Rainfall and Democracy

Stephen Haber

and

Victor Menaldo

The puzzle

Why is the post-war world divided into three different regime equilibria?

1. Stable democracies (e.g., the U.K.)

2. Persistent autocracies (e.g., Oman).

3. Countries that cycle back and forth, but create neither stable democratic institutions nor durable authoritarian institutions (e.g., Peru).

Possible answers abound…but are, at best, incomplete

- Differences in levels of wealth, education and urbanization (Modernization Theory)…yet these are only spuriously associated with democracy (AJRY 2008).

- Reliance on natural resources…yet again the relationship with regime type is spurious (Haber & Menaldo 2010).

- Colonial legacy or factor endowments (AJR 2001; Engerman & Sokoloff 1997)…but these explanations exclude Europe, the Middle East, North Africa and Central Asia, Japan, and Thailand.

Perhaps something basic has been overlooked

Persistent Autocracies

What might cause geographic clustering?

Low Rainfall
Less than 50cm Annually
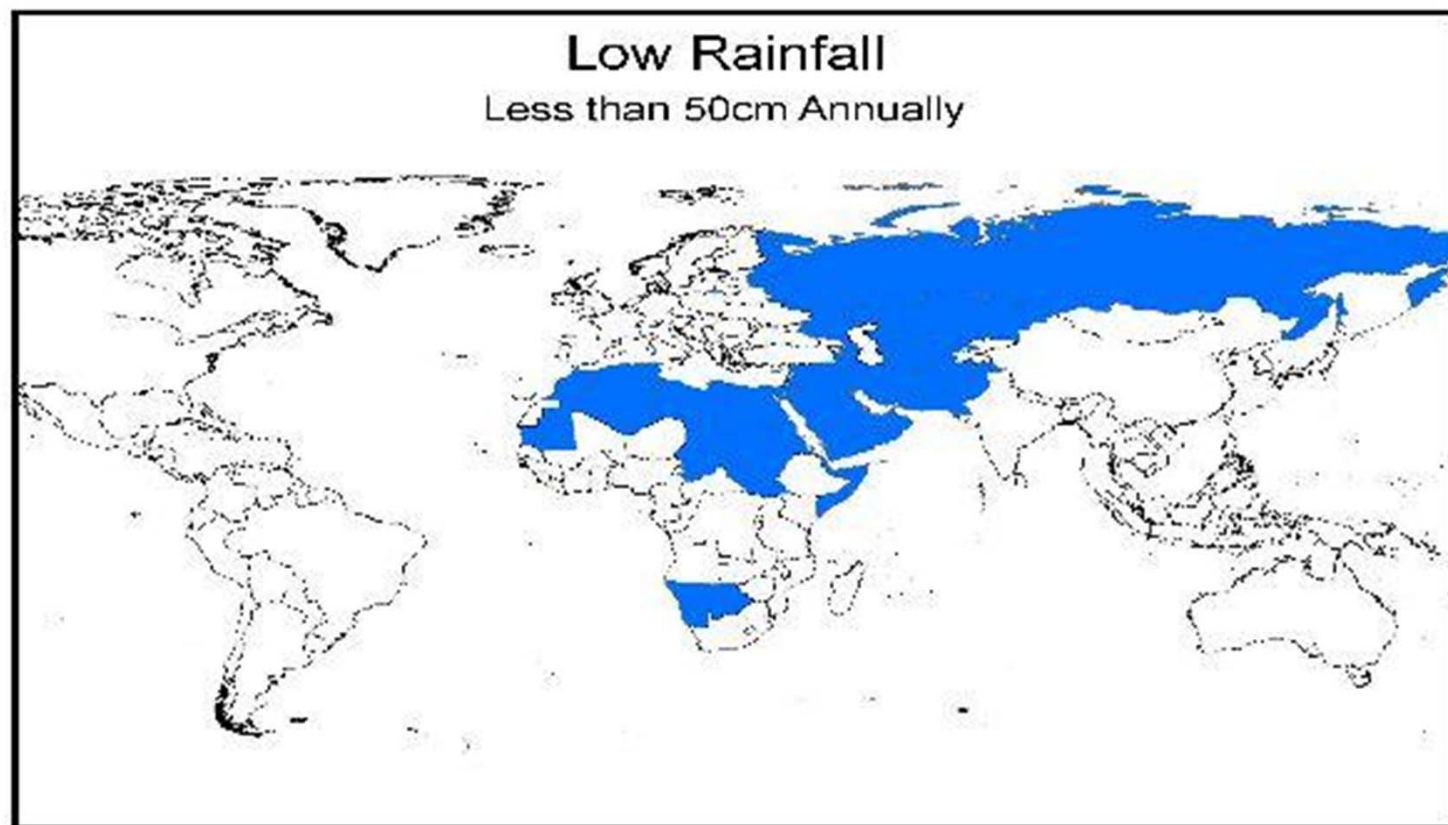
Do low rainfall and persistent autocracy appear to go together?

