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Information and Revolution: The Effect of the Internet upon Authoritarian Regime Transition*

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Abstract

How does the Internet affect authoritarian regimes? This article argues that while the Internet has made mass mobilization easier than ever, its spread has also counter-intuitively allowed savvy authoritarian regimes to become more stable than ever. For the population, higher technical literacy means a demonstrable decrease in transaction costs and thus a greater incidence of collective action. However, higher regime technical literacy gives authoritarians the capacity to monitor their populations and solve the dictator's information problem, thus keeping their populations satisfied without needing to liberalize. The article compiles a new and original data set of measures of technical literacy across all states since the year 2000, and uses a factor analysis approach to construct latent measures of population and regime technical literacy for all country-years. A large-n, cross-country empirical approach finds strong evidence of the theorized relationship between technical literacy and revolution.

1 Introduction

What is the effect of the Internet upon the prospects of democracy?

Popular accounts of the "social media revolutions" of the Color Revolutions and Arab Spring have prompted a rush of empirical work exploring the relationship between new communications technologies and regime transition (Alqudsi-ghabra, Al-bannai, and Al-bahrani, 2011; Hofheinz, 2005; Mackell, 2011; Murphy, 2006; Oghia and Indelicato, 2010; Sereghy, Bunk, and Preiss, 2012; Stepanova, 2011; Zhuo, Wellman, and Yu, 2011). This work has largely focused on case studies over short time periods while engaging with the young, but theoretically rich literature exploring this relationship. Manuel Castells has made perhaps the most significant single contribution to date in this field, with his massive three volume work *The Information Age* (Castells, 2009). Theories of Internet and revolution can be broadly classified into two distinct categories: those who posit that the Internet's capacity for communication should increase the occurrence of revolution in authoritarian regimes, and those who argue that authoritarian stability should be unaffected (or even improved) by the rise of the Internet.

Foundational to the first school of thought, Clay Shirky has argued in several works that the declining transaction costs associated with new communications technologies make it easier for individuals to organize and solve the collective action problem (Shirky, 2009). Larry Diamond dubbed such technology "liberation technology" and the *Journal of Democracy* has examined regularly the role of technology in increasing the ability of social movements to resist regimes, in addition to examining the responses of states to this technology. However, this literature risks a utopian myopia similar to that of work on social capital. In assuming that technology is a normative good providing liberal tools to populations this work can miss how the changes wrought by communications technology have also enabled authoritarian regimes.

The second body of literature has staked out the contrary position, arguing that the Internet has in fact stabilized authoritarian regimes by enhancing their capacity to monitor populations (Morozov, 2012), and destabilized nascent democracies by making short term collective action easy at the expense of building institutions (Faris and Etling, 2008). Others have focused on more specific socio-political problems that arise from the Internet, such as the danger of homophily (the self-sorting of individuals into sheltered groups of those with similar beliefs) (Gentzkow and Shapiro, 2011; Page, 2008; Sunstein, 2009; Wojcieszak and Mutz, 2009), or implications of a digital divide both cross-nationally and domestically (Norris, 2001; Schlozman, Verba, and Brady, 2010).

However, neither set of theories matches the observed pattern of revolution in the Internet

era. The incidence of revolution in the thirty years prior to the millennium, from 1971 to 1999, is significantly lower than the post-Internet period. From 1971 to 1999, 47 revolutions occurred across 2,417 country-years for authoritarian states. From 2000 to 2013 out of a total of 769 country-years for authoritarian states, there were 34 revolutions. Since 2000, roughly one in every 22 authoritarian country-years has seen such a revolution, while in the previous three decades the rate was roughly one in 51 (Geddes, Wright, and Frantz, 2014). Despite the period from 1971 to 1999 including the heyday of the "Third Wave" of democratization and the fall of the Soviet Union, its rate of authoritarian collapse pales in comparison to that of the Internet era. But neither is the other camp exactly correct: among otherwise comparable authoritarian states, greater public Internet usage is negatively correlated with the incidence of revolution, and in fact repressive regimes are *more* likely to expand Internet access (Rød and Weidmann, 2015).

I contend that both camps of Internet theory are flawed because they each only have half the puzzle, and propose that the theoretical insights of the two can be joined into one generalized explanation. Drawing from the first school of thought, I argue that a population's aptitude with the Internet (which I call *population technical literacy*) decreases the transaction costs of collective action and therefore makes the organization of opposition easier. But pulling from the second camp, I also argue that an authoritarian regime's aptitude with the same technologies (which I call *regime technical literacy*) both makes it easier to identify dissidents and reveals otherwise hidden policy preferences of the population. Thus a highly technically literate regime can target the population with policies that repress without indiscriminate force and placate without liberalization.

In this article, I develop the theoretical bases for these technical literacies, introduce original measures for each, and develop a general theory for modeling their interaction (drawing upon the literatures of regime transitions and arms races). Finally, I empirically test the theory in a large-n, cross-country regression framework from 2000 to 2013.

2 Technical Literacy and Revolution

Gellner argues in his classic *Nations and Nationalism* that states encouraged mass literacy (and the social changes it wrought) in order to industrialize, but then reaped the consequences of increased public capacities for collective action that culminated in nationalism and the age of mass movements (Anderson, 1983; Gellner, 1983). In the modern setting, authoritarian states experience a parallel paradox. They exist in a tension between wanting to open up communication (in order to assess public support, efficiently set placating policy, and reap the benefits of globalized trade that depends on these new communications

technologies), while simultaneously wanting to repress communication in order to prevent organization of revolt. Both the 19th and 21st century cases are stories of information. In the former case, mass literacy allowed states to *transmit* information and the population to receive it. The rise of the Internet changed the flow of information again, by largely eliminating the fixed costs of both receiving and sending information for the entire population. The capacity of the population of a state to take advantage of the ability to transmit using the various technologies of transmission, I label *population technical literacy*.

Of course, regimes have their own techniques for attempting to gain the benefits of new communications technologies as they arise, while limiting their exposure to risk. Telephone systems can be constructed, but tapped. Computer networks can be built, but monitored. Postal service is provided, but all mail is read. Photocopiers installed, but duplicates of all copies retained. Such tactics not only allow the regime to maximize gain and minimize risk, but help with the *dictator's information problem*, giving insight into the true level of support among the population and what their particular complaints are. However, such tactics require the regime to have both an additional level of technical expertise in the particular technology being co-opted, and resources to commit to it. While it does not require special training to simply read every piece of mail going through the post offices, it is nevertheless a massive bureaucratic undertaking.

ICTs are trickier, requiring higher orders of technical ability in order to implement selective monitoring or censorship. Egypt, for instance, had the technical ability during the 2011 protests to power down the server facilities that connected the country to the outside world, but the regime had no capacity for selectively restoring access to particular subsections of the network. And so network access was restored after ten days, because the regime could not block opposition communication without also shutting down all non-cash financial transactions in the economy. Iran, in the wake of the Green Revolution, identified Google-owned sites as frequently used by the opposition and had the technical capacity to selectively block them, but had to remove the blocks within days after realizing too late that the entire legislature's official state email was hosted on Gmail. Such abilities are not just functions of throwing resources at the problem, they are also contingent on having the appropriate human capital to address the problem. Building a domestic version of the "Great Firewall of China" requires an army of computer programmers that many authoritarian regimes simply do not have at hand. This particular strain of state capacity, I dub *regime technical literacy*.

