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The origins of (a culture of) cooperation

Giacomo Benati[1], and Carmine Guerriero[2,*]

[1]University of Barcelona, Barcelona, 08014, Spain
[2]University of Bologna, Bologna, 40126, Italy

*Corresponding author: E-mail: c.guerriero@unibo.it

ABSTRACT

We study an investment setting involving time-inconsistent elites and non-elites. The latter embrace norms that provide an intrinsic return on cooperation and may switch to a risk-sharing activity yielding a higher marginal intrinsic return. A more severe consumption risk and/or a smaller investment return increase the profitability of risk-sharing and, in turn, foster cultural accumulation. A limited investment payoff, instead, pushes the elites to enact an inclusive political process to incentivize the non-elites and the latter to reciprocate with strong norms signaling cooperation despite its limited return. These predictions are consistent with data on 44 Mesopotamian polities observed between 3050 and 1750 BCE. While the diffusion of interest-free loans of agricultural products and major irrigation infrastructures was negatively related to the harvest value, the spread of formal merchant institutions was linked to the distance to the trade circuits. Moreover, major irrigation projects were implemented where the climate was more erratic (*JEL* H10, O13, P00, Z10).

No man is an island entire of itself; every man is a piece of the continent, a part of the main.
John Donne, *Devotions upon Emergent Occasions*, Meditation XVII.

1. INTRODUCTION

Vast evidence suggests that a culture of cooperation is the key engine of economic progress (Nowak 2006; Tabellini 2008; Guerriero 2020). Yet, our understanding of its determinants is mainly confined to the well-known correlations between present-day norms and the past experience with an inclusive political process (Putnam et al. 1993; Boix and Posner 1998; Tabellini 2010; Guiso et al. 2016) and/or fierce environmental shocks (Nunn 2020). Contrary to such institutional persistence approach, ecological anthropology has linked past environmental shocks to sudden changes in past cultural norms (Varnum and Grossmann 2017), and a recent literature on state formation and evolution—i.e., state building—has documented a strong negative link between past climate shocks and the inclusiveness of coeval political institutions (Benati et al. 2022). Inspired by this last body of research, we propose to clarify the complex interplay among ecological factors, political institutions and culture by developing a "time inconsistency" theory of the determinants of both state-building and cultural accumulation, and testing its empirical implications on a novel data set of the first formal and informal institutions recorded in Bronze Age Mesopotamia.

Initially characterized by limited social interactions, these societies witnessed, from the mid Holocene period (4500 BCE) on, mounting ecological pressures easing the transfer of assets and decision-making power to rising religious and military groups. These ranks possessed the organizational skills necessary to convince the farmers to participate in the realization of canals and public infrastructure as well as in risk-sharing in exchange for tenured land (Brooke 2014). Not only did these agreements support unprecedented forms of broad cooperation, such cities and states (Henrich et al. 2010; Boix 2015; Palmisano et al. 2021; Dow and Reed 2023), but they also pushed the peasants to embrace norms of cooperation, especially strong where the climate was more erratic (Liverani 2006). Similarly, the even harsher conditions of the beginning of the second millennium, together with the mass diffusion of metals, favored the expansion of long-distance exchanges as an alternative to farming and prompted the religious and military ranks of the polities most interested in incentivizing trade, given its limited potential, to share power with merchant guilds (Postgate 1992). The latter, in turn, spread norms of cooperation in trade (Palmisano 2018).

To elucidate the rational incentives behind these epochal events and provide a general model of the selection of political institutions and cultural norms, we study the interaction between a representative "elite" and a representative "non-elite." While the elite gathers the agents with control over scarce resources and the institutional design, the non-elite is composed by the initially rightless citizens (see footnote 9). Elite and non-elite can cooperate in a joint investment, e.g., farming and/or long-distance trade innovation. The investment delivers a valuable output only if the non-elite exerts a costly effort, and the output value is larger the more favorable are the production conditions. As justified in Section 2, the elite keeps the untaxed output and can neither punish the non-elite nor commit to direct transfers to garner his cooperation.[1] She can, however, incentivize investment by granting an inclusive political process, which entrusts to the non-elite the power to select the tax rate and organize public good provision. As for the non-elite, he can embrace, at a quadratic cost, cultural norms assuring him of an intrinsic return on cooperating in either investment or an alternative consumption risk-sharing activity. The return on cooperative risk-sharing increases with the severity of the factors amplifying consumption risk, is only intrinsic and thus is larger, at the margin, than the intrinsic gain from a cooperative investment.

As Tabellini (2008), we define a "culture of cooperation" as the intrinsic reward from cooperating in economic activities. Since, moreover, we prove that equilibrium norms constitute evolutionarily stable strategies that will then invade the entire population, our approach is strategically consistent with the inter-generational transmission of preferences for actions studied by Bisin et al. (2024) and the selection of beliefs about equilibrium plays discussed by Greif (1994).[2] Different from these alternatives, however, our mechanism explicitly links production conditions to equilibrium norms and allows for sudden cultural changes.

When the investment return is tiny, the non-elite opts for risk-sharing and accumulates the culture maximizing the relative payoff. When, instead, investment becomes sufficiently more appealing than risk-sharing and thus, the elite's time inconsistency issues are severe but not insurmountable, the non-elite picks the more complex investment activity and

[1] We label the elite with "she", the non-elite with "he" and a generic party with "it."
[2] Accordingly, we indistinguishably refer to either the "accumulation" or the "selection" of cultural norms.

cooperates with the elite provided that his political rights are strong and he has accumulated the norms maximizing the intrinsic reward from investment. These are weaker than the cultural levels embraced under risk-sharing. While the inclusive political institution allows the non-elite to fully tax the output and produce his preferred public good, a strong cultural accumulation becomes a commitment device since it credibly signals the non-elite's cooperation despite its limited return. When, finally, the investment return is large, the elite elicits cooperation in investment under autocracy and the non-elite accumulates the optimal culture of cooperation in investment. Ultimately, the non-elite's cultural accumulation is stronger the smaller is the investment return and the more severe is consumption risk.

We evaluate the model implications by analyzing a panel of 44 major Mesopotamian polities spanning each half-century between 3050 and 1750 BCE. Compared to similar databases on pre-industrial and industrial societies (de Oliveira and Guerriero 2018; Guerriero and Righi 2022; Benati and Guerriero 2024), our sample is uniquely fitted to test our theory for three key reasons. First, since the maximum distance between the cultivated fields and the center of the city around which a polity evolved was 30 km (Wilkinson 2003), our data set displays a very large—over a millennium long—panel variation on units demarcated by well-defined, narrow, and stable boundaries and entertaining in economic activities sufficiently simple to credibly link exogenous environmental features to institutions. Crucially, we accurately measure the latter by relying on the universe of sources on the institutional evolution of the best recorded ancient society (Benati et al. 2022).[3] Second, our sample is characterized by epochal episodes of climate change included the 4.2 ka BP megadrought (Weiss 2017). Finally, it is unaffected by major cultural models, like mass education or "Big God" religion, obfuscating the impact of environmental shocks (Turchin et al. 2023).

Lacking credible data on past land suitability, we proxy the return on farming investments with a normalized Storie index multiplying an inverted U-shaped rating curve for temperature and an inverted U-shaped rating curve for rainfall, both averaged over a 30 km radius around each polity and the previous half-century. Conditional on its two components, the index captures climate extremes, which are the most relevant predictors of yield anomalies (Vogel et al. 2019), and it is, in fact, strongly positively correlated with coeval cereal and especially, barley yields in liters per hectare collected from administrative cuneiform texts.

Turning to the return on long-distance trades, we consider the inverse distance between each polity and the Old Babylonian and Old Assyrian trade networks, which channeled the unprecedented exchanges that emerged after the 2000 BCE mass diffusion of metals.

Regarding consumption risk, we rely on the normalized first principal component extracted from two measures of temperature and precipitation seasonality.

For what finally concerns the non-elites' intrinsic reward from cooperating in either risk-sharing or investment, we employ three outcome-based measures. Starting from the intensity of cooperative risk-sharing, we focus on the share of previous half-century during which the institutionalized decision-makers organized microcredit activities in the form of interest-free loans of agricultural products (Hudson 2002; Notizia 2022). This was the main management strategy developed over the sample to tackle agricultural risk (Marston 2011: 191). Turning to the intensity of cooperative investments, we construct proxies for the spread of farming and long-distance trade innovations. We capture the former with the share of previous half-century during which major irrigation works were implemented and the latter with a dummy for the existence over the same period of a formal merchant institution. While the

[3] While the archaeological sources have been gathered by the thousands of campaigns conducted in the last two centuries, the primary sources are collected from the best-preserved corpus of ancient writing (Barjamovic 2013: 120–122), which encompasses hundreds of thousands administrative and legal clay tablets.

excavation and maintenance of artificial canalization were the key infrastructural projects organized as public-private partnerships by elites and tenured farmers as part of the tenure-for-service contract (Rost 2017: 11–12), merchant institutions diffused norms of cooperation in trade by easing exchange innovations, i.e., linking faraway markets, settling legal disputes and offering trade-related financial services (Postgate 1992; Palmisano 2018).

Ultimately, the key assumption underlying our measurement approach is that, conditional on a battery of proxies for unobservable and observable extrinsic motivations—i.e., fixed effects, inclusiveness of the political process, public good provision, severity of conflicts, degree of environmental and institutional circumscription, economic development, irrigation intensity and political instability, our measures of cooperation are mainly driven by culture.

Conditional on polity and time fixed effects, the diffusion of interest-free loans of farming products and major irrigation projects is negatively related to the harvest value, and the spread of formal merchant institutions is positively linked to the distance to the trade circuits. Moreover, major irrigation works were completed where the climate was more erratic.

While these basic estimates are consistent with our predictions, they may be capturing reverse causality, measurement error and/or unobserved heterogeneity. As illustrated in Section 5.4 and the Supplemental Appendix, we evaluate these issues in turn by: (a) confirming that all our regressors are independent from human decisions; (b) either employing alternative measures of cooperative risk-sharing—i.e., diffusion of foodstuff storage activities, interest rate controls and non-commercial debt cancellation—or turning to different proxies for the return on farming and/or risk-sharing; (c) controlling for the aforementioned measures of the extrinsic motivations to cooperate and documenting that our conclusions remain unaffected. Similarly, our results are unchanged when we switch to a panel difference-in-differences design, in which we compare polities experiencing more severe climate shocks, to polities experiencing less severe climate shocks, before and after these ecological fluctuations.

We contribute to the literature on state-building and cultural formation in four key ways.

First, we construct a first general model of how the factors amplifying the elites' time inconsistency issues and the forces magnifying the non-elites' consumption risk shape the inclusiveness of the political process and the non-elites' cultural accumulation and how these institutional arrangements interact.[4] In this perspective, our analysis is complementary to that developed by Benati et al. (2022), who evaluate the untested part of our model by documenting how adverse climate shocks encouraged reforms toward more inclusive political institutions and, in turn, a larger provision of the public goods preferred by the non-elites.

