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MACRO SHOCKS, REGULATORY QUALITY AND COSTLY POLITICAL ACTION

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Abstract

We build a theory of political turnover in autocracies where citizens can only express their political preferences to remove the autocrat through costly mass protest. The disenfranchised are imperfectly informed about the autocrat's choice of economic institution. Workers only observe economic outcomes that could result from rent-extracting economic regulations or adverse economic shocks. The disenfranchised have priors about the autocrat's type and, by extension, policy choices. We propose that macro shocks can affect the cost-benefit calculus of costly political action through an informational channel. For an autocrat that has implemented hidden rent-seeking regulation, negative shocks reduce the perceived probability that the autocrat is benevolent, and increase the probability of opposition. We then empirically investigate this idea for a panel of autocratic countries. Using simple linear probability and logit models with fixed effects and using weather variables as instruments for macro shocks, we demonstrate that adverse economic shocks increase the probability of mass protest episodes only in countries with bad regulations.

Keywords:

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1 Introduction

In recent decades, citizens all over the world took to the streets to protest against predatory autocracies. The most recent wave of revolutionary demands for leadership transitions in autocracies has included the (unsuccessful) "Green Revolution" in Iran (2009) and the "Arab Spring" movements in Tunisia, Egypt, Syria and Libya. These (mostly) unarmed demonstrators choose to risk their lives to oppose autocratic policies. In recent cases, an important motivation appears to be the poor long-run economic conditions that have been left in the wake of autocrats' institutionalized rent-extraction. Moreover, political opposition to autocrats are often associated with macroeconomic shocks, when the economy performed poorly compared to the long-run trend. For instance, the mean growth rate in Tunisia was about 5% from 2004 to 2009, and fell to 2.5% during the 2009 – 2010 period before the mass protests started and was -1.8% during the year a democratic revolution unseated the Ben Ali regime (The World Bank). In September 2012, a burst of protest broke out in Tehran following an unanticipated crash of the Iranian currency and the associated impact on the real incomes of a population that imports many of its basic needs. The Ahmadinejad regime effectively contained the movement and clung onto power.

This paper investigates, theoretically and empirically, the relation between macroeconomic shocks and costly political actions in opposition to autocratic regimes. The examples of Tunisia and Iran highlight some of the issues involved in such an investigation. First, the term "costly political action" is meant to include mass political protests and revolutionary activity that has the intent of removing an autocratic regime, but with a less than certain success rate. In our empirical section, we use data on mass political protest, so throughout we often refer to "costly political action" as "protest".[1] Second, what role did the economic shock play in these examples? The common wisdom in the literature would point to the depressed incomes of the average Tunisian or Iranian and argue that their "opportunity cost" of engaging in revolutionary activities was temporarily lower and, ceteris paribus, revolting became an economically rational use of their time during the period of the shock. But could economic shocks play a more nuanced role in the calculus of political action? This paper proposes an alternative theoretical link between economic shocks and costly political action in autocratic

[1]Both of these events would satisfy our binary dependent variable requirements. Though not our main line of analysis, we demonstrate empirically how the occurrence of mass political protests affects the probability that an autocrat is removed from office in an irregular manner.

countries.

We build a theory of political turnover in autocracies where disenfranchised citizens can only express their political preferences to remove the autocrat through costly mass protest. Our theory abstracts from the coordination problem of political action and considers the disenfranchised as a single player against the elite class, as is common in some strands of the literature (Acemoglu and Robinson 2001, for example). We introduce an *informational* role for macroeconomic shocks in such strategic interactions where the disenfranchised are uncertain about the autocrat's "type", inspired by classic results from the democratic political economy literature. Suppose that the disenfranchised are imperfectly informed about the autocrat's economic policy choice and can only observe economic outcomes. The disenfranchised have priors about the autocrat's type and, by extension, policy choices. In this context economic shocks can be informative. For an autocrat that has institutionalized a hidden, rent-seeking system of regulation, which deteriorates the mean economic outcome, negative shocks reduce the perceived probability that the autocrat is benevolent. Under some not too strong assumptions concerning the distribution of economic shocks, a negative shock occurring when bad regulations are in place produces an economic outcome which is very unlikely to happen when regulations are good. Thus, in our model, negative macro shocks can expose an autocrat as malevolent and signal to the disenfranchised that the masses would be better off if the autocrat were removed. Macro shocks can provide information about the expected benefit of costly political action and may rationalize mass protests, which lead to removal of the autocrat with a strictly positive probability.[2] If the revolt is successful, the autocrat is replaced by a new leader and the disenfranchised return to their initial prior about his replacement.

We then present an economic environment where we model explicitly the introduction of inefficient economic regulations as additional entry costs for firms. This cost prevents entry by non-elite entrepreneurs, which decreases the equilibrium wage and allows connected, elite firms to make abnormal profits (Acemoglu, 2006a,b, 2010). Finally, we present a formal game in which an autocrat chooses the level of inefficient regulation that maximizes his payoff, but at the risk of causing a revolt.

[2]This captures the fact that the success of an initial protest is difficult to predict due to the inherent coordination problem in a revolutionary environments which we do not model explicitly. For papers that endogenize the probability that protests lead to successful revolutions, see, among others Kuran (1989, 1991); Lohmann (1994a,b); Bueno de Mesquita (2010); Ellis and Fender (2010); Edmund (2011); Shadmehr and Bernhardt (2012). While our focus is not on the dynamics of oppositional movements, our paper makes a contribution to this literature that we describe below.

From an empirical perspective, our basic model leads to a hypothesis that is consistent with the opportunity cost story described above:

Hypothesis 1. *Economic shocks, e.g. low levels of growth, are associated with higher probabilities of revolt or, at least, protest.*

However, the informative nature of economic shocks can have an additional implication, which has not been considered in the literature. To the extent that regimes with better regulatory policies in place are less vulnerable to economic shocks, we also have the following hypothesis, which is new to the literature:

Hypothesis 2. *Economic shocks have a smaller impact on the probability of revolt or protest in autocracies with better economic regulations in place.*

We empirically investigate these hypotheses with a 47-year panel of autocratic countries. Using measures of regulatory quality based on economic freedom, we demonstrate how the relationship between economic shocks and costly political action is conditional on the quality of economic regulations. As intended by the data's source (The Fraser Institute), we understand "bad regulation" as anti-competitive regulations on businesses that allow for hidden rent-seeking by connected firms (Coate and Morris, 1995) and we understand "good regulation" as the maintenance of competitive markets and economic freedom. We show that in autocracies with bad regulation negative growth shocks can explain the occurrence of mass protests, whereas they cannot in autocracies with good regulation.

