Supplementary Material for:

"The Origins of (a Culture of) Cooperation."

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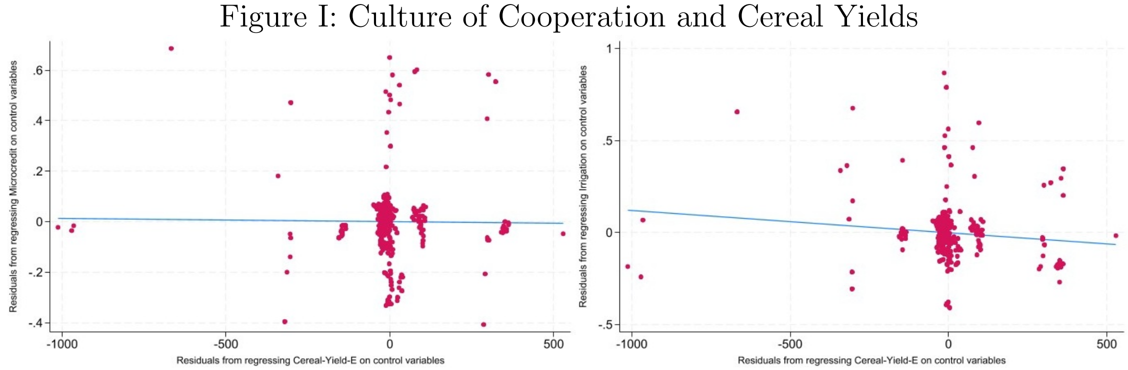
I Supplementary Figures and Tables

Table I: Summary of Variables

	Variable	Definition and Sources	Statistics
Culture of cooperation:	*Storage*:	Share of previous 50 years during which large-scale storage facilities were organized. Sources: see the Internet appendix.	0.088 (0.264)
	Interest-Rate:	Share of previous 50 years during which the institutionalized decision-makers issued decrees fixing interest rates. Sources: see the Internet appendix.	0.029 (0.154)
	Debt:	Share of previous 50 years during which the institutionalized decision-makers issued edicts canceling non-commercial debts. Sources: see the Internet appendix.	0.036 (0.137)
Return on economic activities:	*Cereal-Yield*:	Coeval cereal and, especially barley, yields, in liters per hectare, reported by administrative texts. Source: see Benati et al. (2022).	1070.378 (419.930)
	Cereal-Yield-E:	The variable is obtained by interpolating backward and forward *Cereal-Yield*. Source: see Benati et al. (2022).	1006.453 (423.544)
	PDSI:	Palmer Drought Severity Index averaged over the previous 50 years. Sources: AHV (2019); HWSD dataset.	- 0.256 (0.337)
	Farming-Return-L:	See text. Source: Armstrong et al. (2019).	0.277 (0.240)
	Temperature-L:	Temperature in degrees Celsius averaged over the previous 50 years. Source: Armstrong et al. (2019).	20.196 (3.777)
	Precipitation-L:	Precipitation in mm averaged over the previous 50 years. Source: Armstrong et al. (2019).	26.996 (17.159)
	Temperature-V:	See text. Source: Armstrong et al. (2019).	26.567 (2.835)
	Precipitation-V:	See text. Source: Armstrong et al. (2019).	3.087 (0.403)
	Climate-SD:	Normalized first principal component extracted from standard deviations over previous 50 years of temperature and monthly precipitation. Source: Armstrong et al. (2019).	0.265 (0.241)
Extra controls:	*Polity-Size*:	Estimated settled area of the polity in hectares over the previous 50 years. Sources: see Benati et al. (2022).	50.621 (79.871)
	Political-Institutions-N:	Average of *Political-Institutions* over the remaining polities weighted by the inverse distance to each of them. Sources: see Benati et al. (2022).	2.289 (0.417)
	Irrigation-P:	Normalized—to range between zero and one—product of *Temperature* and the GAEZ irrigation impact score. Sources: www.iiasa.ac.at/Research/LUC/SAEZ/	0.618 (0.333)
	Young-King:	See text. Sources: see the references listed in the Internet appendix.	0.114 (0.319)
	River-Shift:	Dummy for a shift over the previous 50 years of the closest between the Tigris and the the Euphrates. Sources: Adams (1965, 1981) and Adams and Nissen (1972).	0.012 (0.108)
Geography:	*Roughness*:	Terrain roughness. Source: G-Econ dataset.	0.110 (0.151)
	Slope:	Median terrain slope in percentage defined as the tangent of the inclination of the surface of the earth. Source: GAEZ dataset.	0.093 (0.088)
	Latitude:	Latitude of polity. Source: https://www.lingfil.uu.se/research/assyriology/earth	34.057 (2.274)
	Longitude:	Longitude of polity. Source: https://www.lingfil.uu.se/research/assyriology/earth	42.539 (3.834)

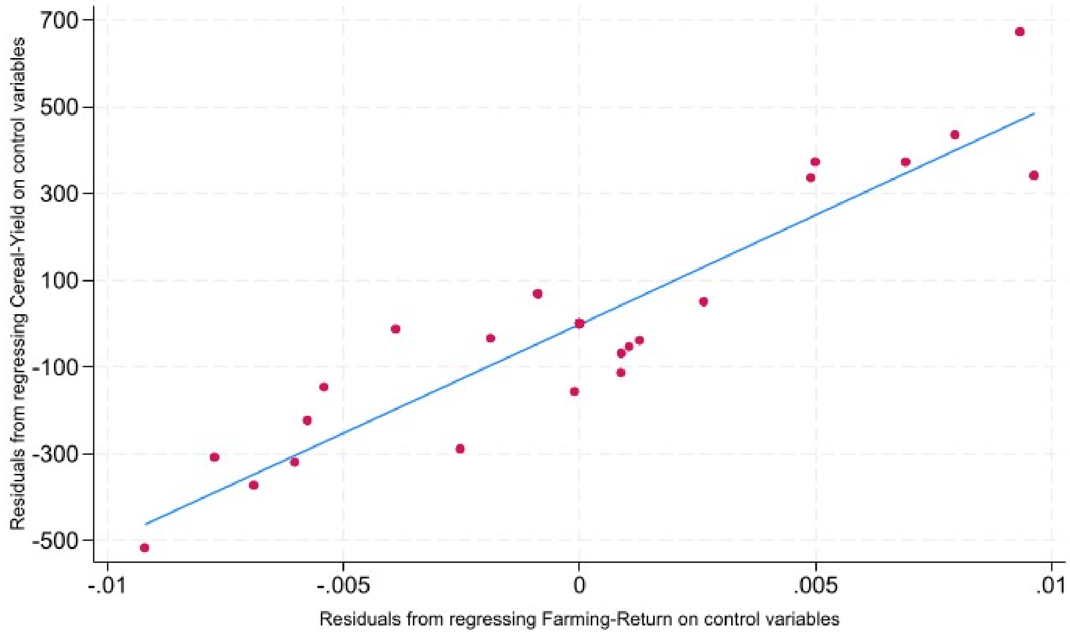
Note: 1. The last column reports the mean value and, in parentheses, the standard deviation of each variable. Both are computed building on the sample used in figures I and II and tables II to VII.

Figure I: Culture of Cooperation and Cereal Yields



Note: 1. The graphs depict the correlations between *Cereal-Yield-E* and, respectively, *Microcredit* and *Irrigation*, conditional on *Temperature*, *Precipitation*, *Climate-Volatility* as well as polity and half-century fixed effects. The graphs are obtained from the 351 data points for which *Cereal-Yield-E* is observed (Benati et al., 2022) and the coefficient on *Cereal-Yield-E* is - 0.00001 in the left graph and - 0.0001 in the right one. Tables 1 and I detail the definition and sources of each variable.