The explanatory power of this theoretical framework emerges from the strategic interaction of population and regime technical literacy. I argue that increased population technical literacy is associated with an increased probability of organization, up to the point that the regime's technical literacy provides it the capacity to solve its information problem. That

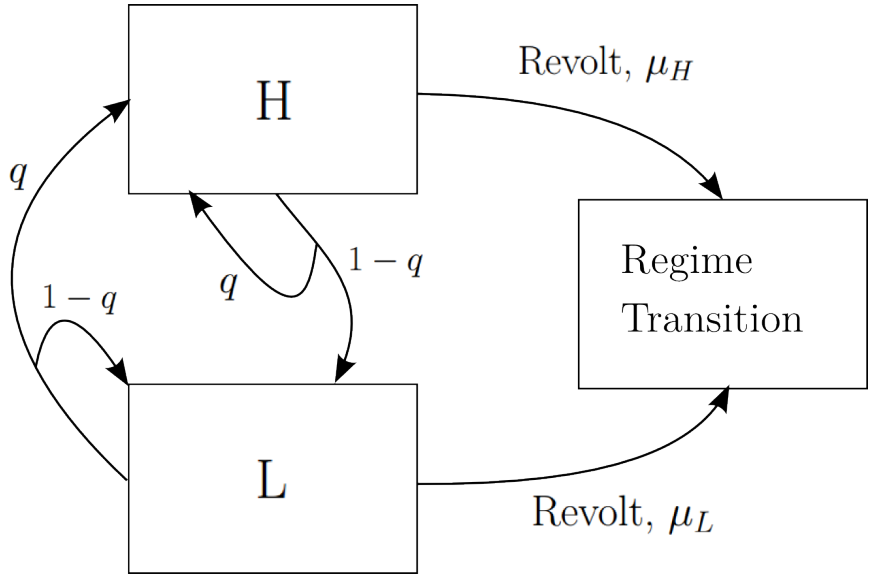
is, the two existing theories of the effect of the Internet on revolution are each correct and incorrect, with the true effect of the Internet being a function of the two, that is not simply a zero-sum affair. While technically literate populations are better able to organize, technically literate regimes are able to better solve their information problem.

In order to model this relationship, I draw from Gehlbach's simplified version of the Acemoglu & Robinson redistributive model of regime transition (Acemoglu and Robinson, 2009; Gehlbach, 2012). This model is of an infinitely repeating Markov game that takes one of three states: dictatorship with a "high attractiveness of revolution," dictatorship with a low attractiveness of revolution, and an absorbing state of regime transition. The game begins in dictatorship and has an exogenously defined probability of which dictatorial state it is in each turn. There are two players: the elites (or rich) and the non-elites (or poor). Each turn in dictatorship, the rich determine how much of their own utility to sacrifice and give to the poor (roughly modeling the notion that there are policies preferred by the poor that are not preferred by the rich), and the poor determine whether to revolt. If revolt occurs, the game changes state to regime transition the following turn and policy is thereafter set exclusively to the preference of the poor. The regime transition state indicates merely that the existing regime is overthrown, which may substantively mean that it is replaced by either another dictatorship or by a democracy.

Even this very basic model introduces key strategic tensions. First, the poor are nominally better off under a new regime since they have a say in policy, but their desire to revolt is tempered by the fact that revolution is costly. Second, the rich can nominally just set redistribution equal to zero each turn, but their desire to do so is constrained by the fact that if life is too miserable for the poor, they will find it cost-beneficial to revolt even though that will destroy a portion of the country's resources. So the cost of revolution creates the *revolution constraint*. If revolution were costless, the poor would always revolt in this model, and there would be no point in the rich trying to buy them off with favorable policies, because they could not give the poor more utility than they'd get under transition anyway. But if revolution is costly enough, the rich can afford to adopt less desirable policies in order to placate the poor to the point of enduring the dictatorship's policies rather than revolting. The cost of revolution in the high and low states is denoted as μ_H and μ_L, respectively, where $\mu_H < \mu_L$. The structure of the model is rendered in Figure 1.

The reason for distinguishing between the high and low states is to capture the notion that in politics, not all turns are created equal. Sometimes exogenous events come together just right to produce so-called *critical junctures*, moments at which the political stars align just right and make collective action a far more likely prospect. The high and low states formalize the intuitive idea that all turns are not just identical in an institutionally predetermined way,

Figure 1: Basic Redistributive Game



that the 1989s and 1848s of history are distinct. And further, the way that states transition in and out of those critical years is a distinct strategic environment that can be modeled. Regardless of whether the previous turn was in the high or low state, the probability of being in the high state in the next turn is q (and implicitly, the probability of being in the low state is $1 - q$).

In the case of this redistribution game, two categories of outcomes are interesting: equilibria in which the rich stay in power indefinitely, and those in which revolution occurs. The solution concept used in this model is that of a Markov-perfect equilbrium that is also a stationary equilibrium, which assumes that players' strategies are determined only by the current state of the game, and not by past or future events. So under what conditions will the poor revolt in this game? To answer this, Gehlbach's simplified version of the Acemoglu & Robinson model derives the present value utility of the poor and rich using Bellman equations in order to calculate the conditions under which not revolting yields a preferable outcome to all players over their alternative choices and derives the following equilibrium condition for this to be the case:

$$\mu_H \geq \delta(1 - q) \tag{1}$$

This simple relation lends itself well to comparative statics. First, by inspection it is clear that revolution is easier to avoid when μ_H is higher. This prediction makes very intuitive sense: the stronger the state's capacity for repression, the less likely the population is to

revolt. In addition, it is also clear by inspection that as q increases, regime transition is also less likely. As Gehlbach notes: "the paradoxical conclusion is that the rich may be better off if the poor pose a frequent revolutionary threat" (Gehlbach, 2012). It is this parameter that I reinterpret in order to generate empirical predictions about the relationship between population and regime technical literacy, and the chance of revolution. The probability of a country shifting into a critical juncture (and staying there in subsequent turns) is a function of the population's ability to organize collective action. A society with a low public capacity for communication is less likely to move into the critical juncture state, while as the transaction costs of communication drop, shifting from one state to another becomes less a generational event and more one that is replicable. Therefore, q partially represents population technical literacy in the context of the model.

However, the probability of shifting *out* of that critical juncture (and staying out of it in subsequent turns) is a function of the regime's ability to monitor the population, whether in terms of being able to monitor demands such that the population can be bought off efficiently, or simply being better able to identify leaders and tactics so as to suppress the potentially historic moment. Thus, q also inversely represents regime technical literacy in the context of the model. Therefore, all else being equal, as population technical literacy increases relative to regime technical literacy in an authoritarian regime, the likelihood of regime transition should decrease.

At face value, it is highly counterintuitive to posit that the better the population is able to collectively organize, the less likely it is that they will collectively organize to overthrow the regime. However, one finding from classic work on democratic transitions is that mass protest tends to yield either full-fledged democratic transition or a retrenchment of authoritarianism (O'Donnell, Schmitter, and Whitehead, 1986). The reason for this is that promises by a dictator are not credible. By virtue of being an authoritarian in the first place, there is no enforcement mechanism ensuring that a dictator keeps promises. Thus, a game of chicken ensues in which the opposition knows that if it lets the historic moment of hundreds of thousands of people in the streets of the capitol pass without forcing a change of power, then any promised reforms will fail to materialize as people leave the streets and the pressure on the dictator dissipates. Increased communication, by making such critical junctures more likely, ironically diminishes their importance. The increased capacity to organize mass action reduces the chance of complete democratization, because the ability to replicate critical junctures means that the population now has a viable mechanism for enforcing authoritarian promises. Thus, a middle ground of compromise becomes strategically feasible for both population and regime. However, this is also contingent on the regime being savvy enough with Internet technologies that it can manage to "read the room", so to speak, in addition

to being able to leverage the repressive capacity of the Internet enough to not lose control entirely.

These competing forces are highly reminiscent of the "contest functions" in the literature on arms races, in which the probability of success in conflict is modeled as a function of the relative competing military strength of each side of the conflict (Richardson, 1960; Skaperdas, 1996). As such, I define *relative technical literacy* as a contest function of both regime (RTL) and population (PTL) technical literacy:

$$RelativeTechnicalLiteracy = \frac{PTL}{PTL + RTL} \tag{2}$$

The mathematical advantage of this approach is that it compresses two variables of competing effects into a single operationalizable quantity. It also evinces several qualities at its limits that reflect our qualitative understanding of how these two measures should interact. For instance, as regime technical literacy drops near to zero then the function approaches one. That is, when a regime is completely incapable of dealing with the communicative capacity of the population, then even minimal organizational capacity by the population is able to frequently shift the country into the critical juncture state. On the other hand, if population technical literacy is held constant, then as regime technical literacy grows very large, then the chance that the country enters the critical juncture state approaches zero.[1]

3 Operationalization

3.1 Revolution

I use the "New Data on Autocratic Breakdown and Regime Transitions" dataset put together by Geddes, Wright, and Frantz as the basis for my measure of transition (Geddes, Wright, and Frantz, 2014). This dataset (which they refer to as the GWF) takes the set of all states that were authoritarian at some point from 1948 to 2010, and codes on a case by case basis what happened with each regime transition, drawing heavily upon the work of Cheibub, Gandhi, and Vreeland (2010) and Alvarez, Cheibub, Limongi, and Przeworski (2000). It defines regime transition as a point at which the "set of formal and/or informal

[1]Note that mathematically, at very low levels of RTL, even a minimal amount of PTL dominates. This can be problematic if using this equation in a formal modeling setting, and has been well analyzed in the conflict literature, since it leads to substantively unrealistic predictions like a single soldier being sufficient to win a war if the opposing party is unarmed. However, in the context of this paper no claims are being made as to the parties strategically choosing a certain level of technical literacy, as those levels are exogenously determined.

rules for choosing leaders and policies" is changed. The original variables in this data set of note are *type of subsequent regime*, a categorical variable that indicates whether the post-transition regime was broadly democratic, authoritarian, or neither (i.e. foreign occupied, ceased to exist, or a collapse of state authority entirely). *How regime ended* is a categorical variable indicating one of nine ways that was the primary force behind the regime ending. This variable includes categories for civil war, foreign occupation, coups, elite change, and most importantly for this project, *mass uprising*, which is defined as "widespread, mostly unarmed demonstrations, riots, and/or strikes".

