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CLIMATE RISK, COOPERATION, AND THE CO-EVOLUTION OF CULTURE AND INSTITUTIONS

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Abstract

This paper examines the relationship between economic risk and the evolution of social cooperation. We hypothesize that trust developed in pre-industrial times as a result of experiences of cooperation aimed at coping with climatic risk. We document that European regions with higher pre-industrial climatic variability display higher levels of trust today. This effect is driven by variability in the growing season months and is more pronounced in agricultural regions. Regarding possible mechanisms, our results indicate that climatic risk favored inter-community exchange and the early adoption of inclusive political institutions which is associated with higher quality of local governments today.

JEL Classification: O13, O11, Z10, Q54, N53

Keywords: Climate, Trust, Cooperation, Political Institutions, Persistence, risk

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Climate Risk, Cooperation, and the Co-Evolution of Culture and Institutions[*]

Johannes C. Buggle Ruben Durante

June 2020

Abstract

This paper examines the relationship between economic risk and the evolution of social cooperation. We hypothesize that trust developed in pre-industrial times as a result of experiences of cooperation aimed at coping with climatic risk. We document that European regions with higher pre-industrial climatic variability display higher levels of trust today. This effect is driven by variability in the growing season months and is more pronounced in agricultural regions. Regarding possible mechanisms, our results indicate that climatic risk favored inter-community exchange and the early adoption of inclusive political institutions which is associated with higher quality of local governments today.

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1 Introduction

There is widespread consensus that cooperation among the members of a society is crucial for economic development. Cultural attitudes that facilitate cooperation outside kinship networks, such as generalized trust, are seen as especially important in this regard.[1][2] Despite the multitude of intriguing results on the role of social trust, few studies have attempted to rigorously investigate the historical origins of trust and to explain the large differences observed both across and within countries (Tabellini, 2010; Nunn and Wantchekon, 2011; Guiso *et al.*, 2016). These studies have documented that historical circumstances, particularly experiences of cooperation or conflict - such as the free-city states of medieval Italy or the slave trade in Africa - can have long-lasting effects on cultural norms of cooperation.

This paper investigates whether other, more fundamental and universal factors may explain differential historical patterns in the emergence of cooperative behavior and in the current levels of trust. In particular, we examine the historical relationship between environmental risk - captured by variability in climatic conditions - and the evolution of cooperation and trust. We 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 economic 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 (Halstead and O'Shea, 2004). While some of these strategies could be efficiently implemented by a single household, many involved some degree of interaction with members of the broader community. In particular, insurance capacity against climate-related

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[1] This argument was originally put forth by 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 include Coleman (1988), Putnam (1993) and Fukuyama (1995). Social capital and trust have been associated with economic growth (Helliwell and Putnam, 1995; Knack and Keefer, 1997; Zak and Knack, 2001; Algan and Cahuc, 2014), well-functioning institutions (Knack, 2002), low corruption and crime (Uslaner, 2002; Buonanno *et al.*, 2009), financial development (Guiso *et al.*, 2004), and trade (Guiso *et al.*, 2009).

[2] The trust literature typically distinguishes between 'generalized' trust and 'limited' trust. We focus on generalized trust, defined by cultural norms that 'promote good conduct outside the small family/kin network, offering the possibility to identify oneself with a society of abstract individuals or abstract institutions' (Algan and Cahuc, 2014). In contrast, limited trust refers to those cases in which individuals trust members of a narrow, well-defined circle of persons, but do not trust - and do not expect to be trusted - by people outside of this circle. Empirical evidence suggests that these two types of trust are negatively correlated (Alesina and Giuliano, 2013). We therefore also analyze the effect of climate variability on the self-reported strength of family ties of surveyed individuals.

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. Indeed, examples of inter-community exchange, and geographically diversified mutual insurance arrangements are well-documented in the historical, anthropological, and economic literature (Dean *et al.*, 1985; Halstead and O'Shea, 2004; Platteau, 2000). Yet, while the gains from mutual insurance relationships increase with distance, incentive and information problems also became more severe. Maintaining socioeconomic connections with geographically distant individuals thus required higher levels of interpersonal trust. To the extent that these experiences of cooperation favored the emergence of a culture of trust that persisted over time, one would expect differences in historical climate variability to explain at least part of the differences in trust observed today.

We 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 trust for a sample of more than 250 thousand respondents living in 239 regions in 25 countries.[3] Our results indicate that regions with higher inter-annual variability in temperature and precipitation during pre-industrial times (i.e., 1500-1750) display higher levels of interpersonal trust today. The effect is primarily driven by climate variability in the growing-season months, consistent with the effect of climatic risk operating mainly through agriculture. This result is robust to controlling for average climatic conditions, other geographic characteristics, and country × wave fixed effects, to alternative definitions of the historical period over which variability is measured, and to the use of a geographic matching estimator. Our baseline results are obtained using historical

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[3] There are several reasons why Europe is a good context to test our 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 inter-generational persistence in occupation (Le Roy Ladurie, 1971). 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. Third, our 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; in this respect, 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 that same region. Finally, Europe is also a continent for which high quality historical climate data are readily available, and where substantial variation in social trust and institutional quality, both across and within countries, has been documented (Tabellini, 2010).

climate data reconstructed from various proxies, but are robust to the use of climate data based on actual weather station records for the period 1900-2000. The effect of historical climate variability on contemporary trust is largely robust to controlling for variability over the last century. This finding supports an explanation based on the historical formation and long-term persistence of trust attitudes over alternative arguments stressing the effect of contemporary variability.

We then explore possible mechanisms through which climate variability may have influenced the evolution of trust norms in the long run. Consistent with the hypothesis that climate shocks in the past affected agricultural incomes, we find that exposure to climate variability in pre-industrial times has significantly larger effects on trust in regions that were primarily agricultural. Moreover, we test whether climate variability is associated with a higher propensity to trade with individuals in other communities (Dean *et al.*, 1985; Nettle, 1998). To this end, we employ data on wheat prices for the years 1500 to 1900 in 98 European markets. We find that market integration - as measured by the difference in wheat prices between two markets - increases in the years after a negative climatic shock, and more so when markets are in greater distance from each other. Moreover, we document that the impact of temperature variability on social cooperation is significantly greater in regions in which a larger spatial variation in climatic and environmental conditions increased the gains from exchanging across locations, and in regions that were more closely connected to the network of Medieval trade. We also document that the effect of past climate on current trust cannot be explained by a large number of alternative mechanisms, including historical economic development, population differences, and economic specialization, nor by the historical degree of conflict, or differences in contemporaneous religiosity.

Finally, we examine the persistence of social trust. We first investigate how climate variability influenced the emergence of political institutions that further supported a culture of trust. As pointed out by Tabellini (2008), culture and institutions can operate as mutually reinforcing strategic complements. On the one hand, shared norms of cooperation create fertile ground for the adoption of more open and participative political institutions; on the other hand, by allowing citizens to participate in public life and by enforcing compliance with shared rules, these institutions further encourage individuals to trust each other. If exposure to climate risk was indeed conducive to trust-enhancing institutions, this could contribute to explaining why climate-driven differences in trust persisted long after climate had become largely unimportant for economic activity. To test this hypothesis, we look at the geographic distribution of *communes*, medieval cities characterized by a more inclusive political organization that imposed constraints on the executive and allowed larger segments of the population to participate (Putnam, 1993, Guiso *et al.*, 2016, Greif and Tabellini, 2017). We find that *communes* were more widespread in regions historically characterized by more variable climate. Furthermore, climate-driven early institutional differences appear to have persisted over time, as the same regions display better functioning local government today. Interestingly, differences in early institutions tend to explain a large part of the impact of climate variability on trust (between 24% and 32%) , which indicates that mutually reinforcing norms and institutions contributed to the perpetuation of a cooperative environment. In addition, we document that past climatic variability only affects social trust of 'locals', but has not effect on cooperativeness of immigrants. Since migrants import their own culture from outside the region, this result supports that trust norms evolved historically as a function of climatic risk, and is suggestive that norms were transmitted locally.

Our research contributes to several strands of literature. First, it builds on previous work on the origins and long-term persistence of social trust and social capital. The few existing studies on the topic have examined specific historical shocks that induced or destroyed cooperation and that had persistent effects on cooperative attitudes, such as the slave trade (Nunn and Wantchekon, 2011), the introduction of the Napoleonic *Code Civil* (Buggle, 2016), or the East German system of mass surveillance (Jacob and Tyrell, 2010).[4] To the best of our knowledge, our paper is the first to systematically explore the role of environmental factors in shaping cooperative behavior, and to document that historical patterns of cooperation in response to environmental risk continue to influence the extent to which individuals trust one another today. In a related paper, Giuliano and Nunn (2017) look at climate variability over a much longer time horizon. Their study documents that societies that inhabit environments with higher lev-

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[4] See Nunn (2012) for a comprehensive survey of the literature on the historical determinants of culture.

els of inter-generational temperature variability are today more open towards change and value traditions less.[5]

Second, our study speaks to previous research on the interplay between culture and institutions, dating back to the work of Banfield (1958) and Putnam (1993), and recently reviewed by Alesina and Giuliano (2015). A recurrent finding in this literature is the strong complementarity between the quality of political institutions and norms of cooperation, which has been studied both theoretically and empirically (Tabellini, 2008, 2010; Nannicini *et al.*, 2013; Padró i Miquel *et al.*, 2015; Guiso *et al.*, 2016; Greif and Tabellini, 2017).[6] Our findings further corroborate this view by documenting a strong link between social trust and the quality of local institutions. Crucially, we take this argument a step further by linking the co-evolution of trust and institutions to exogenous geographic conditions that shaped the structure of social interactions in pre-modern societies.[7]

In this regard, our findings can also be interpreted in the context of the classical debate on the impact of geography on long-run economic development (Sokoloff and Engerman, 2000; Acemoglu *et al.*, 2001). Recent studies have documented various ways in which bio-geographic conditions have shaped long-run socio-economic outcomes, including gender attitudes (Alesina *et al.*, 2013), time preference (Galor and Özak, 2016), ethnic diversity (Michalopoulos, 2012), the timing of the Neolithic revolution (Ashraf and Michalopoulos, 2015), and state centralization (Fenske, 2014). Our findings expand this debate by documenting that geography can also influence the emergence of particular cultural traits and institutions which, in turn, continue to influence current economic outcomes.

Finally, our paper relates to the literature on the relationship between trust and trade studied theoretically and empirically by Dixit (2003), Tabellini (2008), Guiso *et al.* (2009), and Rohner

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[5] Inter-generational and inter-annual temperature variability are strongly correlated. It is thus possible that inter-generational temperature variability is associated with an extended radius of cooperation with strangers outside the family, and therefore an increase in openness towards change and new influences. Giuliano and Nunn (2017) control for trust in strangers and document that cooperation does not explain away the effect of variability on valuing tradition.

[6] Going beyond the specific interactions between cooperation and political institutions, Bisin and Verdier (2017) derive a general model of the joint evolution of cultural and institutional characteristics.

[7] Relatedly, Greif and Tabellini (2010, 2017) compare societal organization in pre-modern Europe and China - the former based on interpersonal cooperation and external enforcement institutions, the latter on kinship loyalty and strong in-group trust. In line with our findings, they argue that in Europe '[...] norms of generalized morality provided the social and cultural foundations for institutions that supported impersonal exchange since the late medieval period' (Greif and Tabellini, 2017).

et al. (2013). Our results emphasize the importance of impersonal trade to insure against risk as a mechanism that links climate fluctuations and the emergence of inter-personal cooperation. In this respect, our findings support Tabellini's (2008) prediction that spatially diversified economic activities, involving frequent interactions with distant partners, favors the diffusion of norms of generalized trust. Our findings also relate to Jha (2013), who documents that historical trade relations decreased inter-religious conflict in India, and emphasizes the importance of the interaction between cooperative behavior and local institutions as a mechanism of persistence.

The remainder of the paper is organized as follows. Section 2 discusses evidence on the relationship between climatic risk and social cooperation, and describes the conceptual framework and its predictions. Section 3 describes the data. Section 4 illustrates the empirical strategy and presents the main results. Section 5 documents evidence on mechanisms, while Section 6 discusses persistence. Section 7 concludes.

2 Conceptual Framework and Hypothesis

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, we hypothesize that a culture of greater trust should have emerged in areas characterized by more variable weather patterns, in which *extra-familial* cooperation, and the establishment of networks of trade and exchange, would have been particularly beneficial to coping with risk.

2.1 Climate Variability and Economic Risk

The influence of climate on human behavior has been recognized at least since the work of Montesquieu (1970 [1748]). More recently, climatic conditions have been related to a number of socio-economic outcomes ranging from agricultural productivity, to health outcomes, and social conflict (Adams *et al.*, 1990; Mendelsohn, 2007; Schlenker *et al.*, 2005; Dell *et al.*, 2012; Gallup and Sachs, 2001; Miguel *et al.*, 2004; Hsiang *et al.*, 2013). Most of these contributions have focused on the impact 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 risk for agriculture and other natural resource-dependent activities. Even today, fluctuations in precipitation and temperature account for a large share of year-to-year variation in crop yields and crop failure rates (Mendelsohn, 2007; Lobell and Field, 2007); this despite the widespread availability of irrigation, chemical fertilizers, and new crop varieties which reduce yield sensitivity to weather conditions. Vulnerability to erratic weather was even more pronounced in past centuries, when the availability of these instruments was limited, and rural communities depended even more on natural resources for survival (Solomou and Wu, 1999; Le Roy Ladurie, 1971; Brunt, 2004). In fact, as Braudel (1973) pointed out, after humans had transitioned to agriculture 'the rhythm, quality, and deficiency of harvests ordered all material life'.

2.2 Insurance Mechanisms and Cooperation

The need to insulate subsistence consumption from climatic fluctuations was a key determinant of the organization of pre-industrial societies. In the absence of well-functioning credit and insurance markets, subsistence farmers 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. Some of these strategies could be efficiently implemented at the household level. For example, farmers could mitigate the economic impact of climate fluctuations by extending the set of livelihood activities to include foraging and fishing (Kates *et al.*, 1987), by diversifying crops (Halstead and O'Shea, 2004), or by selecting varieties of crops that were less sensitive to weather realizations (Morduch, 1995).

A large set of of risk-coping strategies, however, required farmers to interact and cooperate with other members of society, either within or outside their local community. By cooperating, farmers could share the economic consequences of climate shocks and reduce their immediate impacts. For example, communal storage of grains in good years for bad years helped farmers to insure against adverse climatic events, and the scattering of fields within a village that divides plots over larger areas reduced the risk of crop failure due to highly localized weather events (McCloskey, 1976). Moreover, cooperatives and charity organizations provided assistance for their members in times of need. In addition to insurance at the community level, viable strategies to cope with aggregate risk were based on the possibility of pooling risk with other individuals in nearby locations, through trade or mutual insurance relations.[8] In the following, we describe these mechanisms and discuss their historical relevance.

Storage Although storage could be carried out by a single household in isolation, due to significant economies of scale in the storage technology, collective storage facilities entailed large efficiency gains (Stead, 2004). Whether storage was an important risk-sharing device in pre-modern Europe was highly disputed in the economic history literature. While McCloskey and Nash (1984) argued that storage was limited in medieval England because of high storage costs, Fenoaltea (1976) postulated that storage was the premier risk sharing mechanism in medieval England. More recent evidence from England, but also Scandinavia and Southern Europe, documents that there was considerable use of small-scale, as well as large scale, storage of grain (Claridge and Langdon, 2011; Berg, 2007). According to Richardson (2005), storage provided an 'effective method of smoothing' against idiosyncratic as well as common risks. An example of the role of collective storage facilities in coping with weather and price volatility is analyzed by Berg (2007) in his work on the grain banks (*magasins*) in 18th and 19th century Swedish parishes. Parish granaries were constructed and organized by the village community, and administered by trustworthy villagers. They allowed farmers to borrow grain in times of bad harvests and to repay it with small interests, and the communal profits provided funds that were invested in public goods. Similar grain storage institutions existed in Norway, Spain and Italy. Besides village-level storage, storage on a larger scale was practiced on Monastic properties, and in cities with communal institutions. In Italy, for example, public granaries were erected by the communes, such as in Siena and Florence, to store grain of the local community (Keene, 1998). The creation and operation of storage depended on the capacity of the local population to act collectively with other members of the community, with potential important long-term consequences for social cooperation. For the case of Sweden, Berg (2007) speculates that 'perhaps the experience of the *magasins* played a general role in encouraging local economic cooperation through popularly controlled institutions. Such cooperation [..]

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[8] 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). 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).

may have contributed to Sweden's relatively tranquil social evolution.'

Scattering The open-field system was the prevalent agricultural system in England and in large parts of Europe in the Middle Ages. To buffer idiosyncratic, localized climatic shocks, farmers divided their plots into long thin strips scattered across the area. The open fields-system was characterized by a high degree of solidarity and collective action for the rotation and cropping regulations that were decided communally (Mokyr and Press, 2003).[9] 'Cooperation between cultivators was essential in open field agriculture, because the absence of permanent divisions between the strips of each cultivator could otherwise result in theft, encroachment and damage.' (Bailey, 2010). However, while scattering was a viable strategy to share the risks of idisoyncratic shocks among villagers, the division of fields was not apt to buffer covariate weather shocks that reduced average harvests of all villagers.

Communal risk-sharing institutions Besides storage and scattering, other informal insurance arrangements between community members were known in medieval Europe. The need to collectively manage resources and to provide insurance networks against idiosyncratic and aggregate risks triggered the emergence of 'corporations', self-governed associations characterized by voluntary cooperation between unrelated individuals shared power and accountable leaders (De Moor, 2008; Reynolds, 1997; Greif, 2006). The type and scale of these corporation was very diverse, ranging from monasteries, guilds, farmers' cooperatives, and commons in England and Northern Europe, to political corporations such as the self-governed city states in Germany and Northern Italy.

In the context of Medieval Europe, Richardson (2005) points out the role of rural fraternities - voluntary associations of rural farmers - as risk pooling institutions and their importance in coping with both weather- and non-weather related agricultural risk in Medieval England. These rural guilds provided members with solidarity, mutual insurance and access to aid and loans in times of need. Only trustworthy peasants were allowed to become a member of a fraternity, and they were expected to act in line with the collective goals of the association. Similar evidence for 18th century France is available from Baker (2004) who investigates the

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[9] With the enclosure movement, starting in the 16th century in England, however, the open-fields-system was dissolved.

role of regional voluntary associations as collective means used by French peasants to shield themselves against climatic shocks.

In early modern Europe, cooperatives and self-help organizations were crucial for buffering risks and providing aid (McIntosh, 1999). Their common element was the need for mutual trust and cooperation in exchange for help, since 'farmers would only be willing to place their economic welfare in each others' hands if they trusted each other to do a professional job.' (O'Rourke, 2007). In his study of cooperation in Italy, Putnam (1993) underlines the role of self-help associations for producing social capital: 'the regions characterized by civic involvement in the late twentieth century are almost precisely the same regions where cooperatives [...] and mutual aid societies were most abundant in the nineteenth century.'

Trade Insurance mechanisms at the village level are generally particularly effective in providing partial insurance against idiosyncratic shocks. However, these networks are generally too small and spatially concentrated to provide insurance against more aggregate weather shocks. Insurance capacity against climate shocks could be improved by expanding the radius of socio-economic relations to individuals living in distant locations, likely to be affected by shocks in different ways. In particular, the establishment of trade links that allow to import food in times of adverse shocks from regions that were not hit by the same shock were a viable strategy. However, the creation and maintenance of these socio-economic connections entailed high communication and monitoring costs, and therefore required a higher degree of trust. 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'.

