

Rainfall and Democracy

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ABSTRACT: Why have some countries remained obstinately authoritarian despite repeated waves of democratization while others have exhibited uninterrupted democracy? This paper explores the emergence and persistence of authoritarianism and democracy. We argue that settled agriculture requires moderate levels of precipitation, and that settled agriculture eventually gave birth to the fundamental institutions that under-gird today's stable democracies. Although all of the world's societies were initially tribal, the bonds of tribalism weakened in places where the surpluses associated with settled agriculture gave rise to trade, social differentiation, and taxation. In turn, the economies of scale required to efficiently administer trade and taxes meant that feudalism was eventually replaced by the modern territorial state, which favored the initial emergence of representative institutions in Western Europe. Subsequently, when these initial territorial states set out to conquer regions populated by tribal peoples, the institutions that could emerge in those conquered areas again reflected nature's constraints. An instrumental variables approach demonstrates that while low levels of rainfall cause persistent autocracy and high levels of rainfall strongly favor it as well, moderate rainfall supports stable democracy. This econometric strategy also shows that rainfall works through the institutions of the modern territorial state borne from settled agriculture, institutions that are proxied for by low levels of contemporary tribalism.

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There are three varieties of states in the post-cold war world: stable democracies; persistent autocracies; and countries that cycle back and forth between democracy and autocracy. The stable democracies have had representative institutions and broad suffrage for decades, if not for centuries. Prototypical cases include England, the United States, and France. The persistent autocracies have been impervious to democratization for decades, if not for centuries. Even after the collapse of the Soviet Union, when a fourth wave of democratization overturned many long-standing dictatorships, these countries remained authoritarian. Prototypical cases include Myanmar, Gambia, and Oman. The countries that cycle between democracy and autocracy have experimented with both forms of government, but they have neither created enduring representative institutions nor intractable forms of autocratic rule. Prototypical cases include Peru, Indonesia, and Kenya.

Social scientists have long pondered why these three regime equilibria exist. The first scholars who examined this issue wondered why just a few countries were democratic whilst the vast majority was not. They include the founding fathers of modern political science: Lipset (1959, 1963), Huntington (1968), and Dahl (1971). Although these scholars did not share similar views about the specific channels of democratization, they each searched for a narrow set of preconditions. A second generation of scholars, using much more sophisticated analytic tools and quantitative evidence, conceptualize regime type as part of a more general equilibrium condition. For example, Persson and Tabellini (2009) argue and demonstrate that democracy and economic growth reinforce one another (see Bunce 2000 for a review of the genealogy behind this idea). Some of this recent scholarship has focused, in particular, on geographic variables—climate, soil types, and disease environments—as fundamental causes of both regime types and growth (Engerman and Sokoloff 1997; Acemoglu et. al, 2001, 2005). What both

generations of scholars have in common is that they conceive of democracy as an outcome of a long historical process, not simply as a set of procedural rules that are determined randomly.¹

This paper builds upon and goes beyond the literature on democracy as an institutional equilibrium. As Nunn (2009) has pointed out about the recent literature, the evidence that geography determines a society's fundamental institutions—and that those fundamental institutions then determine a range of political and economic outcomes—is adduced solely in reduced form regressions. The institutions that emerge from geography are something of black box: “the exact channels of causality through which history matters” are not fully elucidated (Nunn 2009). Our goal is to take this challenge seriously. We do so by focusing on a factor that has been employed in the literature on economic growth and civil war (e.g. Miguel et. al 2004), but that has not received much attention in the literature on regime types—precipitation.

This paper continues as follows. We first document the puzzle that precipitation and regime types are correlated in a non-linear fashion: in deserts persistent autocracy prospers; moderate rainfall sustains stable democracy; too much rainfall is generally bad for democracy. After outlining the possible explanations for this pattern, we proffer an abbreviated review of both the burgeoning literature on the geographical determinants of long-run institutional development and the literature that posits that without a strong, capable state, consolidated democracy is untenable. We then advance a theoretical framework that tries to make sense of these patterns, and locates the genesis of stable democracy in the institutional trajectory associated with settled agriculture, including feudalism, the advent of the territorial state and

¹ There is a long line of literature in this latter vein, beginning with Rustow (1970), which focuses on transitions to democracy and conceptualizes these events as exogenous and unpredictable.

birth of representative institutions. Conversely, the persistence of autocracy mirrors the persistence of tribalism. Next is an empirical evaluation of the theoretical framework. The first round of multinomial logit regressions evaluates the reduced form relationship between rainfall and regime equilibria; the second round of regressions is an instrumental variables approach that supports the notion that precipitation works through tribalism—or the lack of it, the legacy of settled agriculture—to support different regime equilibria.

THE PUZZLE

We divide the world into three sets of countries that correspond to the conceptualization of regime types as equilibria: stable democracies; persistent autocracies; and regime cyclers. We operationalize a stable democracy as a country that has had a polity score of +7 or above, on a -10 to +10 scale, following Gleditsch and Ward (2006), continually from 1986 to 2006. By setting such a proximate cut-point in time, we include several young democracies in this group (e.g. Brazil), thereby making it difficult to find systematic associations between democratic stability and the factors that cause it. We operationalize a stable autocracy as a country whose polity score has never exceeded +7 at any time in its history. By setting such a wide parameter for stable autocracy, we make it difficult to find systematic differences between democracies and autocracies: even a country that has consistently obtained a polity score of +6 (e.g., Guyana) is coded as a persistent autocracy. We denote the residual category—countries that have had polity scores that have exceeded +7 at some time in their histories, but not on an uninterrupted basis between 1986 and 2006, as regime cyclers. We graph the data for stable democracies and persistent autocracies, sorted by their average annual rainfall, in Figure 1.²

² We take the polity score from Marshall and Jaggers (2008). We take rainfall in 2008 from World Bank Development Indicators, 2010 online edition.

Average annual precipitation and stable democracy appear to be related. At less than 40 cm per year, there are no democracies at all. Instead, this band is populated by some of the world's most notorious dictatorships and almost all of its remaining monarchies, including Chad, Djibouti, Egypt, Jordan, Mauritania, Oman, Saudi Arabia, and Yemen. From 41 to about 90 cm, there is a sizable group of stable democracies. Indeed, there are only three persistent autocracies in this band, and the democracies include countries whose representative institutions have distinguished pedigrees, such as Canada, France, the Netherlands, and the United States. Above the 90 cm threshold, autocracies outnumber democracies, but the pattern does not appear to be monotonic: there are democracies sprinkled among the autocracies in this band; and at the very highest levels of rainfall (above 200 cm) democracy and autocracy appear to be equally common.

Explaining the Puzzle

What explains this surprising pattern? Why is it that deserts (average precipitation below 25 cm) do not support democracy at all? Why is it that democracies cluster at moderate levels of rainfall? Why is democracy possible, but not likely, at high levels of rainfall (above 90 cm)?

There are several classes of possible explanations. One is that rainfall exerts a direct, but non-linear effect, on democratization—but we are hard pressed to imagine why this might be the case. A second explanation is that the apparent relationship between rainfall and democracy is spurious: there is some other factor that causes authoritarianism, and that factor just happens to occur in regions of the world at either the left or right tail of the rainfall distribution. A third, and more likely, class of explanation is that moderate levels of rainfall exert an indirect effect on democratization. For example, moderate rainfall might induce economic growth, and there is a well-known relationship between high per capita income and democracy (Lipset 1959; Epstein

et. al. 2006). Alternatively, perhaps there is a causal relationship between low rainfall and the spread of Islam, and Islam is antithetical to democracy (Lewis 1994: 4). Islam was, of course, born in the Arabian Desert and was spread by mounted warriors across the Middle East, North Africa, and Central Asia—all areas characterized by low precipitation. Finally, perhaps moderate levels of rainfall work on democratization through institutions. There is something about a climate that is neither too dry, nor too wet, that gives rise to the institutions that are fundamental building blocks of stable democracy.

Ahead we advance and test a theory about moderate levels of rainfall influencing the historical development of the fundamental institutions that are conducive to stable democracy. We make three main arguments. Each centers on the relationship between precipitation and settled agriculture—and the institutional and political legacy that settled agriculture continues to make on the distribution of regime types across the world today.

First, societies composed of tribal nomads are not conducive to democratization—indeed they are not even conducive to the emergence of modern territorial states—and the areas of the world that receive little rainfall are heavily populated by tribal peoples. This is not happenstance: one of the few forms of economic activity that can thrive at very low levels of rainfall is nomadic pastoralism. Unless there is some powerful offsetting force, there is little reason for tribal societies to change. Even copious amounts of oil wealth that can finance the growth of a more sedentary, urbanized society may still do little to dent an entrenched tribal culture that evolved over centuries as a byproduct of the scarcity of water and, concomitantly, settled agriculture.

Second, agriculture thrives in areas of the world with moderate levels of rainfall, and the chain of events that is set off by the creation of agricultural surpluses—social differentiation,

economic specialization, urbanization, trade, taxation, and the creation of a state bureaucracy—erode tribal social organization in short order. Instead, modern territorial states emerge. As we will explore in detail below, the modern territorial state, in turn, was a necessary condition for the emergence of the first generation of representative democracies. This does not mean that stable democracy was an inexorable outcome of the modern state—to wit Russia—or that the modern state was a necessary outcome of settled agriculture—to wit the example of Aztec Mexico—but it does mean that the emergence of representative institutions required those earlier developments. In short, it was not an accident that the modern territorial state and representative governments first emerged in Western Europe, an area with moderate levels of rainfall.

Third, when Europe's territorial states set out to conquer regions populated by tribal peoples from the 15th century onward, both in Europe and outside of Europe, the institutions that could emerge in those conquered areas again reflected nature's constraints: the institutions of Western Europe could not be recreated in a desert or a swamp. What the Europeans could do, however, was transform *some* of these societies into profitable cash crop producers. This process was also bounded by the natural environment: it was feasible in some high rainfall areas (e.g., the Caribbean, which became the locus of world sugar production); but it was completely infeasible in areas with very low levels of rainfall (e.g., the Arabian Desert, which was so inhospitable that it was never formally colonized). The result, over the long run, was that tribalism was muted in the former areas, while it remained intact in the latter areas. It is therefore not surprising that the low rainfall areas remain tribal and autocratic. It is also not surprising that *some* of the very high rainfall areas—particularly those where tribal peoples were, quite literally, eradicated and replaced by entirely new populations—gave rise, eventually, to democracies.

LITERATURE REVIEW

We are not the first researchers to have called attention to the importance of geography. Sociologists have pondered the effects of climate on human behavior at least as far back as Montesquieu. Diamond (1997) explains Europe's success in colonizing the rest of the world as a function of its favorable geographic endowment. Hall and Jones (1999) theorize that economic growth is an outcome of social infrastructure (policies and institutions conducive to investment), and use distance from the equator as instrument to control for reverse causality.

