less correlated across neighboring locations, since this would facilitate differentiation and increase the scope for insurance. Column 4 tests this hypothesis by including, together with precipitation variability in the GSM, a measure of spatial correlation in precipitation anomalies. The result of the regression supports an explanation involving risk sharing and mutual insurance: while the coefficient on temporal variability continues to be positive and significant, the coefficient on spatial correlation is negative and highly significant.

I find similar results when looking at temperature (columns 5-7). The relative magnitude of the coefficient on temporal variability in temperature is larger than that on precipitation: one standard deviation increase in annualized temperature variability (column 6) corresponds to a 0.27 standard deviation increase in trust. However, I do not find the same result for spatial correlation in temperature. The coefficient is negative but the standard error is very large. This difference can be attributed to the fact that the spatial correlation in temperature across neighboring locations is, on average, much larger than that for precipitation, and does not offer enough variation to identify an effect. This result is consistent with previous findings in climatology - and particularly with regard to the CRU data on Europe - according to which the pattern in temperature appears to be much more spatially homogeneous than in precipitation. Figure 3 plots the estimated residuals of trust (on the vertical axis) and variability (on the horizontal axis), estimated from a regression against the remaining regressors (regional controls and country fixed effects), respectively for precipitation and temperature.

To verify the robustness of these results I perform a series of checks. The results are presented in Table A.1. First, I re-estimate the main specification (with growing season variability and spatial correlation) using the conditional measure of trust which accounts for differences in individual characteristics of respondents in each region (column 1). The results obtained using the conditional and unconditional measure of trust are qualitatively very similar, suggesting that the relationship between variability and trust are not explained by regional differences in the composition of the respondents' sample. I then replicate the analysis using the detrended measure of variability, to make sure the results are not influenced by long-term trends in climatic conditions (column 2). Once again, the results are very similar. To make sure the results are not driven by the relationship between variability and trust in some particular countries, I re-estimate the main regression excluding Scandinavian countries, usually characterized by extremely high levels of trust (column 3), and former communist countries, which generally display low trust scores (column 4). In both cases, the results remain similar. Finally, Appendix Table A.2 display the results obtained using alternative terms of the growing season which are very similar to those obtained with the base specification.

II.2. Historical variability and social trust

Overall, the results described so far, obtained using climatic data for the twentieth century, suggest the existence of a robust correlation between patterns of temporal and spatial variability in climatic conditions and social trust at the regional level. Insofar as the cross-region distribution of climatic variability in the twentieth century is a good approximation for climatic variability in previous centuries, this evidence supports the thesis of an historical impact of environmental volatility on the emergence of norms of generalized trust. However, the same findings are also consistent with alternative explanations emphasizing the effect of *contemporary* variability on trust. To test whether differences in current levels of trust are related to historical rather than to contemporary climate variability, I replicate the analysis using reconstructed climatic data for the period 1500-2000. Due to their lower spatial resolution (0.5º), the reconstructed data are too coarse to construct an accurate measure of spatial correlation within reasonable distances. Therefore, these data are only used to analyze the relationship between temporal variability in climate and trust.

In the first column of Table 6 I regress trust on precipitation variability for the growing season over the period 1900-2000. Since for this period the ESTPR data are derived from the same CRU data used above (although interpolated over larger areas), not surprisingly the coefficient on precipitation variability is positive and statistically significant (at the 10% level). In column 2 I regress trust on precipitation variability in the growing season calculated over the period 1500-1750. The choice of this particular period is motivated by the desire to capture historical variability over a period characterized by the prevalence of agriculture and natural resource-dependent activities, prior to the onset of the industrial revolution which determined profound changes in the traditional forms of economic and social organization throughout Europe.[35] The coefficient on precipitation variability between 1500 and 1750 is also positive and significant (5% level), and larger than the coefficient on variability between 1900 and 2000. Interestingly, when both variables are included in the regression (column 3), the coefficient on historical variability continues to be positive and significant, while the coefficient on precipitation variability over the last century becomes statistically insignificant. With regard to the magnitude of the effect, a one standard deviation increase in growing season precipitation variability corresponds to an increase of 0.10 standard deviation in trust. Analogous results are found for temperature (columns 3-5): temperature variability between 1500 and 1750 tends to have a positive effect on trust even after controlling for variability between 1900 and 2000, which does not appear to have an independent effect. In the case of temperature the effect is larger: a one standard deviation

[35] Alternative choices of the reference period (e.g. 1500-1700 or 1500-1800) lead to very similar results

increase in growing season variability implies a 0.20 standard deviation increase in trust.

Taken together, these results support an explanation emphasizing the historical influence of climatic volatility on the emergence of norms of mutual trust, as opposed to alternative arguments stressing the effect of contemporary climate variability on current trust attitudes.

III. Climate variability and family ties

III.1. Contemporary variability and family ties

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

To do so I combine the climate data with survey data from the European Value Survey. Table 7 display the summary statistics for all the variables used in the family ties analysis. As before, I start by presenting the result of the analysis using climate data for the period 1900-2000. To measure the strength of family ties I use both the sum and the first principal component of the three relevant questions, as described in the data section. Table 8 present the results separately for precipitation (columns 1-6) and temperature (7-12). All regressions include both country fixed effects and regional geographical controls.

In column 1 I start by regressing the first principal component of family ties on annualized variability in precipitation between 1900-2000. The coefficient on precipitation variability is positive and statistically significant (5%). The result is consistent with that found for social trust and confirm the theoretical predictions: in regions characterized by a more variable climate people tend to attach less importance to the family. Once again, this result is primarily driven by variability in precipitation during the growing season months, while variability during the other months displays no significant effect (column 2). As for the case of trust, the spatial dimension of precipitation variability appears to have a significant effect on the strength of family ties. In this case the coefficient on spatial correlation is positive: more spatially correlated climatic shocks decrease the gain from cooperation with outsiders, and increase the importance of within-family relations. Both effects are fairly large: one standard deviation in precipitation variability in the growing season corresponds to a 0.26 decrease in the strength of family ties, while one standard deviation in spatial correlation corresponds to a 0.11 standard deviation increase in family ties. Very similar results are obtained when using the sum of the three cultural attributes as dependent variable: both the point estimates and significance levels remain mostly unchanged.

Once again, the qualitative results for temperature are analogous: higher inter-annual variability, particularly during the growing season, corresponds to weaker family ties. Furthermore, as with trust, the coefficient on spatial correlation in temperature has the expected sign but is not statistically significant. As with precipitation, the results are very similar when both measures of the strength of family ties are used as dependent variable.

III.2. Historical variability and family ties

Using climate data for the previous centuries I then test whether differences in the strength of family ties are related to historical rather than contemporary variability (Table 9). Once again, the results are consistent with those found for trust: historical variability in the growing season's precipitation and temperature appear to have a negative, large and significant effect on the strength of family ties. This effect remains, and becomes even larger, when controlling for climate variability over the last century, which appears to have no significant effect on the dependent variable, or, in the case of precipitation an inverse - though marginally significant - effect. The magnitude of the coefficients on historical variability is considerable and comparable to what found for trust: a one standard deviation in growing season variability corresponds to a 0.40 standard deviation decrease in the strength of family ties, for precipitation, and a 0.38 standard deviation decrease for temperature.