Anthropological research, as well as historical evidence from Medieval Europe, documents the importance of trade for overcoming environmental risks.[10] Scott (1977), for instance, de-

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[10] 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. King (1971) documents 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 potlatch, a system based

scribes that the formation of social networks was essential to ‘provide households social insurance against the ’normal’ risks of agriculture through an elaborate system of social exchange’. Research on language diversity, in addition, supports the argument that societies widened their social networks in the face of higher economic risk. Nettle (1998) notes that ‘where there is a marked dry season or probability of a drought year [...] households form social ties over a wide area, to gain access to resources elsewhere in time of local shortage. [...] the greater the ecological risk, the larger the social networks people must form to ensure a reliable supply of basic subsistence products’.

During the Medieval period, an important network of trade in grain emerged in Europe that provided regions with food in times of crop shortages and famines (Pounds, 1985; Studer, 2015). A large part of the grain trade was relatively local, and exchange was limited to communities within small regions or between larger settlements and cities and their hinterlands (Bateman, 2011). Whenever the impacts of weather shocks were geographically widespread, however, trade in grain was extended to more distant regions (Gerrard and Petley, 2013). If price differentials caused by climatic shocks were large enough to make up for transportation costs, long-distance trade of grain emerged across European regions. By the end of the Middle Ages, trade relationships spanning several countries were well established and regularly used. Grain was shipped over the sea to coastal areas, it was transported on large, navigable rivers, such as the Rhine river, and over land (Studer, 2015). The Low Countries imported heavily grain from Northern French regions of Artois and Picary, as well as the Rhine area, and even England. Northern Italy imported grain from France, Southern Italy, and sometimes even Northern Europe (Bateman, 2011; Keene, 1998). In 1303, after a year of heavy rains that led to crop failure, Florence bought 26,000 modia of grain from Southern Italy (Day, 2000). Already in the 12th century England and Norway had established a regular trade relationship, exchanging corn for stockfish (Keene, 1998; Hybel, 2002), while at the same time some corn

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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.

was also imported into England from Denmark. By the end of the 13th century, the trade routes linking Northern Europe were fully developed. At the end of the 15th and 16th century, food was imported from even more distant places, when the Baltics became a major supplier of grain for Western Europe (Hybel, 2002).

Crucially, the historical evidence suggests that market integration increased after bad harvests, as new trade relationships were established after periods of food shortages and famines. Alfani (2010), for example, describes a series of famines caused by adverse climatic shocks that covered large areas of Northern Italy in the mid of the 16th century. Because of the wide geographic coverage of the crisis, the traditional nearby suppliers were not able to provide cereals. As a result, grain was imported from far-away Baltic areas. Thus, 'this crisis in fact played a fundamental role in establishing the Baltic as a key source of supply of cereals.' (Alfani, 2010).

2.3 Emergence and Persistence of Social Trust

Previous research in evolutionary anthropology on social learning provides a good theoretical framework to study the emergence of mutual trust (Boyd and Richerson, 1988, 2004) . 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 increases fitness, norms that facilitate fruitful interactions such as trust will be particularly valuable and will become prevalent.[11]

If trust emerged as a response to climate risk, how did differences in trust persist over

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[11] 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.

time, even after weather patterns became less important for economic activity?[12] Growing evidence suggest that in fact cultural attitudes can persist for surprisingly long periods of time (Voigtländer and Voth, 2012; Alesina *et al.*, 2013). At the individual level, this persistence is generally attributed to intergenerational transmission operating through deliberate inculcation by parents. This view is consistent with recent empirical findings documenting the existence of a positive correlation in the propensity to trust between parents and children (Dohmen *et al.*, 2012) and between second-generation immigrants and current inhabitants of the country of origin (Algan and Cahuc, 2010).

An alternative way how cultural norms can be preserved over very long time periods could arise from the interplay of cultural norms with the institutional environment (Belloc and Bowles, 2013). Tabellini (2008), for example, explores theoretically the possibility of strategic complementarities between norms of interpersonal cooperation, and institutions that enforce it. Depending on the initial external environment that a society faces, multiple equilibria are possible that are either characterized by high social trust and 'strong' institutions, or by limited trust and 'weak' institutions (Tabellini, 2008; Greif and Tabellini, 2010, 2017).[13] The mutually-reinforcing character of norms and institutions facilitate the persistence of these equilibria over time. Qualitative and quantitative evidence supports that well functioning political institutions and cooperative behavior go hand in hand (Putnam, 1993; Banfield, 1958; Nannicini *et al.*, 2013; Padró i Miquel *et al.*, 2015).

Moreover, historical evidence suggests that areas with higher capacity to cooperate developed more inclusive institutions in pre-modern Europe (Greif, 2006). Putnam (1993) describes the link between cooperation and governance in Italy, where civic associations 'had contributed to the flourishing communal republics of the twelfth century.' If complementarities between trust and institution are an additional mechanism for the conservation of social cooperation, we would expect institutional arrangements that enforce cooperation between citizens to be more

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[12] This is true for contemporary industrialized countries where a small fraction of the population relies directly on incomes from agriculture. In developing societies where farming is an important source of income weather volatility still plays a major role for economic activity.

[13] Importantly, in Tabellini (2008) the complementarity between institutions and norms depends on the spatial extent of interactions. Local economic activity and local enforcement impede the evolution of generalized trust, and generate a substitutability between institutions and culture. In a context in which impersonal transactions are frequent the model predicts a complementarity between formal institutions and norms, and a more-widespread diffusion of norms of generalized trust.

prevalent in areas with higher historical climatic volatility.

3 Data

To test the hypotheses discussed above, we combine climate data for the last 500 years with survey data on social trust. In what follows we describe the main data sources and the construction of the variables used in our empirical analysis. Appendix Table B1 reports the summary statistics for the main variables, which are described in detail in the Data Appendix.

3.1 Climate Variability

With regard to climatic variables, we focus on variability in temperature and precipitation for measuring weather related risk during pre-industrial times. Both rainfall and temperature have a considerable impact on agriculture and other natural resource-dependent activities, and are highly correlated with other important climatic factors such as relative humidity, cloud cover, and solar radiation. We employ two kinds of climatic data covering different time periods. First, we use reconstructed paleoclimatic data for the period 1500-2000 to assess the degree of historical climate variability. As we are mainly interested in climatic conditions in pre-industrial times, we compute the main measure of climate from 1500, the earliest date for which data are available, until 1750, which is a plausible start date of the Industrial Revolution. In addition, we use gridded data derived from actual weather station records covering the period 1901- 2000. These are high-quality data, both in terms of temporal frequency and spatial resolution, but since they only cover the last century they are an imperfect proxy for past climate.

Climate data 1500 - 2000 Climate data for the last five centuries are available from paleoclimatic studies. These 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. 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) (Luterbacher *et al.*, 2004; Pauling *et al.*, 2006).[14] The cells in the ESTPR grid have width of $0.5\,^{\circ}$, which corresponds to approximately 56 kilometers at the equator. For each cell the data include seasonal observations for each year between 1500-2000.

Climate data 1901 - 2000 For robustness, we also use climate data for the last century available from the TS 1.2 data set constructed by the Climatic Research Unit (CRU) of the University of East Anglia (Mitchell *et al.*, 2004). The CRU TS 1.2 data are in grid format and cover most of the European surface at a 10-minute spatial resolution, which corresponds to approximately 20 kilometers at the equator. Besides their smaller spatial resolution, the CRU 1.2 data have the additional advantage of providing, for each cell, monthly observations for both air temperature and precipitation. The data are constructed from actual climatic records collected at a number of weather stations throughout Europe and generalized at the grid cell level via interpolation.

Using the example of Sicily, Appendix Figure A2 provides a visual sense of the difference in cell size between the CRU and the ESTPR data. 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.

Measuring Climate Variability From the raw temperature and rainfall records we construct measures of inter-annual variability. Each measure of variability is computed first at the cell level, and then aggregated at the regional level. With the historical data we compute for each season s, the standard deviation of the observed climate at the cell level for predefined time-periods, which measures the season-specific variability of temperature or precipitation in cell i. Consider climatic variable x, cell i (part of region r), season s and year y, and define x_{isy} as the value of x in cell i in season s in year y. For each season s, we compute the standard deviation of x_{isy} over all years of interest (denoted σ_{is}), which measures the season-specific variability of variable x in cell i.[15] Finally, we average σ_{is} over all cells in region r to obtain a regional measure of variability in season s, σ_{rs}. Following this procedure we can construct

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[14] 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.

[15] The use of the standard deviation (or variance) as a measure of climatic variability is common in climatology.

measures of variability for the entire 500-year period, but also focus on specific sub-periods, as we do in the empirical analysis. Our main measure of climate variability is the inter-temporal variability during the growing season in the period 1500-1750, that is the average variability in the spring and summer season, averaged over the years 1500 to 1750. The definition 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.[16] The growing season for these crops generally coincides with the spring and summer months.[17] Data from the Food and Agriculture Organization Global Agro-Ecological Zones project (FAO-GAEZ) on the start date and length of the growing period for rainfed wheat in contemporary times allows us to compute an approximation of the relevant months of crop growth for each region in our sample.[18] The distribution of growing months is displayed in Appendix Figure A5. It shows that most of crop growth takes place in the spring and summer months from March to August, as well as September, and to a lesser extent October.[19]

In addition to the separate measures of rainfall and temperature variability, we construct a composite indicator of climatic variability using principal component analysis. As the principal component reflects the overall degree of regional climate variability, we expect it to have the strongest effects on our outcomes of interest. For robustness, we also construct measures of climatic fluctuations over alternative historical periods in the timeframe 1500 to 1900. The same procedure described above is applied to construct measures of climate variability for the period 1901-2000 using the CRU data. The only difference is that, in the case of the CRU data, monthly and not seasonal observations are available. Hence, given x_{imy}, the value of climatic

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[16] Even in current times, cereals continue to have a prominent role in European agriculture. According to EUROSTAT, in 2013 cereal production used more than half of the total arable land in the European Union.

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

[18] Formally, the growing season is defined as the period when temperature are above $5°C$, and rainfall exceeds half the potential evapotranspiration.

[19] Similarly, 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 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).

variable x in cell i in month m in year y, we first compute σ_{im}, the standard deviation of x_{imy} over all years of interest, then average it over the months of interest to obtain σ_i, and finally over all cells in region r to obtain σ_r. In what follows we define the growing season as the months between April and September; however, as discussed below, results are robust to alternative choices of growing season, and to using location specific definitions of the growing period that are highly correlated.

Appendix Figures A1b and A1a show the distribution of the measures of growing season temperature and precipitation variability for the period 1500-1750. Figures 1a and 1b display, instead, the geographic distribution of the same variables, and illustrate well the considerable differences in historical variability both across and within European countries.

Despite the difference in the underlying data and spatial resolution, the regional measures of climatic variability derived from historical and modern records are highly correlated (see Figures A3 and A4). The correlation between variability in 1500-1750 and in 1901-2000 - depicted in Figure A3 - is 0.85 for precipitation, and 0.47 for temperature. This seems reasonable in light of the fact that climatic conditions - both their average and variability - are in large part determined by geographic factors which tend to remain fairly stable over long periods of time.

3.2 Geographic controls

To isolate the effect of climate variability on our outcomes of interest, and to insure that climate is no merely proxying for other geographical factors, we control for a range of variables that the literature has 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 our empirical analysis we control for the average level of temperature and precipitation at the regional level. Long-run averages are constructed from the ESTPR data over the entire period for which information is available.

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.[20] To

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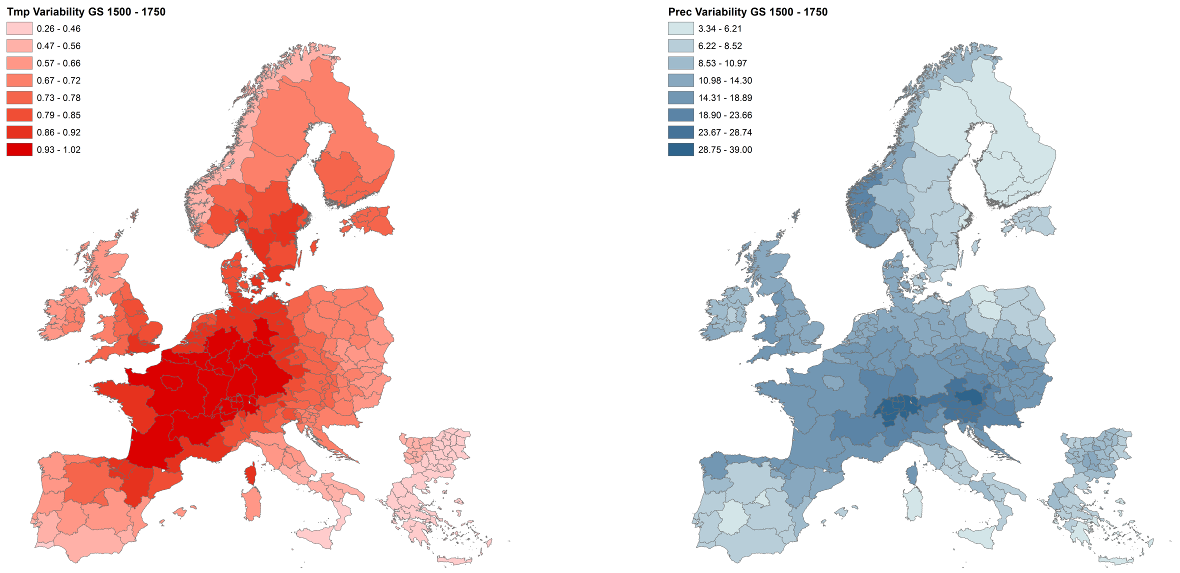
[20] In his study on the environmental origins of ethnolinguistic diversity, Michalopoulos (2012) argues that, by favoring the accumulation of region-specific human capital, differences in land endowments limited population mobility and lead to the formation of localized ethnolinguistic groups.

Figure 1: *Spatial Distribution of Climate*



(a) *Temperature Variability 1500 - 1750* (b) *Precipitation Variability 1500 - 1750*

account for this aspect, in all regressions we include measures of both average land quality and variability in land quality (proxied by its standard deviation) at the regional level. High-resolution data on soil suitability are available from the Food and Agriculture Organization Global Agro-Ecological Zones project (FAO-GAEZ). The FAO-GAEZ data are constructed to measure soil suitability for rain-fed cereals assuming the absence of irrigation, making them particularly suited for the historical analysis of pre-industrial societies. The suitability index ranges from 1 (totally unsuitable) to 8 (very suitable).

Furthermore, terrain ruggedness can also have both a direct and an indirect impact on patterns of human interaction and on economic outcomes (Nunn and Puga, 2012). 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 micro-ecosystems to manifest over relatively small distances; as a consequence, climatic realization on the one side of the mountain can be very different from those on the other side. To control for the relationship between climate variability and topography, we include in all regressions the average altitude of the region, and the mean slope of the terrain. Both measures are derived from the FAO-GAEZ database.

We also take into account differences in access to waterways, in particular to the sea and rivers, that may potentially be correlated with both climate variability and the outcomes under study. 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 without access to the sea to have been historically less exposed to other populations, and 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 and trade, particularly in areas with limited access to the sea. We measure the access to the sea by the nearest distance from the region's centroid to the coastline, and by an indicator variable for whether the region is not landlocked. We also control for the presence of a major rivers passing through each region. Finally, all regressions control for the (log) of a region's area and the region's latitude and longitude, which should capture differences in geographic conditions other than those discussed above.

3.3 Trust

To measure trust in others, we use data from eight rounds of the European Social Survey (ESS), a bi-annual survey designed to monitor individual attitudes across European countries - similar to the American General Social Survey (GSS). The ESS surveys a representative sample of a country's population aged 15 and over. We combine eight rounds of the ESS that were conducted every two years between 2002 and 2016. The ESS covers a large set of countries, however not all countries are surveyed in all rounds. Surveys were conducted in France, for example, in all of the eight rounds, but Greece was included in only four rounds (2002, 2004, 2008, 2010). In addition to the country of origin, the ESS data include information on the region where each respondent reside, which allows to study differences in attitudes at the sub-national level. This approach is more consistent with our theoretical framework, which links the evolution of trust to social responses to climate risk at the local level. The definition of regions in the ESS largely corresponds to each country's administrative divisions, which, in turn, often coincide with one of the three levels of the European NUTS classification.[21] The list of countries and respective number of regions per ESS round is reported in Table B27.

The ESS questionnaire includes a version of the standard trust question, commonly known as the Rosenberg 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 10 means that most people can be trusted'.* Doubts have been raised about the ability of this kind of question to accurately capture trust attitudes. For example, some have argued that the question is 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. This view has been confirmed empirically by Delhey *et al.* (2011), who find that trust in 'most people' relates to out-group trust, i.e., trust in strangers. In addition, responses to survey-based trust questions have been shown to be good predictors of actual behavior in trust experiments, both in the field and in the lab (Glaeser *et al.*, 2000; Fehr *et al.*, 2002; Sapienza *et al.*, 2013).[22] We compute the average trust score of a region as the mean of the individual score of respondents interviewed in the region for each of the eight ESS rounds. In the calculation of average trust, we exclude migrants, i.e., individuals who are born outside the country or whose parents were born outside of the country. We use the population of migrants separately in section 6 when we test for the local persistence of trust.

The regional averages are computed from more than 250,000 individual respondents. The distribution of people surveyed per region and round has a median of 142 individuals, the 10th percentile of people sampled is 40, and the 90th percentile is 321 individuals. Figure 2 depicts the geographic distribution of the trust variable in our sample, and illustrates the well-

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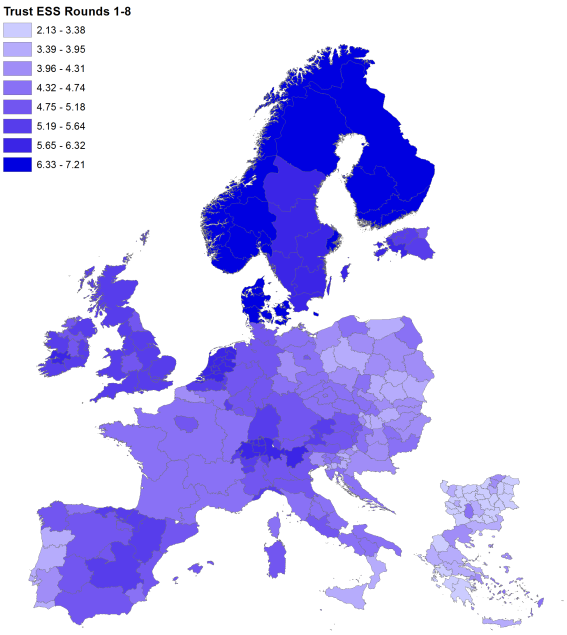
[21] The Nomenclature of Territorial Units for Statistics (NUTS) is a three-level hierarchical classification established by EUROSTAT in order to provide a single uniform breakdown of territorial units for the production of regional statistics for the European Union. Depending on their size countries can have between one to three levels of divisions. In the case of small countries, such as Luxembourg, each of the three NUTS level corresponds to the entire country. The number and size of the ESS regions vary considerably from country to country. While in Germany regions coincide with the 16 Federal States (NUTS1), in Bulgaria the regional classification corresponds to the 28 oblasts (NUTS3).

[22] In our robustness analysis, we additionally consider questions that ask respondents whether they believe other people are fair and whether others are helpful as alternatives measures of cooperation.

documented differences in trust between Northern Europe, on the one hand, and Southern and Eastern Europe, on the other, as well as the sizable differences between regions of the same country.

Figure 2: *Spatial Distribution of Trust*



4 Climate Risk and Social Trust

4.1 Main Results

To test for the relationship between climate variability and cultural and institutional outcomes, we first look at differences in trust across European regions. Using data at the sub-national level allows to control for all country-specific factors that may potentially have an impact on our outcomes of interests - such as the legal system or government regulation (Aghion *et al.*, 2010) - and for the common historical background shared by regions belonging to the same country. Furthermore, this approach alleviates the concerns related to border and country formation inherent to cross-country analysis allowing for a more compelling test of our hypotheses.

