Discussion Paper Series

IZA DP No. 18647

May 2026

Ancestral Inequality and Preferences for Redistribution

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ISSN: 2365-9793

IZA DP No. 18647 May 2026

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Abstract

Using a combination of individual-level, bioclimatic, ethnographic, and archaeological data, we investigate the ancient origins of cross-country variation in preferences for redistribution. Our hypothesis is that contemporary attitudes toward redistribution are shaped by ancestral inequality, which arose as an endogenous adaptation of pre-Neolithic hunter-gatherer societies to seasonal food shortages induced by the seasonality of the wild progenitors of domesticated crops. Employing contemporary survey data and an epidemiological approach, we first show that migrants originating from countries characterized by higher ancestral inequality exhibit lower support for redistribution, and that this relationship is driven by the degree of crop seasonality in the migrants' origin countries. Next, using data on premodern societies, we show that crop seasonality induces food storage practices, which in turn lead to inequality. The positive effect of food storage on inequality is corroborated by data from archaeological sites. Finally, drawing on data from preindustrial polities, we uncover that the mechanism linking food storage to redistributive preferences operates through the positive influence of the former on tolerance for inequality.

JEL classification

D63, H23, N50, O13, Z10

Keywords

preferences for redistribution, seasonal food shortage, crop seasonality, food storage, inequality, tolerance for inequality

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* We thank James Fenske, Oded Galor, Paola Giuliano, Stelios Michalopoulos, Luigi Pascali, Nancy Qian, Alessandro Saia, Uwe Sunde, Thierry Verdier, and seminar and conference participants at the NBER Summer Institute Workshop on Inequality and Macroeconomics, the Belfast Workshop on Cultural Persistence and Transmission, the First Bolzano Workshop on Historical Economics, the ASREC Conference, the ASREC Europe Conference, the Modena Workshop on The Economics of Culture: Ethnicity, Gender, and Their Interactions, the BOMOPAV Meeting, Brown University, and the Universities of Padua, Modena, and Bergamo, for helpful comments and suggestions on earlier drafts. We acknowledge financial support from an Italian University Ministry PRIN 2017 grant.

1 Introduction

Preferences for redistribution lie at the foundation of public interventions aimed at mitigating social inequalities. In the seminal contribution by Meltzer and Richard (1981), the level of inequality determines the median voter's position in the income distribution and, consequently, a society's redistributive preferences and policy outcomes. As with other behavioral traits, at an even deeper layer preferences for redistribution may be rooted in the ancestral characteristics of societies, as shaped by environmental factors that potentially affect embryonal forms of inequalities and continue to exert a persistent influence through evolutionary adaptation (Galor and Moav, 2002) and intergenerational transmission (Bisin and Verdier, 2001). While prior research on other preference traits such as time, risk, and social attitudes has already explored their deep determinants,[1] the origins of observed differences in redistributive preference across societies have remained largely unexplored.

In this paper, we investigate the ancient origins of preferences for redistribution by adopting an evolutionary perspective grounded in ecological anthropology. We focus on adaptive strategies in hunter-gatherer societies—the dominant form of organization for most of human history—and, in particular, on how seasonality in resource variability and the associated predictable risk in food availability may have triggered embryonal forms of societal stratification and inequality even prior to the Neolithic Revolution. We hypothesize that pre-Neolithic seasonal scarcity, through ancestral inequality, persistently shapes contemporary tolerance for inequality itself, with a consequent impact on preferences for redistribution. Specifically, prolonged historical exposure to inequality curbs current demand for redistribution by making inequality socially acceptable.

To test the fundamental hypothesis that seasonal food shortage in the pre-Neolithic era predicts contemporary preferences for redistribution, we draw on influential work in anthropology based on an ecological approach to adaptation and pioneered by Binford (1980). Accordingly, food storage in premodern societies emerges as an optimal strategy in the face of seasonal scarcity as the result of an adaptation of hunter-gatherers to the surrounding ecological environment. Binford (1980) distinguishes between two alternative adaptation strategies in hunter-gatherer societies, depending on food availability throughout the year: "Foragers" exhibit minimal dependence upon storage, while "collectors" engage in food storage to smooth consumption over seasonal cycles. The emergence of food storage among hunter-gatherers is widely argued to have fostered increasing so-

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[1] The ancient origins of time preferences, the incentive to cooperate, risk aversion, and loss aversion have been investigated respectively by Galor and Ozak (2016), Litina (2016), Nazarova (2020), and Galor and Savitskiy (2022), while Becker, Enke, and Falk (2020) apply the same approach to address the global variation in preferences.

cial complexity and wealth disparities (Testart, 1982). Notably, this process predates the Neolithic Revolution, which through the diffusion of agriculture generated a storable food surplus. This implies that inequality originated in food storage practices rather than the onset of agriculture, suggesting that the roots of contemporary preferences for redistribution must be sought in the pre-agricultural era. We provides a detailed review of the relevant anthropological literature in a background section.

Building on these insights, our hypothesis is that pre-Neolithic inequality—driven by seasonal food shortage—reverberates in tolerance toward inequality itself, thereby laying the foundation for aversion to redistribution as expressed by the preference traits we observe in the present day.

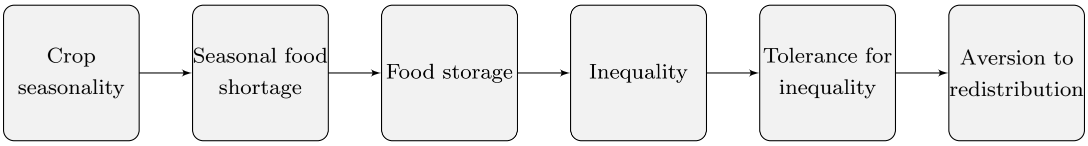

Figure 1: From crop seasonality to preferences for redistribution

Figure 1 summarizes this causal chain: Crop seasonality generates seasonal food shortage; shortage induces food storage; storage eventually fosters inequality; exposure to inequality in turn produces tolerance for it, reducing demand for redistribution. In more detail, with high seasonality, production is concentrated within a short harvest window, creating a need to store food and smooth consumption over the year. Through a process of cultural adaptation (Henrich, 2006), storage induces the development of cultural norms—such as sharing rules, redistribution mechanisms, punishment of hoarding, trust, and monitoring institutions—to address the associated vulnerability to theft and appropriation, elite capture, and free riding. Societies whose norms and institutions are better suited to managing these storage related risks are more likely to survive and reproduce. Over generations, such norms can become stable cultural equilibria and, over the very long run, may even be reinforced through gene–culture coevolution. This process can generate persistent pro-redistribution preferences. As a result, ancestral differences in crop seasonality may translate into enduring cross-country variation in attitudes toward redistribution, even after the original ecological conditions have changed.

Our empirical analysis proceeds in four steps. First, we construct a proxy for seasonal scarcity that captures cross-regional variation in the seasonality of crop availability in the pre-Neolithic era. Second, we examine how contemporary redistributive preferences are shaped by crop seasonality through its effect on ancestral inequality. Third, we exploit ethnographic and archaeological data to examine how, within premodern societies, food storage, social complexity, and inequality respond to variation in crop seasonality. Finally, using data from preindustrial polities, we explore the relationship between food storage and tolerance for inequality.

In more detail, in Section 4 we construct our proxy for seasonal food shortage using biogeographical data on crop wild relatives—that is, the undomesticated progenitors of cultivated crops. Drawing on a variety of sources, we assemble a dataset covering 109 genera of crop wild relatives. Using a machine-learning algorithm, we compute the average suitability for each genus in the sample across a global grid at a $0.5° \times 0.5°$ resolution. We then combine these suitability estimates with information on monthly harvest calendars to construct a cell-level measure of annual crop seasonality, computed as the coefficient of variation averaged across crops in a cell. The resulting crop seasonality measure captures the degree of intra-annual instability in food availability, with higher values indicating greater concentration of harvest opportunities in a limited number of months and, consequently, a stronger need for food storage. In addition, we construct a complementary measure of crop persistency, defined as the share of crop wild relatives that bear fruits throughout the year. To address alternative hypotheses, we also construct a conceptually distinct crop-related measure capturing crop variety, defined as one minus a Herfindahl index of concentration over crop suitability. In the empirical investigation, we aggregate these three indicators to the country level when examining contemporary preferences for redistribution, and to the premodern society level when combining them with ethnographic data.

In Section 5, we begin our regression analysis of the influence of seasonal scarcity using individual-level survey data on contemporary preferences for redistribution from the World Values Survey and the European Social Survey. Both surveys include questions that provide suitable proxies for redistributive attitudes. Our dependent variable captures respondents' agreement with the statement that governments should reduce income differences (in the former survey) or, analogously, that an essential characteristic of democracy is that governments should tax the rich and subsidize the poor (in the latter). To isolate how preference traits are transmitted across generations, we adopt an epidemiological approach (Fernandez, 2007; Giuliano, 2007), restricting the sample to first and second generation migrants. We augment the dataset with a measure of ancestral inequality in migrants' countries of origin that we generate from Giuliano and Nunn (2018) based on information from the Ethnographic Atlas (Murdock, 1967). We find that ancestral inequality is negatively associated with support for redistribution, both in parsimonious specifications that include only residence country and time fixed effects and in specifications that control for potential confounders reflecting institutional and social characteristics of the origin countries. However, when we enter the origin countries' measure of crop seasonality as an additional control, its coefficient is negative and statistically significant, while the coefficient on ancestral inequality loses statistical significance. This is consistent with the fact that the variable capturing ancestral inequality—being generated from the coarse categories describing class stratification in the aforementioned Ethnographic Atlas—is much noisier than crop seasonality, so that the latter better captures the link between food storage and contemporary attitudes. This pattern suggests that crop seasonality is the potential driver of redistributive preferences. In other words, individuals originating from countries historically exposed to more severe seasonal scarcity—and thus likely more dependent on food storage in the distant past—may have developed over time attitudes that reveal lack of support for redistributive policies. Given the correlational nature of our analysis, we provide an extensive battery of robustness checks that supports our findings. Our results are unaffected by the inclusion of potential confounders such as the Gini index, the agricultural share of GDP, and latitude. They are also robust to allowing for differential responses to crop seasonality between first and second generation migrants. Furthermore, using the complementary measure of crop persistency yields consistent conclusions, while crop variety as expected carries no explanatory power. Finally, we show that other preference traits—such as long-term orientation, altruism, and risk aversion—are unrelated to our crop risk measures, providing a falsification test and underscoring the unique relevance of the proposed mechanism for redistributive preferences.

In Section 6, we leverage ethnographic data assembled from three sources—the Binford Hunter-Gatherer dataset (Binford, 1981), the Western North American Indians dataset (Jorgensen, 1980), and the Ethnographic Atlas (Murdock, 1967)—to investigate the influence of crop seasonality on inequality among hunter-gatherers. We proceed in two steps. First, we show that crop seasonality—our proxy for the seasonal risk in food availability—is positively associated with the adoption of food storage practices, even after controlling for continent fixed effects and geographic characteristics of the surrounding environment. As before, the complementary measure of crop persistency yields consistent results, whereas crop variety does not play a role. In a second step, we show that food storage is linked with a society's structure, since its practice is positively associated with population size, social complexity, and the presence of slavery, and negatively associated with socioeconomic equality. Hence, food storage represents the likely channel linking seasonal food shortage to ancestral forms of inequality. This reduced form evidence is corroborated by a battery of robustness checks, including the use of Conley standard errors to account for spatial dependence, controls for latitude and crop storability, 2SLS estimates of the effect of food storage on societal characteristics using the two crop risk measures as instruments, and tests ruling out nomadism rather than food storage as the driver of our results. An extension of the analysis documents a positive effect of scarcity on the emergence of religion, as captured by the presence of beliefs in a moralizing high god within a society. This finding aligns with evidence in social anthropology suggesting that beliefs in moralizing high gods are more prevalent in societies characterized by larger social stratification (Swanson, 1960) and more unstable ecological conditions (Botero et al., 2014).

In Section 7, we further validate the storage-inequality nexus using two alternative sources of archaeological data, both providing measures of inequality in the form of Gini indices computed from household-level data collected from archaeological sites. Regressing the Gini index provided by Bogaard, Fochesato, and Bowles (2019) on crop seasonality confirms that our proxy for food availability risk is positively associated with inequality. The second source, from Basri and Lawrence (2020), provides the geographic locations of archaeological sites, enabling us to merge archaeobotanical data from ADEMNES and construct an alternative measure of persistency, which complements those previously obtained as predictions from current biogeographical data. Consistent with previous findings, the new measure is negatively associated with inequality as captured by the site-level Gini index.

Our analysis thus far suggests that the ecological environment surrounding pre-Neolithic societies, when characterized by seasonal food shortage, fostered the emergence of food storage and in turn inequality. To understand how the long-term influence of the environment results in lower demand for redistribution, it remains to be shown whether higher inequality does lead to higher tolerance for inequality itself, thereby reducing support for redistributive policies through cultural adaptation. In Section 8, using the Seshat dataset on preindustrial polities, we provide an affirmative answer by showing that the presence of food storage sites within a polity is negatively associated with preferences for equality, as captured by whether the polity's ideology promotes egalitarianism. Furthermore, we find that religious beliefs in a moralizing high god represent a mediator for food storage, transmitting its influence on preference for equality beyond the phase in human history in which hunter-gatherers had to rely on storage in the face of environmental duress. We also show that food storage is instead not associated with other polity's characteristics that may correlate with the size of the welfare state, such as preference for prosociality or constraints on the executive as a proxy for fiscal capacity. By contrast, food storage is positively associated with the presence of ideological support for merit promotion, consistent with the negative association between meritocracy and redistribution.

In summary, the broad evidence we provide collectively supports the hypothesis that ecological conditions characterized by seasonal food shortage—proxied by a number of alternative biogeographical measures capturing predictable risk in food availability—fostered food storage as an adaptive response to environmental duress. Over time, the practice of food storage generated demographic expansion, social and institutional complexity, and ultimately inequality. Persistent exposure to inequality in turn increased tolerance for it, thereby reducing the perceived need for redistribution. Through a process of intergenerational transmission, this sequence of conditions, first manifested in premodern societies and polities, continues to shape individual preferences in the present day. The emergence of religions centered on moralizing high gods—which can also be traced to the same ecological determinants—may have acted as a mediator allowing the persistence of egalitarian sentiments well past the phase in human history in which food storage served as an adaptive strategy. Consequently, contemporary cross-country differences in support for redistribution can indeed be traced back to the degree of risk in food availability faced by hunter-gatherers in the pre-Neolithic era.

While our findings lend plausibility to the link between crop seasonality and aversion to redistribution, some caveats are worth noting. First, one might argue that trade could substitute for storage. However, since our analysis crucially focuses on pre-Neolithic hunter-gatherers—who typically lived in relative isolation—this channel is unlikely to be relevant. Similarly, advances in storage technology, particularly refrigeration, could weaken the proposed mechanism, but this concern does not apply to pre-industrial contexts. Institutions could also override ecological pressures. We address this concern in two ways. Using contemporary survey data, we adopt an epidemiological approach to neutralise the influence of current institutional features in destination countries (Section 5), while for hunter-gatherer societies we directly examine the relationship between crop seasonality and institutions, finding that institutions tend to transmit, rather than mitigate, the influence of ecological conditions (Section 6). Indeed, consistent with the cultural adaptation theory (Henrich, 2006), we show that seasonality contributed to the creation of institutional norms—such as beliefs in moralizing high gods—that tend to punish free-riders and that, over time, reinforce preferences for redistribution. Finally, crop seasonality may be correlated with other ecological factors that have been proposed to explain a range of outcomes—though not specifically redistributive preferences—such as latitude or more sophisticated climate- and crop-based measures. In the literature review, we provide a detailed comparison with these alternatives, highlighting the unique ability of crop seasonality to capture the temporal concentration of food availability faced by human populations.