For this project, I use a time frame of the years 2000 to 2013. Prior to 2000, wealthy democracies were the only states with anything approaching widespread Internet access. This means that prior to that point, there was essentially no variation on any of the independent variables involving technical literacy, and as such 2000 makes for a sensible starting point in the study. The year 2013 was selected as the most recent year that data was available for the variables of interest. Unfortunately, the GWF data set is missing the last three years of that time frame (which include among other cases, those of the Arab Spring). I have researched and hand-coded any regime transitions that occurred from 2011 to 2013 according to the GWF rubric in order to accommodate the missing years. In addition, I have aggregated GWF's different types of regime transition into *nonviolent* (insiders, electoral, and mass uprising) and *violent* (military coup, civil war).[2]

3.2 Technical Literacy

The last century has seen an explosion of distinct forms of communication, each with its own form of literacy. These new forms of literacy have challenged preconceived assumptions about measurement. There is a desire in the field of literacy measurement to disaggregate the technical ability to use something from the literacy required for using it for communication. Written literacy encourages this dialectic thinking because the technical abilities to use the written word have become invisible to us through familiarity. But that is because those abilities are taught at such a young age as to no longer be considered a technical skill. For example, knowing how to open a book, how to automatically turn it right-side up, that reading the text of the copyright page is not necessary, that the acknowledgements and introduction are not part of the actual text, or how to use an index and table of contents are all technical skills that are implied components of what is meant by "literacy", but have

[2]I have excluded transitions coded by GWF as having occurred due to foreign invasion. There are only two such cases: Iraq and Afghanistan. American occupation of those two states for nearly the entirety of the time period of the study renders them unsuitable for comparison because of that overwhelming exogenous factor.

almost entirely disappeared from any measurement process (Dalton and Proctor, 2009).

Different technologies of communication have different "scaffoldings" that the content is built upon, and literacy involves understanding the navigation of that scaffolding as much as it does the raw understanding of the text itself (Dalton and Proctor, 2009). With earlier forms of literacy, this distinction did not matter as much because consumers of content required very basic training to be able to successfully use the technology. Compare the amount of knowledge necessary for knowing how to watch a television and for knowing how to use a computer. By definition, the use of a television requires one to be literate in its uses, but the acquisition of that skill set was so trivial and universal as to make "literacy" an overly complicated framework for looking at it. Once a skill becomes quotidian, whether through universality or triviality, its measurement becomes irrelevant except in assessing extreme deficiency.

The fact that new technologies allow individuals to be producers of content rather than just consumers implies an entirely more complex set of active skills as opposed to previously passive ones. This has created a proliferation of literacies with adjectives to describe the ability to use new communications technologies successfully: digital literacy, cyber literacy, Internet literacy, network literacy, information literacy, media literacy, and the catch all "new literacies" (Livingstone, Van Couvering, and Thumim, 2009). I have settled on using the term "technical literacy" in this project as a compromise between the overly general and the overly specific, and with a desire to avoid the rabbit-hole of the semantics of terminology.

Population technical literacy is the ability of the population to communicate via new communications technologies, such as the Internet and cell phones. The desire to measure this concept in a large cross-national context further complicates the picture as it renders direct measures (such as designing tests of technical literacy under the guise of surveys or experiments) infeasible. Therefore in order to capture passive access to the Internet, I have gathered the proportion of the population using the Internet regularly, as a yearly measure (from 2000-2013) determined by national surveys from the International Telecommunications Union (ITU, 2013).

The availability of technology needs tempered by a measure of the ability to use that technology as there can be a great deal of variance in the active level of expertise. Ideally, we would want to know the level of computer proficiency among the population. This is important because being able to use a smart phone is one thing, but having the technical expertise necessary in order to hack that device into a WiFi hotspot when the regime cuts the cell phone networks is quite another level of knowledge. While it would be ideal to measure active technical literacy directly, through cross-country testing or surveys, this is a solution rendered untenable by the resources required. So an indirect measure is required.

The Linux Kernel Mailing List is the primary listserv for development of the Linux kernel, which is the core component of the entire operating system.[3] That central mailing list functions not only as a center of debate and discussion over the development and direction of this chunk of code that runs on a good portion of all electronic devices in the world, but also records as 'messages' changes to the source code committed to the central repository by people around the world. As Robert Love notes "If the Linux kernel community had to exist somewhere physically, it would call the Linux Kernel Mailing List home" (Love, 2010). Each of these messages, being an email, contains the source IP address, which can be used to identify the physical country of origin. This mailing list began in January of 1996, and thus spans the entirety of this project's time span. Because Linux kernel development is a cornerstone of the open source community, and Linux itself has maintained a high level of technical relevance from the mailing list's inception to the present day, this meets the criteria of being long-lived and stable. In addition, work on the project, while skewed towards Western countries, has been global from its earliest days, and the high level of traffic (on average, a thousand messages per day at this point) yields sufficient n to ensure that the measure is not just a dichotomous measure of developed vs. not.

I wrote custom computer code in order to gradually download over a six month period the entirety of the Linux Kernel Mailing List archives (some 2 million messages from 1996 to 2014). I wrote additional code to process the downloaded messages, extracting the multiple layers of IP addresses (headers to messages contain each of the servers through which the message passed on its way to the mailing list's host), and the source email address. Using a database that maps ranges of IP addresses to the physical countries in which particular ranges exist, I identified the country of origin for the vast majority of the messages. In addition, where source email addresses used country-code specific domains (which was the case in approximately 20% of messages), I cross-referenced those against the identified country of origin for the IP address as a robustness check. The two matched in over 95% of cases, which gave me the confidence to trust the accuracy of the IP address identification method for the bulk of the records. The resultant data once processed yielded 102,000 unique user-year pairs, with users posting from 137 different countries. Despite the fact that the distribution of the messages is heavily skewed towards a handful of western developed countries, the existence of data from most countries in the world makes it an excellent measure of active population technical literacy. I logged country-year quantities of LKML activity to adjust for skew, and then normalized it.

In order to construct my measure of population technical literacy, I used exploratory

[3]I collected data from the archive located at lkml.org, though there are several other similar archives of the mailing list.

factor analysis to extract a single common factor underlying the two input variables of LKML usage and Internet usage, and normalized the resultant measure to a hundred point scale for ease of use. Figure

Regime technical literacy is a more difficult measurement challenge because it is a form of state capacity that is expressed in hidden and indirect ways. The ideal measure would be one that gives an accurate idea of how capable a state is at using new communications technology for its own ends. At a very low level, this might be the ability to shut down the Internet and cellular networks to the country. At a higher level it might encompass the ability to selectively shutdown only the services that are causing them problems, which of course implies the ability to tell which services are doing so. The Weberian ideal type of a perfectly technically literate regime would be a state fully capable of monitoring all communications and selectively leveraging them for their own ends. There are two problems with measuring this capacity directly. First, directly measuring whether a state actually shuts down a network (for instance) is a terrible measure of whether it is *capable* of doing so, because the states that have not chosen to do so will be false negatives, lumped in with states that are incapable of doing so. Second, the more technically literate the regime, the more subtle of means it is capable of deploying, which are thus more difficult to measure directly in any way.