More precisely, we pool together several survey waves and regress average trust in region r and survey round t on historical climate variability, geographic controls and country times survey round fixed effects:

$$y_{r,t,c} = \alpha + \beta variability_{r,c} + \Gamma_{t,c} + X'_{r,c}\delta + \varepsilon_{r,c} \tag{1}$$

Subscripts r and c indicate respectively the region and the country, t indicates the survey wave. $y_{r,t,c}$ is the outcome of interest, $variability_{r,c}$ is one of the measure of inter-annual climatic variability, and β the coefficient of interest. $\Gamma_{t,c}$ denotes country × survey wave fixed effects, while $X'_{r,c}$ is the set of all region-specific geographic controls described above. Standard errors are clustered at the country × survey wave level in all regressions. For robustness, we also compute wild cluster bootstrap standard errors, and to account for the possibility that error terms are correlated across neighboring regions (even outside a given country), we also compute standard errors using the method by Conley (1999).[23]

We start by graphically examining the relationship between the level of trust in European regions today and historical climate variability. Figure 3 shows the kernel density for the trust variable separately for regions with above- and below-median variability in both temperature and precipitation over the period 1500-1750 (top and bottom panel respectively). Both graphs indicate a stark difference in the distribution of trust in high-variability vs. low variability regions, with the earlier ones displaying generally higher trust.

In Table 1 we estimate several variants of equation (1), using three different measures of historical climate variability: variability in temperature (columns 1 to 3), variability in precipitation (columns 4 to 6), and the principal component of the two (columns 7 to 9). We first estimate the relationship between trust and temperature variability in the growing season (i.e., spring and summer), controlling for country times wave fixed effect and the full set of geo-

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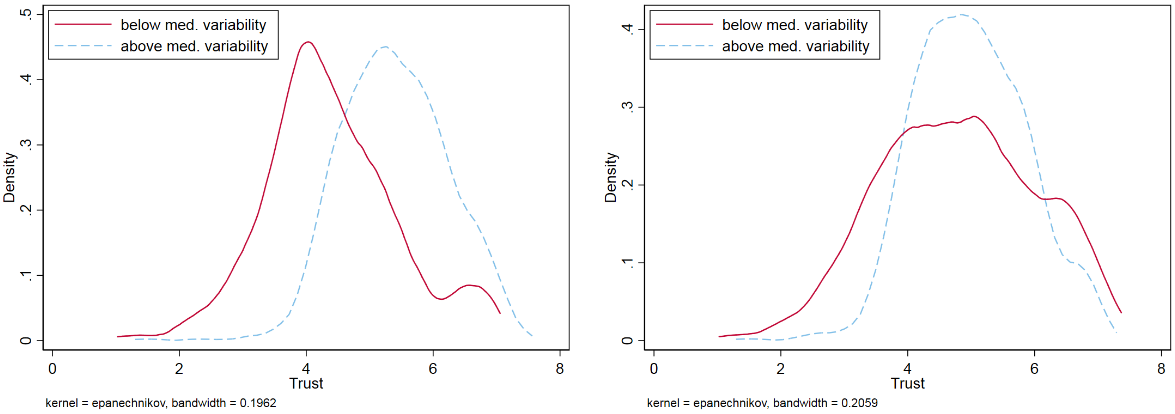
[23] To compute the wild cluster bootstrap p-values, we use the `cgmwildboot` package for Stata by Judson Caskey. We calculate Conley standard errors assuming a cutoff distance of 300km, using the `acreg` command for Stata by Colella *et al.* (2019). Appendix Table B10 shows that distances between 200km and 300km are among the most conservative cutoffs (depending on the right-hand side variable), and that the results are robust to other cutoff distances. We opt for 300km, but the results do not change if we use a cutoff distance of 200km. Appendix Figure A6 illustrates the 300km radius that we assume.

Figure 3: *Kernel Densities*



(a) *Temperature Variability*

(b) *Precipitation Variability*

graphic controls (column 1). The coefficient on temperature variability is positive, statistically significant at the 1% level, and quite sizable: a one-standard deviation increase in temperature variability is associated with an increase in trust of about 17% of a standard deviation. We obtain similar results when looking at the impact of precipitation variability (column 4): a one standard deviation increase in variability is associated with an increase in average trust of 12% of a standard deviation.

Table 1: *Main Results*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:	Trust								
	Temperature			Precipitation			Principal Component		
Variability GS 1500 - 1750	1.031***	0.929***	1.170***	0.018***	0.018***	0.007	0.151***	0.142***	0.148***
	(0.266)	(0.288)	(0.291)	(0.006)	(0.006)	(0.008)	(0.037)	(0.039)	(0.038)
Variability NGS 1500 - 1750		0.135			-0.003			0.043	
		(0.233)			(0.007)			(0.046)	
Variability GS 1900 - 2000			-0.452			0.027**			-0.056
			(0.541)			(0.011)			(0.052)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Number of Clusters	155	155	155	155	155	155	155	155	155
P-value joint significance of variability			0.00			0.00			0.00
p-values Wild Bootstrap									
Variability GS 1500 - 1750	{0.000}***	{0.000}***	{0.000}***	{0.000}***	{0.002}***	{0.454}	{0.000}***	{0.000}***	{0.000}***
Conley S.E. 300km									
Variability GS 1500 - 1750	[0.344]***	[0.340]***	[0.369]***	[0.011]*	[0.011]*	[0.015]	[0.056]***	[0.060]**	[0.057]***

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

We then test whether variability during the growing season months has a larger impact on trust than variability in other months, as one would expect if mutual cooperation emerged in response to economic risk at times in which agriculture was the dominant activity. To examine this aspect, in columns 2 and 5 we control for variability in the non-growing-season months - i.e., fall and winter - computed over the same 250-year period. For both temperature and precipitation we find that, while the coefficient on variability in the growing season remains largely unchanged, variability in non-growing season months has no independent effect on trust. This result is consistent with the effect of climatic variability operating primarily through agricultural risk.

Finally, we test whether differences in trust are driven by historical rather than contemporary climate variability, by controlling in columns 3 and 6 explicitly for variability over the past century. Considering temperature, the findings indicate that variability in pre-industrial times has a positive influence on contemporary trust, while contemporary variability has virtually no effect. However, for precipitation the estimate on historical variability changes and becomes insignificant. This is likely due to the high correlation between historical and contemporary precipitation variability documented above, and the improved precision of the contemporary rainfall data. The two variables are are jointly significant (F-test: p-value: 0.00).

We get consistent results using a composite indicator of historical climatic risk given by the principal component of precipitation and temperature variability in the growing season (columns 7-9). The estimated coefficient is always significant at the 1% level, and is unaffected by the inclusion of contemporary variability or variability in other periods of the year. A one standard deviation increase in the principal component increases trust by 18% of a standard deviation. Finally, we consider two alternative ways of computing standard errors, and report at the bottom of the table wild bootstrap p-values (1'000 repetitions), and standard errors adjusted for spatial correlation following Conley (1999). Both approaches produce very similar conclusions about the significant effects of climate variability on trust.[24].

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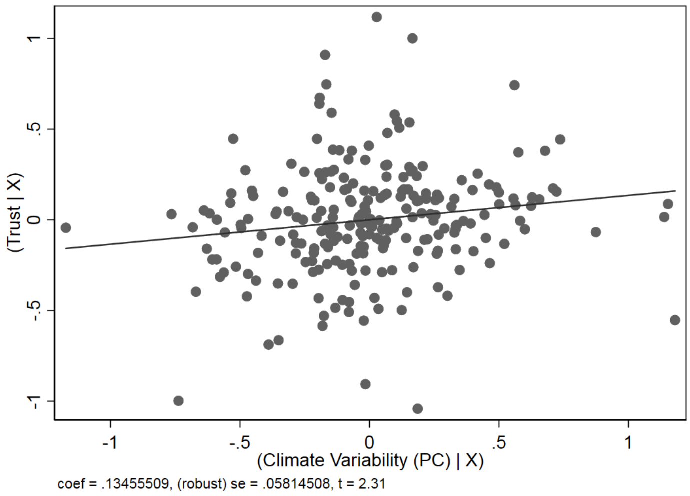
[24] Appendix Table B2 shows the estimated coefficients of all controls. We estimate larger effects of past climate variability on trust today in models without country fixed effects, as reported in Appendix Table B3. However, specifications without country fixed effects are less apt in terms of isolating the effect of climate variability on trust, as country dummies absorb some important climate-geographic and institutional characteristics that are unobserved, but common to all regions within a country, and that plausibly affect trust. In Appendix Table B5, we cluster at the level of the country and find comparable results in terms of statistical inference. Moreover, in Appendix Table B6, we cluster at the level of the location where historical climate data has been recorded. For each region, we computed the closest site of climatic observation, taken from Luterbacher *et al.* (2004). Statistical

We find very similar results when collapsing the data at the regional level and considering the mean of trust over all survey rounds as dependent variable, see Appendix Table B4. We provide a visual representation of this result in Figure 4 where we show the partial regression plot of average regional trust on the principal component of climate variability, conditional on regional controls and country fixed effects.

Figure 4: *Average Trust and Climate Variability (Principal Component)*



NOTES: Partial regression plot between average regional trust and climate variability, conditional on geographic controls and country fixed effects. See Appendix Table B4 for the corresponding regression results.

We then replicate all the results at the individual level using data on self-reported trust, rather than the average regional score. Estimating individual-level regressions allows us to control for a number of respondents' personal characteristics that may vary across regions and be correlated with trust attitudes, in particular gender, age, and education, and to cluster standard errors at the level of the sub-national region. The results, presented in Table 2, confirm the positive and significant effect of all three measures of climate variability on trust attitudes, and allow us to exclude that this relationship is driven by regional differences in respondents' characteristics.

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inference is very similar when clustering at the level climatic observation.

Table 2: *Main Results: Individual Level*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:	Trust								
	Temperature			Precipitation			Principal Component		
Variability GS 1500 - 1750	0.575**	0.769**	0.585**	0.013*	0.014*	0.013	0.098**	0.097**	0.100**
	(0.259)	(0.314)	(0.272)	(0.008)	(0.008)	(0.011)	(0.038)	(0.042)	(0.041)
Variability NGS 1500 - 1750		-0.261			-0.006			0.003	
		(0.270)			(0.007)			(0.045)	
Variability GS 1900 - 2000			-0.039			0.001			0.017
			(0.592)			(0.015)			(0.078)
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	252,364	252,364	252,364	252,364	252,364	252,364	252,364	252,364	252,364
R-squared	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Number of Clusters	239	239	239	239	239	239	239	239	239

NOTE: OLS regressions. The unit of observation is an individual. Individual controls include age and its square, gender, and dummies for years of education. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the sub-national region in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

4.2 Robustness Checks

We perform a number of tests to verify the robustness of the relationship between trust and climate variability, and to explore other related aspects.

First, we check that our results are not driven by presence of outliers with respect to the dependent variable. To this end, in the first two columns of Table 3 we estimate our baseline specification excluding either Scandinavian or former Communist countries, which are generally characterized by very high and very low levels of trust respectively. In both cases, the coefficients on climate variability are very similar to those estimated on the full sample.

We then verify that our results are robust to controlling for the timing of the transition to agriculture. Indeed, previous work suggests that climate variability in ancient times is associated with a delayed adoption of agriculture (Ashraf and Michalopoulos, 2015), and that the timing of such transition can have long-lasting impact on various aspects of economic development which influence cultural attitudes (Olsson and Paik, 2016). To control for this possibility, we construct a regional measure of the timing of the Neolithic revolution that builds on archaeological records from various prehistoric sites in Europe (Pinhasi *et al.*, 2005). The results, shown in columns 5 and 6 of Table 3, show that the timing of the transition to agriculture has no independent effect on trust, and that, controlling for it, does not effect the coefficients of interest.

We also explore whether the impact of climate variability on trust differs for moderate vs. high levels of variability, and, in particular, whether extreme volatility can hamper rather than favor cooperation. To do so, we augment our baseline specification adding a quadratic term. The results, presented in columns 7 and 8 of Table 3, do not provide strong evidence for the existence of an inverted U-shaped between variability and trust: the coefficients of the square of variability are statistically insignificant.

Table 3: *Robustness*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Trust							
	No Scandinavia		No Eastern Europe		Neolithic Revolution		Quadratic	
Temperature Variability GS 1500 - 1750	1.241***		1.291***		1.214***		1.318	
	(0.292)		(0.305)		(0.287)		(2.086)	
Precipitation Variability GS 1500 - 1750		0.021***		0.026***		0.020***		0.007
		(0.007)		(0.006)		(0.007)		(0.017)
Years since Neolithic Revolution					-0.018	0.009		
					(0.066)	(0.065)		
Sq. of Temperature Variability							-0.195	
							(1.373)	
Sq. of Precipitation Variability								0.000
								(0.000)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,296	1,296	999	999	1,395	1,395	1,476	1,476
R-squared	0.74	0.74	0.83	0.83	0.80	0.80	0.83	0.83
Number of Clusters	125	125	111	111	148	148	155	155
Conley S.E. 300km								
Temperature Variability GS 1500 - 1750	[0.408]***		[0.338]***		[0.398]***		[2.093]	
Precipitation Variability GS 1500 - 1750		[0.012]*		[0.010]**		[0.012]*		[0.021]

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Moreover, we investigate the likelihood that the relationship between past climate variability and current trust is driven by unobservable regional characteristics. Following Altonji *et al.* (2005), we compute the ratio $beta_f/beta_r - beta_f$, where $beta_r$ is the coefficient obtained from regressions of trust on climate variability conditional on only country fixed effects, and $beta_f$ the coefficient when adding the full set of geographic controls. We find that adding geographic controls increases the size of the coefficients of climate variability, and therefore compute ratios that are negative. This test thus suggests that, if anything, our estimates are likely biased downwards, and thus increases our confidence that the results are not severely confounded by unobserved regional characteristics.

Other Historical Periods To verify that our results are not sensitive to the choice of the time period used to compute historical climate variability (i.e., 1500-1750 in our baseline), in Appendix Table B7 we re-estimate our main specification using measures of variability for three alternative periods: 1500-1700, 1500-1800, 1500-1900. The choice of the specific period appears to be irrelevant as the estimated effects for both temperature and precipitation variability remains largely unchanged.

Modern Climate Data Related to the above, to make sure our results are not influenced by the coarseness of the reconstructed historical climate data, we re-estimate our main specification using high-resolution climate data for the period 1900-2000 based on actual weather stations records.[25] The results, shown in Table B8, confirm our original findings: regions with more variable climate, particularly temperature variability in growing season months, display significantly higher levels of trust. The magnitude of the effect is also similar: depending on what measure of variability is used, a one standard deviation increase in variability is associated with an increase in trust of between 14% to 18% of a standard deviation. The fact that we find similar effects for climate variability measured in different historical periods, as well as in contemporary times, makes us confident that our baseline regression that use variability in the period 1500-1750 is not driven by climate anomalies specific to this period. In addition, the monthly data for the modern period allows to compute the growing period specific to each region. Using this measure, columns 7 and 8 document very similar effects that are even more precisely estimated, particularly for temperature variability. As additional test we move the commonly defined start and end dates of the growing season. Appendix Table B9 displays the results obtained using alternative terms of the growing season which are largely similar to those of the base specification, although less precise for precipitation variability. Together, these tests gives additional support for the importance of growing-season variability for the emergence of cooperation.

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[25] Using data on contemporary climate to proxy for past climate is motivated by the assumption that the geographic distribution of climatic conditions in the twentieth century is related to that in the past; this assumption seems reasonable in light of the fairly high correlation between past and contemporary variability depicted in Figures A3 and A4.

Geographic Matching To further corroborate our results, we also estimate the effect of climate variability on trust using a nearest neighbor matching procedure. We first identify regions with above-median variability in either precipitation or temperature (i.e., the 'treated' ones). We then match each one of them with the four nearest regions with below-median variability, using only the proximity of the regions' centroids as matching variable, and compare the mean of trust averaged over all waves. The matching estimates, presented in columns 1, 3, and 5 of Appendix Table B16, confirm that high variability in both temperature and precipitation is associated with significantly higher levels of trust. We obtain analogous results when matching regions based on both proximity and geographical controls (columns 2, 4, and 6 of Table B16). The effects are quite sizable: above-median variability is associated with an increase in trust of between 14% and 85% of its standard deviation, or between 3% and 18% of its mean.

Other Indicators of Cooperative Norms In addition, we test whether climate affects related indicators of cooperativeness other than trust. To this end, we use two alternative survey questions from the ESS that ask respondents to evaluate on 10-point scale whether they belief that a) other people are generally fair; and b) whether others are helpful. Both indicators are positively correlated with trust (with correlation coefficients of 0.9 and 0.87 respectively). We combine the two variables into a single measure by extracting the first principal component. Appendix Table B11 displays the results of regressing the principal component of cooperativeness on climate variability across regions, and Appendix Table B12 shows the individual-level results. We observe again that historical temperature and precipitation variability has a positive and significant effect on cooperativeness across regions and individuals.

Moreover, our conceptual framework suggests that climate variability could have fostered norms of reciprocity. In Appendix Section B.5, we investigate the link between climate variability and contemporary measures of positive and negative reciprocity in a sample of 124 regions. The results do not indicate that areas with more variable climate in the past are characterized today by greater levels of reciprocity. To the extent that the measures of reciprocity that we use elicit personalized rather than generalized trust as suggested by the correlation coefficients in Table B13, these findings corroborate, or at the least do not contrast, with our hypothesis.

Table 4: *Family Ties*

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables:		Trust			Family Ties	
Temperature Variability GS 1500 - 1750	0.149**			-0.417**		
	(0.065)			(0.205)		
Precipitation Variability GS 1500 - 1750		0.003*			-0.010*	
		(0.002)			(0.005)	
Principal Component Variability GS 1500 - 1750			0.024**			-0.070**
			(0.010)			(0.031)
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	62,912	62,912	62,912	47,411	47,411	47,411
R-squared	0.13	0.13	0.13	0.12	0.12	0.12
Number of Clusters	226	226	226	218	218	218

NOTE: OLS regressions. The unit of observation is an individual. Individual controls include age and its square, gender, and dummies for education classes. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the sub-national region in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Family Ties To explore another angle of the impact of climatic risk on cultural attitudes, we examine the relationship between historical variability and the strength of family ties. Previous research indicates that the more central are family relations in the life of individuals the less these will tend to trust and engage with other members of the community (Banfield, 1958; Alesina and Giuliano, 2013).[26] If climate variability encouraged extra-familial cooperation and reduced the dependency on the family for insurance purposes, then it should be associated with weaker family ties. To test this hypothesis, we use data on beliefs about the importance of the family available from the European Values Survey (EVS), which covers a sample of 62,000 individuals in 24 countries. In particular, following Alesina and Giuliano (2010), we use as measure of the strength of family ties the principal component of respondents' answers to questions about i) the importance of family in life, ii) parents' responsibilities towards children, and iii) children's respect towards parents. We present the results in Table 4. While in the first three columns we validate our baseline results on trust using the EVS measure, in the following ones we show that historical climate variability has a significant negative impact on the strength of family ties, regardless of what measure of climate is used.

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[26] Consistent with this previous research, we find a strong negative relationship between the strength of family ties and interpersonal trust in our sample (see Appendix Figure A7).

5 Mechanisms

Taken together, the evidence discussed so far points to a very robust relationship between climatic variability and interpersonal trust. In particular, our results suggest that climate-driven economic risk in pre-industrial times favored the emergence of norms of mutual cooperation that persisted even after climate became largely unimportant for economic activity. In what follows we attempt to shed light on the possible mechanisms through which climate influenced patterns of cooperation, and test for alternative mechanisms.