To recap, the remainder of the paper is organized as follows. Section 2 discusses related literature, with particular attention to alternative geographic, climatic, and ecological indicators. Section 3 provides a brief overview of anthropological research on the adaptive strategies of hunter-gatherers and the emergence of food storage prior to the Neolithic Revolution. Section 4 describes the data and the construction of the key variables used in the empirical analysis. Section 5 shows that contemporary preferences for redistribution are shaped by ancestral inequality driven by crop seasonality. Section 6 explores the relationships between crop seasonality, food storage, social complexity, and inequality in premodern societies. Section 7 presents additional supporting evidence from archaeological data. Section 8 investigates the effect of food storage on tolerance for inequality as a mechanism linking storage to redistributive preferences, using data on preindustrial polities. Section 9 concludes. The Appendix contains additional tables and figures.

2 Related literature

This paper contributes to two main strands of the literature. The first examines the determinants of preferences for redistribution, exploring a broad range of correlates, including social mobility (Piketty, 1995; Benabou and Ok, 2001; Alesina and La Ferrara, 2005; Alesina, Stantcheva, and Teso, 2018), institutions (Benabou, 2000; Benabou and Tirole, 2006; Alesina and Fuchs-Schuendeln, 2007), perception of fairness (Alesina and Angeletos, 2005; Durante, Putterman, and Weele, 2014; Ashok, Kuziemko, and Washington, 2015), cultural norms (Alesina and Giuliano, 2011; Luttmer and Singhal, 2011), and preference heterogeneity (Lockwood and Weinzierl, 2015).

Relative to this literature, our focus in on inequality as in the seminal contribution by Meltzer and Richard (1981). However, an empirical nexus between a society's level of inequality and demand for redistribution has been hard to establish (Kenworthy and McCall, 2008; Kuziemko et al., 2015). Even voters' personal characteristics such as age, gender, and race, as well as historical and cultural factors, have been found to account for only a limited share of the observed variation in preferences for redistribution both across and within countries (Alesina and Giuliano, 2011). Hence, our first contribution to this stream is to provide empirical evidence linking inequality and redistributive preferences.

Furthermore, while within prior research on other preference traits such as time, risk, and social attitudes (Dohmen et al., 2012; Falk et al., 2018; Chowdhury, Sutter, and Zimmermann, 2022), the afore-mentioned stream has already explored their ancient origins (Galor and Ozak, 2016; Litina, 2016; Becker, Enke, and Falk, 2020; Nazarova, 2020; Galor and Savitskiy, 2022), we are the first to apply this perspective to redistributive preferences. By emphasizing the role of ancestral inequality and motivations shaped in the distant past, we also complement survey evidence showing that individuals exposed to higher inequality during their lifetimes demand less redistribution (Roth and Wohlfart, 2018), as well as experimental evidence highlighting the importance of moral motivation in driving moral behavior and redistributive choices (Cappelen et al., 2017).[2] Finally, by

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[2] Related work shows that inequality may also influence redistributive preferences indirectly through

investigating the bioclimatic origins of redistributive preferences, we bridge this strand of literature with the one we discuss in detail below.

The second strand of literature to which this paper contributes investigates the long-term influence of geographic and ecological conditions on a wide range of outcomes, including economic development and growth (Diamond, 1997; Galor and Moav, 2002; Hibbs and Olsson, 2004; Olsson and Hibbs, 2005; Spolaore and Wacziarg, 2013; Andersen, Dalgaard, and Selaya, 2016; Litina, 2016; Michalopoulos and Papaioannou, 2020; Matranga, 2024), population dynamics (Lagerlof, 2007; Ashraf and Galor, 2013), the emergence of hierarchies (Mayshar, Moav, and Pascali, 2022), gender roles (Alesina, Giuliano, and Nunn, 2013; Giuliano and Nunn, 2021), and preferences for risk taking (Galor and Ozak, 2016) and loss aversion (Galor and Savitskiy, 2022). A closely related research line investigates the economic and cultural legacies of ancestral lifeways (Michalopoulos, Putterman, and Weil, 2019; Lowes and Le Rossignol, 2022).

Several measures have been proposed in this literature to explain various, often related aspects of economic, social, and human development. A baseline dimension is *latitude.* Distance from the equator has been indicated as a key driver of prosperity (Gallup, Sachs, and Mellinger, 1999), operating through channels such as social infrastructure (Hall and Jones, 1999), institutions (Acemoglu, Johnson, and Robinson, 2001), and disease ecology shaped by ultraviolet radiation (Andersen, Dalgaard, and Selaya, 2016). Relatedly, Diamond (1997) attributes Eurasia's historical economic success to agglomeration economies and technological diffusion associated with agriculture, which were facilitated by ecological homogeneity along an East-West axis, since sharing the same latitude results in a larger variety of easily domesticable plants. Hibbs and Olsson (2004) and Olsson and Hibbs (2005) provide empirical support for this hypothesis, confirming that geography and biogeography, including East-West orientation, influenced the timing of the transition to agriculture and, ultimately, contemporary economic development. Bleaney and Dimico (2011) further confirm the same hypothesis using more detailed estimates of the timing of the transition provided by Putterman and Trainor (2006).[3] Our measure of crop seasonality is correlated with latitude, since higher latitudes tend to exhibit stronger seasonal cycles in climate and daylight. However, latitude is a coarse geographic proxy, whereas

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channels such as education (Galor and Zeira, 1993; Benabou, 1996) and work incentives (Perotti, 1993).

[3] In the spirit of Diamond (1997), measures of *variety* are proposed by Ashraf and Galor (2011), who base it on the count of domesticated plant and animal species available in a region prior to the Neolithic Revolution, and use it as an instrument for the timing of the latter to proxy for the technological level. Their plant-based variety measure is aggregated at the level of nine global macro regions, whereas our variety measure is available at a much finer resolution. Measures of variety (inversely) based, as ours, on a Herfindahl index are used by Fiszbein (2022) in the context of mid-nineteenth-century US counties, for 36 product shares in agricultural output, with a positive long-run effect on population density and income per capita; and by Fenske (2014), for ecological shares in Africa, with a positive effect on the incentives to trade.

our crop seasonality measure captures the temporal concentration of suitability-weighted harvest availability and thus directly reflects the need to store food in order to smooth consumption. As a result, locations at similar latitudes may face very different degrees of seasonal scarcity, depending on crop composition and phenology.

Matranga (2024) introduces *climate seasonality* as an explanation for the onset of agriculture. This measure, constructed from paleoclimatic temperature and precipitation data, captures intra-annual variability in climatic conditions. While highly correlated with latitude, climate seasonality increased substantially over time due to oscillations in Earth's axial tilt, peaking 12,000 years ago just prior to the invention of agriculture. By inducing seasonal scarcity, heightened seasonality prompted hunter-gatherers to abandon nomadism and adopt food storage to smooth consumption, thereby facilitating the transition to agriculture. While our measure of crop seasonality is related to climate seasonality, it is based on crop rather than climate data (and is available at a finer spatial resolution). Moreover, Matranga's (2024) measure operates through climatic constraints on mobility and agricultural adoption, whereas ours reflects consumption-smoothing pressures arising from seasonal food shortage, catching more directly the economic constraint faced by humans. Thus, the two measures capture related but distinct channels through which seasonal environments shape long-run economic and social outcomes.[4]

Galor and Ozak (2016) analyze crop *growth cycles*—the duration between planting and harvest—combined with crop yield, using FAO-GAEZ data. Their focus is on the timing of returns to investment, through which longer production cycles shape patience and intertemporal preferences. By contrast, crop seasonality measures the temporal concentration of harvest availability rather than the length of the production process itself. It therefore abstracts from investment duration and yield and instead focuses on the timing of consumption opportunities and the resulting need for storage.

Sestito (2024) introduces a measure of *crop cyclicality*, or growing period heterogeneity, based on FAO-GAEZ data for the dominant cultivated crop in each cell. This measure captures the fraction of the year during which crops in different cells are not simultaneously growing, thereby emphasizing spatial heterogeneity in production cycles. He

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[4] Other related measures focus on climatic variability rather than on food availability. Using modern cross-sectional climate data, Ashraf and Michalopoulos (2015) construct *climate variability* as the intertemporal standard deviation of temperature and document a hump-shaped relationship with the timing of the Neolithic Revolution. Galor and Savitskiy (2022) introduce *temperature volatility*, defined as the variance of monthly temperature over time and averaged across months, and *temperature spatial correlation*, defined as the correlation between monthly temperature deviations in a given cell and those of neighboring cells; these measures are respectively negatively and positively associated with loss aversion. Giuliano and Nunn (2021) propose a measure of *intergenerational climate variability*, based on paleoclimatic temperature anomalies, to study the persistence of cultural norms across generations. While these measures capture different dimensions of climatic risk, across years, space, or generations, they do not directly measure the timing or concentration of food availability.

shows that such spatial heterogeneity impedes state formation by reducing the efficiency of taxation and labor extraction. By contrast, our measure of crop seasonality focuses on temporal unevenness in food availability within locations rather than on spatial coordination across locations. Moreover, our measure incorporates multiple wild relatives of cultivated crops within each cell, capturing a broader set of ecological risks relevant to pre-agricultural societies.

Finally, Mayshar, Pascali, and Moav (2022) argue that the *appropriability* (or storability) of agricultural output, rather than agriculture per se, is at the roots of state formation, challenging the conventional view according to which the origin of the state rests on the adoption of farming and the consequent increase in land productivity. They distinguish cereals, which can be stored and consequently appropriated and taxed, from roots and tubers, which cannot. To overcome issues related to modern indicators, they assemble a dataset of the potential geographic distributions of wild relatives of domesticated crops, as a proxy for the domestication potential of each crop in a region. The distributions are produced by the Global Crop Diversity Trust (GCVT) using a machine-learning algorithm (Maxent). Following Diamond (1997), they interpret the presence of more numerous and varied wild relatives as indicative of higher land productivity and, to test their appropriability theory, track cereal vs. tuber prevalence. By contrast, our crop seasonality measure does not capture intrinsic storability of crops, but rather the temporal concentration of food availability within a location. As such, crop seasonality captures predictable intra-annual shortages, which generate incentives for food storage irrespective of whether the underlying crops are intrinsically easy to store, appropriate, or tax. Moreover, while we similarly rely on data on crop wild relatives, we generate our own distributions for a larger set of genera using the same algorithm from the GCVT.

To conclude, by capturing the temporal concentration of food availability faced by human populations—rather than broader climatic variability, geographic gradients, or biological constraints on production—crop seasonality is the measure most directly relevant for understanding food storage and its implications.

3 Background

The Neolithic Transition represents a fundamental milestone in human history. The shift from hunting and gathering to agriculture led to an increase in food production, enabling storage and in turn the expansion of economic surplus and population size (Childe, 1936, 1954). This transformation triggered profound social, institutional, and economic changes that ultimately laid the foundations for modern societies. However, recent research has revisited this traditional view, suggesting that several of these developments predated the advent of domestication. Archaeological and archaeobotanical evidence indicates that food storage emerged among pre-agricultural societies as an adaptive response to seasonal fluctuations in resource availability. Storage facilities such as bins, silos, pits, and granaries have been documented across Mesolithic societies in Europe (Cunningham, 2011), among Early Natufian and Pre-Pottery Neolithic communities in the Southern Levant (Kuijt and Finlayson, 2009), and within hunter-gatherer tribes in North America (Dunham, 2000).[5]

Among hunter-gatherer societies, food storage emerged as an adaptive strategy suited to specific ecological conditions and aimed at reducing the risk of food shortages associated with seasonal downturns in resource availability (Binford, 1980; Woodburn, 1980; Testart 1982; Wiessner 1982; Keeley, 1988; Kelly, 1995). Binford (1980) distinguishes between two types of hunter-gatherers based on their adaptive strategy: 'Foragers' and 'collectors'. Foragers are highly mobile, rely on daily food collection, and do not engage in storage. Collectors, by contrast, inhabit environments characterized by greater spatial and temporal variability in resources, and rely on food storage to smooth consumption across seasons. This strategy reduces residential mobility, which is limited to short logistic expeditions to manage spatial variation in resource availability. These distinct adaptive strategies generate differences in social complexity. Food storage and reduced residential mobility facilitate surplus accumulation, which then fosters the emergence of elites, specialization, and inheritability of wealth or status. As a result, storing hunter-gatherer societies tend to exhibit greater sedentarism, higher population density, and more pronounced socioeconomic inequalities (Testart, 1988, 1989; Wesson, 1999). As Testart (1982, p. 530) observes, the only difference in terms of social complexity between *"storing hunter-gatherers and agriculturalists lies in whether the staple food species are wild or domesticated."*

A parallel research line in social anthropology has explored the ramifications of these developments for the emergence of organized religion. Specifically, beliefs in moralizing high gods—active, rather than otiose, supernatural entities that reward and punish behavior to enforce moral norms—are more prevalent in societies characterized by larger population size, hierarchical organization, and social differentiation (Swanson, 1960; Peregrine, 1996; Whitehouse et al., 2022; Bentzen and Gokmen, 2023). Evidence further suggests that the causal relationship runs from social complexity to early forms of organised religion, rather than the reverse, as argued by some (Norenzayan, 2013). The prevalence

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[5] Kuijt and Finlayson (2009) report large granaries used to store wild cereals (Hordeum spontaneum, Lens orientalis, and Avena sterilis) at the Pre-Pottery Neolithic excavations site at Dhra'. Large-scale archaeological investigations at a Precontact Native American archaeological site in southwestern Lower Michigan document cache pits for nuts, fruit seeds, berries, and wild rice (Dunham, 2000), while Woodman (1985) identifies hazelnut storage pits at the Mesolithic site of Lough Boora in Ireland.

Table 1: Adaptive strategies in premodern societies

Foragers	**Collectors**
Low spatial and temporal variation in resources	High spatial and temporal variation in resources
No storage	Storage
Residential mobility	Radiating mobility
Non-sedentary	Sedentary/semi-sedentary
Simple social structure	Complex social structure
Moralizing high gods present	Moralizing high gods absent
Sharing, no inequality	Surplus, accumulated wealth, inequality

Notes: The content of the table is adapted from Binford (2001).

of such beliefs has also been linked to ecological conditions associated with harsher and more unstable environments (Botero et al., 2014). Furthermore, contrary to early views that moralizing high gods were absent among early humans due to the allegedly egalitarian nature of hunter-gatherer societies (Peoples et al., 2016), recent work documents the emergence of professional religious specialists, representing some of the earliest forms of formalised social leadership, among hunter-gatherers, particularly in contexts where food storage was present (Watts et al., 2022).

Table 1 presents a schematic overview of Binford's (2001) classification of hunter-gatherers' adaptive strategies. Taken together, the anthropological evidence suggests that exposure to seasonal variability in resource availability and the resulting adoption of food storage not only shaped early economic organization but also fostered enduring norms regarding inequality and resource distribution. This evolutionary pathway provides the foundation for our hypothesis that ecological adaptation in the pre-Neolithic era continues to exert a persistent influence on contemporary preferences for redistribution.