Social scientists have recently turned their attention to the ways in which geographic factors condition the development of long-run institutions, employing European colonization as a natural experiment. Engerman and Sokoloff (1997) focus on differences in climate, soil quality, and the size of the native population across the Americas at the time of European colonization. They argue that the natural environment of Latin America was conducive to plantation agriculture using slave labor or large-scale mining employing an abundant indigenous population. Latin American societies were therefore characterized by enclaves of Europeanized elites that dominated vast populations of African Slaves or Native Americans. Tremendous differences in human capital meant that, after independence, it was an easy matter for elites to capture the state: they crafted political institutions that gave them power beyond their numbers and economic institutions that afforded them tremendous competitive advantages. Engerman and Sokoloff also argue that the natural environment of Canada and the United States had none of Latin America's "advantages:" it was too cool and dry to grow sugar; there was no obvious mineral wealth; and the indigenous population was sparse. The resulting societies were therefore composed of immigrant small farmers who were evenly matched in terms of educational attainment and political sophistication. After independence, elites in Canada and the United

States had to bargain with these citizen-farmers, who became increasingly adept at projecting political power and demanding policies and regulations that promoted a more level economic playing field. The long-run outcomes were universal suffrage, sustained economic growth, and rising standards of living.

Acemoglu, Johnson, and Robinson (2001) also focus on the natural experiment created by European colonization, but for them the crucial variable is the disease environment. Where Europeans faced high mortality, which is to say where heat and humidity favored the species of mosquitos that carry Malaria and Yellow Fever, they set up “extractive” institutions designed to maximize their economic return over the short run. Where Europeans faced low mortality risk, because the climate was drier and cooler, they set up “settler” institutions designed to create a political and economic environment that resembled Western Europe. These initial colonial institutions then conditioned long-run paths of institutional development: places with extractive institutions (e.g., the Congo) went down a path leading to autocracy and underdevelopment; places with settler institutions (e.g., the United States) went down a path leading to democracy and high per capita incomes.

The seminal contributions of Engerman and Sokoloff (1997) and Acemoglu, Johnson, and Robinson (2001) have pushed social scientists to take geography—and history—seriously. They are, however, incomplete explanations of why we observe three distinct regime equilibria around the planet. Engerman and Sokoloff (1997) focus solely on the Americas. Acemoglu, Johnson, and Robinson (2001) restrict their analysis to Western European colonies. Places that were skipped over by European powers because they were inhospitable (e.g., the Arabian Peninsula), that were integrated into a mother country (e.g., Turkistan, which was conquered and made part of Russia proper), that remained outside of the colonial system because they were

buffer states (e.g., Thailand), or that remained sovereign states because they had the potential to resist colonization (e.g., Japan), lie outside of their frameworks. The countries of Europe itself—both those that were colonizers and those that were not—also fall outside of the Engerman-Sokoloff and Acemoglu, Johnson, and Robinson theoretical purviews.

We are also not the first researchers to have noted that today's consolidated, liberal democracies emerged out of the modern territorial state. Downing (1992) argues that liberal democracy has its roots in the constitutionalism and decentralized rule that emerged out of medieval Europe. Bunce (2000: 714) notes that today's enduring liberal democracies emerged out of an earlier process of the creation of strong states, "which were, because of their historical development, unusually endowed with...the culture and the practice of the rule of law, and rational and politically accountable public administration." Similarly, Levi (2002) maintains that the civic engagement and widespread voluntary association required to make democracy work over the long term presupposes a strong and competent state that can provide the physical and communications infrastructure to connect disparate citizens. Moreover, only a strong state can provide the legal infrastructure that nourishes trust—by deterring opportunism—and allows governments to make credible commitments to citizens in exchange for their loyalty.

As far as we know, however, we are the first to offer a theory connecting the level of rainfall to the emergence of stable democracies and to the resilience of persistent autocracies. Our framework also specifies the intermediate steps between precipitation and the regime equilibria that are currently observed today. Finally, we offer an empirical test of the theory based on an all-inclusive cross-national dataset that includes both the postcolonial states that are the focus of the variation in institutions examined by Sokoloff and Engerman (1997) and

Acemoglu et al. (2001) and the colonizing states from Western Europe whose rare democratic institutions first fascinated the likes of Lipset (1959, 1963), Huntington (1968), and Dahl (1971).

THEORY

Any reasonable theory about the distribution of regime equilibria has to explain three sets of facts. First, it has to explain why the initial emergence of democracy took place in Western Europe, and not, say, in Central Asia. Second, it has to explain why those democracies persisted. Why didn't British democracy go the same route as, say, Nigerian democracy? Third, it has to explain why it was possible to recreate Western Europe's representative institutions in some areas of the world, but not in others. Why did democracy flourish in Canada, Trinidad and Tobago, and Botswana, but failed to gain even a toehold in Uzbekistan, Kuwait, and Liberia?

Tribalism versus Modern Territorial States

Let us begin with a fact that is obvious, but often overlooked: if one goes far back enough in history all societies were tribal. The reason is not hard to divine: the nuclear family is a basic biological unit; there are scale economies in obtaining the necessities of survival (e.g., hunting, child rearing, defense); and thus nuclear families sharing common ancestors band together, forming clans. When the scale economies of survival exceed the number of nuclear families that can actually trace their genes to a common ancestor, the boundaries of the clan are extended to include people who are more remotely related, who are related only by marriage, or whose kinship is fictive—which is to say that clans aggregate into tribes.

The fact that a tribe is essentially an aggregation of families means that it is not exactly clear where the family ends and the tribe begins—a distinction that is abundantly clear in the antithesis of the tribe, the modern territorial state. Modern territorial states exist outside of the family, and compete with the family for an individual's allegiance (Strayer 2005: 9). In fact,

members of the same nuclear family may be citizens of different territorial states. Tribes on the other hand, do not exist outside of the family; tribes are an extension of the family.

The implications of this fundamental difference between a tribal society and a modern territorial state for political organization are profound. In a tribal society, a small group of high status individuals makes all of the collective decisions, adjudicates disputes, performs administrative tasks, and interprets the supernatural. Tribal elders embody a seamless merger between all of these duties—this fusion of power and roles is the antithesis of the clear division between the political, legal, administrative and religious spheres that is the sine qua non of modernity (Weber 1949). These individuals therefore occupy the nodes of all of the conceivable networks in the tribal society. They are not bound by institutionalized rules, but by custom. The very fact that the members of the tribe are loyal to this small group of elders—either a single tribal leader, or a family that has a hereditary claim on leadership—means that even these customs may be modified in short order. After all, the legitimation of customs is spiritual; and since tribal elders are the only conduits between the demands of the spiritual world and the practical realities faced by their tribes, it is not clear where short run political exigencies end and customs begin. Indeed, in a tribal society, almost nothing is institutionalized—this even includes the physical borders of the tribe, which can change with the seasons (Strayer 1967, 2008).

Conversely, modern territorial states are characterized by impersonal, institutionalized rules that allow strangers to interact with one another. No dense family networks are required to build trust between individuals—a task that would otherwise span several generations—or to police those interactions. Disputes that arise from those interactions are adjudicated by specialists in justice, following pre-established rules (judges, operating in a legal system). The administration of the state is also carried out by specialists who follow routinized procedures in

an institutionalized context (bureaucrats). In the modern territorial state there is usually a separation of the secular and the sacred: political leaders are not priests, and make no claim to a special relationship with the supernatural (Weber 1949; Strayer 2005: 10-11).

It should be obvious why the institutions of liberal democracy first emerged in modern territorial states, and not in tribal societies, but what needs to be explained is why the modern territorial state first emerged in Western Europe. The answer is moderate amounts of rainfall, which were conducive to the creation of societies based on agricultural production, not nomadic pastoralism or foraging.

None of this happened by accident: the decline of tribalism and the emergence of the modern territorial state was the outcome of a long historical process rooted in the existence of agricultural surpluses (Spruyt 1994). That is to say, the first blow against tribal societies was the Neolithic Revolution, which generated surpluses that fueled trade, specialization, and social differentiation. In short, agriculture gave rise to states. The first states fell into either of two classes: city states that were socially cohesive but militarily weak; or dynastic empires that were militarily powerful but socially fragmented (Tilly 1990; Strayer 2005: 11). These early states tended to be ephemeral: the city states were subject to military conquest (often by the empires at their borders); the empires, by virtue of the fact that they were made up of disparate tribes, lacked the social cohesion necessary to survive one or two incompetent dynasts. A few of the empires proved to be remarkably durable. Indeed, the most successful of them, Han China and Rome, owed their longevity to their ability to integrate the tribal peoples that they conquered.

Settled Agriculture and Feudalism

When the Roman Empire fell the tribal political structure that had suffused Europe was partially regenerated (Greif 2006); but their instauration proved to be short-lived. The same

agricultural surpluses that had earlier fueled the city states of the Eastern Mediterranean, and the empires of Egypt, Carthage, and Rome, created opportunities for individuals to specialize: in crop production, in manufacturing, in trade—and, crucially, in violence. As early as the tenth century, landlord-peasant societies began to emerge, replacing the tribal kingdoms that had earlier dotted the European countryside. Experts at violence, skilled in the use of horses and armor, they exchanged protection from marauding groups, such as the Vikings, Visigoths, and Saracens, for taxes in labor and in kind. These knights controlled extensive farmlands, but not territories in the modern sense. Instead, knights controlled people within particular jurisdictions, and they themselves were subordinate to a set of overlords with complicated overlapping jurisdictions to whom they pledged military support in exchange for the recognition of their right to rule (Spruyt 1994).

Gradually, the gulf between military specialists and farmers widened due to the accumulation of wealth associated with the control of the surpluses produced by settled agriculture. By extension, these specialists appropriated noble titles and reduced the farmers to serfs, thereby undermining allegiance based on clan or tribe. Indeed, the medieval notion that society is divided into orders, one of which has “blue blood,” is antithetical to core idea of a clan or tribe, which is that all members are kin. The surpluses generated by agriculture also gave rise to classes of merchants and artisans who resided in cities that became increasingly independent of the lords. The emergence of a merchant class to facilitate that trade was a direct threat to the manorial system—but it was in the interest of the specialists in violence who had been the most successful: the medieval kings.

In one sense, the resulting manorial system was a step backward from the consolidated empires that preceded it: it was much more politically and economically decentralized. Indeed,

the economy reverted to barter as long distance trade collapsed in the wake of political fragmentation. In another sense, however, the emergence of a concept of nobility, separate from the clergy and peasantry, broke down the notions of clan and tribe that had dominated Europe even through the period of the great empires. Political leadership was no longer determined by the status of being a tribal elder, but by blood line.