Theoretical advancements. Our paper addresses two prominent questions in the literature, which can highlight our theoretical contributions. First and foremost, what is the role of economic shocks in catalyzing costly political action that may result in leadership change or political transition? Second, are the political implications of economic shocks symmetric across autocracies, or are some autocrats more vulnerable to growth shocks than others? Of course, there is debate among economists surrounding the above questions. Taking them in turn, we will explain how our paper contributes to the debate.

Our main contribution concerns the role of macroeconomic shocks in prompting oppositional political action in autocratic countries (revolutions, civil conflict, mass protest movements, etc.), on which there is a rapidly emerging literature. In this literature, one of the most common themes is that adverse economic shocks reduce the "opportunity cost" of political action (Grossman 1991; Acemoglu and Robinson 2001, 2006; Chassang and Padro-i-Miquel 2009; Blattman and Miguel 2010; Ellis and Fender 2010, to name a few). The basic idea is that when the economy is in a recessionary period, the net benefit of costly political action may exceed that of agents' next best alternative. In these theoretical models, the direct cost of political action is assumed to be proportional to average income in the period so macro shocks *directly* affect the perceived costs of opposition and can catalyze social conflict.[3] To borrow the language of Brückner and Ciccone (2011), negative economic shocks present a "window of opportunity" during which the incentive for political opposition is particularly strong.

By contrast, in our framework, economic shocks are purely informative. Economic shocks do not modify the opportunity cost of revolt (in our model the cost of revolt is additive) but the opinion individuals have concerning the autocrat, which informs about the expected net benefit of contesting the autocrat. The roots of our approach are in the classic papers from the democratic political accountability literature, where voters are not certain about the extent to which politicians are representing the general interest vis-a-vis special-interest groups (Barro, 1973; Ferejohn, 1986). Under imperfect information, voters (protesters in our model) may extract information from the business cycle (Alesina *et al.*, 1997).[4] In our basic model agents use economic outcomes to revise their prior probability about whether an autocrat has chosen a good institution. If this probability is revised below a certain level then it is in the interests of the agents to protest with the intent to remove the autocrat from power. This is similar to ideas expressed in Kuran (1991), where revolutions could be propelled by economic disappointments, that is, by outcomes that fall short of expectations.

Our second primary question further differentiates our paper from previous research: Are the political effects of economic shocks symmetric across autocracies? Empirically, not all economic shocks result in opposition to the autocrat. In accordance with this,

[3]Acemoglu and Robinson (2001, 2006) are prominent examples of this logic applied to the theory of transitions to democracy, which they argue are more likely to occur during recessionary periods that temporarily reduce the opportunity cost of revolt and thus heighten the revolutionary threat. In these models, the elite are more likely to concede democracy to the masses (and the redistribution that ensues) during recessionary periods, rather than undergo destructive revolution, in which the elite lose everything. There is recent empirical evidence that democratization is more likely to occur during periods of slower growth (Burke and Leigh, 2010; Brückner and Ciccone, 2011), which does not contradict the opportunity cost story, but does not allow for the effect of macro shocks on political outcomes to be conditional on other economic features of autocratic regimes.

[4]Alesina *et al.* (1997), for example describes how negative economic shocks may inform voters' opinions about the leader's unobserved competence level. Cite others as well. See Persson and Tabellini (2000) and Besley (2006) for examples of textbook expositions. Ales *et al.* (2012) have independently developed a model with ideas similar to ours.

our theory predicts that negative economic shocks lead to costly political action when shocks are informative for the disenfranchised, but should otherwise have no effect. Uncertainty, in our model, concerns the autocrat's "type" and the quality of regulatory policies put in place, which are unobservable to workers. In our model, negative macro shocks are necessary conditions for workers to engage in costly political action, but they are not sufficient. Macro shocks only lead to protests in autocracies that have put in place anti-competitive regulation, since it is in those environments where negative growth shocks are informative to the disenfranchised.[5]

The asymmetric effect of economic shocks could be studied in existing models of social conflict, though we are not aware of other studies to have made this point. For example, according to Acemoglu and Robinson (2001, 2006), macro shocks increase the revolutionary threat through the opportunity cost channel, but the effect must surely depend on the degree of inequality in the economy which is the underlying motivation for opposition to the autocracy in their model. Societies with lesser degrees of income inequality should require larger economic shocks to trigger the revolutionary threat.[6] In other words, the impact of an economic shock on political stability of the autocracy is dependent upon underlying structural features of the economy.[7]

Finally, even though our paper abstracts from the collective action problem, we believe that our results are of interest for the literature on the dynamics of protest. Many papers focus on the coordination problem of collective action and explain how shocks to the social sentiment about the dictator can allow the opposition to coordinate (Kuran, 1989; Lohmann, 1994b; Bueno de Mesquita, 2010; Edmund, 2011; Kricheli *et al.*, 2011). Room for improvement in this literature is to put forth an economic

[5]There are many examples in recent history of dictators who have implemented sound regulatory policies and have enjoyed political stability. Singapore, South Korea, China, Argentina, Brazil and Mexico all exhibited strong economic performance and political stability during periods they were ruled autocratically.

[6]Amazingly, we are not aware of any paper that has attempted to empirically test this subtlety of Acemoglu and Robinson's theory.

[7]We considered adding a third question to this list of primary questions: What are the underlying structural economic sources of opposition to autocratic regimes? Vahabi (2010) identifies two functions of social conflict that express the distinct sources of opposition: "In its *appropriative* role, social conflict redistributes wealth without the mutual consent of all participants. In its *rule-producing* role, it is the source of institutional change." The workhorse models of Acemoglu and Robinson (2001, 2006), with their focus on income inequality and fiscal policy, implicitly assume that opposition is driven by the former. Our model, with its focus on hidden predation and commercial policy, assumes the opposition to be driven by the latter. See also Campante and Chor (2012), Dorsch and Maarek (2012), and Dorsch *et al.* (2012) for other papers that concentrate on the rule-producing role of social conflict. Clearly, the appropriateness of either modeling assumption depends on which historical episodes of social conflict have inspired the research.

intuition for what determines sentiment for the dictator and, moreover, could shock the distribution of those sentiments. Our contribution is to link such uncertain sentiment for the dictator to macroeconomic outcomes. Macro shocks can update workers' priors about the dictator's type, which establishes an economic foundation for the shocks to sentiment that catalyze revolutionary entrepreneurs into action.