4 Data

4.1 Wild relatives of domesticated crops

To construct a proxy for ancestral seasonal food shortage, we rely on biogeographical information on crop wild relatives (WRs). WRs are undomesticated plant species that are genetically related to cultivated crops. Data on WRs is obtained from the Global Biodiversity Information Facility (GBIF).[6] This source provides 1,239,097 georeferenced occurrence records collected from over 100 data providers worldwide. However, nearly one third of these records correspond to cultivated plants. To filter out the latter, we

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[6] See www.gbif.org/dataset/07044577-bd82-4089-9f3a-f4a9d2170b2e#description.

downloaded data on nearly 250 contemporary crops from the Global Germplasm Resources Information Network (GRIN-Global).[7] For each crop, GRIN-Global reports the associated WRs.[8] We match this information with the GBIF data to filter out cultivated crops. This procedure yields 713,496 georeferenced occurrence records for 1,906 WR species belonging to 109 genera, listed in Table A1.[9] Next, for each of the 109 genera in the sample, we follow standard practice in archaeobotanical and biogeographical research to model potential geographic distributions starting from point coordinates of observed occurrences. Specifically, we use MaxEnt, a maximum entropy species distribution modeling algorithm[10] to predict suitability for each genus starting from georeferenced occurrence localities and a set of climatic variables—including temperature, temperature in the coldest and warmest quarters, daily and seasonal temperature variation, isothermality, precipitation, precipitation in the driest and wettest quarters, precipitation seasonality, and wind speed—as well as topographic variables such as solar radiation and elevation.[11] As an illustration, Figure A1 displays the predicted geographic distribution of Coffea, the genus containing the WRs of coffee. White dots indicate point coordinates of the Coffea WRs in our sample, while color shades represent the predicted suitability for coffee generated by the MaxEnt model.

After obtaining the suitability distributions for each genus in our sample, we partition the world into 0.5° × 0.5° square grid cells (where 1° corresponds to approximately 111 km^2 at the equator) and overlay this grid onto the spatial distribution of the WRs, to compute the average suitability of each genus within each cell. Using the resulting suitability measures for the 109 genera, we construct three cell-level variables. The first two are indices of predictable risk in food availability derived from information on harvest seasons and are designed to capture the stability of food availability over the course of the year. To construct the two risks measures we follow two distinct approaches, which we detail below. The third variable measures crop variety.

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[7] See npgsweb.ars-grin.gov/gringlobal/taxon/taxonomysearchcwr.

[8] Information is provided for WRs in the primary, secondary and tertiary pool, i.e., independently of their relationship with domesticated crops. We include all pools because we want a measure of the potential resource environment independent on domestication feasibility. By contrast, Mayshar, Moav, and Pascali (2022) restrict attention to plants in the primary gene pool, those that can be directly mated with a domestic crop.

[9] A crop's genus groups species that share common characteristics and ancestors. For example, beans belong to the genus Phaseolus, which includes WR species such as Phaseolus microcarpus, as well as domesticated species such as Phaseolus coccineus (runner bean), Phaseolus vulgaris (common bean), and Phaseolus lunatus (lima bean). Similarly, the genus Triticum includes wild progenitors such as Triticum boeoticum (wild einkorn wheat) and Triticum dicoccoides (wild emmer wheat), which gave rise to domesticated wheat (Triticum aestivum).

[10] The algorithm was developed by the Center for Biodiversity and Conservation at the American Museum of Natural History (AMNH). See biodiversityinformatics.amnh.org/open_source/maxent/ and Phillips, Anderson, and Schapire (2006).

[11] Data is from WorldClim, see worldclim.org/.

4.1.1 Crop seasonality

The first measure, which we label crop seasonality, is obtained by combining cell-level suitability of WRs with georeferenced information on harvest seasons for 19 modern crops (i.e., species), each corresponding to one of the genera in our sample and also listed in Table A1. Harvest calendar data is drawn from the Crop Calendar Dataset of the University of Wisconsin-Madison's Center for Sustainability and the Global Environment (CSGE).[12] For each crop, we construct a binary variable taking value one if the crop is harvested during a given month, and zero otherwise. We then combine this information with the crop's average suitability within each $0.5^\circ \times 0.5^\circ$ grid cell, to obtain an indicator of suitability-weighted harvest availability. This indicator captures the fact that a crop contributes more to harvest in months when it is harvested and if the cell is highly suitable for it. Next, averaging across months, we compute the mean of this indicator for each crop within a cell. This measure represents a yearly average measure of the harvest potential in that cell. We also compute the corresponding standard deviation and coefficient of variation. Finally, we average over crops to obtain crop seasonality as the average yearly coefficient of variation for each cell. Thus, crop seasonality captures crop-level harvesting patterns and hence the intra-annual variation in food variability at the cell level.

Formally, let c index cells, $m \in \{1, \ldots, 12\}$ months of the year, and $k \in \{1, ..., K\}$ crops (or genera, or species). Let S_{ck} denote the average suitability of cell c for crop k, and D_{km} be the harvest availability indicator, constructed as a dummy variable taking value one if crop k is harvested in month m, and 0 otherwise. Define the suitability-weighted harvest availability of crop k in cell c and month m as $H_{ckm} = S_{ck}\, D_{km}$. Averaging across months, the average suitability-weighted harvest availability indicator for cell c for crop k is given by

$$\mu_{ck} = \frac{1}{12} \sum_{m=1}^{12} H_{ckm}$$

and the corresponding standard deviation is

$$\sigma_{ck} = \sqrt{\frac{1}{12-1} \sum_{m=1}^{12} \left(H_{ckm} - \mu_{ck}\right)^2}$$

Crop seasonality in cell c for crop k is then defined as the coefficient of variation of H_{ckm}, given by $\frac{\sigma_{ck}}{\mu_{ck}}$. Averaging across crops, we obtain our final measure of average crop seasonality for cell c as:

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[12] See sage.nelson.wisc.edu/data-and-models/datasets/crop-calendar-dataset/ and Sacks et al. (2010).

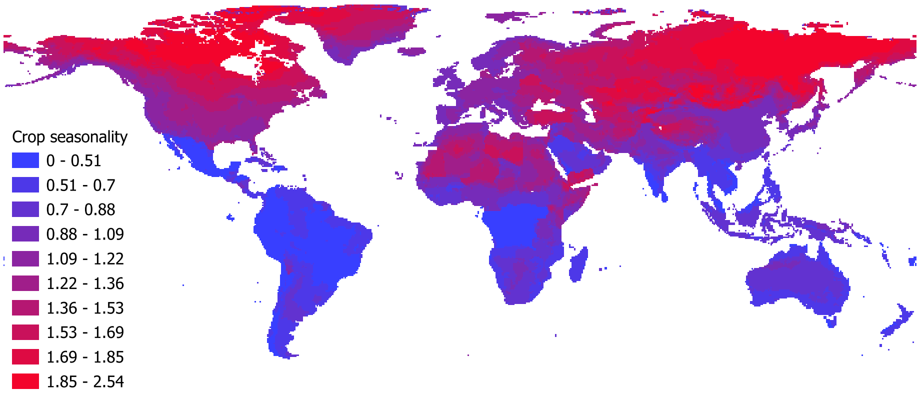

Figure 2: The geographic distribution of crop seasonality

$$\mathit{Crop\ Seasonality}_c = \frac{1}{K}\sum_{k=1}^{K}\frac{\sigma_{ck}}{\mu_{ck}}$$

The index measures temporal unevenness in suitability-weighted harvest opportunities. In other words, it indicates how uneven, over the course of the year, the average suitability-weighted availability of harvestable crops is within a cell. More precisely, it captures the extent to which a cell's suitability-weighted harvest availability is concentrated in some months rather than evenly spread across the year. Lower values of the index indicate that monthly harvest availability is relatively constant throughout the year. Hence, the cell has stable, year-round access to harvestable crops, which implies lower need for food storage. Conversely, high values of the index indicate that harvest availability is concentrated in a few months, with long periods of scarcity alternating with short periods of abundance, and higher need for food storage to smooth consumption. Figure 2 illustrates the geographic distribution of crop seasonality.

A potential limitation of this first measure is that the harvest season lengths provided by the CSGE reflect contemporary agricultural conditions and are therefore likely longer than those prevailing thousands of years ago, due to the advent of irrigation, fertilization, and other modern inputs. To address this concern, we construct the second measure, which we describe below.

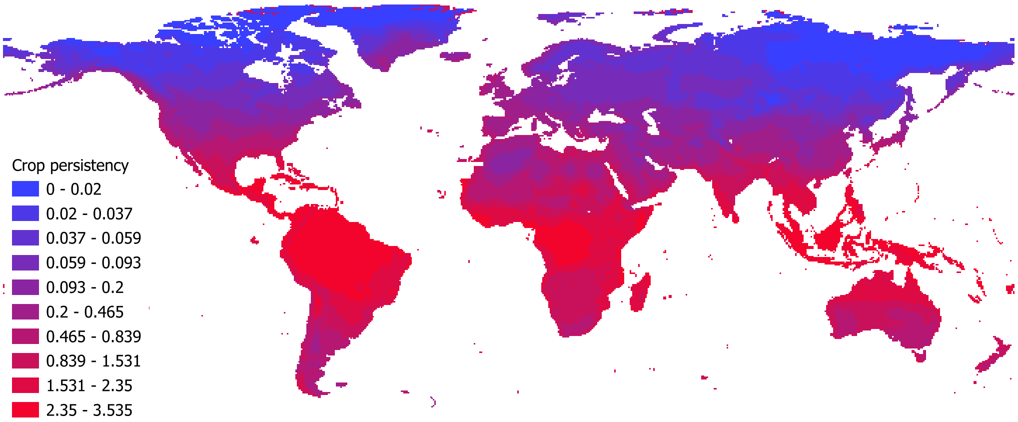

Figure 3: The geographic distribution of crop persistency

4.1.2 Crop persistency

The second measure capturing the stability of harvesting over the year is labeled crop persistency. This measure relies on information from the United States Department of Agriculture (USDA) Plants Database[13] on plants that bear seeds or fruits throughout the year. In our sample, these plants correspond to the nine genera marked with an asterisk in Table A1.[14] We match these "persistent" species to our WR data and compute, for each cell, the average suitability of WRs that bear seeds or fruits throughout the year. Crop persistency is defined as the ratio of the average suitability of persistent WRs to the average suitability of all WRs within a 0.5° × 0.5° grid cell. Formally, let $p \in \{1, ..., P\}$, with $P \leq K$, index persistent crops and let S_{cp} denote the average suitability of cell c for persistent crop p. Crop persistency in cell c is then given by:

$$Crop\ Persistency_c = \frac{\frac{1}{P}\sum_{p=1}^{P} S_{cp}}{\frac{1}{K}\sum_{k=1}^{K} S_{ck}}$$

This index captures whether a cell is relatively better suited to crops that can produce throughout the year than to the broader set of crops considered. Values above one indicate that, on average, persistent crops exhibit higher suitability than the typical crop

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[13] See plants.usda.gov/.

[14] To be noticed is that, according to the USDA definitions, plants that produce seeds or fruits year-round are those that require to be picked when ripe and consequently continuous harvesting. These plants differ from those that produce fruits that persistently stay on the branch and consequently do not require harvesting. Our focus is on the former.

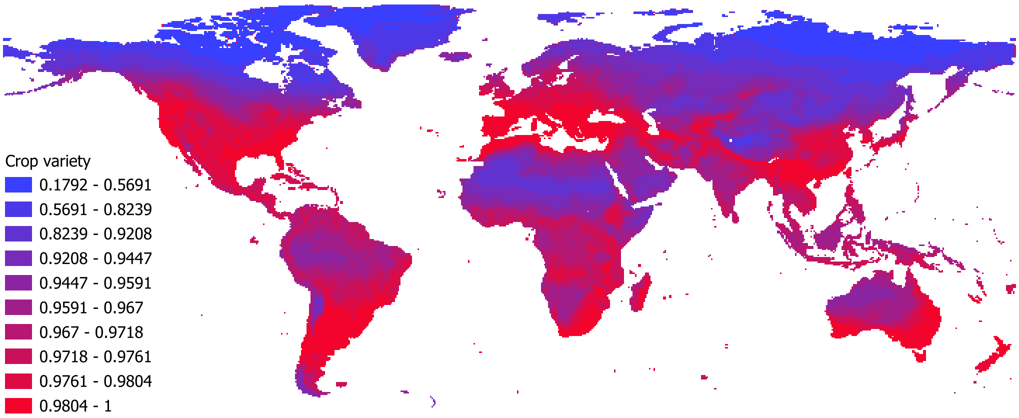

Figure 4: The geographic distribution of crop variety

in the cell. Values below one indicate the opposite, consistent with environments in which suitability is concentrated in seasonal crops. Figure 3 depicts the geographic distribution of crop persistency.

The two measures introduced so far are complementary and strongly (inversely) correlated, with an average correlation coefficient of -0.78.

4.1.3 Crop variety

The third variable we construct, labeled crop variety and illustrated in Figure 4, captures food richness and diversity, reflecting crop variability in terms of diet within a cell. Specifically, crop variety is defined as one minus a Herfindahl index of concentration over crop suitability for each cell. Formally, crop variety in cell c is given by:

$$Crop\ Variety_c = 1 - \sum_{k=1}^{K} \left(\frac{S_{ck}}{\sum_{j=1}^{K} S_{cj}} \right)^2$$

This index measures how evenly suitability is distributed across crops within a cell. When suitability is concentrated in a small number of crops, the Herfindahl index is high and crop variety is correspondingly low. Conversely, when suitability is more evenly distributed across a large number of crops, the Herfindahl index decreases and crop variety increases, reflecting greater potential for resource and dietary diversification.

The above three indicators—crop seasonality, crop persistency, and crop variety—

can be employed at different levels of aggregation. In Section 5, we aggregate them at the country level to combine them with survey data on contemporary preferences for redistribution. In Section 6, we instead exploit their granular variation by matching them to ethnographic data at the level of premodern societies.

4.2 Contemporary preferences for redistribution

We measure contemporary preferences for redistribution employing individual-level responses to survey questions on from two sources: The World Values Survey (WVS) and the European Social Survey (ESS).[15] To implement an epidemiological approach, we restrict attention to survey waves in which respondents report their own and their parents' country of origin. Accordingly, for the WVS we employ two waves (2010-2014 and 2017-2022), covering individuals living in 53 countries, of whom approximately 7,000 are first or second generation migrants originating from 133 countries. For the ESS, we rely on 10 waves, conducted between 2002 and 2020 and covering individuals in 37 countries, including approximately 30,000 first or second generation migrants originating from 166 countries.[16] In addition to collecting individual characteristics, both surveys elicit respondents' preferences for redistribution. In the WVS, we refer to the question asking respondents to what extent they agree with the statement that "*The government should take measures to reduce differences in income levels.*" Responses range from strong agreement (coded at 1) to strong disagreement (coded as 5). We rescale this variable so that higher values correspond to stronger support for redistribution. Analogously, in the ESS we refer to the question asking respondents to what extent they agree that an essential characteristic of democracy is that "*Governments tax the rich and subsidize the poor.*" Responses are recorded on a scale from 0 (strongly against democracy) to 10 (essential characteristic of democracy). For falsification exercises, we shall also employ proxies for other preference traits, to be described below.

We combine this data with a proxy for ancestral inequality drawn from Giuliano and Nunn's (2018) Ancestral Characteristics of Modern Populations database,[17] which uses language-based matching based on the Ethnologue (Eberhard, Simons, and Fennig, 2022) and information from the Ethnographic Atlas to construct weighted averages of characteristics of preindustrial ancestors of a country's modern population. Specifically, we proxy ancestral inequality using the share of a country's ancestral population that

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[15] Data can be downloaded respectively from worldvaluessurvey.org/ and europeansocialsurvey.org/.

[16] The resulting samples of migrants represent about 10 percent of the full samples of respondents in both surveys. The composition of migrants differs across surveys: First generation migrants represent about 75 percent of migrants in the WVS, whereas only a handful, often with incomplete information, appear in the ESS.

[17] See nathannunn.arts.ubc.ca/data/.

exhibited at least some form of wealth differentiation.

4.3 Ethnographic data

To study the impact of seasonal food shortage on food storage, and in turn inequality, we employ ethnographic data from three sources: The Binford Hunter-Gatherer (Binford) dataset (Binford, 1981), the Western North American Indians (WNAI) dataset (Jorgensen, 1980), and the Ethnographic Atlas (EA) (Murdock, 1967). The Binford dataset covers 339 hunter-gatherer societies with no or low reliance on agriculture, including many which are located in Australia and western North America. The WNAI dataset covers 172 societies from western North America, about 20 of which do not overlap with the other datasets. The EA collects ethnographic information on 1,291 societies, ranging from small hunter-gatherer groups to complex agricultural societies, with particularly extensive coverage of Africa and western North America. Approximately two-thirds of the societies in Binford are also included in the EA.