Second, our estimates qualify the meaning of the correlations between pre-industrial environmental shocks and present-day cultural norms documented by the institutional persistence literature. While Buggle and Durante (2021) link medieval climate risk with present-day trust, Giuliano and Nunn (2021) estimate negative correlations between pre-industrial climate volatility and present-day preferences for traditional norms. Different from these empirical contributions, we embrace a theory-based econometric approach, which identifies the determinants of past cultural norms and thus, allows us to escape the "compression of history" trap (Austin 2008; Arroyo Abad and Maurer 2021).

Third, our results on the interplay among environmental factors, institutions and cooperation resemble those discussed by a related strand of literature on institutional formation in ancient societies (Mayshar et al. 2017; Allen et al. 2023; Mayoral and Olsson 2025).

[4] Boranbay and Guerriero (2019) study the specific environment in which investment must fail under autocracy.

Different from us, however, this body of research does not explicitly recognize the roles of the elites' lack of commitment and the non-elites' risk-sharing needs.

Finally, we provide the first evidence on the ability of ancient societies to devise a complex mix of inclusive political institutions, forceful culture and strong fiscal capacity to adapt to the consequences of climate change (Benati and Guerriero 2021, 2023).[5]

The paper proceeds as follows. In Section 2, we discuss our general theory of endogenous (in)formal institutions, illustrating its predictions in Section 3. Next, we first report in Section 4 anecdotal evidence on Bronze Age Mesopotamia consonant with these implications and then, we describe in Section 5 our empirical test. Finally, we conclude in Section 6, and we report figures and tables (data construction and extra tables) in the (Internet) appendix.

2. THEORY

2.1 The economy

We evaluate the interaction between a representative elite and a representative non-elite, who can cooperate in a joint investment, e.g., either a farming or a long-distance trade innovation. The investment delivers an output of value $V > 0$ only if the non-elite exerts an effort costing $\gamma > 0$. V is larger the more favorable are the production conditions, e.g., the milder is the climate and the more accessible are the trade circuits.

2.2 Cultural accumulation

By incurring a quadratic cultural accumulation cost $c^2/2$, the non-elite gains an intrinsic return c from cooperating in investment and an intrinsic reward τc from cooperating in an alternative risk-sharing activity.[6] τ picks the factors amplifying consumption risk—e.g., climate volatility, and is larger than 1. This last assumption is justified by the fact that risk-sharing is a less complex economic activity, which does not require a partner with complementary inputs—i.e., the elite, does not produce a taxable output and entirely hinges on the non-elite's intrinsic motivations. A case in point is an interest-free loan of agricultural products, which did not need any initial capital by the elite, supported subsistence farming only and rested on the peasants' goodwill (Hudson 2002).

Assuming that the non-elite directly selects the psychological gain from cooperating captures two key insights of Malthusian growth theories and evolutionary psychology (Boranbay and Guerriero 2019). First, a social group dictates to its members norms maximizing its fitness via vertical, oblique and horizontal transmission channels (Barkow et al. 1992; Clark 2005). Second, these values are stronger the larger the culturally-driven advantage is (Nowak 2006). More generally, the equilibrium culture c^* is an evolutionarily stable strategy being also a strict subgame perfect equilibrium (Maynard Smith and Price 1973). Accordingly, it will invade the entire non-elite's group even if experimented by a minority of households.[7]

2.3 Political process

We maintain that the elite cannot entice the non-elite by either punishing him or committing to direct transfers, but she can enact an inclusive political institution granting him the power to fix the tax rate and guide public good provision (Boranbay and Guerriero 2019; Benati et al. 2022). Under autocracy, both decisions are taken by the elite. The index $r \in \{A, I\}$ picks

[5] Because of the lack of an appropriate measurement and empirical strategy, the only previous formal attempts to study this resilience mechanism have found no significant evidence (Turchin et al. 2023).

[6] In our linear environment, risk aversion can be interpreted as the existence of another state of the world producing an expected utility lower than the certain scenario of no cooperation (Guerriero 2023).

[7] Andersen et al. (2017) propose a similar argument, building on a replicator dynamics equilibrium concept.

the political institution, i.e., A for autocracy and I for the inclusive political regime. Public good provision has a technology linear in the tax revenues $g_r = V\delta_r$, and a supply g_r of public good delivers a sub-utility ρg_r to the group selecting δ_r and a sub-utility βg_r to its partner. We impose the following restriction: $0 < \beta < \rho < 1$.

While $\rho < 1$ entails that the public good is less valuable than the private one, $\beta < \rho$ captures the degree of heterogeneity in the groups' preferences for the common goods and/or their lower ability to provide the public good favorite by a partner.[8] In our sample, the non-elite preferred the participation in a conscripted army over the construction of public and ritual buildings, and the elite displayed opposite preferences (see Section 4).

2.4 Payoffs

All agents are risk neutral and have an outside option that we normalize to zero. Notably, the elite's payoff from investment π_r equals the untaxed output value plus the public good consumption payoff, i.e., $\pi_A = (1-\delta_A)V + \rho\delta_A V$ and $\pi_I = (1-\delta_I)V + \beta\delta_I V$. The non-elite's ex ante utility from investment—i.e., U_r—is, instead, given by the intrinsic reward on cooperating net of the cultural accumulation cost plus the public good consumption payoff net of the effort cost—i.e., $U_A = c^* - \frac{(c^*)^2}{2} + \beta\delta_A V - \gamma$ and $U_I = c^* - \frac{(c^*)^2}{2} + \rho\delta_I V - \gamma$, whereas his ex ante utility from sharing consumption risk equals $\tau c^* - \frac{(c^*)^2}{2}$.

2.5 Timing

At time t_0, the non-elite accumulates culture. At time t_1, the elite picks the political regime. At time t_2 and under autocracy (the inclusive political regime), the elite (non-elite) selects the tax rate δ_A (δ_I). At time t_3, the non-elite chooses between investment and risk-sharing and the elite decides whether to invest. At time t_4, either risk is shared or private and public goods are produced. Next, the payoffs are realized.

2.6 Discussion

In evaluating our setup, several remarks should be borne in mind.

First, group formation should be seen as driven by unforeseen military and technological shocks endowing the non-elite with skills complementary to those of the elite and leaving to the latter the control over resources and institutional design (see the Supplemental Appendix).[9]

Second, as Boranbay and Guerriero (2019) and Benati et al. (2022), we maintain that the elite keeps control and transfer rights to the input, leaving to the non-elite only the use rights. Hence, she retains the untaxed output. Albeit this assumption captures, for instance, the distribution of property rights over our sample and the fact that the elites appropriated most of the output (Steinkeller 1999: 290; Cripps 2007: 11–22; Garfinkle 2013a: 112–113), we can relax it (see footnote 14 and Benati et al. 2022).

Third, the elite might embrace the stick instead of sharing her power to incentivize the non-elite (Mayshar et al. 2017). Yet, this strategy would be ineffective since the elite cannot always garner the non-elite's participation (Benati et al. 2022). Accordingly, culture is unaffected by conflicts in our sample (see Section 5.4 and Benati and Guerriero 2022).

Fourth, the hypothesis that the elite lacks the commitment to write contracts with the non-elite builds on a long literature on the time inconsistency issues inherent to politics (North and Weingast 1989; Barzel and Kiser 1991; Acemoglu and Robinson 2000;

[8] Implicitly, we also assume that elite cannot commit to contract away the inefficiency of public good provision.

[9] In Bronze Age Mesopotamia, the elites "were the landholders during the urban revolution period, religious ranks during the proto- and city-states periods and the temples and palaces during the kingdoms and empires periods, whereas (the non-elites were) the temples during the urban revolution period, military ranks during the city-states period and merchants during the empires period" (Benati and Guerriero 2022: 34–35).

Boranbay and Guerriero 2019), and it is justified in our case by the fact that contractual agreements were enforced by courts controlled by the same elite promising not to renege on future transfers (Acemoglu 2003).[10] We assume, instead, that the group in power can always commit to a tax policy. While this assumption is irrelevant in the case of the inclusive political regime since the non-elite would never deviate from full-taxation, it can be justified in the case of autocracy by foreseeing that the non-elite can impose a large punishment ζ on an elite deviating to her preferred zero tax level by rising up and/or refusing to fight against external enemies (Acemoglu 2003).[11] In our sample, the second threat was significantly more credible than the first one since all major revolts ended up in mass murder (Yoffee and Seri 2019), whereas conscription was not only crucial for self-defense but it also constituted a key element of the tenure-for-service contract (see Section 4). More generally, our analysis will stand should we assume that $(\rho-\beta)g_r$ is the share of output expropriated or redistributed by the group in power, should we let the elite commit to direct transfers or should we allow her to offer a high-powered contract (see footnote 14). Hence, our assumptions on the asymmetry in the preferences, ability and property rights of the two groups are mild.

Finally, our results will remain similar should we allow the decision-maker to select the type of public good and the elite to accumulate culture (Boranbay and Guerriero 2019).

2.1.1 Endogenous cultural accumulation

We solve the game by backward induction. A non-elite opting out of investment obtains an interim—at time t_3—payoff of τc^* and an ex ante—at time t_0—utility of $\tau c^* - \frac{(c^*)^2}{2}$. Then, he accumulates $c^* = \tau$, which entails an ex ante (interim) payoff of $\tau^2/2$ (τ^2).