Empirical advancements. There is evidence that negative macro shocks are associated with various forms of political instability in developing economies. In an early empirical contribution to this literature, Collier and Hoeffler (1998) find that adverse macroeconomic outcomes are associated with a greater probability of civil war. Miguel *et al.* (2004) identify a causal link between economic shocks and civil conflict in Africa, using weather variation to instrument for changes in economic growth rates.[8] Burke and Leigh (2010) and Brückner and Ciccone (2011) also use weather variation to instrument for economic growth and demonstrate that growth slowdowns have a causal impact on political transitions towards democracy. These results are all consistent with our Hypothesis 1, as well as the opportunity cost explanation of the effect of macro shocks on the probability of social conflict. But they cannot address our Hypothesis 2, which qualifies the link between economic shocks and social conflict.

Our empirical investigation of Hypothesis 2 uses a panel dataset at the country level for the 1960-2007 period to explain variation in the probability that mass political protests occur with macroeconomic shock episodes. We use several identification strategies both for our protest dependent variable and for measuring economic shocks, which we describe in detail below. In all of our estimation strategies, we are concerned with estimating how the effect of marco shocks *depends on* the regulatory quality in place, which we approximate using economic freedom indicators specific to economic regulation. To begin, we estimate simple linear probability models (LPM) with country and time dummies that include an interaction term between the economic shock variable and regulatory quality. While we would like to use interaction terms throughout the analysis, their use is problematic for non-linear estimators, such as logit (Ai and Norton, 2003), and when one of the covariates may be endogenous (Greene, 2000). To continue our investigation of Hypothesis 2 without the aid of interaction terms, we divide the sample into two groups (bad and good regulation) and compare the impacts of economic shocks for the two subsamples.

Empirical research relating economic shocks to political instability has been increas-

[8] More recent evidence comes from Berman and Coutennier (2012), who use geographic data on conflict at micro level and building exposure of regions to macro shock (price of commodities).

ingly concerned with endogeneity. Since the seminal work of Miguel *et al.* (2004), the use of weather variation to instrument per capita growth rates in developing economies has become widely accepted and we continue in that tradition, using variation in temperature, level of temperature and variation in rainfall as instruments for our economic shock variables. Running the two-stage estimation procedure for the good and bad regulation subsamples, we are able to determine whether exogenous variation in the shock variables has a differential effect for the two groups.

As far as we know, ours is the first study to examine how the impact of economic shocks on social conflict depends on some other economic characteristic (regulatory quality in our study). Furthermore, our theoretical intuition that macro shocks affect the political stability of autocratic regimes differently also lead us to think about our instruments. In their study of how weather variations correlate with economic growth, Dell *et al.* (2012) convincingly show that there are significant differences between rich and poor countries. Following this result, we improve dramatically the strength of our instruments by interacting the weather variables with development quartile indicators. To our knowledge, this constitutes a methodological contribution to the literature.

Our results are consistent with the studies cited above in so far as we find that macro shocks increase the probability of mass protests. We find, however, that the effect is only statistically significant in countries with bad economic regulation. The result supports our informational theory of macro shocks and suggests that the opportunity cost story is only one part of the complex relationship between macro shocks and social conflict. Finally, we provide some evidence to support the notion that mass political protests are real political mechanisms for unseating dictators by estimating the impact of political protests on the probability of irregular leadership transitions.[9]

The remainder of the paper is organized as follows. Section 2 presents our theory of political turnover in autocracies, section 3 presents our empirical methodology and data used, section 4 presents the empirical results and section 5 offers concluding remarks.

2 General Model

In this section we present a simple, but relatively general, model of a situation capturing the main features described above. We present assumptions that imply our hypotheses

[9]Our results here are consistent with previous research to demonstrate that occurrences of mass protests are significantly correlated with occurrences of (i) democratization (Burke and Leigh, 2010) and (ii) autocratic replacement (Kricheli *et al.*, 2011).

about the effect of economic shocks on protests and how the quality of regulation affects this relationship. How weaker assumptions can result in situations that have similar properties is also discussed.

The utility (or payoff) of a worker in the economy depends on the outcome of the economy. This outcome will be called the wage, although it could be anything that the workers care about. This wage, $w(y, c)$, depends on both the value of an economic shock, y, and the level of regulation, c, chosen by a dictator. The level of regulation is also the source of rents for an elite. We assume w is differentiable, increasing in y and decreasing in c. In addition, assume that for each wage w and each c, there is a unique shock $y(w, c)$ such that $w(y(w, c), c) = w$. This is satisfied if $w(y, c)$ is a one-to-one function of y for each fixed c. Therefore, $y(w, c)$ is a well-defined function that is increasing in w and increasing in c. A worker's utility is then $U(w(y, c))$ where U is a concave, differentiable, and increasing function of w.

Workers do not observe the value of the economic shock y and do not know the level of c chosen by the autocrat. However, the distribution function F and density f of the economic shock are common knowledge. We also define $g(w|c) \equiv f(y(w, c))$, i.e. this is the density function of w conditional on c. We assume that g satisfies the monotone likelihood ratio property (MLRP) with $g(w|c)/g(w|c')$ increasing in w for $c < c'$. Therefore, we assume that a low payoff to the workers is bad news about the policy choice of the ruler in the sense of Milgrom (1981). As an example, suppose a worker's utility is just their wage, the equilibrium wage is normally distributed, and higher (lower) levels of regulation shift this distribution of wages to the left (right). This is shown in Figure 2. The given wage provides workers with information about whether a given wage is due to an economic shock with efficient policy or whether it is due to bad policy with a less extreme shock. As we show later in section 2.1, a worker's belief that a bad policy has been selected depends on the ration $g(w|c)/g(w|c')$. Essentially, the higher this ratio the higher the probability the worker will assign to the dictator having chosen a bad policy, i.e. the dictator is rent-seeking.

The workers also have the choice to revolt, which we assume leads to the autocrat being replaced with probability $0 < \rho < 1$[10]. Since in this model all workers are identical, each worker will make the same choice. Therefore the workers can be considered a single player in our game. Revolting costs a worker μ units of utility. This cost is

[10] As mentioned in the introduction many coordination games of revolution feature a random probability of success. See Lohmann (1994b) or Kuran (1989). This parameter captures this feature even we otherwise ignore the coordinate problem.