Figure II: Farming Return and Cereal Yields



Note: 1. The graph depicts the correlation between *Cereal-Yield* and *Farming-Return*, conditional on *Temperature*, *Precipitation*, *Climate-Volatility* and half-century fixed effects. The graph is obtained from the 32 data points for which *Cereal-Yield* is observed and the coefficient on *Farming-Return* is 50132.62. Tables 1 and I detail the definition and the sources of each of the variables we use.

Table II: Heckman Selection Model

	(1)	(2)	(3)
		The dependent variable is:	
	Microcredit	*Irrigation*	*Karum*
Farming-Return	- 0.170 (0.069)**	- 0.313 (0.068)***	
Climate-Volatility	0.039 (0.046)	0.127 (0.050)***	0.028 (0.028)
Trade-Network			- 4.964 (0.772)***
		Selection equation	
Roughness	2.869 (0.372)***	2.869 (0.368)***	1.633 (0.298)***
Slope	- 2.448 (0.481)***	- 2.446 (0.474)***	- 3.190 (0.451)***
Latitude	0.062 (0.037)*	0.063 (0.037)*	0.105 (0.020)***
Longitude	- 0.071 (0.032)**	- 0.071 (0.032)**	- 0.006 (0.026)
Estimation		Full maximum likelihood	
P-value of the Test of Independent Equations	0.91	0.05	0.81
Number of Selected Observations	1188	1188	1188
Number of Nonselected Observations	1053	1053	1053

Notes:
1. Standard errors in the parentheses. *** denotes significant at the 1% confidence level; **, 5%; *, 10%.
2. The thirty-nine nonselected cities are Abu Salabikh, Halab, Malitya, Babylon, Borsippa, Hattusha, Damascus, Puzrish-Dagan, Ni.Ru, Arrapha, Oylum Hoyuk, Anshan, Mashkan-Shapir, Kisurra, Pashime, Dilbat, Bad-Tibira, Nutur, Tell al-Wilaya, Der, Tell Arbid, Terqa, Tunip, Marad, Sippar Amnanum, Azu, Tell Hamoukar, Shaduppum, Kutha, Zabalam, Qadesh, Kutalla, Urum, Malgium, Nigin, Titrish Hoyuk, Tutul el-Baqarat, Umm al-Aqareb and Mugdan.
3. The dependent variable of the selection equation is the polity's sampling probability. Moreover, to achieve convergence of the maximization of the likelihood of the specifications in columns (2) and (3), we constrain the number of iterations to be zero.
4. The specifications always include half-century fixed effects and both *Temperature* and *Precipitation* in columns (1) and (2).

Table III: Alternative Proxies for the Returns on Investment and Risk-sharing Activities

	(1)	(2)	(3)	(4)	(5)
			Panel A. The dependent variable is:		
	Microcredit	*Irrigation*	*Microcredit*	*Irrigation*	*Microcredit*
PDSI	- 0.037 (0.031)	- 0.052 (0.032)*			
Farming-Return-L			- 1.538 (1.602)	0.089 (1.648)	
Farming-Return					- 9.734 (3.209)***
Climate-Volatility	0.098 (0.140)	0.308 (0.145)**	0.155 (0.140)	0.370 (0.144)***	
Temperature-V					- 0.020 (0.034)
Precipitation-V					0.054 (0.050)
Temperature-L			- 0.275 (0.269)	- 0.565 (0.277)**	
Temperature-L^2			0.014 (0.006)**	0.025 (0.006)***	
Precipitation-L			0.008 (0.036)	0.015 (0.037)	
Precipitation-L^2			0.0001 (0.0002)	- 0.00005 (0.00018)	
Estimation			Polity and half-century fixed effects OLS		
Within R^2	0.14	0.15	0.15	0.17	0.15
Number of Observations	1188	1188	1188	1188	1188
			Panel B. The dependent variable is:		
	Irrigation	*Karum*	*Microcredit*	*Irrigation*	*Karum*
Farming-Return	- 7.255 (3.317)**		- 7.240 (3.264)**	- 5.060 (3.375)	
Climate-Volatility					
Temperature-V	- 0.028 (0.035)	- 0.027 (0.034)			
Precipitation-V	0.130 (0.052)**	0.013 (0.050)			
Climate-SD			0.184 (0.674)	1.806 (0.697)***	0.245 (0.544)
Climate-SD^2			- 1.368 (0.412)***	- 1.653 (0.426)***	- 1.294 (0.386)***
Trade-Network		- 4.926 (0.781)***			- 5.132 (0.775)***
Estimation			Polity and half-century fixed effects OLS		
Within R^2	0.15	0.15	0.16	0.16	0.16
Number of Observations	1188	1188	1188	1188	1188

Notes: 1. Standard errors in parentheses. *** denotes significant at the 1% confidence level; **, 5%; *, 10%.
2. The specifications in columns (1), (2) and (5) of panel A and in columns (1), (3) and (4) of panel B also include *Temperature* and *Precipitation*.

Table IV: Clustered and Wild Bootstrapped Standard Errors

	(1)	(2)	(3)	(4)	(5)	(6)
	The dependent variable is:					
	Microcredit	*Irrigation*	*Karum*	*Microcredit*	*Irrigation*	*Karum*
Farming-Return	- 9.806 (4.005)**	- 7.373 (4.885)		- 9.806 (- 2.45)***	- 7.373 (- 1.51)	
Climate-Volatility	0.139 (0.216)	0.342 (0.192)*	0.022 (0.097)	0.139 (0.65)	0.342 (1.781)*	0.022 (0.231)
Trade-Network			- 4.844 (2.702)*			- 4.844 (- 1.794)*
Estimation	Polity and half-century fixed effects OLS					
Within R^2	0.15	0.15	0.15	0.15	0.15	0.15
Number of Observations	1188	1188	1188	1188	1188	1188

Notes: 1. Standard errors clustered at the polity level (T-test obtained from wild bootstrapped standard errors clustered at the polity level) in the parentheses of columns (1) to (3) ((4) to (6)). *** denotes significant at the 1% confidence level; **, 5%; *, 10%.
2. The specifications in columns (1), (2), (4) and (5) also include *Temperature* and *Precipitation*.

Table V: Allowing for Spatial Correlation

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. The dependent variable is:					
	Microcredit	*Irrigation*	*Karum*	*Microcredit*	*Irrigation*	*Karum*
Farming-Return	- 9.806 (3.689)***	- 7.373 (3.510)**		- 9.806 (4.025)**	- 7.373 (3.915)*	
Climate-Volatility	0.139 (0.189)	0.342 (0.177)**	0.022 (0.156)	0.139 (0.204)	0.342 (0.196)*	0.022 (0.153)
Trade-Network			- 4.844 (1.021)***			- 4.844 (1.016)***
Estimation	Polity and half-century fixed effects OLS					
Within R^2	0.22	0.29	0.27	0.22	0.29	0.27
Number of Observations	1188	1188	1188	1188	1188	1188
	Panel B. The dependent variable is:					
	Microcredit	*Irrigation*	*Karum*	*Microcredit*	*Irrigation*	*Karum*
Farming-Return	- 9.806 (4.274)**	- 7.373 (4.073)*		- 9.806 (4.433)**	- 7.373 (4.105)*	
Climate-Volatility	0.139 (0.214)	0.342 (0.211)*	0.022 (0.152)	0.139 (0.223)	0.342 (0.218)	0.022 (0.149)
Trade-Network			- 4.844 (1.018)***			- 4.844 (1.031)***
Estimation	Polity and half-century fixed effects OLS					
Within R^2	0.22	0.29	0.27	0.22	0.29	0.27
Number of Observations	1188	1188	1188	1188	1188	1188

Notes: 1. Conley's (1999) standard errors with Bartlett kernel. The distance beyond which the correlation between error terms is assumed to be zero is 30 (60) km in columns (1) to (3) ((4) to (6)) of panel A and 90 (120) km in columns (1) to (3) ((4) to (6)) of panel B. *** denotes significant at the 1% confidence level; **, 5%; *, 10%.
2. The specifications in columns (1), (2), (4) and (5) also include *Temperature* and *Precipitation*.