Once the inclusive political process has been embraced, a non-elite foreseeing to participate in investment maximizes his net utility by redistributing via public spending the production value, subject to granting the elite a non-negative payoff. Since the elite's utility under full taxation is $\beta V > 0$, the non-elite can pick $\delta_I^* = 1$ and obtain an ex ante utility of $c^* - \frac{(c^*)^2}{2} + \rho V - \gamma$ and an interim payoff of $c^* + \rho V - \gamma$, implying the interim participation constraint $c^* + \rho V - \gamma \geq \tau c^* \leftrightarrow V \geq \frac{\gamma + (\tau-1)c^*}{\rho} \equiv \hat{\Omega}(c^*)$. At time t_0 and for $V \geq \hat{\Omega}(c^*)$, the non-elite maximizes his ex ante utility by choosing between norms optimal under cooperative investment—i.e., 1—and τ.[12] The former is preferred if $\frac{1}{2} + \rho V - \gamma \geq \frac{\tau^2}{2} \leftrightarrow V \geq \frac{\gamma + \frac{\tau^2-1}{2}}{\rho} \equiv \underline{\Omega}$. Since $\frac{\tau^2-1}{2} > \tau - 1$, $\underline{\Omega} > \hat{\Omega}(1)$. Ultimately, for $r = I$, the non-elite picks $c^* = 1$, $\delta_I^* = 1$ and investment for $V \geq \underline{\Omega}$, and she selects $c^* = \tau$ and risk-sharing otherwise.[13]

After having kept autocracy, the elite selects a δ_A maximizing the linear utility function

$$\max_{\delta_A \in [0,1]} \quad (1-\delta_A)V + \rho \delta_A V, \tag{1}$$

subject to satisfying all participation constraints. Since the elite favors private to public good consumption, she would pick a tax rate $\hat{\delta}_A = \frac{\gamma + (\tau-1)c^*}{\beta V}$ such that the non-elite's interim participation constraint binds. Given this tax policy, the non-elite prefers to accumulate a culture τ and share risk over picking $c^* = 1$ and investing since $\frac{1}{2} + \beta \hat{\delta}_A V - \gamma < \frac{\tau^2}{2}$ being $\frac{\tau^2-1}{2} > \tau - 1$. Hence, the elite selects instead a $\delta_A^* = \frac{\gamma + \frac{\tau^2-1}{2}}{\beta V} \leq 1$ such that, in t_0, the non-elite

[10] Only at the beginning of the second millennium BCE, courts started to be populated by elders, merchants and other representatives of the non-elite (Westbrook 2003: 365–368; Wilcke 2007: 35–41).

[11] To elaborate, a $\zeta > V - \pi_A$ will suffice. Similarly, the elite could also renege on her time t_1's regime choice. If she reinstated autocracy at time t_2, the non-elite would then switch to risk-sharing. If, instead, the elite could take her power back at time t_3, the non-elite could discourage this move by imposing a $\zeta > V - \pi_I$.

[12] $c^* = 0$ is impossible since selecting $c^* = \tau$ and sharing risk bring to the non-elite an ex ante payoff of $\frac{\tau^2}{2} > 0$.

[13] The non-elite will never deviate to $c^* = 1$ whenever $\hat{\Omega}(1) \leq V \leq \underline{\Omega}$ since $\frac{\tau^2-1}{2} < \tau^2 - \tau$.

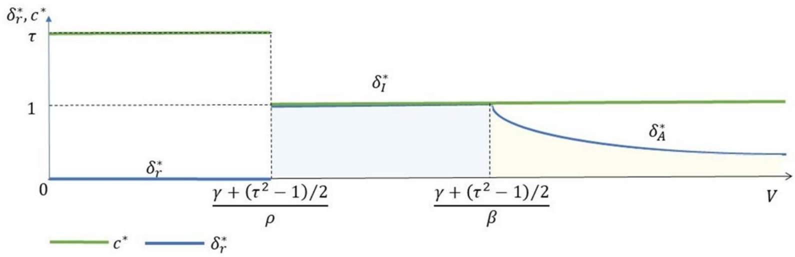

Figure 1. Endogenous cultural accumulation.*Note*: The figure depicts the optimal levels of both a culture of cooperation c^* and the tax rate δ_r^* as a function of the output value V and under the following parameter restrictions, i.e., $\gamma = 0$, $\tau = 2$, $\rho \to 1$ and $\beta = 1/2$.

is indifferent between accumulating $c^* = 1$ to invest and embracing an intrinsic reward τ to share risk if $V \geq \frac{\gamma + \frac{\tau^2 - 1}{2}}{\beta} \equiv \bar{\Omega}$, with $\bar{\Omega} > \underline{\Omega}$. For $V \geq \bar{\Omega}$, $\pi_A = (1 - \delta_A^*)V + \rho\delta_A^* V$ is larger than the elite's payoff under the inclusive political regime—βV—and autocracy prevails.

Ultimately, in a world of inefficient public good provision, the elite prefers to direct fiscal policies and pick a tax rate falling with the output value if faced with mild time inconsistency issues, i.e., $V \geq \bar{\Omega}$ (see Figure 1). When, however, her time inconsistency issues become severe but not overwhelming—i.e., $\underline{\Omega} \leq V < \bar{\Omega}$, only a reform toward the inclusive political regime, combined with the non-elite's accumulation of a culture maximizing his investment payoff, makes possible cooperation.[14] Crucially, cultural accumulation relaxes the non-elite's participation constraint, allowing his credible commitment to cooperation despite the limited payoff from public good provision. Interestingly, such a "commitment dimension of cultural accumulation" would even induce the non-elite to consider norms of cooperation stronger than the full-cooperative level $c^* = 1$ when investment always delivers a payoff larger than the return on risk-sharing and it is feasible only under the inclusive political regime (Boranbay and Guerriero 2019).[15] When, finally, the investment return is tiny—i.e., $V < \underline{\Omega}$, the non-elite opts for risk-sharing and picks a culture maximizing its payoff. Notably, a larger marginal return on risk-sharing τ discourages investment—i.e., increases $\underline{\Omega}$—and makes the inclusive political institution more necessary to support cooperation, i.e., raises $\bar{\Omega} - \underline{\Omega}$.

The following proposition summarizes the key implications of our analysis:

Proposition: *For* $0 < \beta < \rho < 1 < \tau$ *and: 1.* $V < \frac{\gamma + \frac{\tau^2 - 1}{2}}{\rho}$, *the non-elite accumulates a culture* τ *and shares risk under any regime r; 2.* $\frac{\gamma + \frac{\tau^2 - 1}{2}}{\rho} \leq V < \frac{\gamma + \frac{\tau^2 - 1}{2}}{\beta}$, *the elite enacts the inclusive political regime, whereas the non-elite picks a culture* $c^* = 1$, *selects the maximum tax rate* $\delta_I^* = 1$ *and invests; 3.* $V > (=) \frac{\gamma + \frac{\tau^2 - 1}{2}}{\beta}$, *the elite keeps the autocratic regime and selects* $\delta_A^* = \frac{\gamma + \frac{\tau^2 - 1}{2}}{\beta V} < (=) 1$, *whereas the non-elite accumulates* $c^* = 1$ *and invests.*

3. EMPIRICAL IMPLICATIONS

The model implications can be restated as testable predictions as follows:

[14] In an institutional vacuum, the elite can entice the non-elite only by credibly committing to transfers. Then, she would offer εV, with $\varepsilon > \beta$, as either a direct transfer or a sharecropping contract. This payment induces cooperation for $\frac{\gamma}{\varepsilon} < V < \bar{\Omega}$. When both transfers and inclusive institutions are available, an elite willing to invest will use them for $\frac{\gamma}{\varepsilon} < V < \underline{\Omega}$ and $\varepsilon > \rho$ since they are inferior to any public good consumption.

[15] This option—i.e., $\hat{c} = \frac{\gamma - \rho V}{1 - \tau}$—satisfies the non-elite's interim participation constraint and his less restrictive ex ante participation constraint for $V < \hat{\Omega}(1)$, but it is not an equilibrium since $\hat{c} - \frac{\hat{c}^2}{2} + \rho V - \gamma = \tau\hat{c} - \frac{\hat{c}^2}{2} < \frac{\tau^2}{2}$.

Testable predictions: *The non-elite's cultural accumulation is stronger the smaller is the investment return and the more severe is consumption risk.*

4. STATE AND CULTURE IN BRONZE AGE MESOPOTAMIA

We start our test of the model predictions by analyzing the economic and institutional evolution of Mesopotamia over the Early and Middle Bronze Age. Consonant with our model, drops in the returns on farming and/or long-distance trade forced the elites to grant strong non-elites' political rights [**a**] and the non-elites to gain strong norms of cooperation [**b**]. Moreover, larger consumption risk incentivized cultural accumulation [**c**].

4.1 Urban revolution (3800–3300 BCE) and proto-states (3300–3100 BCE) periods

Initially characterized by limited hierarchy, low population density and only basic forms of production and exchange (Liverani 2014: 44), Mesopotamia developed the first forms of stable state institutions (Liverani 2014: 43–45).[16] To illustrate, the drying up of the later 4th millennium induced the collapse of the urban sites in Upper Mesopotamia and encouraged the reclamation of the marshy Alluvium (Liverani 2014: 53–61; Riehl et al. 2014: 3).

While, indeed, Upper Mesopotamia enjoyed rainfall sufficient to rely on rain-fed-based farming operated over the flat tablelands around each settlement (Hole 1994: 137), the scarcity of precipitation, together with its mismatch with the agricultural cycles, magnified in Lower Mesopotamia the returns on artificial irrigation and, in turn, the organizational skills necessary for its construction and maintenance (Brooke 2014: 203). These precious inputs were provided by priestly leaders, who established themselves as the first institutionalized decision-makers (Hole 1994: 138–139; Steinkeller 2019: 113). At first, they transferred increasingly large estates from the landholding groups and communal ownership to their households and allotted them to specialized workers in exchange for services and/or a share of the produce (Englund 1998: 176–181; Liverani 2014: 51–69). Next, they extended their control over vital public tasks like supporting local economic activities, gathering taxes and overseeing the first large-scale infrastructural projects and, notably, the construction of an extended canal system [**a**]. Such an endeavor was completed by the mid of the third millennium, directed the winter rains and the spring snow coming from the Iranian and Turkish mountains toward the South, and made possible irrigation-based farming on the outer slopes of the levees of the great rivers (Hole 1994: 138; Wilkinson and Hritz 2013: 23; Garfinkle 2013a: 100; Widell et al. 2013b; Liverani 2014: 65–67, 93, 232; Wilkinson et al. 2015; Rost 2017). While doing so, the temples also proposed norms of cooperation [**b**], which were accepted as expression of gratitude to "a super-human entity […] essential for the survival of the community" (Liverani 2006: 63) and were particularly welcome where consumption risk was severe [**c**]. In these locations, the religious ranks favored cooperation by organizing key risk-sharing activities, i.e., fostering inter-city cultic interactions, supervising scribal training, storing foodstuffs and regulating dispute adjudication, interest rates and commodity prices (Monaco 2012; Matthews and Richardson 2019).