Low Rainfall — Less than 50cm Annually

Persistent Autocracies
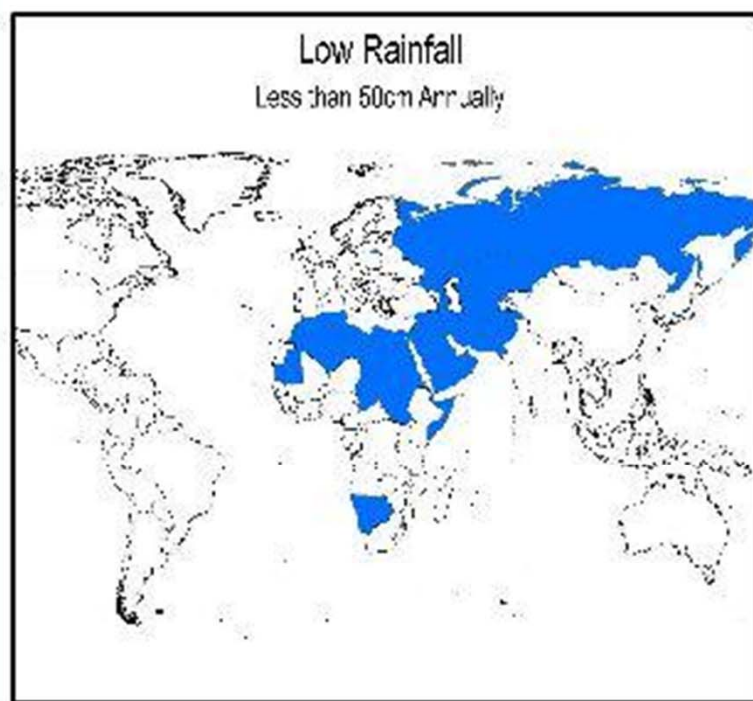
Does the pattern work in reverse?

Stable Democracies
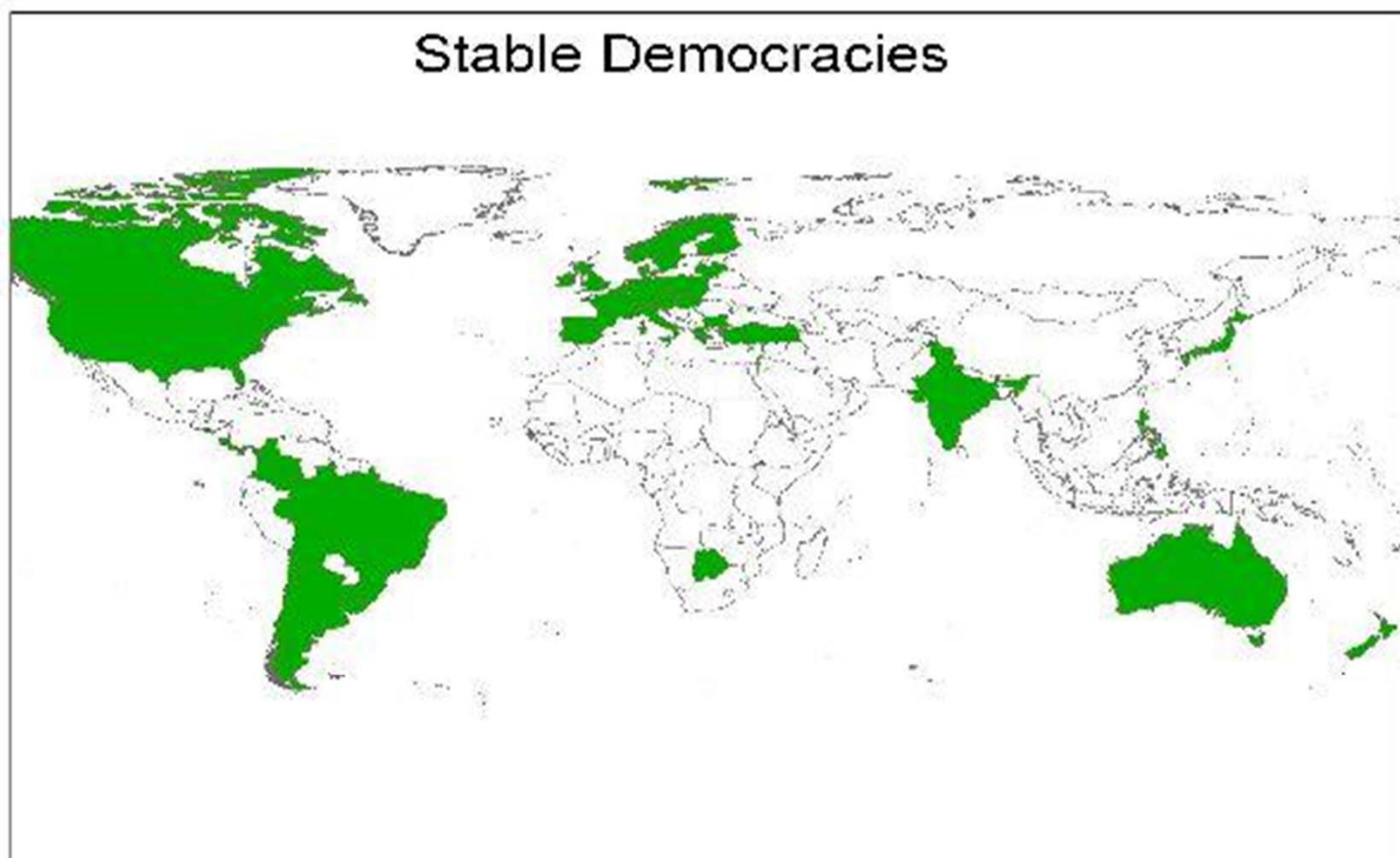
What might cause clustering?

Moderate Rainfall

Do moderate rainfall and stable democracy appear to go together?