The advent of the modern territorial state

In time, the very success of medieval agriculture undermined feudalism. Settled agriculture permitted a sustained economic renaissance in Europe beginning in the 12th century. Agricultural surplus fueled trade and economic specialization, and a merchant class, independent of the nobility, clergy, or peasants, emerged. This class supported the centralization of political power, because centralized territorial control facilitated trade by lowering transaction costs (Spruyt 1994). Only a centralized political authority could create and impose uniform weights and measures, a single currency, and a uniform legal code—all measures strongly supported by merchants and reciprocated by monarchs seeking greater revenues. Merchants also sought to preserve their independence from the emerging centralizing state by creating walled towns that paid a local noble, or the king, for the right to autonomy. The power of landlords began to decrease in an inverse relationship to the ascendance of the merchant class.

As political units became wealthier and more centrally organized as a result of the synergy between monarchs and fledgling capitalists, they began to pose a security threat to each other, therefore incentivizing the search for regular revenues and the erection of standing armies (Tilly 1991). Monarchs therefore transitioned away from tax farming and reliance on the sale of land and offices and towards permanent taxation. The permanent collection of taxes required a chancery, as well as an educated, professional workforce that was both literate and numerate. It

also incentivized the standardization of currency, which required a royal mint, and a clearer delineation of private property, which required a registry and tax assessors. In short, a professional bureaucracy was necessary to provide the public goods that lowered the transaction costs associated with longer distance and impersonal trade, permanent taxation, and continued political centralization.

The modern state also required a system of justice based on objective legal criteria, not arbitrary and capricious practices such as “trial by ordeal” or “trial by combat.” The king directly administered justice in capital cases, or delegated it to royal officials (provosts). Kings also, however, delegated the administration of justice to parliaments (Strayer 2005), which were also important in that they could be used to mobilize revenues beyond those available to the king from his own domains and customary taxes (Herb 2003: 2053). The administration of justice also required courts.

This profound political and administrative transformation occurred in fits and starts. It moved faster in some areas of Europe than others. So did its associated epiphenomena: a bevy of new concepts and norms spread unevenly, but definitively, over the European continent. The modern territorial state represented a major innovation in social organization that profoundly changed political culture through two revolutionary and complementary concepts: undivided sovereignty and citizenship. The territorial state not only came to hold a monopoly on the use of violence within a demarcated area, it also obtained a monopoly on the political legitimacy and allegiance of the people who resided within its borders.

The emergence of permanent representative institutions

The advent of political institutions that represented the interests of the monarch’s subjects was part and parcel of the modern territorial state. As Strayer (2005: 64-5) has noted,

representative assemblies first emerged in Medieval Europe, and “were closely associated with the growth of medieval courts and medieval jurisprudence.” Kings had to find a way for the propertied classes and corporate groups to give their consent. Indeed, well before the first European kingdoms began to congeal into modern territorial states in the late Middle Ages, there was already abundant precedent for corporate groups to be represented at the local level. Moreover, as Greif (2006) has pointed out, Medieval Europe was dotted with such corporate groups: guilds, fraternities, universities, communes, and city-states. These corporate groups were, of course, a reflection of a society in which clans and tribes were no longer the organization through which the nuclear family sought protection. Instead, nuclear families relied on corporations, particularly fraternities and guilds, to provide a social safety net and secure property rights. “...by the thirteenth century, most European principalities had representative bodies to approve taxation and communes were represented in all of them. Economic corporations, therefore, had the ability to impact policies and, in the long run, they were influential in transforming the European state into a corporation in the form of a democracy” (Greif 2006: 310).

We hasten to emphasize, however, that there is nothing deterministic about the claim that liberal democracy first emerged in Western Europe as the byproduct of a long historical process engendered by settled agriculture and its associated institutions. That is, this is not to say that the actual timing of important events such as the liberalizing reforms that weakened the power of the crown or the widening of the franchise was not a function of other factors. Take Downing (1992), who generally agrees with the premise that emergence of modern, centralized states were a prerequisite for liberal democracy in Western Europe. Yet he argues that the belated emergence of liberal democracy in France and Germany was due to the fact that these states did

not have the luxury of adopting a strategy of extracting surplus revenues for war-making via representative institutions the way that Sweden, the Dutch Republic and England did. Similarly, factors such as the strength of political parties, the type of religious cleavages, and the ideologies espoused by elites are purported to explain the actual timing of democratic deepening in the Western European states during the nineteenth century.³ None of these explanations about the timing of liberal reforms and the details unique to each case are incompatible with our basic point about the long-run determinants of stable democracy.

Why Democracy Became Stronger and Survived

We have argued that the institutions that gave rise to stable democracy were those that emerged from settled agriculture. A new social order based on stratification between lords and peasants displaced tribes, and it itself eventually succumbed to political centralization. The concomitant administrative revolution engendered by the requirements of long-distance trade and permanent taxation underpinned proto-representative institutions that facilitated both taxation and the centralization of justice within the state's borders. Why, however, did liberal democracy become so entrenched in states that underwent such as transformation and manage to survive serious challenges?

The answer is that the original democracies that emerged from the process outlined above were involved—and continue to be involved—in an equilibrium characterized by increasing returns. The institutions that originally put democracy in train also generated new incentives to support even more robust forms of democracy: the franchise was broadened over time and governments became increasingly more responsive to citizen demands and accountable. First,

³ In a recent edited volume on “The Historical Turn in Democratization Studies” (Capoccia and Ziblatt 2010).

once strong states with efficient taxation systems emerged, politicians developed a comparative advantage in reaching political office via elections because they were able to match demands for public goods with the supply of public goods. This further increased the incentive to bolster the efficiency of the tax system and to improve the quality of the public goods demanded by voters. In turn, the increasingly sophisticated public goods provided by centralized states promoted the practices needed to make democracy work amongst strangers across large relatively large territorial expanses. On the one hand, both physical and communications infrastructure, e.g., post offices, helped to build and sustain the civic engagement and widespread voluntary association that supports democracy. On the other hand, a legal system based on the rule of law promoted impersonal contract enforcement in a way that discouraged predatory behavior—therefore bolstering trust among citizens and citizens’ trust in the government (Levi 2002: 45).

The Lack of Settled Agriculture and Tribalism

In the absence of the climatic conditions necessary for settled agriculture and the emergence of landlord-peasant societies, the modern territorial state did not emerge. The absence of a modern territorial state, with its concomitant institutions of justice, taxation, and bureaucratized administration, foreclosed the development of representative government. Instead, tribalism endured.

When the territorial states of Western Europe set out to conquer regions populated by tribal peoples from the 15th century onwards, the institutions that could emerge in those conquered areas reflected nature’s constraints. Generally speaking, the Europeans largely ignored areas that were too dry to support agriculture. To the degree that they showed any interest at all, it was because these areas had strategic importance. For example, Great Britain created protectorates over the tribal monarchies of the Persian Gulf because those areas were on

the way to India: had another power controlled them, Britain's trade to its most valuable colony could have been interdicted. Similarly, Great Britain and Russia divided up Afghanistan as part of "the Great Game" (the Anglo-Russian race for control of Asia). As a result, there was little incentive for anyone—either the Europeans or the native populations—to transform tribal social organization or create a modern territorial state. At a much later stage of world history, and in response to new sets of geo-strategic considerations, the European powers drew lines on maps denoting these areas as "countries," but to this day it is not clear that they really constitute "modern states."

Colonialism, Precipitation and Institutional Diffusion

There were a few areas that the Europeans colonized that happened to have moderate levels of rainfall. These include the present-day countries of Canada, the United States, Australia, South Africa, Argentina, Peru, and Mexico. Here the colonizers re-created European agriculture. If the indigenous people of those areas happened to have a tribal social organization—as they did just about everywhere except Mexico and Peru—the Europeans pushed them aside, usually at the point of a gun. It is little wonder that all of these colonies emerged as modern territorial states, or that the majority of them are stable democracies.

Many of Europe's colonies were too tropical to establish European agriculture. What the Europeans could do, however, was transform *some* of these societies into profitable cash crop producers. This process was also bounded by the natural environment: it was feasible in some high rainfall areas (e.g., the Caribbean, which became the locus of world sugar production); but it was completely infeasible in areas with very low levels of rainfall (e.g., the Arabian Desert, which was so inhospitable that it was never formally colonized). The result, over the long run, was that tribalism was muted in the former areas, while it remained intact in the latter areas. It is

therefore not surprising that the low rainfall areas remain tribal and autocratic. It is also not surprising that *some* of the very high rainfall areas—particularly those where tribal peoples were, quite literally, eradicated and replaced by entirely new populations—gave rise, eventually, to democracies.

In short, average annual precipitation explains a good deal of the variation in regime types around the globe. The key is this: representative political institutions emerge and thrive in a particular institutional environment—the modern territorial state; and the modern territorial state is an outcome of a long historical process whose roots are found in the surpluses generated by settled agriculture.

EMPIRICAL IMPLICATIONS

This theoretical framework generates several testable implications. First, there should be a positive correlation between extremely low levels of rainfall and the persistence of tribal social structures. Second, there should be a negative correlation between moderate levels of rainfall and tribal social structures—because those were the areas where tribalism was swept aside entirely as a result of the dominance of settled agriculture. Third, it logically follows that tribal social structures should be associated with persistent autocracy, while the absence of tribalism should be associated with stable democracy.

In order to operationalize these hypotheses a measure of tribalism should have the following characteristics: it should reflect the historical fact that tribes ceased to be of importance in some areas of the world well before colonialism; it should reflect the fact that some areas of the world were tribal until they were colonized, and may remain somewhat tribal today; and it should capture the fact that in some areas of the world tribalism has remained almost intact until the present day. We therefore generate an index of tribalism based on the

frequency with which the Encyclopedia Britannica (Academic Edition) country entries employ words that capture the importance of tribe in their descriptions of a country's 20th and 21st century social structure. Our approach is similar to that of Adelman and Morris (1967).⁴ Our index varies from 0 to 50, with a mean of 3.6 and a standard deviation of 8.0.