I instead endeavor to identify measurable elements of society that betray the capacity of the state to act without requiring a measurement of action itself. I have identified two such indirect measures: the pattern of hosting mirrors in states over time, and the sale of a state's country-code top-level domains. I will discuss each of these measures in turn, but what unifies them is that they represent publicly available figures that require large scale, institutional support. In addition, each requires high technical literacy, without being connected at all to either politics, or direct action taken by the regime. As such, they are the sort of measures that we expect to increase hand-in-hand with regime technical literacy, regardless of the particular political strategies vis-a-vis technology undertaken by the regime.

First, through Internet records, I acquired the number of domains in existence under each top level country code each year going back to 1990 when the possibility of doing so first started.[4] Top level domains are the two or three letters after the period at the end of a URL. For example, the familiar ".com" is the most commonly used one in the world. A number of other general top level domains exist in order to multiply the number of possible web addresses as demand has grown exponentially: .org, .edu, et cetera (but interestingly, not ".etc"). Top level country-codes were an innovation established prior to ICANN in the late eighties. These two letter domains were intended to allow different states to control different parts of the Internet. For example, URLs ending in ".uk" are from the United

Kingdom, while ".ru" indicates Russia. These country code top level domains (CCTLDs) correspond to countries as defined by the ISO, although some exceptions have gotten onto the list over the years and stayed for one reason or another. For example, ".eu" has been added for general European Union usage, while ".su" was created for the Soviet Union since it was still in existence at the time. Russia has retained control over the ".su" domain in addition to the more contemporaneous ".ru".

Each of these CCTLDs is held in reserve by ICANN up until the point that the state in question either takes active control of registrations of domain names or designates a third party to do so. Typically states have their telecommunications ministry or equivalent administer the domains. Outside of the United States, the websites and Internet resources of most state agencies are hosted on domains within their particular CCTLD (American agencies tend to use the ".gov" extension instead). And so the amount of domains hosted within the CCTLD is a rough measure for how much the state engages with the Internet in general. In addition, some states have made the decision to not allow any registration on their CCTLD other than official state websites, while others have gone to the opposite extreme and sold domain en masse. Such commercialization is especially common with CCTLDs that happen to match popular word endings in other languages. For example, Libya has sold enormous quantities of domains in its ".ly" domain to companies seeking to take advantage of those letters being the English language adverbial ending (for example, bit.ly). In a sense, CCTLDs are a free source of income for a state. But they require the technical capacity to both realize that fact and to capitalize upon it. For these reasons, the quantity of domains inside each CCTLD is a good measure for regime technical literacy.

An additional component of regime technical literacy is the capacity to commit institutional support for technical causes. An excellent measure of this is the presence of mirrors for various open source software. Mirrors are exact duplicates of the contents of servers, in order to help ease the load on any one server. For example, if you download a web browser for your computer, you might be downloading it from any of hundreds of different servers scattered around the world rather than a single central server. This serves the purpose of redundancy, but also of efficiency in ensuring that your download is coming from somewhere physically nearby on the network to reduce the amount of the network that a given data transfer has to traverse. Mirrors are not trivial to set up, requiring many gigabytes of dedicated server space, along with significant bandwidth in order to accommodate large quantities of downloads. For this reason, mirrors tend to be hosted at government funded facilities, most often

[4]The Internet Services Consortium (located at isc.org), a non-profit that helps develop Internet standards and server software such as BIND and DHCP, keeps a public database of this information. The data is archived at six month intervals (January and July), so I averaged the January and July figures to arrive at a single value for the year for each state.

university research labs.

I have selected several programming languages and server software packages that maintain records going back to the late nineties.[5] Each package shares a number of critical properties. First, it is a popular enough package that there is a reasonable expectation of there being enough demand to support a meaningful number of mirrors across many countries. Second, each by virtue of being programming languages and server installations are apolitical tools without any of the baggage that might go along with politically meaningful tools such as blogging software or audio-video software. These represent the raw tools for doing computer development and thus would be least likely to be targeted for specific political censorship among software packages. This is important because it makes it a good measure in the context of this project, in which the potential for political influence on each variable raises the specter of endogeneity. This is a measure of regime technical literacy from two perspectives. First, it is a measure of a certain level of state capacity and technical savvy to be able to recognize the need for and support the institutional deployment of large scale systems like this in the first place. Second, it represents a dedication on the part of the regime to make sure that its own population has quicker and more efficient access to such technologies for their own uses.

Each of the software packages identified above features a mirrors status web page that updates in real time to add new mirrors as they join the network, or remove other that stop responding. Mirrors with unreliable connections (or just going down at occasional intervals for maintenance or loss of network connectivity) might hop on and off that status list with some frequency. I then accessed cached versions of those status pages going back to the year 2000 for each of the packages. I wrote a program to download every cached version along with the appropriate timestamp for each, which amounted to several hundred data points for each package over the time span, rather than just a static number per year. I then aggregated those with simple averages for how many mirrors each state had active for each package over the course of the year, thus capturing variation in the ability to keep mirrors up, which would be lost in simple annual snapshots.

As with population technical literacy, I perform an exploratory factor analysis on the three input variables for regime technical literacy and then normalize the output to a hundred point scale.

Figures 2 and 3 render the estimated population and regime technical literacies for every state in the world, factored by year. All country-years have a corresponding dot (i.e., the shown dots are not outliers as is often the case in graphs of this style). The left-right position

[5]The Apache Web Server, the Comprehensive Perl Archive Network (CPAN), GNU, FreeBSD, and OpenBSD.

Figure 2: Box Plot (Median and Quartiles) of Estimated Population Technical Literacies by Year

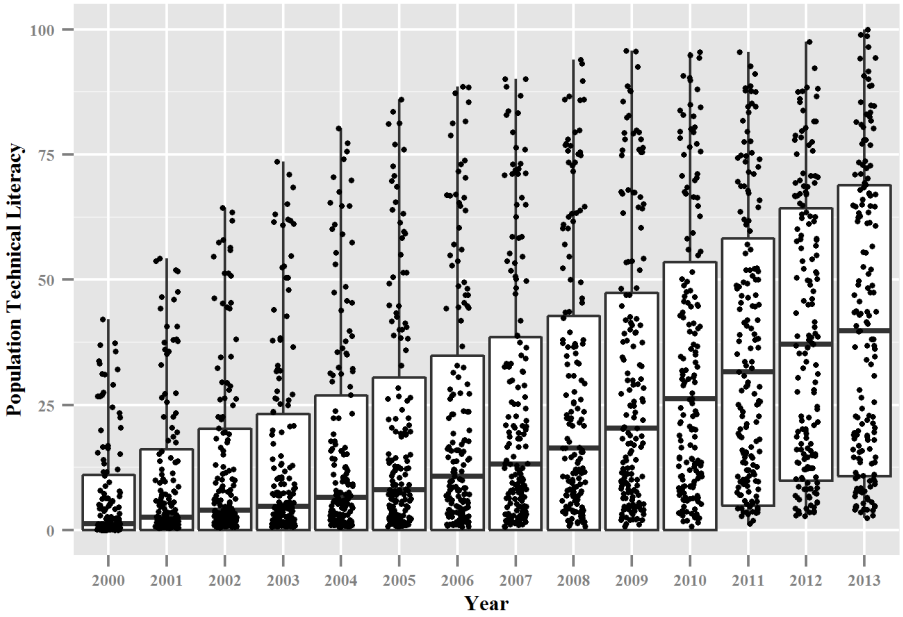
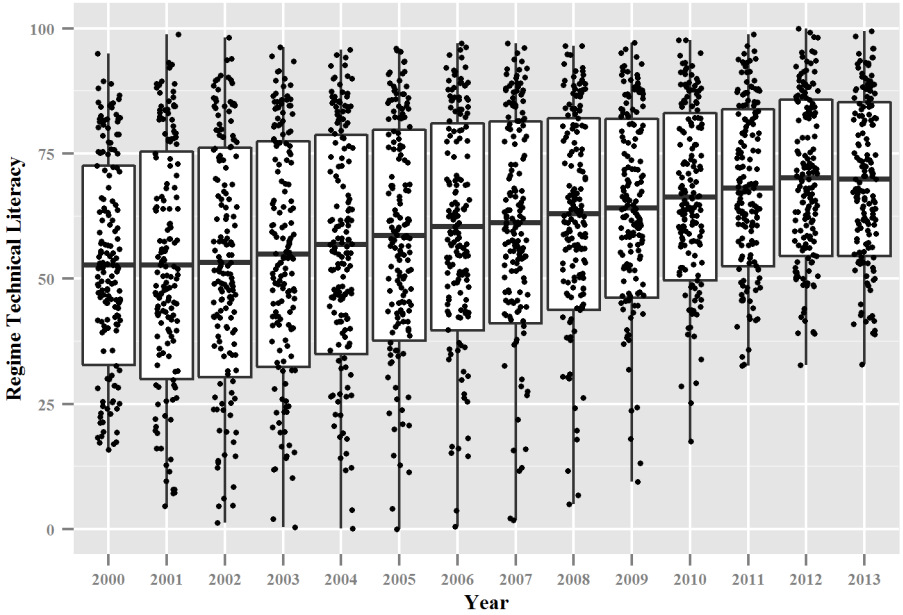