Moderate Rainfall

Stable Democracies

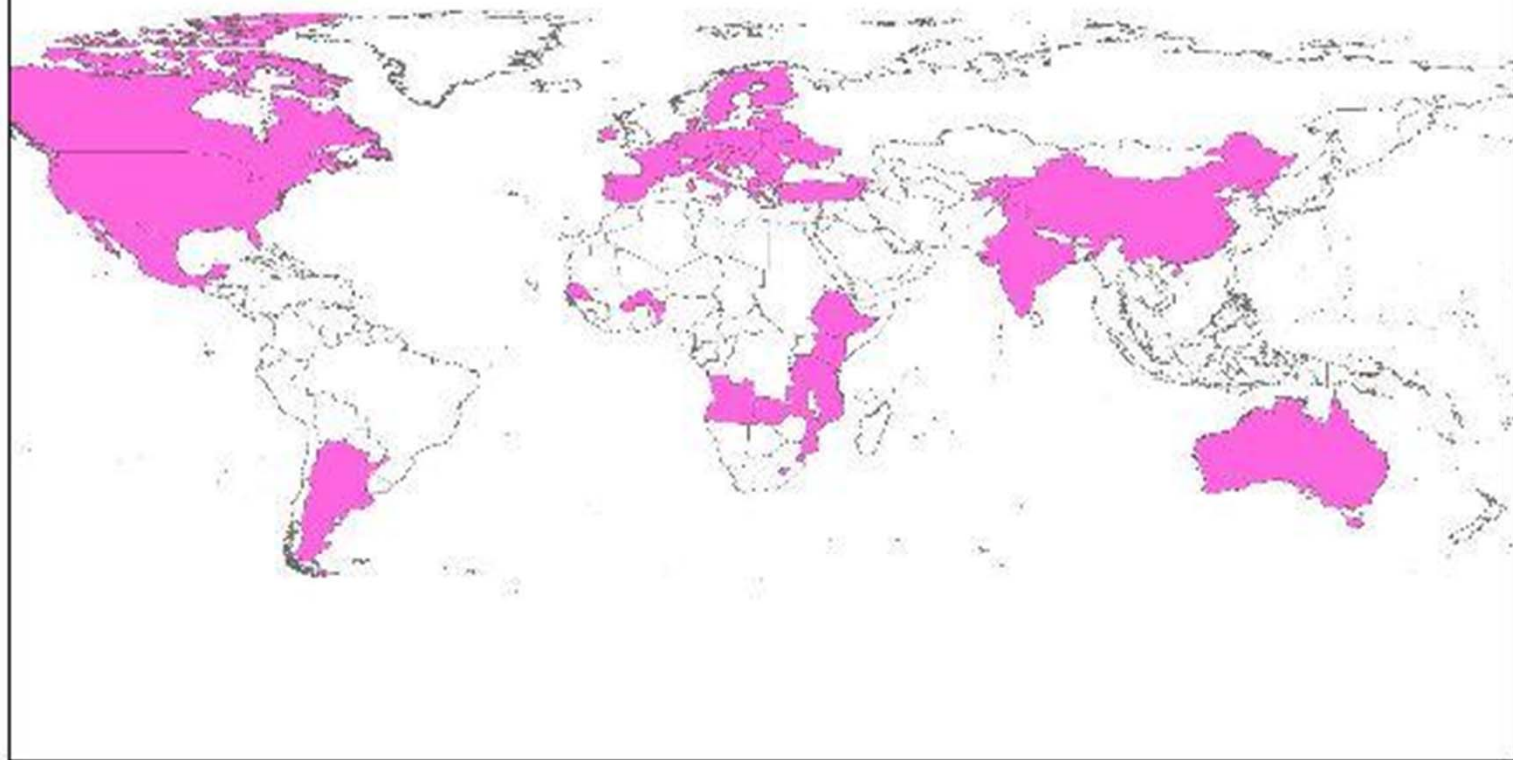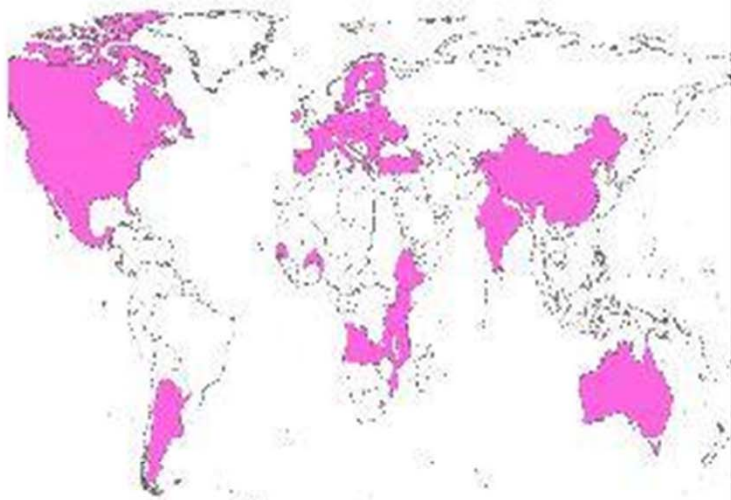# What happens if we graph the data on rainfall and regime types?

Stable Democracies and Persistent Autocracies, by Rainfall

- ■ Stable Democracies
- ■ Persistent Autocracies

Average Rainfall (cm 2008)

Countries (left to right): Egypt, Qatar, Algeria, Kuwait, Yemen, Iraq, Kazakhstan, Namibia, Morocco, Botswana, Russia, Kyrgyzstan, Canada, Turkey, Sweden, Greece, Tajikistan, U.S.A., Swaziland, Belgium, France, Korea North, Austria, Slovenia, Malawi, Uruguay, C.A.F., Nepal, Congo Kin, Congo Br, Sri Lanka, Brazil, Laos, Jamaica, Bhutan, Guyana, Fiji, Panama, PNG

Does the moderate rainfall/democracy pattern vanish when we include regime cyclers?