Table VI: Alternative Dependent and Control Variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. The dependent variable is:					
	Storage	*Interest-Rate*	*Debt*	*Microcredit*	*Irrigation*	*Karum*
Farming-Return	- 9.067 (5.815)	- 28.194 (2.951)***	- 5.764 (2.626)**	- 10.031 (3.198)***	- 7.642 (3.303)**	
Climate-Volatility	0.409 (0.254)*	0.190 (0.129)	0.147 (0.115)	0.156 (0.140)	0.362 (0.145)**	0.050 (0.138)
Trade-Network						- 4.197 (0.780)***
Polity-Size				0.0002 (0.0001)***	0.0002 (0.0001)***	0.0003 (0.0001)***
Estimation	Polity and half-century fixed effects OLS					
Within R^2	0.09	0.42	0.41	0.15	0.16	0.17
Number of Observations	1188	1188	1188	1188	1188	1188
	Panel B. The dependent variable is:					
	Microcredit	*Irrigation*	*Karum*	*Microcredit*	*Irrigation*	*Karum*
Farming-Return	- 7.661 (3.287)**	- 2.656 (3.356)		- 8.485 (3.329)**	- 5.266 (3.437)	
Climate-Volatility	0.171 (0.140)	0.412 (0.143)***	0.051 (0.140)	0.149 (0.140)	0.358 (0.145)**	0.029 (0.139)
Trade-Network			- 4.926 (0.775)***			- 4.964 (0.779)***
Political-Institutions-N	- 0.041 (0.014)***	- 0.090 (0.015)***	- 0.029 (0.014)**			
Irrigation-P				3.240 (2.196)	5.172 (2.267)**	2.313 (1.607)
Estimation	Polity and half-century fixed effects OLS					
Within R^2	0.15	0.18	0.16	0.15	0.16	0.15
Number of Observations	1188	1188	1188	1188	1188	1188
	Panel C. The dependent variable is:					
	Microcredit	*Irrigation*	*Karum*	*Microcredit*	*Irrigation*	*Karum*
Farming-Return	- 6.953 (3.210)**	- 6.024 (3.354)*		- 9.835 (3.190)***	- 7.407 (3.295)**	
Climate-Volatility	0.132 (0.138)	0.338 (0.145)**	0.023 (0.138)	0.130 (0.140)	0.331 (0.144)**	0.014 (0.139)
Trade-Network			- 5.161 (0.775)***			- 4.927 (0.773)***
Young-King	0.088 (0.016)***	0.042 (0.017)**	0.058 (0.016)***			
River-Shift				0.139 (0.038)***	0.157 (0.039)***	0.100 (0.038)***
Estimation	Polity and half-century fixed effects OLS					
Within R^2	0.17	0.16	0.16	0.16	0.16	0.16
Number of Observations	1188	1188	1188	1188	1188	1188

Notes: 1. Standard errors in parentheses. *** denotes significant at the 1% confidence level; **, 5%; *, 10%.
2. The specifications in columns (1) to (5) of panel A and in columns (1), (2), (4) and (5) of panels B and C also include *Temperature* and *Precipitation*.

Table VII: Panel Difference-in-differences Design

	(1)	(2)	(3)	(4)	(5)	(6)
	The dependent variable is:					
	Microcredit	*Irrigation*	*Karum*	*Microcredit*	*Irrigation*	*Karum*
Farming-Return	- 10.417 (4.259)**	- 7.169 (5.024)		- 10.988 (3.945)***	- 6.764 (4.663)	
Climate-Volatility	0.130 (0.210)	0.324 (0.195)*	0.034 (0.102)	1.370 (0.488)***	1.785 (0.464)***	0.318 (0.854)
Trade-Network			- 3.876 (2.509)			- 3.894 (2.441)
Control variables	NO	NO	NO	YES	YES	YES
Estimation	Polity and half-century fixed effects panel difference-in-differences					
P-value for insignificant pre-trends	0.13	0.45	0.37	0.27	0.23	0.78
Number of Observations	1188	1188	1188	1188	1188	1188

Notes: 1. Standard errors clustered at the polity level in parentheses. *** denotes significant at the 1% confidence level; **, 5%; *, 10%.
2. The specifications in columns (1), (2), (4) and (5) also include *Temperature* and *Precipitation*, whereas those in columns (4) to (6) also incorporate *Great-Rivers-Flow*, *Climate-Volatility*^{2}, *Political-Institutions*, *Public-Buildings*, *External-Conflicts*, *Internal-Conflicts* and *Circumscription*.
3. The "p-value for insignificant pre-trends" refers to the p-value from an F-test that the coefficients on *Farming-Return* and *Climate-Volatility*, both lagged one period, are zero.

II Endogenous Group Formation and Cooperation

Alternative theories of state-building embrace views different from our own. Acemoglu and Robinson (2012) and Boix (2015) agree on the opposite roles of the church and the merchants, whereby only the latter facilitated reforms towards more inclusive political institutions and a market structure rewarding producers, but they have different views of the military. While Boix (2015) claims that military techniques advantaging the looters (producers) ease the formation of stable (unstable) monarchical (republican) regimes, Acemoglu and Robinson (2012) consider the army as the keeper of the status quo. Similarly, North et al. (2009) maintain that the military specialists keep their strength "both to balance one another's power and to overawe their respective clients" [North et al. 2009, p. 20], whereas "nonmilitary elites either control or enjoy privileged access to a vital function like religion, production, community allocation of resources, justice, trade, or education" [North et al. 2009, p. 19-20]. Next, we discuss the inconsistency between these claims and the economic and institutional evidence on Bronze Age Mesopotamia. While doing so, we emphasize that religious, military and merchant ranks arose because of unforeseen technological shocks endowing them with skills complementary to those of the existing elites and that their participation in institutional formation eventually turned them in elite members. As discussed in section 4, these institutional dynamics constitute a key implicit assumption of our model.

Temple.—During the urban revolution period, priestly figures, able to coordinate public good provision, formed the first "great organizations" [Liverani 2014, p. 53, 62-63]. Not only could these religious households co-opt the farmers that migrated from the rain-fed North to the Alluvium during the increasingly dry Chalcolithic period to organize irrigation infrastructures, but they also oversaw the rise of an easily taxable manufacturing sector (Hole, 1994; Dow and Reed, 2023). These dynamics eased urbanization, the rise of city-states and a growing elite-nonelite cooperation in investment [Hole 1994, p. 138-139]. Hence, once part of the elites, religious ranks supported state-building by cooperating with rising non-elite groups. Moreover, they provided guidance on how to share consumption risk to the palatial ranks, first, and the merchants, later, and they limited inter-polity conflicts by promoting shared cultic practices to deities [Matthews and Richardson 2019, p. 21]. These activities helped lock the non-elites in the agreements previously reached with the temple. Even if subordinate to the city rulers, the temples continued to be very influential up to the end of the third millennium by providing military aids and/or performing gubernatorial functions during crises [Steinkeller 2019, p. 126, 132-133]. Finally, during the empires period, the religious elites outsourced economic activities to farmers and private traders [Van De Mieroop 2015, p. 84]. This shift eased the economic and political integration of the merchants and induced the economic supremacy of the palatial ranks (Adams, 2009).