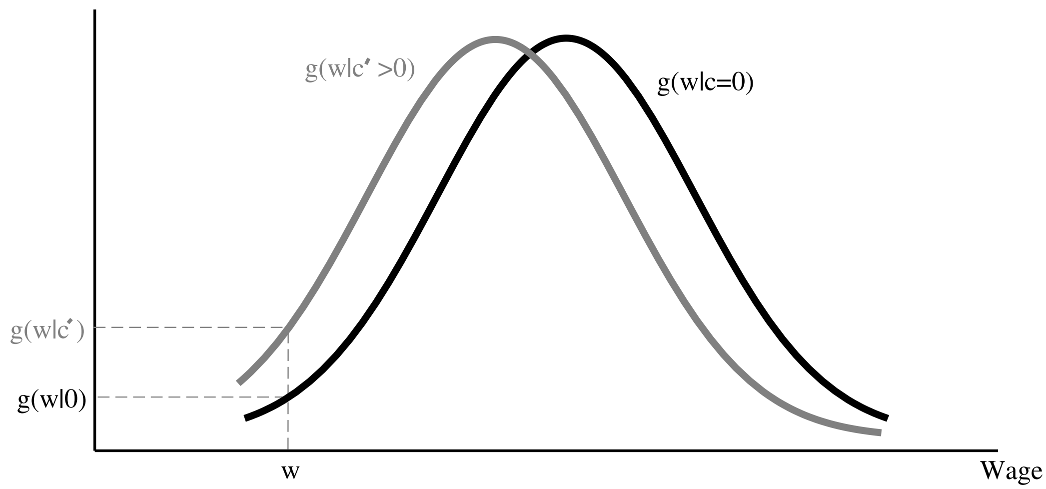

Figure 1: More regulation ($c' > c = 0$) shifts density of wages to the left.

independent of the economic shock so that we are focusing on the effect of the shock on revolts solely through the information channel. This is in contrast to Acemoglu and Robinson (2001) that assumes a proportional cost which lowers the opportunity cost of revolting during recessions. Instead, in our model, shocks affect the likelihood of revolt by changing the workers' opinion about the policy choice of the autocrat and thus the potential benefits of replacing him.

We model the information structure as one involving incomplete information about the motivation of the autocrat. With probability ε the autocrat acts in the interests of the workers and always sets the level of regulation to zero. This results in a distribution of wages that is shifted as far to the right as possible. We call the autocrat "benevolent" in this case. With probability $1 - \varepsilon$ the autocrat acts in the interest of the elite and chooses $c \in [0, \overline{c}]$ to maximize their expected payoff. Note that the autocrat's choice of c is made before the the economic shock occurs. Let c^*, which could be $\overline{c}$, be the level of c that maximizes the payoff of the elite $\Pi(c)$ in the given interval. This would be the level of regulation chosen if the possibility of revolt was ignored and, indeed, it is chosen in the second period where there is no possibility of revolt. When there is a successful revolt, the autocrat is replaced with another according to these probabilities. This situation is also consistent with the interpretation that $\Pi(c)$ represents the payoff to the ruler or, alternatively, that the elite are making the choice of c.

Finally, there is a common discount factor β for both the elite and the workers, who care about the discounted sum of their payoffs in the two periods. The autocrat, depending on his type, cares about this discounted sum as long as he is in power. If the autocrat is removed from power then he cares only about the appropriate one-period payoff. This makes the model consistent with either the having an autocrat (and not having an elite) whose payoff per period is given by the function Π or having the elite have dictatorial power.

2.1 Worker's Problem

Next we consider a worker's optimal choice when they observe a wage of w. Let $b(w)$ be the probability workers believe that the ruler will act in their interest in this case. Then workers revolt if the expected present utility of not revolting is less than the expected present utility of revolting, i.e.

$$U(w)+\beta\Big[b(w)\mathbf{E}U(w(y,0))+(1-b(w))\mathbf{E}Uw((y,c^*))\Big]$$
$$< U(w)-\mu+\beta\Big[\rho\Big(\varepsilon\mathbf{E}U(w(y,0))+$$
$$(1-\varepsilon)\mathbf{E}Uw((y,c^*))\Big)+(1-\rho)\Big(b(w)\mathbf{E}U(w(y,0))+(1-b(w))\mathbf{E}U(w(y,c^*))\Big)\Big],$$

where $\mathbf{E}$ denotes the expected value taken with respect to the random shock y.

This is equivalent to workers revolting if their beliefs satisfy

$$b(w)<\frac{-\mu+\beta\rho\Big(\varepsilon\mathbf{E}U(w(y,0))-\varepsilon\mathbf{E}U(w(y,c^*))\Big)}{\beta\rho\Big(\mathbf{E}U(w(y,0))-\mathbf{E}U(w(y,c^*))\Big)}$$

or

$$b(w)<\varepsilon-\frac{\mu}{\beta\rho\Big(\mathbf{E}U(w(y,0))-\mathbf{E}U(w(y,c^*))\Big)}. \tag{1}$$

This condition says that there will be a revolt if the workers believe the probability that the autocrat is benevolent is low enough. More specifically, it implies a revolt if the workers reduce their prior probability that the autocrat is benevolent by more than the ratio of the cost of revolt to the present value of the expected gain from revolting. There will never be a revolt if the right-hand side of (1) is negative. This can be used to determine a constraint on μ depending on the parameters ε, β, ρ and the expected gain from revolting that guarantees that a revolt could occur.

We assume that workers update their beliefs using Bayes' rule, which will be the case if we consider perfect Bayesian equilibrium. This means that

$$b(w) = \frac{\Pr\{(y,c)|\text{autocrat is benevolent and } w = w(y,c)\}}{\Pr\{(y,c)|w = w(y,c)\}}.$$

Let $\sigma(c)$ be the probability density for the worker's beliefs about the current level of c. In the game we consider later this is the autocrat's (equilibrium) mixed strategy. Since a benevolent autocrat will always choose $c = 0$ and for each c there is a unique y yielding a given w, the continuous random variable version of Bayes' rule implies

$$b(w) = \frac{\varepsilon f(y(w,0))}{\varepsilon f(y(w,0)) + (1-\varepsilon)\int \sigma(c) f(y(w,c))dc}$$

or

$$b(w) = \frac{\varepsilon g(w|c=0)}{\varepsilon g(w|c=0)) + (1-\varepsilon)\int \sigma(c) g(w|c)dc}$$

Now divide both the numerator and denominator of this by $g(w|c=0)$. This gives

$$b(w) = \frac{\varepsilon}{\varepsilon + (1-\varepsilon)\int \sigma(c)\frac{g(w|c)}{g(w|0)}dc}. \tag{2}$$

By the assumption that g satisfies the MLRP, $\frac{g(w|c)}{g(w|0)}$ is decreasing in w. Therefore, $b(w)$ is increasing in w. These facts and condition (1) imply that there exists a w^* such that if $w < w*$ then workers will revolt.

Let y^* be such that $y^* \equiv y(w^*, c')$. Then all shocks $y < y^*$ will result in a wage less than w^* and therefore a revolt. This result implies our first prediction in the sense that workers will revolt when economic shocks are bad enough, i.e. less than y^*.