Figure 3: Box Plot (Median and Quartiles) of Estimated Regime Technical Literacies by Year



of a dot within a year does not have statistical or substantive meaning; it is only random "jitter" in order to make the dots more visible. The boxes in each plot represent the median

technical literacy in that year, bounded by 25% and 75% quantiles in each direction, while the whiskers indicate the minimum and maximum.

Of note for both population and regime technical literacy is that they are each steadily growing over time, which is expected on both fronts due to the growth in Internet technologies since 2000. Regime technical literacy seems to have leveled off in the last few years of the sample, which points to perhaps the end of a transitional regime in which regimes that made strategic decisions regarding investment in their own state capacity have reached a new equilibrium. Curiously, there remains a significant group of states that have experienced little to no growth in population technical literacy over time, even as the rest of the world has steadily increased and pulled the mean up with it. This has the effect in both technical literacies of the standard deviation remaining more or less constant across all years, even as the mean has grown faster than the median. This is because while the average literacy is growing over time, there is a relatively static group of countries at the bottom that are hardly growing at all. Thus, the skew of the distribution shifts, lifting the mean more quickly over time than the median.

Finally, I constructed the relative technical literacy variable by plugging in the population and regime technical literacies for each country-year into equation one.

4 Empirics

Empirical testing of proposed causes of authoritarian failure is a relatively common occurrence in political science, and a large literature of existing models exist that can be drawn upon. As such, rather than reinventing the wheel, I adapt the basic set of control variables specified in Rød & Weidmann's 2015 paper *Empowering activists or autocrats? The Internet in authoritarian regimes*: log of per capita GDP, percentage GDP growth, log of oil & gas dependence, log of trade openness, incidence of civil war, log of total population, percent of population that is urban, and dummy variables for whether the regime was military, monarchy, or personalistic (Rød and Weidmann, 2015). This suite of variables is representative of the field of cross-country work on determinants of authoritarian failure.

Though in their empirical work, the Internet ends up having the no discernible statistical effect on authoritarian regime transition, my framework provides a possible explanation for this anomaly beyond Rød & Weidmann's conclusion that the Internet must be more a tool of repression than a tool of liberation. Were that simple explanation the case, their empirical work should have instead demonstrated a significant but negative relationship between the Internet and democratization, rather than no relationship at all. Since the two primary schools of thought on the matter posit that the Internet should have *some*

effect (one claiming positive, one claiming negative), then finding *no* effect is not indicative that the negative school is correct, but that there is a more complex relationship than just positive or negative. My theoretical framework of a contest function between population and regime technical literacy serves exactly that purpose. As such, replacing the Internet usage variable in Rød & Weidmann's framework with my measure of relative technical literacy, is an efficient way of testing my theory within the context of the larger regime transition literature.

In addition, I run additional models in order to control for additional theories that have become standard alternative explanations for when and why authoritarian regimes collapse, especially in light of the Color Revolutions and Arab Spring. First, a strong argument has been made that diffusion accounts for an important component of authoritarian fragility, predicting that revolutions tend to beget revolutions in nearby countries (Beissinger, 2007; Bunce and Wolchik, 2010; Bunce and Wolchik, 2011). To operationalize this, I combined the GWF regime transition data set described in detail in the last section with a standard coding from the Quality of Government Institute that places each state in one of ten regions (Teorell et al., 2015).[6] I coded this by creating a dichotomous variable that was set to zero for all states in the year 2000. When an authoritarian regime transition of any sort occurred in any state within a region in a year, then the variable was set to one for all subsequent years *after* for all states in that region. In the discussion that follows, this variable is referenced as *Diffusion*.

However, others have argued that the Color Revolutions in particular show too much variation in technique to be the product of diffusion, and that although the three early and successful Color Revolutions were relatively close to each other chronologically, their occurrence is better explained by a combination of electoral cycles and regime weakness (Hale, 2005; Hale, 2006; Way, 2008). In order to operationalize the former, a dichotomous variable was created indicating whether each state had national legislative or executive elections in that year, populated using the Global Database on Elections and Democracy (Democracy and Assistance, 2016). In the discussion that follows, this variable is referenced as *Election*.

[5]Using my measure of population technical literacy in place of their measure of Internet usage yields substantially similar results across the board in the regression results presented in this paper. I present the results using their measure for the sake of parsimony: that is, the only change I am making to their basic model as presented is adding my variable of interest and updating the end point of the data from 2010 to 2013.

[6]The regions and their bounds are: "1. Eastern Europe and post Soviet Union (including Central Asia); 2. Latin America (including Cuba, Haiti & the Dominican Republic); 3. North Africa & the Middle East (including Israel, Turkey & Cyprus); 4. Sub-Saharan Africa; 5. Western Europe and North America (including Australia & New Zealand); 6. East Asia (including Japan & Mongolia); 7. South-East Asia; 8. South Asia; 9. The Pacific (excluding Australia & New Zealand); 10. The Caribbean (including Belize, Guyana & Suriname, but excluding Cuba, Haiti & the Dominican Republic)"

State weakness is operationalized using the number of individuals serving in the armed forces per capita, which is available in the World Development Indicators database (World Bank, 2015). While this is a less than ideal measure – the size of the armed forces is guarantee neither of their quality or willingness to follow orders – it is an operationalization that has become standardized in the field for lack of a less flawed measure (Albertus and Menaldo, 2012; Francisco, 1995; Hanson and Sigman, 2013; Hendrix, 2010; Soifer, 2008). For this measure, there were several country-years of missing data, which I interpolated by taking the mean of the preceding and following years. There was low enough year-to-year variance in this data that more complex interpolative techniques were deemed unnecessary. In the discussion that follows, this variable is referenced as *Coercive Capacity*.

The following equation describes the general model:

$$\Pr\left(Revolution_{it}\right) = x_{it}\beta_1 + q_{it}\beta_2 + z_{it}\beta_3 + \theta_i + \gamma_t + \epsilon_{it} \tag{3}$$

Where x_{it} is a three element row-vector of the variables for country i in year t required for the alternate hypotheses detailed above (Election, Diffusion, and Coercive Capacity), q_{it} is the relative technical literacy calculated from the derived values of population and regime technical literacy ($\frac{PTL}{PTL+RTL}$), z_{it} is a vector of the control variables specified in Rød & Weidmann, θ_i is a 76 element vector of country-fixed effects, γ_t is a 14 element vector for year-fixed effects, and ϵ_{it} is an idiosyncratic error.

Table 1 shows the regression results of democratic transition upon several models of slightly different independent variables for illustrative purposes.[7] This table reports the coefficients of each variable along with the standard error in parentheses. All models use country and year fixed effects. Models 1 and 2 use a dichotomous dependent variable of whether the authoritarian regime experienced regime failure, whereas models 3 and 4 use V-Dem's measure of polyarchy as the dependent variable and then (Coppedge et al., 2017a; Coppedge et al., 2017b; Coppedge et al., 2017c; Coppedge et al., 2017d; Marquardt and Pemstein, 2017; Pemstein et al., 2015).

First, note that as Rød & Weidmann model found, internet usage is not significant in either model it is included in, but relative technical literacy is, and has a negative effect on the likelihood on both democratic transition and level of polyarchy, which is consistent with my theory's prediction. Second, note that the addition of relative technical literacy scantly shifts the other significant variables at all, showing that it is introducing an explanatory element independent from those already in the model. Third, that finding holds up with little change even when country and year fixed effects are included, while the other covariates

[7] Each of these models was run using the *lm* function in R.