5.1 Agriculture

A crucial element of our hypothesis argues that climate variability induced cooperation because it affected agricultural incomes. We found supportive evidence for this idea since climate variability measured in the agricultural growing season affects trust, but not variability outside the growing season. In this sub-section, we take this hypothesis further and test whether erratic climate favored the emergence of trust more strongly in areas in which incomes were mainly derived from agricultural activities in historical times. For this test, we exploit regional variation in the share of labor in agriculture in 1900, available for a sub-set of 130 of the regions of our sample, compiled by Rosés and Wolf (2018). The year 1900 is the earliest period for which this labor shares in different is widely available. We divide the sample of regions into those in which agriculture was the dominant source of income in 1900 (share of labor in agriculture larger than 50%), and those in which industry and service occupations were predominant.

Table 5 reports the interaction effects between past climate variability and a dummy for agricultural dominance. We observe that the effects of past climate variability on trust are significantly larger in predominantly agricultural regions.[27] Temperature and precipitation variability have an impact on trust that is twice as large in regions in which the majority of people worked in agriculture in 1900. These results strongly support the hypothesis that weather shocks fostered a culture of cooperation because climate variability posed a risk to incomes

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[27] We find similar results when we interact agricultural dominance in 1900 with climate variability measured over the period 1500 to 1900, see Appendix Table B17.

Table 5: *Historical Importance of Agriculture*

	(1)	(2)	(3)
Dependent variable:	Trust		
Temperature Variability GS 1500 - 1750	0.579** (0.285)		
× Share Agriculture > 50 % (1900)	0.775*** (0.283)		
Precipitation Variability GS 1500 - 1750		0.014 (0.010)	
× Share Agriculture > 50 % (1900)		0.017*** (0.006)	
Principal Component Variability GS 1500 - 1750			0.091* (0.050)
× Share Agriculture > 50 % (1900)			0.138*** (0.040)
Share Agriculture > 50 % (1900)	-0.607** (0.249)	-0.250** (0.096)	-0.047 (0.050)
Geographic Controls	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes
Observations	895	895	895
R-squared	0.83	0.83	0.84
Number of Clusters	101	101	101

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

from agricultural activities.

5.2 Historical Trade

Our conceptual framework of section 2 suggests that a particularly effective mechanism through which pre-industrial societies could insure against aggregate climate risk was through the development of trade relationships with neighboring localities. Indeed, historical studies of Medieval Europe document that spatially dispersed exchange networks were instrumental in allowing communities to overcome food shortages caused by aggregate weather shocks, and that short and long-distance trade relationships of grain were well established in the Middle Ages.

This implies that climate variability in pre-industrial times should be associated with the propensity to engage in inter-community exchange. In this sub-section, we examine whether market integration as measured by grain price movements increased in areas hit by erratic climatic shocks in pre-modern Europe. We follow a large literature in economic history and look at the co-movements of commodity prices, to test whether markets became more integrated after erratic climatic shocks (Blyn, 1973; Jacks *et al.*, 2011; Bateman, 2011). Since we are interested in grain trade, we employ data on the prices of wheat, which was the most widely traded grain. In their seminal work, Allen and Unger (2019) have collected data on wheat prices for a total of 98 European markets. We locate each market on a grid of 0.5 degree latitude/longitude, and merge it to the corresponding cell-level yearly temperature and precipitation for the years 1500 to 1900.[28]

The law of one price predicts that if market integration increases, the average price gap between markets should decrease. Looking at price movements between markets therefore provides a measure of market integration. We compute for each market i the absolute difference of the log price of wheat of market i in year t from the log price of wheat in each of the remaining markets j, for all j. We estimate the following model:

$$\texttt{PriceGap}_{ij,t} = |(log(price_{i,t}) - log(price_{j,t})| = \gamma_{ij} + \lambda_t + \beta\texttt{ClimateShock}_{it-1} + \epsilon_{ijt}$$

where ij denote pairs of markets, and t years. γ_{ij} are market pair fixed effects, and λ_t are time fixed effects. $\texttt{PriceGap}_{ij,t}$ is the absolute difference in the log of wheat prices between market i and j.

The period from 1500 to 1900 was characterized by cold and wet growing seasons that caused frequent failures of harvests (e.g. Wigley *et al.*, 1985; Grove, 2019). This suggests that abnormally low temperatures, and abnormally high levels of rainfall during the spring and summer months should have affect harvests the most. To test whether this presumption is reflected in the data, we first regress local wheat prices on temperature and precipitation during the previous year's growing season. Since increasing wheat prices are an indication of local food shortage, we expect cold temperatures and heavy rains to go along with higher prices. The results of these auxiliary regressions, reported in Appendix Table B18, document that indeed prices increase in markets if local temperatures are abnormally low, or if local pre-

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[28] Appendix Figure A9 shows the location of markets.

cipitation is abnormally high (see also Appendix Figure A10).[29] Our main variable of interest, $\texttt{ClimateShock}_{it}$, is thus defined as the deviation of growing-season temperature and precipitation from their respective long-run mean in the vicinity of market i in year $t-1$. For easier interpretation, we define temperature shocks as $-1\times$ the deviation of growing season temperature from the long-run mean. If climate shocks lead to larger market integration (i.e. smaller average price gaps), we would expect the coefficient of climate shocks β to be negative and significantly different from zero.

Table 6: *Market Integration and Climate Shocks 1500 - 1900*

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	$\texttt{PriceGap}_{\mathrm{ij,t}}$					
Temperature Shock		-0.005*				
		(0.003)				
L.Temperature Shock	-0.010***	-0.008***	0.068***			
	(0.003)	(0.003)	(0.009)			
L2.Temperature Shock		-0.011***				
		(0.003)				
L3.Temperature Shock		-0.005*				
		(0.003)				
L4.Temperature Shock		-0.003				
		(0.002)				
L5.Temperature Shock		-0.012***				
		(0.003)				
L.Temperature Shock × (log) Distance_ij			-0.012***			
			(0.001)			
Precipitation Shock					-0.007**	
					(0.003)	
L.Precipitation Shock				-0.016***	-0.014***	-0.010
				(0.005)	(0.003)	(0.026)
L2.Precipitation Shock					-0.009***	
					(0.003)	
L3.Precipitation Shock					0.000	
					(0.002)	
L4.Precipitation Shock					0.006**	
					(0.003)	
L5.Precipitation Shock					-0.002	
					(0.003)	
L.Precipitation Shock × (log) Distance_ij						-0.001
						(0.004)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	510,711	396,833	510,711	511,129	398,125	511,129
R-squared	0.89	0.91	0.89	0.89	0.91	0.89
Number of Clusters	6,802	6,199	6,802	6,802	6,200	6,802

NOTE: OLS regressions. The unit of observation is a pair of markets i and j. Heteroscedastic-robust standard errors clustered at the pair in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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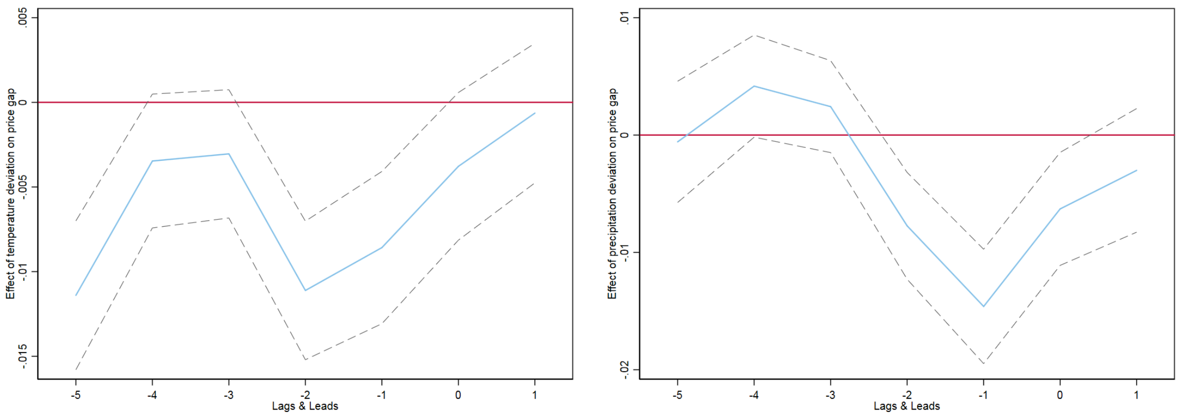
[29] These findings are in line with Anderson *et al.* (2016), who, using the same data to measure grain prices in Europe, find that cold temperatures increased wheat prices in the period 1100 to 1799.

Table 6 reports the results and Figure 5 illustrates the estimated coefficients. The coefficient of growing-season temperature shocks in the previous year reported in column 1 is negative and significant. This suggests that adverse temperatures led to an increase in market integration in the year after the shock. Column 2 reports the coefficient of temperature shocks for the current year and five lags. The negative coefficients of lagged climate variability suggests that the effect on market integration is persistent. In column 3, we test whether the reduction in price gaps varies with the distance between markets. Indeed, the interaction of temperature shocks and the distance between markets reveals substantial heterogeneity. Adverse temperature shocks increases on average the price gaps between close-by markets, but, as suggested by the negative coefficient of the interaction, markets that are farther away from each other become more integrated. The sum of the coefficient of temperature and its interaction with distance becomes negative at a distance between markets of 270km. This is about the distance between the markets in Paris (France) and Ghent (Belgium). We interpret this finding as evidence that long-distance trade was a viable insure strategy to cope with temperature shocks. Considering rainfall shocks in columns 4-6, we find a similar reduction in wheat price gaps in the years after adverse shocks that is persistent. However, we do not detect a differential effect with respect to the distance between markets. This could suggest that - contrary to temperature shocks - rainfall shocks were primarily insured against on a more local level. This would be consistent with the fact temperature varies over much larger areas. As the spatial correlation of rainfall is lower than the correlation of temperature across space, shocks to temperature can not be insured locally.

Overall, the evidence presented in Table 6 suggests that trade - as measured by price movements - increased in the years after adverse climatic events. In the case of temperature, this effect is stronger and more pronounced for markets that are in greater distance to each other, suggesting that temperature shocks induced trade with far away regions. These differences in the effects for temperature and precipitation are in line with the stronger impacts of temperature on social trust that we documented above.

Figure 5: *Temporal Effect of Climate Shocks on Market Integration*



(a) *Temperature*

(b) *Precipitation*

NOTES: This figure shows the estimated lag and lead coefficients of the climate shocks on the average price gap.

5.3 Heterogeneous Effects

Our conceptual framework provides us with a number of testable hypotheses about the heterogeneity of the effect of climatic variability depending on local characteristics. In particular, such heterogeneous effects can give additional insights on the importance of trade vice versa other insurance mechanisms. In this sub-section, we investigate whether the effects of climate on trust are stronger in regions were inter-community exchange was more beneficial because of the natural geography or proximity to trade infrastructure. We examine several of these predictions in Table 7, by interacting growing-season temperature variability with average regional characteristics.[30]

Spatial Correlation of Climate The conceptual framework predicts that cooperation would be more beneficial in areas in which weather fluctuations are more unsynchronized across locations (higher spatial variability) since this would increase the potential insurance benefit from risk pooling with neighbors. We therefore expect inter-temporal variation of temperature to have heterogeneous effects depending on the strength of the correlation of temperature shocks. To test this idea, we construct two measures of spatial variability using high-resolution modern-day climatic data: i) we first measure the pairwise correlation of monthly temperature in cell

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[30] We focus on temperature, as temperature variability has a stronger and more robust effect on social trust today.

Table 7: *Heterogeneous Effects*

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	Trust					
Temperature Variability GS 1901 - 2000 CRU 1.2	0.914***	0.428*				
	(0.224)	(0.234)				
× Avg. Correlation Temp $> Median$	-0.636**					
	(0.262)					
× Spatial Variability Temp $> Median$		0.463**				
		(0.186)				
Temperature Variability GS 1500 - 1750			0.789***	0.732***	1.213***	1.008***
			(0.236)	(0.275)	(0.274)	(0.292)
× Spatial Variability Suitability $> Median$			0.433**			
			(0.209)			
× SD Altitude $> Median$				0.481**		
				(0.239)		
× Dist. Medieval Trade Route $> Median$					-0.423**	
					(0.206)	
× CalDiff (Wheat-Potato) $> Median$						0.084
						(0.328)
Main Effect Interacted Variable	0.876**	-0.668***	-0.340**	-0.450**	0.332**	-0.191
	(0.354)	(0.256)	(0.161)	(0.198)	(0.160)	(0.284)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.83	0.83	0.83	0.83	0.83	0.83
Number of Clusters	155	155	155	155	155	155

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

i with the monthly temperature in the eight cells j that are neighbors of i. We then take the average of the correlation coefficients across all cells i that belong to region r; ii) we compute for each month the range of temperature across the cells that belong to a common region, defined as the maximal value of temperature in month m of year t minus the minimal temperature in the same month m of year t. We then average the range across all months and years, which measures the average spatial variability of temperature shocks within a region. With these measures at hand, we can estimate whether inte-temporal variability has a larger effect on cooperation in regions in which shocks are less correlated. Columns 1 and 2 of Table 7 show that the inter-temporal temperature variability has indeed a smaller influence on trust in regions in which the correlation of temperature shocks is high (i.e., above the median of the distribution). Column 2 suggest that the effect of temperature variability is twice as large in magnitude in regions in which the spatial variability is above the median of the distribution. These findings are in line with the idea that temperature shocks were inducing cooperation if the insurance capacity across localities within a region was high.

Environmental Diversity Similar to the spatial variability of climate, regions in which the environment was more diverse the gains from trade were higher (Fenske, 2014). In more diverse ecological environments, localities could specialize in different subsistence activities, and were therefore in a better position to buffer climatic shocks via economic exchange. To measure diversity of the local geography within a region, we study the variability of the quality of land for growing wheat, and local altitude variation, as more mountainous environments are characterized by a higher biodiversity and micro-climates (Spehn and Körner, 2005). Column 3 reports that temperature variability has larger effects on cooperation in regions that are characterized by a higher variation in the quality of land (measured by the range of suitability within a region). Column 4 finds that climate variability increased trust more strongly in more mountainous areas. These results are in line with the hypothesis that cooperation was fostered by risk pooling through economic exchange across localities.

Access to Trade If climate variability affected cooperation via long-distance trade, then we should observe larger effects on trust in regions that had access to the network of pre-industrial long-distance trade. To test this hypothesis we collect information on the distribution of trade routes in Medieval Europe from Shepherd (1926). Appendix Figure A11 displays the main European trade routes. We compute the (log) distance of the centroid of each region to the closest trade route, and classify regions into those with distances below and above the median distance to trade routes. Column 5 shows that in regions that were relatively far away from Medieval trade routes (i.e., with distances above the median distance), the effect of temperature shock on trust is significantly reduced. This supports the hypothesis that an easier access to long-distance exchange increased the insurance capacity of regions and fostered cooperation.

Storage Capacity If storage fostered cooperation, we should expect climate risk to have larger effects in regions with a higher capacity to store food. We make use of the fact that cereals had a large advantage over tubers in terms of its storability. Following Mayshar *et al.* (2016), we compute the caloric difference between growing wheat and potato - the main cereals and tubers in pre-industrial Europe - for each region using data on caloric suitability of crops from Galor and Özak (2016).[31] If storage produced cooperation, then we would expect the interaction effect between temperature variability and storage to be positive and significant. As column 6 shows, temperature variability has an additional positive impact in places with a higher caloric difference between wheat and potato suitability, which, however, is not significantly different from zero.

5.4 Accounting for Alternative Explanations

There are a number of alternatives that could explain the link between historical climate variability and the emergence of trust. In this sub-section we test for several of those. Table 8 reports the empirical results.

Table 8: *Alternative Explanations*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable:	Trust											
Temperature Variability GS 1500 - 1750	1.009***		0.900***		1.216***		1.076***		1.030***		1.029***	
	(0.272)		(0.327)		(0.302)		(0.320)		(0.267)		(0.266)	
Precipitation Variability GS 1500 - 1750		0.018***		0.023***		0.029***		0.026***		0.019***		0.018***
		(0.006)		(0.007)		(0.007)		(0.007)		(0.006)		(0.006)
Number of Cities (> 5000 inhabitants)	-0.002	-0.005										
	(0.003)	(0.003)										
(log) GDP pc 1900			0.148**	0.211***								
			(0.072)	(0.069)								
(log) Pop 1900					-0.080***	-0.073***						
					(0.025)	(0.025)						
Share Industry (1900)							-0.503***	-0.303*				
							(0.183)	(0.175)				
Share Service (1900)							0.875***	1.004***				
							(0.208)	(0.213)				
Number of Conflicts 1500-1900									0.021***	0.022***		
									(0.006)	(0.006)		
Number of Years with Conflict 1500 - 1900											0.001	0.001
											(0.001)	(0.001)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,476	1,476	895	895	895	895	895	895	1,476	1,476	1,476	1,476
R-squared	0.83	0.83	0.83	0.83	0.84	0.83	0.84	0.84	0.83	0.83	0.83	0.83
Number of Clusters	155	155	101	101	101	101	101	101	155	155	155	155
Conley S.E. 300km												
Temperature Variability GS 1500 - 1750	[0.335]***		[0.431]**		[0.395]***		[0.417]***		[0.344]***		[0.343]***	
Precipitation Variability GS 1500 - 1750		[0.011]*		[0.010]**		[0.009]***		[0.011]**		[0.010]*		[0.011]*

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Economic Development It is possible that regions with greater climate variability were historically richer, and different levels of economic development led to differences in trust. We

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[31] The potatoe was introduced in Europe at the end of the 16th century, and started to began widely cultivated around 1700. While potatoes are the least perishable among the tuber, 'potatoes do not keep very well in storage' (McNeill, 1999) and can only be stored for several months, unlike grain that can be stored for several years.

control for two measures of historical economic development in the regressions of trust on climate variability. The first proxy of past development we consider is historical urbanization, measured as the number of cities with at least 5’000 inhabitants per region in the year 1500. Controlling for historical urbanization does not affect the influence of past climatic variability on trust (Columns 1 and 2). Next, we control for regional incomes per capita measured in 1900 and taken from Rosés and Wolf (2018) (available for a sub-sample of 130 regions). The year 1900 is the first year for which regional income data is available. It should be noted that GDP measured in 1900 is likely endogenous to differences in historical cooperation. Nevertheless, columns 3 and 4 document that the effects of climate on trust, while smaller, are robust to controlling for past incomes per capita.

Population Another alternative is that population dynamics were different in regions with erratic climates. Extreme shocks that caused famines might have increased death rates, which, in a Malthusian world, reduced population and increased incomes. It is possible that cooperation was easier to sustain in regions with smaller populations. Therefore, in columns 5 an 6, we control for the regional (log) population in 1900, available for a sub-set of our regions (again taken from Rosés and Wolf (2018)). We find that population differences do not explain away the impact of climate variability on trust.

Economic Specialization A related possibility is that regions with more erratic weather transitioned earlier from agriculture to industrial production and service economies, which could have affected social trust directly or through economic development. We examine this possibility by controlling in columns 7 and 8 for the labor share in industry and services in the year 1900 (again taken from Rosés and Wolf (2018)). The effects of climate on trust are robust to the inclusion of these controls, and thus unlikely to be driven by differential structural transformation.