IV. Trust, climate variability and historical background

The evidence presented above confirms the existence of a robust relationship between historical climate variability and current differences in trust. As a further robustness check, I then explore the relationship between this result and findings from a previous study by Tabellini (2005) which emphasize the impact of early political institutions on differences in trust across European regions. Doest the effect of historical variability on trust persist when controlling for early political institutions? Finding that this is the case would suggests that the demand for insurance against erratic weather may have fostered the emergence of trust by favoring the adoption of other, more informal collective arrangements whose long-lasting effect of trust is not captured by historical differences in institutions.

To explore this issue I extend my empirical analysis to include a regional measure of early political institutions: constraints on the executive between 1600-1850, available from Tabellini (2005) for 69 European regions. This variable was coded for different 40-year windows around the years 1600, 1700, 1750, 1800, and 1850, and takes values from 1 (unconstrained authority) to 7 (maximum accountability and constraints). To be consistent with the time frame used in the construction of the historical variability measure described above, I consider constraints on the executive in 1600, 1700 and 1750. Following Tabellini (2005), I use the first principal component of the three variables as my main measure of early political institutions. However, all the results described below are remain mostly unchanged when using each of the three variables separately or their arithmetic average (Tables A.A.3 and A.A.4). Tabellini's data also include regional measures of urbanization (around 1850) and literacy (around 1880), which I include as additional regressors in my analysis to explore the relative importance of patterns of early economic development and human capital accumulation on trust attitudes. Summary statistics for all the variables used in this section are shown in Table 10.

Table 11 reports the results of the regressions, all of which include country fixed effects and the set of standard regional controls used before. In column 1 I regress the unconditional trust measure on precipitation variability in the growing season alone. The results for the smaller sample (66 regions) confirm those found for larger sample: the coefficient on precipitation variability (in the growing season months) is positive, large, and statistically significant.[36] Again, when historical and contemporary variability are included in the regression (column 2), only the first one displays a positive and significant coefficient (10% level). Column 3 displays the result of the regression of trust on early institutions, literacy rate in 1880, and urbanization rate around 1850. The results are consistent with Tabellini's findings: past level of education and, particularly, early political institutions, display a positive and significant effect on current levels of trust (significant at the 10% and 1% level respectively). Finally, the regression in column 4 includes precipitation variability along with the three historical variables. When doing so, the coefficient on precipitation variability continues to be positive and statistically significant (5% level), while those on constraints on the executive and literacy rate remain practically unchanged. With regard to the magnitude of the coefficients, the effect of historical precipitation variability and early institutions on trust are comparable: while one standard deviation increase in historical precipitation variability corresponds to a 0.33 standard deviation increase in trust, one standard deviation increase in the principal component of constraints on the executive between 1600 and 1750 corresponds to a 0.45 standard deviation increase in trust. Similar results hold for historical temperature variability (columns 5-8), which display a positive and significant coefficient even when controlling for contemporary variability. Unlike for precipitation, however, when historical temperature variability is included in the regression along with early institutions, literacy rate and urbanization (column 8), the point estimate on variability drops significantly - from 2.343 to 1.962 - as well as does the coefficient on early institutions, from 0.146, when variability is not included, to 0.091, which suggest that the two variables are correlated. Based on the point estimates in column 8, historical temperature variability appears to have a relatively larger impact on trust than early institutions: one standard deviation increase in historical temperature variability increases trust by 0.56 standard deviation, compared to a 0.26 standard deviation increase for early political institutions.

V. Conclusion

Social trust has become the object of extensive research in economics as part of a broader agenda on the impact of culture on economic performance. Nevertheless, the economic origins of trust remain relatively unexplored, limiting our understanding of the phenomenon and its implications for economic development. Recent theoretical and empirical findings indicate that historical circumstances - in particular historical experiences of cooperation - can have considerable and long-lasting effects on the level of trust of a community, providing a coherent framework for further research on the historical determinants of trust.

This paper contributes to this growing literature by examining the historical relationship between risk and the emergence of mutual cooperation and trust. In doing so, it focuses on a primitive and universal source of environmental risk: climate volatility. The hypothesis advanced and tested in this paper is that norms of generalized trust developed in pre-industrial times as a result of experiences

[36] Three of the 69 regions included in Tabellini's original sample, are not covered by the climatic data I use and are hence excluded from the current analysis. These regions are: Madeira and Azores Islands (Portugal) and Canaries Island (Spain).

of cooperation triggered by the need for subsistence farmers to cope with climatic risk. Since cooperation was particularly valuable in riskier environments, norms of trust became more prevalent in areas exposed to more erratic weather. These norms were then transmitted from generation to generation and managed to persist even after climate patterns had become less crucial for economic activity. Insofar as these norms continue to influence the trust attitudes of the descendants, one should expect to observe higher levels of trust in regions historically characterized by higher climatic variability.

My empirical results provide support for this prediction in the context of Europe. Combining detailed climate data for the period 1500-2000 and contemporary survey data from the European Social Survey I find that interannual variability in both temperature and precipitation has a significant positive effect on current levels of trust at the regional level. This effect is mainly driven by climatic variability in the growing season months. Furthermore, trust is higher in regions with more spatially heterogeneous precipitation, in which risk-sharing through geographic differentiation would have been more effective. Finally, trust is related to historical climate variability (between the 16th and the 18th century) but not to contemporary variability (over the 20th century), a result which contrasts with alternative explanations on the impact of contemporary variability on current trust.

These findings are further corroborated by evidence on the relationship between climatic variability and individuals' beliefs on the importance of the family in their life. In line with recent studies documenting the existence of a negative empirical relationship between trust within and outside the family, I find that in regions with higher temporal and spatial variability in climate, people have weaker family ties. As in the case of trust, the strength of family ties is related to historical variability, but not to contemporary variability, which appears to have no independent explanatory power.

The last part of the paper attempts to shed some light on the relationship between trust, climate variability and early political institutions. To do so I extend my empirical analysis to control for measures of historical political and economic development at the regional level available from Tabellini (2005). The results confirm the importance of early political institutions (and, to a lesser extent, early literacy) for the emergence and diffusion of mutual trust (Tabellini, 2005). On the other hand, historical climate variability continues to have a considerable impact on trust, which suggests that the demand for insurance that aroused from exposure to erratic weather may have favored the adoption of other more informal collective arrangements.

This research provides a new point of investigation into the emergence of social norms as a product of collective responses to risk. However, the present study can provide only suggestive evidence on the specific channel(s) through which exposure to climate variability may have favored the development of a culture of trust. As the availability and quality of historical data improve, future research should aim at shedding further ligth on this crucial question.