Table 1: Impact of Internet Usage and Technical Literacy upon Democratization

	Dependent variable:			
	Democratic Transition		Polyarchy	
	(1)	(2)	(3)	(4)
% Internet penetration$_{t-1}$	0.0002		−0.0001	
	(0.0004)		(0.0004)	
Relative Technical Literacy		−0.047*		−0.045**
		(0.026)		(0.021)
ln(GDP pc)$_{t-1}$	−0.008	−0.002	−0.038**	−0.035**
	(0.019)	(0.019)	(0.016)	(0.015)
GDP pc growth$_{t-1}$	0.012	−0.001	0.098**	0.095**
	(0.056)	(0.053)	(0.046)	(0.044)
ln(Trade openness)$_{t-1}$	−0.001	0.0004	0.038***	0.040***
	(0.008)	(0.008)	(0.010)	(0.010)
ln(Oil/gas income)$_{t-1}$	−0.0003	−0.0004	−0.001	−0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Ongoing civil war	0.016	0.016	0.001	0.001
	(0.010)	(0.010)	(0.008)	(0.008)
Military regime	−0.001	−0.006	0.057	0.053
	(0.091)	(0.091)	(0.074)	(0.074)
Monarchy	0.069	0.083	0.137	0.143
	(0.124)	(0.123)	(0.126)	(0.118)
Personalist regime	0.006	−0.002	0.060	0.056
	(0.036)	(0.035)	(0.082)	(0.082)
ln(Total population)$_{t-1}$	−0.002	0.004	0.115**	0.119**
	(0.043)	(0.043)	(0.052)	(0.050)
% Rural population$_{t-1}$	0.042	0.060	0.128	0.132
	(0.184)	(0.182)	(0.145)	(0.145)
Constant	0.072	−0.075	−1.574*	−1.653*
	(0.762)	(0.743)	(0.878)	(0.856)
Observations	769	769	729	729
Adjusted R^2	0.572	0.574	0.910	0.911
Note:				*p<0.1; **p<0.05; ***p<0.01

of the Rød & Weidmann model drop out of significance due to their very nearly constancy over the time of the study (and thus their variance is just absorbed by the fixed effects). And while I do not report the individual coefficients of the country and year fixed effects directly, they do contain some expected patterns. For instance, the fixed effect for 2011 (the height of the Arab Spring), is highly significant and positive in all models using fixed effects.

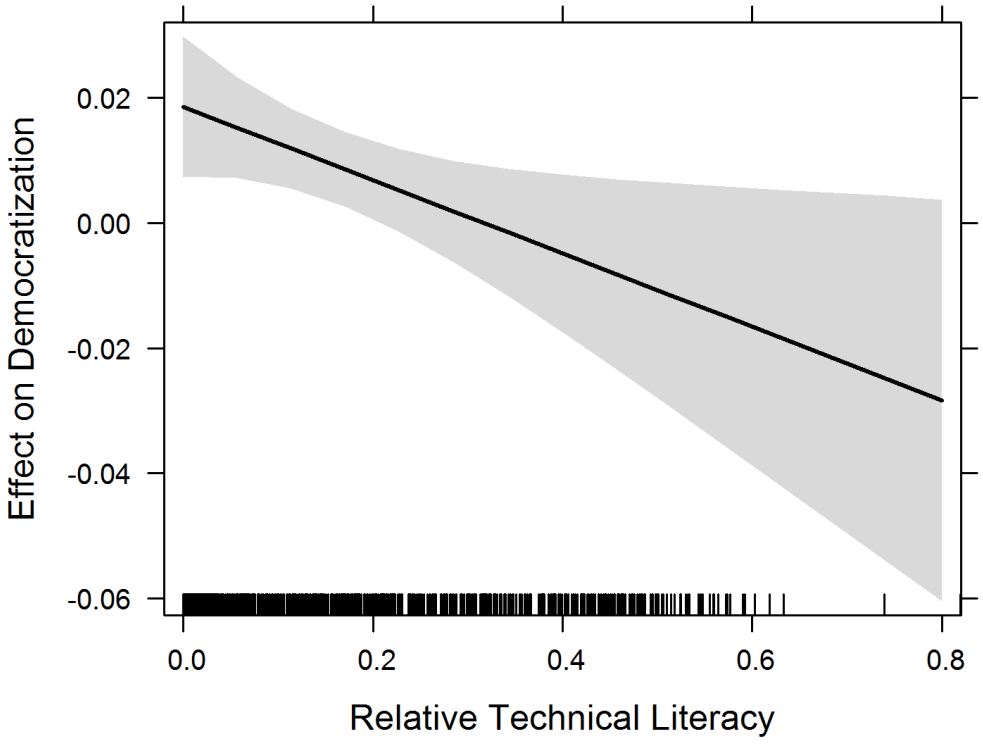
Figure 4 renders the effects of relative technical literacy upon the chance of democratic regime transition, based on the regression run in model four. The ticks on the x-axis represent individual country-year data points. At very low values, relative technical literacy has a positive effect on the chance of democratization, while at higher levels, the effect is increasingly negative. This follows from the theoretical expectation that when regime technical literacy is very low relative to the population, the population is better able to organize without any offsetting capability by the regime. And at higher levels, it should have an increasingly negative effect as the regime is better able to accommodate the population and move the country out of any critical junctures that develop. The magnitude of the effect for higher values of relative technical literacy is to decrease the dichotomous regime transition variable by about 0.02. While this seems at first glance a minor effect, recall that this is the chance of transition in a given country-year, and that over the time range of 2000 to 2013, only 18% of authoritarian regimes underwent regime transition. Thus, a two percentage point per year shift is in relative terms quite substantively significant.

In addition, I run these regressions using three different dependent variables to tease out some additional explanatory power: democratic transition, nonviolent transition, and violent transition (as defined in the previous section's discussion of the GWF data set). Table 2 reports the regression results of the three additional models with the additional alternative explanation variables added.

Relative technical literacy displays behavior consistent with my theory. It is a negative and significant predictor of democratization as my theory suggests, but less so in the case of predicting nonviolent transition. However, it is positive and significant as a predictor of violent transition. This is reflecting how when authoritarian regimes do have the capacity via technical literacy to remain stable, if they fall, it will be violently, because they have the capacity to deal with nonviolent opposition efficiently.

The diffusion variables provide mixed support for their theorized effect, being only significant in the nonviolent context. These results support the idea that while having revolutions in the same region is associated with an increase in the fall of authoritarian regimes through nonviolent means, it is not 'democratic values' so much as instability that is sparked by neighboring instability. Or in other terms: the fact that instability tends to spread within a region is not indicative of the population's organizational capacity to construct a democratic

Figure 4: Effects of Relative Technical Literacy on Democratic Regime Transition



regime in the wake of the previous regime's fall.

A similar effect can be seen with regard to the behavior of the Internet penetration variable, having a positive and significant impact (though admittedly, a substantively very slight one given the magnitude of the coefficient) on whether nonviolent authoritarian collapse occurs. As with the diffusion variable, this supports the idea of the Internet helping the population solve their collective action problem, but being able to do so does not in any way increase the ability to solve the problem of how to consolidate democracy having overthrown the regime in question.

On the other hand, the literature arguing that authoritarian elections represent critical junctures finds strong support in both models one and two, with the occurrence of elections in an authoritarian state in the prior year being a strong positive indicator of the possibility of both nonviolent regime transition generally, and democratic transition specifically. Finally, coercive capacity is decidedly insignificant in models five and six, although it does have the expected sign and high significance for model seven, in that an increase in the regime's coercive capacity reduces the chance that it will experience a violent fall.