4.2 City-states period (3100–2550 BCE)

The 3200–2850 BCE droughts significantly reduced the returns on farming in the Alluvium (Liverani 2014: 89; Ristvet 2017: 38–40), pushing the religious ranks to share their power

[16] "Lower" ("Upper") Mesopotamia gathers the regions of Southern (Northern) Iraq and Southwestern Iran (Northern Israel, Northeastern Syria, and Southeastern Turkey) (Liverani 2014, table 1.1). Furthermore, we label with proto(city)-states era the Late Uruk (Jemdet Nasr and Early Dynastic) period(s) and with kingdoms (empires) era the Pre-Sargonic (Akkadian, Ur III and Old Babylonian) period(s).

with a rising military class [**a**], who had left the temple to establish the "palace" under the authority of kingly figures (Staubwasser and Weiss 2006: 379–380; Marchesi and Marchetti 2011: 90–100; Garfinkle 2013a: 108–110; Steinkeller 2019: 122–123). These palatial households succeeded in involving a larger share of the population in farming by offering leasing and renting contracts as well as tenure-for-service—i.e., "šŭku"—agreements eventually more appealing than those proposed by the temples (Cripps 2007: 12–20). Not only did the conscripted farmers participate in the realization of valuable public projects [**b**], such as fortifications (Rost 2017: 10), but they also gained unique risk-sharing benefits [**c**], i.e., access to irrigation facilities, draft animal power and food, in times of peace, and to the booty after military victories (Richardson 2011: 17–36; Wilkinson et al. 2015: 413; Steinkeller 2018: 10–11; Sallaberger 2019). The farmers' involvement in both activities diffused "ideologies of common participation" (Yoffee 2005: 17–39) intended as a set of shared values supporting the political structure of the state. In Upper Mesopotamia, instead, the milder but volatile post-2700 BCE climatic conditions favored the rise of extended royal families supported by both religious ranks and elders' councils [**a**] (Archi 2015: 570–591; Ristvet 2017: 40), the intensification of public good provision [**b**] (Rost 2017; Steinkeller 2019) and the spread of the first communal large-scale food storage facilities [**c**] (Vacca 2020: 314–316).

4.3 Kingdoms period (2550–2350 BCE)

Thanks to the mix of intensified warfare and milder climatic conditions, the royal households imposed their political supremacy by limiting the temples' ability to tax and enslave their debtors in the South and by curbing the power of the religious ranks and elders' councils in the North [**a**] (Liverani 2014: 99–122). Following the post-2450 BCE rise in climate volatility, moreover, not only did canal construction take-off (Rost 2017: 10–12), but both debt cancellation edicts and interest rate regulation were implemented [**c**] (Wilcke 2007: 21–25). The goal of these reforms was to "reunify nuclear families separated [by] imprisonment for debt [and] debt bondage" (Wilcke 2007: 21). By committing to forego debts and assist the needy, the institutionalized decision-makers sustained a steady pool of warriors and farmers, ultimately building a culture of cooperation [**c**] (Sterba 1976; Hudson 2002: 29–31; Richardson 2012; Everest-Phillips 2019: 60). The even more severe increase in climate risk in the North also fueled the organization of centralized storage emplacements easing "[risk-]sharing, mutual aid, the fostering of community, and the cementing of social bonds" [**c**] (Paulette 2015: 31).

4.4 Empires period (2350–1750 BCE)

After having consolidated their control over Lower Mesopotamia, the Akkadian kings conquered large portions of the Fertile Crescent (Sallaberger and Schrakamp 2015: 105–112; Steinkeller 2020: 46–47). The Southern city-states were—at least at first—left to local rulers in exchange for tributes. The Northern polities, instead, were managed by governors appointed by the king and assisted by royal functionaries and local religious households [**a**] (Steinkeller 2020: 47–51). Such an institutional arrangement was, however, fragile, and the cold, dry and volatile climate that hit Greater Mesopotamia between 2200 and 1900 BCE favored the emergence between 2120 and 2000 BCE of the Ur III kingdom, which was divided in core provinces controlled by co-opted governors and peripheral regions administered by crown functionaries [**a**] (Wilcke 2007: 70–72; Garfinkle 2013b; Cookson et al. 2019; Steinkeller 2020: 54–67). Meanwhile, canalization was intensified [**b**] (Rost 2017: 11–14). Eventually, the Ur III kings were defeated by the semi-nomadic Amorites, which extended between 2000 and 1850 BCE their control over competing polities (Yoffee 2005: 145–146; Liverani 2014: 175–181; Ristvet 2017: 49). To manage the quarrelsome landscape, the Amorites negotiated with tribal leaders and councils of elders [**a**] (Fleming

2004: 33, 75; Ziegler 2008: 50; Liverani 2014: 224). Moreover, they started to accommodate interest-free barley loans to tenured farmers via the "še-ur5-ra"—i.e., barley loan—system and to issue decrees relieving debts and regulating interest rates [**b**, **c**] (Hudson 2000, 2002; Renger 2002; Richardson 2012; Simonetti 2013; Notizia 2022). These policies helped the farmers escape indebtedness and commit to cooperation (Adams 2009; Richardson 2012: 33–43; Richardson 2016: 751–753).

The mix of falling farming return and rising climate volatility, together with the mass diffusion of metal tools, prompted, from 2000 BCE on, the emergence of a new exchange landscape around the Old Assyrian network, which traded textiles and tin for precious metals between Ashur and Kanesh, and the Old Babylonian network, which exchanged metals for textiles between Shush and Hazor (Liverani 2014: 163, 190, 212–218; Barjamovic 2018: 121–125). Different from the third millennium trade circuits, which were organized by agents of the institutionalized decision-makers and merchant families, the second millennium trade networks were dominated by private entrepreneurs, which were able to accumulate, for the first time, increasing political power (Van De Mieroop 2015: 89–92; Barjamovic 2018: 128; Yoffee and Barjamovic 2018: 816). To illustrate, temple and palatial ranks of the polities most interested in fostering long-distance trades because part of the less dense junctions of the trade circuits—i.e., Ashur, Emar and Tuttul—started to provide trade-related public goods—i.e., secure trade routes and inter-polity exchange treaties—and substitute the Ur III administrators with merchant guilds [**a**] (Postgate 1992: 221; Garfinkle 2010: 186–193; Van De Mieroop 2015: 89–92; Barjamovic 2018: 123–128; Palmisano 2018: 22). Under the auspices of the institutionalized decision-makers, these groups organized themselves around formal institutions, such as karums, port authorities and merchant courts, which, in turn, fostered norms of cooperation in exchange by coordinating trade innovations, i.e., linking trade nodes, settling trade-related disputes and offering financial services [**b**] (Postgate 1992: 218–221, 300; Palmisano 2018: 22). This revolution was completed under the Old Assyrian kingdoms that dominated Upper Mesopotamia during the dry 1950–1780 BCE period and the Isin-Larsa and Old Babylonia kingdoms that ruled Lower Mesopotamia over the harsh 2017–1763 BCE period (Liverani 2014: 192–218). These polities expanded public good provision and adopted edicts remitting debts and abolishing debt-based slavery [**b**, **c**] (Westbrook 2003: 362–407; Richardson 2011: 21–32; Liverani 2014: 187–188).

Only the unifying conquests of Hammurabi (1810–1750 BCE) hampered these dynamics by transferring power from temples and merchants to the palace (Liverani 2014: 242).

5. EVIDENCE

Albeit anecdotal evidence is informative, empirical evidence is usually more convincing. We focus then on the major Mesopotamian polities, which are best documented for each half-century between Early Bronze Ages I-IV and the Middle Bronze Age I (Liverani 2014, table 1.1), i.e., 3050–1750 BCE (while the names of these cities and the corresponding present-day archaeological sites are reported in Table 1, their locations are displayed in Figure 2).[17] To elaborate, we select the 44 polities for which information on their institutional evolution is sufficiently detailed and that evolved around one single city (Westenholz 2002: 26), whose location is sufficiently certain and whose settled area was larger than five hectares for most of the 3050–1750 BCE period (see for details the Supplemental Appendix). Crucially, sample selection does not seem to be an issue since the estimates of an Heckman model, run on a sample encompassing our 44 cross-sections plus other 39

[17] These are collected from the Ancient Near East Placemarks available at https://zenodo.org/record/6384045

Table 1. Major Bronze Age Mesopotamian polities and hydro-climatic records.

Polities: RAIN-FED FARMING: Abarsal (*Tell Khuera*), Alalakh (*Tell Atchana*), Ashnakkum (*Chagar Bazar*), Ebla (*Tell Mardikh*), Emar (*Tell Meskene*), Gasur (*Yorgan Tepe*), Gubla (*Byblos*), Hama (*Hama*), Harran (*Harran*), Hazor (*Hazor*), Kahat (*Tell Barri*), Kanesh (*Kultepe*), Karkemish (*Karkemish*), Nabada (*Tell Beydar*), Nagar (*Tell Brak*), Qatna (*Tell Mishrifeh*), Qattara (*Tell Rimah*), Shashrum (*Tell Shemshara*), Shubat-Enlil (*Tell Leilan*), Tuba (*Umm el-Marra*), Ugarit (*Ras Shamra*), Urbilum (*Erbil*), Urkesh (*Tell Mozan*). IRRIGATION FARMING: Adab (*Bismaya*), Ashur (*Qal'aat Sherqat*), Eridu (*Abu Shahrein*), Eshnunna (*Tell Asmar*), Girsu (*Tello*), Hattam (*Tell Agrab*), Isin (*Ishan Bahriyat*), Kish (*Tell Uhaimir*), Lagash (*Tell al-Hiba*), Larsa (*Tell Senkereh*), Mari (*Tell Hariri*), Nineveh (*Ninive*), Nippur (*Nuffar*), Shuruppak (*Fara*), Shush (*Susa*), Sippar (*Abu Habbah*), Tuttul (*Tell Bi'a*), Tutub (*Khafajah*), Umma (*Tell Jokha*), Ur (*Tell al-Muqayyar*), Uruk (*Tell al-Warka*). Hydro-climatic Records: SPELEOTHEMS: Jeita and Kuna Ba caves. LAKE SEDIMENTS: Eski Acigol, Hula, Mirabad, Van and Zeribar lakes.

Note: The historical names of the polities that constitute the cross-section identifiers are in regular lowercase type, and those of the present-day archaeological sites and hydro-climatic records are in Italic lowercase font.

polities for which only the independent variables are observed, suggest that the residuals of regression and selection equations are unrelated at a 5% statistical level or higher (see Table II of the Supplemental Appendix). To identify selection, we exploit the fact that nonselected polities mainly lied either on the Levantine cost or at traveling distance to the great rivers and were abandoned to ease societal resilience in favor of settlements either placed over the northern flat tablelands or directly overlooking the great rivers (Kennett and Kennett 2006; Ristvet and Weiss 2013). As a result, the polity's sampling probability is strongly and positively related to the terrain roughness—i.e., *Roughness*, significantly and negatively linked to the median terrain slope—i.e., *Slope*—and strongly and positively (negatively) correlated to the polity's latitude (longitude).

Regarding the span of our sample, two are the key constraints that have guided our choice. First, the institutional evolution of the period preceding the invention of the logographic writing is still ill-understood (Liverani 2014: 62–77). Second, the emergence of the Levantine empires at the end of our sample induced a shift of the political core toward the eastern Mediterranean, the reduction in written sources and the collapse of the Babylonian and Assyrian trading circuits, obscuring in this way the evolution of the single polities (Liverani 2014: 271; Green et al. 2024: 176). By relying on the "middle chronology," it is, instead, possible to accurately link historical to archaeological data over our sample. Crucially, the Ancient Near East Placemarks and middle chronology are widely accepted by the extant literature (Sallaberger and Schrakamp 2015; Manning et al. 2016).