If the above cutoff w^* is associated with shocks y^* in the left tail of the density f then we also have our second prediction that an economic shock has a smaller effect on the probability of revolt when there is better regulation. When there is less regulation (i.e. lower c), which leads to better outcomes (e.g. wages) for workers for any given shock, then the probability of obtaining a sufficiently bad shock to cause a revolt is lower. In the above, less regulation means that c' is lower and this implies that $y(w^*, c')$ is lower. If we are in the left hand tail then $g(w|c')$ will be lower. Therefore, the beliefs given by (2) will be higher at low w and the cutoff wage will then be lower, which will require a worse economic shock to achieve. So, the probability of a revolt will be lower with a lower c', i.e. better regulation makes revolt less likely.

The assumption that $g(w|c)$ satisfies the MLRP is probably very strong since g is the composition of two functions. However, if we only want low w to be associated with revolts and high w to be associated with no revolts then the following property is sufficient.

$$\begin{aligned} &\frac{g(w|c>0)}{g(w|c=0)} \longrightarrow \infty \text{ as } w \longrightarrow 0, \text{ and} \\ &\frac{g(w|c>0)}{g(w|c=0)} \longrightarrow 0 \text{ as } w \longrightarrow \infty. \end{aligned} \tag{3}$$

With this assumption, which is weaker than the MLRP, there is a low enough w such that beliefs given by (2) will result in (1) being satisfied and workers revolting for any wage below that level. Also, for all large enough w workers' beliefs will be such that no revolt will occur.

Even the conditions given in (3) might not be appropriate. In some economic environments it is likely that the equilibrium wage will be bounded below and above. So, if $w \in [\underline{w}, \overline{w}]$ then what we really want is $\frac{g(\underline{w}|c>0)}{g(\underline{w}|c=0)}$ is such that this ratio defines beliefs $b(\underline{w})$ given by (2) that satisfy (1), i.e. observing the lowest possible wage will cause workers to revolt. Similarly, we would want a wage of $\overline{w}$ to result in no revolt. Then continuity of g would imply that there wages near the lower bound would also result in a revolt and for wages near the upper bound there would be no revolt. Without additional assumptions what occurs at intermediate wages is unknown. If one thinks of this section and our two hypotheses as describing what happens when extreme economic outcomes occur (due to extreme shocks) then this is no problem.

2.2 An Economic Environment

Next, we describe an economic environment that yields the above intuition. We consider a labor matching model in which productivity shocks determine wages. However, workers observe only the common posted wage and not the specific productivity shock. This yields a model where the distribution of productivity shocks affects the distribution of the wage.

The model draws on section 5.1 of Rogerson *et al.* (2005). This is a one-shot model in which firms post wages. There are initially u unemployed workers and v vacancies (one per firm). Unemployed workers and firms with vacancies are matched according to a constant returns matching function $M(u, v)$ with the usual properties. A worker finds a job with probability $M(u, v)/u = M(1, v/u)$ and a vacancy is filled with probability

$M(u,v)/v = M(u/v,1)$. Both of these probabilities are functions of queue length, $q = u/v$, and will be denoted by $m_u(q)$ and $m_v(q)$, respectively. Each unemployed worker and each firm with a vacancy take w and q as given. Any match produces output y, which is divided between the worker and firm according to the posted wage. At the end of the period, unmatched vacancies get 0 while unmatched workers get b, which is the outside option for a worker.

Our model differs from Rogerson *et al.* (2005) in that the entry cost firms must pay to post a vacancy has two components. This cost is $c_e = c_0 + c$, where c_0 corresponds to entry costs as given in Rogerson *et al.* (2005) and c is an additional entry cost due to inefficient regulation chosen by an autocrat. These additional costs are purely wasteful, but will provide rents to firms owned by the elite who do not have to pay these costs. These additional costs can be considered shadow costs as in Blanchard and Giavazzi (2003). Djankov *et al.* (2002) shows that such costs can be very important in low income economies and show that they are associated with deterioration in long run economic outcomes, in line with public choice theories of regulation.

To describe the equilibrium wage, we first consider the problem facing a worker. Let U be the highest utility the worker can get by applying for a job. Then he will apply for a job only if he thinks the queue length at that job is such that the probability of being hired is not too low. Formally, a worker is willing to apply to a particular firm offering wage $w > b$ only if

$$U \leq m_u(q)w + [1 - m_u(q)]\, b. \tag{4}$$

In equilibrium, this is satisfied with equality. If not, then all workers would want to apply to this firm, which would cause q to rise and reduce the right hand side. Therefore, (4) with equality describes how a firm's wage and queue length are related in equilibrium.

A firm will choose w to maximize its expected profit

$$V = \max_{w,q}\{-c_e + m_v(q)(y - w)\} \tag{5}$$

taking (4) with equality as a constraint (assuming that U is given). Using the constraint and $m_v(q) = qm_u(q)$, this becomes

$$V = \max_{q}\{-c_e + m_v(q)(y - b) - q(U - b)\}.$$

The first order condition for this is

$$m_v'(q)(y-b) = U - b. \tag{6}$$

This implies that in equilibrium, each firm will choose the same q, which must equal the economy-wide queue length q^*. Therefore, (6) determines the equilibrium value of a worker's utility U. Using this and (4) at equality we obtain the equilibrium wage

$$w^* = (1-\zeta)b + \zeta y, \tag{7}$$

where $\zeta = q^* m_v'(q^*)/m_v(q^*)$ is the equilibrium elasticity of the probability a vacancy is filled with respect to the queue length. The assumptions on the matching function guarantee that ζ is between 0 and 1.

Using the wage equation and (5), we obtain

$$V = -c_0 - c + m_v(q^*)(1-\zeta)(y-b) \tag{8}$$

Middle class entrepreneurs create vacancies until $V = 0$ (free entry condition). First, note that if middle class entrepreneurs realize no profit, this is not the case of entrepreneurs connected with elite. They realize an expected profit equal to c due to regulation imposed on other entrepreneurs. Therefore, we can think of c as the payoff to the elite (or the autocrat) in this situation. Acemoglu (2006a, 2010) refers to such a policy as "manipulating factor prices".

Another property of such an equilibrium is that an increase in c_e (due to regulations) has the same effect as a decrease in productivity y has on queue length q and on wages. An increase in c_e increases q and therefore lowers b and w. A lower y also increases q and lowers job creation, b and wages with a direct and an indirect effect. If workers only observes the market wage, they have to infer whether a particular outcome is due to inefficient regulations or productivity shocks. For instance, productivity y being normally distributed implies that the distribution of w^* is also normal by (7) if we assume that ζ is constant so that entry costs only effect b. In this case, a change in c_e affects b through changes in the equilibrium queue length and thus just shifts the mean of the wage distribution.

2.3 A Formal Game and Equilibrium Institutions

In this subsection, we describe a formal game that is consistent with our presentation of the general model. However, our first two predictions we test later in the paper rely only on the analysis in section 2.1 and not the game presented here. In this model the quality of economic institutions are endogenously determine as a function of environment a dictator faces.