Table 2: Impact of Different Theories on Varieties of Regime Transitions

	Dependent variable:		
	Democratization	Nonviolent Transition	Violent Transition
	(5)	(6)	(7)
Relative Technical Literacy	−0.053**	−0.0832*	0.072*
	(0.027)	(0.054)	(0.043)
% Internet penetration$_{t-1}$	0.0003	0.001*	−0.0004
	(0.0004)	(0.001)	(0.001)
Diffusion	0.010	0.054***	−0.006
	(0.009)	(0.018)	(0.015)
Election	0.012**	0.028***	−0.005
	(0.005)	(0.011)	(0.008)
Coercive Capacity	0.003	0.016	−0.035***
	(0.006)	(0.011)	(0.009)
ln(GDP pc)$_{t-1}$	−0.009	−0.077*	−0.018
	(0.020)	(0.039)	(0.031)
GDP pc growth$_{t-1}$	0.012	0.223**	0.143
	(0.056)	(0.112)	(0.089)
ln(Trade openness)$_{t-1}$	0.0003	0.001	0.004
	(0.008)	(0.016)	(0.013)
ln(Oil/gas income)$_{t-1}$	−0.0001	0.0003	−0.0001
	(0.001)	(0.002)	(0.002)
Ongoing civil war	0.015	0.011	0.032*
	(0.010)	(0.021)	(0.017)
Military regime	−0.013	0.309	0.042
	(0.094)	(0.189)	(0.150)
Monarchy	0.095	0.378	−0.057
	(0.125)	(0.251)	(0.200)
Personalist regime	−0.002	0.111	0.139**
	(0.042)	(0.084)	(0.067)
ln(Total population)$_{t-1}$	0.002	−0.132	−0.076
	(0.046)	(0.092)	(0.073)
% Rural population$_{t-1}$	0.052	0.458	−0.297
	(0.184)	(0.370)	(0.293)
Constant	−0.005	2.269	1.560
	(0.804)	(1.620)	(1.285)
Country Fixed Effect	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes
Observations	769	769	769

Note: *p<0.1; **p<0.05; ***p<0.01

Table 3: Democratic and Autocratic Change, by Relative Technical Literacy

	Democratic Transition	**Authoritarian Transition**	**No Transition**
Above median:	(3 states) Haiti Tunisia Yugoslavia	(2 states) Egypt Morocco	(23 states) e.g. China Iran Russia
Below median:	(13 states) e.g. Lebanon Thailand Ukraine	(8 states) e.g. Malaysia Kyrgyzstan Libya	(27 states) e.g. Botswana Laos North Korea

5 Discussion

Table 3 details which states experienced transitions of which type: transition to democracy, transition to a different authoritarian regime, and regimes that experienced no transition. In order to highlight the possible effects of relative technical literacy, the table is further subdivided into states with a relative technical literacy that is either below or above the median value of relative technical literacy for all states. The year used is either 2013 (in the case of regimes that did not fall) or the year in which a transition occurred.

Note just how stable authoritarian regimes with higher than the median relative technical literacy are over the last fifteen years. Of the 26 total instances of authoritarian regime transition, only four of them took place in states with a relative technical literacy above the median for the year of the transition, one of which was Yugoslavia in the very first year of the study (2000). Of the 28 states with above median values, only 5 experienced transition (18%), while 21 of the 48 (44%) states below the median experienced transition. Because it is tabular count data, the statistical significance of this pattern can be assessed with a χ^2 test. In this case, the test statistic calculates out to 5.27, with two degrees of freedom, which is relatively significant at a $p = 0.07$. This is a powerful illustration of the theory at work, showing a distinct pattern in line with theoretical predictions.

The examples presented in the table also help evaluate whether the theory seems to be operating according to what we know about the countries within each cell. The states in the two bottom left cells are represent the overwhelming majority of authoritarian regime transitions that occurred from 2000 to 2013, and are typified by regimes that were faced with mass mobilization and appeared to have little capacity to respond effectively to popular demands.

The top right cell is perhaps the best indicator at face value of the mechanism that I theorize. The typical cases are the authoritarian regimes like Russia, China, and Iran that have evinced a relatively high usage of the Internet by the population, that has been matched by highly mobilized regime capacity for using the Internet for nuanced purposes.

China is perhaps the most prototypical case, with reports of some 50,000 full time state employees dedicated to monitoring and reading online social media, aided by the systematic deployment of state-owned (and heavily policed) alternatives to popular foreign online applications. In addition, China has actively demonstrated the partial reform mechanism at work. For example, the rise of environmental protest in China over the last decade has been met not with widespread repressive crackdown as might have been expected a generation ago, but with piecemeal environmental reforms in response to specific protests. Secure in knowing when and where protest will happen due to comprehensive social media monitoring, and willing to forgo coercive force when the political demands are limited to specific local grievances, China's regime is a prototype for authoritarians who would placate without liberalizing. And their population acts as a similar model for the theorized mechanism of making limited demands because of confidence in being able to mobilize again if the regime reneges on promises.

While no regime matches China's for sheer sophistication in this regard, the others in the bottom right cell, those that had above median relative technical literacy and were stable, also share many of the same characteristics. Putin's regime in Russia has made steady progress towards a high level of regime technical literacy, with examples abounding of the regime's utilization of Internet technologies for subtle purposes. For instance, the regime has gradually consolidated social media networks used by Russians under the umbrella of corporations friendly to the regime, whether they are domestic companies (like vKontakte) or foreign ones (like the California-based Live Journal, which is the blogging platform used by the vast majority of Russian bloggers). In addition, the creation of a large network of professional online "trolls" and artifical news agencies to feed false information onto Russian language social media and Internet sites, especially in the wake of the war in Ukraine in 2014 represents an expansion of the regime's ability to ensure that possible critical junctures are quickly delegitimized through seemingly grassroots efforts. Finally, small examples of the partial reform mechanism continue to proliferate. For example, the use of street art that paints the faces of local government officials around gaping potholes in roads, and then posting the art online has acted as a sort of public shaming of local officials (and resulted in the filling in of potholes that are repeatedly defaced).

Forcing an authoritarian regime to fill potholes might seem a trivial concession from one perspective, but in another way it is the perfect representation of the mechanism at work here. Authoritarian regimes do not fall when idealists demand democracy for democracy's sake, for idealists are few and easily dispatched. Authoritarian regimes fall when normal people with mundane concerns take to the streets by the millions, because they have been driven to the breaking point by unresponsive government. They fall when people are sufficiently angry

about the potholes. It is profoundly ironic that the Internet, in giving people a voice, also makes it easier for dictators to listen to them and therefore alleviate the mundane problems that in previous generations would mount to a boiling point.

References

Acemoglu, Daron and James A Robinson (2009). *Economic Origins of Dictatorship and Democracy*. Cambridge University Press.

Albertus, Michael and Victor Menaldo (2012). "Coercive capacity and the prospects for democratization". In: *Comparative Politics* 44.2, pp. 151–169.

Alqudsi-ghabra, Taghreed M, Talal Al-bannai, and Mohammad Al-bahrani (2011). "The Internet in the Arab Gulf Cooperation Council (AGCC): Vehicle of Change". In: *International Journal of Internet Science* 6.1, pp. 44–67.

Anderson, Benedict (1983). *Imagined Communities*. Verso.

Beissinger, Mark R (2007). "Structure Political Example The in Modular Diffusion of Revolutions Phenomena : BulldozerlRose / OrangelTulip". In: *Perspectives on Politics* 5.2, pp. 259–276.

Bunce, Valerie and Sharon Wolchik (2010). "Defeating Dictators : Electoral Change and Stability in Competitive Authoritarian Regimes". In: *World Politics* 62.1, pp. 43–86.

— (2011). *Defeating Authoritarian Leaders in Postcommunist Countries*. Cambridge University Press.

Castells, Manuel (2009). *The Information Age: Economy, Society, and Culture*. Wiley-Blackwell.

Coppedge, Michael, John Gerring, Staffan Lindberg, Svend-Erik Skaaning, and Jan Teorell (2017a). "V-Dem Comparisons and Contrasts with Other Measurement Projects". In: *V-Dem Working Paper* 45.

Coppedge, Michael, John Gerring, Staffan Lindberg, Svend-Erik Skaaning, Jan Teorell, David Altman, Michael Bernhard, Steven Fish, Adam Glynn, Allen Hicken, Carl Henrik Knutsen, Joshua Krusell, Anna Lührmann, Kyle Marquardt, Kelly McMann, Valeriya Mechkova, Moa Olin, Pamela Paxton, Daniel Pemstein, Josefine Pernes, Constanza Sanhueza Petrarca, Johannes von Römer, Laura Saxer, Brigitte Seim, Rachel Sigman, Jeffrey Staton, Natalia Stepanova, and Steven Wilson (2017b). "V-Dem [Country-Year/Country-Date] Dataset v7". In: *Varieties of Democracy (V-Dem) Project*.