Military.—The expansion of the *sŭku* agreements and the resulting rise of military organizations during the city-states period did not freeze the status quo but induced a further division of the decision-making power whereby the palace jointly organized with the temple farming activities and public good provision (Prentice, 2010; Richardson, 2011). During the kingdoms period, then, new and costly technologies, such as the war-cart and tin-bronze weapons, together with the increased returns on farming, further empowered the military ranks [Marchesi and Marchetti 2011, p. 203, 213, 216; Richardson 2011, p. 18]. Contrary to Boix's (2015) claim however, the palatial households did not crush the other decision-makers, as attested by their cooperation with the temples in the management of economic assets. A case in point is the series of reforms issued by Urukagina, king of Lagash (ca 2330 BCE), who reduced the tax-raising power of temples but outsourced to them the control over farming activities in exchange for a steady flow of revenues [Sallaberger 2018, p. 184]. In a similar manner, in Lagash, even if the digging and maintenance of main watercourses was a royal prerogative, the religious households maintained the control over local irrigation [Rost 2017, p. 10]. During the empires period, finally, despite the rising costs of armory and incidence of warfare [Lafont, 2009; Richardson 2011, p. 34-39; Foster 2016, p. 166-168], palatial ranks favored the enfranchisement of both the merchant families and the farmers of the annexed polities [Seri, 2005; Adams, 2009; Barjamovic 2018, p. 128-129]. Moreover, through the distribution of tenured lands, military conscription turned the soldiers into economic stakeholders with their own collective political power [Richardson 2011, p. 20-48].

Merchants.—Contrary to Acemoglu and Robinson's (2012) and Boix's (2015) idea, the merchants did not simply acquire power when long-distance trades became lucrative. Their empowerment was only possible because of the contemporaneous fall in the returns on the prevailing farming activities. To elaborate, during the fourth and third millennia, merchants merely converted, as private entrepreneurs and institutional agents, commodities into wealth without participating in decision-making [Wilcke 2007, p. 33, 37; Garfinkle, 2010; Foster 2016, p. 180-181; Winters, 2019]. Similarly, in the Ur III period, merchants were organized into guilds, embedded into the provincial administration of the empire [Steinkeller 2004, p. 97-103; Garfinkle 2010, p. 192-193]. The adverse climate shocks of the 2000 BCE, together with the unprecedented diffusion of metals and the collapse of the imperial administrative structure, changed this trend [Garfinkle 2010, p. 186-188; Greenfield, 2013; Barjamovic 2018, p. 123]. For the first time, long-distance trades were jointly organized by the institutionalized decision-makers and the merchant guilds [Adams, 2009; Barjamovic 2018, p. 128; Yoffee and Barjamovic 2018, p. 816-817], who gained the political role of the ex-Ur III administrators (Seri, 2005; Adams, 2009). More important, the merchants did not simply ease the protection of the status quo but championed reforms towards a more open social order. Notably, not only did the chamber of affairs—karum—of Sippar organize long-distance trade but it also supervised, together with the palace, tax collection, judicial activities, royal granaries, the construction of public buildings and defense [Harris 1975, p. 69-70].

III Sample Selection and Measurement Error

Sample Selection.—The city-based polities appeared during the late 4th millennium BCE and by the early 3rd millennium BCE were the dominant form of political unit throughout the Near East [Garfinkle 2013a, p. 95]. Each polity was governed under different political institutions [Grafinkle 2013a, p. 107-109]. Yet, the main ruler usually managed through the royal household and the palatial administration—i.e., scribes, military officials and governors—taxation, the provision of public goods, justice and mass economic production [Garfinkle 2013a, p. 108-109]. This power was possibly shared with the temple and/or assemblies of elders and/or economic groups, i.e., merchants [Garfinkle 2013a, p. 110].

To select our cross-section identifiers, we focus on the polities whose major city reached for most of the 3050-1750 BCE period an urban status, whose location is certain and for which sufficient information on institutional evolution is available. These cities developed political organization exceeding village-level and have been typically capitals of ancient city-states/reigns/empires (Bauer et al., 1998; Wilcke, 2007; Sallaberger and Schrakamp, 2015). As a consequence of our selection criteria, we have excluded the following cities:

I. Cities that for most of the 3100-1750 BCE period did not reach urban status—i.e., an estimated settled area of more than five hectares—and thus, did not develop coordination systems above village-level. Notable examples of cities that reached an urban status outside the 3100-1750 BCE period are Arslantepe, Boğazkale, Jemdet Nasr, Tell al-Ubaid, Tell Ashara, Tell ed-Der, Tell Nebi Mend, Tell Sifr and Tell Uqair.

II. Cities that, albeit being documented as urban sites over the 3100-1750 BCE period, have been interested by limited or no archaeological exploration, e.g. sites not systematically excavated or only subjected to surface sampling. Key examples are Aleppo, Babil, Birs Nimrud, Damascus, Drehem, Kirkuk, Tell Abu Duwari, Tell Abu Hatab, Tell Abu Sheeja, Tell Aqar, Tell al-Deylam, Tell al-Madain, Tell Asharneh, Tell as-Sadoum, Tell Hadidi, Tell Harmal, Tell Ibrahim, Tell Ibzaikh, Tal i-Malyan, Tell Yassir and Tell Zurghul.

III. Cities that, albeit being documented as urban sites over the 3100-1750 BCE period and systematically excavated, cannot be securely matched with ancient polities. Crucial examples are Abu Salabikh, Oylum Hoyuk, Tell al-Wilaya, Tell Arbid, Tell Hamoukar, Titrish Hoyuk, Tutul el-Baqarat, Umm al-Aqareb and Umm el-Jir.

IV. Cities that have not been surely located by archaeologists. The most notable examples are Akkad, Akshak, Armium and Irisagrig.

Measurement Error.—Two are the key sources of measurement error created by the low and/or asymmetric quality of some of our archaeological data. First, the middle chronology is affected by errors ranging between 8 and 30 years (Sallaberger and Schrakamp, 2015; Manning et al., 2016). This, however, is not a major issue in our case being our variables of interest based on the events in the previous half-century. Second, observations on the beginning of third millennium are obtained from deep stratigraphic soundings and not from the more reliable extensive excavations and modern surveys that have produced the data on the rest of the sample [Matthews 2004, p. 12-15, 159, 163; Banning, 2002; Wilkinson 2003, p. 33-43].[I] The fact, however, that this asymmetry uniformly affects the sample greatly

[I] Another source of noise in our estimates might be the asymmetry in the methodologies adopted for each archaeological site and reflecting the different periods in which they were applied. Yet, "several studies have shown broad agreement in the demographic trends produced by the SPD of radiocarbon dates and other limits its impact since, conditional on half-century fixed effects, measurement errors assume a "classical" form, i.e., they are independent of all the true variables. This remark has two key consequences (Angrist and Pischke, 2009). First, errors in the measurement of the dependent variable do not affect the magnitude of the coefficients attached to the independent variables but inflate their standard errors decreasing, in this way, their statistical significance. Second, measurement errors in the independent variables decrease the relative coefficients making our estimates a lower bound of the true impact of environmental conditions on cultural evolution. Together the two effects do not affect the message of our empirical analysis.