We describe the economic institutions by a level of regulation, c, where lower c represent better institutions. The level of c also determines the amount of rent accruing to the elite. This rent, which is the payoff to the elite, is given by $\Pi(c)$. We assume Π is a concave differentiable increasing function with a maximum level of regulation $\bar{c}$.[11]

We assume revolts impose a cost of μ_e on the elite.

The following summarizes the timing of the moves in the game.

1. The type of the autocrat is chosen: benevolent with probability ε and acting in the interest of the elite with probability $1-\varepsilon$. The type is unknown to the workers.

2. The autocrat chooses a level of regulation c in the interval $[0, \bar{c}]$, which is also unobserved by the workers.

3. The value of an unobserved shock y is determined according to the distribution F.

4. The shock and regulation determine the utility of a worker, $u = U(w(y, c))$, which is observed.

5. Given the this utility, the workers update their beliefs that the autocrat acts in their interests using Bayes' rule and decide whether or not to revolt. Let $b(u)$ be the updated probability that the workers think the autocrat will always choose $c = 0$. Formally, they choose a probability, $r(u) \in [0, 1]$, of revolt that can depend on their observed utility u.[12]

[11]For example, the elite payoff could be c, which is the elite profit in the goods market in the labor matching model, minus a cost, $C(c)$ of enforcing the regulation, which is a convex function of c. So $\Pi(c) = c - C(c)$ is concave and attains a maximum at $\bar{c}$ with $C'(\bar{c}) = 1$.

[12]Actually the decision to revolt depends on the beliefs; however, on the equilibrium path those beliefs will depend on the observed utility. So, we can restrict the probability of revolt to depend on the utility.

6. First-period payoffs are determined. The elite get $\Pi(c) - r\mu_e$ and workers get $U(w) - r\mu_a$.

7. A revolt is successful and replaces the autocrat with probability ρ. The type of the new autocrat is chosen with probabilities as in step 1.

8. The existing autocrat (if there is no revolt or if it was not successful) or the new autocrat (if a successful revolt occurred) chooses the level of regulation in the second period.

9. A new value of a shock is determined according to the distribution F.

10. Second-period payoffs are determined and the game ends.

Notice that the autocrat cannot modify policy (regulation) within the period if there is an adverse realization of the shock and wage. This captures the fact that the policy choice can be thought of as an institutional choice. Any modification in the institutions would take time to have an economic impact. It seems realistic to assume that the mean outcome depends on long run institutional choice and can't be affected within the time frame. This motivates our use of a two-period model instead of a fully dynamic one. The institutions are chosen by an autocrat and the average outcome is a random variable. Workers then decide whether or not to try to replace the autocrat depending on this average outcome.

Our solution concept for the game is perfect Bayesian equilibrium (PBE). We use backward induction to solve for the equilibrium. In the second period workers have no incentive to revolt since it provides no future benefits but has a cost μ_a. Therefore, even if workers were allowed to revolt in the second period they would rationally choose not to do so. As a result, as in many political agency models (see Persson and Tabellini (2000)), with probability $1 - \varepsilon$ the ruler captures the maximum possible rent on the second period and sets $c = c^*$.[13] A benevolent autocrat will always set $c = 0$, i.e. the minimum level of regulation, in each period since this maximizes a worker's expected utility as $U(y, c)$ is assumed to be decreasing in c.

Therefore, to complete the description of a PBE, we must find

- a non-benevolent autocrat's first-period choice of the level of regulation, σ, which is in general a probability density over different $c \in [0, \overline{c}]$;

[13] In the case mentioned earlier with $\Pi(c) = c - C(c)$, $c^* = \overline{c}$.

- a worker's probability, $r(u)$, of revolting, which depends on the observed first-period utility, u; and
- a worker's belief, $b(u)$, about the probability that the autocrat is benevolent, which depends on the observed first-period utility, u. This belief must be defined by Bayes' rule given σ, ε and F.

To do this we first examine the non-benevolent autocrat's problem. In section 2.1, assumptions are given that guarantee workers will choose a "cutoff" strategy, in which they revolt if they observe a wage below some level. Assume this level is w^*. Also, let $y^*(c) = y(w^*, c)$. Therefore, given our assumptions, we have $w(y, c) < w^*$ if and only if $y < y^*(c)$. The non-benevolent autocrat's best reply (given the workers' cutoff strategy) in the first-period is the c that solves

$$\max_c \int\limits_{w(y,c)>w^*} \Pi(c) + \beta\Pi(c^*)dF(y) + \int\limits_{w(y,c)<w^*} \Pi(c) - \mu + (1-\rho)\beta\Pi(c^*)dF(y), \qquad (9)$$

which can be rewritten as

$$\max_c \Pi(c) + \beta\Pi(c^*) - [\mu + \rho\beta\Pi(c^*)]\, F(y^*(c)).$$

The objective function of this problem is continuous in c and the elite are restricted to choose c in the interval $[0, \overline{c}]$. Therefore, there will be a solution to the elite's problem. Next, we describe conditions that guarantee this solution is unique, i.e. the elite choose a pure strategy.

The first order condition for this problem is

$$\Pi'(c) - [\mu + \rho\beta\Pi(c^*)]\, f(y^*(c))\frac{\partial y^*}{\partial c} = 0.$$

Since we know that there is a solution to (9), the solution will be unique if the first derivative of the objective function is monotone and the second order condition is satisfied. This is true if

$$\Pi''(c) - [\mu + \rho\beta\Pi(c^*)] \left[f'(y^*(c)) \left(\frac{\partial y^*}{\partial c}\right)^2 + f(y^*(c))\frac{\partial^2 y^*}{\partial c^2} \right] < 0$$

for all $c \leq \overline{c}$.

If the payoff function of the elite is concave then the above condition will be satisfied if

$$\frac{\partial^2 y^*}{\partial c^2} > -\frac{f'(y^*(c))\left(\frac{\partial y^*}{\partial c}\right)^2}{f(y^*(c))}. \tag{10}$$

If the density of shocks is unimodal and the solution to (9) yields a y^* less than its peak, which will be true if $y^*(\overline{c})$ is less than its peak, then the right hand side of (10) will be negative. In this case, (10) will be satisfied if the function $y^*(c)$ is convex. All that is really needed is that the function giving the "cutoff" shock in terms of the level of regulation is not "too concave", in the sense given by inequality (10). Therefore, under these conditions the dishonest elite will play a pure strategy and choose one level of regulation given any "cutoff" wage describing the workers' strategy.

The above gives conditions under which both the workers and autocrat play a pure strategy, where the strategy of a worker is described by a cutoff wage. If these are continuous then a Nash equilibrium will exist. We next show that that is the case.