The three datasets are assembled by the Database of Places, Language, Culture, and Environment (D-PLACE),[18] which combines ethnographic data for over 1,900 societies with a wide range of environmental, cultural, and geographic variables. After removing societies that appear in more than one source, we obtain a sample of 1,388 distinct societies, whose geographic distribution is shown in Figure A2. When resolving overlaps, we retain all societies in Binford, which unlike the EA provides consistent data on food storage, followed by the EA and the WNAI. To be noticed is that D-PLACE provides only 40 variables from the original Binford dataset, out of over 200, and food storage—which is key to our investigation—is not among them. Hence, we integrate additional variables including food storage from Marwick et al. (2023).[19]

The resulting dataset provides geographic coordinates for the location of each society, along with information on nomadism, social complexity, and inequality, among other practices. As mentioned, information on food storage is only available in Binford and WNAI, for a total of 360 societies. We code a binary variable which takes value one if a group is dependent on food storage, and zero otherwise.[20] Food storage is practiced in 250 societies, corresponding to 69 percent of the sample with storage information. Figure A3 illustrates the geographic distribution of these societies.

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[18] See d-place.org/contributions and Kirby et al. (2016).

[19] See benmarwick.r-universe.dev/binford.

[20] In Binford, we code the ordered variable capturing dependence upon storage as taking value one when storage is used during seasonal and/or other low productivity phases of the year, as well as only for special events. In WNAI, we code an ordered variable capturing the presence of major storage places for food as taking value one for any combination of pits, caves, or rock shelters, dwelling or high platform or house roof, and special storage structure, e.g., masonry granary.

In the empirical analysis, we use four additional variables capturing key dimensions of societal organization. As a proxy for population size we employ a binary variable taking value one if the group's population exceeds 50 members. We proxy institutional complexity coding a binary variable indicating the presence of jurisdictional hierarchy above local autonomy.[21] We further include two binary indicators respectively capturing the presence of slavery and socioeconomic equality (defined as absence of any kind of class differentiation). Finally, even though the variable is only present in the EA, we code a binary variable indicating the presence of beliefs in a high god[22] supportive of human morality.[23]

To gather information on geo-bioclimatic features associated with each society, we augment the dataset with geographic controls (elevation, ruggedness, rivers and basins, and distance from the coast) sourced from WorldClim, by dividing the world into square grid cells of size 0.5° x 0.5° and overlaying cells onto the location of the societies.

4.4 Archaeological sites data

Several archaeological studies have recently exploited household-level data from excavated sites to understand the origins of inequality and its relationship with domestication and social complexity. We draw on two such datasets to complement our analysis of the link between seasonal food variability and inequality.

(i) Bogaard, Fochesato, and Bowles (2019): This dataset collects information on archaeological sites spanning societies from Ohalo II in the southern Levant, dated to approximately 23,000 years ago, to eighteenth-century AD communities of the Pacific Northwest. In total, it includes 146 observations covering sites across Eurasia, North America, and Mesoamerica. Some sites are observed at multiple points in time, providing some temporal variation in addition to cross-sectional variation. The authors assemble social and wealth indicators that they use to compute Gini indices of inequality. They do not provide precise geographic coordinates for the sites but, for most of them, if the Gini index is computed using households from various sites within an area, they provide either the name of the site or the small region. Using either the name of the site or the small region, we georeference the sites via Google Earth using centroid coordinates and then

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[21] This variable is coded as zero in the absence of jurisdictional hierarchy, i.e., if the group is autonomous with no articulated hunter-gatherer complex (Binford), is composed of independent families (EA), or has no territorial organization larger than the residential kin group (WNAI).

[22] A high god is defined as a spiritual being believed to have created all reality and/or to be its ultimate governor (Swanson, 1960).

[23] In the EA, beliefs in high gods are recorded using an ordered variable with four categories: High god absent or not reported; high god present but otiose or not concerned with human affairs; high god present and active in human affairs but not supporting human morality; and high god present, active, and supportive of human morality. We code the binary variable as one only in the last case.

spatially merge them with the above described grid cells to assign geographic characteristics associated to each site. The absence of precise coordinates likely introduces some measurement error, while repeated observations of the same sites over time may induce other empirical issues. We explicitly address them in the empirical analysis below.

(ii) Basri and Lawrence (2020): This dataset uses information on household composition from 36 different sites concentrated in the Near East to compute a Gini index for each site. The authors also report the number of households observed, as well as house and site size. Some sites are observed across multiple phases, yielding a total of 54 observations spanning the period from 9850 to 700 BC. Because the dataset also provides the geographic location of the sites, we merge it with archaeobotanical data from the Archaeobotanical Database of Eastern Mediterranean and Near Eastern Sites (ADEMNES),[24] which provides information on domesticated and wild crops from geographic regions in Aegean Greece, Turkey, western Iran, Iraq, Syria, Lebanon, Israel, Jordan, and northern Egypt, covering periods from the Epipaleolithic to the Medieval era, with a special focus on the Bronze and Iron Ages. Crucially, because crop data in ADEMNES is derived from archaeological sites, rather than modern sources for WRs, this merge allows us to test the robustness of our findings using an alternative source. For 20 of the 36 sites in Basri and Lawrence (2020), we identify exact matches in ADEMNES, yielding 37 observations. For other 16 sites not covered in ADEMNES, we assign information on wild and domesticated crops from the closest site.[25] Data on WRs is then matched with data on current plants that bear fruits year-round from the USDA Plants Database.

4.5 Preindustrial polities data

Data on preindustrial polities spanning the period between the Neolithic and Industrial Revolutions (approximately 13600 BC to 1900 CE) is drawn from Seshat: Global History Databank (Seshat),[26] which compiles information on social and political complexity, religion, and ideology at the polity level. A polity is defined as an independent political unit, ranging in scale from villages to empires. The project defines 35 natural geographic areas (NGAs), stratified across 10 world regions and three levels of antiquity of complex societies. From these NGAs, Seshat samples nearly 360 distinct polities (some observed at multiple points in time). Whereas the above described archaeological and ethnographic data provides measures of inequality, Seshat represents a unique source of information that can generate a proxy for preferences for equality. Specifically, we construct a mea-

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[24] See ademnes.de/.

[25] For example, Tell es-Sawwan, a Samarran archaeological site close to Baghdad, is matched with Choga Mami, the closest Samarran site in the same area around Baghdad.

[26] See seshat-db.com/, Turchin et al. (2015, 2017), and Whitehouse et al. (2022).

sure of preference for equality based on whether a polity exhibits ideological enforcement of egalitarianism, as reflected in religious doctrines, philosophical statements, or practices making claims about equality (e.g., a statement that all humans are equal). The same source also reports information on the presence of food storage sites among utilitarian public buildings. We code this information as a binary variable taking value one when storage sites are present or inferred as present. Although the Seshat data pertains to the period past the Neolithic Transition, a similar association between storage and attitudes toward inequality is likely to have existed even prior to it (Testart, 1982, p. 530). To investigate the potential link between preferences for equality and religious beliefs, we also extract information on the presence within a polity of moralizing beliefs and practices involving supernatural punishment or reward. We code a binary variable taking value one when such punishments or rewards are believed to be certain and predictable, rather than arbitrary or capricious. Finally, for falsification and robustness tests, we collect additional information on the presence within a policy of ideological enforcement of prosociality and the promotion of merit, as well as the presence of executive constraints on the rulers imposed by government agencies (judicial or legislative),

Table A2 summarizes variable definitions and sources for the datasets and Table A3 reports summary statistics.

5 Seasonal food shortage, ancestral inequality, and contemporary preferences for redistribution

In this section, we begin our empirical analysis by exploring the persistence of the effect of seasonal food shortage on contemporary preferences for redistribution. Our central hypothesis is that exposure to seasonal food shortages in the distant past reverberates on individual preferences for redistribution up to the present day through ancestral inequality. To proxy for the latter, we use the share of a country's ancestral population exhibiting at least some form of wealth distinction, generated from Giuliano and Nunn (2018). Data on preferences for redistribution is drawn from the WVS and the ESS. The WVS asks respondents whether the government should reduce differences in income levels. Similarly, the ESS asks whether an essential characteristic of democracy is that governments tax the rich and subsidize the poor. To neutralise the effect of current institutions and focus on the portable influence of inequality on individual preferences through the intergenerational transmission of cultural traits, we adopt an epidemiological approach that focuses on migrants, thereby exploiting variation in ancestral inequality across countries of origin.[27]

We estimate with OLS the following equation:

$$P_{i,c,t,a} = \alpha_c + \delta_t + \beta_1 \; AI_a + \beta_2 \; SFS_a + X'_{i,c,t,a} \; \Theta + Y'_a \; \Gamma + \epsilon_{i,c,t,a} \qquad (1)$$

where $P_{i,c,t,a}$ denotes the preferences for redistribution of individual i, living in country c at time t and originating from country a. α_c and δ_t respectively denote country c and time t fixed effects (the latter corresponding to waves). The explanatory variable AI_a denotes the level of ancestral inequality in origin country a, proxied by the share of the ancestral population exhibiting at least some form of wealth distinction. The variable SFS_a captures seasonal food shortage in origin country a. The vector $X_{i,c,t,a}$ includes individual-level controls, namely age and gender and, depending on the specification, the language spoken at home, while the vector Y_a comprises additional controls referring to origin country a. Because the treatment varies at the origin country level, standard errors are clustered at that level.

Table 2 reports the estimation results, where the dependent variables are our (standardized) proxies for preferences for redistribution. For the WVS (Panel A), the sample is composed of migrants currently living in 53 countries and originating from 133 countries. For the ESS (Panel B), the corresponding figures are 37 and 166. In Model 1, together with ancestral inequality we only include residence country and time fixed effects, together with controls for age and gender. The main regressors are also standardized to have mean zero and unit standard deviation, to facilitate comparisons of the magnitudes of the effects. Ancestral inequality in the origin country is negatively and significantly correlated with preferences for redistribution: A one standard deviation increase in its value is associated with a reduction in the dependent variable by approximately 0.02/0.03 standard deviations. In the next two models we insert additional controls, all referring to the origin country. In Model 2, we control for the share of the ancestral population exhibiting a level of jurisdictional hierarchy above one and the share that was nomadic, both generated from Giuliano and Nunn (2018), to account for potentially competing institutional channels. In Model 3, we further add the share of natives (i.e., the current population who used to live within the country before Columbus), drawn from Putterman and Weil (2010), as well as genetic diversity (i.e., ancestry-adjusted genetic heterozygosity) and the share of the population of European descent, both from Ashraf and Galor (2013), to control for variation in population structure. We also add the estimated share of the population in the destination country with ancestry from the same origin country[28]

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[27] Luttmer and Singhal (2011) also apply an epidemiological approach to study redistributive preferences, and find a persistent effect on migrants of their origin country preferences.

[28] This share is computed as the number of respondents from a given country divided by the total

Table 2: Seasonal food shortage and preferences for redistribution

	(1)	(2)	(3)	(4)	(5)
	Panel A: WVS				
Dependent variable:	Reduce Income Differences				
Ancestral Inequality	-0.030***	-0.032***	-0.029**	-0.024*	-0.014
	(0.011)	(0.012)	(0.013)	(0.013)	(0.014)
Jurisdictional Hierarchy above One		0.001	0.012	0.023	
		(0.015)	(0.014)	(0.017)	
Nomadism		-0.005	-0.005	-0.003	
		(0.014)	(0.015)	(0.016)	
Crop Seasonality				-0.046***	-0.039***
				(0.017)	(0.014)
Adjusted R^2	0.031	0.030	0.031	0.032	0.032
Observations	6966	6966	6915	6889	6889
Clusters	133	133	129	126	126
Country & Time FE	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes
Home Language FE	No	No	Yes	Yes	Yes
Other Controls	No	No	Yes	Yes	No
Joint Hypothesis	.	.	.	0.390	.
	Panel B: ESS				
Dependent variable:	Tax the Rich and Subsidize the Poor				
Ancestral Inequality	-0.019**	-0.021**	-0.014*	-0.010	-0.012*
	(0.009)	(0.010)	(0.008)	(0.008)	(0.007)
Jurisdictional Hierarchy above One		-0.000	0.003	0.007	
		(0.009)	(0.008)	(0.008)	
Nomadism		-0.005	-0.013	-0.005	
		(0.010)	(0.011)	(0.012)	
Crop Seasonality				-0.041**	-0.034**
				(0.018)	(0.016)
Adjusted R^2	0.068	0.068	0.075	0.075	0.075
Observations	31719	31719	31407	31391	31609
Clusters	166	166	149	146	152
Country & Time FE	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes
Home Language FE	No	No	Yes	Yes	Yes
Other Controls	No	No	Yes	Yes	No
Joint Hypotheses	.	.	.	0.304	.

Notes: The unit of observation is an individual. The dependent variables are proxies for preferences for redistribution. Ancestral inequality is the share of the ancestral population in the origin country with at least some form of wealth distinction. Jurisdictional hierarchy above one is the share of ancestral population in the origin country with a level of jurisdictional hierarchy above one. Nomadism is the share of ancestral population in the origin country which is nomadic. Crop seasonality is an inverse measure of stability of food availability throughout the year in the origin country. Individual controls include age and gender. Other controls include the share of natives, genetic diversity, the share of the population of European descent, and the share of the population in the destination country from the origin country, all with reference to the origin country. Robust standard errors adjusted for clustering at the origin country level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

and individual-level fixed effects for the preferred language spoken at home. The latter two variables are normally used in epidemiological analyses to control for network effects and adaptation. The effect of ancestral inequality found in Model 1 is confirmed despite a loss in statistical significance for both samples of respondents. When in Model 4 we also include our measure of crop seasonality in the individual's origin country, as a proxy for seasonal scarcity in the distant past, its coefficient is negative as expected and highly significant, while the coefficient on ancestral inequality further loses statistical significance. Specifically, it is no longer significant in the ESS sample, while its significance level is reduced to 10 percent in the WVS sample. An F-test of joint hypotheses on insignificant variables fails to reject the null of joint significance for jurisdictional hierarchy, nomadism, and the above mentioned other controls, so that only ancestral inequality and crop seasonality, together with individual controls and home language fixed effects, are retained in Model 5. In this final specification, crop seasonality emerges as a potential driver of preferences for redistribution, suggesting that individuals originating from countries exposed to more severe seasonal food shortage in the pre-domestication era are today less likely to demand a reduction in income differences through redistributive policies. The fact that crop seasonality dominates inequality, rather than being absorbed, is largely due to the noise in the measure of ancestral inequality and the relative selectivity of the hunter-gatherer societies represented in the EA. For example, the societies located in Australia and Latin America show almost no variation in inequality, while crop seasonality does show variation (Figure 2). Hence, crop seasonality better captures the variation in food storage and inequality, as we shall show in the next section.

Given the correlational nature of our analysis, in the Appendix, we report a number of extensions and robustness checks. Table A4 probes the potential influence of additional covariates that we add sequentially to Model 4 of Table 2. In Model 1, we enter the origin country's contemporary Gini index.[29] While contemporary inequality need not be related to ancestral inequality, and indeed their correlation is actually negative (respectively -0.18 and -0.19 in the WVS and ESS samples), it could in principle exert an additional influence or else absorb the influence of crop seasonality through an intergenerational transmission mechanism. We show that this is not the case, as the additional regressor is not showing a significant coefficient in either sample. In Model 2, we control for the origin country's agricultural share of GDP,[30] to capture the possibility that in countries with a larger agricultural share domesticated crops could confound the influence of

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number of respondents in the destination country.

[29] Data is from the World Bank, averaged over the period 1960-2022. See data.worldbank.org/indicator/SI.POV.GINI.