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Table 1: EUROPEAN SOCIAL SURVEY: NUMBER OF RESPONDENTS BY COUNTRY/ROUND

Country	*Round 1*	*Round 2*	*Round 3*	*Mean trust score*
Austria	2,257	2,256	2,405	4.9
Belgium	1,899	1,778	1,798	4.9
Bulgaria	-	-	1,400	2.2
Czech Republic	1,360	3,026	-	3.3
Denmark	1,506	1,487	1,505	6.3
Estonia	-	1,989	1,517	4.6
Finland	2,000	2,022	1,896	6.0
France	1,503	1,806	1,986	4.3
Germany	2,919	2,870	2,916	4.2
Greece	2,566	2,406	-	4.8
Hungary	1,685	1,498	1,518	4.1
Ireland	2,046	2,286	1,800	4.6
Italy	1,207	1,529	-	4.6
Luxembourg	1,552	1,635	-	5.7
Netherlands	2,364	1,881	1,889	4.9
Norway	2,036	1,760	1,750	5.6
Poland	2,110	1,716	1,721	2.9
Portugal	1,511	2,052	2,222	3.9
Slovakia	-	1,512	1,766	4.2
Slovenia	1,519	1,442	1,476	4.1
Spain	1,729	1,663	1,876	5.0
Sweden	1,999	1,948	1,927	5.6
Switzerland	2,040	2,141	1,804	5.6
United Kingdom	2,052	1,897	2,394	4.3
Total	**39,860**	**44,600**	**37,566**	

Figure 1: DISTRIBUTIONS OF TRUST SCORE IN ESS REGIONS

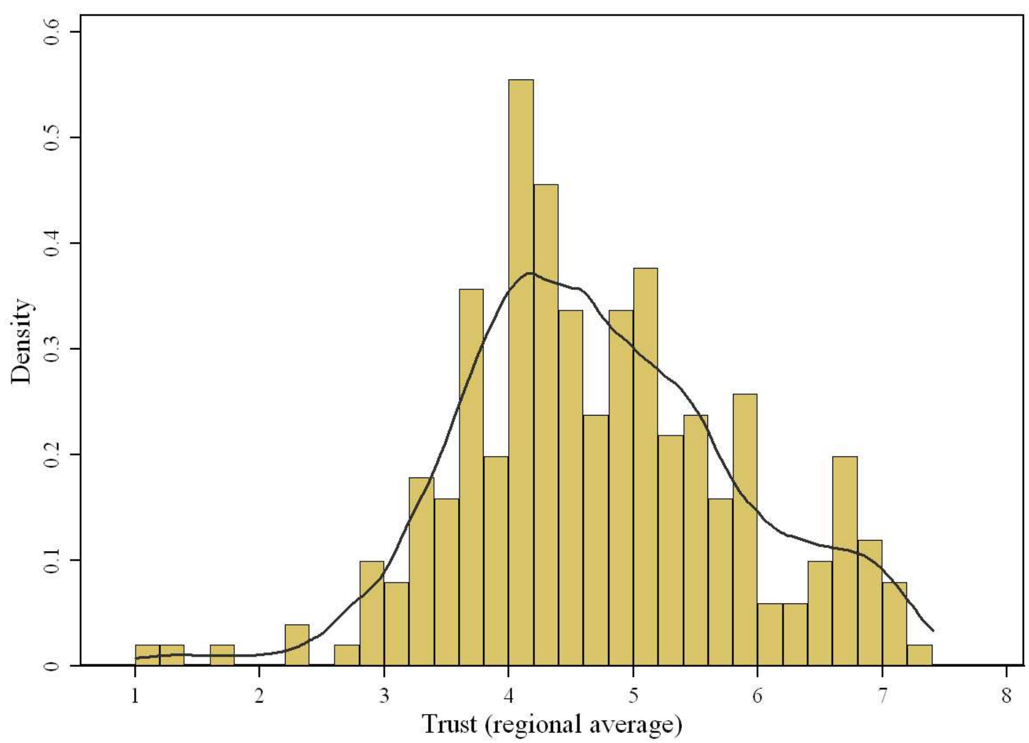

Table 2: EUROPEAN VALUE STUDY - NUMBER OF RESPONDENTS BY COUNTRY/WAVE

Country	*Round 1 (1989-1993)*	*Round 2 (1994-1999)*	*Round 3 (1999-2004)*	*Family important (1-4)*	*Respect parents (1-2)*	*Parents' responsibility (1-2)*	*Family Ties (P.C.)*	*Family Ties (sum)*
Austria	1,460	-	1,522	3.854	1.695	1.690	-0.110	7.250
Belgium	2,792		1,912	3.820	1.725	1.777	0.040	7.344
Bulgaria	1,034	1,072	1,000	3.798	1.842	1.711	0.081	7.371
Czech Republic	3,033*	1,147	1,908	3.842	1.726	1.631	-0.137	7.230
Denmark	1,030	-	1,023	3.856	1.429	1.612	-0.610	6.900
Estonia	1,008†	1,021	1,005	3.697	1.775	1.710	-0.113	7.207
Finland	588†	987	1,038	3.771	1.674	1.682	-0.244	7.129
France	1,002	-	1,615	3.836	1.759	1.819	0.160	7.431
Germany	3,437	2,026	2,036	3.717	1.629	1.629	-0.409	7.006
Greece	-	-	1,139	3.799	1.692	1.679	-0.136	7.225
Hungary	999†	650	1,000	3.871	1.822	1.767	0.201	7.472
Ireland	1,000	1,012†	-	3.894	1.776	1.802	0.236	7.502
Italy	2,018	-	2,000	3.868	1.811	1.875	0.385	7.600
Luxembourg	-	-	1,211	3.857	1.592	1.784	-0.072	7.277
Netherlands	1,017		1,003	3.725	1.366	1.806	-0.491	6.939
Norway	1,239	1,127†	-	3.862	1.453	1.875	-0.146	7.222
Poland	1,920	1,153†	1,095	3.898	1.884	1.800	0.370	7.598
Portugal	1,185	-	1,000	3.705	1.811	1.867	0.177	7.404
Slovakia	1,602‡	1,095	1,331	3.868	1.762	1.734	0.100	7.404
Slovenia	1,035	1,007†	1,006	3.783	1.802	1.847	0.221	7.457
Spain	4,147	1,211	2,409	3.821	1.825	1.847	0.297	7.524
Sweden	1,047	1,009†	1,015	3.852	1.469	1.783	-0.276	7.131
Switzerland	-	1,212	-	3.792	1.714	1.692	-0.139	7.209
United Kingdom	1,788	1,093	1,959	3.865	1.709	1.831	0.129	7.417
Total	34,381	16,882	29,227					

** Of these, for 2,109 individuals intreviewed in 2001 no information on the region of residence was available.*
† No information on the respondent's region of residence available.
‡ Of these, for 1,136 individuals intreviewed in 1999 no information on the region of residence was available.

