Appendix for:

Institutional Adaptation to Environmental Change

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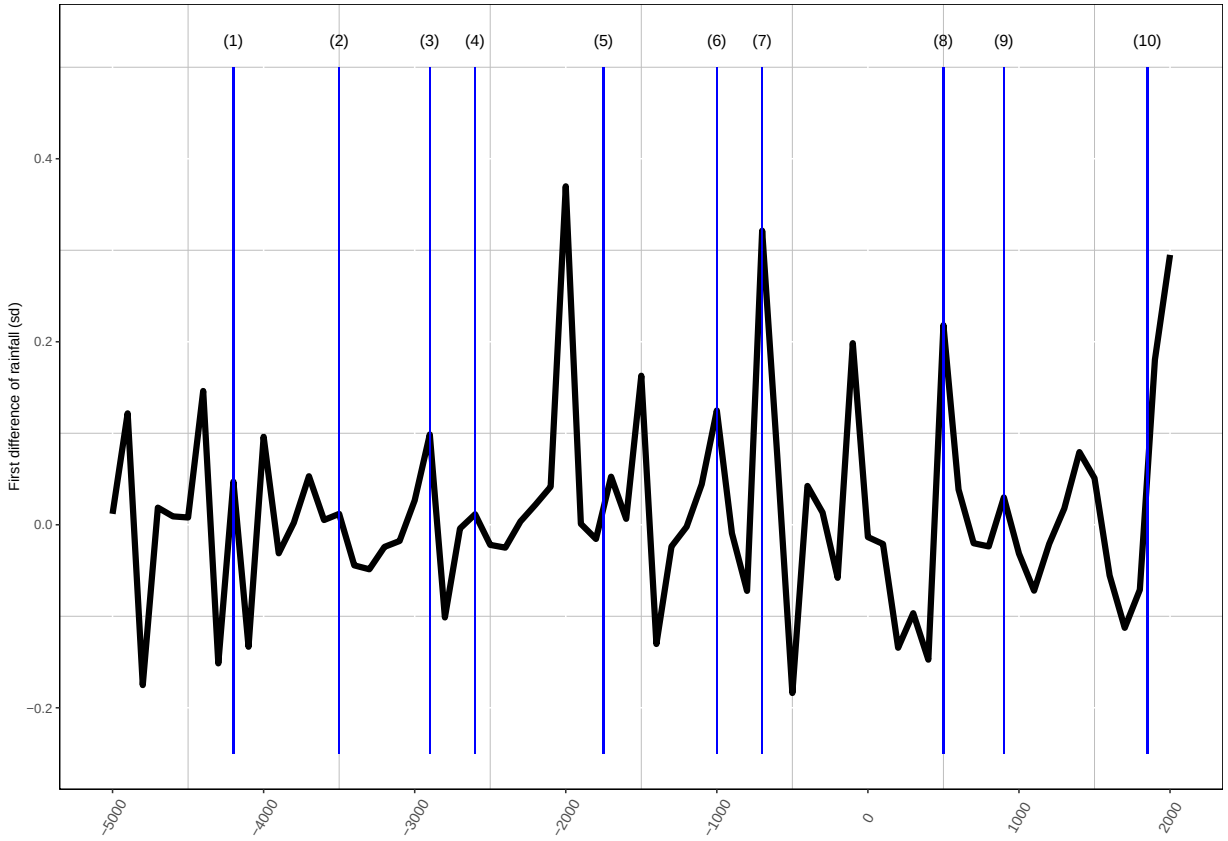
1 Additional tables

In figure A1, we relate changes in rainfall in Turkey to river shifts in southern Iraq. The x-axis measures time, and the y-axis measures the first difference of the fifty year standard deviation of yearly rainfall. The source and construction of this data are described in the data appendix. Vertical lines indicate river shifts in Iraq, and the continuous line measures the time-series of rainfall. The idea of this graph is to provide intuition for the assertion by historians that river flow levels (see section 3.2.1 of the paper), the primary driver of river shifts in Iraq, are in turn driven by rainfall patters in Turkey.

Figure A1 provides graphical intuition for this assertion. River shifts in Iraq occur coincidental with increases in the volatility of rainfall in Turkey. Although it is impossible with the available data to provide a causal link between rainfall changes in Turkey and river shifts in Iraq, the available data support the take of historians on the ultimate - exogenous - source of changes in river flow level, and river shifts. We provide further supporting evidence for the exogeneity of river shifts in table 3 in the paper.