Preliminary Data Analysis

Figure 2 plots the Tribalism Index against average annual rainfall by Regime Equilibria (we show the regime cyclers as well in this figure).⁵ The patterns suggested by Figure 2 are consistent with the three hypotheses outlined above. And as Figure 3 and Table 1 demonstrate, Persistent Autocracies tend to cluster in those regions of the world that are extremely dry and that are characterized by tribalism. In the first quintile of the rainfall distribution (43.5 cm and below), 70 percent of the countries are persistent autocracies, and 23 percent are Regime Cyclers. There are only two stable democracies in this group of low rainfall countries (Botswana and Israel), accounting for only seven percent of the cases—and they are at the far right tail of the rainfall distribution in this quintile (41.6, and 43.5 cm, respectively). This first quintile of the rainfall distribution is also heavily laden with tribal societies: 96 percent of the countries have positive scores on the tribalism index. Moreover, the level of tribalism among these countries is extremely high: the quintile mean is 13.4 (compared to an overall mean of 3.6); and nine of the 11 countries that are at least one standard deviation above the overall mean are located in this

⁴ The pattern displayed in Figure 2 is not sensitive to dropping any of the specific terms. For a discussion of the methods and sources, and how they depart from Adelman and Morris (1967), see the appendix that we will post to the web upon publication.

⁵ Later we refer to this index as the *Nomad + Tribal* index to distinguish it from other variations; these are introduced ahead and employed in the forthcoming regressions to ensure robustness.

quintile. Not surprisingly, the median tribalism score in this quintile is 9 (compared to an overall median of zero).

Stable democracies, by contrast, tend to cluster in the areas of moderate rainfall and low tribalism. As Table 1 and Figure 3 demonstrate, in the second quintile of the rainfall distribution (46 to 78.8 cm) 48 percent of the countries are stable democracies. There are only two persistent autocracies in this quintile; they account for seven percent of the cases (Regime Cyclers make up the remaining 44 percent). Only 52 percent of the countries receive positive scores on the tribalism index, and even in the positive cases the level of tribalism is extremely low: the quintile mean is only 1.7 (compared to an overall mean of 3.6, and a first quintile mean of 13.4); while the quintile median is only 1 (compared to an overall median of zero, and a first quintile median of 9).

At higher levels of rainfall the pattern flips once again: stable democracies become increasingly scarce; while persistent autocracies become increasingly plentiful. Stable Democracies account for 36 percent of the cases in the third quintile of the rainfall distribution, 19 percent in the fourth quintile, and 23 percent in the fifth quintile. Persistent Autocracies account for 36 percent of the cases in the third quintile, 42 percent in the fourth quintile, and 23 percent in the fifth quintile. By the fifth quintile, Regime Cyclers dominate, accounting for 54 percent of the cases. Tribalism becomes progressively less common across the three quintiles, so that by the fifth quintile the mean is only 0.7 and the median is zero.

MULTIVARIATE ANALYSIS

Three empirical objectives guide the statistical analyses that follow. The first is to investigate the statistical relationship between countries' level of precipitation and their regime equilibrium—whether they are observed as persistent autocracies, regime cyclers, or stable democracies. We

expect that the conditions that favor stable agriculture, namely sufficient rainfall, but not too much of it, will be correlated with consolidated democracy today. Conversely, we expect that the absence of these conditions, deserts, will be correlated with persistent autocracy today; moreover, relatively high levels of precipitation will also tend to be associated with persistent autocracy. Provided that these hypotheses are not rejected, our second objective is: 1) to assess whether rainfall in fact works through the institutions associated with settled agriculture to sustain democracy over the long-run, with these institutions proxied for by the *lack* of tribalism and 2) to assess whether the lack of rainfall works through the institutions associated with inveterate tribalism to sustain persistent autocracy. Isolating the variation in contemporary regime types that is a function of precipitation segues into the third objective: to identify a valid instrument for tribalism that can address concerns about endogeneity. Specifically, using measures of rainfall as instrumental variables may allow us to gain traction on the question of whether a country's degree of tribalism today indeed has a causal effect on its contemporary regime type. That is, using rainfall to capture the component of tribalism that is orthogonal to the error term will allow us to rule out reverse causation running from persistent autocracy to the strong tribal identities and practices that persist to this day in countries such as Afghanistan.

These three empirical objectives dictate that we undertake two rounds of regressions. The first round is relatively straightforward: to establish whether there is an association between moderate levels of rainfall and stable democracy and, conversely, whether there is an association between the lack of rainfall, or too much rainfall, and persistent autocracy. The second round is more sophisticated: to establish whether rainfall actually works through tribalism to sustain persistent autocracy and, conversely, whether it works through the lack of tribalism to sustain persistent democracy. The first, more straightforward, round of regressions calls for establishing a reduced-

form correlation between rainfall and regime types. The second, more sophisticated, round of regressions requires that we estimate our models via a two-stage instrumental variables approach.

We constructed a cross-sectional dataset with global scope in order to test the hypotheses implied by these two rounds of regressions. For the models with the most data coverage we observe 156 countries; for the model with the least data coverage we observe 134 countries. The dependent variable in the first round of regressions, as well as in the second-stage of the instrumental variables regressions that constitute the second round of regressions, is the regime equilibrium observed between 1986 and 2006. The chief independent variables of interest in the first round of regressions are measures of rainfall measured in 2008; these measures then become instrumental variables in the second round of regressions. The chief independent variables of interest in the second round of regressions are indexes of tribalism that are time-invariant variables constructed from contemporary reference sources. The control variables used in both rounds of regressions are averaged either between 1986 and 2006 or 1966 and 2006, depending on the specification. However, we also estimated a series of regressions, some of which will be reported ahead, in which the regime equilibrium is measured between 1993 and 2008. Finally, as a robustness check, we also estimated and report a series of two-stage OLS regressions in which regime type is measured in a more conventional way: as the cross-sectional average level of the Polity Score between 1986 and 2006.

Round 1 Regressions: Multinomial Logit Regressions

We expect that once a critical precipitation threshold is reached—that is, once desertic conditions are no longer prevalent—increases in rainfall will begin to increase the odds of stable democracy. Below that threshold, increases in rainfall are inconsequential: they cannot alter the fact that settled agriculture simply cannot be sustained and persistent autocracy will flourish instead. However, we expect the positive association between increasing rainfall and the odds of stable

democracy to eventually reverse itself once a second critical precipitation threshold is reached: the onset of a level of rainfall above the “moderate band”—a level of rainfall that is too high to sustain most types of settled agriculture. Finally, based on the graphical analysis of the data conducted above (see Figures 2 and 3), we expect yet another twist: at some point, moving from high levels of rainfall to even higher levels of rainfall may not necessarily harm a country’s democratic prospects, as attested by Costa Rica, Colombia, and Papua New Guinea. As we have already argued, in these postcolonial regimes very high levels of rainfall were not a death knell for democracy. More generally, extremely high levels of rainfall may again increase the odds of observing democracy despite the fact that, generally, rainfall above the “moderate belt” (between about 50 cm of average rainfall per year and 120 cm) is conducive to persistent autocracy and cycling between regime types. Accordingly, the magnitude of the positive effect between increased rainfall and democracy at the highest threshold of precipitation should be much more muted than the positive effect at moderate levels of rainfall.

Because a nuanced non-linear relationship between rainfall and democracy is hypothesized we must introduce rainfall and several higher order terms into the regressions. We expect to detect a cubic relationship where the relationship between rainfall and stable democracy is at first positive, then negative, and then positive again. Therefore, we generated non-linear transformations of the natural log of Rainfall (we logged rainfall because it is considerably right-skewed). Specifically, we constructed three restricted cubic splines of $\log(\text{Rainfall})$ with four 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 location of these four knots was 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 knots that were produced via this algorithm correspond to the following (non-logged) values of Rainfall: the first knot is located at 9.29 cm; the second knot is located at 63.84 cm; the third knot is located at 131.37 cm; and the fourth knot is located at 266.33 cm.

Three issues drive our choice of econometric specification in this first round of regressions. First, the dependent variable is the particular “regime equilibrium” that is observed—persistent autocracy, cycling between regime types, and stable democracy. This is an exhaustive set of nominal categories and, accordingly, they are inherently unordered. This approach to measuring regime type requires a multinomial estimation approach in which the odds of observing one of the three possible equilibriums are assessed in relation to the odds of observing the other possibilities. Therefore, we chose to estimate multinomial logit models. Second, there are several alternative explanations for regime types besides the level of precipitation. In order to mitigate bias these alternatives must be empirically assessed—several of these competing explanations necessitate controlling for variables whose omission would otherwise confound the relationship between rainfall and regime type. Therefore, we controlled for these variables. Third, the dataset is composed of a set of countries from around the globe characterized by significant heterogeneity. We must consider the possibility that the values of the variables of interest for the former colonies in the dataset might be correlated by virtue of sharing a common colonial master: the European colonial powers practiced unique strategies of rule and each imposed similar institutions across their colonial possessions, often in spite of cultural and historical differences. For example, French colonies in the Caribbean, such as French Guyana, received similar political systems as colonies in Africa, such as Senegal. Therefore, to adequately address the heteroskedasticity and intragroup correlation implied by this fact we estimated robust standard errors clustered by colonial heritage as defined and coded by Hadenius & Teorell (2005).

The multinomial logit models estimated to generate the first round of regressions are characterized by the following functional form. Let the variable Z_i be a random variable indicating the Regime Equilibrium that is observed in country i between 1986 and 2006. Let $Z_i = 0$ denote Persistent Autocracy, $Z_i = 1$ indicate cycling between Autocracy and Democracy and $Z_i = 2$ represent Stable Democracy. Then it follows that a multinomial logit model for $P(Z_i = j), j = 0, 1, 2$ can be formulated as:

$$P(Z_i = j) = \exp(\beta'_j x_i) / (\exp(\beta'_0 x_i) + \exp(\beta'_1 x_i) + \exp(\beta'_2 x_i)).$$

Setting $\beta'_0 = 0$ allows us to calculate the probability of observing a Persistent Autocracy, Regime Cycler, and Stable Democracy as:

$$P(Z_i = 0) = 1 / (1 + \exp(\beta'_1 x_i) + \exp(\beta'_2 x_i))$$

$$P(Z_i = 1) = \exp(\beta'_1 x_i) / (1 + \exp(\beta'_1 x_i) + \exp(\beta'_2 x_i)) \quad (1)$$

$$P(Z_i = 2) = \exp(\beta'_2 x_i) / (1 + \exp(\beta'_1 x_i) + \exp(\beta'_2 x_i))$$

To complete the model, we define the elements of the vector \mathbf{x}_i as consisting of the three restricted cubic rainfall splines outlined above, and an error term. Control variables will be added to the vector as well; we will discuss them in the order in which they are introduced to the baseline model.