Figure 2: DISTRIBUTION OF FAMILY TIES (P.C) BY EVS REGIONS

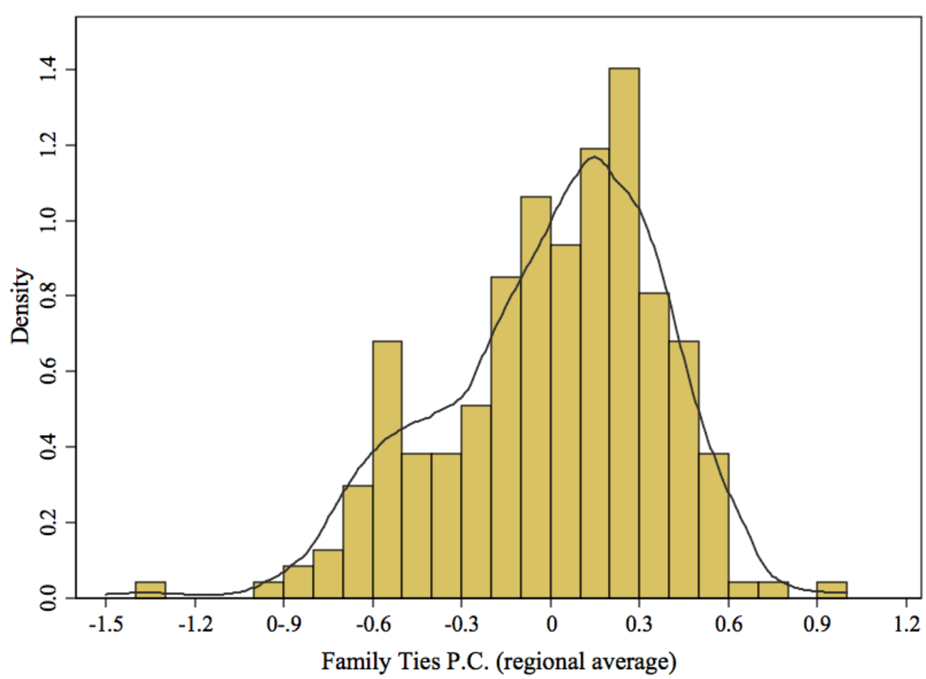

Table 3: FAMILY TIES (EVS) - CORRELATION AMONG VARIABLES

	Family important	*Respect parents*	*Parents' responsibility*	*Family Ties (P.C.)*
Family important				
Respect parents	0.087			
Parents' responsibility	0.088	0.169		
Family Ties (P.C.)	0.512	0.695	0.698	
Family Ties (sum)	0.627	0.652	0.638	0.990

Observations: 55754

Table 4: SUMMARY STATISTICS FOR THE TRUST-CLIMATE ANALYSIS

Variable	Obs.	Mean	Std. Dev.	Min	Max
Trust:					
Trust unconditional (0-10)	251	4.72	1.12	1.11	7.31
Climate 1900-2000:					
Precipitation variability 12 months (mm)	251	34.15	12.21	17.43	76.17
Precipitation variability GSM (mm)	251	33.98	10.99	15.04	77.68
Precipitation variability NGSM (mm)	251	34.38	16.23	12.27	87.62
Precipitation spatial correlation	251	0.93	0.04	0.89	0.98
Temperature variability 12 months (°C)	251	1.64	0.29	1.03	2.43
Temperature variability GSM (°C)	251	1.35	0.16	0.90	1.71
Temperature variability NGSM (°C)	251	2.04	0.51	1.11	3.45
Temperature spatial correlation	251	0.98	0.00	0.96	0.99
Precipitation Average 12 months (mm)	251	66.64	22.40	32.32	148.98
Temperature Average 12 months (°C)	251	9.12	3.22	-1.47	17.63
Climate 1500-2000:					
Precipitation variability GSM 1500-1750 (mm)	248	15.31	7.38	6.92	49.10
Precipitation variability GSM 1900-2000 (mm)	248	16.78	6.39	7.85	51.45
Temperature variability GSM 1500-1750 (°C)	248	0.78	0.17	0.30	1.14
Temperature variability GSM 1900-2000 (°C)	248	1.01	0.20	0.64	1.57
Precipitation average 1500-2000 (mm)	248	67.28	26.06	28.40	166.40
Temperature average 1500-2000 (°C)	248	8.76	3.34	-1.59	17.56
Controls:					
Terrain Ruggedness	251	1.43	1.50	0.01	7.99
Soil Suitability average (0-6)	251	2.28	0.86	0	4.90
Soil Suitability st.dev.	251	1.03	0.41	0	2.02
Area (km^2)	251	17,077	23,954	96	168,466
Landlocked	251	0.55	0.50	0	1
Distance to the coast (km)	251	149.93	147.22	0	588.47
Number of major rivers	251	1.18	1.58	0	11
Latitude (°)	251	48.70	6.41	35.23	68.85

Table 5: SOCIAL TRUST AND CLIMATE VARIABILITY
CLIMATE DATA: 1900-2000

	Dependent variable: Trust in others (unconditional regional average)							
	Precipitation				Temperature			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variability (12 Months)	0.133**	0.155***			1.060**	1.028***		
	(0.058)	(0.042)			(0.490)	(0.304)		
Variability (growing season months)			0.193***	0.168***			0.958**	1.019***
			(0.068)	(0.044)			(0.390)	(0.293)
Variability (non-growing season months)			-0.012				0.255	
			(0.031)				(0.283)	
Spatial Correlation				-5.747***				-2.918
				(1.988)				(13.680)
Average Temperature		0.007	0.025	0.040*		0.035	0.036	0.036
		(0.035)	(0.038)	(0.023)		(0.033)	(0.033)	(0.033)
Average Precipitation		-0.051*	-0.046*	-0.044**		0.028	0.026	0.027
		(0.026)	(0.024)	(0.016)		(0.017)	(0.018)	(0.017)
Average Terrain Ruggedness		0.030	0.043	0.037		0.074	0.064	0.072
		(0.061)	(0.067)	(0.043)		(0.054)	(0.059)	(0.057)
Soil Quality (Average)		-0.003	-0.008	0.008		-0.000	-0.001	-0.000
		(0.036)	(0.034)	(0.024)		(0.034)	(0.036)	(0.035)
Soil Quality (St. Dev.)		0.031	0.028	0.047		0.030	0.023	0.029
		(0.064)	(0.068)	(0.055)		(0.057)	(0.063)	(0.059)
Area		-0.323	-0.211	-0.054		-0.197	-0.205	-0.197
		(0.215)	(0.228)	(0.130)		(0.206)	(0.204)	(0.206)
Landlocked		0.008	0.007	0.057		-0.006	-0.013	-0.005
		(0.098)	(0.101)	(0.075)		(0.109)	(0.105)	(0.108)
Distance to the Coast		0.060	0.052	0.025		0.027	0.025	0.027
		(0.048)	(0.048)	(0.030)		(0.043)	(0.041)	(0.043)
Access to Rivers		0.071**	0.062**	0.040*		0.055*	0.054*	0.055*
		(0.029)	(0.029)	(0.023)		(0.030)	(0.030)	(0.031)
Latitude		0.058**	0.057**	0.054***		0.038	0.042	0.039
		(0.028)	(0.024)	(0.019)		(0.029)	(0.030)	(0.029)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251	251	251	251	251	251	251	251
Number of clusters	24	24	24	24	24	24	24	24
R-square	0.881	0.888	0.889	0.945	0.883	0.889	0.889	0.889

*OLS regressions. Robust standard errors clustered at the country level in parenthesis. ***, ** and * indicates significance at the 1, 5 and 10% level.*

Figure 3: CLIMATE VARIABILITY AND TRUST
OLS RESIDUALS (AFTER CONTROLLING FOR COUNTRY F.E. AND REGIONAL CONTROLS)