IV Measuring a Culture of Cooperation

To measure the intensity of culture, we construct proxies that capture cooperation in either consumption risk-sharing or investment. Starting from the former, we focus on (a) interest-free consumption loans, (b) large-scale foodstuff storage facilities, (c) debt cancellation edicts, and (c) interest rate regulation. Turning to the latter, we consider the diffusion of irrigation infrastructures and merchant organizations. Although, some of these activities were practiced before the beginning of our sample, it is after the 2700 BCE that the intensity of cooperation became sufficiently stable [Paulette 2016, p. 89-92]. We rely on polity- and period-specific secondary sources based on written contracts, royal inscriptions, and other legal sources (e.g., Skaist, [1994]; Roth, [1997]; Westbrook, [2003]; Wilcke, [2007]) as well as as primary sources extracted by the CDLI website, i.e., https://cdli.ucla.edu/ To reconstruct the coverage of laws, we relied on historical maps detailing the changes in the polity borders (Roaf, 1990; Liverani, 2014; de Boer, 2014; Sauvage, 2020). Next, we illustrate the historical evolution of the cooperation in both risk-sharing and investment over our sample.

Cooperation in Risk-sharing

<u>Interest-free Loans</u>

Interest-bearing loans of agricultural products—such as cereals, beer and wine—offered by the institutionalized decision-makers started to be attested as soon as writing was introduced in Mesopotamia (Graeber, 2011; Monaco, 2012). Nevertheless, it is only after

archaeological indices (e.g. raw site count, estimated settlement size)" [Palmisano et al. 2021, p. 4].

about 2500 BCE that these practices expanded, both geographically and in scope (Archi, 2002). Private money lending and interest-free loans were possibly introduced around 2300 BCE [Garfinkle 2004, p. 3-5; Wilcke 2007, p. 111-112]. Particularly noteworthy was the introduction of the "še ur5-ra" system in all the major Alluvium polities during the Ur III period (Notizia, 2019). This practice envisioned interest-free barley loans, which were granted by the institutionalized decision-makers to the tenured farmers before the harvest and possibly returned once the crop was stored [Skaist 1994, p. 38, fig. 3]. Accordingly, the še ur5-ra system worked as "charitable emergency loans" [Richardson 2016, p. 781], protecting tenured farmers from negative shocks to crop production by extending credit on generous terms [Steinkeller 2002, p. 116; Notizia, 2022]. Crucially,[II] it also prevented dependent laborers from turning to private money lenders, decreasing the risk of default and debt bondage [Garfinkle 2004, p. 26; Notizia, 2019]. During the Old Babylonian period, še ur5-ra/*hubullum* grain loans started to bear interests [Skaist 1994, p. 38], but other types of interest-free loans were available. To illustrate, while the šu-lá loan contracts were typical of the Alluvium [de Boer 2017, p. 28], the *hubutattum* contract was employed in North [Skaist 1994, p. 50-56, Table 3, fig. 5]. Other types of contracts were the ze-ra-nu and našapakūtum, even it is unclear whether they required interest payments [Skaist 1994, p. 56-63, 77-81].

Table VIII: Secondary and Primary Sources Employed to Construct *Microcredit*

Period	Polity name	Secondary sources (references)	Primary sources (CDLI keywords)
2100 - 2050	Girsu	Notizia (2019, 2020)	še ur5-ra
	Lagash	Notizia (2019, 2020)	še ur5-ra
2050 - 1900	Girsu	Notizia (2019, 2020)	še ur5-ra
	Lagash	Notizia (2019, 2020)	še ur5-ra
	Nippur		še ur5-ra, eš-de2-a and šu-la2-a
	Shush	Notizia (2019, 2020)	še ur5-ra
	Umma		še ur5-ra
	Ur		še ur5-ra
1900 - 1800	Eshnunna	Skaist (1994)	šu-la2-a
	Kish	Skaist (1994)	še ur5-ra, eš-de2-a and šu-la2-a
	Larsa	Skaist (1994)	šu-la2-a
	Nippur		še ur5-rav
	Shush		še ur5-ra, eš-de2-a and šu-la2-a
	Sippar	Harris (1960)	še ur5-ra, eš-de2-a and šu-la2-a
	Tutub	Skaist (1994)	še ur5-ra and eš-de2-a
	Umma		še ur5-ra
	Ur	Skaist (1994)	šu-la2-a
1800 - 1750	Eshnunna	Skaist (1994)	šu-la2-a
	Kish		šu-la2-a
	Larsa	Skaist (1994)	šu-la2-a
	Mari	Harris (1960)	še ur5-ra
	Nippur	Skaist (1994)	šu-la2-a
	Shush	Harris (1960)	še ur5-ra, eš-de2-a and šu-la2-a
	Sippar	Skaist (1994)	še ur5-ra, eš-de2-a and šu-la2-a
	Tutub	Skaist (1994)	še ur5-ra and eš-de2-a
	Ur	Skaist (1994)	šu-la2-a

[II] Richardson [2016, p. 778-779] documents frequent pleas for 1 silver shekel loans in Old Babylonian letters, enough to purchase ca 300 liters of barley and stave off starvation. Additionally, Harris [1960, p. 131-132] suggests that the Old Babylonian temples issued indigence/solvency loans to relieve the burdens of debtors.

The key secondary source employed to construct the variable *Microcredit* is Skaist (1994), who mapped the spatial and chronological distribution of loan contracts in the Alluvium between the late 3rd and the early 2nd millennium BCE. We have supplemented this data with more recent period-specific studies on loaning practices (Harris, 1960; Notizia, 2019; 2020) and primary sources directly collected from the CDLI database. Building on the aforementioned evidence, we have searched the keywords "še ur5-ra," "eš-de2-a" and "šu-la2-a," which according to Skaist (1994) and the Electronic Pennsylvania Sumerian Dictionary denote the main interest-free loans, and selected 947 administrative and contractual texts. Table VIII lists for each relevant period and polity the keywords reported by these texts.

Large-scale Foodstuff Storage Facilities

Albeit the storage of foodstuff represented a crucial consumption risk-sharing mechanism among both hunter-gatherers and early farmers (Halstead and O 'Shea, 1989), the shift from foraging to farming also corresponded to a move towards hoarding as main buffering strategy (Bogaard et al., 2010). This innovation fostered, during the second half of the 4th millennium BCE, the adoption of increasingly sophisticated technologies for storing food (Hildebrand and Schilling, 2016; Manzanilla and Rothman, 2016), and notably, large-scale, centrally managed facilities [Paulette, 2016, p. 86-89; Frangipane, 2018; Benati 2018, p. 112-125].

To construct the variable *Storage*, we have exploited both secondary and primary sources. Starting from the former, we have analyzed the existing studies of the spatial and chronological distribution of excavated remains of granaries and/or storage facilities (Pfälzner, 2002; Paulette, 2015; 2016; Benati, 2016; Vacca, 2020). Turning to the latter, we have singled out a set of cuneiform terms that, according to the extant literature, indicate the existence of central granaries and selected the 3327 administrative and contractual CDLI documents that report these keywords. We have focused on the terms: (i) i3-dub "silo;" (ii) guru7 "granary;" (iii) ka-guru7 "granary supervisor;" (iv) našpakum "cereal storage/granary" [Paulette 2016, p. 90; Johnson, 2017; Rattenborg 2016, p. 86; Widell 2018, p. 32; Borrelli 2020, p. 47]. Based on our source (see table IX), the following patterns can be identified.

While major storage facilities appeared from the inception of the Bronze Age [Paulette 2016, p. 89-92], a proper take-off took place in the post-2700 BCE period in the Northern polities of Abarsal, Ebla, Hama, Nabada, Nagar, Qatna, Shubat Enlil, Ugarit and Urkesh

[Paulette 2015, p. 73-87, 101-113; Vacca 2020, p. 298] and in the Southern cities of Adab, Girsu, Isin, Lagash, Shuruppak and Ur [Benati, 2013; Paulette 2015, p. 127-136, 151-161].