[30] Data is from the World Bank, averaged over the period 1960-2022. See data.worldbank.org/indicator/NV.AGR.TOTL.ZS.

their respective wild relatives embedded in the crop seasonality measure. While the new regressor displays a positive coefficient in the ESS sample, its inclusion does not alter previous conclusions regarding crop seasonality. In Model 3, we enter latitude, despite its relatively high correlation with crop seasonality (0.57 in both samples).[31] While its coefficient is not significant per se, its inclusion makes the coefficient on crop seasonality lose significant in the ESS sample, but again previous results are broadly confirmed. Crop seasonality retains its influence even after controlling for latitude because the two measures are conceptually and empirically distinct. As discussed in the literature review, latitude reflects broad geographic gradients that correlate with economic, biological, and social outcomes. Because higher latitudes tend to exhibit stronger seasonal cycles in temperature and daylight, latitude is naturally associated with greater seasonality, generating a positive correlation with our crop seasonality measure. However, latitude is a coarse, purely geographic proxy that does not directly capture the timing or concentration of food availability. The table also reports an F-test of joint hypotheses, that is significant only when we add the agriculture share using the ESS sample.

In principle, first and second generation migrants may respond differently to the influence of crop seasonality in their origin countries: While the behavior of the first generation may more closely reflect origin country's cultural traits, with modest interference from the destination country's environment, the behavior of the second generation should reveal the strength of intergenerational transmission of culture. Furthermore, unlike second generation, first generation migrants are self-selected, with potential consequences for their outcomes including preferences. As mentioned in the data section, the relative representation of first vs. second generation migrants differs across surveys. While for the ESS the estimated sample in Table 2 consists exclusively of second generation migrants, in the WVS second generation represent a small fraction of the migrants, so that estimating, e.g., Model 5 for a sample confined to second generation migrants would reduce the number of observations to 1,675 (from 6,889) and the number of origin countries to 86 (from 126). Hence, to assess potential differences in the influence of crop seasonality on redistributive preferences between the two migrant groups in the WVS, in Table A5 we introduce a binary variable indicating second generation status (Model 1) and then also its interaction with crop seasonality (Model 2). The fact that their coefficients lack statistical significance reassuringly suggests that no difference is detected between the attitudes of first vs. second generation migrants. This conclusion also increases our confidence in comparing the results from the WVS sample with those from the ESS.

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[31] We take this variable, which is meant to reflect historical latitude, from Giuliano and Nunn (2018), who construct a measure of historical latitude using the average historical distance from the equator of a country's ancestors, using the latitude of ethnic-group centroids reported in the EA.

To explore the role of our alternative crop measures, Table A6 begins with a parsimonious specification showing that crop seasonality preserves its negative correlation with preferences for redistribution when entered without further controls other than country and time fixed effects and individual-level controls (age, gender, and home language) (Model 1). In Model 2, we replace crop seasonality with crop persistency—an inverse measure of seasonality defined as the share of crops bearing fruits year-round—while in Model 3 we instead replace it with crop variety. The positive sign of the coefficient on crop persistency confirms the direction of the effect for both measures of risks in food availability. By contrast, the insignificant coefficient on crop variety shows that the influence on redistribution of ecological factors reflecting Diamond's (1997) hypothesis does not run through this dimension.

Finally, for the same specifications in Table A6, in Tables A7 and A8 we probe whether the persistent influence of seasonal food shortage extends to other preference traits. From the WVS, we consider proxies for long-term orientation ("*Important child qualities: Thrift saving money and things*") and altruism ("*Important child qualities: Unselfishness*"). From the ESS, we use an alternative measure of preferences for redistribution ("*Society fair when income and wealth is equally distributed*") and measures of long-term orientation ("*Plan for future or take each day as it comes*") and risk aversion ("*Important to seek adventures and have an exciting life*"). We test both the effect of crop seasonality (top panels) and crop persistency (bottom panels). Their influence on the alternative measure of preferences for redistribution is confirmed. No influence is detected, instead, for long-term orientation, risk aversion, and altruism as captured by unselfishness. This last finding suggests that the effect on redistribution is not related to altruistic preferences, and confirms the idea that the effect of seasonal scarcity, through our proxies, works through ancestral adaptation strategies rather than altruistic behavior.

Taken together these findings support our hypothesis that areas of the world historically characterized by more pronounced seasonal food shortage, and therefore likely driven in the distant past to greater reliance on storage, may have developed over time attitudes that lead to lower support for redistributive policies. Thus, preferences traits shaped by ecological factors have been transmitted across generations and become prevalent over the long run.

6 Seasonal food shortage, storage, and ancestral inequality in premodern societies

As argued by Binford (1980) and Testart (1982), ecological conditions characterized by seasonal scarcity induced the adoption of food storage as an adaptive strategy. In turn, food storage led to population growth, the emergence of social complexity, and inequality. In this section, we use ethnographic data to empirically test both of these predictions. A potential limitation from using this data comes from the selectivity of the societies represented in ethnographic datasets (Lowes, 2021). The selection of societies in the EA, as well as related datasets, was designed to create a globally representative sample of pre-industrial human cultures, rather than an exhaustive listing of every society in existence. To ensure data quality, the selection prioritized societies with strong ethnographic documentation, which is likely to cause a bias given the non-randomness of the selection. Hence, it is possible that societies that practiced storage were more likely to survive, while among those not practicing storage only those in areas where food availability was particularly abundant throughout the year survived. This, in principle, could cause an upward bias. However, studies evaluating the validity of these datasets—as Bahrami-Rad, Becker, and Henrich (2021) do for the EA—tend to minimize such a distortion.

We begin by exploring the relationship between the ecological environment and the adoption of food storage, using the Binford and WNAI datasets for information on the latter. Over a cross section of societies, we estimate the following equation by OLS:

$$S_i = \alpha_c + \beta \ SFS_i + G_i' \ \Gamma + \epsilon_i \tag{2}$$

where the outcome variable S_i is a binary indicator taking value one if food storage is practiced by group i. The term α_c denotes continent fixed effects.[32] The main regressor, SFS_i, captures the intensity of seasonal food shortage faced by group i. The vector G_i includes geographic controls for group i, namely elevation, ruggedness, rivers and basins, and distance from the coast. In addition to robust standard errors, we compute Conley (1999) standard errors using a spatial cutoff of 300 km to account for potential spatial dependence.

Our next step turns to the relationship between food storage and various dimensions of societal features. We estimate by OLS the following equation:

$$Y_i = \alpha_c + \beta \ S_i + G_i' \ \Gamma + \epsilon_i \tag{3}$$

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[32] Continents are defined following the World Bank classification of world regions: East Asia and Pacific, Europe and Central Asia, Latin America and Caribbean, Middle East and North Africa, North America, South Asia, and sub-Saharan Africa.

Table 3: Seasonal food shortage and storage

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:			Food Storage			
Crop Seasonality	0.329 (0.020)*** [0.015]***	0.221 (0.027)*** [0.024]***			0.279 (0.029)*** [0.026]***	
Crop Persistency			-0.271 (0.034)*** [0.032]***			-0.275 (0.035)*** [0.032]***
Crop Variety				-0.022 (0.008)*** [0.006]***	0.053 (0.009)*** [0.008]***	0.006 (0.005) [0.004]
Adjusted R^2	0.591	0.784	0.772	0.653	0.805	0.772
Observations	360	360	360	360	360	360
Sample Mean	0.694	0.694	0.694	0.694	0.694	0.694
Geographic Controls	No	Yes	Yes	Yes	Yes	Yes
Continent FE	No	Yes	Yes	Yes	Yes	Yes

Notes: The unit of observation is an ethnic group. The dependent variable is a binary taking value one if an ethnic group is dependent on food storage. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Crop variety is a measure of dietary richness. Geographic controls include elevation, ruggedness, rivers and basins, and distance from the coast. Conley (1999) standard errors for a window of 300 km in parentheses and robust standard errors in square brackets. *** p<0.01, ** p<0.05, * p<0.1.

where the outcome of interest Y_i captures four main dimensions, each coded as a binary variable. Population size is proxied by an indicator equal to one if the group comprises more than 50 members. Institutional complexity is captured by the presence of a jurisdictional hierarchy beyond the local level. Social structure is measured using two indicators: The presence of slavery and the presence of socioeconomic equality.

Table 3 reports the estimation results for Equation (2). The main regressors are standardized to have mean zero and unit standard deviation. Our preferred methodology is to compute Conley (1999) standard errors, for a window of 300 km, but for comparison we also present (below) robust standard errors. More severe seasonal scarcity, proxied by crop seasonality, is associated with an increase in the likelihood of food storage in Models 1 and 2, respectively without and with continent fixed effects and geographic controls. The latter controls include conditions affecting food production, such as elevation and ruggedness, as well as controls for the presence of water bodies (rivers and basins) and distance from the coast, to capture the fact that fishing-based societies tend to exhibit more inequality to the potential for resource control. In Model 3, we replace crop seasonality with crop persistency—the share of crops bearing fruits year-round, which implies lower seasonality—and obtain a consistently negative coefficient, as expected. In Model 4, for crop variety, we find a negative coefficient sign, indicating a lower likelihood of

Table 4: Food storage, social complexity, and inequality

	(1)	(2)	(3)	(4)
Dependent variable:	Population>50	Hierarchy	Slavery	Socioec. Equality
Food Storage	0.100	0.046	0.145	-0.384
	(0.033)***	(0.019)**	(0.073)**	(0.056)***
	[0.032]***	[0.017]***	[0.055]***	[0.054]***
Adjusted R^2	0.060	0.037	0.276	0.250
Observations	243	359	360	360
Sample Mean	0.613	0.474	0.471	0.508
Geographic Controls	Yes	Yes	Yes	Yes
Continent FE	Yes	Yes	Yes	Yes

Notes: The unit of observation is an ethnic group. The dependent variables are binary respectively taking value one if population is above 50 members, jurisdictional hierarchy is present, slavery is present, and class differentiation is absent. Food storage is a binary variable taking value one if an ethnic group is dependent on food storage. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Crop variety is a measure of dietary richness. Geographic controls include elevation, ruggedness, rivers and basins, and distance from the coast. Conley (1999) standard errors for a window of 300 km in parentheses and robust standard errors in square brackets. *** p<0.01, ** p<0.05, * p<0.1.

food storage in environments characterized by greater dietary richness. However, once either of the two seasonality-related measures is included, the coefficient on crop variety becomes either positive (Model 5) or statistically insignificant (Model 6), while the estimated effects of crop seasonality and crop persistency remain stable. These results indicate that crop variety does not play a role in explaining the adoption of food storage.

Table 4 reports the estimation results for Equation (3). After controlling for continent fixed effects and geographic variables, it shows a positive association of food storage with population size (Model 1),[33] institutional complexity (Model 2), and slavery (Model 3), while the association with socioeconomic equality is consistently negative (Model 4).

In the Appendix, we report a series of extensions and robustness checks.[34] Some of the geo-climatic characteristics captured by our crop risk measures are highly correlated with latitude, which may nevertheless exert an independent influence on the outcomes of interest. Hence, we add to the sets of regressions presented in Tables 3 and 4 the (standardized) value of latitude. In Table A9, latitude tends to display a significantly positive coefficient but its inclusion does not affect the sign and significance of the coeffi-

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[33] Results are unchanged, and therefore not reported for brevity, when using an alternative binary variable capturing population size above 100 individuals.

[34] For brevity, in the Appendix tables, since the corresponding significance levels largely align with those of robust standard errors we only conservatively report Conley (1999) standard errors, unless otherwise specified.

cients on crop seasonality and persistency, albeit their size is reduced. In Table A10, the coefficient on latitude is never significant and the effect of storage is preserved despite a reduction in size and significance. As in the previous section, the fact that crop seasonality retains a statistically significant coefficient even after controlling for latitude confirms the difference between the two measures, despite their correlation. In particular, crop seasonality is better suited to capture the economically relevant constraint faced by human populations, namely the need to smooth consumption in the presence of temporally concentrated food availability.

In Panel A of Tables A11 and A12, we add to the benchmark specifications an indicator capturing the storability of crops, constructed as the average suitability for the WRs of storable crops (namely, Avena, Hordeum, Oryza, Secale, Setaria, Sorghum, Triticum, and Zea). Mayshar, Pascali, and Moav (2022) argue that crop storability determines appropriability and, in turn, state formation. In Table A11, the coefficient on the (standardized) storability measure is positive and significant as expected, but its inclusion does not alter previous conclusions regarding crop seasonality and persistency, despite a reduction in the coefficient's size for the former. In Table A12, crop storability shows statistical significance only for population size (Model 1) and equality (Model 4), but again its inclusion does not alter previous results regarding food storage. Panel B of the same two tables introduces an alternative, inversely related measure of storability, defined as the average suitability for the WRs of roots and tubers (namely, Dioscorea, Ipomoea, and Manihot).[35] Previous results are confirmed in Table A11, despite the fact that the new regressor tends to show a consistently negative and significant coefficient (Models 1, 2, and 4). In Table A12, instead, it is never significant, but its inclusion tends to attenuate the estimated effect of storage on hierarchy and slavery (Models 2 and 3). The fact that crop seasonality retains a statistically significant coefficient even after controlling for storability confirms that the two measures are conceptually distinct, as discussed in the literature review. While storability captures whether the agricultural output of a region is easily stored, appropriated, and taxed, focusing on intrinsic differences across crop types, our measure does not capture intrinsic storability of crops, but rather the temporal concentration of food availability within a location. Regions dominated by storable crops may nevertheless experience low crop seasonality if harvests are spread across the year, while regions with high crop seasonality may face strong incentives to store food even when available crops are only weakly appropriable.

Next, we estimate in Table A13 the structural model in which food storage is instru-

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[35] Dioscorea, Ipomoea, and Manihot respectively correspond to the domesticated species yams, sweet potato, and cassava. Even though Solanum, which corresponds to potato, is biologically a tuber, following Mayshar, Pascali, and Moav (2022) we do not include it, as in terms of seasonality and storability it can be classified as a quasi-cereal.

mented using the two alternative measures of risk in food availability, in two separate panels. The first-stage relationships between each instrument and food storage are strong and significant, with reassuring values of the F statistics. In the second stage, both instruments show a statistically significant correlation with socioeconomic equality (Model 4), with magnitudes comparable to those obtained using OLS. For the first three outcomes, instrumenting with crop persistency produces estimates that more closely align with the OLS, whereas instrumenting with crop seasonality yields more mixed results, likely because this measure relies on harvest season information for only 19 crops.[36]

Table A15, which is necessarily confined to the EA sample—the only one providing information on beliefs in a moralizing high god—allows us to explore the ramifications of our crop indicators for the emergence of organized religion. We find that crop seasonality promotes the diffusion of such beliefs, whereas crop persistency consistently does the opposite. These findings are in line with research in social anthropology reviewed in the background section, which documents that beliefs in moralizing high gods are associated with larger population size and greater social complexity and, at a deeper level, with ecological instability and environmental duress (Botero et al., 2014). In particular, among hunter-gatherers, the presence of food storage has been indicated as a key predictor of the emergence of a organized religions characterized by professional religious specialists (Watts et al., 2022).

Finally, since the adaptive strategies that lead collectors to store food are associated with infrequent residential moves, whereas foragers exhibit minimal dependence upon storage and high mobility, in Table A16 we explore how nomadism enters the picture that we have so far outlined. For the sake of comparison across the models we present in this table, we confine the sample to societies for which information on food storage is available, as the latter enters in Model 4. In Models 1 and 2, where nomadism is the dependent variable, the coefficients on both crop seasonality and crop persistency display the expected signs but lack statistical significance. In Model 3, we do detect a positive association between nomadism—now the main regressor—and equality, but it vanishes in Model 4 when we also enter food storage, which instead fully preserves its influence. These findings suggest that food storage, rather than nomadism, represents the driver of the influence of seasonal food shortage on food storage and, in turn, inequality.