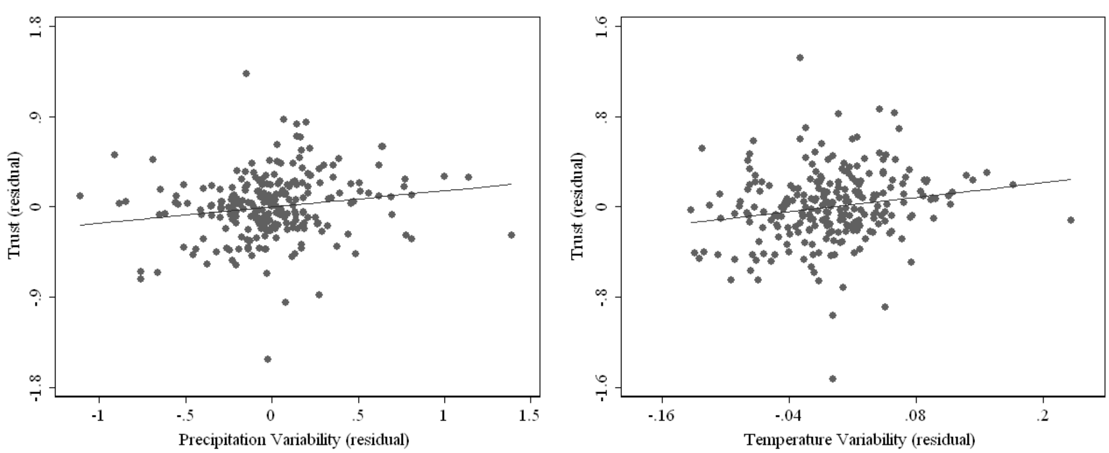

Table 6: SOCIAL TRUST AND CLIMATE VARIABILITY
CLIMATE DATA: 1500-2000

	Dependent variable: Trust in others (unconditional regional average)					
	Precipitation			Temperature		
	(1)	(2)	(3)	(4)	(5)	(6)
Variability GSM (1500-1750)		0.132**	0.141**		1.303***	1.311***
		(0.050)	(0.059)		(0.248)	(0.369)
Variability GSM (1900-2000)	0.109*		-0.026	1.040**		-0.019
	(0.057)		(0.043)	(0.455)		(0.580)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Regional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	248	248	248	248	248	248
Number of clusters	24	24	24	24	24	24
R-square	0.894	0.895	0.895	0.890	0.890	0.890

*OLS regressions. Regional controls: mean temperature, mean precipitation, average ruggedness index, soil suitability (average and standard deviation), area, dummy for landlocked, distance from of the region's centroid from the coast, number of major rivers passing through the region, latitude of the region's centroid. Robust standard errors clustered at the country level in parenthesis. ***,** and * indicates significance at the 1, 5 and 10% level.*

Table 7: Summary statistics for the Family Ties-climate analysis

Variable	Obs.	Mean	Std. Dev.	Min	Max
Family ties:					
Family ties first principal component	220	0.02	0.35	-1.01	0.91
Family ties sum (0-8)	220	7.31	0.26	6.62	7.92
Climate 1900-2000:					
Precipitation variability 12 months (mm)	220	34.38	12.31	17.43	76.17
Precipitation variability GSM (mm)	220	34.13	11.00	15.04	77.68
Precipitation variability NGSM (mm)	220	34.72	16.36	12.27	91.60
Precipitation spatial correlation	220	0.93	0.04	0.90	0.98
Temperature variability 12 months (°C)	220	1.64	0.30	1.03	2.43
Temperature variability GSM (°C)	220	1.35	0.17	0.90	1.71
Temperature variability NGSM (°C)	220	2.04	0.53	1.11	3.45
Temperature spatial correlation	220	0.98	0.00	0.96	0.99
Precipitation Average 12 months (mm)	220	66.80	22.00	39.28	148.06
Temperature Average 12 months (°C)	220	9.06	3.28	-1.47	17.63
Climate 1500-2000:					
Precipitation variability GSM 1500-1750 (mm)	217	16.30264	6.65	6.84	39.73
Precipitation variability GSM 1900-2000 (mm)	217	19.96012	7.11	10.56	52.41
Temperature variability GSM 1500-1750 (°C)	217	0.718353	0.17	0.30	1.02
Temperature variability GSM 1900-2000 (°C)	217	0.928003	0.14	0.64	1.33
Precipitation average 1500-2000 (mm)	217	67.78502	26.59	34.96	166.40
Temperature average 1500-2000 (°C)	217	8.70063	3.40	-1.59	17.56
Controls:					
Terrain Ruggedness	220	1.43	1.50	0.01	7.99
Soil Suitability average (0-6)	220	2.26	0.89	0.002544	4.90
Soil Suitability st.dev.	220	1.05	0.41	0	1.973814
Area (km^2)	220	20,124	8,209	96	102,466
Landlocked	220	0.51	0.50	0	1
Distance to the coast (km)	220	142.73	139.76	0.2751	585.74
Number of major rivers	220	1.22	1.75	0	15
Latitude (°)	220	49.06	6.52	36.74	68.85

Table 8: FAMILY TIES AND CLIMATE VARIABILITY
CLIMATE DATA: 1900-2000

	Family Ties (Principal Component)						Family Ties (Sum)					
	Precipitation			Temperature			Precipitation			Temperature		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variability (12 Months)	-0.072**			-0.392*			-0.069**			-0.416*		
	(0.033)			(0.214)			(0.031)			(0.227)		
Variability (growing season months)		-0.081***	-0.086***		-0.692***	-0.592***		-0.079**	-0.083***		-0.692***	-0.576***
		(0.029)	(0.023)		(0.219)	(0.188)		(0.028)	(0.021)		(0.220)	(0.196)
Variability (non-growing season months)		-0.004			0.063			-0.003			0.046	
		(0.024)			(0.130)			(0.023)			(0.137)	
Spatial Correlation			4.567**			7.592			5.158**			10.925
			(1.825)			(8.782)			(1.903)			(8.286)
Regional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	220	220	220	220	220	220	220	220	220	220	220	220
Number of clusters	24	24	24	24	24	24	24	24	24	24	24	24
R-square	0.826	0.828	0.832	0.826	0.832	0.832	0.782	0.783	0.789	0.783	0.789	0.791

*OLS regressions. Regional controls: mean temperature, mean precipitation, average ruggedness index, soil suitability (average and standard deviation), area, dummy for landlocked, distance from of the region's centroid from the coast, number of major rivers passing through the region, latitude of the region's centroid. Robust standard errors clustered at the country level in parenthesis. ***, ** and * indicates significance at the 1, 5 and 10% level.*

Table 9: FAMILY TIES AND CLIMATE VARIABILITY
CLIMATE DATA: 1500-2000

	Family Ties (Principal Component)				Family Ties (Sum)			
	Precipitation		Temperature		Precipitation		Temperature	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variability GSM (1500-1750)	-0.205**	-0.300**	-0.205**	-0.306***	-0.769***	-0.876***	-0.781***	-0.880***
	(0.085)	(0.112)	(0.081)	(0.100)	(0.211)	(0.228)	(0.205)	(0.209)
Variability GSM (1900-2000)		0.129*		0.138		0.362		0.334
		(0.074)		(0.081)		(0.344)		(0.327)
Regional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	218	218	218	218	218	218	218	218
Number of clusters	24	24	24	24	24	24	24	24
R-square	0.830	0.833	0.785	0.789	0.836	0.837	0.792	0.793

*OLS regressions. Regional controls: mean temperature, mean precipitation, average ruggedness index, soil suitability (average and standard deviation), area, dummy for landlocked, distance from of the region's centroid from the coast, number of major rivers passing through the region, latitude of the region's centroid. Robust standard errors clustered at the country level in parenthesis. ***, ** and * indicates significance at the 1, 5 and 10% level.*