Table IX: Secondary and Primary Sources Employed to Construct *Storage*

Period	Polity name	Secondary sources (references)	Primary sources (CDLI keywords)
2700 - 2600	Hama	Vacca (2020)	
	Shubat Enlil	Paulette (2015)	
	Ur	Benati (2013)	
2600 - 2550	Hama	Vacca (2020)	
	Shubat Enlil	Paulette (2015)	
	Ur	Benati (2013)	
2550 - 2500	Ebla	Vacca (2020)	
	Qatna	Vacca (2020)	
	Shubat Enlil	Paulette (2015)	
	Shuruppak	Paulette (2015)	ka-guru7
	Ur	Benati (2013)	guru7, ka-guru7 and i3-dub
2500 - 2340	Abarsal	Pfälzner (2002)	
	Adab		guru7
	Ebla	Vacca (2020)	
	Girsu	Paulette (2016)	guru7 and ka-guru7
	Hama	Vacca (2020)	
	Isin		guru7
	Lagash	Paulette (2016)	guru7, ka-guru7 and i3-dub
	Nagar	Paulette (2015)	
	Nabada	Vacca (2020)	
	Qatna	Vacca (2020)	
	Shubat Enlil	Paulette (2015)	
	Umma		guru7
	Ur	Benati (2013)	
2340 - 2200	Abarsal	Pfälzner (2002)	
	Adab		guru7 and ka-guru7
	Ebla	Vacca (2020)	
	Eshnunna		guru7
	Girsu	Paulette (2016)	guru7, ka-guru7 and i3-dub
	Lagash	Paulette (2016)	guru7, ka-guru7 and i3-dub
	Nagar	Paulette (2015)	
	Qatna	Vacca (2020)	
	Shubat Enlil	Paulette (2015)	
	Shush		ka-guru7
	Tutub		guru7
	Umma		guru7, ka-guru7 and i3-dub
	Ugarit	Vacca (2020)	
	Ur	Benati (2013)	
	Urkesh	Paulette (2016)	
2200 - 2100	Abarsal	Pfälzner (2002)	
	Nagar	Paulette (2015)	
	Urkesh	Paulette (2016)	
2100 - 2000	Girsu	Borrelli (2020); Widell (2018)	guru7, ka-guru7 and i3-dub
	Lagash	Borrelli (2020); Widell (2018)	guru7, ka-guru7 and i3-dub
	Nagar	Paulette (2015)	
	Nippur	Widell (2018)	guru7, ka-guru7 and i3-dub
	Shuruppak		ka-guru7
	Umma	Paulette (2016)	guru7 and ka-guru7
	Ugarit	Vacca (2020)	
	Ur	Paulette (2015)	guru7, ka-guru7 and i3-dub
2000 - 1850	Adab		guru7 and ka-guru7
	Hama	Benati (2016)	
	Isin		guru7
	Larsa		guru7 and i3-dub
	Nagar	Paulette (2015)	
	Umma		guru7 and ka-guru7
	Ur	Paulette (2015)	guru7
1850 - 1800	Alalakh	Benati (2016)	
	Hama	Benati (2016)	
	Larsa	Breckwoldt (1996)	guru7 and i3-dub
	Tutub		guru7
1800 - 1750	Alalakh	Benati (2016); Lauinger (2007)	naszpakum
	Ashnakkum	Dolce (1989)	
	Hama	Benati (2016)	
	Isin		guru7, ka-guru7 and i3-dub
	Larsa		guru7, ka-guru7 and i3-dub
	Mari		guru7
	Nippur		guru7, ka-guru7 and i3-dub
	Sippar		guru7 and i3-dub
	Tuttul	Rattenborg (2016)	
	Tutub		guru7
	Ur	Paulette (2015)	guru7

This innovation process further intensified during the Akkadian and post-Akkadian periods in both the rain-fed North—e.g. Abarsal, Khuera, Nagar, Shubat-Enlil, Ugarit and

Urkesh, [Pfälzner 2002, p. 272; Paulette 2015, p. 54-126; Vacca 2020, p. 472]—and the irrigated South, i.e., Adab, Eshnunna, Girsu, Lagash, Susa, Tutub and Umma. Next, and during the Ur III period, large-scale foodstuff storage facilities expanded in the Southern towns of Girsu, Lagash, Nippur, Sippar, Shuruppak, Umma and Ur [Paulette 2015, p. 151-161, 2016, p. 94-96; Johnson 2017; Widell, 2018; Borrelli, 2020] and in the Northern polities of Nagar and Ugarit [Paulette 2015, p. 82; Vacca 2020, p. 472]. A final diffusion wave interested, during the post-Ur III period, the rain-fed polities of Hama and Nagar [Paulette 2015, p. 82; Benati 2016, p. 125-126], Ashnakkum and Alalakh [Dolce 1989, p. 28-29; Benati 2016, p. 145-146; Rattenborg 2016, p. 210], and Mari and Tuttul [Rattenborg 2016, p. 275-276, 369], as well as the irrigation-based farming polities of Isin, Larsa, Nippur, Sippar, Tutub, Umma and Ur [Dolce 1989, p. 27-28; Breckwoldt, 1996].

Debt Cancellation Edicts

Edicts proclaiming the retroactive cancellation of debts and overdue tax obligations started to be promulgated in Lower Mesopotamia by the pre-Sargonic kings of Girsu/Lagash around 2450 BCE [Renger 2002, p. 142; Wilcke 2007, p. 21-25]. The so-called amar-gi4 "liberation" or "clean slates" edicts temporarily relieved non-elites of noncommercial debts and tax-related obligations such as corvée [Wilcke 2007, p. 21]. Similar measures were issued during the Ur III period in the Alluvium by Gudea of Lagash, his son Ur-Ningirsu and Urnamma of Ur [Hudson 2002, p. 7; Renger 2002, p. 144; Wilcke 2007, p. 25].

From 2000 BCE on, five major structural changes favored the promulgation of debts remission edicts, such as the *andurarum* or *mišarum* (Charpin, 1990; Renger, 2002; Simonetti, 2013).[III] First, the rule of partible inheritance entailed that all first-generation descendants were entitled to a share of the family estate [Adams 2009, p. 8]. This usage worsened land property fractionalization decreasing, at the same time, the returns on land holding. Second, palaces and temples started to sell their estates to private entrepreneurs who further squeezed the share left to the tenured farmers [Renger 2002, p. 144-145; Van De Mieroop 2015, p. 83-84]. Third, the adverse climate shocks of the early 2nd millennium BCE, made

[III] While Charpin [2014, p. 46-47] claim that these edicts were universally applied and especially among the poorest social strata, Richardson [2016, p. 780] suggests that the relief was mostly intended for the indebted personnel of the institutionalized decision makers. Surely, this system of relief was complementary to emergency loans since it was mostly directed at solving long-term insolvency problems.

small-scale farming increasingly unprofitable forcing tenants to rely more heavily on private credit [Jacobsen 1982, Appendix 19; Richardson 2015, fig. 3; Van De Mieroop 2015, p. 85-86; Benati et al., 2021; Farber 2021, p. 71, 74]. Fourth, rules allowing debt-bondage became more widespread [Steinkeller 2002, p. 124]. Finally, political instability eased the transfers of forfeited land, labor, and capital from the tenants to private entrepreneurs [Adams 2009, p. 8; Farber 2021, p. 266-269]. To counteract the mix of these distortionary phenomena, Old Babylonian rulers canceled debts and returned forfeited land by decree every 15 or 20 years over the 1800-1600 BCE period [Renger 2002, p. 144-155; Simonetti 2013, p. 316]. These edicts were issued so often that loan contracts started to incorporate clauses trying to insulate the creditors from them [Simonetti 2013, p. 317-318]. Similar debt cancellation edicts were issued by the rulers of Mari, Aleppo/Yamhad, Shamshi-Addu and Ashur [Van De Mieroop 2002, p. 78; Simonetti 2013, p. 322-327]. Finally, indirect evidence on debt cancellation edicts in Kanesh is provided by the trade contracts produced by the Assyrian merchants operating in the local karum [Simonetti 2013, p. 321-322; Michel 2013, p. 49].