FIGURE A1: RAINFALL AND RIVER SHIFTS



Notes: this graph relates changes in the 50 year standard deviation of rainfall in Turkey to river shifts in southern Iraq. River shifts are numbered, and the numbers correspond to those in table 1 in the paper and table 3 in the data appendix, which contain descriptions of each shift. The coincidence of increases in rainfall volatility and river shifts supports the claim that river shifts ultimately result from increases in flow level brought on by increases in upstream rainfall.

2 Additional tables

Table A1 extends table 5 column (1) by testing robustness to omitting the included period x rainfall and period x temperature covariates, as well as to using the extent in hectares of settlements rather than the number of settlements. We do not use extent of settlements in the main text because our archeological data do not provide a time-varying measure of settlement size. We therefore only know maximum extent and this table assesses robustness to an panel-wide size effect, testing whether there are a few large settlements driving our results. Throughout all exercises the effect of a river move is stable. We lose some precision on the size results, but the point estimates are stable.

tables A2 and A3 repeat table 5, with two changes. Table A2 shows the period $k-2$ coefficients rather than reporting p-values. Results are therefore identical to those in the main tables. Table A3 reports results using the restricted control group described in section 3.2.2.

Tables A4 and A5 show $k-2$ coefficients, and show results with the restricted sample described in section 3.2.2 for table 6, showing the robustness of the state formation results for the city states period. Table A6 repeats table 6, controlling for the number of conflicts in our panel of local conflicts described in the data appendix. The effect of a river shift is stable, and gets slight more precisely estimated. Tables A7, A8 and A9 repeat these analyses for table 7, which estimates the effect of a river shift on state formation in the centralized states period. The result of that table is robust throughout. Table A10 and table A11 report $k-2$ coefficients and results with a restricted sample for table 9, which showed the effect of a river shift on canal construction. Overall, all results hold up. For the results using our restricted control group, the sizes of the point estimates fluctuate due to sometimes small samples. These small samples results from our rather restrictive main specifications which only considers grid cells directly adjacent to rivers.

Tables A12 and A13 implement the same exercise for table 9, reporting $k-2$ coefficients and results with a limited sample. All results go through. Table A14 instead creates 'synthetic periods' for each experiment. One question we face is whether the fact that we follow the periodization the archeologists impacts our results. In table A14 we therefore created periods of 200 years before and after the river move, for the city states and centralized states experiment and 450 years before and after the river move for the placebo experiment. We use these 'pre' and 'post' periods in a standard difference-in-differences specification and report the effect of river shift[1] As in table 9, there is no effect of river move on settlement when there is a

[1]We create these periods by combining archeological periods to add up to equal sized 'synthetic periods' around a river move. For the city states period this means using period 7 as pre-period and period 8 as post period. For the centralized states experiment,

state, in the city states and centralized states experiment, and a strong negative response in the placebo period.

TABLE A1: THE EFFECT OF A RIVER MOVE ON SETTLEMENT SIZE

Dependent variable:	Nr. of settlements		Log settlement size (ha)	
	(1)	(2)	(3)	(4)
river move (yes/no) t-2	-0.0199	-0.0193	0.0140	0.0145
	(0.0333)	(0.0333)	(0.0320)	(0.0320)
river move (yes/no)	-0.124***	-0.125***	-0.0614*	-0.0618*
	(0.0336)	(0.0335)	(0.0350)	(0.0350)
Period x archeological excavation	Y	Y	Y	Y
Period x rainfall	N	Y	N	Y
Period x temperature	N	Y	N	Y
P-value pre-trend	0.55	0.56	0.66	0.65
Observations	72042	72042	72042	72042
R^2	0.26	0.26	0.32	0.32

Notes: All regressions are estimated using OLS. All estimated coefficients are standardized. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). Nr. of settlements is the count of settlements. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

we use period 13 and 14 (combined) as pre period, and period 15 as post period. For the placebo experiment we use period 16 as pre period and period 17 as post.