Columns 1 and 2, Table 2, assess the relationship between the regime equilibrium and the three restricted cubic splines of $\log(\text{Rainfall})$. In Column 1 the $\log(\text{odds})$ of being observed as a Regime Cycler are estimated versus the $\log(\text{odds})$ of being a Persistent Autocracy. In Column 2 the $\log(\text{odds})$ of being a Stable Democracy are estimated versus the $\log(\text{odds})$ of being a Persistent Autocracy. In both columns the sign on each of the rainfall splines supports our predictions. The first spline is positive; the second spline is negative; the third spline is positive. Each spline is highly statistically significant. Finally, as expected, the magnitude of the (non-linear) effect of rainfall on the odds of being observed as a stable democracy is considerably higher than the effect of rainfall on

the odds of being observed as a Regime Cyclers. So, although moderate rainfall increases the odds of being observed as a Regime Cyclers versus a Persistent Democracy, it is far more likely that moderate rainfall will favor stable democracy than it will favor cycling between autocracy and democracy.

Figure 4 plots the probability of being observed as a Stable Democracy as a function of $\log(\text{Rainfall})$ —that is, as it varies across its range—along with 95% Confidence Intervals. Figure 4 reveals that starting at around 20 cm of rainfall there is a very steep increase in the odds of observing stable democracy as a function of increasing rainfall. The apogee of this positive effect is reached at about 55 cm of rainfall, when the probability of Stable Democracy is roughly 57%. Once that threshold is surpassed, however, the positive relationship between increases in rainfall and stable democracy reverses: increases in precipitation above 55 cm of rainfall lower the odds of observing stable democracy. The lowest odds of observing a Stable Democracy after that point is located around 148 cm of rainfall, when the probability of stable democracy is less than 20%. Thereupon the odds of stable democracy again improve as a function of increased rainfall—but they improve only slightly. The probability of observing a Stable Democracy again reaches 30% at the highest value of rainfall, 314 cm.

In Columns 3 and 4 the rainfall splines are omitted. Instead, a suite of variables that represent alternative explanations of regime type are included. This allows us to generate a benchmark model that we can use to compare the rainfall results to. We include *Regional Democratic Diffusion* following Gleditsch and Ward (2006) measured as the percentage of democracies in a country's geographic-cultural region, with each region defined by Hadenius & Teorell (2005). Because it has been argued that higher levels of Per Capita Income promote democracy (Lipset 1959) we include $\log(\text{Per Capita GDP})$ in real 2000 international dollars. Including *Economic Growth*, the growth rate of GDP per capita, addresses the hypothesis that, holding income levels constant, economic growth

promotes democracy (Gasiorowski 1995). *Total Fuel Income Per Capita* (measured in thousands of constant 2007 dollars) is included to address the possibility that natural resource reliance hinders democracy (Ross 2001). This measure is logged after adding 1 (to deal with the zero values) because the data is considerably right-skewed.⁶ Finally, *Percent Muslim* (the percentage of the population that practices Islam) is included because it has been argued that Islam is incompatible with liberal democracy (see Ross 2001 for an empirical test of this hypothesis).

Column 3 again estimates the odds of observing a Regime Cycler versus a Persistent Autocracy; Column 4 estimates the odds of observing a Stable Democracy versus a Persistent Autocracy. Let us restrict attention to only the coefficients that are statistically significant at conventional levels. Greater democracy in the region increases the odds of cycling between autocracy and democracy versus remaining an autocracy and greater reliance on income from oil decreases the odds of cycling between regime types versus remaining an autocracy. Greater democracy in the region also increases the odds of stable democracy versus persistent autocracy; moreover, greater wealth also improves the odds of stable democracy versus persistent autocracy.⁷

While in Columns 4 and 5 the same suite of variables that represent alternative explanations of regime type are again included, the three restricted cubic rainfall splines from Columns 1 and 2 are reintroduced. Despite the fact that we have now controlled for democratic diffusion at the regional

⁶ For a discussion of the sources and methods used to develop each of these control variables, as well as our dependent variables and tribalism indexes, see our Appendix on Sources and Methods.

⁷ Interestingly, there is no evidence for a “resource curse” here: although increased reliance on oil makes it less likely to transit from persistent autocracy into a state of cycling between autocracy and democracy, it does not make it less likely that a country will be observed as a stable democracy. These (non)results are compatible with Haber and Menaldo (2010).

level, wealth levels, the rate of economic growth, oil reliance and the influence of Islam, the results for precipitation are largely unchanged. In Column 4 the log(odds) of being observed as a Regime Cyclers are estimated versus the log(odds) of being a Persistent Autocracy. In Column 5 the log(odds) of being a Stable Democracy are estimated versus the log(odds) of being a Persistent Autocracy. In both columns the sign on each of the rainfall splines again supports our predictions. The first spline is positive; the second spline is negative; the third spline is positive. Each spline is highly statistically significant. Finally, as expected, the magnitude of the (non-linear) effect of rainfall on the odds of being observed as a stable democracy is considerably higher than the effect of rainfall on the odds of being observed as a Regime Cyclers. Finally, the negative effect between Fuel Income and the odds of transiting between autocracy and democracy, versus remaining an autocracy, is no longer statistically significant once precipitation is controlled for.

Might it be the case that the rainfall splines are unwittingly picking up the effects of different colonial strategies and practices? For example, could the total absence of stable democracies in desertic conditions be a lingering effect of British suzerainty? The British competed with the Ottoman Empire over control of the Middle East and Central Asia during the eighteenth and nineteenth centuries, eventually displacing the Ottomans and exercising indirect rule by dispatching a series of “political residents” throughout North Africa and the Persian Gulf—including agents who resided in Egypt and Somalia and what is now modern day Yemen, Bahrain, Kuwait, Oman, Qatar, and the United Arab Emirates. Perhaps the legacy of British institutions associated with their “protectorate” regime—the extension of their security blanket—and not the (lack of) rainfall endemic to this region accounts for the democratic deficit that characterizes these countries today? Likewise, perhaps French patterns of colonialism based on a strategy of political centralization and

overweening micromanaging from Paris accounts for the lack of democracy at relatively high levels of rainfall beyond the “moderate rainfall belt” identified in this paper?

To address concerns of this sort, Columns 7 and 8 rerun the model represented in Columns 5 and 6, with the only difference being that dummy variables for *Colonial Origin* from Hadenius & Teorell (2005) are added to the regression.⁸ The direction, magnitude and statistical significance of the coefficients for the rainfall splines are, essentially, unchanged. The only difference is that the magnitude of the positive effect of increases in precipitation for the third spline (the highest precipitation threshold) is reduced. As for the control variables, the only coefficient that remains statistically significant for the regime cyclers versus the persistent autocracies is Per Capita Income; for the stable democracies versus the persistent autocracies both Regional Democratic Diffusion and Economic Growth are significant at conventional levels.

We have established a statistically significant, non-linear correlation between precipitation and regime type that is robust to the inclusion of alternative explanations and controls for colonial origin. Once desertic conditions are surpassed, increases in rainfall begin to increase the odds of stable democracy. Below that threshold settled agriculture simply cannot be sustained and persistent autocracy flourishes instead. However, the positive association between increasing rainfall and the odds of stable democracy eventually reverses beyond the “moderate band”—a level of rainfall that is too high to sustain settled agriculture. Finally, at some point, moving from high levels of rainfall to even higher levels of rainfall is not necessarily a death knell for democracy. Extremely high levels of

⁸ There are nine dummies in total: Dutch, Spanish, Italian, US, British, French, Portuguese, Belgian, British-French and Australian. The baseline category, which is coded as “0”, consists of both countries that were never colonized by a Western overseas power and the British settler colonies (the US, Canada, Australia, Israel, and New Zealand).

rainfall again increase the odds of observing democracy, although the magnitude of the positive effect between increased rainfall and democracy at the highest threshold of precipitation is much more muted than the positive effect at moderate levels of rainfall. Is it the case, however, that rainfall works through the legacy of the institutions of settled agriculture and, concomitantly, the absence of tribalism, to support stable democracy and, conversely, works through tribalism, the absence of settled agriculture, to nourish persistent autocracy? We now turn to answering this question.

Round 2 Regressions: Instrumental Variables

Below we conduct a new round of regressions that will allow us to evaluate the hypothesis that precipitation affects regime types by working through tribalism. First, when rainfall is either too low or too high tribalism will endure and map onto persistent autocracy. Second, and conversely, when rainfall is moderate the legacy of settled agriculture will mean that stable democracy will be favored. Specifically, we estimate a series of two-stage instrumental variables regressions by employing the so-called control function approach. This approach requires three steps: 1) we first estimate the effect of our rainfall splines on tribalism, using alternative variants of the tribalism index as the dependent variable 2) we then calculate the residuals from that first stage regression 3) we then insert the vector of these residuals directly into a second stage regression where the dependent variable is the regime equilibrium and the chief independent variable of interest is the tribalism index. The last procedure allows us to estimate the effect of the purely exogeneous component of tribalism on regime type.

The advantage of the “control function approach” to instrumental variables regression is twofold. First, a standard t-test on the coefficient for the residuals obtained in the second stage offers an immediate test of the endogeneity of tribalism. Second, this approach can be employed for

nonlinear second stage estimation techniques, including multinomial logit regressions, which is again required given that regime type is measured as a nominal (unordered) category.

The first-stage regression equation is an OLS model of the following structure:

$$\begin{aligned} \text{Tribalism Index}_i = & \alpha + b_1 \text{Rainfall Spline One}_i + b_2 \text{Rainfall Spline Two}_i + b_3 \text{Rainfall Spline} \\ & \text{Three}_i + \mathbf{x}_i + e_{it} \end{aligned} \quad (2)$$

where i is the country and \mathbf{x}_i is a vector of exogenous control variables that will also be added to the second-stage regression. These controls will again include a measure of democratic diffusion at the regional level, log(Per Capita Income), economic growth, oil reliance, the influence of Islam, and dummy variables that identify countries' colonial origin. In order to ensure that these control variables are exogenous when entered into the second-stage equation where Regime Equilibrium is the dependent variable, a requirement of unbiased estimation when using a two-stage instrumental variables approach, the control variables are now two-decade averages calculated between 1966 and 1986. Similar to equation (1), the second-stage regression equation is a multinomial logit model. There are some notable differences between them, however. Besides the fact that the control variables are, as just mentioned, two-decade averages calculated between 1966 and 1986, this equation now includes an index of tribalism instead of rainfall splines as well as a vector of residuals, e_{it} , calculated from equation (2).

Three things are expected from these instrumental variables regressions. First, the Rainfall splines are expected to be correlated with the endogenous variable, Tribalism, which is also the dependent variable in the first stage regression. Second, the rainfall splines are not expected to be correlated with the error term of the second stage regression, where Regime Equilibrium is the dependent variable, once tribalism is controlled for. Third, we expect to find evidence that Tribalism is indeed endogenous; however, introducing the residuals from the first-stage regression directly into

the second stage will allow us to neutralize any endogeneity bias running from autocracy to tribalism and therefore render Tribalism exogenous.