Interest Rate Regulation

Attempts to fix prices and interest rates were aimed at counteracting fluctuations caused by productivity shocks and avoiding that tenants were forced into debt because of the harvest destruction [Farber 1978, p. 17-21; Hudson 2000, p. 139, 147; Hudson 2002, p. 24; Farber, 2021]. As stated in the Hammurabi Code, interest rate regulation was "meant to give a weak debtor—a small farmer or tenant—some legal protection and help" [Hudson 2019, p. 50-51]. Interest rates on short-term commodity loans ranged, at the end of the 4th millennium BCE, between 10% and 20% [Monaco 2012, p. 178]. During the pre-Sargonic period, the interest rate on commercial debts denominated in silver soared to around 20% per year, whereas agrarian debts denominated in barley ranged between 20% and 33% [Hudson 2000, p. 133, 147-148; Van De Mieroop 2002, p. 62-65, 84-85]. In the face of these interest rate fluctuations, law codes and edicts kept rates stable between the Ur III and the Old Babylonian periods [Skaist 1994, p. 140-141; Hudson 2000, p. 142; Van De Mieroop 2002, p. 68-69]. In the aftermath of the promulgation of the Urnamma code [Roth 1997, p. 13-22], interest regulations were included in the laws issued by the Old Babylonian rulers, such as Lipit-Ishtar, king of Isin [Roth 1997, p. 23-35], Dadusha, king of Eshnunna [Roth 1997, p.

57-70], and Hammurabi of Babylon [Roth 1997, p. 71-142]. Indirect evidence about interest rates-regulation comes, moreover, from the trade contracts signed by the merchants operating between the Assyrian karum of Kanesh and the city of Ashur and from the inscriptions of the Sukkalmah period rulers of Susa/Elam [Veenhof, 1995, p. 1722-1724, 1736; Potts 1999, p. 174, Table 6.4; Dercksen 2004, p. 46-47]. As a consequence of these edicts, during the Old Babylonian period, barley was lent in the Northern part of the alluvium at an interest rate of 33.3% and in its Southern portion at a 20% interest rate, whereas the interest rate on commercial debts denominated in silver was stable at 20% [Skaist 1994, p. 138]. Finally, while the normal interest rate among Assyrian traders was 30%, the karum of Kanesh paid a 20% interest rate on money deposited in its safes and the City Hall of Ashur charged the accredited merchants a 10% yearly interest rate [Dercksen 2004, p. 47].

Cooperation in Farming and Long-Distance Trade Investments

Irrigation Infrastructures

To construct the number of archaeologically and historically attested irrigation infrastructures built over the previous half-century, we focus on the primary sources on the development of state-sponsored artificial canalization works that were organized over the 4th and especially 3rd millennium BCE [Wilkinson and Hritz, 2013; Wilkinson et al., 2015; Rost, 2017; 2019; Altaweel, 2019; Middeke-Conlin, 2020]. To begin with, we employ the Mesopotamian Year Names database, which is available at https://cdli.ucla.edu/tools/yearnames/yn_index.html, and collects royal inscriptions detailing the kings' accomplishments, i.e., battles, construction of public buildings, temple dedications, and canals digging. Moreover, we rely on the RIME-RIMA series, which are the most complete editions of royal deeds. Although the technology necessary to build artificial waterways was already present at the household level, it was only during the late 4th millennium BCE that, because of the increasingly arid climate that triggered the drying up of the southern Alluvium, urban centers became increasingly reliant on irrigated farming organized above household-level [Wilkinson et al., 2015; Rost 2017, p. 6-9; Altaweel, 2019]. The 3rd millennium BCE witnessed a further intensification of these large-scale public-private partnerships [Rost 2017, p. 9]. To elaborate, monumental inscriptions and administrative records indicate that both the excavation and maintenance of artificial canals was jointly organized by the institutionalized decision-makers and state personnel via the corvée system whereby peasants enjoying use rights over institutional land assets were required to perform a quota of work in public building projects that also comprised excavation and maintenance of canalization networks [Rost 2017, pp. 11-12]. While the digging and maintenance of the main canals became a fundamental ingredient of the royal attempt to co-opt a larger workforce from the countryside [Richardson, 2012; Rost 2017, p. 12], the temples managed the local waterway networks [Rost 2017, p. 10]. Finally, the increasingly erratic and dry climate of the early 2nd millennium BCE raised the frequency of disastrous floods, prompting massive state interventions in the maintenance of irrigation infrastructures [Rost 2017, p. 12-13]. The following stylized patterns can be identified.

While the 3050-2650 BCE period was characterized by limited investment in irrigation infrastructures, a proper take-off took place after 2650 BCE and, especially, around 2400 BCE. To illustrate, the pre-Sargonic rulers of the major Southern polities—i.e., Ur, Girsu, Lagash, Kish and Umma—heavily invested in digging canals, although the scope of such waterway networks remained essentially local [Rost 2017, p. 10]. These investments drastically dropped around 2300 BCE, when Greater Mesopotamia was shaken by the intense inter-state warfare that accompanied the rise of the Akkadian empire. The levels of centralized intervention on the irrigation networks remained low throughout the Akkadian and post-Akkadian phases except in the major centers of Adab, Isin, Kish and Nippur [Rost 2017, p. 11]. A dramatic acceleration was again experienced after 2100 BCE, when the Ur III kings consolidated their control over the Alluvium and heavily invested in public goods provision [Rost 2017, p. 11-12; Marchetti et al. 2019, fig. 8f]. Investment in irrigation infrastructures remained generally high throughout the post-Ur III phase when the Amorite states were forced to deal with the increasingly drier climate [Rost 2017, p. 12-14]. Not only did canalization intensified in the Southern polities, but large-scale artificial irrigation practices also spread in the Northern part of the Alluvium and, notably, in Mari and Ashur.

Merchant Institutions

Despite the large farming productivity, early states, such as Egypt and the Mesopotamian city-states, lacked relevant inputs, like stones and/or metals, and demanded precious commodities for the elites' conspicuous consumption [Kristiansen 2018, p. 87]. These consumption features pushed the more peripheral regions rich of stones, metals and luxury goods to setup, during the fourth millennium, primordial long-distance commercial networks (Algaze, 2008; Kristiansen, 2018). These far-flung exchanges, however, significantly shrunk at the end of the fourth millennium BCE to revive again almost a millennium afterwards during the second urbanization wave (Massa and Palmisano, 2018). Although most scholars agree on the fact that these archaic long-distance trades consisted of state-run exchanges of low-bulk/high-value items that were required by palatial elites (Crawford, 2013; Massa and Palmisano, 2018), novel information from the Ebla state archives suggests that existence of a stable cooperation between institutionalized decision-makers and private traders in the exchange of substantial volumes of raw materials and finished products such as metals, olive oil, textiles and timber (Winters, 2019; Benati and Bonechi, 2019). Already around 2400/2300 BCE in Syria indeed, long-distance trades were regulated by political treaties and supported by institutional infrastructures such as ports, specialized trading communities, trading quarters, markets, armed escorts and so forth [Yoffee and Barjamovic, 2018 p. 821; Winters, 2019]. Already at the end of third millennium BCE, emergent merchant families contracted with the temple and/or palace and, in some cases and in an unstructured manner, became part of the ruling elites [Garfinkle, 2012; Yoffee and Barjamovic 2018, p. 821].