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[36] Table A14 reports reduced form estimates in which the same outcome variables are regressed directly on crop seasonality (top panel) and crop persistency (bottom panel), yielding consistent results despite a loss in statistical significance. Because food storage does not enter these reduced forms, to lend external validity to our results we can also estimate them using the entire sample, including observations from the EA. These results (not reported for brevity) consistently indicate that crop seasonality decreases the probability of socioeconomic equality, while crop persistency increases it.

Table 5: Archaeological evidence: Bogaard, Fochesato, and Bowles (2019)

	(1)	(2)	(3)	(4)
Dependent variable:		Gini Index		
Crop Seasonality	0.328***	0.319***	0.204**	
	(0.095)	(0.084)	(0.098)	
Neolithic Revolution		0.081	0.1001	
		(0.074)	(0.076)	
Year Linear Trend		0.409**	0.582***	
		(0.200)	(0.176)	
Neolithic R.× Year L.Trend			0.190**	
			(0.084)	
Crop Persistency				-0.226**
				(0.100)
Adjusted R^2	0.186	0.258	0.277	0.224
Observations	151	151	151	151
Continent FE	Yes	Yes	Yes	Yes

Notes: The unit of observation is an archaeological site. The dependent variable is a Gini index computed using household information. Crop seasonality is an inverse measure of stability of food availability throughout the year. Neolithic Revolution is a binary variable for the period after the Neolithic Revolution. Crop persistency is a measure of stability of food availability throughout the year. Continent fixed effects refer to Europe, North America, and South America. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

7 Further evidence from archaeological sites

To further investigate the relationship between seasonal food shortage and inequality, we exploit a dataset collected from archaeological sites by Bogaard, Fochesato, and Bowles (2019). We estimate variants of Equation (3) in which the outcome variable is inequality, measured by a Gini index (reformulated after the Bowles and Carlin's (2020) correction for the bias in the computational algorithm), and the main regressor is crop seasonality. Given the relatively small number of observations and consequent asymptotic concerns, we include a parsimonious set of controls. In Table 5, Model 1, which includes only continent fixed effects (Europe, North America, and South America), displays a positive and significant coefficient on (standardized) crop seasonality when the (standardized) Gini index is the dependent variable. The coefficient remains very similar after adding as further controls a binary variable for the period past the Neolithic Revolution and a year linear trend (Model 2). The interaction between the latter two variables (Model 3) is positively associated with the Gini index, as expected. Despite the fact that the inclusion of the interaction attenuates the size and significance of the crop seasonality coefficient, the role of the latter remains detectable. Model 4 replicates Model 1 replacing crop seasonality with crop persistency, and yields consistent results.

Additionally, to assess the robustness of our results to crop measures generated by

Table 6: Archaeological evidence: Basri and Lawrence (2020) and ADEMNES

	(1)	(2)
	Panel A: Individual Data	
Dependent variable:	Gini Index	
Share Persistent Crops	-0.374***	-0.274**
	(0.129)	(0.135)
Share Wild Crops	-0.120	-0.135
	(0.298)	(0.313)
Crop Fractionalization	0.041	-0.156
	(0.204)	(0.212)
Adjusted R^2	0.207	0.310
Observations	53	53
Other Controls	Yes	Yes
Region FE	No	Yes
	Panel B. Collapsed Data	
Dependent variable:	Gini Index	
Share Persistent Crops	-0.435***	-0.249*
	(0.152)	(0.142)
Share Wild Crops	-0.154	-0.137
	(0.330)	(0.364)
Crop Fractionalization	-0.059	-0.203
	(0.234)	(0.247)
Adjusted R^2	0.197	0.272
Observations	35	35
Other Controls	Yes	Yes
Region FE	No	Yes

Notes: The unit of observation is an archaeological site. The first panel keeps multiple observations for each site. The second panel collapses entries for sites with multiple observations. The dependent variable is a Gini index computed using household information. Share persistent crops is a measure of stability of food availability throughout the year. Share wild crops is the share of wild crops over all crops. Crop fractionalization is a measure of dietary richness. Other controls include household density and a year linear time trend. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

alternative sources, we merge another dataset on archaeological sites, compiled by Basri and Lawrence (2020), with archaeobotanical data on WRs from ADEMNES. In Table 6 (top panel), the main regressor is a newly-generated measure of crop persistency, defined as the share of crops which bear fruits or seeds year-round. Again, given the limited number of observations, we rely on parsimonious specifications. Specifically, we control for the share of wild crops from ADEMNES and crop variety measured as a fractionalization index. In Model 1, we also control for household density, defined as the number of households divided by the size of the archaeological site, and a year linear trend. In Model 2 we further add region fixed effects. While the top panel keeps multiple observations whenever available for some sites, the bottom panel collapses them at the site level, to mitigate concerns arising from multiple excavation phases for a single site. Across all models, the new (standardized) measure of crop persistency exhibits a negative association with the (standardized) Gini index, corroborating previous results.

8 Food storage and tolerance for inequality in preindustrial polities

The preceding sections have suggested that more severe seasonal food shortage is associated with a higher likelihood of food storage and, in turn, higher population size, social complexity, and inequality. Whether higher levels of inequality within ancestral populations foster acceptance of a more unequal society and lower demand for redistribution in the present day—or else whether the opposite holds true—remains an open question.[37] In this section, we address this question using the Seshat dataset on preindustrial polities. Specifically, we test whether food storage—which as previously established leads to inequality—induces tolerance for or aversion to inequality itself. A positive association between food storage and tolerance for inequality would represent the channel linking food storage to lower contemporary support for redistribution. The Seshat dataset is unique in providing information that can proxy for preferences for equality. In particular, it includes a binary variable indicating whether within a polity doctrines or ideological statement that enforce egalitarian principles are present or presumed to be present. We regress this variable on a binary variable for the presence of food storage sites within the polity.

Seshat also records information on religious beliefs and, specifically, on the presence within a polity of moralizing beliefs and practices involving supernatural punishment

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[37] The literature on the impact of contemporary (rather than ancestral) inequality on preferences for redistribution reaches mixed conclusions, both theoretically and empirically. See Alesina and Giuliano (2011).

Table 7: Food storage and preference for equality in preindustrial polities

	(1)	(2)	(3)	(4)	(5)
			Panel A: No Interaction		
Dependent variable:	Equality	Population (Log)	Prosociality	Merit Promotion	Executive Constraints
Food Storage Sites	-0.684***	2.351***	0.022	0.645***	0.109
	(0.109)	(0.784)	(0.024)	(0.115)	(0.357)
Moralizing Religious Beliefs	0.443**	1.489*	0.166	-0.002	0.680*
	(0.175)	(0.870)	(0.138)	(0.169)	(0.335)
Adjusted R^2	0.607	0.831	0.106	0.517	0.407
Observations	125	129	101	105	52
Clusters	29	30	30	29	13
Sample Mean	0.616	11.750	0.980	0.352	0.481
Controls	Yes	Yes	Yes	Yes	Yes
Natural Geo Area FE	Yes	Yes	Yes	Yes	Yes
			Panel B: With Interaction		
Food Storage Sites	-0.658***	2.473***	0.024	0.647***	0.109
	(0.112)	(0.800)	(0.025)	(0.116)	(0.357)
Moralizing Religious Beliefs	-0.013	2.102**	-0.025*	0.105	0.680*
	(0.020)	(0.988)	(0.014)	(0.067)	(0.335)
Food Storage S.*M. R. Beliefs	0.541**	-0.740	0.219	-0.123	
	(0.198)	(1.246)	(0.157)	(0.192)	
Adjusted R^2	0.607	0.831	0.106	0.517	0.407
Observations	125	129	101	105	52
Clusters	29	30	30	29	13
Sample Mean	0.616	11.750	0.980	0.352	0.481
Controls	Yes	Yes	Yes	Yes	Yes
Natural Geo Area FE	Yes	Yes	Yes	Yes	Yes

Notes: The unit of observation is a polity. Equality is a binary variables for the presence within a polity of an ideological enforcement of equality. Population (log) is the logarithm of a polity's population. Prosociality, merit promotion, and executive constraints are binary variables respectively for the presence of an enforcement of prosociality or merit promotion and of constraints on the executive. Food storage sites is a binary variable for the presence of food storage sites. Moralizing religious beliefs is a binary variable for the presence of certain moralizing religious beliefs. Controls include the date from which a polity exists, polity duration, and an ordered variable for settlement hierarchy. Wild bootstrapped standard errors clustered at the NGA level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

or reward. We include this variable as a control, as such beliefs may contribute to shaping preferences for equality by promoting norms of social justice. As discussed in the background section and corroborated by our analysis of hunter-gatherer societies (Table A15) moralizing religious beliefs represent a by-product of social complexity and, ultimately, food storage.

In Table 7, Model 1 in Panel A reports the results for the dependent variable capturing preference for equality in specifications that, in addition to moralizing religious beliefs, control for NGA fixed effects,[38] the date of polity emergence, polity duration, and an ordered variable for settlement hierarchy which we use as a proxy for the level of social complexity within the polity. The coefficient shows that the presence of food storage sites is negatively associated with a polity's preference for equality. At the same time, the presence of moralizing religious beliefs is positively associated with it. In Panel B, the interaction between the two regressors displays a significantly positive coefficient,

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[38] Each NGA corresponds to a sampling point, three for each of 10 major regions across the globe.

while the influence of storage is attenuated. This pattern suggests that moralizing religion dampens the negative effect of storage on egalitarian ideology. However, because the emergence of moralizing religious beliefs is itself fostered by food storage, we can interpret their role as that of a replacement for storage: Religious beliefs may act as an enforcement device that transmits the influence of storage on preferences for equality beyond the historical period in which storage was a direct response to environmental risk. In other words, religions centered on moralizing high gods may play a long-term role in sustaining egalitarian norms, even after food storage ceases to be necessary in response to environmental duress.

In subsequent models, we test the effect of storage on other characteristics of a polity. In line with our previous results, polities with food storage facilities exhibit populations (entered in logarithms) over twice as large as those without storage (Model 2). As a falsification test, we test the effect of storage on preference for prosociality (Model 3), a trait that reflects a disposition toward altruism, cooperation, and concern for others, and thus a propensity to benefit others through public goods provision (Fehr and Schmidt, 1999). Reassuringly, no correlation is detected for this trait. By contrast, storage does show a positive correlation with merit promotion (Model 4), consistent with the view that meritocracy, with its emphasis on individual achievement, equality of opportunity, and rejection of welfare transfers (Alesina and La Ferrara, 2005), is associated with tolerance for inequality. Finally, we find no influence of storage on constraints on the executive (Model 5), which proxy for a polity's institutional quality in terms of rule of law enforcement and political accountability. These institutional features are, in turn, closely related to fiscal capacity and a polity's ability to raise revenues to fund public goods (Besley and Persson, 2009). Furthermore, for none of the additional dependent variables do we detect a significant influence of the interaction between storage and moralizing religious beliefs.[39]

The above results confirm the hypothesis that food storage not only leads to higher ancestral inequality but also fosters greater tolerance for inequality itself. Furthermore, they reveal that the emergence of organized religions can contribute to perpetuate the influence of food storage on preferences for equality in the long run, even beyond the phase in human history in which hunter-gatherers relied on storage as an adaptive response to environmental stress.

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[39] The interaction term is omitted in Model 5 due to collinearity.

9 Conclusion

We have investigated the ancient roots of contemporary preferences for redistribution by adopting an evolutionary perspective on preference formation. Our analysis suggests that the seasonality of the ecological environment in the pre-Neolithic era—captured by the seasonality of the wild relatives of domesticated crops—may indeed have exerted a persistent influence on contemporary attitudes toward redistribution, through the following mechanisms. Our crop seasonality measure captures the extent to which harvest availability in a cell is temporally concentrated in a subset of months, after accounting for local crop suitability: Higher values indicate stronger intra-annual instability in food availability, with short periods of abundance followed by longer periods of scarcity. In ecological environments characterized by more severe crop seasonality, hunter-gatherers developed food storing strategies in order to smooth consumption. This adaptation set the conditions for the emergence of population growth, social complexity, and inequality. We also uncover a link between crop seasonality and the emergence of religion. Archaeological evidence confirms the positive association between food storage and inequality. Among preindustrial polities, food storage is associated with greater tolerance for inequality, and this association constitutes the channel through which crop seasonality, via food storage, reverberates negatively on redistributive preferences. In the same setting, the emergence of organized religions can perpetuate the influence of food storage on preferences for equality well beyond the pre-Neolithic phase in human history. Turning to the present day, as we show using contemporary survey data, migrants originating from countries characterized by greater crop seasonality in the pre-Neolithic era—and thus stronger reliance on food storage—exhibit lower support for redistributive policies.

Taken together, these findings highlight how ecological adaptation to environmental conditions has shaped contemporary outcomes, linking ancestral survival strategies to contemporary attitudes toward inequality and redistribution. Recognizing these deep-rooted determinants is essential for interpreting cross-country variation in redistributive preferences and can inform the design of policies and institutions aimed at addressing inequality.

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APPENDIX

Ancestral Inequality and Preferences for Redistribution

Graziella Bertocchi, Arcangelo Dimico, Gian Luca Tedeschi

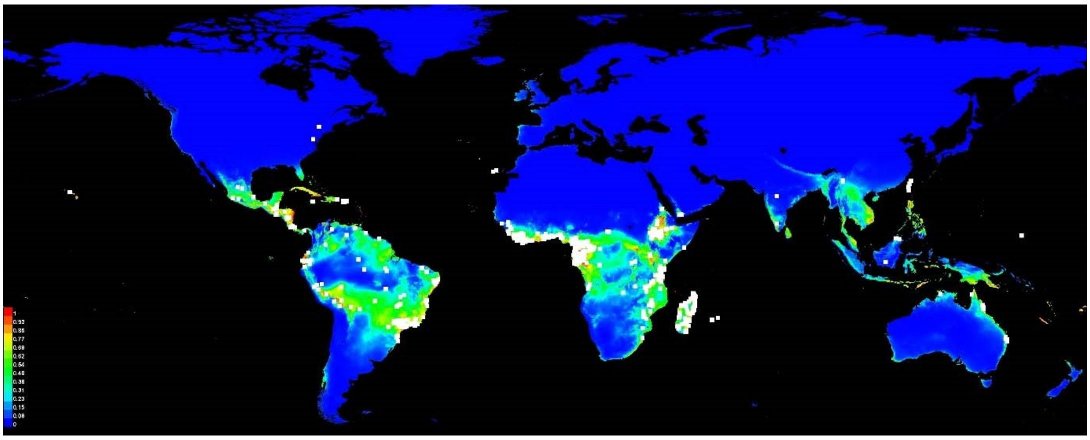

Figure A1: The predicted geographic distribution of suitability for Coffea

Note: Dots indicate point coordinates of the wild relatives of Coffea in the sample. Color shades represent the Maxent-generated predicted suitability for coffee, with blue, red, and green respectively indicating zero, maximum, and intermediate suitability.