Table 10: SUMMARY STATISTICS FOR THE TRUST-CLIMATE-INSTITUTIONS ANALYSIS

Variable	Obs.	Mean	Std. Dev.	Min	Max
Trust:					
Trust unconditional (0-10)	66	4.77	0.57	2.70	5.84
Climate 1500-2000:					
Precipitation variability GSM 1500-1750 (mm)	66	16.24	4.46	8.16	31.12
Precipitation variability GSM 1900-2000 (mm)	66	17.94	4.30	10.22	36.03
Temperature variability GSM 1500-1750 (°C)	66	0.74	0.17	0.39	1.01
Temperature variability GSM 1900-2000 (°C)	66	0.84	0.08	0.64	0.99
Precipitation average 1500-2000 (mm)	66	58.12	20.85	22.55	115.07
Temperature average 1500-2000 (°C)	66	13.84	2.54	8.93	18.64
Historical background:					
Institutions 1600-1750 (first principal component)	66	0.00	1.65	-1.34	3.06
Institutions 1600-1750 (average)	66	2.24	1.55	1	5
Urbanization rate (1880)	66	11.61	13.35	0	57.43
Literacy rate (1880)	64	55.40	25.73	14.60	96.50
Controls:					
Terrain Ruggedness	66	1.26	1.03	0.02	4.10
Soil Suitability average (0-6)	66	2.24	0.57	0.99	3.79
Soil Suitability st.dev.	66	1.21	0.37	0.37	1.95
Area (km^2)	66	30,137	28,676	161	145,130
Landlocked	66	0.35	0.48	0	1
Distance to the coast (km)	66	97.66	99.19	0.31	417.20
Number of major rivers	66	2.06	2.59	0	15
Latitude (°)	66	46.11	5.52	37.22	56.19

Table 11: TRUST, CLIMATE VARIABILITY AND INSTITUTIONS
CLIMATE DATA: 1500-2000

	Dependent variable: Trust in others (unconditional regional average)							
	Precipitation				Temperature			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variability GSM (1500-1750)	0.404**	0.620*		0.476**	2.364**	2.123**		1.962*
	(0.144)	(0.271)		(0.166)	(0.935)	(0.849)		(1.003)
Variability GSM (1900-2000)		-0.308				0.702		
		(0.214)				(0.951)		
Contraints on Executive P.C. (1600-1750)			0.148***	0.155**			0.148***	0.091**
			(0.036)	(0.045)			(0.036)	(0.031)
Literacy (1880)			0.010*	0.009**			0.010*	0.005
			(0.004)	(0.004)			(0.004)	(0.004)
Urbanization (1850)			-0.003	-0.002			-0.003	-0.002
			(0.003)	(0.004)			(0.003)	(0.003)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	66	66	64	64	66	66	64	64
Number of clusters	8	8	8	8	8	8	8	8
R-square	0.724	0.727	0.753	0.767	0.769	0.770	0.753	0.781

*OLS regressions. Regional controls: mean temperature, mean precipitation, average ruggedness index, soil suitability (average and standard deviation), area, dummy for landlocked, number of major rivers passing through the region, distance from of the region's centroid from the coast, latitude of the region's centroid. Robust standard errors clustered at the country level in parenthesis. ***, ** and * indicates significance at the 1, 5 and 10% level.*