Let $\mathcal{B}_a(w^*) =$ the c that solves (9), i.e. the autocrat's best reply to the workers' "cutoff strategy" defined by w^*. Let $\mathcal{B}_W(c) =$ the w^* that is the "cutoff wage" that describes when a worker revolts given c, i.e. the workers' best reply to the autocrat's choice of the level of regulation c.

Since the autocrat's problem (9) is continuous in w^* and we have assumed that it has a unique solution, the elite's best reply function, $\mathcal{B}_a$, is a continuous function of w^*.

The best reply "cutoff wage", w^*, will be given by the solution to the equation where this belief, $b(w^*) =$ the right hand side of (1). If $g(w|c)$ is continuous in w and c then $b(w^*)$ is clearly a continuous function of w^*. Therefore, $\mathcal{B}_W(c)$ will be continuous in c.

So, both best reply functions are continuous. Then a Nash equilibrium will exist if the map $\mathcal{E}$ defined by $\mathcal{E}(c, w) = \mathcal{B}_a(w) \times \mathcal{B}_W(c)$ maps points in a compact set to itself. We have explicitly assumed that the autocrat can only choose levels of regulation in the interval, $[0, \overline{c}]$. In order to bound the possible cutoff wages, note that clearly wages cannot be less than zero. Actually, one could argue that there was a positive lower bound on wages. To get an upper bound on the "cutoff wage" it could be assumed that the support of $g(w|c)$ and f are bounded so that there is a maximum possible wage no matter what the shock. Then both c and w would be in compact sets and there would be a fixed point of the map $\mathcal{E}$. Such a fixed point would define a Nash equilibrium, which would be a PBE if we define beliefs consistent with Bayes' rule.

We have not excluded the possibility of multiple equilibrium in the previous analysis. In addition, there might also be mixed strategy equilibrium, which we do not explicitly describe.[14]

3 Empirical analysis

In this section we test the main implications of our theoretical model. First, economic shocks, e.g. low levels of growth, are associated with higher probabilities of revolt or, at least, costly political action (protest). Second, an economic shock has a smaller impact on the probability of revolt or protest if there are better regulatory policies in place. We find that economic shocks substantially increase the probability that protests occur and the impact is statistically significantly greater in countries with less efficient economic regulations.[15] We tackle the endogeneity issues using an instrumental variable strategy that follows Miguel *et al.* (2004) in using weather data to instrument shocks to economic growth. Finally, to demonstrate that mass protests have real political effects, we estimate the impact of protest on the probability of leadership transition.

3.1 Empirical strategy

In this subsection we detail our empirical strategy and present the data used, the summary statistics of which are presented in table 1.[16] Our theory highlights the informative nature of economic shocks in autocratic countries. To identify autocratic regimes and quality of political institutions, we use the Polity IV data set, which provides annual classifications of regime type for all nations with populations exceeding 500,000. Countries receive a *polity* score along a 21-point continuum from -10 (most autocratic) to +10 (most democratic). The *polity* score is an institution-based measure of regime type that reflects the competitiveness and regulation of political participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive. We classify countries as autocratic (or emerging democracies) when they have a lagged *polity* score less than 4. We also try different cutoffs as a robustness check.

To investigate our theoretical idea, we first estimate the following relation for a panel of countries that are autocratic or emerging democracies:

[14]Although we have shown that workers can have a strategy defined by a cutoff wage when the autocrat chooses a probability distribution over the levels of regulation.

[15]For robustness, we consider several different measures of economic shocks and protest episodes, which are described in more detail below.

[16]We use as a base the dataset of Burke and Leigh (2010), available on the website of *American Economic Journal: Macroeconomics.*

$$\Pr(protest_{it}=1)=\beta_0+\beta_1\times shock_{it}+\beta_2\times shock_{it}\times regulation_{it}+\sum_{n=3}\beta_n X_n+\alpha_i+\alpha_t+\mu_{it} \quad (11)$$

Equation (11) is estimated using both a fixed effects linear probability model (LPM) and a fixed effects logit model. A probit model is not estimated because it is not suited to a fixed effects treatment (Greene, 2000). As our main dependent variable, we use the protest data sourced from Databanks International by Banks (2008), which has also been used by Burke and Leigh (2010) and Kricheli *et al.* (2011). For each country/year observation, the number of political demonstrations involving more than one hundred people is reported based upon mentions in the New York Times. In our baseline regressions we use a binary variable ($protest_{it}$) that takes value one if there is at least one costly political action in the country over the year. We also consider alternative dependent variables. We define another binary variable ($big\_protest_{it}$) that takes value one when at least three protests occurred in a given country over the year. We also define a count variable ($count\_protest_{it}$) that simply corresponds to the number of political actions in a given country over the year. Note that our model does not consider the intensity of revolt. Individual may choose the level of effort or an initial protest can generate an information cascade (Lohmann, 1994b; Ellis and Fender, 2010) or a bandwagon effect (Kuran, 1989) that amplify the initial political action. Nevertheless those two effects are random and can be summarize in our model by the probability the (initial) protest degenerate into an autocrat replacement. In our sample of autocracies and emerging democracies the unconditional mean value of the binary variable $protest_{it}$ is 0.1552.

Using GDP growth per capita data ($growth_{it}$) from the World Development Indicators measured in purchasing power parity, we built our macro shock variable in four different ways. Our primary macro shock variable isolates negative growth episodes ($negative\_growth_{it}$) and is defined in the following way:

$$negative\_growth_{it} = \begin{cases} -1\times growth_{it} & \text{if } growth_{it} \leq 0 \\ 0 & \text{if } growth_{it} > 0. \end{cases}$$

We also consider three alternative measures of negative macro shocks. We define a specific threshold for each country to consider whether a particular growth episode can be considered as an economic shock depending on the growth profile of a given country

i. We compute the mean growth rate ($growth_i^m$) and its standard deviation ($growth_i^{sd}$) within each country i for the period considered. Denoting the country-specific growth threshold as $x_i = growth_i^m - growth_i^{sd}$, we define our next two economic shock variables in the following ways:

$$truncated\_shock_{it} = \begin{cases} -1 \times (growth_{it} - x_i) & \text{if } growth_{it} \leq x_i \\ 0 & \text{if } growth_{it} > x_i, \end{cases}$$

and

$$binary\_shock_{it} = \begin{cases} 1 & \text{if } growth_{it} \leq x_i \\ 0 & \text{if } growth_{it} > x_i \end{cases}$$

Finally, we simply use the growth rate ($growth_{it}$) directly.