Conflict A final alternative mechanism relates to the possibility that regions with more variable climate were experiencing more conflict and wars.[32] Social conflict, in turn, could have

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[32] A large literature documents the relationship between climate shocks and conflict in the context of contemporary developing countries, but also in historical times. For a comprehensive survey see for example Burke *et al.* (2015).

influenced cooperation and/or institutional development. To test for the influence of historical conflict on trust, we make use of information on historical conflicts from the Conflict Catalogue by Brecke (1999). The Conflict Catalogue reports all violent conflicts since 1400 AD with more than 31 deaths. We consider two alternative measures of historical, regional conflict intensity. Columns 9 and 10 control for the total number of conflicts per region over the period 1500 - 1900, while columns 11 and 12 control for the number of years with a conflict. Neither of these measures changes the positive effects of past climate variability on contemporary trust.[33]

5.5 Religiosity

Another alternative mechanisms stems from the fact that in Medieval Europe religious institutions, such as churches and monasteries, were providers of insurance and welfare. Insurance provided by religious institutions could have strengthened membership in religious communities and religiosity, which, in turn, could have produced trust. In fact, Ager and Ciccone (2017) show in the context of 19th century United States, that counties with greater rainfall risk membership had larger religious communities, and that parts of these effects persist until today. If a similar mechanism operated within Europe, we would expect to observe stronger religiosity in regions with higher historical climate variability. To test for a link between past climate and contemporary religiosity, we look at self-reported measures of religiosity and church attendance of respondents surveyed in the European Social Survey. At the regional level, we find a negative association between past climate variability and the degree of self-reported religiosity, as well as with the number of times people pray and go to church (Appendix Table B19). When looking across individuals, there are no significant differences in religiosity associated with climate variability (Appendix Table B20). As an alternative test for the importance of religiosity, we add the religiosity measures as controls to our main regressions of trust on climate. As shown in Appendix Tables B21 and B22, neither at the regional nor at the individual level does controlling for religiosity affect the impact of past climate variability on trust.[34]

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[33] Measuring conflict intensity instead over the period 1500 to 1750 gives almost identical results.

[34] In addition, in Appendix Table B23, we control for the presence of Bishop in Medieval cities as a proxy for the distribution of religious institutions in Medieval times. The impact of climate on trust is unaffected by controlling for the historical presence of a Bishop.

6 Persistence Mechanism

In this section we investigate two possible mechanisms of persistence of social trust. The first mechanism relates to the interplay between formal institutions and cooperative norms. In addition, we study the effect of past climate on trust in locals and migrants, which gives insights about the inter-generational transmission of trust.

6.1 Institutions

We first examine whether climate variability influenced early political institutions, and how this effect may have persisted over time and interacted with the effect on cultural attitudes documented above. We use information on the presence of *communes* - i.e., councils of consuls - across European cities over the period 800-1800. Detailed data on the geographical distribution of *communes* in all European cities with more than 10,000 inhabitants, and on the degree of autonomy of local institutions, were assembled by Bosker *et al.* (2013) from a wealth of historical sources. Based on this information, we first identify as communal cities those that adopted a *commune* during the period 1500-1800, and then compute, for each region, the share of communal cities over total cities. We code this variable as missing for those regions for which no information on *communes* is available. In line with what discussed by Putnam (1993), Greif (2006) and Greif and Tabellini (2017) about the functioning and impact of the *communes*, this variable provides a good measure of the historical presence of institutions that favored citizens' participation and fueled interpersonal cooperation.

In columns 1-3 of Table 9 we regress the share of cities in a region with a *commune* on historical variability in both temperature and precipitation, controlling for regional geographic characteristics and for modern country fixed effects. The results consistently indicate that cities in regions with more variable climate were significantly more likely to adopt participatory political institutions. The estimated coefficients imply large magnitudes: a one standard deviation increase in historical variability is associated with an increase in the share of communal cities of 54% of a standard deviation for temperature and of 44% of a standard deviation for precipitation. We find a similarly large and significant effect using the principal component of variability in temperature and precipitation. To account for the small number of countries at which we cluster standard errors in our main specifications (19), we additionally report at the bottom of Table 9 wild bootstrap p-values and alternatively standard errors that are adjusted for spatial correlation. The statistical inference is very similar under both methods. In addition, we assess selection on unobservables following Altonji *et al.* (2005). The ratios we compute are negative, suggesting that the conditional beta coefficient obtained, if anything, underestimates the true effect.[35]

Table 9: *Institutions*

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A Dependent variables:	Share of Communal Cities			Quality of Government 2013		
Temperature Variability GS 1500 - 1750	1.246*** (0.345)			0.828* (0.424)		
Precipitation Variability GS 1500 - 1750		0.025*** (0.008)			0.040*** (0.013)	
Principal Component Variability GS 1500 - 1750			0.190*** (0.044)			0.173*** (0.048)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	147	147	147	156	156	156
R-squared	0.77	0.76	0.77	0.88	0.89	0.89
Number of Clusters	19	19	19	20	20	20
p-values Wild Bootstrap						
Variability GS 1500 - 1750	{0.004}***	{0.026}**	{0.000}***	{0.088}*	{0.022}**	{0.004}***
Conley S.E. 300km						
Variability GS 1500 - 1750	{0.329}***	{0.010}**	{0.051}***	{0.483}*	{0.013}***	{0.064}***

	(1)	(2)	(3)	(4)	(5)	(6)
Panel B Dependent variable:	Trust					
Temperature Variability GS 1500 - 1750	1.148*** (0.301)	0.870*** (0.288)				
Precipitation Variability GS 1500 - 1750			0.023** (0.010)	0.016 (0.010)		
Principal Component Variability GS 1500 - 1750					0.165*** (0.047)	0.123** (0.047)
Share of Communal Cities		0.241*** (0.084)		0.276*** (0.088)		0.243*** (0.087)
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	957	957	957	957	957	957
R-squared	0.78	0.79	0.78	0.78	0.78	0.79
Number of Clusters	129	129	129	129	129	129

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Standard errors clustered at the country level in Panel A, and at the country-wave level in Panel B. *** p<0.01, ** p<0.05, * p<0.1.

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[35] In Appendix Table B24, we explore robustness of the relationship between early institutions and climate variability. The table documents that temperature and precipitation variability also increases the likelihood that at least one communal city was located in the region. Furthermore, the results are robust to controlling for other relevant city characteristics. In particular, we control for the share of cities with a bishop, the share of cities with a university, the share of cities connected to a Roman road, as well as the total number of cities.

We are also interested in understanding to what extent differences in local institutions triggered by differential exposure to climatic risk persisted over time. To this end, we collect data on the quality of regional governments in various European countries, available from the Quality of Government (QoG) institute (Charron *et al.*, 2014). The QoG assessment of local government quality is based on a large survey of more than 85,000 European citizens, and has a structure similar to the World Bank Governance Indicator (WGI). In particular, the data include four types of indicators: i) government quality, ii) impartiality, iii) corruption in areas which sub-national governments are responsible for, and iv) political accountability. The composite measure of government quality at the regional level is given by the average of these four components, standardized by the country average WGI score, and is available for 153 NUTS regions in 17 European countries.[36] Hence, the QoG score is a good measure of the quality of government and of the effectiveness of public good provision at the local level - net of national institutional features - and tends to vary considerably both across and within countries.

In columns 4-6 of Table 9, we regress the composite measure of contemporary government quality at the regional level on the different measures of historical climate variability, controlling for other regional characteristics and country fixed effects. The results are largely consistent with those of historical institutions: a more volatile environment in pre-industrial times is associated with better functioning political institutions at the local level. The effect is also quite sizable: a one-standard-deviation increase in historical variability is associated with an increase in governmental quality of 14% of a standard deviation for temperature, and of 25% for precipitation.

The results on political institutions - and their link with those on culture discussed above - are open to various interpretations. One possibility is that exposure to environmental risk influenced local political organization directly, by increasing the demand for institutions more conducive to coordination and risk-sharing, and that these, in turn, reinforced and perpetuated a culture of mutual trust. Alternatively, climate variability may have influenced institutions indirectly, through its effect on cultural attitudes, as shared norms of cooperation would create a fertile ground for a more open political system. This interpretation would be consistent

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[36] The classifications of regions in the QoG data differs slightly for some countries from the regions included in the ESS survey data and are on average larger.

with Putnam (1993) view that civic engagement has contributed to the success of the Italian Medieval communes and later regional government. Though our data do not allow us to distinguish between these hypotheses, our results provide strong support for the view that culture and institutions are complements (Tabellini, 2010), and that their mutually reinforcing relationship contributes to their long-term persistence.

To get a sense of what part of the effect of climate variability on trust is mediated by institutions, in the lower Panel of Table 9 we regress trust on historical climate variability and early institutions, both separately and together, including regional controls and country × survey wave fixed effects. When included separately, variability displays a positive, significant, and sizable effect on trust, regardless of what measure of variability we use. When both variables are included together, however, the coefficients on variability decreases substantially (between one fourth to one third) and the coefficient for precipitation becomes insignificant. Throughout, the effect of institutions remains significant at the 1% level. To test more formally how much of the effect of historical climate variability on current trust is indeed mediated by early political institutions, we perform Sobel-Goodman mediation test. The test allows us to calculate how much of the effect of climate on trust is direct, and how large the indirect effect is, i.e. the portion of the effect of climate on trust that is mediated by institutions. The test result, reported at the bottom of Table 9 confirms that between 24% and 32% the effect of historical climate variability on current trust is indeed mediated by early political institutions.

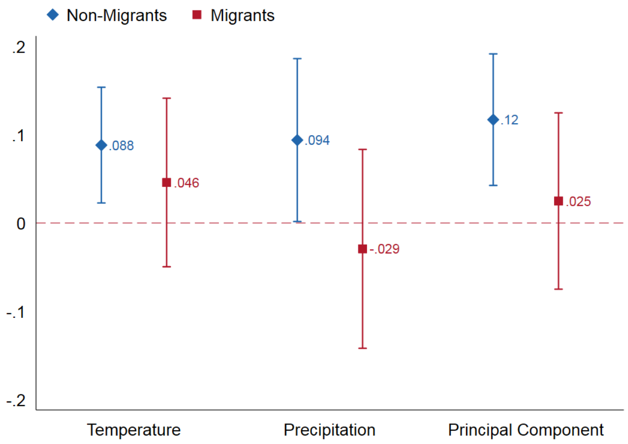
Taken together, these results suggest that climatic risk had a persistent effect on culture at least in part by favoring the emergence of a set of rules and institutions that made it easier to trust and cooperate with strangers.

6.2 Cultural Transmission

Besides an institutional persistence mechanism, it is possible that trust norms persisted through a process of inter-generational transmission. Without a historical measure of trust we cannot directly test whether culture persisted and how it was transmitted. Despite this drawback, the survey data that we employ to measure culture today gives us the possibility to conduct an alternative test: to contrast the effects of climate variability on trust in a population of locals (i.e., non-migrants that compose our main sample) to its effect in a population of migrants that have only recently moved to the region. If climate variability favored cooperation historically, and this effect persists in people, we would expect to find a larger effect of climate on trust in locals, and a smaller effect (or none at all) on trust of migrants, as they do not have any ancestors from that region. If past climatic risk affects trust today mainly because it affected the external institutional or economic environment that migrants are also exposed to, we would expect that past variability has an impact on migrant's trust.[37]

Migrants are defined as individuals that were born outside the country or that have at least one parent that was born in another country (we cannot observe birth region). We then examine how climate variability relates to self-reported trust of migrants and non-migrants by regressing trust of migrants and non-migrants separately on historical climate variability measured in the region where they are currently living. Figure 6 reports the estimated coefficients. Contrary to the positive and significant effects of climate on trust observed in the local population, the influence of climate variability on trust of migrants is closer to zero and statistically insignificant.[38] These results are in line with the view that the effects of culture on cooperation are historically determined, and (at least) partly transmitted inter-generationally.

Figure 6: *Effect of Climate Variability on Trust for Locals and Migrants*



NOTES: This figure shows the estimated coefficients of climate variability on trust in non-migrant and migrant populations.

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[37] This approach follows the logic of the epidemiological approach that has documented that the culture of migrants reflect the culture of their country of origin (Fernandez and Fogli, 2009; Fernández, 2011).

[38] Regression results for the migrant sample are reported in Appendix Table B25. Appendix Table B26 reports results from interacting the migrant identifier with past climate variability. The results are consistent in that the interaction effect is negative and statistically significant.

7 Conclusion

Social trust has been the object of extensive research in economics as part of a broader agenda on the impact of culture on economic performance. However, the origins of great differences in trust attitudes observed both across and within countries remain relatively unexplored, limiting our understanding of this phenomenon and its implications for economic development. Recent theoretical and empirical findings indicate that historical circumstances - in particular experiences of cooperation and conflict - can have considerable and long-lasting effects, providing a coherent framework for further research on the historical determinants of trust.

This paper contributes to this literature by examining the historical relationship between risk and the emergence of cooperative attitudes. We focus, in particular, on a primitive and universal source of environmental risk: climate variability. We advance and test the hypothesis that norms of generalized trust developed in pre-industrial times as a result of experiences of cooperation triggered by the need for subsistence farmers to cope with climatic risk. Since cooperation was particularly valuable in riskier environments, persistent norms of trust became more prevalent in areas exposed to more erratic climate. Our analysis provides empirical support for this prediction in the context of Europe. Our findings document that regions with higher historical variability in temperature and precipitation display higher levels of trust today. These effects are pronounced in regions that were predominantly agricultural, in line with the view that climate shocks increased cooperation to insure agricultural incomes. Regarding possible mechanisms, we find evidence consistent with the idea that regions with more variable climate were more likely to engage in mutually-insuring exchange with other communities. These areas were also more likely to adopt participative political institutions which benefited from and further reinforced cooperative norms, and whose impact continues to be reflected in current higher quality of local government.

Our findings indicate that, by influencing the evolution of norms and institutions, geographic factors can have a long-lasting impact on human cooperation. They also support the view of culture and institutions as complements that reinforce and perpetuate one another, and which should ideally be studied jointly rather than in isolation.

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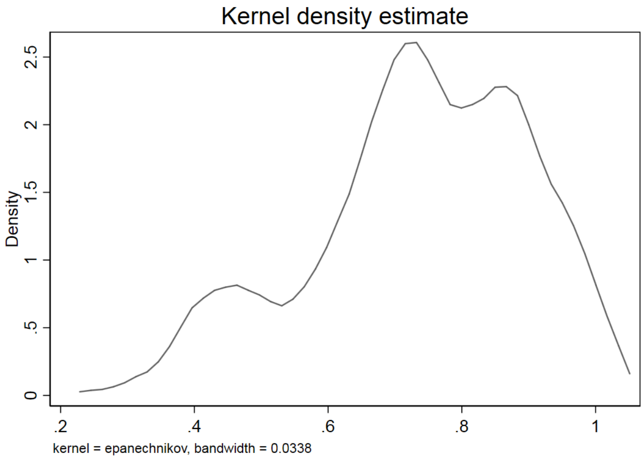
Online Appendix for
Climate Risk, Cooperation, and the Co-Evolution of Culture and Institutions