Stable Democracies and Other Regime Types, by Rainfall
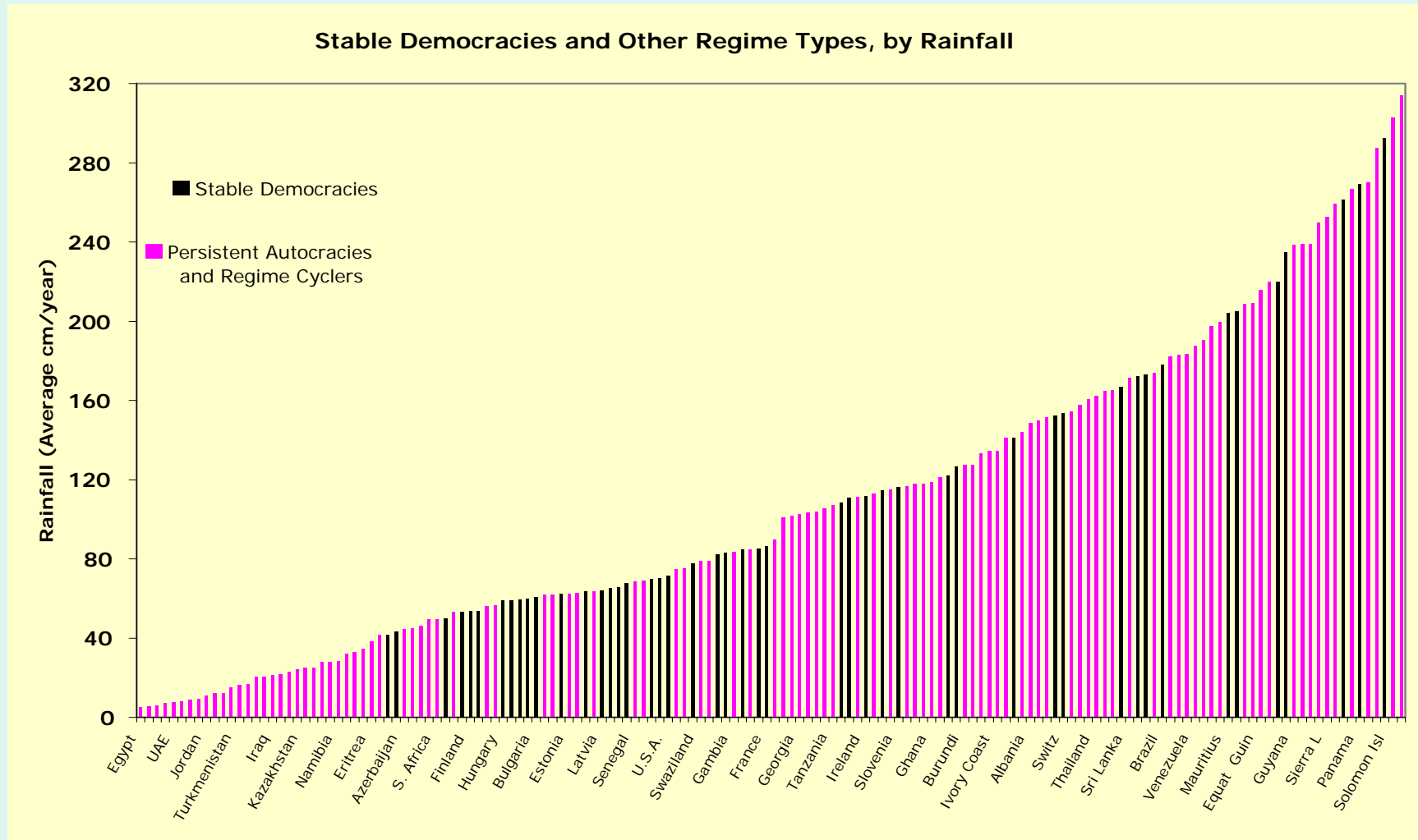
Possible mechanisms?

1. A direct channel???

2. The relationship is spurious.

3. Rainfall exerts an indirect effect on democracy.

   A. via economic growth?

   B. via Islam?

   C. via institutions?

Goal of this paper

To present a theory that rainfall exerts a long-run, indirect effect on regime equilibria by working through institutions.

To test that theory against evidence.

To assess alternative hypotheses--by controlling for per capita income, democratic diffusion, colonial heritage, and Islam.

The barebones theory

1. If you go back far enough all societies were organized around tribes.
2. Tribal social organization is the antithesis of the modern territorial state.
3. The modern territorial state emerged and survived in places with moderate levels of rainfall (not just places with water that allowed agriculture)
4. Modern democracy first emerged out of the modern territorial state.
5. When democracy spread out from Europe, it was again subject to nature's constraints.

The barebones history

1. Agricultural surplus gave rise to social differentiation, specialization, trade, and urbanization.

2. There were scale economies in promoting markets and providing justice.

3. Hence, territorial states emerged out of European feudalism.

4. Representative institutions were built into these states from their inception.

5. In time, representative institutions became more inclusive, giving rise to the first democracies.

6. These democracies were characterized by increasing returns.

What happened when the European territorial states conquered the rest of the world?

1. They ignored the areas that were too dry (e.g. the Saudi Peninsula) to support agriculture. These areas remained tribal.

2. They adapted areas of moderate rainfall into Neo-Europes (e.g. Canada), and wiped out their tribal peoples.

3. They turned *some* of the areas that were very wet into cash crop producers--and in so doing replaced the tribal peoples with new immigrants (e.g. the Caribbean).