Coppedge, Michael, John Gerring, Staffan Lindberg, Svend-Erik Skaaning, Jan Teorell, David Altman, Michael Bernhard, Steven Fish, Adam Glynn, Allen Hicken, Carl Henrik Knutsen, Joshua Krusell, Anna Lührmann, Kyle Marquardt, Kelly McMann, Valeriya Mechkova, Pamela Paxton, Daniel Pemstein, Laura Saxer, Brigitte Seim, Rachel Sigman, and Jeffrey Staton (2017c). "V-Dem Codebook v7". In: *Varieties of Democracy (V-Dem) Project*.

Coppedge, Michael, John Gerring, Staffan Lindberg, Svend-Erik Skaaning, Jan Teorell, Joshua Krusell, Kyle Marquardt, Valeriya Mechkova, Daniel Pemstein, Joefine Pernes, Laura Saxer, Natalia Stepanova, Eitan Tzelgov, Yi-ting Wang, and Steven Wilson (2017d). "V-Dem Methodology v7". In: *Varieties of Democracy (V-Dem) Project*.

Dalton, Bridget and C Patrick Proctor (2009). "The Changing Landscape of Text and Comprehension in the Age of New Literacies". In: *Handbook of Research on New Literacies*. Ed. by Julie L. Coiro, Michelle Knobel, Colin Lankshear, and Donald J. Leu. New York, NY: Routledge. Chap. 11.

Democracy, International Institute for and Electoral Assistance (2016). *Global Database on Elections and Democracy*. URL: `http://www.idea.int/db/index.cfm`.

Faris, Robert and Bruce Etling (2008). "Madison and the Smart Mob: The Promise and Limitations of the Internet for Democracy". In: *Fletcher Forum of World Affairs* 32, p. 65.

Francisco, Ronald A (1995). "The Relationship between Coercion and Protest An Empirical Evaluation in Three Coercive States". In: *Journal of Conflict Resolution* 39.2, pp. 263–282.

Geddes, Barbara, Joseph Wright, and Erica Frantz (2014). "Autocratic breakdown and regime transitions: A new data set". In: *Perspectives on Politics* 12.02, pp. 313–331.

Gehlbach, Scott (2012). *Formal Models of Domestic Politics*. Cambridge University Press.

Gellner, Ernest (1983). *Nations and Nationalism*. Cornell University Press.

Gentzkow, Matthew and Jesse M Shapiro (2011). "Ideological segregation online and offline". In: *The Quarterly Journal of Economics* 126.4, pp. 1799–1839.

Hale, Henry (2005). "Regime Cycles: Democracy, Autocracy, and Revolution in Post-Soviet Eurasia". In: *World Politics* 58.October, pp. 133–165.

— (2006). "Democracy or autocracy on the march? The colored revolutions as normal dynamics of patronal presidentialism". In: *Communist and Post-Communist Studies* 39.3, pp. 305–329.

Hanson, Jonathan and Rachel Sigman (2013). "Leviathan's Latent Dimensions: Measuring State Capacity for Comparative Political Research". In: *APSA 2011 Annual Meeting Paper*. URL: `https://ssrn.com/abstract=1899933`.

Hendrix, Cullen S (2010). "Measuring state capacity: Theoretical and empirical implications for the study of civil conflict". In: *Journal of Peace Research* 47.3, pp. 273–285.

Hofheinz, Albrecht (2005). "The Internet in the Arab World: Playground for Political Liberalization". In: *International Politics and Society*, pp. 78–96.

ITU (2013). *Percentage of Individuals Using the Internet 2000-2012*. Tech. rep. International Telecommunications Union. URL: `https://www.itu.int/en/ITU-D/Statistics/Pages/default.aspx`.

Livingstone, Sonia, Elizabeth Van Couvering, and Nancy Thumim (2009). "Converging Traditions of Research on Media and Information Literacies". In: *Handbook of Research on New Literacies*. Ed. by Julie L. Coiro, Michelle Knobel, Colin Lankshear, and Donald J. Leu. New York, NY: Routledge. Chap. 4.

Love, Robert (2010). *Linux Kernel Development*. Addison-Wesley Professional. 440 pp.

Mackell, Austin (2011). "The IMF versus the Arab spring". In: *The Guardian*. URL: `https://www.theguardian.com/commentisfree/2011/may/25/imf-arab-spring-loans-egypt-tunisia`.

Marquardt, Kyle and Daniel Pemstein (2017). "IRT models for expert-coded panel data". In: *V-Dem Working Paper* 41.

Morozov, Evgeny (2012). *The Net Delusion: The Dark Side of Internet Freedom*. PublicAffairs, p. 448.

Murphy, Emma C (2006). "Agency and Space: the political impact of information technologies in the Gulf Arab states". In: *Third World Quarterly* 27.6, pp. 1059–1083.

Norris, Pippa (2001). *Digital Divide: Civic Engagement, Information Poverty, and the Internet Worldwide*. Cambridge University Press, p. 320.

O'Donnell, Guillermo, Philippe C. Schmitter, and Laurence Whitehead (1986). *Transitions from Authoritarian Rule, Vol. 4: Tentative Conclusions about Uncertain Democracies*. The Johns Hopkins University Press, p. 96.

Oghia, Michael J and Helen Indelicato (2010). "Ruling the Arab Internet : An Analysis of Internet Ownership Trends of Six Arab Countries". URL: `http://www.arabmediasociety.com/?article=779`.

Page, Scott E. (2008). *The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies*. Princeton University Press.

Pemstein, Daniel, Kyle Marquardt, Eitan Tzelgov, Yi-ting Wang, and Farhad Miri (2015). "The V-Dem Measurement Model: Latent Variable Analysis for Cross-National and Cross-Temporal Expert-Coded Data". In: *V-Dem Working Paper* 21.

Richardson, Lewis Fry (1960). *Arms and insecurity: A mathematical study of the causes and origins of war*. Boxwood Press.

Rød, Espen Geelmuyden and Nils B Weidmann (2015). "Empowering activists or autocrats? The Internet in authoritarian regimes". In: *Journal of Peace Research* 52.3, pp. 338–351.

Schlozman, Kay Lehman, Sidney Verba, and Henry E. Brady (2010). "Weapon of the Strong? Participatory Inequality and the Internet". In: *Perspectives on Politics* 8.02, pp. 487–509.

Sereghy, Zsolt, Sarah Bunk, and Bert Preiss, eds. (2012). *The Arab Revolutions: Reflections on the Role of Civil Society, Human Rights and New Media in the Transformation Processes*. Austrian Study Center for Peace and Conflict Resolution.

Shirky, Clay (2009). *Here Comes Everybody: The Power of Organizing Without Organizations*. Penguin.

Skaperdas, Stergios (1996). "Contest success functions". In: *Economic theory* 7.2, pp. 283–290.

Soifer, Hillel (2008). "State infrastructural power: Approaches to conceptualization and measurement". In: *Studies in Comparative International Development* 43.3-4, pp. 231–251.

Stepanova, Ekaterina (2011). "The role of information communication technologies in the Arab Spring". In: *Ponars Eurasia* 15, pp. 1–6.

Sunstein, Cass R (2009). *Republic.com 2.0*. Princeton University Press.

Teorell, Jan, Stefan Dahlberg, Soren Holmberg, Bo Rothstein, Felix Hartmann, and Richard Svensson (2015). *The Quality of Government Standard Dataset, version Jan15*. URL: `http://www.qog.pol.gu.se`.

Way, Lucan (2008). "The Real Causes of the Color Revolutions". In: *Journal of Democracy* 19.3, pp. 55–69.

Wojcieszak, Magdalena E. and Diana C. Mutz (2009). "Online Groups and Political Discourse: Do Online Discussion Spaces Facilitate Exposure to Political Disagreement?" In: *Journal of Communication* 59.1, pp. 40–56.

World Bank (2015). *World Development Indicators*. URL: `http://data.worldbank.org/data-catalog/world-development-indicators`.

Zhuo, Xiaolin, Barry Wellman, and Justine Yu (2011). "Egypt: The First Internet Revolt?" In: *Peace Magazine* Jul/Sep, pp. 6–10.