We only report the results for the second-stage multinomial logit regressions where the dependent variable is the Regime Equilibrium. These are depicted in the top half of Table 3. To conserve space, we have omitted the output from the first-stage regressions where Tribalism is the dependent variable. Instead, in the bottom half of Table 3 we report the joint-significance tests (Wald-tests) for the rainfall cubic spline terms obtained from those regressions. We note that each coefficient always returns the expected sign (positive, negative, and positive, respectively) and is statistically significant—both individually and jointly.

In Column 1 we estimate the odds of observing a Regime Cycler versus a Persistent Autocracy; Column 2 estimates the odds of observing a Stable Democracy versus a Persistent Autocracy. Tribalism is measured as the Nomad Index (see appendix on sources and methods), which varies from 0 to 21.⁹ A greater degree of tribalism decreases the odds of cycling between

⁹ We note that this was *not* the measure of tribalism displayed in Figures 2 and 3. Instead, the Nomad + Tribal variant of the index was employed there. Using Nomad + Tribal in the above-mentioned preliminary analyses of the data, instead of the Nomad Index, allowed us to more accurately depict how the data is distributed. The former variant of tribalism is far more inclusive, capturing both societies that are implicitly tribal, because they are nomadic, and societies that are explicitly tribal, whether or not they are nomadic. On the other hand, using the Nomad Index as the primary measure of tribalism in these regressions makes it harder to find in favor of our hypotheses because it is based on an indirect and less exhaustive accounting of tribalism. Shortly ahead, we also report the regression results if the Nomad + Tribal Index is used to operationalize tribalism.

autocracy and democracy versus remaining an autocracy at the 10 percent level of statistical significance. A greater degree of tribalism also decreases the odds of stable democracy versus persistent autocracy—a result that is highly statistically significant (p-value is .004). It is also the case that there are strong grounds to suspect that Tribalism is indeed an endogenous variable: the coefficient on the residuals from the first stage regression is 0.446 with a p-value of .018—a result that holds across the models depicted in Table 3 and justifies an instrumental variables approach over a regular multinomial logit approach.

Figure 5 plots the probability of being observed as a Stable Democracy as a function of Tribalism—that is, as it varies across its range—along with 95% Confidence Intervals.¹⁰ A precipitous decline in the odds of observing stable democracy, versus persistent autocracy, occurs once the Tribalism Index takes on positive values. While the predicted probability of being a stable democracy is almost 30% when Tribalism equals 0, once a country is coded as having a tribalism score of five, e.g., Mali, the probability that it will be observed as stable democracy is less than 5%. Indeed, once Tribalism is greater than 6 (Mongolia), the probability of stable democracy is essentially 0%.

In Columns 2 and 3 we now use the Nomad + Tribal Index instead of the Nomad Index. The coefficient is still negative across both columns. Although the results weaken below conventional levels of statistical significance when evaluating the effects of tribalism on the odds of regime cycling versus persistent autocracy, they remain statistically significant at the 5 percent level for stable democracy versus persistent autocracy. In Columns 4 and 5 we return to measuring tribalism

¹⁰ To calculate these predicted probabilities Regional Democratic Diffusion, log(Per Capita Income), Economic Growth Rate, log(Total Fuel Income), and Muslim are set to their mean values; Colonial Origin is set to “0”.

as the Nomad Index. However, the dependent variable is now coded in a way that biases against the ability to find a negative relationship between tribalism and stable democracy. Instead of coding a country as a stable democracy if it has had a Polity Score of at least 85 or above (on a normalized scale between 0 and 100) since 1986, we now code a country as a stable democracy if it has had a Polity Score of at least 85 or above since 1993—thus allowing for several younger democracies to make it into this category. The coefficient on Tribalism remains negative and statistically significant at the 10 percent level for both Columns 5 and 6. The odds of being a Regime Cycler versus a Persistent Autocracy are reduced as tribalism increases; likewise, the odds of being a Stable Democracy versus a Persistent Autocracy are also reduced as tribalism increases. The same holds true when tribalism is again measured as the Nomad + Tribal Index. These results are reported in Columns 7 and 8. Finally, we note that if we re-estimate each of the regressions depicted in Table 3 after taking the natural of the tribalism indexes (after adding 1) the results are materially unaffected. The results from the two-stage instrumental variables regressions reported in Table 3 adduce support for the hypothesis that low and relatively high precipitation works through tribalism to affect contemporary regime types. Conversely, moderate rainfall also works through the lack of tribalism implied by the legacy of settled agriculture to affect a country's contemporary regime types. Moreover, these regressions demonstrate that tribalism is a robust predictor of persistent autocracy, and the lack of it a robust predictor for stable democracy, despite the fact that there is evidence that tribalism is partially endogenous to contemporary regime types.

But could the results obtained thus far be driven by the peculiar way in which regime types are conceptualized: as an equilibrium that can take one of three forms: persistent autocracy; cycling back and forth between autocracy and democracy; and stable democracy? What if instead of this

nominal, unordered classification of regime types we evaluated the relationship between precipitation, tribalism and the contemporary level of democracy?

Measuring Regime Types as the Polity Score

In Table 4 we report the results from a series of two-stage least squares (2SLS) instrumental variables regressions. The dependent variable, regime type, is now measured as the average Polity Score exhibited by countries between 1986 and 2006. The chief independent variable of interest is tribalism measured as the Nomad Index in Columns 1 through 3 and then as the Nomad + Tribal Index in Columns 4 through 6. In the first-stage regressions, the dependent variable is again these measures of tribalism (Nomad Index and Nomad + Tribal Index, respectively). Similarly, the instrumental variables are again the three restricted cubic rainfall splines that were used in the multinomial logit instrumental variables regressions outlined above. The top half of Table 4 reports the results from the second stage regressions. The bottom half of Table 4 reports three important statistics about the wisdom of using a 2SLS approach: 1) the joint-significance tests (F-tests) for the rainfall splines from the first-stage regression; 2) an endogeneity test that evaluates the hypothesis that tribalism is exogenous, with failure to reject implying that a 2SLS model is not justified, and a regular OLS approach is preferred; 3) a Score Test of the over-identifying restrictions that evaluates the hypothesis that the instruments are exogenous, with failure to reject implying that the instruments are valid.

In Column 1 the bivariate relationship between the level of Polity and Tribalism is evaluated. The coefficient is, as expected, negative and highly statistically significant ($<.001$). A 1 point increase in the Nomad Index induces a 6 point drop (out of 100 points) in the average Polity Score between 1986 and 2006. While the endogeneity test on Tribalism suggests that this Nomad Index is indeed endogenous, the failure to reject the exogeneity of the rainfall splines suggests that these are

valid instrumental variables. We note that the results for these tests are consistent across the rest of the models reported in Table 3. In Column 2 we add the following control variables to the regression: Regional Democratic Diffusion, log(Per Capita Income), Economic Growth, log(Fuel Income Per Capita) and Percent Muslim.¹¹ The coefficient on Tribalism is still negative and although the substantive and statistical significance is reduced, the results are still significant at the 5 percent level. In Column 3 we add Colonial Origin dummies. The statistical significance of the Nomad Index strengthens considerably and the substantive significance remains unchanged. Columns 4 through 6 repeat the same structure as Columns 1 through 3. The only difference is that instead of using the Nomad Index as the measure of tribalism, the Nomad + Tribal Index is used. Although the substantive significance of the coefficient on Tribalism is somewhat weaker across these three models, the statistical significance of the coefficient is almost identical to its counterpart in the first set of models. Needless to say, the relationship between Tribalism and democracy remains negative. Most importantly, both the endogeneity tests on the tribalism measures and the Score Tests for the over-identifying restrictions suggest that the relationship between tribalism and regime type runs from the former to the latter.

CONCLUSION

Why have some countries remained obstinately authoritarian despite repeated waves of democratization while others have exhibited uninterrupted democracy? Settled agriculture

¹¹ These control variables are again measured as the average between 1986 and 2006 instead of between 1966 and 2006. The reason for this is that we can now avail over-identification tests of the exogeneity of the control variables in order to ensure that they are indeed orthogonal to the error term in the second-stage of the 2SLS regression—a diagnostic that is unavailable when availing the “control function” approach to instrumental variables estimation (Table 3).

requires moderate levels of precipitation, and settled agriculture eventually gave birth to the fundamental institutions that under-gird today's stable democracies. Although all of the world's societies were initially tribal, the bonds of tribalism weakened in places where the surpluses associated with settled agriculture gave rise to trade, social differentiation, and taxation. In turn, the economies of scale required to efficiently administer trade and taxes meant that feudalism was eventually replaced by the modern territorial state, which favored the initial emergence of representative institutions in Western Europe. Subsequently, when these initial territorial states set out to conquer regions populated by tribal peoples, the institutions that could emerge in those conquered areas again reflected nature's constraints. An instrumental variables approach demonstrated that while low levels of rainfall cause persistent autocracy and high levels of rainfall strongly favor it as well, moderate rainfall supports stable democracy. Moreover, rainfall works through the institutions of the modern territorial state borne from settled agriculture—institutions that are proxied for by low levels of contemporary tribalism.