APPENDIX

Figure A.1: GEOGRAPHIC DISTRIBUTIONS OF TRUST SCORE IN ESS REGIONS

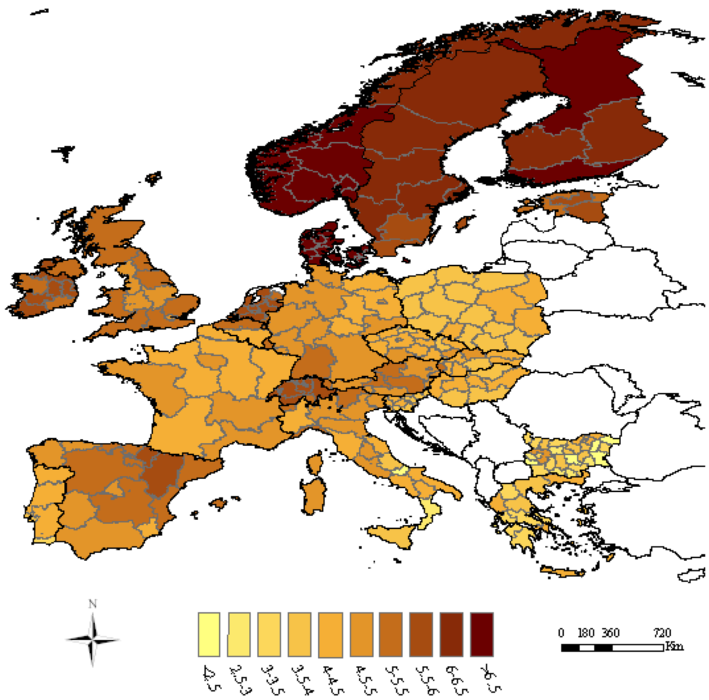

Figure A.2: GEOGRAPHIC DISTRIBUTION OF FAMILY TIES (P.C) IN EVS REGIONS

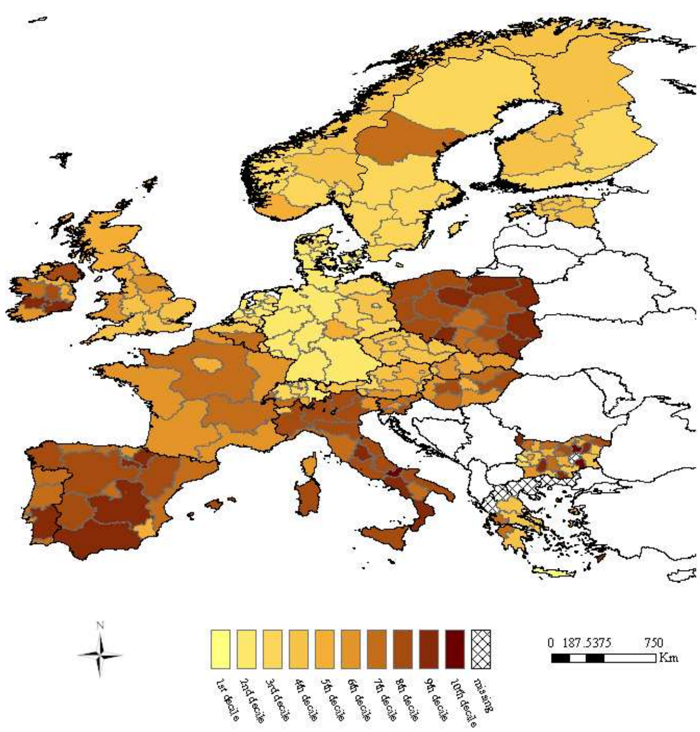

Figure A.3: GRID CELL SIZE FOR CONTEMPORARY AND HISTORICAL CLIMATE DATA

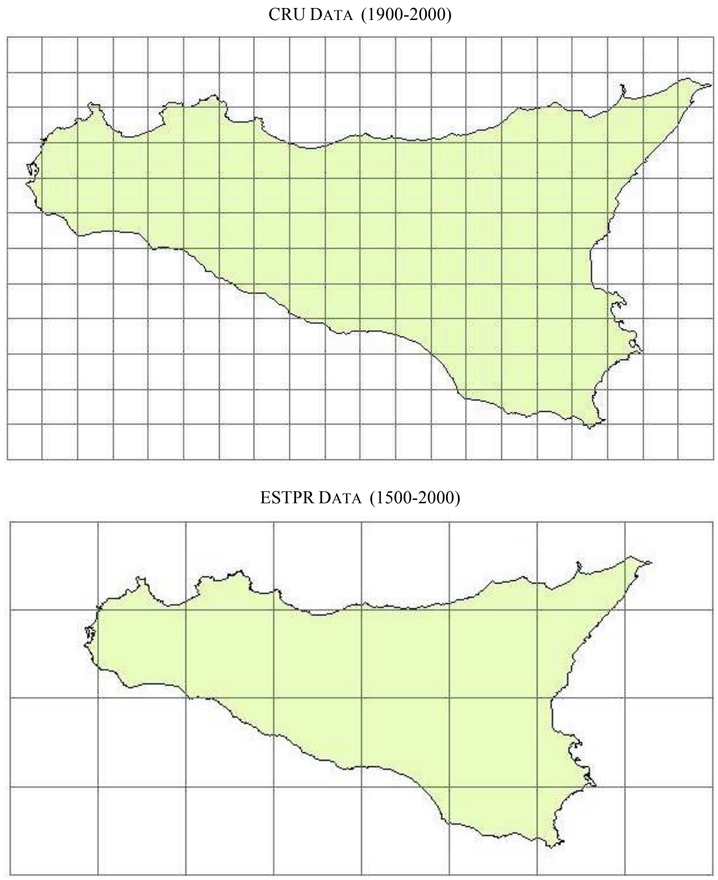

Figure A.4: CLIMATE 1900-2000 AND 1500-1900

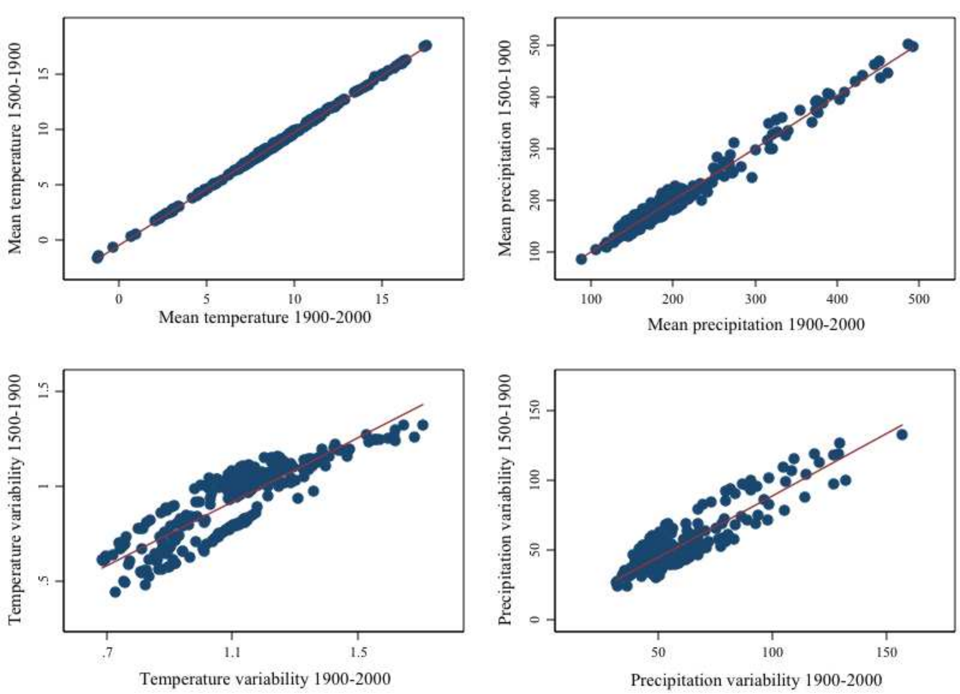

Table A.1: SOCIAL TRUST AND CLIMATE VARIABILITY (1900-2000) (ROBUSTNESS CHECKS)

	Precipitation				Temperature			
	Dependent variable:				Dependent variable:			
	Trust (conditional)	Trust (uncon.)	Trust (uncon.)	Trust (uncon.)	Trust (conditional)	Trust (uncon.)	Trust (uncon.)	Trust (uncon.)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variability GSM	0.132***		0.167***	0.211***	1.060***		0.977***	1.518***
	(0.041)		(0.054)	(0.049)	(0.333)		(0.328)	(0.443)
Variability GSM (detrended)		0.118***				0.635***		
		-0.03				(0.208)		
Spatial Correlation	-4.461**	-5.687***	-6.202**	-8.909***	7.999	-3.385	-0.314	-7.414
	(2.093)	(1.958)	(2.596)	(1.744)	(11.277)	(13.915)	(14.354)	(14.650)
Average Temperature	0.038*	0.040*	0.043*	0.053**	0.025	0.032	0.033	0.085***
	(0.021)	(0.023)	(0.024)	(0.023)	(0.029)	(0.033)	(0.036)	(0.027)
Average Precipitation	-0.029**	-0.042**	-0.029	-0.055**	0.023	0.023	0.021	0.020
	(0.014)	(0.015)	(0.020)	(0.020)	(0.019)	(0.018)	(0.026)	(0.015)
Average Terrain Ruggedness	0.038	0.035	0.012	0.038	0.039	0.071	0.075	0.129**
	(0.039)	(0.043)	(0.041)	(0.042)	(0.057)	(0.058)	(0.062)	(0.050)
Soil Quality (Average)	0.001	0.007	-0.009	0.036	-0.006	0.001	-0.016	0.003
	(0.022)	(0.024)	(0.030)	(0.024)	(0.035)	(0.034)	(0.045)	(0.041)
Soil Quality (St. Dev.)	0.041	0.042	0.096	0.041	0.010	0.027	0.038	0.035
	(0.047)	(0.055)	(0.060)	(0.059)	(0.059)	(0.057)	(0.090)	(0.071)
Area	0.013	-0.060	0.016	-0.021	-0.171	-0.195	-0.043	-0.055
	(0.106)	(0.132)	(0.126)	(0.139)	(0.183)	(0.212)	(0.167)	(0.213)
Landlocked	0.039	0.053	0.037	0.070	-0.023	0.003	-0.015	0.019
	(0.067)	(0.076)	(0.081)	(0.086)	(0.096)	(0.105)	(0.109)	(0.122)
Distance to the Coast	0.030	0.027	0.028	0.054	0.034	0.028	0.038	-0.007
	(0.029)	(0.030)	(0.033)	(0.051)	(0.034)	(0.044)	(0.047)	(0.066)
Access to Rivers	0.044**	0.040*	0.034*	0.038	0.056*	0.058*	0.049	0.040
	(0.017)	(0.023)	(0.018)	(0.027)	(0.027)	(0.031)	(0.031)	(0.035)
Latitude	0.046**	0.055***	0.046**	0.065***	0.045	0.042	0.052	0.053
	(0.018)	(0.019)	(0.022)	(0.020)	(0.027)	(0.030)	(0.040)	(0.032)
Scandinavian regions	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Ex-communist regions	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251	251	217	167	251	251	217	167
Number of clusters	24	24	20	18	24	24	20	18
R-square	0.951	0.944	0.884	0.955	0.892	0.888	0.794	0.928

*OLS regressions. The dependent variable is the conditional measure of trust in columns 1 and 5, and the unconditional measure of trust in the other ones. Scandinavian regions (all regions of Denmark, Finland, Norway and Sweden) are excluded from the sample in columns 3 and 7; formerly communist regions (all regions of Bulgaria, Czech Republic, Estonia, Hungary, Poland, and Slovakia, and the eastern regions of Germany) are excluded from the sample in columns 4 and 8. Robust standard errors clustered at the country level in parenthesis. ***, ** and * indicates significance at the 1, 5 and 10% level.*