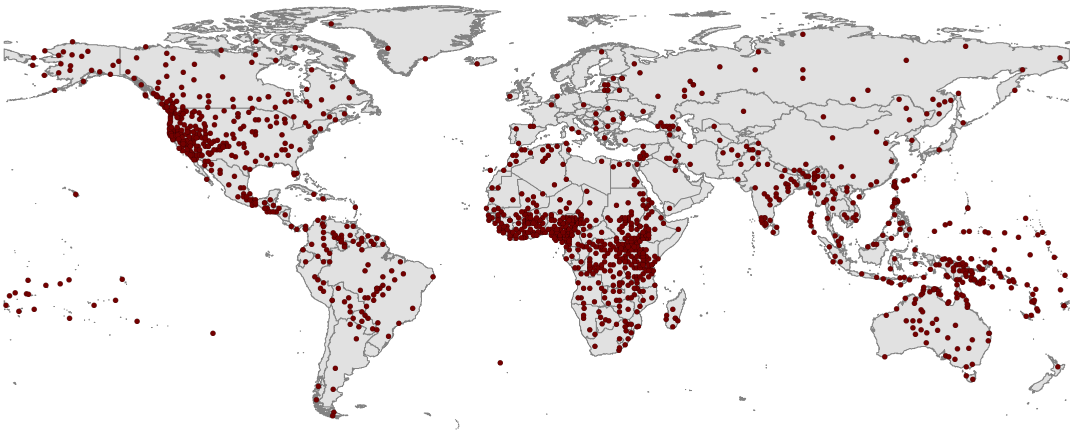

Figure A2: The geographic distribution of the sample of preindustrial societies

Note: Dots indicate centroid coordinates of the societies in the sample.

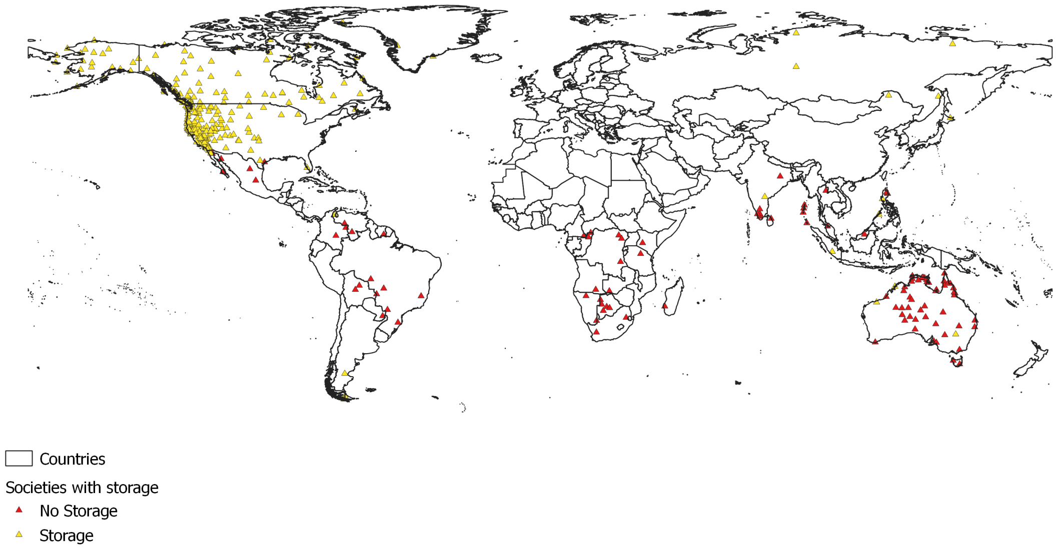

Figure A3: The geographic distribution of food storage practices in preindustrial societies

Note: Yellow and red triangles respectively indicate centroid coordinates of the societies in the sample with and without storage.

Table A1: List of genera in the sample and corresponding crop species with harvest season

Genus	**Crop**	**Genus**	**Crop**	**Genus**	**Crop**
Aegilops		Agropyron		Allium	
Ananas*		Arachis	Groundnuts	Armoracia	
Artocarpus*		Asparagus		Atalantia	
Avena	Oats	Beta	Sugarbeets	Blitum	
Brassica	Rapeseed	Cajanus*		Camellia	
Capsella		Capsicum		Carica*	
Carthamus		Carya		Castanea	
Cenchrus		Chenopodium		Cicer	
Citrullus		Citrus		Clausena	
Coffea		Coincya		Colocasia	
Comarum		Corylus		Crambe	
Cucumis		Cucurbita		Cynara	
Daucus		Digitaria		Dioscorea	Yams
Diospyros		Diplotaxis		Drymocallis	
Echinochloa		Elaeis		Elettaria	
Eleusine	Millet	Elymus		Eruca	
Erucastrum		Ficus*		Fragaria	
Glycine	Soybean	Gossypium*	Cotton	Helianthus	Sunflower
Hirschfeldia		Hordeum	Barley	Imperata	
Ipomoea*	Sweet Potato	Isatis		Juglans	
Lactuca		Lathyrus	Pulses	Leymus	
Lupinus		Malus		Mangifera	
Manihot*	Cassava	Medicago		Miscanthus	
Moricandia		Musa		Nicotiana	
Olea		Oryza	Rice	Panicum	
Persea		Phaseolus		Phoenix	
Piper		Pistacia		Prunus	
Psathyrostachys		Psidium		Pyrus	
Raphanus		Ribes		Rorippa	
Rubus		Saccharum		Secale	Rye
Sesamum		Setaria		Sinapis	
Solanum*	Potatoes	Sorghum	Sorghum	Spinacia	
Theobroma		Thinopyrum		Trachystoma	
Tripsacum		Triticum	Wheat	Vaccinium	
Vanilla		Vasconcellea		Vavilovia	
Vicia		Vigna		Vitis	
Zea	Maize				

Notes: The genera marked with an asterisk bear seeds or fruits throughout the year.

Table A2: Variable definitions and sources

Variable	Definition	Source
Crop Seasonality	Average seasonal variation of modern crops weighted by corresponding WR suitability.	GBIF, GRIN-Global, WorldClim, CSGE
Crop Persistency	Share of WRs that bear seeds or fruits throughout the year weighted by WR suitability.	GBIF, GRIN-Global, WorldClim, USDA
Crop Variety	One minus Herfindahl index of concentration of WR suitability.	GBIF, GRIN-Global, WorldClim
Reduce Income Differences / Tax the Rich and Subsidize the Poor	Measure of preference for redistribution based on on responses to “The government should take measures to reduce differences in income levels” / An essential characteristic of democracy is that “Governments tax the rich and subsidize the poor.”	WVS, ESS
Society Fair when Equal	Measure of preference for redistribution based on responses to “Society fair when income and wealth is equally distributed.”	ESS
Long-Term Orientation	Measure of long-term orientation based on responses to “Important child qualities: Thrift saving money and things” / “Plan for future or take each day as it comes.”	WVS, ESS
Risk Aversion	Measure of risk aversion based on responses to “Important to seek adventures and have an exciting life.”	ESS
Unselfishness	Measure of unselfishness based on responses to “Important child qualities: Unselfishness.”	WVS
Age	Respondent’s age in years.	WVS, ESS
Female	Dummy variable equal to 1 for female respondents.	WVS, ESS
Ancestral Inequality	Share of ancestral population with wealth distinction.	Giuliano and Nunn (2018)
Jurisdictional Hierarchy above One	Share of ancestral population with a level of jurisdictional hierarchy above one.	Giuliano and Nunn (2018)
Share Nomadic	Share of ancestral population classified as nomadic.	Giuliano and Nunn (2018)
Share Natives	Share of current population who used to live within the country before Columbus.	Putterman and Weil (2010)
Genetic Diversity	Ancestry-adjusted genetic heterozygosity.	Ashraf and Galor (2013)
Share Europeans	Share of population of European descent.	Ashraf and Galor (2013)
Share Same Ancestry	Share of respondents in destination country with the same origin country (ancestry) as respondent.	WVS, ESS
Gini Index	Gini coefficient averaged over 1960-2022.	World Bank
Agricultural Share	Share of agriculture in GDP averaged over 1960-2022.	World Bank
Latitude (Historical)	Absolute distance from the equator of ancestors, based on EA ethnicity-level measure.	Giuliano and Nunn (2018)
Food Storage	Binary equal to 1 if society is dependent on food storage.	Binford (1981), WNAI
Nomadism	Binary equal to 1 if society is nomadic.	Binford (1981), WNAI, Murdock (1967)
Population>50	Binary equal to 1 if society’s population exceeds 50 individuals.	Binford (1981), WNAI, Murdock (1967)
Hierarchy	Binary equal to 1 if jurisdictional hierarchy above local autonomy exists.	Binford (1981), WNAI, Murdock (1967)
Slavery	Binary equal to 1 if slaves are present.	Binford (1981), WNAI, Murdock (1967)
Socioeconomic Equality	Binary equal to 1 if no kind of class differentiation exists.	Binford (1981), WNAI, Murdock (1967)
Moralizing High God	Binary equal to 1 if beliefs in a high god exist.	Murdock (1967)
Elevation	Mean elevation.	WorldClim
Ruggedness	Mean terrain ruggedness.	WorldClim
Rivers and Basins	Number of rivers or water basin.	WorldClim
Distance from the Coast	Distance to nearest coastline.	WorldClim
Latitude	Absolute distance from the equator.	WorldClim
Crop Storability	Average suitability for the WRs of storable crops	GBIF, GRIN-Global
Tuber Suitability	Average suitability for the WRs of roots and tubers	GBIF, GRIN-Global
Gini Index (Households)	Household-based Gini coefficient.	Bogaard, Fochesato, and Bowles (2019); Basri and Lawrence (2020)
Neolithic Revolution	Binary equal to 1 if archaeological site is post-Neolithic.	Bogaard, Fochesato, and Bowles (2019)
Year	Calendar year of archaeological site.	Bogaard, Fochesato, and Bowles (2019)
Share Persistent Crops	Share of archaeobotanical crops that bear seeds or fruits all year.	Basri and Lawrence (2020), ADEMNES
Share Wild Crops	Share of wild crops.	Basri and Lawrence (2020), ADEMNES
Crop Fractionalization	One minus Herfindahl index of crop concentration.	Basri and Lawrence (2020), ADEMNES
Household Density	Number of households over size of archaeological site.	Basri and Lawrence (2020)
Food Storage Sites	Binary equal to 1 if public food storage sites exist.	Seshat
Equality	Binary equal to 1 if an ideological enforcement of equality exists.	Seshat
Population	Population size.	Seshat
Prosociality	Binary equal to 1 if religious thought reinforces prosociality.	Seshat
Merit Promotion	Binary equal to 1 if procedures for promotion based on performance exist.	Seshat
Executive Constraints	Binary equal to 1 if executive constraints on the rulers exist.	Seshat
Moralizing Religious Beliefs	Binary equal to 1 if moralizing beliefs and practices involving supernatural punishment or reward exist.	Seshat
Date from Which Polity Exists	Earliest recorded date at which polity is documented to exist.	Seshat
Duration	Duration in years of polity’s existence.	Seshat
Hierarchy	Number of levels in settlement hierarchy.	Seshat

Table A3: Summary Statistics

	Mean	*S.D.*	*Min*	*Max*	*N*
Individuals (WVS/ESS)					
Reduce Income Differences / Tax the Rich and Subsidize the Poor†	0.14	0.20	0	1	49160
Society Fair when Equal†	0.61	0.28	0	1	4160
Long-Term Orientation†	0.69	0.31	0	1	14870
Risk Aversion†	0.58	0.30	0	1	39826
Unselfishness†	0.87	0.09	0	1	7523
Age	47.47	17.76	13	114	50409
Female	0.55	0.50	0	1	50816
Crop Seasonality†	0.64	0.21	0	1	50694
Crop Persistency†	0.16	0.23	0	1	50855
Crop Variety†	0.89	0.20	0	1	50855
Ancestral Inequality	0.96	0.15	0	1	50885
Jurisdictional Hierarchy Above One	0.98	0.06	0	1	50885
Nomadic	2.32	1.05	1	8	50885
Share Natives	0.88	0.21	0	1	50454
Genetic Diversity	0.73	0.02	1	1	50454
Share Europeans	0.64	0.45	0	1	50454
Share Same Ancestry	0.08	0.20	0	1	50885
Gini Index†	0.30	0.16	0	1	49876
Agricultural Share†	0.18	0.15	0	1	49154
Latitude (Historical)	39.19	16.54	-35	69	50885
Ethnic Groups (Binford-WNAI-Ethnographic Atlas)					
Food Storage	0.69	0.46	0	1	360
Nomadism	0.09	0.28	0	1	1288
Population>50	0.61	0.49	0	1	697
Hierarchy	0.47	0.50	0	1	1255
Slavery	0.47	0.50	0	1	1226
Socioeconomic Equality	0.51	0.50	0	1	1214
Moralizing High God	0.32	0.47	0	1	601
Crop Seasonality†	0.38	0.19	0	1	1364
Crop Persistency†	0.42	0.28	0	1	1388
Crop Variety†	0.96	0.08	0	1	1388
Elevation	620.99	629.92	-15	4677	1388
Ruggedness	182.41	194.62	2	1152	1388
Rivers and Basins	2.50	7.81	0	91	1388
Distance from the Coast	3.63	3.92	0	22	1388
Latitude	14.94	24.22	-55	78	1388
Crop Storability†	0.41	0.19	0	1	1388
Tuber Suitability†	0.39	0.30	0	1	1388
Archaeological Sites (Bogaard, Fochesato, and Bowles, 2019)					
Gini Index (Households)	0.33	0.19	0	1	151
Crops Seasonality†	0.60	0.20	0	1	151
Crop Persistency†	0.13	0.19	0	1	151
Neolithic Revolution	0.93	0.26	0	1	151
Year	-2672.72	3073.65	-21000	1775	151
Archaeological Sites (Basri and Lawrence, 2020 and ADEMNES)					
Gini Index (Households)	0.29	0.15	0	1	53
Share Persistent Crops†	0.27	0.24	0	1	53
Share Wild Crops†	0.73	0.28	0	1	53
Crop Fractionalization†	0.75	0.24	0	1	53
Household Density†	0.11	0.19	0	1	53
Preindustrial Polities (Seshat)					
Food Storage Sites	0.78	0.41	0	1	251
Equality	0.50	0.50	0	1	228
Population (Log)	11.03	3.78	3	19	265
Prosociality	0.98	0.15	0	1	167
Merit Promotion	0.29	0.46	0	1	187
Executive Constrains	0.46	0.50	0	1	89
Moralizing Religious Beliefs	0.57	0.50	0	1	291
Date from Which Polity Exists	-454.90	2255.99	-13600	1895	369
Duration	364.11	607.32	-253	4400	367
Hierarchy	3.24	1.70	0	7	352

Notes: Variables marked with † are normalized to the [0,1] interval; all other variables are in original units.