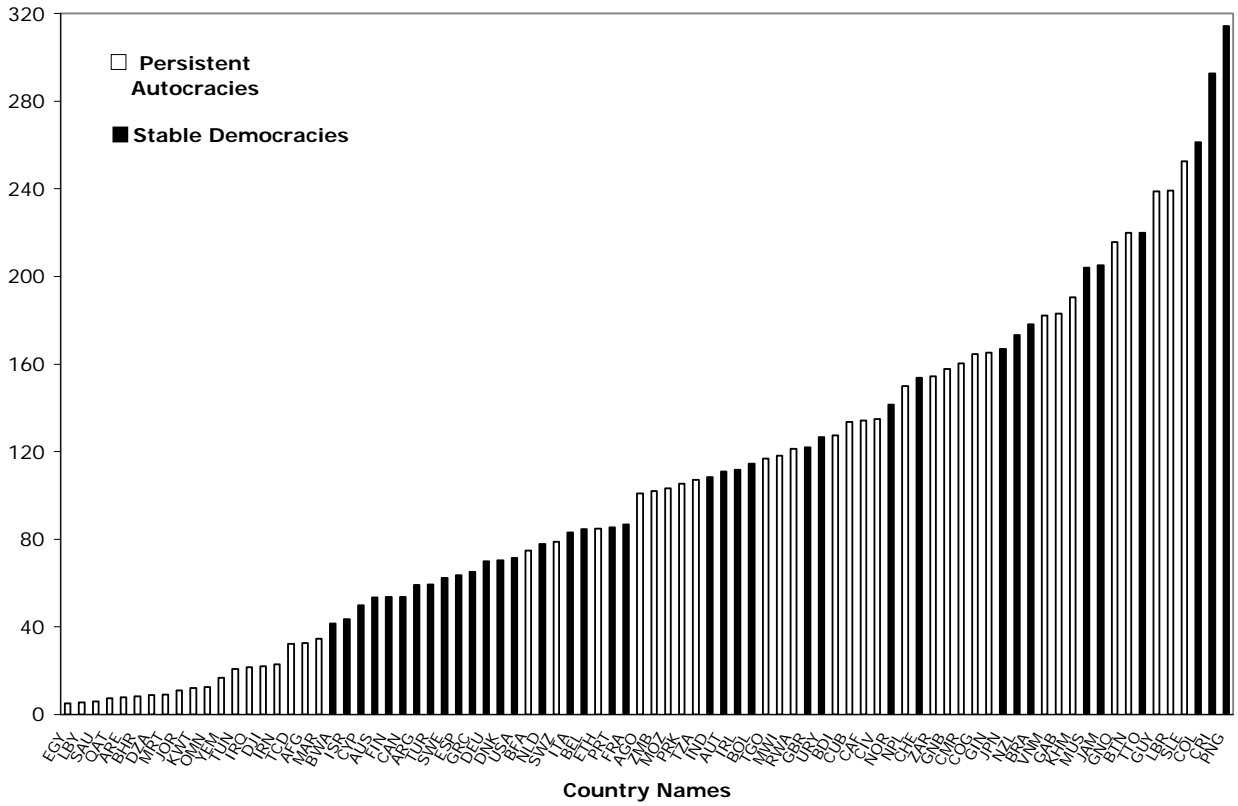
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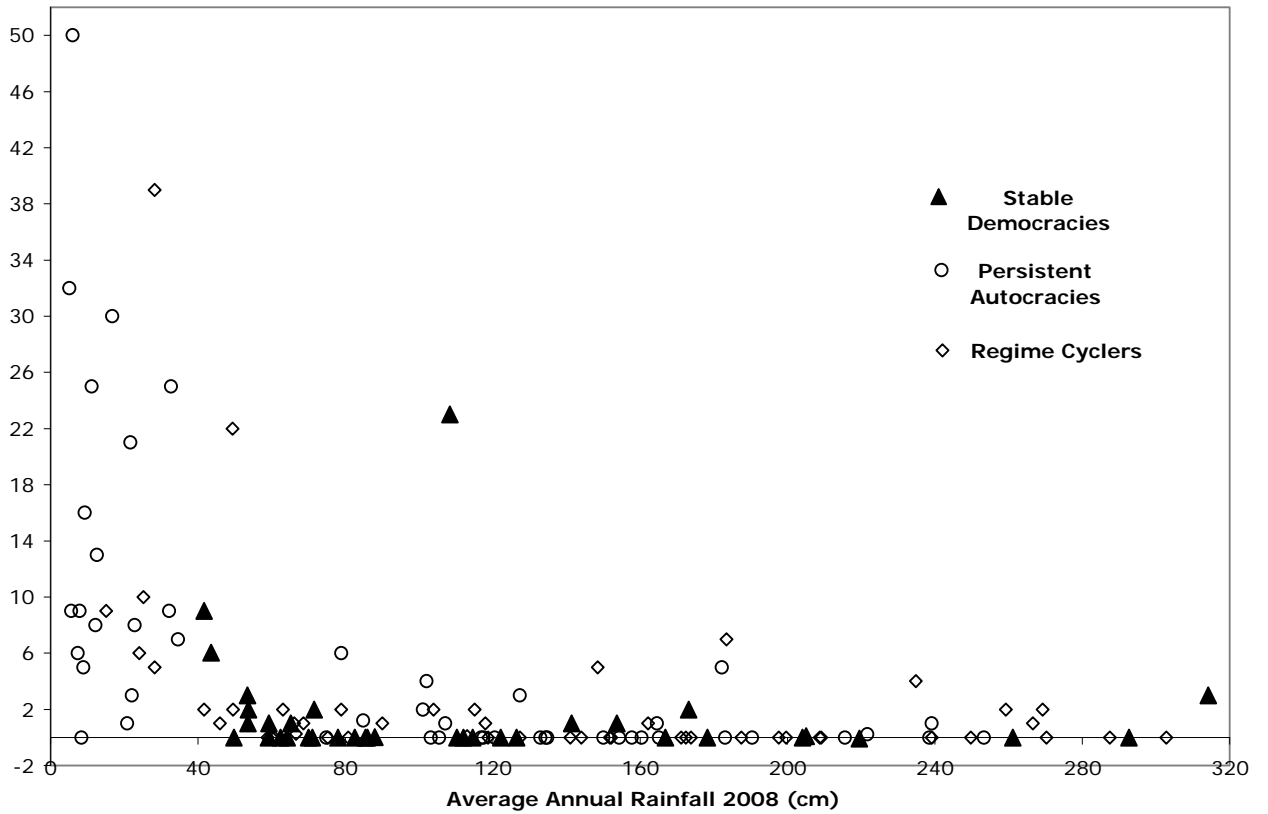
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Figure 1: Stable Democracy, Persistent Autocracy, and Rainfall



Note: the Y-axis is the average amount of rainfall per year in cm. measured in 2008.
 Source: World Bank Development Indicators 2010.

Figure 2: Precipitation, Tribalism, and Autocracy



Note: the Y-axis is the tribalism index (Nomad + Tribal).

Source: coded by authors using Encyclopedia Britannica (Academic Edition).

Figure 3: Stable Democracies and Persistent Autocracies, by Rainfall Quintile

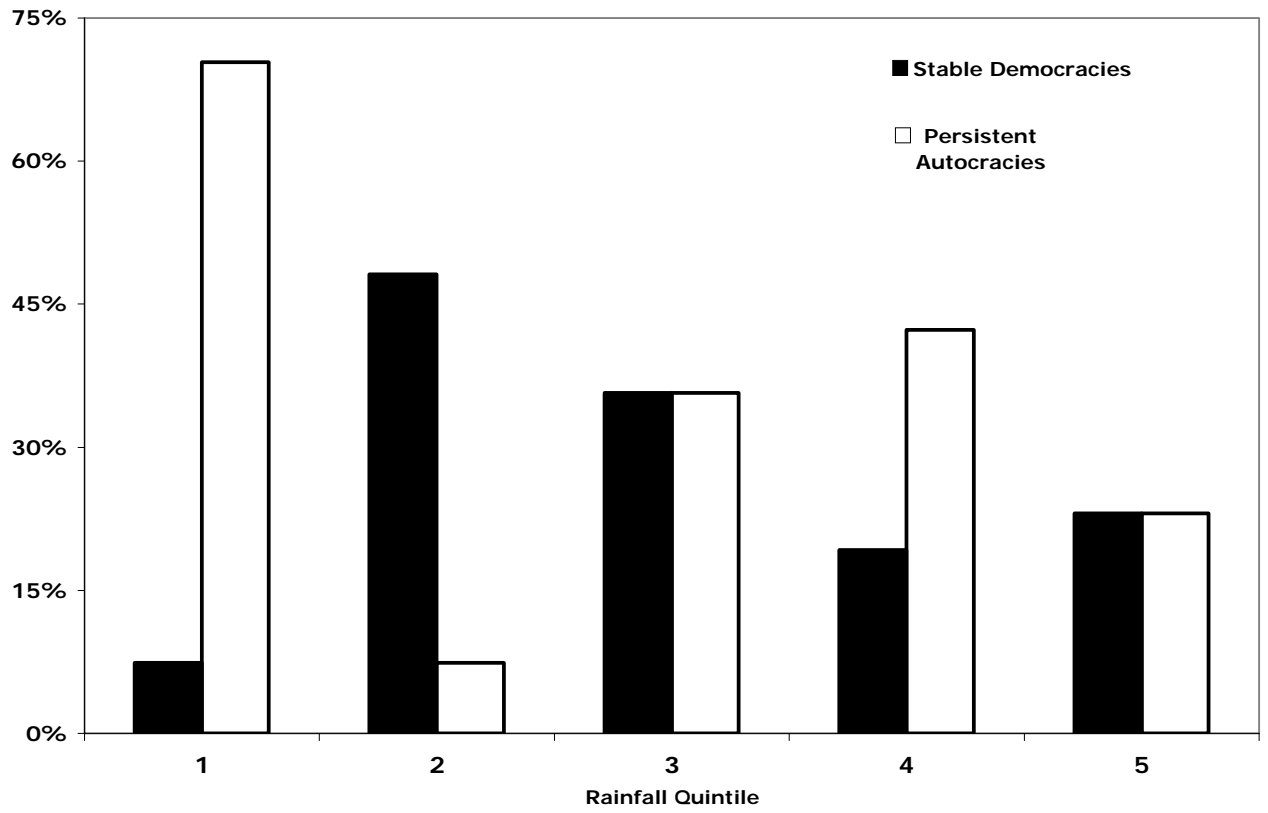


Table 1
 Summary Data on Regime Types and Tribalism, by Rainfall Quintile

Rainfall Quintile	Mean Rainfall cm/year	Maximum Rainfall cm/year	Percent Stable Democracies	Percent Regime Cyclers	Percent Persistent Autocracies	Percent with Positive Tribal Score	Average Tribalism Score (max=50)	Standard Deviation	Median Tribalism Score
1	20	44	7%	22%	70%	96%	13.4	12.5	9
2	63	79	48%	44%	7%	52%	1.7	4.3	1
3	107	127	36%	29%	36%	36%	1.4	4.4	0
4	159	183	19%	38%	42%	31%	0.9	1.9	0
5	240	314	23%	54%	23%	23%	0.7	1.6	0

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

Dependent Variable is the Regime Equilibrium (see text)