Since the maximum distance between cultivated fields and settled center was 30 km (Wilkinson 2003: 125; Liverani 2014: 106), we average environmental variables over a 30 km radius around the coordinates of the major city of each polity. Moreover, we follow Acemoglu et al. (2005) and Guerriero (2020), and we construct our non-institutional and institutional variables on the bases of information on the half-century preceding each period.

5.1 Measurement

5.1.1 Return on investment and risk-sharing activities

Next, we define our proxies for, respectively, the return on farming investments, the return on long-distance trade investments and the return on risk-sharing activities.

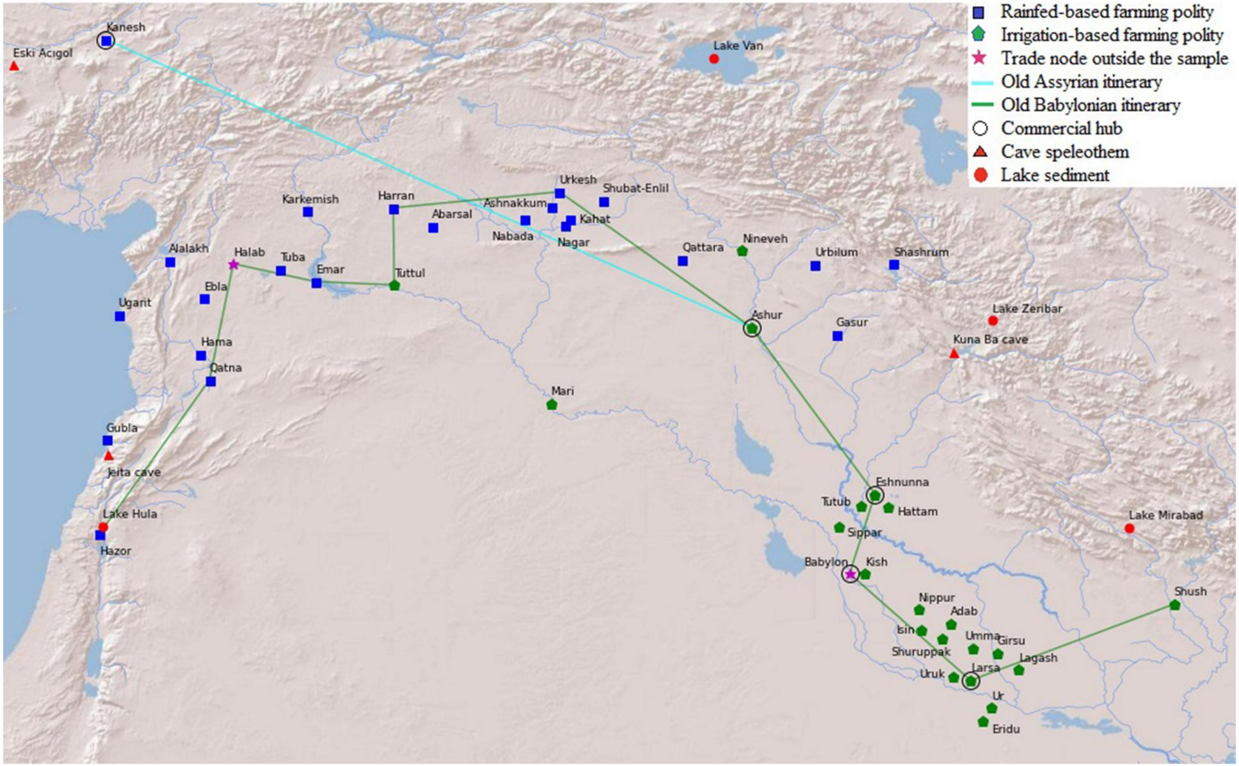

Figure 2. Farming and trade in Bronze Age Mesopotamia.*Note*: The figure depicts the locations of the polities part of the sample, those of the hydro-climatic records and the structure of both the Old Assyrian and Old Babylonian trade networks. The latter is extrapolated from figure 12.4 in Liverani (2014).

5.1.1.1 Return on farming investments

While cereals were the dominant crops, olive oil became, because of its use as cooking and perfume-making ingredient, the farming output most exchanged over the second millennium BCE (Paulette 2013: 102–103). An extensive botanical literature has analyzed these crops concluding that cereals (olive) farming is favored by a more suitable land, requires an altitude between 0 and 3050 m, needs a temperature ranging between 5 and 37 (higher than 4) degrees Celsius and suffers from water scarcity (Serna-Saldivar 2010; Oteros et al. 2013). While, however, we do not consider the altitude since the highest polity of the sample is Kanesh with its 1106 m,[18] we cannot employ the available land suitability data because by construction they are unable to properly capture the historical soil capacity to retain and supply nutrients and water.

To elaborate, these indicators are produced by the GAEZ project on the basis of post-1981 agro-climatic factors—i.e., radiation and temperature—and, possibly, present-day agro-edaphic conditions, such as the terrain management systems and the soil salinity (Fischer et al. 2021). Since the latter can reflect past human intervention and, in turn, past institutional formation, the extant literature has focused on the land suitability indexes based only on agro-climatic conditions under low-input farming, which should be then independent from human decisions (Bentzen et al. 2016; Litina 2016). Yet, this approach is correct only if historical climatic conditions can be proxied by present-day ones. This hypothesis is unreasonable in our sample whereby the potential barley yield under low-input use calculated via agro-climatic conditions only and expressed in tons per hectare—i.e., *Barley-PY*—is negatively and insignificantly correlated with the historical cereal yields in liters per hectare—i.e., *Cereal-Yield*—over the available 32 observations,[19] conditional on the rating curves for temperature and rainfall, the proxy for climate volatility discussed below as well as half-century fixed effects. This evidence reflects the fact that the post-1960 global warming has altered the productivity ranking of our polities by improving the climatic conditions of Upper Mesopotamia while worsening those of Lower Mesopotamia.[20]

Building on these remarks and the fact that almost half of the variation of cereal yield anomalies is explained by the combined effect of temperature and rainfall (Vogel et al. 2019), we focus on a normalized Storie index (O' Geen et al. 2008: 1), calculated as the product of an inverted U-shaped rating curve for the temperature in degrees Celsius T normalized to range between 0 and 1—i.e., *Temperature*—and an inverted U-shaped rating curve for the monthly rainfall in mm R normalized to range between 0 and 1—i.e., *Precipitation*, all averaged over the previous half-century, i.e., *Farming-Return* $= (T/100) * (R/100)$ (see Table 2 and Table I [Supplemental Appendix] for definitions and sources of all our variables).[21] To construct this variable, we consider all months within a year for two key reasons. First, lower winter temperatures extended the period of dormancy of plants reducing the effectiveness of floods (Hole 1994: 127). Second, cereals were planted between September and January and were harvested between March and August (Widell et al. 2013a: 86). We collect the

[18] Any linear impact of the altitude is absorbed by the polity fixed effects.

[19] Figure I in the Supplemental Appendix suggests that our results are similar when we substitute our proxy for the farming return with a variable *Cereal-Yield-E* obtained by interpolating backward and forward *Cereal-Yield*. This strategy, however, induces a large loss of degrees of freedom and magnifies the likelihood of reverse causation and measurement errors due to the bureaucrats' incentives to misreport yields (Postgate 1984).

[20] While Ebla and Ugarit, among the least productive rain-fed-based farming polities, display a large *Barley-PY* value, Girsu, the most productive irrigation-based farming polity, exhibits an average *Barley-PY* value.

[21] The baseline rating curve for temperature T ranges between 1 and 100, linearly rises between 5 and 25 degrees Celsius and linearly falls for larger temperatures (Hosseini et al. 2017), whereas that for rainfall R ranges between 1 and 100, linearly increases between 0 and 150 mm and linearly decreases otherwise (Ciccone and Ismailov 2022). While we do not include in our Storie index the land suitability because unavailable, we add the terrain slope to the version of our proxy employed in Section 5.4.2 (O' Geen et al. 2008).

Table 2. Summary of variables.

	Variable	Definition and sources	Statistics
	Microcredit:	Share of previous 50 years during which the institutionalized decision-makers issued interest-free loans of agricultural products. Sources: see the Supplemental Appendix.	0.024 (0.142)
Culture of cooperation:	*Irrigation*:	Share of previous 50 years, during which the institutionalized decision-makers organized large-scale irrigation works. Source see the Supplemental Appendix.	0.037 (0.153)
	Karum:	Dummy for the existence over the previous 50 years of a formal merchant institution, i.e., karum, port authority or court. Sources: see the Supplemental Appendix.	0.022 (0.146)
	Farming-Return:	See text. Source: Armstrong et al. (2019).	0.099 (0.051)
	Farming-Return-E:	See text. Source: Armstrong et al. (2019).	0.121 (0.064)
Investment and risk-sharing return:	*Temperature*:	Rating curve for temperature in degrees Celsius averaged over the previous 50 years. Source: Armstrong et al. (2019).	0.759 (0.189)
	Precipitation:	Rating curve for precipitation in mm averaged over the previous 50 years. Source: Armstrong et al. (2019).	0.180 (0.114)
	Trade-Network:	See text. Sources: see Benati et al. (2022).	0.002 (0.007)
	Climate-Volatility:	See text. Source: Armstrong et al. (2019).	0.615 (0.242)
	Great-Rivers-Flow:	See text. Source: Armstrong et al. (2019).	0.265 (0.152)
	Political-Institutions:	Five-point score rising with the division of the decision-making power over a 40 years window around each date. Sources: see Benati et al. (2022).	2.305 (1.052)
	Public-Buildings:	Number of public and ritual buildings built over the previous half-century. Sources: see Benati et al. (2022).	1.085 (1.831)
Control variables:	*External-Conflicts*:	Number of external conflicts over the previous 50 years. Sources: see Benati et al. (2022).	0.301 (1.469)
	Internal-Conflicts:	Dummy for uprisings and/or rebellions over the previous 50 years. Sources: see Benati et al. (2022).	0.029 (0.169)
	Circumscription:	Ratio of the temperature to its average over the remaining polities weighted by their inverse distance, all averaged over the previous 50 years. Source: Armstrong et al. (2019).	0.977 (0.122)

Note: The last column reports the mean value and, in parentheses, the standard deviation of each variable. Both are computed building on the sample used in Tables 3–5.

underlying climatic data from Armstrong et al. (2019), who, in turn, simulate these series for each month between 60,000 and 0 BP—i.e., 1950—and the northern hemisphere at a 0.5 degree spatial resolution combining discrete equations for fluid motion with grid-specific information on land, soil and plant characteristics. Finally, to take into account also the linear effects of the two normalized rating curves, we also include both of them in the specifications.[22]

Three observations confirm the validity of our measurement strategy. First, the Armstrong et al.'s (2019) data are more widely available and more granular than the available proxy data, which are, instead, based on a handful of sources of variation. Nevertheless, the correlation between *Temperature* and the oxygen stable isotope ratios extracted from the seven cave speleothems and lake sediments nearest to our polities (Palmisano et al. 2021) is 0.24 and significant at 1%, conditional on half-century fixed effects (see Figure 2 and Table 1). Second, the correlation between *Farming-Return* and *Cereal-Yield* is 0.93 and significant at 1%, conditional on *Temperature, Precipitation*, our proxy for climate volatility as well as half-century fixed effects (see Figure II in the Supplemental Appendix). Finally, we obtain similar results when we either use as an excluded instrument for *Farming-Return* an alternative proxy including also a decreasing rating curve for the terrain slope based on GAEZ orographic information—*Farming-Return-E* (see Section 5.4.2), substitute the Palmer Drought Severity Index—PDSI—for *Farming-Return* (see Table III of the Supplemental Appendix),[23] or consider the temperature and rainfall in levels controlling for their nonlinear impact on culture through their squares (see Table III of the Supplemental Appendix).