Hypotheses

Low rainfall is associated with tribalism

Low rainfall is associated with autocracy
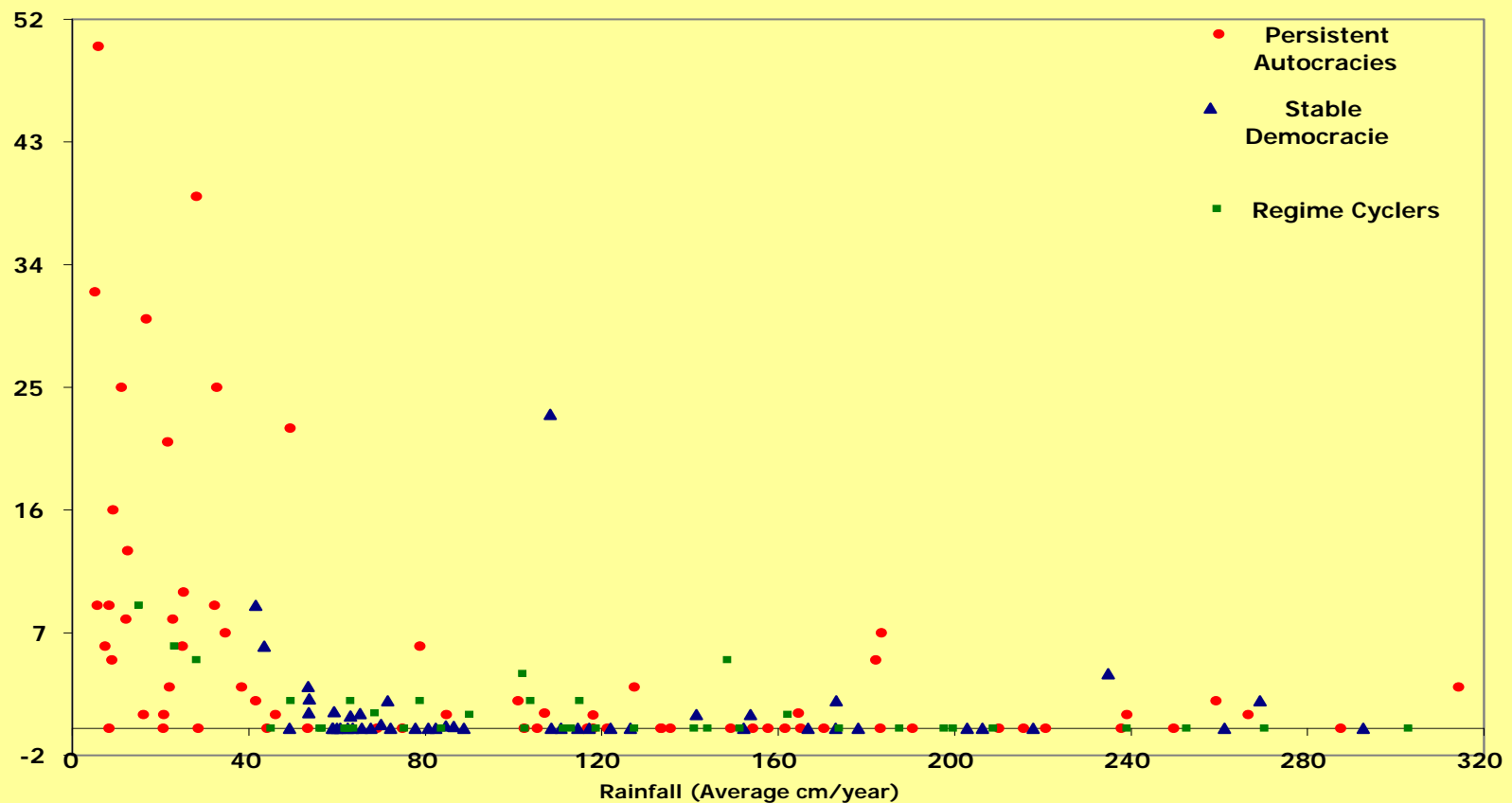
Low rainfall works on autocracy through tribalism

Moderate rainfall is inversely related to tribalism

Moderate rainfall is associated with democracy

These patterns are attenuated at very high levels of rainfall

The relationship between rainfall, tribalism, and regime types

Regime Equilibrium Types, by Rainfall and Tribalism

Rainfall & Regime Equilibria, Reduced Form

Table 2. The relationship between Rainfall and Democracy (Multinomial Logit Regressions)