Johannes C. Buggle Ruben Durante

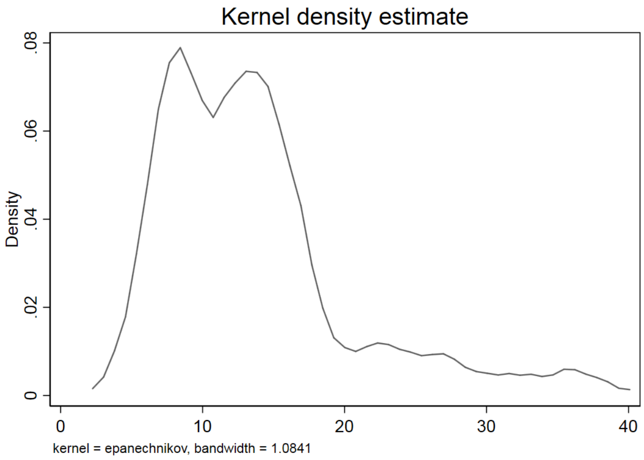
June 2020

A Additional Figures

Figure A1: *Distribution Functions of Climate Variability*

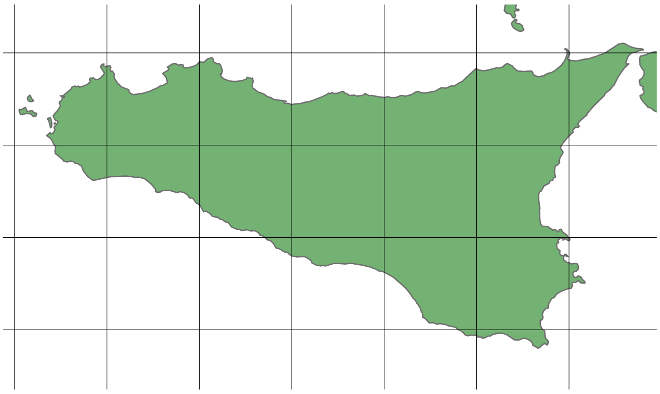


(a) *Temperature Variability Growing Season 1500 - 1750*

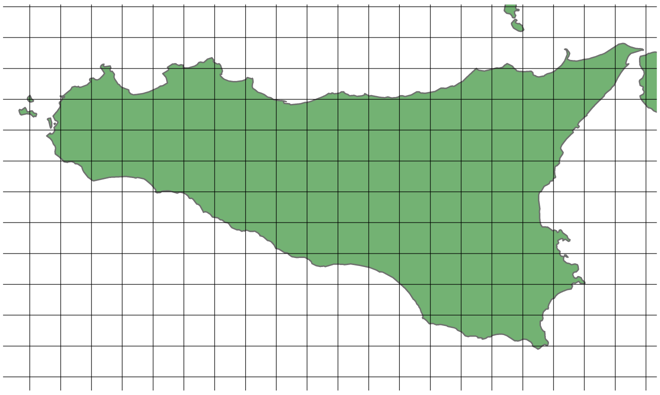


(b) *Precipitation Variability Growing Season 1500 - 1750*

Figure A2: *Spatial Resolution of Climatic Data*

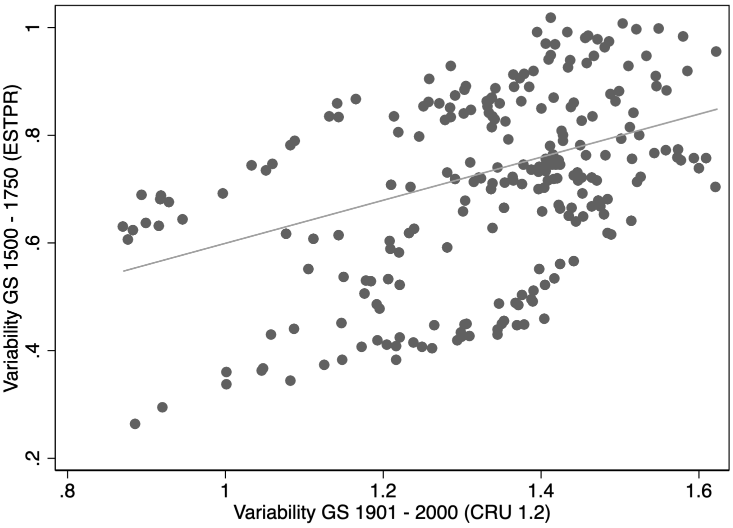


(a) *ESTPR Grid 1500 - 1900*

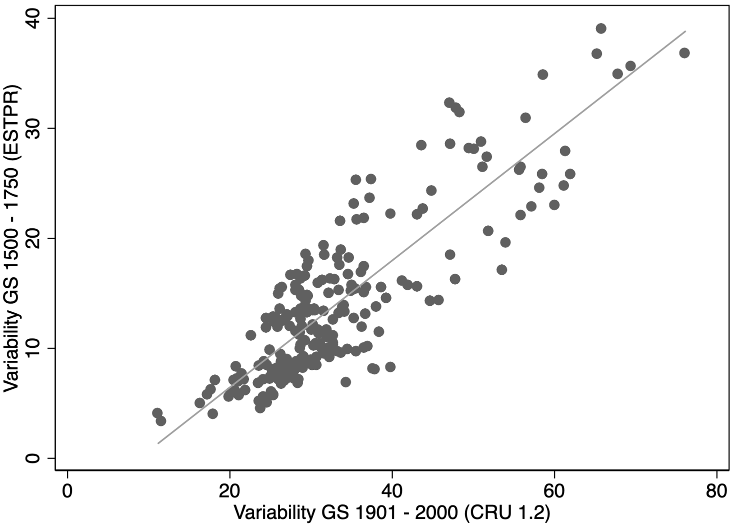


(b) *CRU 1.2. Grid 1901 - 2000*

Figure A3: *Correlation of Historical and Contemporaneous Climate Variability*

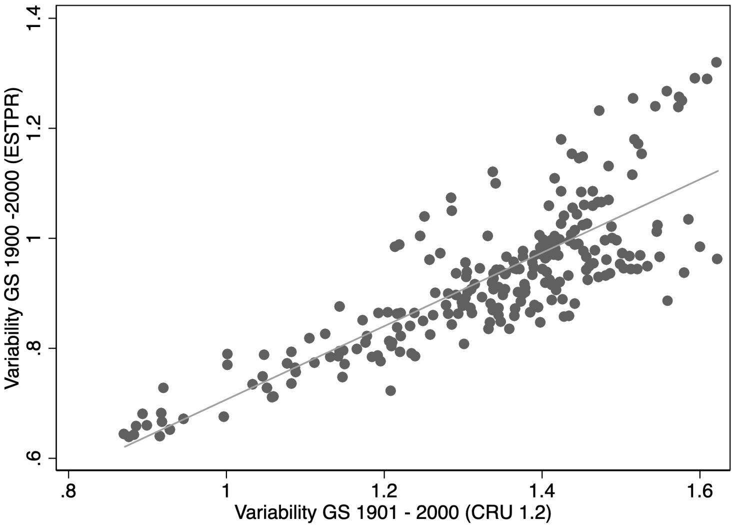


(a) *Temperature*

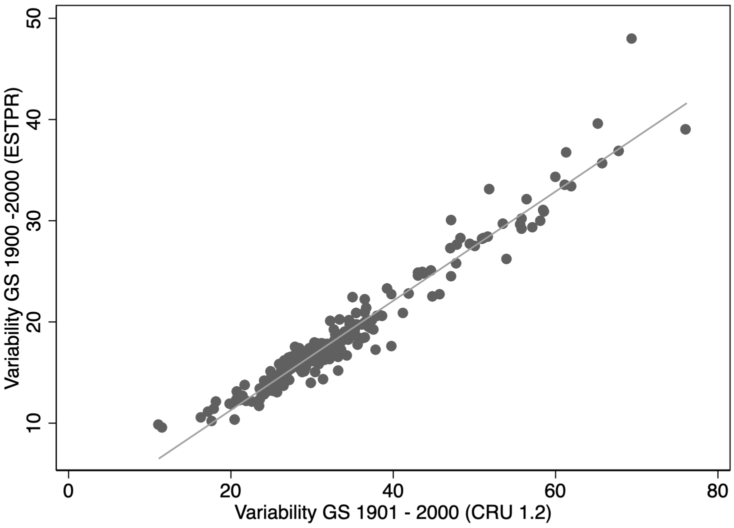


(b) *Precipitation*

Figure A4: *Correlation of ESTPR and CRU 1.2 Climate Variability*

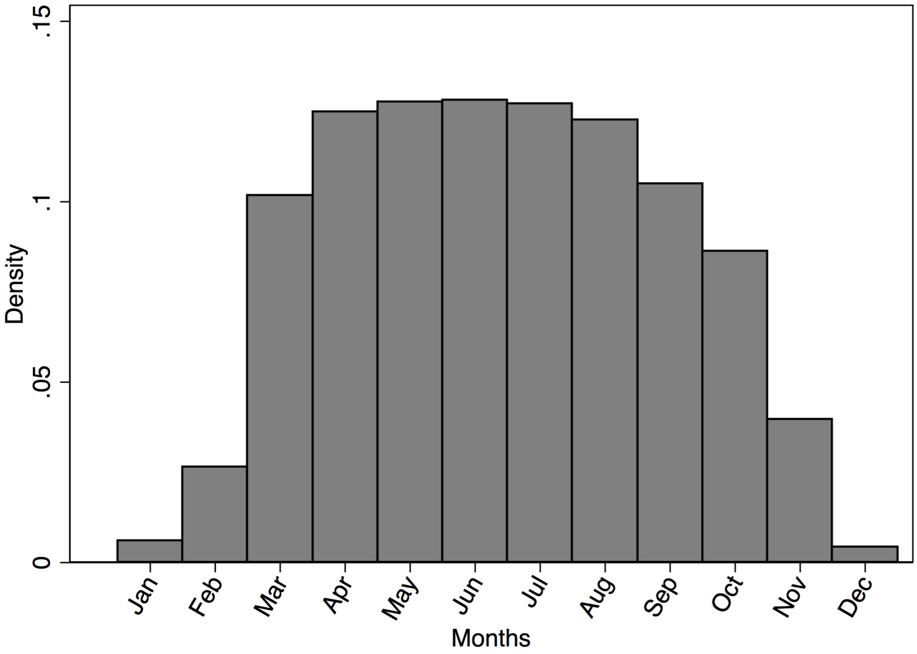


(a) *Temperature*



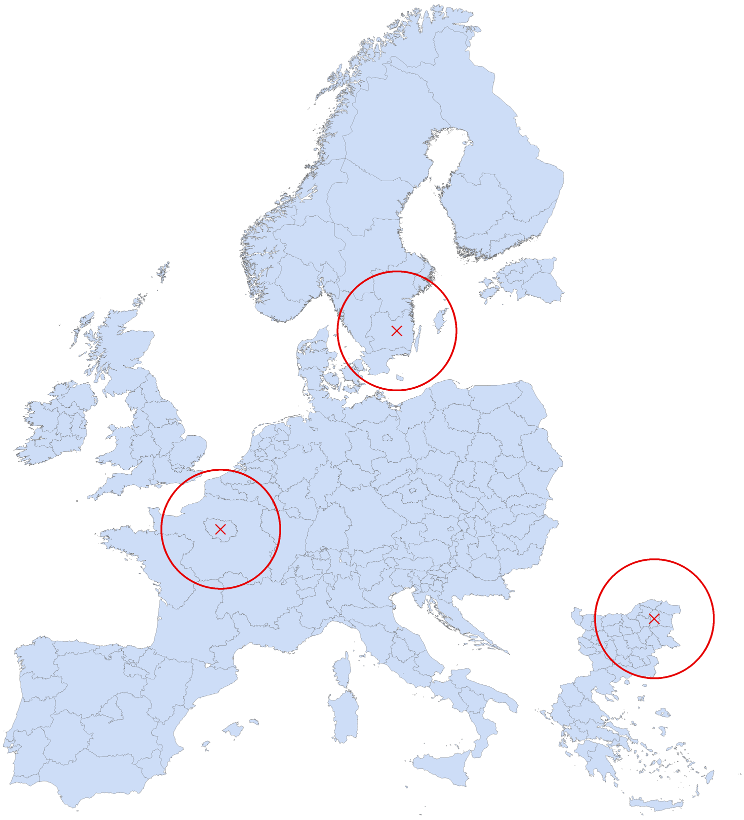
(b) *Precipitation*

Figure A5: *Growing Season Months*



NOTES: Distribution of growing season months in sampled regions. The growing months are calculated using grid-cell level data from the Food and Agriculture Organization Global Agro-Ecological Zones project (FAO-GAEZ) on the start month of the grop cycle for growing low-input rainfed wheat, and the length of the growing season, aggregaed to each region.

Figure A6: *Distance Cutoffs for Conley S.E.*



NOTES: Illustration of the 300km radius used to compute standard errors that allow for spatial correlation.

Figure A7: *Bivariate Correlation of Trust and Family Ties*

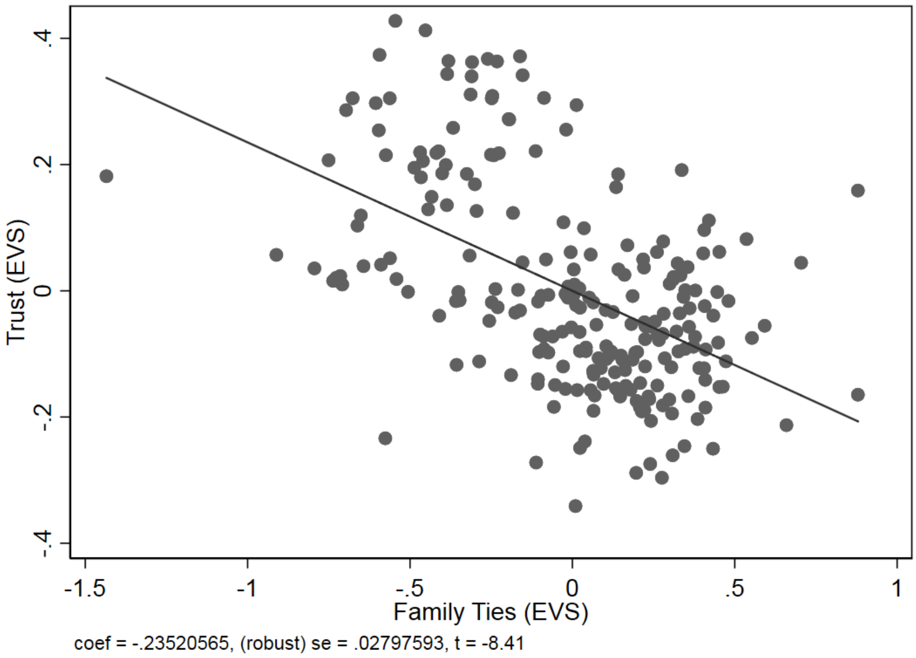


Figure A8: *Bivariate Correlation of Institutions and Trust*

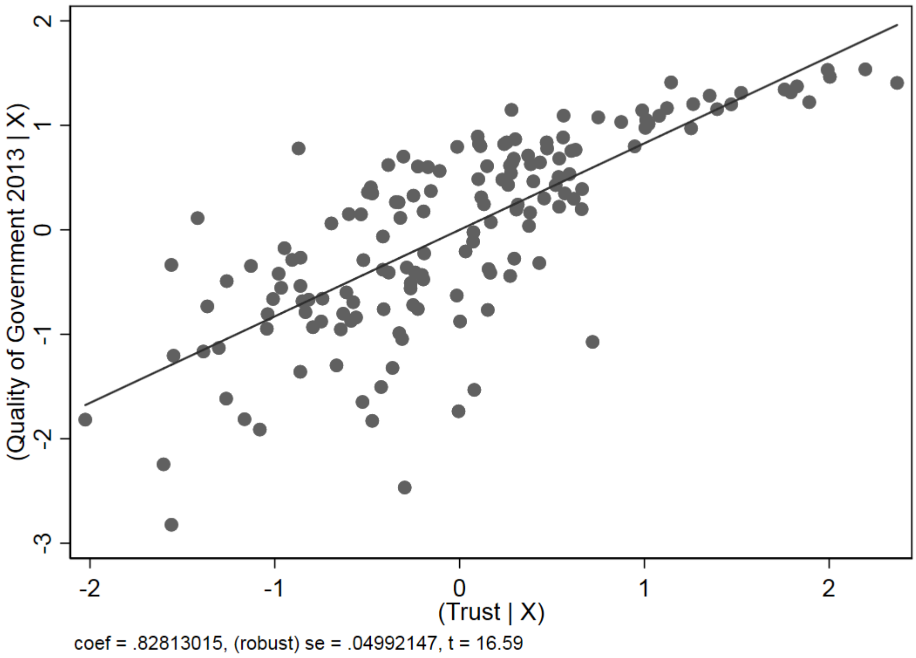
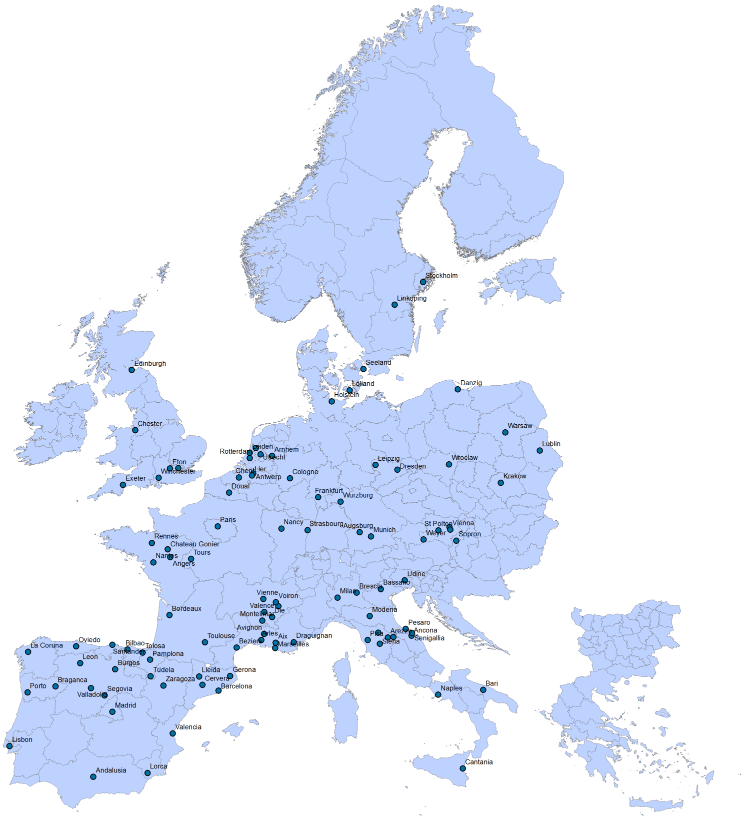
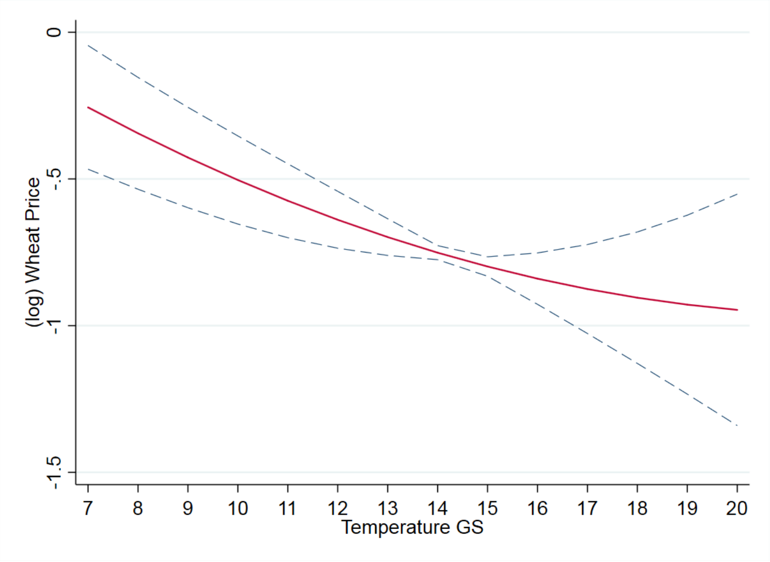


Figure A9: *Location of Wheat Markets*

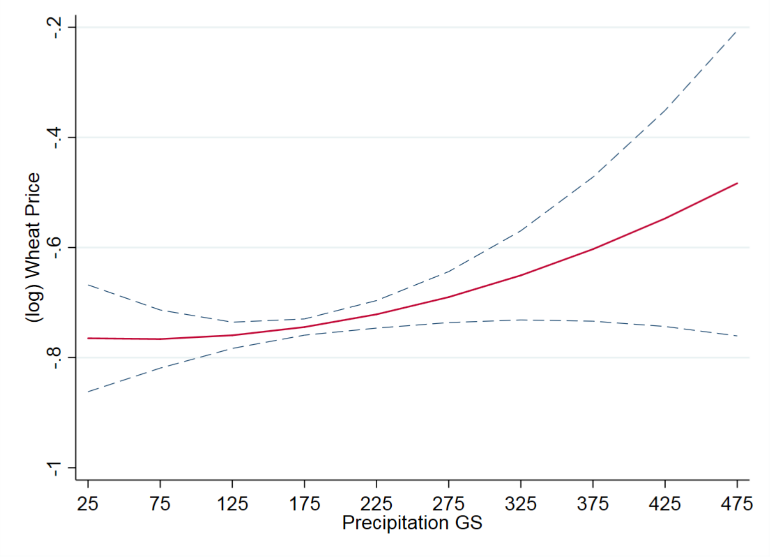


NOTES: This figure shows the location of medieval markets for which price data on wheat is available. Source: Allen and Unger (2019).

Figure A10: *Climate Shocks and Wheat Prices*



(a) *Temperature*



(b) *Precipitation*

Figure A11: *Medieval European Trade Routes*

Notes: Taken from the Historical Atlas by William R. Shepherd (1926).

B Additional Tables

B.1 Descriptive Statistics

Table B1: *Summary Statistics*

Panel A: Trust, Climate, and Geographic Controls	Mean	sd	Min	Max	N
Trust	4.90	1.06	1.03	7.37	1,476
Precipitation Variability GS 1500 - 1750	13.66	6.91	3.34	39.00	1,476
Precipitation Variability NGS 1500 - 1750	12.40	5.99	2.66	34.98	1,476
Precipitation Variability GS 1900 - 2000	18.04	5.60	9.49	47.92	1,476
Temperature Variability GS 1500 - 1750	0.74	0.16	0.26	1.02	1,476
Temperature Variability NGS 1500 - 1750	1.05	0.28	0.44	1.47	1,476
Temperature Variability GS 1900 - 2000	0.94	0.14	0.64	1.32	1,476
Principal Component Variability GS 1500 - 1750	-0.00	1.21	-3.06	3.68	1,476
Principal Component Variability NGS 1500 - 1750	0.00	1.06	-2.70	1.95	1,476
Principal Component Variability GS 1900 - 2000	0.00	1.08	-4.04	2.73	1,476
Precipitation Variability GS 1901 - 2000 CRU 1.2	32.49	10.12	11.18	76.10	1,476
Precipitation Variability NGS 1901 - 2000 CRU 1.2	35.33	16.17	14.47	92.13	1,476
Precipitation Variability GS (Location Specific) 1901 - 2000 CRU 1.2	33.91	10.62	17.99	76.10	1,452
Temperature Variability GS 1901 - 2000 CRU 1.2	1.34	0.17	0.87	1.62	1,476
Temperature Variability NGS 1901 - 2000 CRU 1.2	1.97	0.47	1.12	3.21	1,476
Temperature Variability GS (Location Specific) 1901 - 2000 CRU 1.2	1.42	0.17	0.98	1.76	1,452
Principal Component Variability GS 1901 - 2000 CRU 1.2	0.00	1.03	-3.44	3.51	1,476
Principal Component Variability NGS 1901 - 2000 CRU 1.2	0.00	1.28	-3.11	2.78	1,476
Mean Precipitation 1500 - 2000	0.67	0.26	0.28	1.71	1,476
Mean Temperature 1500 - 2000	8.56	3.27	-1.59	17.58	1,476
River	0.41	0.49	0.00	1.00	1,476
(log) Area	9.25	1.23	5.09	12.33	1,476
Latitude	49.39	6.41	35.23	68.85	1,476
Longitude	10.82	10.01	-9.18	27.93	1,476
Terrain Slope	3.83	1.40	1.00	7.00	1,476
Distance to Coast (in 1000 km’s)	0.16	0.16	0.00	0.65	1,476
Coastal Region (0/1)	0.46	0.50	0.00	1.00	1,476
Suitability for Rainfed Cereals (mean)	4.11	1.21	1.00	7.97	1,476

Table B1 (continued)