5.1.1.2 Return on long-distance trade investments

Boranbay and Guerriero (2019) and Guerriero and Righi (2022) document that the medieval lords expanded the political rights of the merchants in polities whose trade potential was the smallest because most distant to the trade circuits. Building on this intuition, we elect as proxy for the return on long-distance trade investments the variable *Trade-Network* defined as the inverse distance between each polity and the Old Babylonian and Old Assyrian trade networks. The two trade circuits channeled the unprecedented exchanges that emerged after the 2000 BCE diffusion of metals.

Three were the specific features of these networks. First, polities were involved in a single network by law (Barjamovic 2013: 128). Second, the connecting nodes injected into the networks goods produced by the nearest partners not laying on the routes (Liverani 2014: 216–217; Barjamovic 2018: 120–125). Finally, the connecting nodes were divided in simple transit points and full-fledged hubs—i.e., Ashur, Babylon, Larsa, Kanesh and Sippar—in which professional merchants organized the inter-hub trade (Barjamovic 2018: 122–128; de Boer 2022). The hubs revolved around a formal merchant institution, which contracted sworn agreements between nodes, settled trade-related disputes and offered financial services (Postgate 1992: 218–221, 300; Palmisano 2018: 22). Ultimately, *Trade-Network* equals: a) zero if the polity did not have any access to the trade circuits and so its distance to them was infinite; b) inverse distance to the nearest node of the network to which the polity belonged if it was part of a trade circuit but not a node; c) inverse distance to the nearest hub along the trade network to which the polity belonged if it was a node. Crucially, *Trade-Network* is positively and

[22] The attached coefficients are positive and significant (see Table 3). Nevertheless, this evidence is still consistent with our testable predictions because the correlation between *Temperature* (*Precipitation*) and *Cereal-Yield* is statistically insignificant (negative and significant at one percent), conditional on *Farming-Return*, *Precipitation* (*Temperature*), our proxy for climate volatility and half-century fixed effects.

[23] The PDSI is an inverse measure of the severity of droughts, and it ranges between -10 and 10.

significantly—at 1%—correlated with a measure of trade expansion developed by Benati et al. (2022), conditional on time dummies and climate volatility.

5.1.1.3 Return on risk-sharing

To pick the return on risk-sharing, we focus on the farming sector, which was the most relevant in the sample (see Section 4), and we construct based on the Armstrong et al.'s (2019) data the normalized—to range between 0 and 1—first principal component extracted from the averages over the previous 50 years of the thermal excursion between the hottest and the coldest months of the year, obtained censoring each of the two temperatures at zero degree Celsius, and the precipitation of the wettest month minus that of the driest month all divided by the mean monthly precipitation, i.e., *Climate-Volatility*. As suggested by Matranga (2024), contrary to the standard deviation, the first measure avoids counting seasonality over negative and thus, unproductive temperature levels, whereas the second measure doesn't place unwarranted emphasis on areas that are very rainy to begin with. Crucially, results listed in Table III of the Supplemental Appendix suggest that our conclusions are unchanged when we either consider the two components of our proxy for the return on risk-sharing—i.e., *Temperature-V* and *Precipitation-V*—or we substitute *Climate-Volatility* with the normalized first principal component extracted from the standard deviations over the previous 50 years of the temperature and the monthly precipitation—i.e., *Climate-SD*—and its square (Boranbay and Guerriero 2019; Matranga 2024).

5.1.2 A culture of cooperation

The large literature on the origins and impact of culture has proposed three main measures of cultural norms, and, notably, the values self-reported to stratified surveys such as the World Value Surveys (Tabellini 2010), the activity of moralizers—e.g., Cistercians and Franciscans in medieval Europe (Boranbay and Guerriero 2019)—spreading stronger norms wherever the return on cultural accumulation was larger, and outcome-based proxies (Guiso et al. 2016). Given the impossibility of obtaining survey data for our sample and the difficulties in disentangling the political and cultural roles of the institutionalized decision-makers and, especially, the temples, we rely on the last option. For an outcome-based measure to qualify as a reliable proxy for culture, its link with the psychological reward from the particular action should be stable and unaffected by extrinsic motivations (Guiso et al. 2016). Accordingly, we construct measures of the intensity of cooperation in risk-sharing as well as farming and long-distance trade innovations that are, at least conditional on key unobservable and observable proxies for extrinsic motivations, the closest possible to this ideal. Operationally, we build on the analyses of the single periods, polity-specific secondary sources informed by archaeological remains and the administrative and contractual cuneiform records stored by the Cuneiform Digital Library Initiative (CDLI) database and mentioning keywords revealing the diffusion of norms of cooperation (see the Supplemental Appendix).

Starting from the intensity of cooperative risk-sharing, we build on the archaeological literature on the management strategies developed by ancient societies to tackle agricultural risk. Two were the key approaches: intensification and diversification (Marston 2011: 191–195). While the former is aimed at fostering farming efficiency via overproduction, the latter comprises crop diversification, which was limited in our sample by the primordial adoption of drought-tolerant species like barley (Riehl 2009), and both large-scale food sharing and foodstuff storage, which spread in, respectively, the Alluvium and Upper Mesopotamia from the middle of the third millennium (Hudson 2002; Paulette 2015; Notizia 2022). Since between the two strategies, food sharing was the one more credibly shaped by intrinsic motivations only, we focus in the main regressions on the share of previous half-century during which the institutionalized decision-makers accommodated interest-free loans of agricultural products such as cereals, beer and wine, i.e., *Microcredit*. These microcredit initiatives, indeed, survived only when tenants impoverished by adverse climate shocks paid back the initial loans to abide by norms of cooperation (Skaist 1994; Garfinkle 2004: 3–5; Wilcke 2007: 111–112), and thus, their spread captures the diffusion of risk-sharing activities successful only because of cultural accumulation (Hudson 2002; Notizia 2022). To construct *Microcredit*, we build on both secondary sources based on the archaeological evidence on the distribution of loan contracts in the Alluvium and the 947 administrative and contractual CDLI texts mentioning interest-free loans. A particularly noteworthy example was the so-called "še-ur5-ra" system (Notizia 2022), which envisioned the grant by the institutionalized decision-maker of interest-free barley loans to the tenured farmers (Skaist 1994: 38, Figure 3). They were accommodated before the harvest and possibly paid back after the crop. Accordingly, not only did they provide an immediate relief to the distress caused by food shortage but also prevented tenured farmers from turning to private money lenders and becoming victim of debt bondage (Garfinkle 2004: 26; Notizia 2022).

Building on these remarks, we also construct three—more noisy—alternatives to *Microcredit*. First, we evaluate the spread of food storage initiatives by exploiting the archaeological reports documenting storage structures and the 3327 administrative and contractual CDLI texts mentioning central granaries. Based upon these sources, we construct the share of previous half-century during which large-scale foodstuff storage facilities were organized by the institutionalized decision-makers, local communities and/or family groups, i.e., *Storage*. Crucially, these initiatives required the contributors' cooperation to preserve the stock and avoid shortage (Angourakis et al. 2015; Carballo and Feinman 2016), and they were often accompanied by redistribution to the needy (Paulette 2015: 26). Moreover, they tended to be more effective than food sharing where climate seasonality was more impactful and in particular, in the rain-fed-based farming polities of Upper Mesopotamia where the lack of widespread irrigation systems made risk-sharing over time more relevant than diversification across space (Wilkinson 1997; Paulette 2015: 26). Second, we consider the share of previous half-century during which the institutionalized decision-makers issued decrees fixing the interest rate, i.e., *Interest-Rate*. Finally, we rely on the share of previous half-century during which the institutionalized decision-makers issued edicts canceling non-commercial debts, i.e., *Debt*. The indicators *Interest-Rate* and *Debt* pick provisions assuring that the defaulting tenants did not abandon the land or, even worse, were enslaved and sold to repay their debts (Hudson 2000: 139, 147; Adams 2009: 8; Van De Mieroop 2015: 85–86). Being the returns on re-assigning the land and selling an enslaved tenant net of the turnover costs non-negligible, creditors did not oppose interest rate restrictions and debt cancellation edicts only if intrinsically motivated to cooperate with the debtors.

Ultimately, even if the activities underlying our measures of the intensity of cooperation in risk-sharing were partially shaped at first by public policy intervention, their endurance was only possible because of the non-elites' internalized norms of cooperation, i.e., their intrinsic reward from repaying a loan of farming products in times of famine, storing food that was possibly going to be redistributed to those in need, lending money at a negligible interest rate and/or in anticipation that the debtor could legally default. Consistent with this view, our analysis remains substantially unaffected conditional on polity and time fixed effects, inclusiveness of the political process, public good provision, severity of external and internal conflicts, degree of environmental and institutional circumscription, economic development, irrigation intensity and degree of political instability (see Section 5.4).