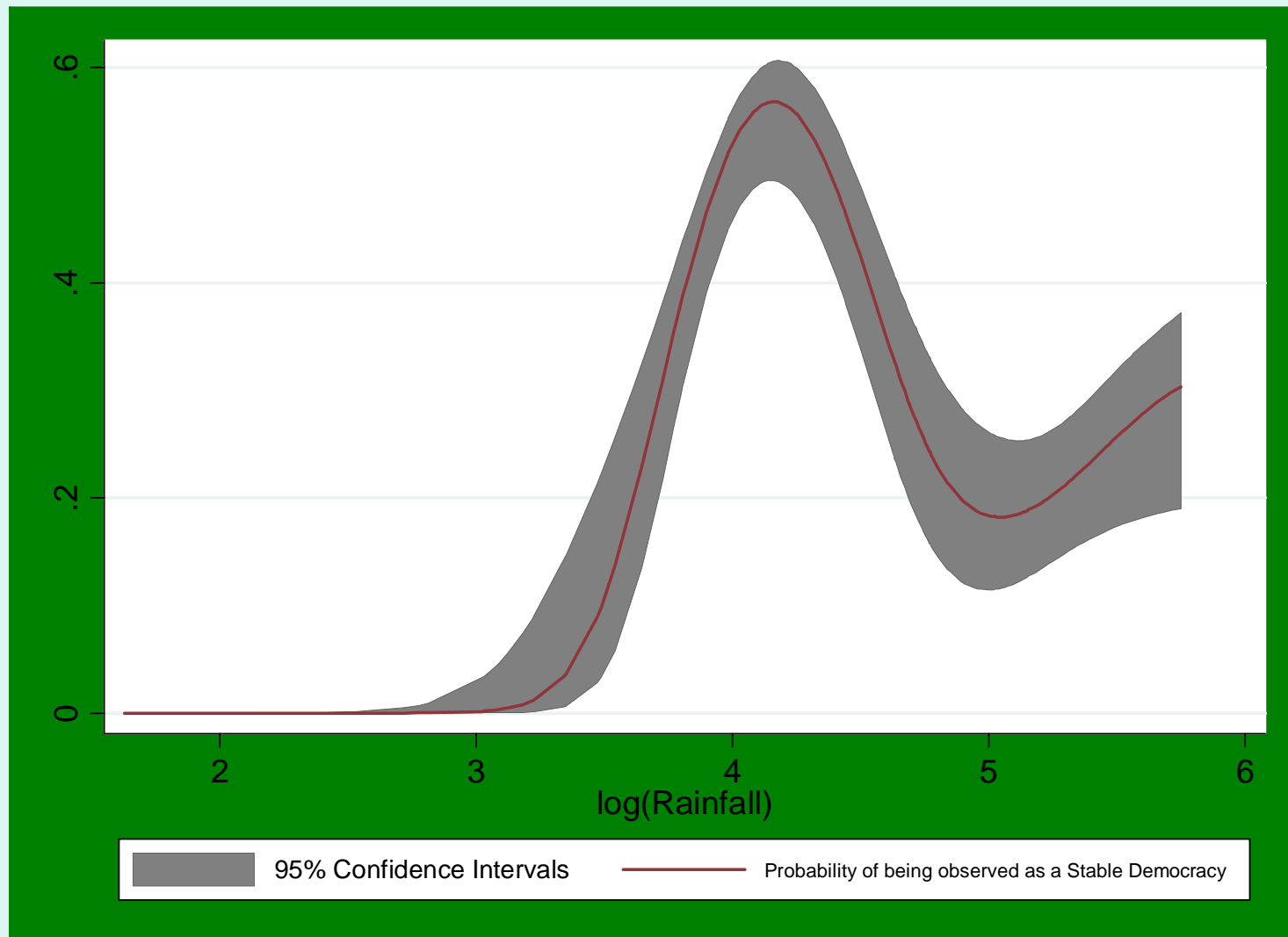Dependent Variable is the Regime Equilibrium (see text)

Robust t-statistics in brackets (clustered by Colonial Origin in Model 4)

	MODEL 1		MODEL 2		MODEL 3		MODEL 4	
	Regime Cycler	Stable Democracy	Regime Cycler	Stable Democracy	Regime Cycler	Stable Democracy	Regime Cycler	Stable Democracy
Rainfall (Cubic Spline 1)	5.379	16.016			4.91	8.801	4.893	8.282
	[2.78]***	[4.20]***			[2.42]**	[2.82]***	[2.21]**	[2.59]***
Rainfall (Cubic Spline 2)	-7.074	-17.352			-6.579	-11.211	-6.008	-9.765
	[3.02]***	[4.48]***			[3.03]***	[2.96]***	[2.59]***	[2.63]***
Rainfall (Cubic Spline 3)	54.87	105.759			44.899	74.636	31.613	48.793
	[3.17]***	[4.36]***			[3.05]***	[2.24]**	[2.24]**	[1.29]
Regional Democratic Diffusion			0.073	0.112	0.062	0.104	0.109	0.166
			[4.35]***	[2.71]***	[6.95]***	[4.41]***	[6.73]***	[8.82]**
log(GDP Per Capita)			0.291	1.582	0.412	1.769	0.297	1.681
			[1.03]	[2.67]***	[1.15]	[2.24]**	[1.09]	[1.60]
Economic Growth Rate			0.218	0.206	0.185	0.511	0.295	0.671
			[1.48]	[0.72]	[1.21]	[2.55]***	[1.48]	[2.23]**
log(Fuel Income Per Capita)			-0.213	-0.273	-0.111	-0.119	0.001	-0.023
			[5.41]***	[1.61]	[1.36]	[1.66]*	[0.01]	[0.17]
Percent Muslim			0.001	0.001	0.01	0.018	0.01	-0.025
			[1.34]	[0.31]	[1.01]	[0.67]	[1.24]	[0.76]
F-test on Rainfall Splines	27.1	27.1			47.85	47.85	88,757.39	88,757.39
p-value	0	0			0	0	0	0
Colonial Origin Dummies	NO	NO	NO	NO	NO	NO	YES	YES
F-test on Colonial Dummies							16,885.58	16,885.58
p-value							0	0
Observations	134	134	134	134	134	134	134	134
pseudo r-squared	0.17	0.17	0.43	0.43	0.49	0.49	0.56	0.56

* significant at 10%; ** significant at 5%; *** significant at 1%

Constant estimated but not reported; Control variables are averaged between 1986 and 2006; results robust to removing Regional Democratic Diffusion and estimating regional dummy variables instead. Baseline category is a Persistent Autocracy, defined as a country that in no time in its history ever had a normalized Polity Score of 85 or above. Stable Democracy is a country that has had a Polity Score of 85 or above for all years since 1986. Cyclers go back and forth above and below this threshold. Restricted cubic splines with 4 knots where rainfall is defined to be a continuous smooth function that is linear before the first knot, a piecewise cubic polynomial between adjacent knots, and is linear after the last knot. The knots are chosen according to Table 2.3 of Harrell (2001) where the smallest knot may not be less than the 5th smallest value of rainfall and the largest knot may not be greater than the 5th largest value of rainfall.

The marginal effect of Rainfall on Stable Democracy

95% Confidence Intervals — Probability of being observed as a Stable Democracy

Notes: see text for Stable Democracy coding. Predictions computed from a multinomial regression where Persistent Autocracy is the baseline category (see text for coding). Fitted values calculated from 3 (restricted cubic) Rainfall Splines.

Does Rainfall work through tribalism/settled agriculture?