Table A4: Seasonal food shortage and preferences for redistribution: Additional controls

	(1)	(2)	(3)
		Panel A: WVS	
Dependent variable:		Reduce Income Differences	
Ancestral Inequality	-0.024*	-0.016	-0.024*
	(0.013)	(0.013)	(0.013)
Crop Seasonality	-0.052***	-0.048***	-0.048**
	(0.018)	(0.018)	(0.019)
Gini Index	0.001		
	(0.003)		
Agricultural Share		0.004	
		(0.002)	
Latitude			0.000
			(0.001)
Adjusted R^2	0.032	0.032	0.032
Observations	6753	6847	6889
Clusters	115	124	126
Country & Time FE	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes
Home Language FE	Yes	Yes	Yes
Other Controls	Yes	Yes	Yes
Joint Hyp.	0.520	0.140	0.510
		Panel B: ESS	
Dependent variable:		Tax the Rich and Subsidize the Poor	
Ancestral Inequality	-0.008	-0.005	-0.010
	(0.009)	(0.009)	(0.008)
Crop Seasonality	-0.040**	-0.042**	-0.039*
	(0.019)	(0.017)	(0.020)
Gini Index	-0.000		
	(0.003)		
Agricultural Share		0.004**	
		(0.002)	
Latitude			-0.000
			(0.001)
Adjusted R^2	0.076	0.074	0.075
Observations	30866	30126	31391
Clusters	135	144	146
Country & Time FE	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes
Home Language FE	Yes	Yes	Yes
Other Controls	Yes	Yes	Yes
Joint Hypothesis	0.540	0.025	0.520

Notes: The unit of observation is an individual. The dependent variables are proxies for preferences for redistribution. Crop seasonality is an inverse measure of stability of food availability throughout the year. Gini index is an average over the period 1960-2022. Agricultural share is an average over the period 1960-2022. Individual controls include age and gender. Other controls include the share of natives, genetic diversity, the share of the population of European descent, and the share of the population in the destination country from the origin country, all with reference to the origin country. Robust standard errors adjusted for clustering at the country of origin level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A5: Seasonal food shortage and preferences for redistribution: Second generation migrants - WVS

	(1)	(2)
Dependent variable:	Reduce Income Differences	
Ancestral Inequality	-0.014	-0.015
	(0.014)	(0.014)
Crop Seasonality	-0.039***	-0.041**
	(0.015)	(0.019)
Second Generation	0.008	0.008
	(0.034)	(0.033)
Second Generation*Crop Seasonality		0.009
		(0.039)
Adjusted R^2	0.032	0.032
Observations	6889	6889
Clusters	126	126
Country & Time FE	Yes	Yes
Individual Controls	Yes	Yes
Home Language FE	Yes	Yes

Notes: The unit of observation is an individual. The dependent variables are proxies for preferences for redistribution. Crop seasonality is an inverse measure of stability of food availability throughout the year. Second generation is a binary variable for second generation migrants. Individual controls include age and gender. Robust standard errors adjusted for clustering at the country of origin level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A6: Seasonal food shortage and preferences for redistribution: Alternative crop measures

	(1)	(2)	(3)
		Panel A: WVS	
Dependent variable:		Reduce Income Differences	
Crop Seasonality	-0.033*		
	(0.018)		
Crop Persistency		0.043**	
		(0.017)	
Crop Variety			0.009
			(0.012)
Adjusted R^2	0.089	0.089	0.088
Observations	6831	6885	6885
Clusters	126	133	133
Country & Time FE	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes
Home Language FE	Yes	Yes	Yes
		Panel B: ESS	
Dependent variable:		Tax the Rich and Subsidize the Poor	
Crop Seasonality	-0.028*		
	(0.015)		
Crop Persistency		0.022**	
		(0.011)	
Crop Variety			0.011
			(0.013)
Adjusted R^2	0.075	0.075	0.074
Observations	31609	31672	31672
Clusters	152	163	163
Country & Time FE	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes
Home Language FE	Yes	Yes	Yes

Notes: The unit of observation is an individual. The dependent variables are proxies for preferences for redistribution. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Crop variety is a measure of dietary richness. Individual controls include age and gender. Robust standard errors adjusted for clustering at the country of origin level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A7: Seasonal food shortage and preferences: Other preference traits - WVS

	(1)	(2)
Dependent variable:	Long-Term Orientation	Unselfishness
	Panel A: Crop Seasonality	
Crop Seasonality	-0.000	-0.000
	(0.014)	(0.013)
Adjusted R^2	0.051	0.089
Observations	7034	7262
Clusters	126	126
Country & Time FE	Yes	Yes
Individual Controls	Yes	Yes
Home Language FE	Yes	Yes
	Panel B: Crop Persistency	
Crop Persistency	0.004	-0.020
	(0.011)	(0.013)
Adjusted R^2	0.050	0.090
Observations	7098	7326
Clusters	133	133
Country & Time FE	Yes	Yes
Individual Controls	Yes	Yes
Home Language FE	Yes	Yes

Notes: The unit of observation is an individual. The dependent variables are proxies for long-term orientation and altruism. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Crop variety is a measure of dietary richness. Individual controls include age and gender. Robust standard errors adjusted for clustering at the country of origin level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A8: Seasonal food shortage and preferences: Other preference traits - ESS

	(1)	(2)	(3)
Dependent variable:	Society Fair when Equal	Long-Term Orientation	Risk Aversion
	Panel A: Crop Seasonality		
Crop Seasonality	-0.055**	0.009	0.000
	(0.026)	(0.017)	(0.011)
Adjusted R^2	0.079	0.074	0.127
Observations	4094	7240	31323
Clusters	133	142	152
Country & Time FE	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes
Home Language Controls	Yes	Yes	Yes
	Panel B: Crop Persistency		
Crop Persistency	0.073***	-0.015	-0.008
	(0.022)	(0.014)	(0.010)
Adjusted R^2	0.081	0.074	0.127
Observations	4103	7259	31389
Clusters	138	150	164
Country & Time FE	Yes	Yes	Yes
Home Language FE	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes

Notes: The unit of observation is an individual. The dependent variables are proxies for preference for fairness, long-term orientation, and risk aversion. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Crop variety is a measure of dietary richness. Individual controls include age and gender. Robust standard errors adjusted for clustering at the country of origin level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A9: Seasonal food shortage and storage: Controlling for latitude

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:			Food Storage			
Crop Seasonality	0.123***	0.159***			0.219***	
	(0.040)	(0.038)			(0.040)	
Crop Persistency			-0.186***			-0.191***
			(0.041)			(0.041)
Crop Variety				0.018**	0.052***	0.023***
				(0.009)	(0.008)	(0.007)
Latitude	0.211***	0.085*	0.121***	0.214***	0.081	0.137***
	(0.039)	(0.050)	(0.040)	(0.049)	(0.051)	(0.044)
Adjusted R^2	0.710	0.792	0.801	0.762	0.814	0.805
Observations	360	360	360	360	360	360
Sample Mean	0.694	0.694	0.694	0.694	0.694	0.694
Geographic Controls	No	Yes	Yes	Yes	Yes	Yes
Continent FE	No	Yes	Yes	Yes	Yes	Yes

Notes: The unit of observation is an ethnic group. The dependent variable is a binary taking value one if an ethnic group is dependent on food storage. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Crop variety is a measure of dietary richness. Latitude is the absolute distance from the equator. Geographic controls include elevation, ruggedness, rivers and basins, and distance from the coast. Conley (1999) standard errors for a window of 300 km in in parentheses and robust standard errors in square brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A10: Food storage, social complexity, and inequality: Controlling for latitude

	(1)	(2)	(3)	(4)
Dependent variable:	Population>50	Hierarchy	Slavery	Socioec. Equality
Food Storage	0.081**	0.045	0.111	-0.284***
	(0.039)	(0.034)	(0.088)	(0.078)
Latitude	0.012	0.000	0.022	-0.062
	(0.016)	(0.016)	(0.039)	(0.039)
Adjusted R^2	0.057	0.034	0.275	0.256
Observations	243	359	360	360
Sample Mean	0.613	0.474	0.471	0.508
Geographic Controls	Yes	Yes	Yes	Yes
Continent FE	Yes	Yes	Yes	Yes

Notes: The unit of observation is an ethnic group. The dependent variables are binary respectively taking value one if population is above 50 members, jurisdictional hierarchy is present, slavery is present, and class differentiation is absent. Food storage is a binary variable taking value one if an ethnic group is dependent on food storage. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Crop variety is a measure of dietary richness. Latitude is the absolute distance from the equator. Geographic controls include elevation, ruggedness, rivers and basins, and distance from the coast. Conley (1999) standard errors for a window of 300 km in in parentheses and robust standard errors in square brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A11: Seasonal food shortage and storage: Controlling for storability

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:			Food Storage			
			Panel A: Crop Storability			
Crop Seasonality	0.375***	0.263***			0.289***	
	(0.017)	(0.026)			(0.027)	
Crop Persistency			-0.276***			-0.273***
			(0.035)			(0.035)
Crop Variety				-0.036***	0.033***	-0.005
				(0.010)	(0.007)	(0.005)
Crop Storability	0.109***	0.072***	0.023**	0.033**	0.055***	0.026**
	(0.015)	(0.012)	(0.011)	(0.016)	(0.012)	(0.012)
Adjusted R^2	0.679	0.812	0.775	0.657	0.819	0.775
Observations	360	360	360	360	360	360
Sample Mean	0.694	0.694	0.694	0.694	0.694	0.694
Geographic Controls	No	Yes	Yes	Yes	Yes	Yes
Continent FE	No	Yes	Yes	Yes	Yes	Yes
			Panel B: Tuber Suitability			
Crop Seasonality	0.279***	0.187***			0.250***	
	(0.038)	(0.030)			(0.034)	
Crop Persistency			-0.284***			-0.286***
			(0.065)			(0.065)
Crop Variety				0.001	0.051***	0.006
				(0.006)	(0.009)	(0.005)
Tuber Suitability	-0.082*	-0.061*	0.014	-0.196***		0.012
	(0.047)	(0.032)	(0.053)	(0.035)		(0.053)
Adjusted R^2	0.600	0.788	0.772	0.729	0.808	0.772
Observations	360	360	360	360	360	360
Sample Mean	0.694	0.694	0.694	0.694	0.694	0.694
Geographic Controls	No	Yes	Yes	Yes	Yes	Yes
Continent FE	No	Yes	Yes	Yes	Yes	Yes

Notes: The unit of observation is an ethnic group. The dependent variable is a binary taking value one if an ethnic group is dependent on food storage. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Crop variety is a measure of dietary richness. Crop storability is the average suitability for wild relatives of storable crops. Tuber suitability is the average suitability for wild relatives of roots and tubers. Geographic controls include elevation, ruggedness, rivers and basins, and distance from the coast. Conley (1999) standard errors for a window of 300 km in in parentheses and robust standard errors in square brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A12: Food storage, social complexity, and inequality: Controlling for storability

	(1)	(2)	(3)	(4)
Dependent variable:	Population>50	Hierarchy	Slavery	Socioec. Equality
	Panel A: Crop Storability			
Food Storage	0.112***	0.047***	0.140**	-0.377***
	(0.033)	(0.018)	(0.070)	(0.052)
Crop Storability	0.060**	-0.010	0.041	-0.052**
	(0.025)	(0.010)	(0.039)	(0.021)
Adjusted R^2	0.118	0.038	0.289	0.265
Observations	243	359	360	360
Sample Mean	0.613	0.474	0.471	0.508
Geographic Controls	Yes	Yes	Yes	Yes
Continent FE	Yes	Yes	Yes	Yes
	Panel B: Tuber Suitability			
Food Storage	0.094***	0.065	0.165*	-0.407***
	(0.035)	(0.040)	(0.091)	(0.068)
Tuber Suitability	-0.005	0.015	0.016	-0.019
	(0.014)	(0.024)	(0.035)	(0.026)
Adjusted R^2	0.056	0.037	0.275	0.249
Observations	243	359	360	360
Sample Mean	0.613	0.474	0.471	0.508
Geographic Controls	Yes	Yes	Yes	Yes
Continent FE	Yes	Yes	Yes	Yes

Notes: The unit of observation is an ethnic group. The dependent variables are binary respectively taking value one if population is above 50 members, jurisdictional hierarchy is present, slavery is present, and class differentiation is absent. Food storage is a binary variable taking value one if an ethnic group is dependent on food storage. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Crop variety is a measure of dietary richness. Crop storability is the average suitability for wild relatives of storable crops. Tuber suitability is the average suitability for wild relatives of roots and tubers. Geographic controls include elevation, ruggedness, rivers and basins, and distance from the coast. Conley (1999) standard errors for a window of 300 km in parentheses and robust standard errors in square brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A13: Seasonal food shortage, storage, and inequality: IV

	(1)	(2)	(3)	(4)
Dependent variable:	Population>50	Hierarchy	Slavery	Socioec. Equality
	Panel A: Crop Seasonality			
Food Storage	0.030	-0.009	-0.048	-0.232**
	(0.052)	(0.044)	(0.092)	(0.118)
Adjusted R^2	0.055	0.030	0.258	0.242
Observations	243	359	360	360
Sample Mean	0.074	0.036	0.194	0.106
Geographic Controls	Yes	Yes	Yes	Yes
Continent FE	Yes	Yes	Yes	Yes
F-test	73.878	86.869	86.857	86.857
First stage: Food Storage				
Crop Seasonality	0.216***	0.221***	0.221***	0.221***
	(0.025)	(0.024)	(0.024)	(0.024)
	Panel B: Crop Persistency			
Food Storage	0.129**	-0.048	0.132	-0.474***
	(0.059)	(0.094)	(0.107)	(0.100)
Adjusted R^2	0.059	0.018	0.276	0.248
Observations	243	359	360	360
Sample Mean	0.074	0.036	0.194	0.322
Geographic Controls	Yes	Yes	Yes	Yes
Continent FE	Yes	Yes	Yes	Yes
F-test	70.951	73.486	73.525	73.525
First stage: Food Storage				
Crop Persistency	-0.276***	-0.271***	-0.271***	-0.271***
	(0.033)	(0.032)	(0.032)	(0.032)

Notes: The unit of observation is an ethnic group. The dependent variables are binary respectively taking value one if population is above 50 members, jurisdictional hierarchy is present, slavery is present, and class differentiation is absent. Food storage is a binary variable taking value one if an ethnic group is dependent on food storage. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Geographic controls include elevation, ruggedness, rivers and basins, and distance from the coast. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A14: Seasonal food shortage, social complexity, and inequality: Reduced forms

	(1)	(2)	(3)	(4)
Dependent variable:	Population>50	Hierarchy	Slavery	Socioec. Equality
	Panel A: Crop Seasonality			
Crop Seasonality	0.006	-0.002	-0.011	-0.051
	(0.013)	(0.010)	(0.024)	(0.035)
Adjusted R^2	0.085	0.057	0.285	0.227
Observations	243	359	360	360
Sample Mean	0.074	0.036	0.194	0.678
Continent FE	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes
	Panel B: Crop Persistency			
Crop Persistency	-0.036*	0.013	-0.036	0.128***
	(0.019)	(0.025)	(0.039)	(0.036)
Adjusted R^2	0.091	0.058	0.287	0.247
Observations	243	359	360	360
Sample Mean	0.074	0.036	0.194	0.678
Continent FE	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes

Notes: The unit of observation is an ethnic group. The dependent variables are binary respectively taking value one if population is above 50 members, jurisdictional hierarchy is present, slavery is present, and class differentiation is absent. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Geographic controls include elevation, ruggedness, rivers and basins, and distance from the coast. Conley (1999) standard errors for a window of 300 km in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A15: Seasonal food shortage and beliefs in a moralizing high god

Dependent variable:	(1) Moralizing High God
	Panel A: Crop Seasonality
Crop Seasonality	0.182***
	(0.028)
Adjusted R^2	0.289
Observations	584
Sample Mean	0.485
Continent FE	Yes
Geographic Controls	Yes
	Panel B: Crop Persistency
Crop Persistency	-0.223***
	(0.030)
Adjusted R^2	0.320
Observations	600
Sample Mean	0.485
Continent FE	Yes
Geographic Controls	Yes

Notes: The unit of observation is an ethnic group. The dependent variables is a binary for the presence of beliefs in a moralizing high god. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Geographic controls include elevation, ruggedness, rivers and basins, and distance from the coast. Conley (1999) standard errors for a window of 300 km in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A16: Seasonal food shortage, storage, and nomadism

	(1)	(2)	(3)	(4)
Dependent variable:	Nomadism		Socioec. Equality	
Crop Seasonality	-0.019			
	(0.035)			
Crop Persistency		0.019		
		(0.046)		
Nomadism			0.102*	0.046
			(0.060)	(0.056)
Food Storage				-0.372***
				(0.058)
Adjusted R^2	0.241	0.241	0.206	0.249
Observations	360	360	360	360
Sample Mean	0.211	0.211	0.678	0.678
Geographic Controls	Yes	Yes	Yes	Yes
Continent FE	Yes	Yes	Yes	Yes

Notes: The unit of observation is an ethnic group. Nomadism is a binary variable taking value one if an ethnic group is fully nomadic. Socioeconomic equality is a binary variable taking value one if class differentiation is absent. Crop seasonality is an inverse measure of stability of food availability throughout the year. Crop persistency is a measure of stability of food availability throughout the year. Food storage is a is a binary variable taking value one if an ethnic group is dependent on food storage. Geographic controls include elevation, ruggedness, rivers and basins, and distance from the coast. Conley (1999) standard errors for a window of 300 km in parentheses. *** p<0.01, ** p<0.05, * p<0.1.