Regarding the intensity of cooperative investments, we study cooperation in farming and long-distance trade innovations. We capture the former with the share of previous half-century during which the institutionalized decision-makers coordinated major irrigation

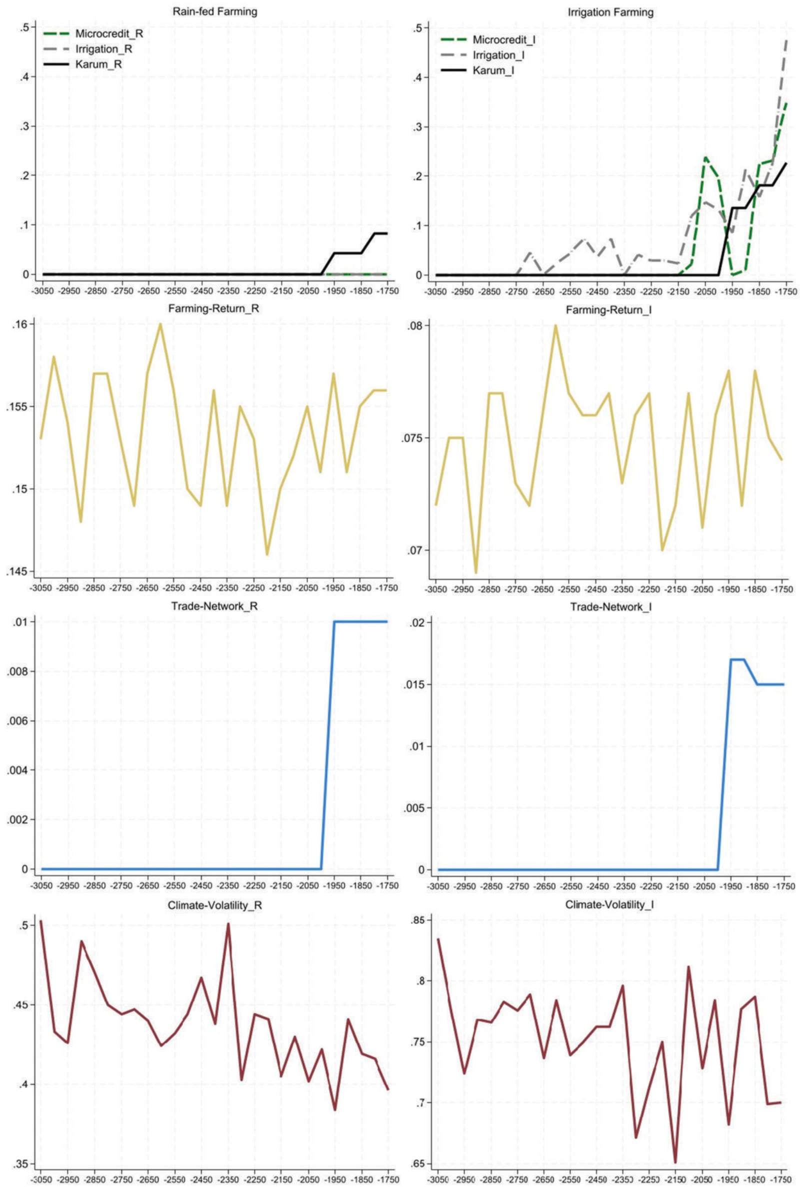

Figure 3. Culture of cooperation, return on investment, and climate volatility.*Note*: The left (right) graphs illustrate the links among our three main proxies for culture—i.e., *Microcredit, Irrigation* and *Karum*, our measures of the investment return—*Farming-Return* and *Trade-Network*—and our proxies for the return on risk-sharing—i.e., *Climate-Volatility*—for the subsample of rain-fed (irrigation)-based farming polities. Table 1 lists the polities part of each of the two groups, whereas Table 2 and the Supplemental Appendix report the definition and sources of each variable.

works—i.e., *Irrigation*—and the latter with a dummy for the existence over the previous half-century of a formal merchant institution such as a karum, port authority or court, i.e., *Karum*. While merchant institutions were aimed at fostering cooperation between the ruling elites and the rising merchant ranks in the organization of trade innovations—i.e., linking faraway markets, settling legal disputes and offering financial services (Barjamovic 2018; Palmisano 2018), the excavation and maintenance of artificial canals were the key infrastructural projects jointly organized by the institutionalized decision-makers and the tenured farmers as a part of the tenure-for-service contract (Rost 2017: 11–12).

Once again, our reliance on both *Irrigation* and *Karum* rests on the assumption that, conditional on relevant observables and unobservables (see Section 5.4), enduring cooperation in investment is mainly driven by forceful norms of cooperation.

5.2 Estimating equation

A glance at Figure 3 reveals that the model predictions square with our data. Three patterns are evident. First, the worsening of the climatic conditions between proto- and city-states periods reduced the farming output and magnified consumption risk, favoring the cooperation between non-elites and elites in the realization of the first irrigation infrastructures in the marshy Alluvium. Second, the heightened climate volatility of the kingdoms period further accelerated the diffusion of irrigation works in the South. Finally, the severe droughts of the empires period squeezed the farming output, encouraging the spread of microcredit activities and large-scale hydraulic projects in Lower Mesopotamia and the diffusion of merchant institutions in the less dense Old Assyrian trade network.

Turning to multivariate analysis, we run by OLS the following panel models

$$Y_{p,t} = \alpha_p + \beta_t + \boldsymbol{\gamma}'\mathbf{X}_{p,t} + \boldsymbol{\delta}'\mathbf{Z}_{p,t} + \varepsilon_{p,t}, \tag{2}$$

where $Y_{p,t}$ is a proxy for culture, i.e., *Microcredit*, *Irrigation* and *Karum*. α_p encapsulates polity fixed effects controlling for time-independent determinants of $Y_{p,t}$, i.e., environmental traits, such as the land suitability for agriculture and pasture (Litina 2016), and predetermined shocks like the out of Africa exodus of modern humans and the agricultural revolution (Ashraf and Galor 2013; Olsson and Paik 2016).[24] β_t incorporates time dummies picking up macro-shocks like epidemics, which modulated the incentives to escape the Malthusian trap and cooperate (Voigtländer and Voth 2009).[25] $\mathbf{X}_{p,t}$ includes *Temperature*, *Precipitation* and *Farming-Return* if $Y_{p,t}$ is either *Microcredit* or *Irrigation*, and it incorporates *Trade-Network* if the dependent variable is *Karum*. Moreover, $\mathbf{X}_{p,t}$ always gathers *Climate-Volatility*. Finally, $\mathbf{Z}_{p,t}$ possibly includes the extra controls discussed in Section 5.4.

We document in the Supplemental Appendix that our conclusions are similar when we consider either the within-polity correlation or the spatial dependence in $\varepsilon_{p,t}$ possibly driven by, respectively, institutional persistence or regional climatic patterns. To do so, we cluster the standard errors at the polity level and we rely on the Conley's (1999) standard errors.[26]

[24] While Ashraf and Galor (2013) document that prehistoric migratory distance to East Africa is related to genetic diversity and present-day trust, Olsson and Paik (2016) claim that an early Neolithic transition to agriculture favors patriarchal cultural values over norms of generalized morality.

[25] Since cultural norms are not very persistent in our sample (see Figure 3), our results do not suffer the drawbacks typical of staggered difference-in-differences estimates (Baker et al. 2022).

[26] Our Conley's (1999) standard errors with Bartlett kernel are constructed for four thresholds beyond which the correlation between error terms is assumed to be zero, i.e., 30, 60, 90 and 120 km. These figures correspond to once, twice, thrice and fourfold the maximum distance between the settled center and cultivated fields. Our results survive when we switch to the Cameron et al.'s (2008) wild cluster bootstrapping to deal with a possible bias driven by the small number of clusters (see the Supplemental Appendix).

5.3 Basic empirical results

Table 3 displays the basic estimates, which are consistent with the anecdotal evidence discussed in Sections 4 and 5.2 and the model testable predictions. There are three key observations. First, a one-standard-deviation increase in our proxy for the return on farming investments is associated with a significant—at 1%—3.45-standard-deviation decrease in the diffusion of interest-free loans of agricultural products and a significant—at 5%—2.41-standard-deviation fall in the spread of large-scale irrigation infrastructures. Second, a one standard-deviation rise in our proxy for the return on long-distance trades is related to a significant—at 1%—0.34 fall in the expected value of *Karum*. Finally, a one-standard-deviation increase in the severity of climate volatility is associated with a significant—5%—0.54-standard-deviation rise in the spread of irrigation facilities.

While this last result is driven by a larger return on risk-sharing, the first two capture the combined impact of a fall in the investment return and the aforementioned commitment dimension of cultural accumulation, i.e., the non-elites' incentive to support reforms toward more inclusive political regimes by embracing norms credibly signaling participation. Benati et al. (2022) confirm this interpretation by documenting that, in our own sample, a proxy for the farming return is also inversely related to the indicator of the division of the decision-making power discussed below, which, in turn, is positively linked to the provision of public and ritual buildings and the organization of conscripted armies. Together with our results, these estimates provide the first evidence of the institutional resilience to climate change of ancient societies. Moreover, given the persistence of culture (Guerriero 2020), they also shed light on the link between pre-industrial climate shocks and present-day norms of cooperation reported by a recent literature (Buggle and Durante 2021; Giuliano and Nunn 2021).

5.4 Gaining more insights about causality

Albeit consistent with the testable predictions, OLS estimates may be capturing reverse causality, might be significantly attenuated by measurement error and/or may be driven by an omitted variables bias. Next, we assess these endogeneity issues in turn.

5.4.1 Evaluating the impact of reverse causality

The independence of the proxies for the severity of consumption risk, return on farming investments and inverse distance to the trade networks from human decisions excludes reverse causation from institutions to environmental conditions. While this remark is self-evident for the first two factors, it is less obvious for the last one. Yet, the structure of the trade circuits channeling the second millennium exchanges of metals was determined hundreds of years before the trade revolution by geographic features, as the distance to the great rivers and the presence of flat tablelands and stone deposits, orthogonal to the second millennium climate shocks and the location of metal deposits (Warburton 2024). To test this idea, we follow Angrist and Pischke (2009), and we add *Trade-Network* lead one time period as extra control. If reverse causality was an issue, then one would expect even stronger correlations between the current spread of formal merchant institutions and future values of *Trade-Network* because of the plausible lag with which a culture of cooperation would affect the return on long-distance trades. As detailed in column (1) of Table 4, this is not the case.

5.4.2 Evaluating the impact of measurement error

Turning to measurement errors, three are the key remarks. First, our results are qualitatively similar when we either turn to alternative proxies for the return on farming and/or risk-sharing (see the Supplemental Appendix) or instrument *Farming-Return* with the variable

Table 3. The origins of a culture of cooperation.

	(1)	(2)	(3)
	The dependent variable is:		
	Microcredit	*Irrigation*	*Karum*
Farming-Return	−9.806	−7.373	
	(3.208)***	(3.317)**	
Climate-Volatility	0.139	0.342	0.022
	(0.140)	(0.145)**	(0.139)
Trade-Network			−4.844
			(0.775)***
Temperature	6.609	9.435	
	(2.111)***	(2.183)***	
Precipitation	5.060	6.308	
	(2.468)**	(2.552)**	
Estimation		OLS	
Within R^2	0.15	0.15	0.15
Number of observations	1188	1188	1188

Notes: Standard errors are in parentheses.
*** and ** denote significant at the 1% and 5% confidence level, respectively. All specifications include polity and half-century fixed effects.

Table 4. Gaining more insights about causality.