TABLE A2: THE EFFECT OF A RIVER MOVE ON SETTLEMENT, WITH K-2 POINT ESTIMATES

Dependent variable:	Nr. of settlements		
Sample:	*Full sample*	*High environmental pressure*	*Low environmental pressure*
	(1)	(2)	(3)
river move (yes/no) k-2	-0.0202	-0.0263	0.199
	(0.0333)	(0.0340)	(0.196)
river move (yes/no)	-0.124***	-0.133***	0.0948
	(0.0336)	(0.0343)	(0.192)
Period x archeological excavation	Y	Y	Y
Period x rainfall	Y	Y	Y
Period x temperature	Y	Y	Y
Observations	72042	52425	18951
R^2	0.26	0.26	0.22

Notes: All regressions are estimated using OLS. All estimated coefficients are standardized. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). Nr. of settlements is the count of settlements. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

TABLE A3: THE EFFECT OF A RIVER MOVE ON SETTLEMENT, RESTRICTED SAMPLE

Dependent variable:	Nr. of settlements		
Sample:	*Full sample*	*High environmental pressure*	*Low environmental pressure*
	(1)	(2)	(3)
river move (yes/no) k-2	0.0297	0.0144	0.407**
	(0.0292)	(0.0296)	(0.176)
river move (yes/no)	-0.0863**	-0.103***	0.270
	(0.0383)	(0.0393)	(0.189)
Period x archeological excavation	Y	Y	Y
Period x rainfall	Y	Y	Y
Period x temperature	Y	Y	Y
P-value pre-trend	0.31	0.63	0.02
Observations	18720	16320	2271
R^2	0.50	0.50	0.39

Notes: All regressions are estimated using OLS. All estimated coefficients are standardized. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). Nr. of settlements is the count of settlements. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

TABLE A4: THE EFFECT OF A RIVER MOVE ON STATE FORMATION: CITY STATES, WITH K-2 POINT ESTIMATES

Dependent variable:	Under city state (yes/no)	Nr. of admin buildings nearest city	Admin building area nearest city (m2)
	(1)	(2)	(3)
river move (yes/no) t-2	0.0145	-0.0302	18.83
	(0.0193)	(0.0471)	(143.1)
river move (yes/no)	0.110***	0.108***	374.6***
	(0.0418)	(0.0343)	(129.6)
Period x archeological excavation	Y	Y	Y
Period x rainfall	Y	Y	Y
Period x temperature	Y	Y	Y
Mean dep. var.	0.29	0.27	923.92
Observations	2559	2559	2559
R^2	0.78	0.86	0.88

Notes: All regressions are estimated using OLS. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). Under city state (yes/no) is an indicator equal to one if the nearest city has at least one administrative building. Nr. of admin buildings nearest city is the sum of the number of admin buildings and the number of ziggurats in the nearest city. Admin building area nearest city (m2) is the total area in square meters of all admin buildings and ziggurats in the capital city that governs the nearest city. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

TABLE A5: THE EFFECT OF A RIVER MOVE ON STATE FORMATION: CITY STATES, RESTRICTED SAMPLE

Dependent variable:	Under city state (yes/no)	Nr. of admin buildings nearest city	Admin building area nearest city (m2)
	(1)	(2)	(3)
river move (yes/no) t-2	0.0299	-0.00256	-19.65
	(0.0236)	(0.0592)	(184.9)
river move (yes/no)	0.0755	0.0255	65.45
	(0.0510)	(0.0392)	(130.8)
Period x archeological excavation	Y	Y	Y
Period x rainfall	Y	Y	Y
Period x temperature	Y	Y	Y
P-value pre-trend	0.21	0.97	0.92
Mean dep. var.	0.37	0.34	1086.91
Observations	1191	1191	1191
R^2	0.81	0.85	0.90

Notes: All regressions are estimated using OLS. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). Under city state (yes/no) is an indicator equal to one if the nearest city has at least one administrative building. Nr. of admin buildings nearest city is the sum of the number of admin buildings and the number of ziggurats in the nearest city. Admin building area nearest city (m2) is the total area in square meters of all admin buildings and ziggurats in the capital city that governs the nearest city. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

TABLE A6: THE EFFECT OF A RIVER MOVE ON STATE FORMATION: CITY STATES, CONTROLLING FOR CONFLICT

Dependent variable:	Under city state (yes/no)	Nr. of admin buildings nearest city	Admin building area nearest city (m2)
	(1)	(2)	(3)
river move (yes/no)	0.111***	0.0944**	340.2**
	(0.0417)	(0.0413)	(146.7)
Conflicts	Y	Y	Y
Period x archeological excavation	Y	Y	Y
Period x rainfall	Y	Y	Y
Period x temperature	Y	Y	Y
P-value pre-trend	0.47	0.80	0.41
Mean dep. var.	0.29	0.27	923.92
Observations	2559	2559	2559
R^2	0.78	0.89	0.90

Notes: All regressions are estimated using OLS. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). Under city state (yes/no) is an indicator equal to one if the nearest city has at least one administrative building. Nr. of admin buildings nearest city is the sum of the number of admin buildings and the number of ziggurats in the nearest city. Admin building area nearest city (m2) is the total area in square meters of all admin buildings and ziggurats in the capital city that governs the nearest city. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. Conflicts is the number of conflicts the nearest city was involved in. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