Table A.2: SOCIAL TRUST AND CLIMATE VARIABILITY (1900-2000)
(WITH DIFFERENT TERMS OF GROWING SEASON)

	Dependent variable: Trust in others (unconditional regional average)							
	Precipitation				Temperature			
	Growing season months:				Growing season months:			
	March to October	April to November	March to November	April to September	March to October	April to November	March to November	April to September
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variability GSM	0.169***	0.150***	0.150***	0.175***	1.133***	1.718***	1.129***	1.060**
	(0.042)	(0.040)	(0.037)	(0.049)	(0.315)	(0.586)	(0.294)	(0.380)
Spatial Correlation	-5.652***	-5.687***	-5.601**	-5.911***	3.959	-0.946	2.686	4.122
	(1.977)	(2.024)	(2.026)	(1.989)	(13.859)	(14.845)	(13.896)	(13.873)
Average Temperature	0.034	0.035	0.031	0.044*	0.033	0.017	0.032	0.029
	(0.023)	(0.023)	(0.022)	(0.023)	(0.032)	(0.035)	(0.033)	(0.031)
Average Precipitation	-0.048***	-0.041**	-0.044**	-0.038**	0.023	-0.048	0.024	0.019
	(0.017)	(0.016)	(0.016)	(0.016)	(0.019)	(0.029)	(0.018)	(0.020)
Average Terrain Ruggedness	0.032	0.037	0.034	0.037	0.058	0.038	0.060	0.056
	(0.043)	(0.042)	(0.042)	(0.042)	(0.060)	(0.067)	(0.060)	(0.062)
Soil Quality (Average)	0.008	0.008	0.008	0.008	-0.004	-0.007	-0.004	-0.004
	(0.024)	(0.024)	(0.024)	(0.023)	(0.037)	(0.036)	(0.036)	(0.036)
Soil Quality (St. Dev.)	0.045	0.047	0.046	0.049	0.019	0.030	0.023	0.015
	(0.056)	(0.054)	(0.055)	(0.054)	(0.063)	(0.066)	(0.061)	(0.064)
Area	-0.080	-0.087	-0.105	-0.025	-0.234	-0.259	-0.244	-0.219
	(0.127)	(0.131)	(0.129)	(0.130)	(0.203)	(0.210)	(0.208)	(0.200)
Landlocked	0.052	0.054	0.050	0.059	-0.008	0.008	-0.004	-0.006
	(0.074)	(0.074)	(0.074)	(0.075)	(0.101)	(0.095)	(0.102)	(0.097)
Distance to the Coast	0.027	0.029	0.030	0.021	0.028	0.056	0.023	0.028
	(0.031)	(0.031)	(0.031)	(0.030)	(0.039)	(0.044)	(0.040)	(0.038)
Access to Rivers	0.042*	0.043*	0.044*	0.037	0.058*	0.066**	0.059*	0.056*
	(0.023)	(0.023)	(0.023)	(0.023)	(0.031)	(0.029)	(0.031)	(0.030)
Latitude	0.052**	0.054***	0.052**	0.055***	0.046	0.058**	0.044	0.052*
	(0.019)	(0.019)	(0.020)	(0.019)	(0.028)	(0.026)	(0.028)	(0.028)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251	251	251	251	251	251	251	251
Number of clusters	24	24	24	24	24	24	24	24
R-square	0.945	0.944	0.944	0.946	0.889	0.889	0.889	0.889

*OLS regressions. "Variability GSM" is the variability in the growing season months defined as the months from March to October (columns 1 and 5), April to November (columns 2 and 6), March to November (columns 3 and 7) and April to September (columns 4 and 8). Robust standard errors clustered at the country level in parenthesis. ***, ** and * indicates significance at the 1, 5 and 10% level.*

Table A.3: TRUST, PRECIPITATION VARIABILITY AND INSTITUTIONS
(WITH DIFFERENT MEASURES OF CONSTRAINTS ON THE EXECUTIVE)

	Dependent variable: Trust in others (unconditional regional average)							
	Constraints on the executive:							
	Average 1600-1750	Average 1600-1750	1600	1600	1700	1700	1750	1750
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Precipitation Variability GSM (1500-1750)		0.478**		0.469**		0.450**		0.502**
		(0.170)		(0.142)		(0.160)		(0.187)
Contraints on the Executive	0.163***	0.171**	0.147***	0.153**	0.152***	0.156**	0.142***	0.157**
	(0.040)	(0.050)	(0.039)	(0.045)	(0.040)	(0.053)	(0.033)	(0.052)
Literacy (1880)	0.010*	0.009**	0.011**	0.010**	0.009*	0.009*	0.009	0.009
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.006)	(0.005)
Urbanization (1850)	-0.003	-0.002	-0.003	-0.002	-0.003	-0.002	-0.003	-0.001
	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	64	64	64	64	64	64	64	64
Number of clusters	8	8	8	8	8	8	8	8
R-square	0.752	0.767	0.755	0.769	0.747	0.760	0.746	0.762

*OLS regressions. "Constraints on the executive" is the average score for the years 1600, 1700, and 1750 in columns 1 and 2, the score for 1600 (columns 3 and 4), for 1700 (columns 5 and 6) and for 1750 (columns 7 and 8). Regional controls: mean temperature, mean precipitation, average ruggedness index, soil suitability (average and standard deviation), area, dummy for landlocked, number of major rivers passing through the region, distance from of the region's centroid from the coast, latitude of the region's centroid. Robust standard errors clustered at the country level in parenthesis. ***, ** and * indicates significance at the 1, 5 and 10% level.*

Table A.4: TRUST, TEMPERATURE VARIABILITY AND INSTITUTIONS
(WITH DIFFERENT MEASURES OF CONSTRAINTS ON THE EXECUTIVE)

	Dependent variable: Trust in others (unconditional regional average)							
	Constraints on the Executive:							
	Average 1600-1750	Average 1600-1750	1600	1600	1700	1700	1750	1750
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Temperature Variability GSM (1500-1750)		1.977*		1.904*		2.034*		2.133*
		(1.004)		(0.981)		(1.020)		(1.013)
Contraints on the Executive	0.163***	0.102**	0.147***	0.087**	0.152***	0.085**	0.142***	0.105***
	(0.040)	(0.033)	(0.039)	(0.033)	(0.040)	(0.035)	(0.033)	(0.025)
Literacy (1880)	0.010*	0.005	0.011**	0.006	0.009*	0.004	0.009	0.004
	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)	(0.006)	(0.005)
Urbanization (1850)	-0.003	-0.002	-0.003	-0.002	-0.003	-0.002	-0.003	-0.002
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	64	64	64	64	64	64	64	64
Number of clusters	8	8	8	8	8	8	8	8
R-square	0.752	0.781	0.755	0.780	0.747	0.778	0.746	0.783

*OLS regressions. "Constraints on the executive" is the average score for the years 1600, 1700, and 1750 in columns 1 and 2, the score for 1600 (columns 3 and 4), for 1700 (columns 5 and 6) and for 1750 (columns 7 and 8). Regional controls: mean temperature, mean precipitation, average ruggedness index, soil suitability (average and standard deviation), area, dummy for landlocked, number of major rivers passing through the region, distance from of the region's centroid from the coast, latitude of the region's centroid. Robust standard errors clustered at the country level in parenthesis. ***, ** and * indicates significance at the 1, 5 and 10% level.*