Suitability for Rainfed Cereals (sd)	0.93	0.33	0.00	1.96	1,476
Altitude	0.34	0.34	-0.00	2.12	1,476
Panel B: Climate in Other Periods	Mean	sd	Min	Max	N
Precipitation Variability GS 1500 - 1700	12.71	6.45	3.18	37.13	1,476
Precipitation Variability GS 1500 - 1800	13.40	6.69	3.32	38.48	1,476
Precipitation Variability GS 1500 - 1900	13.28	6.18	3.55	36.25	1,476
Temperature Variability GS 1500 - 1700	0.71	0.17	0.23	1.01	1,476
Temperature Variability GS 1500 - 1800	0.77	0.15	0.30	1.00	1,476
Temperature Variability GS 1500 - 1900	0.81	0.14	0.37	1.01	1,476
Precipitation GS: March - September	32.26	10.32	14.73	75.79	1,476
Precipitation GS: March - October	33.44	10.88	17.37	77.22	1,476
Precipitation GS: April - October	33.81	10.68	15.04	77.68	1,476
Precipitation GS: April - November	34.24	10.95	17.99	77.90	1,476
Temperature GS: March - September	1.42	0.20	0.91	1.81	1,476
Temperature GS: March - October	1.43	0.19	0.93	1.85	1,476
Temperature GS: April - October	1.36	0.16	0.90	1.70	1,476
Temperature GS: April - November	1.40	0.18	0.93	1.83	1,476
Panel C: Other Indicators of Cooperation (ESS)	Mean	sd	Min	Max	N
Cooperativeness (PC)	0.01	1.36	-5.17	2.56	1,476
Pray	3.34	1.13	1.22	6.77	1,476
Religiosity	4.59	1.27	0.76	8.52	1,476
Church attendance	2.62	0.77	1.25	4.98	1,476
Panel D: Individual Level (ESS)	Mean	sd	Min	Max	N
Trust	5.09	2.43	0.00	10.00	301,858
Cooperativeness (PC)	0.00	1.23	-3.26	2.89	299,717
Pray	3.29	2.43	1.00	7.00	298,423
Religiosity	4.58	3.02	0.00	10.00	300,513
Church attendance	2.54	1.52	1.00	7.00	301,384
Panel E: Individual Trust Family Ties (EVS)	Mean	sd	Min	Max	N
Trust	0.35	0.48	0.00	1.00	62,912

Table B1 (continued)

Family Ties	-0.05	1.13	-5.14	0.89	47,411
Panel F: Communal Institutions	Mean	sd	Min	Max	N
Share of cities with a Commune	0.63	0.41	0.00	1.00	151
Share of cities with a Bishop	0.34	0.39	0.00	1.00	151
Number of cities	4.07	5.69	1.00	40.00	151
Share of cities with a University	0.18	0.31	0.00	1.00	151
Share of cities with a Roman Road	0.21	0.32	0.00	1.00	151
Panel G: Modern Institutions	Mean	sd	Min	Max	N
Quality of Government (2013)	0.23	0.92	-2.60	1.76	156
Panel H: Wheat Prices	Mean	sd	Min	Max	N
Price Gap	0.88	1.03	0.00	10.07	572,503
Temperature Shock	-0.01	0.71	-2.61	2.81	572,057
Precipitation Shock	-0.00	0.34	-1.73	2.25	572,503

B.2 Further Robustness Analysis of the Main Results

Table B2: *Main Results: All Controls Reported*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:	Trust								
	Temperature			Precipitation			Principal Component		
Variability GS 1500 - 1750	1.031***	0.929***	1.170***	0.018***	0.018***	0.007	0.151***	0.142***	0.148***
	(0.266)	(0.288)	(0.291)	(0.006)	(0.006)	(0.008)	(0.037)	(0.039)	(0.038)
Variability NGS 1500 - 1750		0.135			-0.003			0.043	
		(0.233)			(0.007)			(0.046)	
Variability GS 1900 - 2000			-0.452			0.027**			-0.056
			(0.541)			(0.011)			(0.052)
Mean Precipitation 1500 - 2000	0.231*	0.238*	0.191	-0.007	0.047	-0.388**	0.054	0.161	-0.106
	(0.118)	(0.121)	(0.136)	(0.121)	(0.156)	(0.185)	(0.114)	(0.155)	(0.199)
Mean Temperature 1500 - 2000	0.041	0.045	0.039	0.026	0.027	0.025	0.050	0.053	0.049
	(0.034)	(0.036)	(0.034)	(0.034)	(0.035)	(0.035)	(0.036)	(0.037)	(0.036)
River	0.120***	0.123***	0.121***	0.135***	0.135***	0.128***	0.124***	0.125***	0.124***
	(0.038)	(0.038)	(0.038)	(0.039)	(0.039)	(0.039)	(0.038)	(0.038)	(0.038)
(log) Area	-0.021	-0.021	-0.020	-0.035***	-0.035***	-0.029**	-0.024*	-0.024*	-0.023*
	(0.015)	(0.015)	(0.015)	(0.013)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
Latitude	0.038*	0.040*	0.041*	0.038*	0.037*	0.036*	0.047**	0.047**	0.050**
	(0.020)	(0.021)	(0.021)	(0.022)	(0.022)	(0.021)	(0.022)	(0.021)	(0.022)
Longitude	-0.005	-0.006	-0.001	-0.011	-0.011	-0.014	-0.006	-0.007	-0.005
	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Terrain Slope	-0.038	-0.035	-0.044	-0.050*	-0.051*	-0.041	-0.045	-0.042	-0.047*
	(0.028)	(0.029)	(0.028)	(0.029)	(0.029)	(0.029)	(0.028)	(0.029)	(0.028)
Distance to Coast (in 1000 km's)	0.294*	0.274	0.323*	0.088	0.101	0.099	0.189	0.204	0.186
	(0.173)	(0.175)	(0.175)	(0.156)	(0.154)	(0.157)	(0.161)	(0.160)	(0.162)
Coastal Region (0/1)	0.065	0.065	0.063	0.037	0.037	0.019	0.057	0.058	0.049
	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.042)	(0.042)	(0.042)	(0.041)
Suitability for Rainfed Cereals (mean)	-0.034	-0.033	-0.035	-0.007	-0.006	-0.015	-0.027	-0.024	-0.026
	(0.041)	(0.041)	(0.041)	(0.035)	(0.036)	(0.033)	(0.038)	(0.038)	(0.038)
Suitability for Rainfed Cereals (sd)	-0.041	-0.044	-0.041	-0.028	-0.032	-0.025	-0.036	-0.046	-0.034
	(0.049)	(0.050)	(0.049)	(0.048)	(0.049)	(0.047)	(0.048)	(0.050)	(0.047)
Altitude	0.191	0.220	0.215	0.245	0.244	0.151	0.272	0.287	0.274
	(0.184)	(0.192)	(0.190)	(0.194)	(0.194)	(0.193)	(0.187)	(0.189)	(0.189)
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Number of Clusters	155	155	155	155	155	155	155	155	155

NOTE: OLS regressions. The unit of observation is a region. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B3: *Main Results: Without Country FE*

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	Trust					
	Temperature		Precipitation		Principal Component	
Variability GS 1500 - 1750	1.813***	1.031***	0.071***	0.018***	0.313***	0.151***
	(0.270)	(0.266)	(0.008)	(0.006)	(0.038)	(0.037)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE		Yes		Yes		Yes
Observations	1,482	1,476	1,482	1,476	1,482	1,476
R-squared	0.63	0.83	0.64	0.83	0.64	0.83
Number of Clusters	161	155	161	155	161	155

NOTE: OLS regressions. The unit of observation is a region. All regressions control for mean precipitation, mean temperature, average altitude, average terrain slope, area, longitude, latitude, distance to coast, coastal dummy, average soil quality and its standard deviation, as well the number of major rivers. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B4: *Main Results: Region Average*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable:	Average Trust											
	Temperature				Precipitation				Principal Component			
Variability GS 1500 - 1750	1.872***	1.082**	0.814**	1.473**	0.062***	0.012	0.012	-0.000	0.305***	0.135**	0.116*	0.127**
	(0.634)	(0.437)	(0.379)	(0.675)	(0.019)	(0.009)	(0.009)	(0.010)	(0.088)	(0.055)	(0.060)	(0.055)
Variability NGS 1500 - 1750			0.351				-0.004				0.080	
			(0.353)				(0.012)				(0.079)	
Variability GS 1900 - 2000				-1.192				0.027**				-0.091
				(1.183)				(0.012)				(0.073)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE		Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes
Observations	239	238	238	238	239	238	238	238	239	238	238	238
R-squared	0.73	0.92	0.92	0.92	0.73	0.91	0.91	0.91	0.74	0.92	0.92	0.92
Number of Clusters	25	24	24	24	25	24	24	24	25	24	24	24
F-Test joint significance				0.06				0.05				0.03
p-values Wild Bootstrap												
Variability GS 1500 - 1750	{0.054}*	{0.000}***	{0.016}**	{0.002}***	{0.020}**	{0.126}	{0.172}	{0.972}	{0.010}***	{0.004}***	{0.048}**	{0.020}**
Conley S.E. 300km												
Variability GS 1500 - 1750	[0.515]***	[0.464]**	[0.362]**	[0.527]***	[0.012]***	[0.011]	[0.011]	[0.015]	[0.061]***	[0.069]*	[0.070]*	[0.070]*

NOTE: OLS regressions. The unit of observation is a region. All regressions control for mean precipitation, mean temperature, average altitude, average terrain slope, area, longitude, latitude, distance to coast, coastal dummy, average soil quality and its standard deviation, as well the number of major rivers. Heteroscedastic-robust standard errors clustered at the country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B5: *Main Results: Cluster at Country Level*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:	Trust								
	Temperature			Precipitation			Principal Component		
Variability GS 1500 - 1750	1.031***	0.929**	1.170**	0.018*	0.018*	0.007	0.151***	0.142**	0.148***
	(0.351)	(0.406)	(0.422)	(0.010)	(0.010)	(0.013)	(0.050)	(0.057)	(0.050)
Variability NGS 1500 - 1750		0.135			-0.003			0.043	
		(0.348)			(0.010)			(0.073)	
Variability GS 1900 - 2000			-0.452			0.027*			-0.056
			(0.821)			(0.013)			(0.083)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Number of Clusters	24	24	24	24	24	24	24	24	24
P-value joint significance of variability			0.02			0.01			0.01

NOTE: OLS regressions. The unit of observation is a region. All regressions control for mean precipitation, mean temperature, average altitude, average terrain slope, area, longitude, latitude, distance to coast, coastal dummy, average soil quality and its standard deviation, as well the number of major rivers. Heteroscedastic-robust standard errors clustered at the country level parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B6: *Main Results: Cluster at Site of Observation*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:	Trust								
	Temperature			Precipitation			Principal Component		
Variability GS 1500 - 1750	1.031*** (0.301)	0.929** (0.355)	1.170*** (0.291)	0.018** (0.008)	0.018** (0.008)	0.007 (0.012)	0.151*** (0.044)	0.142*** (0.045)	0.148*** (0.046)
Variability NGS 1500 - 1750		0.135 (0.331)			-0.003 (0.009)			0.043 (0.061)	
Variability GS 1900 - 2000			-0.452 (0.688)			0.027 (0.018)			-0.056 (0.085)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Number of Clusters	88	88	88	88	88	88	88	88	88
P-value joint significance of variability			0.00			0.01			0.00

NOTE: OLS regressions. The unit of observation is a region. All regressions control for mean precipitation, mean temperature, average altitude, average terrain slope, area, longitude, latitude, distance to coast, coastal dummy, average soil quality and its standard deviation, as well the number of major rivers. Heteroscedastic-robust standard errors clustered at the closest site of climatic observation in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B7: *Robustness to Alternative Periods*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Trust							
Temperature Variability GS 1500 - 1750	1.031*** (0.266)							
Temperature Variability GS 1500 - 1700		0.955*** (0.256)						
Temperature Variability GS 1500 - 1800			1.034*** (0.290)					
Temperature Variability GS 1500 - 1900				1.182*** (0.335)				
Precipitation Variability GS 1500 - 1750					0.018*** (0.006)			
Precipitation Variability GS 1500 - 1700						0.016** (0.007)		
Precipitation Variability GS 1500 - 1800							0.019*** (0.007)	
Precipitation Variability GS 1500 - 1900								0.021*** (0.008)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Number of Clusters	155	155	155	155	155	155	155	155

NOTE: OLS regressions. The unit of observation is a region. All regressions control for mean precipitation, mean temperature, average altitude, average terrain slope, area, longitude, latitude, distance to coast, coastal dummy, average soil quality and its standard deviation, as well the number of major rivers. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B8: *Modern Climate*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Trust							
	Temperature			Precipitation			Principal Component	
Variability GS 1901-2000	0.703***	0.664***		0.011*	0.010		0.158***	0.144***
	(0.207)	(0.232)		(0.007)	(0.007)		(0.050)	(0.053)
Variability NGS 1901-2000		0.059			0.229			0.078
		(0.189)			(0.164)			(0.065)
Variability GS (Location Specific)			0.808***			0.011*		
			(0.205)			(0.006)		
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,476	1,476	1,452	1,476	1,476	1,452	1,476	1,476
R-squared	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Number of Clusters	155	155	155	155	155	155	155	155
Conley S.E. 300km								
Variability GS	[0.294]**	[0.317]**	[0.324]**	[0.294]**	[0.295]**	[0.007]	[0.062]**	[0.063]**

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B9: *Robustness to Alternative Definitions of the Growing Season*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable:	Trust									
Temperature Variability GS 1901 - 2000 CRU 1.2	0.703*** (0.207)									
Temperature GS: March - September		0.581*** (0.218)								
Temperature GS: March - October			0.630*** (0.221)							
Temperature GS: April - October				0.742*** (0.212)						
Temperature GS: April - November					0.776*** (0.226)					
Precipitation Variability GS 1901 - 2000 CRU 1.2						0.011* (0.007)				
Precipitation GS: March - September							0.011 (0.008)			
Precipitation GS: March - October								0.011 (0.008)		
Precipitation GS: April - October									0.012 (0.007)	
Precipitation GS: April - November										0.009 (0.008)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Number of Clusters	155	155	155	155	155	155	155	155	155	155

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B.3 Conley Standard Errors

Table B10: *Robustness to Alternative Conley Cutoffs*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:	Trust						
Cutoff (in km):	100	200	300	400	500	600	700
Temperature Variability GS 1500 - 1750	1.031***	1.031***	1.031***	1.031***	1.031***	1.031***	1.031***
	(0.347)	(0.358)	(0.344)	(0.314)	(0.256)	(0.200)	(0.184)
Precipitation Variability GS 1500 - 1750	0.018**	0.018*	0.018*	0.018*	0.018**	0.018***	0.018***
	(0.008)	(0.010)	(0.011)	(0.010)	(0.008)	(0.007)	(0.007)
Observations	1,482	1,482	1,482	1,482	1,482	1,482	1,482

NOTE: OLS regressions. The unit of observation is a region. All regressions control for country x wave fixed effects, mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Standard errors adjusted for spatial dependence assuming different cutoffs in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B.4 Alternative Measures of Cooperation

Table B11: *Alternative Indicators of Cooperation*

	(1)	(2)	(3)
Dependent variable:	Cooperativeness Principal Component		
Temperature Variability GS 1500 - 1750	0.791** (0.333)		
Precipitation Variability GS 1500 - 1750		0.013** (0.006)	
Principal Component Variability GS 1500 - 1750			0.113*** (0.043)
Geographic Controls	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes
Observations	1,476	1,476	1,476
R-squared	0.86	0.86	0.86
Number of Clusters	155	155	155

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B12: *Alternative Indicators of Cooperation: Individual Level*

	(1)	(2)	(3)
Dependent variable:	Cooperativeness Principal Component		
Temperature Variability GS 1500 - 1750	0.304**		
	(0.153)		
Precipitation Variability GS 1500 - 1750		0.003	
		(0.003)	
Principal Component Variability GS 1500 - 1750			0.040**
			(0.021)
Individual Controls	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes
Observations	250,677	250,677	250,677
R-squared	0.21	0.21	0.21
Number of Clusters	239	239	239

NOTE: OLS regressions. The unit of observation is an individual. Individual controls include age and its square, gender, and dummies for years of education. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the sub-national region level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B.5 Reciprocity

In this subsection, we investigate the effect of past climate variability on contemporary measures of reciprocity. To measure reciprocity, we use individual data from the *Global Preference Survey (GPS)* (Falk *et al.*, 2016, 2018), a survey conducted in 25 European countries in 2012 that is representative at the country level. The GPS data elicits positive and negative reciprocity via an experimentally validated questionnaire. Positive reciprocity is measured with the size of a thank you gift in exchange for help in a hypothetical scenario, as well as the individual's willingness to return a favor. Each of the two items receives about half of the weight in the construction of positive reciprocity. Negative reciprocity is assessed with the willingness of the individual to take revenge, and his/her willingness to punish unfair behavior towards himself/herself or towards others. Each of the three items receives roughly one-third of the weight in the construction of negative reciprocity.

We aggregate the two measures of reciprocity to the regional level by taking their averages. For 124 of the regions included in the GSP regions we find a corresponding region in our sample. We first explore the correlation of reciprocity with our measures of trust and family ties. The correlation coefficients are reported in Table B13. While trust and reciprocity (both positive and negative) display a weak and statistically insignificant negative correlation, reciprocity is positively correlated with the strength of family ties (significant at the 1% level) which, in turn, is negatively correlated with trust. These patterns suggest that the GPS measures of reciprocity are in our sample more strongly associated with measures of "personalized trust" (i.e., towards relatives and friends) than with "generalized trust" (i.e., towards strangers).

Table B13: *Correlation of Reciprocity with Trust and Family Ties at the Region Level*

	Trust	Positive Reciprocity	Negative Reciprocity	Family Ties
Trust	1			
Positive Reciprocity	-0.083	1		
Negative Reciprocity	-0.109	0.077	1	
Family Ties	-0.553	0.274	0.307	1

NOTE: This table displays pairwise correlation coefficients of cultural measures averaged at the regional level for 124 regions.

Next, we explore the effect of historical climate variability on reciprocity across regions and across individuals, respectively. Table B14 displays the regression results at the region-level. The table documents negative coefficients of variability on reciprocity. The estimated coefficients are statistically significant in some specifications: in Column 1 we estimate a statistically significant negative effect of temperature variability on positive reciprocity, and Column 4 finds a statistically significant negative effect of precipitation variability on negative reciprocity. Table B15 displays regression results at the individual level. Here, no clear pattern emerges. While the relevant coefficients are almost always negative, all coefficients are statistically insignificant. Taken together, the results from across 124 regions seem to indicate that areas with more variable climate in the past are characterized today by lower levels of reciprocity, though this relationship is not very robust. To the extent that the GPS measures of reciprocity elicit personalized rather than generalized trust as suggested by the correlation coefficients in Table B13, these findings corroborate, or at the least do not contrast, with our hypothesis.

Table B14: *Reciprocity: Region Level*

	(1)	(2)	(3)	(4)
Dependent variables:	Positive Reciprocity		Negative Reciprocity	
Temperature Variability GS 1500 - 1750	-0.525** (0.261)		-0.091 (0.300)	
Precipitation Variability GS 1500 - 1750		-0.008 (0.009)		-0.015** (0.007)
Geographic Controls	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes
Observations	124	124	124	124
R-squared	0.61	0.60	0.85	0.85
p-values Wild Bootstrap				
Temperature Variability GS 1500 - 1750	{0.002}***		{0.760}	
Precipitation Variability GS 1500 - 1750		{0.230}		{0.118}

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Robust standard errors in parentheses. P-values from wild-cluster bootstrap in curved brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B15: *Reciprocity: Individual Level*

	(1)	(2)	(3)	(4)
Dependent variables:	Positive Reciprocity		Negative Reciprocity	
Temperature Variability GS 1500 - 1750	-0.380 (0.243)		-0.002 (0.220)	
Precipitation Variability GS 1500 - 1750		0.002 (0.009)		-0.005 (0.006)
Subjective Math Skills	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Number of Clusters	124	124	124	124
Observations	12,582	12,582	12,308	12,308
R-squared	0.06	0.06	0.10	0.10

NOTE: OLS regressions. The unit of observation is an individual. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Standard errors clustered at the region-level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.6 Geographic Matching

Table B16: *Matching*

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	Trust					
	Temperature		Precipitation		Principal Component	
Above Median GS Variability	0.488*** (0.082)	0.867*** (0.081)	0.138* (0.080)	0.587*** (0.091)	0.040 (0.106)	0.595*** (0.102)
Matching Variables	Long/Lat	Long/Lat & Geo	Long/Lat	Long/Lat & Geo	Long/Lat	Long/Lat & Geo
Observations	239	239	239	239	239	239

NOTE: The unit of observation is a region. Geographic variables used for matching regions are mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. *** p<0.01, ** p<0.05, * p<0.1.