This mixture of trade and politics, however, bears no comparison with the institutional evolution fueled by the exchanges that, starting from the 2000 BCE diffusion of metals in virtually all households, integrated the resources-rich Mediterranean and Anatolian peripheries with the Mesopotamian polities through the action of nomadic and semi-nomadic communities [Greenfield, 2013; Kristiansen 2018, p. 88-89; Barjamovic 2018, p. 122-123]. These trade flows were channeled by two major interlocking circuits—Old Assyrian and Old Babylonian trade networks—structured around connecting nodes and organized by communities of private traders that relied upon free agents and foreign commercial settlements [Barjamovic 2018, p. 124-125]. The Old Assyrian trade network linked merchants in Ashur with their representatives in Kanesh [Liverani 2014, p. 213], which, in turn, were related to a commercial network extending throughout Anatolia [Barjamovic 2018, p. 128]. Texts from the city of Sippar imply, furthermore, the existence of a Babylonian network linking Sippar with the Southern and Eastern ports, like Eshnunna and Susa, through institutions similar to those employed within the Old Assyrian trade network [Barjamovic 2018, p. 125]. Similarly, there were permanently settled Sippar merchants in Susa [Barjamovic 2018, p. 125]. To illustrate, Sippar operated as hub for both the routes that brought tin across the Zagros and down along the Diyala River and the itineraries that brought copper from Dilmun along the Euphrates River through Mari into Syria [Barjamovic 2018, p. 125].

Different from the fourth and third millennium exchange circuits, the Old Assyrian and Old Babylonian trade networks were organized around merchant organizations which managed, together with the institutionalized decision-makers, the provision of the public goods supporting trade—i.e., construction and maintenance of trade routes and defensive systems and the diffusion of inter-polity agreements—and eased, in this way, the establishment of powerful merchant families as the third institutionalized decision-making power [Van De Mieroop, 2015; Barjamovic, 2018; Yoffee and Barjamovic 2018, p. 816]. The mix of the collapse of the Ur III empire and the intensified inter-polity interaction greatly facilitated this process by paving the way for the rise of the karum [Postgate 1992, p. 300]. Managed by urban elites, the karum represented both a guild and a chamber of affairs regulating trade, and it possessed its own quarter or port quay [Harris 1975, p. 257-269; Palmisano 2018, p. 22]. The karum liaised with the other institutionalized decision-makers granting the rising merchant households political and legal power [Postgate 1992, p. 300]. In Ashur for instance, the same individuals acted as commercial agents, financial intermediaries and oligarchs [Yoffee and Barjamovic 2018, p. 818]. Other cities, such as Emar, Tuttul and Sippar, specialized in overland trade and displayed similar oligarchic institutions [Harris, 1975; Fleming, 2004; Yoffee and Barjamovic 2018, p. 817]. The karum in our sample was established, first, in Ashur, Eshnunna, Kanesh and Larsa and, then, in Babylon, Karkemish, Kish and Sippar [Kraus, 1982; Goddeeris, 2002; Barjamovic 2018, p. 125; Palmisano, 2018].

V Tackling Unobserved Heterogeneity: Details

Controlling for Observables.—In table VI, we document that considering the other factors related by the extant literature to state-building leaves unchanged our conclusions.

First, we evaluate the institutional effect of modernization by considering the estimated settled area in hectares of each polity over the previous half-century (Inglehart and Welzel, 2005), i.e., *Polity-Size*. This figure is obtained by observing walled area, distribution of pottery fragments and extension of settlement remains over archaeological sites, and it is correlated with urbanization and population density [Colantoni 2017, p. 95-106]. As expected, economic development is positively linked to cultural accumulation.

Second, we consider the average of *Political-Institutions* over the remaining polities weighted by the inverse distance to each of them, i.e., *Political-Institutions-N*. This proxy picks the negative impact on the non-elites' culture of political reforms in neighboring polities inducing, in turn, a rise in the inclusiveness of the polity's political process (Carneiro, 1970: Fleck and Hanssen, 2013). Consistent with such a political circumscription hypothesis, *Political-Institutions-N* is negatively and significantly related to cultural accumulation.

Third, we test the Wittfogel's (1957) idea that despotism was necessary to organize large-scale irrigation systems by incorporating in $\mathbf{Z}_{p,t}$ the normalized—to range between zero and one—product of *Temperature* and the irrigation impact score produced by the GAEZ project for the entire planet at a 5 arc-minute resolution, i.e., *Irrigation-P* (Bentzen et al., 2016). Consistent with a negative impact of *Irrigation-P* on the inclusiveness of the political process, this proxy is positively and significantly related to the intensity of culture.[IV]

Fourth, we construct a measure of political instability defined as the average over the other polities of a dummy for the ascent to the throne, over the previous half-century, of kings twenty or younger weighted by the inverse distance to each of them, i.e., *Young-King*. Intuitively, an inexpert ruler is more vulnerable to attacks and may be more willing to enact a more inclusive political institution (Cassidy et al., 2015). Inconsistent with this view, *Young-King* is positively and significantly linked to culture.

Finally, we test the idea that a shift over the previous half-century of the segment of either the Tigris or the Euphrates closest to the polity—i.e., *River-Shift*—created a demand for state institutions supporting public canalization (Allen et al., 2023). Contrary to this speculation, the great rivers avulsion seems to favor and not hinder cultural accumulation.

Using Selection on Observables to Assess the Bias from Unobservables.—

[IV] The irrigation impact score equals one for areas unsuitable for agriculture, two for those such that additional water does not increase yields, five for areas in which irrigation can more than double yields and values between two and four for cases intermediate between the one and five scenarios. Being based on present-day agro-edaphic conditions, this index is likely determined by historical institutions and thus, endogenous.

Despite our attempts to control for observable factors, the estimates presented so far may still be biased by unobservable factors. To evaluate this issue, we calculate the index proposed by Bellows and Miguel (2009) to measure how much stronger selection on unobservables, relative to selection on observables, must be to explain away the entire estimated effects. To see how the index is calculated, consider a regression with a restricted set of controls and one with a full set of controls. Next, denote the estimate of the coefficient attached to the variable of interest from the first regression λ^R, where R stands for "restricted," and that from the second regression λ^F, where F stands for "full." Then, the index is the absolute value of $\lambda^F/(\lambda^R - \lambda^F)$. The intuition behind the formula is as follows. The lower the absolute value of $(\lambda^R - \lambda^F)$ is, the less the estimate of the coefficient attached to the variable of interest is affected by selection on observables, and the stronger selection on unobservables needs to be to explain away the entire effect. Similarly, the higher the absolute value of λ^F is, the greater is the effect that needs to be explained away by selection on unobservables.

We consider the specifications without controls listed in table 3 as the restricted regressions and those incorporating all controls in columns (4) to (6) of table 4 as the full regressions. We report the indexes calculated from the regressions with dependent variable *Microcredit*, *Irrigation* and *Karum* in columns (1) to (3) of table 5, respectively. Two are the key observations. First, no index is lower than one. Second, the median (average) of these indexes is 18.18 (3.11). As a consequence, to attribute the entire estimates to selection effects, selection on unobservables would have to be on average more than eighteen times greater than selection on all observables, which seems unlikely.

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