Table 3. The relationship between Tribalism and Democracy (IV Multinomial Logit Regressions)

Dependent Variable is the Regime Equilibrium (see text)

Robust t-statistics in brackets clustered by Colonial Origin

REGIME EQUILIBRIUM CODING	MAIN CODING				ROBUSTNESS CODING			
	Regression 1		Regression 2		Regression 3		Regression 4	
Multinomial Logit Instrumental Variables Control Function Approach (second-stage)								
EQUILIBRIUM	Regime Cycler	Persistent Dem.	Regime Cycler	Persistent Dem.	Regime Cycler	Persistent Dem.	Regime Cycler	Persistent Dem.
Tribalism	-0.312	-0.884	-0.214	-0.884	-0.403	-0.277	-0.28	-0.277
	[1.82]*	[2.92]***	[1.62]	[1.93]**	[1.82]*	[1.83]*	[1.70]*	[1.83]*
Regional Democratic Diffusion	0.011	0.053	0.013	0.059	0.025	0.033	0.028	0.033
	[0.43]	[6.14]***	[0.56]	[6.14]***	[0.88]	[2.17]**	[1.06]	[2.17]**
log(GDP Per Capita)	-0.037	1.445	-0.342	0.44	-0.242	1.126	-0.551	1.126
	[0.10]	[1.60]	[0.77]	[1.18]	[0.53]	[2.31]**	[1.21]	[2.31]**
Economic Growth Rate	-0.003	0.279	-0.05	0.374	0.025	0.026	0.02	0.026
	[0.04]	[4.45]***	[0.46]	[3.77]***	[3.41]***	[6.68]***	[3.20]***	[6.68]***
log(Fuel Income Per Capita)	-0.082	-0.086	-0.004	0.047	-0.104	-0.158	-0.012	-0.158
	[0.86]	[0.53]	[0.03]	[0.38]	[1.30]	[1.03]	[0.10]	[1.03]
Percent Muslim	0.005	0.018	0.012	0.024	0.013	-0.017	0.023	-0.017
	[0.49]	[0.63]	[1.12]	[0.55]	[1.36]	[1.89]*	[1.90]*	[1.89]*
Colonial Origin Dummies	YES	YES	YES	YES	YES	YES	YES	YES
F-test on Colonial Dummies	8,066.45	8,066.45	7,491.23	7,491.23	13,351.04	13,351.04	190,000	190,000
p-value	0	0	0	0	0	0	0	0
Observations	134	134	134	134	144	144	144	144
pseduo r-squared	0.46	0.46	0.46	0.46	0.64	0.64	0.64	0.64
Measure of Tribalism	Nomad	Nomad	Nomad + Tribal	Nomad + Tribal	Nomad	Nomad	Nomad + Tribal	Nomad + Tribal
F-test Rainfall Splines, first-stage	530.22	530.22	8.65	8.65	176.41	176.41	12.05	12.05
p-value	0	0	0.005	0.005	0	0	0.002	0.002
Test of Tribalism endogeneity	0.446	0.489	0.202	0.535	0.556	0.351	0.264	0.24
p-value	0.018	0.036	0.11	0.005	0.012	0.059	0.088	0.053
r-squared, first-stage	0.46	0.65	0.53	0.53	0.64	0.64	0.52	0.52

* significant at 10%; ** significant at 5%; *** significant at 1%

Constant estimated but not reported; in addition to (logged) Rainfall Splines, first-stage regression also includes the independent variables from second-stage regression. Control variables are two-decade avgs. prior to 1986, for Main Coding and two-decade avgs. prior to 1993 for Robustness Coding; results robust to removing Regional Democratic Diffusion and estimating regional dummy variables instead. Results also robust to logging the Tribalism Indexes. Test for endogeneity of Tribalism Indexes is a t-test on the residuals from the first-stage regression.