TABLE A7: THE EFFECT OF A RIVER MOVE ON STATE FORMATION: CENTRALIZED STATES, WITH K-2 POINT ESTIMATES

Dependent variable:	Distance to nearest capital (m)	Nr. of admin buildings capital city	Admin building area capital city (m2)
	(1)	(2)	(3)
river move (yes/no) k-2	387.8	-0.108	137.7**
	(1857.9)	(0.0853)	(65.05)
river move (yes/no)	-14919.1***	0.247***	825.9***
	(3473.3)	(0.0430)	(121.0)
Period x archeological excavation	Y	Y	Y
Period x rainfall	Y	Y	Y
Period x temperature	Y	Y	Y
Mean dep. var.	61692.79	1.35	22579.15
Observations	2829	2829	2829
R^2	0.91	0.90	0.99

Notes: All regressions are estimated using OLS. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). Distance to nearest capital (m) is the distance to the nearest capital city in meters. A capital city is a city that dominates at least one other city (see the data appendix). Distance is measured from a grid cell's centroid. Nr. of admin buildings in capital is the sum of the number of admin buildings and the number of ziggurats in the capital city that governs the nearest city. Admin building area capital city (m2) is the total area in square meters of all admin buildings and ziggurats in the nearest city. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

TABLE A8: THE EFFECT OF A RIVER MOVE ON STATE FORMATION: CENTRALIZED STATES, RESTRICTED SAMPLE

Dependent variable:	Distance to nearest capital (m)	Nr. of admin buildings capital city	Admin building area capital city (m2)
	(1)	(2)	(3)
river move (yes/no) k-2	164.9	-0.103	68.30
	(1976.8)	(0.0901)	(68.65)
river move (yes/no)	-11768.4***	0.176***	615.7***
	(3765.4)	(0.0465)	(132.5)
Period x archeological excavation	Y	Y	Y
Period x rainfall	Y	Y	Y
Period x temperature	Y	Y	Y
P-value pre-trend	0.93	0.25	0.32
Mean dep. var.	57823.36	1.27	22213.77
Observations	1257	1257	1257
R^2	0.88	0.89	1.00

Notes: All regressions are estimated using OLS. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). Distance to nearest capital (m) is the distance to the nearest capital city in meters. A capital city is a city that dominates at least one other city (see the data appendix). Distance is measured from a grid cell's centroid. Nr. of admin buildings in capital is the sum of the number of admin buildings and the number of ziggurats in the capital city that governs the nearest city. Admin building area capital city (m2) is the total area in square meters of all admin buildings and ziggurats in the nearest city. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

TABLE A9: THE EFFECT OF A RIVER MOVE ON STATE FORMATION: CENTRALIZED STATES, CONTROLLING FOR CONFLICT

Dependent variable:	Distance to nearest capital (m)	Nr. of admin buildings capital city	Admin building area capital city (m2)
	(1)	(2)	(3)
river move (yes/no)	-14919.1***	0.315***	825.9***
	(3473.3)	(0.0719)	(121.0)
Conflicts	Y	Y	Y
Period x archeological excavation	Y	Y	Y
Period x rainfall	Y	Y	Y
Period x temperature	Y	Y	Y
P-value pre-trend	0.83	0.65	0.03
Mean dep. var.	61692.79	1.43	22579.15
Observations	2829	2829	2829
R^2	0.91	0.87	1.00

Notes: All regressions are estimated using OLS. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). Distance to nearest capital (m) is the distance to the nearest capital city in meters. A capital city is a city that dominates at least one other city (see the data appendix). Distance is measured from a grid cell's centroid. Nr. of admin buildings in capital is the sum of the number of admin buildings and the number of ziggurats in the capital city that governs the nearest city. Admin building area capital city (m2) is the total area in square meters of all admin buildings and ziggurats in the nearest city. Conflicts is the number of conflicts the nearest city was involved in. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

TABLE A10: THE EFFECT OF A RIVER MOVE ON PUBLIC GOOD PROVISION, WITH K-2 POINT ESTIMATES

Dependent variable:	On canal (yes/no)		
Periods in sample:	*City States*	*Centralized State*	*Invasion*
	(1)	(2)	(3)
river move (yes/no) k-2	0.00849	-0.00403	0.0905*
	(0.0300)	(0.0119)	(0.0544)
river move (yes/no)	0.0936***	0.282***	0.0710
	(0.0249)	(0.0578)	(0.0646)
Period x archeological excavation	Y	Y	Y
Period x rainfall	Y	Y	Y
Period x temperature	Y	Y	Y
Mean dep. var.	0.31	0.43	0.52
Observations	2559	2829	1899
R^2	0.87	0.88	0.77