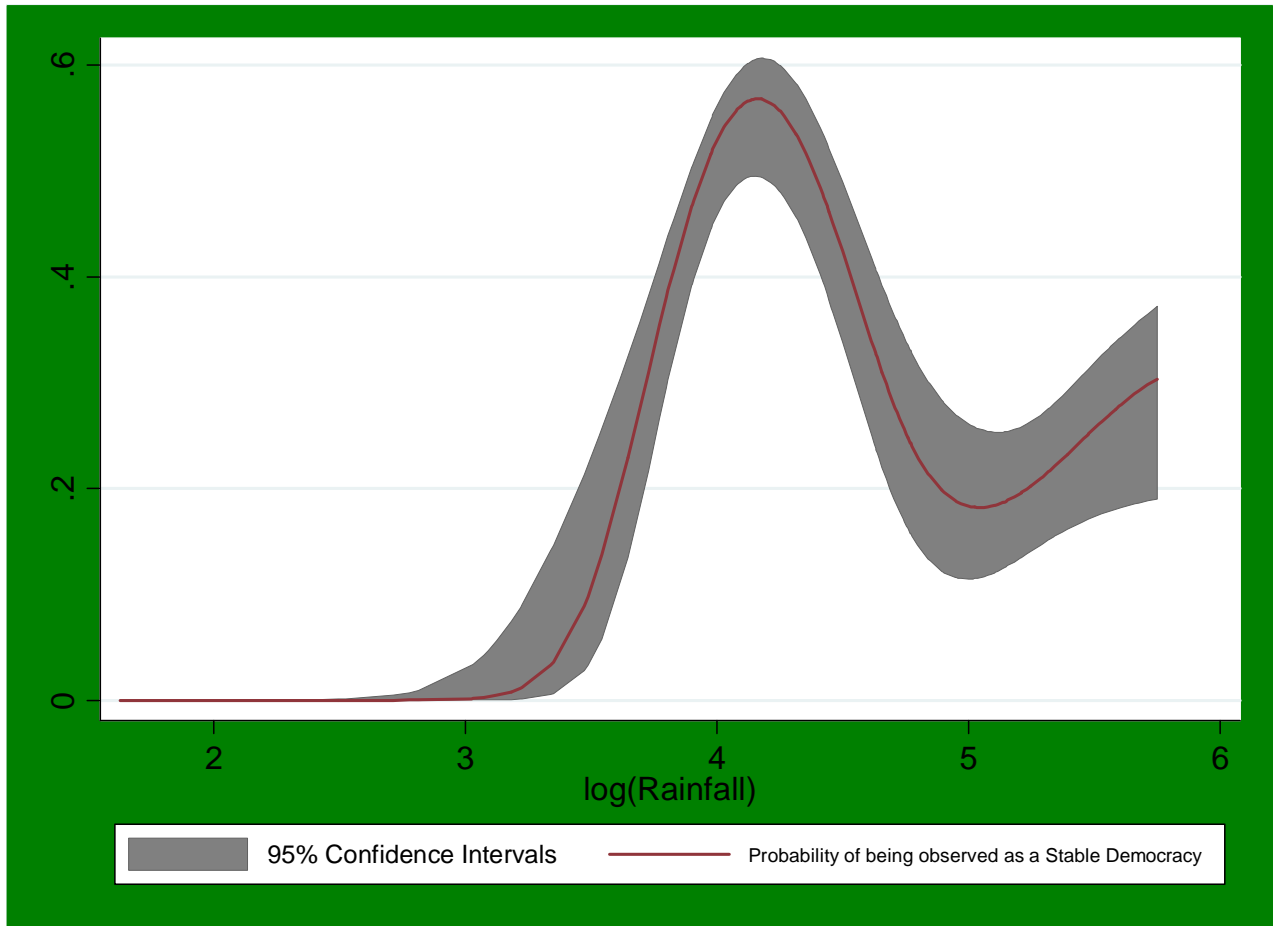
Robust t-statistics in brackets (clustered by Colonial Origin in Model 4)

	MODEL 1		MODEL 2		MODEL 3		MODEL 4	
	<i>Regime Cyclers</i>	<i>Stable Democracy</i>	<i>Regime Cyclers</i>	<i>Stable Democracy</i>	<i>Regime Cyclers</i>	<i>Stable Democracy</i>	<i>Regime Cyclers</i>	<i>Stable Democracy</i>
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.

Figure 4. Probability of Stable Democracy as a function of Rainfall



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.

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

Dependent Variable is the Regime Equilibrium (see text)

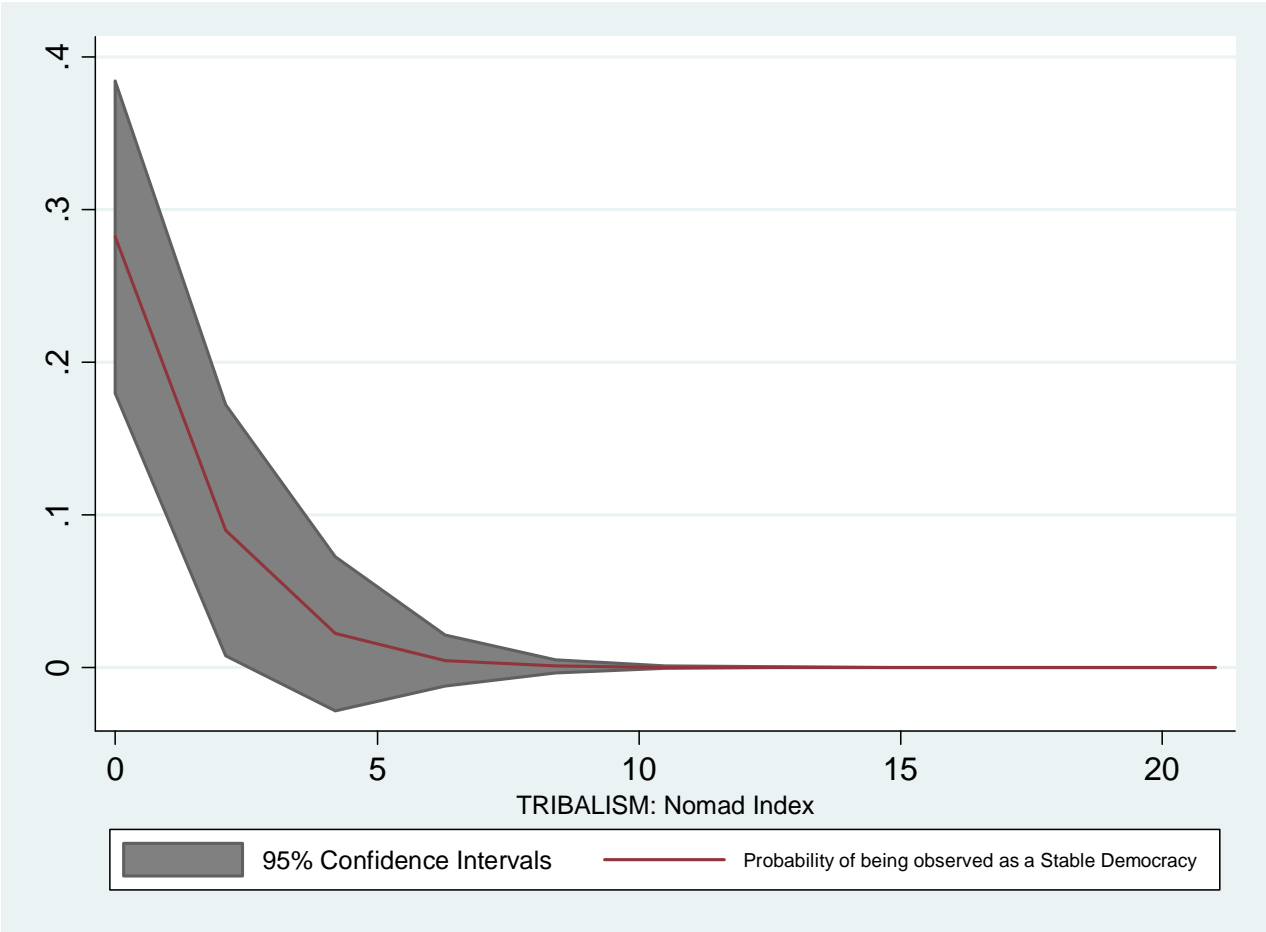
Robust t-statistics in brackets clustered by Colonial Origin

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	<i>Regime Cyclor</i>	<i>Persistent Dem.</i>	<i>Regime Cyclor</i>	<i>Persistent Dem.</i>	<i>Regime Cyclor</i>	<i>Persistent Dem.</i>	<i>Regime Cyclor</i>	<i>Persistent Dem.</i>
Tribalism	-0.312 [1.82]*	-0.884 [2.92]***	-0.214 [1.62]	-0.884 [1.93]**	-0.403 [1.82]*	-0.277 [1.83]*	-0.28 [1.70]*	-0.277 [1.83]*
Regional Democratic Diffusion	0.011 [0.43]	0.053 [6.14]***	0.013 [0.56]	0.059 [6.14]***	0.025 [0.88]	0.033 [2.17]**	0.028 [1.06]	0.033 [2.17]**
log(GDP Per Capita)	-0.037 [0.10]	1.445 [1.60]	-0.342 [0.77]	0.44 [1.18]	-0.242 [0.53]	1.126 [2.31]**	-0.551 [1.21]	1.126 [2.31]**
Economic Growth Rate	-0.003 [0.04]	0.279 [4.45]***	-0.05 [0.46]	0.374 [3.77]***	0.025 [3.41]***	0.026 [6.68]***	0.02 [3.20]***	0.026 [6.68]***
log(Fuel Income Per Capita)	-0.082 [0.86]	-0.086 [0.53]	-0.004 [0.03]	0.047 [0.38]	-0.104 [1.30]	-0.158 [1.03]	-0.012 [0.10]	-0.158 [1.03]
Percent Muslim	0.005 [0.49]	0.018 [0.63]	0.012 [1.12]	0.024 [0.55]	0.013 [1.36]	-0.017 [1.89]*	0.023 [1.90]*	-0.017 [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
pseudo 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.

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”.

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 [4.14]***	-2.423 [2.44]**	-2.433 [3.47]***	-3.344 [3.96]***	-1.589 [2.32]**	-1.864 [3.51]***
Regional Democratic Diffusion		0.41 [4.41]***	0.365 [2.44]**		0.404 [4.04]***	0.369 [2.26]**
log(GDP Per Capita)		6.776 [2.40]**	6.392 [2.41]**		5.947 [1.98]**	4.961 [1.31]
Economic Growth Rate		0.907 [1.04]	0.793 [1.88]*		0.868 [0.91]	0.772 [1.77]*
log(Fuel Income Per Capita)		-2.39 [3.34]***	-2.573 [6.64]***		-2.063 [2.81]***	-2.153 [3.57]***
Percent Muslim		-0.11 [1.47]	-0.114 [1.35]		-0.079 [0.87]	-0.067 [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						
F-test Rainfall Splines, first-stage	<i>Nomad</i>	<i>Nomad</i>	<i>Nomad</i>	<i>Nomad + Tribal</i>	<i>Nomad + Tribal</i>	<i>Nomad + Tribal</i>
p-value	13.67	14.87	359.13	9.12	9.93	66.32
Test of Tribalism endogeneity	0	0	0	0	0	0
p-value	49.718	7.479	4.675	46.435	9.027	3.979
Test of overidentifying restrictions	0	0	0.06	0	0.003	0.077
p-value	1.644	3.381	2.198	2.18	3.247	1.887
r-squared, first-stage	0.44	0.19	0.33	0.34	0.19	0.389
	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.