B.7 Historical Agriculture

Table B17: *Historical Importance of Agriculture*

	(1)	(2)	(3)
Dependent variable:		Trust	
Temperature Variabiltiy GS 1500 - 1900	0.903** (0.372)		
× Share Agriculture > 50 % (1900)	0.720** (0.304)		
Precipitation Variabiltiy GS 1500 - 1900		0.015 (0.012)	
× Share Agriculture > 50 % (1900)		0.018** (0.008)	
Principal Component Variabiltiy GS 1500 - 1900			0.096* (0.058)
× Share Agriculture > 50 % (1900)			0.144*** (0.043)
Share Agriculture > 50 % (1900)	-0.595** (0.282)	-0.251** (0.108)	-0.041 (0.051)
Geographic Controls	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes
Observations	895	895	895
R-squared	0.83	0.83	0.84
Number of Clusters	101	101	101

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B.8 Wheat Prices in European Markets 1500 - 1900

Table B18: *Climate Shocks and Wheat Prices*

	(1) (log) Price Wheat	(2) (log) Price Wheat	(3) (log) Price Wheat	(4) (log) Price Wheat
L.Temperature GS	-0.056***	-0.133***		
	(0.020)	(0.049)		
L.Temperature GS × L.Temperature GS		0.003		
		(0.002)		
L.Precipitation GS			0.001*	-0.000
			(0.000)	(0.001)
L.Precipitation GS × L.Precipitation GS				0.000
				(0.000)
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Observations	13,059	13,059	13,069	13,069
R-squared	0.89	0.89	0.89	0.89
Number of Clusters	98	98	98	98

NOTE: OLS regressions. The unit of observation is a market. Heteroscedastic-robust standard errors clustered at the market in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B.9 Religiosity

Table B19: *Climate Variability and Religiosity*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variables:	Church attendance			Pray			Religiosity		
Temperature Variability GS 1500 - 1750	-0.498**			-0.936***			-1.700***		
	(0.247)			(0.280)			(0.327)		
Precipitation Variability GS 1500 - 1750		-0.013*			-0.015			-0.011	
		(0.007)			(0.010)			(0.015)	
Principal Component Variability GS 1500 - 1750			-0.087**			-0.135***			-0.197***
			(0.039)			(0.048)			(0.061)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.85	0.85	0.85	0.84	0.84	0.84	0.80	0.79	0.79
Number of Clusters	155	155	155	155	155	155	155	155	155

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B20: *Religiosity: Individual Level*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variables:	Church attendance			Pray			Religiosity		
Temperature Variability GS 1500 - 1750	0.053 (0.403)			-0.262 (0.489)			-0.653 (0.543)		
Precipitation Variability GS 1500 - 1750		-0.001 (0.010)			0.002 (0.015)			0.028 (0.019)	
Principal Component Variability GS 1500 - 1750			0.004 (0.062)			-0.024 (0.079)			0.006 (0.100)
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	252,005	252,005	252,005	249,429	249,429	249,429	251,282	251,282	251,282
R-squared	0.25	0.25	0.25	0.29	0.29	0.29	0.22	0.22	0.22
Number of Clusters	239	239	239	239	239	239	239	239	239

NOTE: OLS regressions. The unit of observation is an individual. Individual controls include age and its square, gender, and dummies for years of education. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the sub-national region level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B21: *Religiosity as Controls*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:					Trust				
Temperature Variability GS 1500 - 1750	1.054*** (0.269)			1.052*** (0.275)			1.086*** (0.272)		
Precipitation Variability GS 1500 - 1750		0.019*** (0.007)			0.018*** (0.007)			0.018*** (0.006)	
Principal Component Variability GS 1500 - 1750			0.156*** (0.039)			0.154*** (0.039)			0.157*** (0.039)
Church attendance	0.046 (0.048)	0.040 (0.049)	0.049 (0.048)						
Pray				0.023 (0.042)	0.015 (0.042)	0.022 (0.042)			
Religiosity							0.032 (0.031)	0.020 (0.031)	0.029 (0.031)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476
R-squared	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Number of Clusters	155	155	155	155	155	155	155	155	155

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B22: *Religiosity as Controls: Individual Level*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:	Trust								
Temperature Variability GS 1500 - 1750	0.566** (0.254)			0.598** (0.257)			0.604** (0.260)		
Precipitation Variability GS 1500 - 1750		0.013* (0.008)			0.014* (0.008)			0.012 (0.008)	
Principal Component Variability GS 1500 - 1750			0.096*** (0.037)			0.101*** (0.038)			0.097*** (0.037)
Church attendance	0.069*** (0.006)	0.069*** (0.006)	0.069*** (0.006)						
Pray				0.010** (0.004)	0.010** (0.004)	0.010** (0.004)			
Religiosity							0.041*** (0.003)	0.041*** (0.003)	0.041*** (0.003)
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	251,305	251,305	251,305	248,751	248,751	248,751	250,649	250,649	250,649
R-squared	0.19	0.19	0.19	0.18	0.18	0.18	0.19	0.19	0.19
Number of Clusters	239	239	239	239	239	239	239	239	239

NOTE: OLS regressions. The unit of observation is an individual. Individual controls include age and its square, gender, and dummies for years of education .Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the sub-national region level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B.10 Robustness to Additional Historical Characteristics

Table B23: *Additional Historical Controls*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable:	Trust									
Temperature Variability GS 1500 - 1750	1.135***		1.151***		1.165***		1.148***		1.146***	
	(0.300)		(0.301)		(0.296)		(0.301)		(0.295)	
Precipitation Variability GS 1500 - 1750		0.022**		0.023**		0.023**		0.023**		0.022**
		(0.010)		(0.010)		(0.010)		(0.010)		(0.010)
Share of Cities with a Bishop	0.056	0.058							0.049	0.058
	(0.047)	(0.048)							(0.051)	(0.052)
City with a Bishop			0.020	0.012						
			(0.036)	(0.037)						
Share of Cities with a University					0.048	0.025			0.025	-0.001
					(0.051)	(0.052)			(0.055)	(0.056)
City with a University							-0.001	-0.007		
							(0.038)	(0.040)		
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	957	957	957	957	957	957	957	957	957	957
R-squared	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
Number of Clusters	129	129	129	129	129	129	129	129	129	129

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country-wave level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B.11 Robustness of the Effect of Climate Variability on Communal Institutions

Table B24: *Early Political Institutions: Robustness*

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables:	Any Communal City			Share of Communal Cities		
Temperature Variability GS 1500 - 1750	0.827** (0.337)			1.130*** (0.327)		
Precipitation Variability GS 1500 - 1750		0.018** (0.008)			0.023** (0.008)	
Principal Component Variability GS 1500 - 1750			0.131** (0.050)			0.173*** (0.045)
Number of cities				-0.010** (0.004)	-0.012** (0.004)	-0.011** (0.004)
Share of cities with a Bishop				0.050 (0.066)	0.057 (0.069)	0.051 (0.067)
Share of cities with a University				0.144* (0.075)	0.117 (0.079)	0.132 (0.076)
Share of cities with a Roman Road				0.157* (0.076)	0.160* (0.086)	0.153* (0.080)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	147	147	147	147	147	147
R-squared	0.75	0.75	0.75	0.80	0.79	0.80
Number of Clusters	19	19	19	19	19	19
Conley S.E. 300km						
Variability GS 1500 - 1750	{0.488}*	{0.011}*	{0.072}*	{0.334}***	{0.009}***	{0.049}***
p-values Wild Bootstrap						
Variability GS 1500 - 1750	{0.090}*	{0.044}**	{0.058}*	{0.010}***	{0.014}**	{0.002}***

NOTE: OLS regressions. The unit of observation is a region. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B.12 Migrants

Table B25: *Effect of Climate on Trust in Migrants*

	(1)	(2)	(3)
Dependent variable:		Trust	
Temperature Variability GS 1500 - 1750	0.299		
	(0.377)		
Precipitation Variability GS 1500 - 1750		-0.004	
		(0.010)	
Principal Component Variability GS 1500 - 1750			0.021
			(0.051)
Individual Controls	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes
Observations	46,532	46,532	46,532
R-squared	0.11	0.11	0.11
Number of Clusters	237	237	237

NOTE: OLS regressions. The unit of observation is an individual. Individual controls include age and its square, gender, and dummies for years of education. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the sub-national region level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B26: *Effect of Climate on Trust in Migrants: Interactions*

	(1)	(2)	(3)
Dependent variable:		Trust	
Temperature Variability GS 1500 - 1750	0.650**		
	(0.268)		
× Migrant	-0.720***		
	(0.132)		
Precipitation Variability GS 1500 - 1750		0.013*	
		(0.008)	
× Migrant		-0.010***	
		(0.002)	
Principal Component Variability GS 1500 - 1750			0.102***
			(0.037)
× Migrant			-0.082***
			(0.013)
Migrant	0.394***	-0.039	-0.158***
	(0.104)	(0.041)	(0.019)
Individual Controls	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes
Country x Wave FE	Yes	Yes	Yes
Observations	298,901	298,901	298,901
R-squared	0.17	0.17	0.17
Number of Clusters	239	239	239

NOTE: OLS regressions. The unit of observation is an individual. Individual controls include age and its square, gender, and dummies for years of education. Geographic controls include mean precipitation, mean temperature, average altitude, average terrain slope, (log) area, longitude, latitude, distance to coast, coastal dummy, a dummy for rivers, and average soil quality and its standard deviation. Heteroscedastic-robust standard errors clustered at the sub-national region level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B27: *Countries and Regions included in the Main Analysis*

	ESS round								
Country-Code	1	2	3	4	5	6	7	8	Total
AT - Austria	9	9	9	0	0	0	9	9	45
BE - Belgium	3	3	3	3	3	3	3	3	24
BG - Bulgaria	0	0	28	28	28	28	0	0	112
CH - Switzerland	6	7	7	7	7	7	7	7	55
CZ - Czechia	8	8	0	8	8	8	8	8	56
DE - Germany	16	16	16	16	16	16	16	16	128
DK - Denmark	5	5	5	5	5	5	5	0	35
EE - Estonia	0	5	5	5	5	5	5	5	35
ES - Spain	16	16	16	16	16	16	16	16	128
FI - Finland	4	3	3	3	1	4	4	4	26
FR - France	8	8	8	8	8	8	8	0	56
GB - Great Britain	12	12	12	12	12	12	12	12	96
GR - Greece	13	13	0	10	12	0	0	0	48
HR - Croatia	0	0	0	2	1	0	0	0	3
HU - Hungary	7	7	7	7	7	7	7	7	56
IE - Ireland	8	8	1	1	8	8	8	8	50
IT - Italy	18	0	0	0	0	18	0	19	55
LU - Luxembourg	1	1	0	0	0	0	0	0	2
NL - Netherlands	12	12	12	12	12	12	12	12	96
NO - Norway	7	7	7	7	7	7	7	7	56
PL - Poland	16	16	16	16	16	16	16	16	128
PT - Portugal	5	5	5	5	5	5	5	5	40
SE - Sweden	8	8	8	8	8	8	8	8	64
SI - Slovenia	12	12	12	12	0	0	0	0	48
SK - Slovakia	0	8	8	8	8	8	0	0	40
Total	194	188	187	198	193	201	156	162	1,479

C Data Appendix and Variable Description

European Social Survey

- **Trust (ESS)** The main specification uses average regional and individual level trust constructed from eight rounds of the European Social Survey. The survey asks the following question: '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 10 means that most people can be trusted'. Source: European Social Survey rounds 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016.

- **Cooperativeness (ESS)** In addition to trust, we look at two other questions measuring cooperativeness that ask respondents to evaluate the following statements on a scale from 0 to 10: i) 'Most people try to take advantage of you, or try to be fair', where 0 indicates that 'Most people try to take advantage of me', and 10 that 'Most people try to be fair'; ii) 'Most of the time people helpful or mostly looking out for themselves', where 0 indicates 'People look mostly out for themselves', and 10 indicates that 'People mostly try to be helpful'. We combine both variables by extracting the principal component. Source: European Social Survey rounds 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016.

- **Religiosity (ESS)** We assess religiosity using three variables. First, the ESS asks respondents to evaluate on a scale their own religiosity on a scale from 0 (not at all religious) to 10 (very religious). Second, respondents are asked to indicate how often they attend religious services apart from special occasions (answers ranging from never to every day). Third, respondents are asked to indicate how often they prey apart outside of religious services (answers range from never to every day). We recode all variables so that higher values indicate stronger religiosity and more frequent religious service attendance and prayers. Source: European Social Survey rounds 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016.

European Values Survey

- **Trust & Family Ties (EVS/WVS)** In additional specifications we use information on social trust from the EVS/WVS that comes from the question: 'Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?'. The resulting variable is a dummy taking on the value one if the respondent answers 'most people can be trusted', and zero for 'can't be too careful'.

  Following Alesina and Giuliano (2010), we also employ three of the EVS/WVS 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 asks the respondent how important is family in his/her life, the possible answers ranging from ‘not very important’, to very important. The second question 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’, or whether they always have this duty, regardless of parents’ qualities and faults. Finally, the third question 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’, or whether ‘it’s parents’ duty to do their best for their children even at the expense of their own well-being’. We extract the first principal component of the three variables. Source: EVS/WVS integrated values survey 1981-2007.

Climate Data

- **Historical Climatic Variability and Averages (1500 - 2000)** Historical fluctuations and averages of rainfall and temperature for the period 1500 to 2000 are constructed with the use of seasonal climatic data from the *European Seasonal Temperature and Precipitation Reconstruction* data set, see Luterbacher *et al.* (2004) and Pauling *et al.* (2006). The historical climate has been reconstructed from environmental proxies and documental evidence, and interpolated on a grid with a spatial resolution of 0.5 degrees and an extent of 130 columns & 70 rows for temperature and 140 columns & 82 rows for precipitation. Measures of average climate and climate volatility are first constructed at the grid-cell level and then aggregated at the regional level. Since precipitation levels per season are reported in the data as the sum of three months, we scale the data by factor 3. The following main variables are used: *Precipitation Variability GS 1500-1750* measures average inter-temporal variability in precipitation during the growing (spring and summer) season. *Precipitation Variability NGS 1500-1750* measures average inter-temporal variability in precipitation during the non-growing (fall and winter) season. *Temperature Variability GS 1500-1750* measures average temporal variability in temperature during the growing (spring and summer) season. *Temperature Variability NGS 1500-1750* measures average temporal variability in temperature during the non-growing (fall and winter) season. *Mean Precipitation 1500 - 2000* and *Mean Temperature 1500 - 2000* measure average precipitation and temperature over the period 1500 to 2000.

- **Contemporary Climatic Variability and Averages (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 *et al.*, 2004). The data are in grid format with a spatial resolution of 0.1 arc-minutes and contains monthly observations of air temperature and precipitation, constructed from actual climatic records collected at weather stations throughout Europe, and generalized at the grid cell level using interpolation. As with the historical climate records we construct averages and standard deviations of temperature and precipitation over different seasons. These measures are constructed at the grid-cell level and then aggregated at the regional level.

- **Growing Season** To calculate the region specific growing season, we compute the average start month of the growth cycle for low-input, rainfed wheat using grid-cell level data from the FAO-GAEZ database. In addition, from the same data source, we use gridd-cell level data on the length of the growing period to compute the average duration and end month of the growing season. Using the modern climate data, we also construct two measure of the spatial variability of temperature. 1. We measure the pairwise correlation of monthly temperature in cell i with the monthly temperature in the eight cells j that are neighbors of i. We then take the average of the correlation coefficients across all cells i that belong to region r. 2.We compute for each month mt the range of temperature shocks across the cells that belong to a common region, defined as the maximal value of temperature in month m of year t minus the minimal temperature in the same month m of year t. We then average the range across all months and years, which measures the average spatial variability of temperature shocks within a region.

Geographic Controls

- **(log) Area** The area of a region measured in (log) square kilometers. Own calculation using ArcGIS.

- **Latitude & Longitude** Latitude and longitude of regional centroids. Own calculation using ArcGIS.

- **Terrain Slope** The mean slope of the terrain, computed using geospatial data of median terrain slope classes at a 5 arc-minute resolution from the FAO-GAEZ database.

- **Altitude** The average altitude measured in kilometers, and its standard deviation are computed using geospatial data of the median altitude at a 5 arc-minute resolution taken from the FAO-GAEZ database.

- **Suitability for Rainfed Cereals** The average suitability, its standard deviation and its range are computed using geospatial data of suitability (index) for low input level rainfed cereals at a 5 arc-minute resolution taken from the FAO-GAEZ database.

- **Distance to Coast** Shortest distance from the region's centroid to the nearest coast in 1000 kilometers. Own calculation using ArcGIS and a shapefile of coastlines included in the 'Global Self-consistent, Hierarchical, High-resolution Geography Database', version 2.3.4 (January 1, 2015), of the National Centers for Environmental Information (NCEI) .

- **Coastal Dummy** Dummy variable taking on the value 1 if the region is located at the coast, 0 otherwise. Own calculation using ArcGIS.

- **River** River is a dummy taking on the value 1 if a river is present in a region, and 0 otherwise, using the spatial location of rivers included in the Water Information System for Europe (WISE) project of the European Environment Agency.

- **Caloric Difference Wheat and Potato** We compute the caloric difference between growing wheat and potato for each region using data on caloric suitability of crops under low-input rainfed conditions taken from Galor and Özak (2016).

Wheat Prices

- **Wheat Prices in 98 Medieval Markets** Data on the prices of wheat in 98 European markets over the period 1500 to 1900 come from the Allen-Unger Commodity Prices Dataset (Allen and Unger, 2019).

Institutions

- **Share of Communal Cities and Medieval City Characteristics** The data on characteristics of European cities between 800 and 1800 are taken from Bosker *et al.* (2013). The authors include cities in the dataset if their population exceeded 10,000 at least once during the sample period. The share of communal cities in a region is computed as the number of cities with a commune in the period 1500 to 1800 divided by the total number of cities. The share of cities with a Bishop, a University, or a Roman Road is computed similarly. The number of cities is equal to the total number of cities per region included in the dataset.

- **Quality of Government 2013** The regional average of governmental quality is taken from the EU Regional Data of the Quality of Government Institute.
  See qog.pol.gu.se/data/datadownloads/qogeuregionaldata.

Other Variables

- **Population, GDP per capita & Employment Shares in 1900** Population, estimates of per capita incomes, and employment shares in agriculture, industry and services for the year 1900 are taken from Rosés and Wolf (2018). Out of the 173 regions that the dataset contains, we were able to merge 130 NUTS-2 regions located in 14 Western European countries: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Norway Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

- **Number of Cities in 1500 and Distance to Cities** The number of cities in 1500 per region, as well as the distance from the regional centroid to the closest city in 1500 is calculated using geo-referenced information about the existence and location of European cities in 1500 that is based on the database assembled by Bairoch *et al.* (1988).

- **Historical Conflict** Information on the location of historical conflicts come from the Conflict Catalogue by Brecke (1999). The Conflict Catalogue reports all violent conflicts since 1400 AD with more than 31 deaths. We consider two alternative measures of historical, regional conflict intensity: i) the total number of conflicts per region over the period 1500 - 1900; and ii) the number of years with a conflict.
- **Medieval European Trade Routes** The location of Medieval trade routes is based on the map in the Historical Atlas by Shepherd (1926).

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