	(1)	(2)	(3)	(4)	(5)	(6)
	The dependent variable is:					
	Karum	*Microcredit*	*Irrigation*	*Microcredit*	*Irrigation*	*Karum*
Farming-Return		−9.820	−5.235	−10.929	−7.455	
		(3.542)***	(3.663)	(3.122)***	(3.345)**	
Climate-Volatility	0.020	0.139	0.334	1.275	1.711	0.276
	(0.140)	(0.140)	(0.145)**	(0.462)***	(0.495)***	(0.413)
Trade-Network	−5.169					−4.033
	(1.693)***					(0.762)***
Trade-Network$(t+1)$	0.341					
	(1.580)					
Great-Rivers-Flow				2.817	1.615	1.204
				(0.928)***	(0.995)	(0.924)
Climate-Volatility^2				−0.739	−0.915	−0.186
				(0.302)**	(0.323)***	(0.266)
Political-Institutions				−0.002	0.006	0.013
				(0.004)	(0.004)	(0.004)***
Public-Buildings				0.004	0.010	0.002
				(0.003)	(0.003)***	(0.003)
External-Conflicts				0.023	0.006	0.023
				(0.003)***	(0.003)*	(0.003)***
Internal-Conflicts				0.088	0.026	0.035
				(0.024)***	(0.026)	(0.024)
Circumscription				−3.282	−12.268	4.908
				(5.152)	(5.520)**	(2.887)*
Estimation	OLS	IV	IV	OLS	OLS	OLS
Within R^2	0.15	0.15	0.15	0.24	0.19	0.23
Number of Observations	1188	1188	1188	1188	1188	1188

Notes: Standard errors are in parentheses.
***, **, and * denote significant at the 1%, 5%, and 10% confidence level, respectively. All specifications include polity and half-century fixed effects. Those in columns (2)–(5) also consider *Temperature* and *Precipitation*. In columns (2) and (3), the endogenous variable is *Farming-Return*, whereas the excluded instrument is *Farming-Return-E*.

Farming-Return-E (see columns (2) and (3) of Table 4).[27] Second, our conclusions stand when we switch to three alternative dependent variables, i.e., diffusion of foodstuff storage activities, spread of interest rate controls and diffusion of non-commercial debt cancellation (see the Supplemental Appendix). Finally, we clarify in the Supplemental Appendix why it is unlikely that our estimates are biased by other sources of measurement errors created by the low and/or asymmetric quality of some of our archaeological data.

5.4.3 Evaluating the impact of unobserved heterogeneity

We pursue a three-step strategy to evaluate the role of unobserved heterogeneity.

5.4.3.1 Controlling for observables

First, we assess the impact on the main coefficients of considering the other key determinants of culture identified by the extant literature.

First, we test the possibility that the availability of an extended canal system in the Alluvium made less relevant shocks to the farming return. To elaborate, we follow an expanding literature identifying the rainfall at the source of the great rivers as the key determinant of the intensity of their flooding and, in turn, the effectiveness of irrigation systems (Gholami et al. 2024; Mayoral and Olsson 2025), and we construct a variable equal to the rating curve for the growing season precipitation for the polities relying on rain-fed farming and the rating curve for the winter-spring precipitation of the source of the nearest between the two great rivers for the polities employing irrigation,[28] i.e., *Great-Rivers-Flow*.[29]

Second, Boranbay and Guerriero (2019) explicitly model cooperation in risk-sharing and conclude that cultural accumulation rises with the severity of consumption risk at its moderate values and then drops at its high values making cheating too appealing. To evaluate this mechanism, we also consider the square of *Climate-Volatility*.

Third, both our theoretical model and our institutional analysis suggest that a culture of cooperation and the inclusiveness of the political process co-evolve in response to changes in the return on investment and/or risk-sharing activities (see also Boranbay and Guerriero 2019). Accordingly, we consider a one to five indicator increasing in the degree of division of the decision-making power, i.e., *Political-Institutions*.[30] Following the extant literature (Acemoglu et al. 2005; Guerriero 2020), Benati et al. (2022) construct *Political-Institutions* on the basis of the main events in a 40-year window around each time period. Crucially, considering *Political-Institutions* also allows us to evaluate whether *Irrigation* is mechanically capturing a rise in public good provision aimed at counteracting environmental shocks (Paulette 2016; Allen et al. 2023). To further assess this point, we also consider the number of public and ritual buildings (Benati et al. 2022), i.e., *Public-Buildings*.

Fourth, a well-known body of research suggests that more intense external and internal conflicts might push the elites to grant more inclusive political institutions because of, respectively, the need of persuading the non-elites to defend the polity and the risk of being expropriated (Acemoglu and Robinson 2000; Besley and Persson 2009; Chaney 2013).

[27] The t-test on this excluded instrument is 66.64 (results available upon request).

[28] For the polities relying on rain-fed farming, we focus on the growing season local precipitation to avoid multicollinearity between *Farming-Return* and *Great-Rivers-Flow*.

[29] By shaping the ability of the supply of soil moisture to meet its demand as well as the efficiency of the harvest storage, the mixture of temperature and rainfall affected yields anomalies in combination with and independently of the abundance of the two great rivers' flooding (Redmond 2002).

[30] To illustrate, the index equals one for polities mostly dominated by another political entity, two in the absence of any of the three possible institutionalized decision-makers—i.e., temple, extended royal family and town elites (North et al. 2009), three when only one was active, four when two were controlling policy-making, and five when the political power was contested among all three institutionalized decision-makers.

As suggested by our model, such a conflict-driven rise in the inclusiveness of the political process will dilute the non-elites' incentives to signal commitment by accumulating culture. We, then, consider a proxy for external conflicts defined as the number of external wars in which the polity participated over the previous half-century—i.e., *External-Conflicts*—and a measure of internal conflicts constructed as a dummy for polities experiencing over the previous half-century either an uprising against the institutionalized power or a rebellion against an external ruler, i.e., *Internal-Conflicts*. To obtain these indicators, we build on monumental inscriptions and secondary sources on warfare (Benati et al. 2022).

Finally, a growing strand of research opened by Carneiro (1970) asserts that the degree of "environmental circumscription," which is the difference between the productivity of a polity and that of the surroundings, is a deterrent to exit and unrest and thus, discourages reforms toward a more inclusive social order (Ahmed and Stasavage 2020; Mayoral and Olsson 2025). Since the temperature was the single most relevant determinant of the farming return (BGZ 2022), we consider the ratio of the temperature to its average over the remaining polities weighted by their inverse distance, all averaged over the previous 50 years—i.e., *Circumscription*. As stressed by Benati et al. (2021), *Circumscription* is also an inverse proxy for the incentive to share consumption risk across space via trade.

We consider these seven observable factors together in columns (4) to (6) of Table 4. Seven are the key observations. First, the message of our analysis is essentially the same. Second, the evidence on the inverted U-shaped link between climate volatility and culture is mixed in our sample. Third, the fact that effectiveness of the Southern irrigation system is only significantly—and positively—associated to *Microcredit* is consistent with the idea that food sharing was a feasible management approach only when a canal system made possible diversification of agricultural risk across space and not only over time via food storage, as it was the case in the Fertile Crescent. Fourth, the inclusiveness of the political process and public good provision are only weakly related to the strength of culture being formal and informal institutions driven by environmental conditions (Boranbay and Guerriero 2019). Fifth, the severity of external conflicts is positively associated with cultural formation, which is inconsistent with Besley and Persson's (2009) conclusions. Sixth, the severity of internal conflicts tends to be insignificant, which is inconsistent with the Acemoglu and Robinson's (2000) results but consonant with the estimates discussed by Boranbay and Guerriero (2019) and Benati et al. (2022). Finally, the evidence on *Circumscription* is mixed and thus, inconsistent with the circumscription theory's and the Buggle and Durante's (2021) conjectures.

We document in the Supplemental Appendix that our conclusions are similar when we also evaluate the intensity of urbanization, degree of political circumscription, degree of political instability and two alternative proxies for the irrigation intensity. Interestingly, while the irrigation potential is positively related to culture via a less inclusive political order (Bentzen et al. 2016), river avulsion seems to favor cultural accumulation (Allen et al. 2023).

5.4.3.2 Bias from unobservables

Second, we calculate how much greater the influence of unobservables, relative to that of the main observables, would need to be to explain away our estimates. We find that it would have to be on average more than eighteen times greater than the influence of observables, which is unlikely (see Table 5 and the Supplemental Appendix).

5.4.3.3 Panel difference-in-differences

We re-estimate equation (2) via a panel difference-in-differences design including in $\mathbf{Z}_{p,t}$ *Climate-Volatility* and either *Farming-Return* or *Trade-Network*, all lagged one period (see the Supplemental Appendix). Two are the key remarks. First, our conclusions are the same.

Table 5. Using selection on observables to assess the bias from unobservables.

	(1)	(2) The dependent variable is	(3)
	Microcredit	*Irrigation*	*Karum*
The index is calculated for			
Farming-Return	9.73	90.91	
Climate-Volatility	1.12	1.25	1.09
Trade-Network			4.97

Note: The restricted set of controls includes those employed in the specifications reported in Table 3, whereas the "full set" of covariates incorporates those used in the specifications listed in columns (4)–(6) of Table 4. The sample size is 1,188.

Second, the p-value of an F-test that the coefficients on the lagged variables are zero implies that the parallel trend assumption is verified.

5.4.3.4 Discussion

These robustness checks make it difficult to envision that our estimates are driven by mechanisms different from those we model and thus, we take them as consistent with causality running from environmental conditions to (a culture of) cooperation.

6. CONCLUDING COMMENTS

We have developed a unifying theory of how the factors amplifying the elites' time inconsistency issues and the forces magnifying the non-elites' consumption risk shape the inclusiveness of the political process and the non-elites' cultural accumulation and how these institutional arrangements interact in determining economic outcomes. Crucially, we have also evaluated the model testable predictions on the determinants of the non-elites' culture exploiting a novel data set on the first institutions recorded in Bronze Age Mesopotamia.

We conclude by proposing two avenues for further research. First, a key unanswered empirical question is to disentangle the direct economic effect of a more forceful non-elites' cultural accumulation from its indirect economic impact going through weaker elites' incentives to enact a more inclusive political process and the smaller fiscal capacity prevailing under autocracy. Unlike the extant literature (Besley and Persson 2009), our results suggest that the environmental determinants of state-building should be employed to isolate the truly exogenous impact of its components (Guerriero and Righi 2022). Second, as discussed in Section 5.1, it is difficult to uniquely identify the moralizers in our sample and no survey of the population can be performed. Yet, another outcome-based proxy for a culture of cooperation can be developed by calculating the frequency with which the term "cooperation" and its synonyms are found in literary cuneiform texts (Liverani 2006: 64–66).

SUPPLEMENTARY MATERIAL

Supplemental material is available at *Journal of Law, Economics, & Organization* online.

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