Notes: All regressions are estimated using OLS. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). On canal (yes/no) is an indicator variable equal to one if a canal crosses a grid cell. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

TABLE A11: THE EFFECT OF A RIVER MOVE ON PUBLIC GOOD PROVISION, RESTRICTED

Dependent variable:	On canal (yes/no)		
Periods in sample:	*City States*	*Centralized State*	*Invasion*
	(1)	(2)	(3)
river move (yes/no) k-2	-0.00529	-0.00306	0.0108
	(0.0382)	(0.0120)	(0.0689)
river move (yes/no)	0.137***	0.270***	0.0375
	(0.0382)	(0.0621)	(0.0881)
Period x archeological excavation	Y	Y	Y
Period x rainfall	Y	Y	Y
Period x temperature	Y	Y	Y
P-value pre-trend	0.89	0.80	0.88
Mean dep. var.	0.30	0.44	0.55
Observations	1191	1257	669
R^2	0.81	0.83	0.74

Notes: All regressions are estimated using OLS. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). On canal (yes/no) is an indicator variable equal to one if a canal crosses a grid cell. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

TABLE A12: THE EFFECT OF A RIVER MOVE ON SETTLEMENT, WITH K-2 POINT ESTIMATES

Dependent variable:	Nr. of settlements		
Periods in sample:	*City States*	*Centralized State*	*Invasion*
	(1)	(2)	(3)
river move (yes/no) k-2	0.0157	0.0249	0.0760
	(0.123)	(0.0507)	(0.0800)
river move (yes/no)	0.107*	0.0206	-0.287***
	(0.0553)	(0.0792)	(0.0897)
Period x archeological excavation	Y	Y	Y
Period x rainfall	Y	Y	Y
Period x temperature	Y	Y	Y
Observations	2559	2829	2541
R^2	0.75	0.82	0.70

Notes: All regressions are estimated using OLS. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). Nr. of settlements is the count of settlements. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

TABLE A13: THE EFFECT OF A RIVER MOVE ON SETTLEMENT, RESTRICTED SAMPLE

Dependent variable:	Nr. of settlements		
Periods in sample:	*City States*	*Centralized State*	*Invasion*
	(1)	(2)	(3)
river move (yes/no) k-2	-0.186	0.0578	0.0916
	(0.143)	(0.0656)	(0.122)
river move (yes/no)	0.113	0.118	-0.313**
	(0.0733)	(0.103)	(0.127)
Period x archeological excavation	Y	Y	Y
Period x rainfall	Y	Y	Y
Period x temperature	Y	Y	Y
P-value pre-trend	0.20	0.38	0.45
Observations	1191	1257	1020
R^2	0.68	0.82	0.70

Notes: All regressions are estimated using OLS. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). Nr. of settlements is the count of settlements. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.

TABLE A14: THE EFFECT OF A RIVER MOVE ON SETTLEMENT, SYNTHETIC PERIODS

Dependent variable:	Nr. of settlements		
Periods in sample:	*City States*	*Centralized State*	*Invasion*
	(1)	(2)	(3)
River move (yes/no)	0.0278	-0.00553	-0.305***
	(0.0409)	(0.0867)	(0.0934)
Period x archeological excavation	Y	Y	Y
Mean dep. var.	0.23	0.34	0.31
Observations	2650	3975	2650
R^2	0.90	0.83	0.78

Notes: All regressions are estimated using OLS. The cross-sectional unit of observation is a 5x5 kilometer grid cell. The time-series period is an archeological period (see data appendix). Nr. of settlements is the count of settlements. River move (yes/no) is an indicator equal to one if the nearest river was within 5 kilometers in period t-1 the previous period and is further than 5 kilometers away in period t. Period x archeological excavation is a vector of period-relative-to-treatment fixed effects interacted with indicators for each of the three main archeological surveys of settlement we use. These surveys are described and mapped in the data appendix. Period x rainfall is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. Period x temperature is a vector of period-relative-to-treatment fixed effects interacted with average rainfall. All regressions include period and unit fixed effects. Heteroskedasticity robust standard errors clustered at the unit level are in parentheses. * indicates significance at the 10 percent level, ** at the 5 percent level, *** at the 1 percent level.