Marginal Effect of Tribalism on Stable Democracy

Figure 5. Probability of Stable Democracy as a function of Tribalism
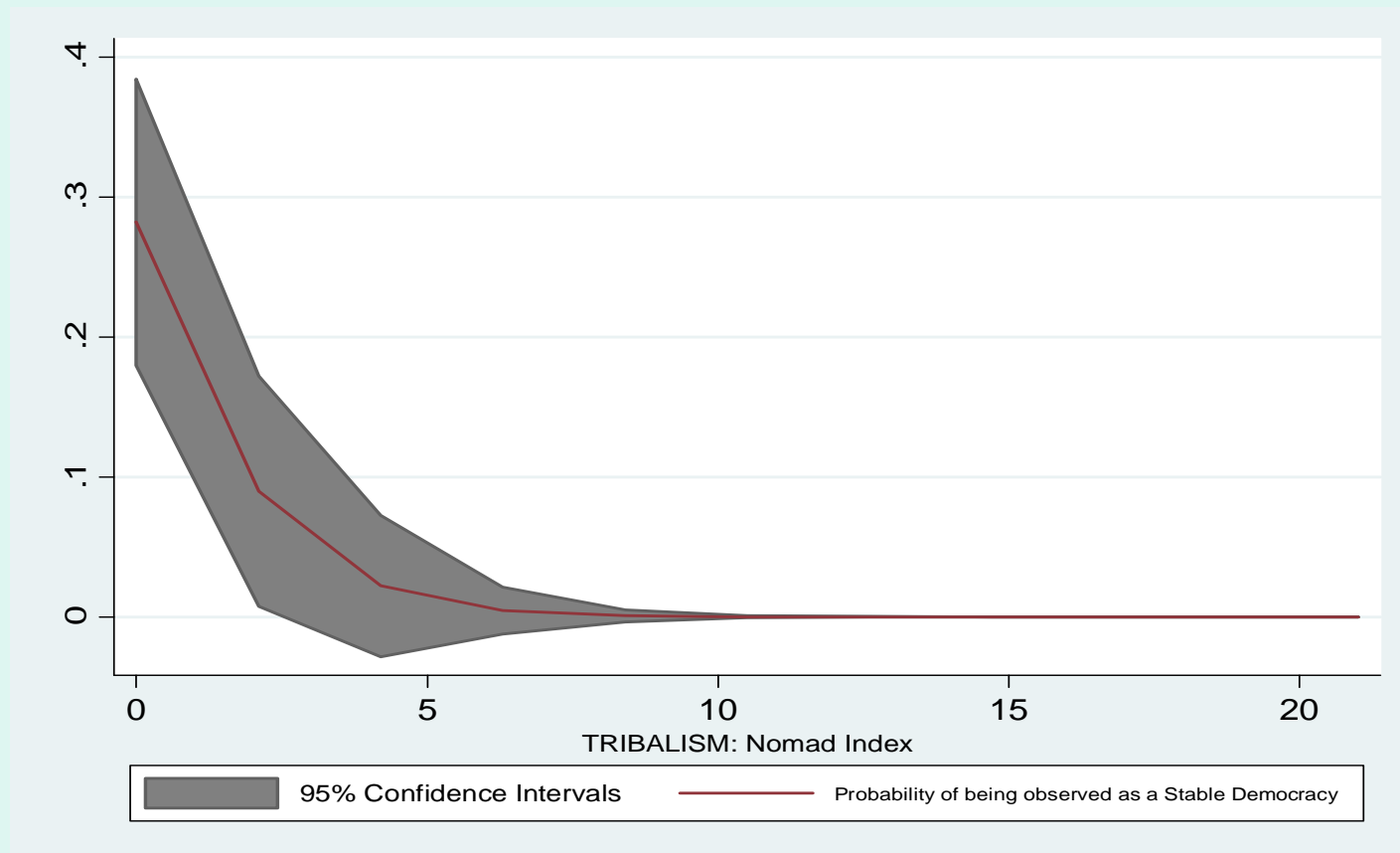
Notes: see text for Nomad Index coding and Stable Democracy. Predictions computed from a multinomial two-stage instrumental regression where Persistent Autocracy is the baseline (see text for coding) and Tribal Index is instrumented with 3 Rainfall Splines; Regional Democratic Diffusion, log(Per Capita Income), Economic Growth Rate, log(Total Fuel Income), and Muslim set to their mean values; Colonial Origin set to "0".

Is effect of tribalism robust to using OLS instead of multinomial logit?

Table 4. The relationship between Tribalism and Democracy (2SLS Instrumental Variables)

Dependent Variable is the average, Normalized Polity Score (0 to 100), between 1986 and 2006

Robust t-statistics in brackets (clustered by Colonial Origin in Models 3 and 6).

	(1)	(2)	(3)	(4)	(5)	(6)
2SLS Instrumental Variables (second-stage)						
Tribalism	-5.985	-2.423	-2.433	-3.344	-1.589	-1.864
	[4.14]***	[2.44]**	[3.47]***	[3.96]***	[2.32]**	[3.51]***
Regional Democratic Diffusion		0.41	0.365		0.404	0.369
		[4.41]***	[2.44]**		[4.04]***	[2.26]**
log(GDP Per Capita)		6.776	6.392		5.947	4.961
		[2.40]**	[2.41]**		[1.98]**	[1.31]
Economic Growth Rate		0.907	0.793		0.868	0.772
		[1.04]	[1.88]*		[0.91]	[1.77]*
log(Fuel Income Per Capita)		-2.39	-2.573		-2.063	-2.153
		[3.34]***	[6.64]***		[2.81]***	[3.57]***
Percent Muslim		-0.11	-0.114		-0.079	-0.067
		[1.47]	[1.35]		[0.87]	[0.67]
Colonial Origin Dummies	NO	NO	YES	NO	NO	YES
F-test on Colonial Dummies			14,206.88			970,000
p-value			0			0
Observations	156	156	156	156	156	156
r-squared	0.05	0.58	0.6	0.05	0.5	0.5
Measure of Tribalism	*Nomad*	*Nomad*	*Nomad*	*Nomad + Tribal*	*Nomad + Tribal*	*Nomad + Tribal*
F-test Rainfall Splines, first-stage	13.67	14.87	359.13	9.12	9.93	66.32
p-value	0	0	0	0	0	0
Test of Tribalism endogeneity	49.718	7.479	4.675	46.435	9.027	3.979
p-value	0	0	0.06	0	0.003	0.077
Test of overidentifying restrictions	1.644	3.381	2.198	2.18	3.247	1.887
p-value	0.44	0.19	0.33	0.34	0.19	0.389
r-squared, first-stage	0.54	0.58	0.59	0.37	0.42	0.39

* significant at 10%; ** significant at 5%; *** significant at 1%

Constant estimated but not reported; in addition to (logged) Rainfall Splines, first-stage regression also includes the independent variables from second-stage regression. Control variables are averaged between 1986 and 2006; results robust to removing Regional Democratic Diffusion and estimating regional dummy variables instead. Results also robust to logging the Tribalism Indexes. Test for endogeneity of Tribalism Indexes is a robust regression based test. Test of overidentifying restrictions on the exogeneity of instruments is a Wooldridge (1995) robust score test.

Empirical extensions in progress

1. <u>Improving the rainfall measure</u>. Monthly observations for all weather stations since 1697.

    A. Allows us to capture variation within countries

    B. Allows us to check for cross-sectional robustness.

2. Regressions to be run on increasingly restrictive stable democracy windows.

3. Additional control variables: Linguistic fragmentation.

3. Out of sample historical tests

    A. Ancient Egypt, Mesopotamia, and Greece.

    B. Rainfall, tribalism, and the extent of the Roman Empire.