We interact our shock variable with a regulation of business/freedom of business variable in order to capture the main prediction of the model: the impact of economic shocks on the probability of protest is conditional on regulatory quality. The marginal impact of a shock corresponds to $\beta_1 + \beta_2 \times regulation$.[17] We use the Fraser Institute index of regulation of credit, labor and business to measure regulatory quality. The index ranges from 0-10 where 0 corresponds to a high level of government regulation of markets and 10 corresponds to economic freedom.[18] Djankov *et al.* (2002) very convincingly argue that such anti-competitive regulation are related to rent capture by the elite, in line with public choice theories of regulation, and that the level of such regulations are quite heterogeneous across developing countries. As such, regulatory quality ($regulation$) is also included independently as a control variable.

The Fraser Institute data is available for every 5 years starting in 1970 and every year after 2000. Therefore we interpolate unavailable data assuming constant growth rates between data observations. This seems reasonable since we do not observe large swings in the level of regulation for a country over time.

[17] As an alternative strategy, we also divide the sample of autocracies into good and bad regulation sub-samples and estimate (11) without $\beta_2 \times shock_{it} \times regulation_{it}$ term for both sub-samples.

[18] More explicitly 0 corresponds to 'low percentage of deposits held in privately owned banks', 'high foreign bank license denial rate', 'private sector's share of credit is close to the base-year-minimum', 'deposit and lending rates is fixed by the government and real rates is persistently negative', 'high impact of minimum wage', 'widespread use of price controls throughout various sectors of the economy', and 'starting a new business is generally complicated' and 10 corresponds to 'high percentage of deposits held in privately owned banks', 'low foreign bank license denial rate', 'private sector's share of credit is close to the base-year-maximum', 'interest rates is determined primarily by market forces and the real rates is positive', 'low impact of minimum wage', 'no price controls or marketing boards', and 'starting a new business is generally easy'.

We also include a battery of additional controls that have been used in the literature. We first control for development levels, and also interact these with our macro shock variable to ensure that the effect of the shock on protest is not merely a symptom of lower development levels.[19] We use two different variables to control for the level of development. We first follow Burke and Leigh (2010) by constructing a country-specific development level variable ($develop_{it}$). It takes the value 0 when country GDP per capita in $t-1$ is within 30 log points of the sample average and takes the value 1 (-1) when GDP per capita is between 30 and 60 log points above (below) the sample average, and is 2 (-2) when GDP per capita is more than 60 log points above (below) the sample average. This allows us to control for the impact of long run economic growth on the probability a country experiences mass protest. As an alternative measure of development, we use secondary education enrollment rates ($education_{it}$) from the World Bank Education Statistics. Apart from its role as a proxy for development level, education may also have an independent impact on costly political action (Campante and Chor, 2012) and may also affect the degree of macroeconomic volatility, so it is crucial to control for it.[20]

We also include a control for the quality of political institutions using *polity*, since even among autocracies, the quality of political institutions varies and may impact the probability of protest and the probability an economic shock occurs. The more democratic the country is, the more elections can truly aggregate citizen preferences over the ruler and the less necessary it is to invest in alternative (costly) political actions to replace bad leaders. Additionally, as a demographic control, we include the percentage of the population over the age of sixty-five, taken from the World Development Indicators. A youthful population is more likely to rebel and may also increase the probability of experiencing an economic shock.

Finally, as a crude way of dealing with reverse causality bias, we include the lagged protest variable in some regressions. Indeed, protests and riots in $t-1$ may affect the level of economic growth in t and previous protests in $t-1$ may be correlated with the probability of having a protest in t.[21] This may result in dynamic panel bias of

[19] Djankov *et al.* (2002) show that regulations of entry are much more abundant in lower income economies (with substantial heterogeneity, however) and the probability of protest may be related itself to the development level.

[20] Empirically, there exists a clear relation between education and democracy when focusing a cross section data. However, as shown by Acemoglu *et al.* (2005), the relationship is not robust to the inclusion of country fixed effects.

[21] That previous protests may increase the likelihood of current protests has theoretical roots in the literature. Kuran (1989), for example, discusses how bandwagon effects may change the cost-

the estimated coefficient of the lagged variable. However, this bias decreases with the number of time periods and should not be too large given our sample covers the period 1970-2007.

We then deal more carefully with the endogeneity issue. Protests may lead to a deterioration of economic outcomes so that negative growth may be due to the protests rather than the reverse. This will result in a downward bias in the magnitude of the OLS coefficient of an economic shock on protest. On the other hand, if protests result in higher economic outcomes (due, perhaps to subsequent regime change and better policies) then the OLS coefficient will overestimate the magnitude of the effect of economic shocks. Our expectation is that the bias of OLS estimates are downwards. For example, in Tunisia the protests starting at the end of 2010 were followed by a sharp recession in 2011. We present the OLS estimates for various specifications even though we expect their coefficients to be biased.

As has become standard in the literature on economic shocks and civil conflicts, we employ a two-stage instrumental variable strategy using weather variables as instruments for GDP growth. In a path-breaking study, Miguel *et al.* (2004) use the variation in rainfall as an instrument for GDP growth and find a causal impact of macroeconomic shocks on conflict in sub-Saharan Africa. Since this seminal contribution, other authors have employed a similar methodology. Burke and Leigh (2010) study the impact of macroeconomic shocks on democratic change events for a broad range of countries. They test for three subsets of instruments: temperature variation, rainfall variation and variation in commodity prices, finding that only temperature variation is a strong instrument in their sample.[22] Brückner and Ciccone (2011) use variations in rainfall as an instrument for variations of GDP and determine a causal impact of recessions on democratic change in sub-Saharan economies, though they do not provide information on the strength of the instrument in their sample. Dell *et al.* (2012), while not a study that uses weather variation as an instrument for economic growth, highlight the crucial role of temperature levels in the development process, especially for poor countries. In our paper, we use variation in both temperature and rainfall (Burke and Leigh, 2010; Brückner and Ciccone, 2011) as well as temperature levels (Dell *et al.*, 2012) as instruments for our macro shock variable. Formally, our first step estimate for

benefit of revolutionary activity. Similarly, Lohmann (1994b) and Ellis and Fender (2010) consider how information cascades may alter the cost-benefit of political collective action.

[22] F stats on excluded instrument are between 1.91 and 3.50 for rainfall depending on regressions and between 0 and 3.70 for commodity price depending on regressions. F stats on excluded instruments for temperature are between 11.14 and 14.65

(11) writes:

$$shock_{it} = \beta_0 + \beta_1 temp_{it} + \beta_2 \Delta temp_{it} + \beta_3 \Delta rain_{it} + \sum_{n=4} \beta_n X_n + \alpha_i + \alpha_t + \mu_{it}, \quad (12)$$

where *temp* corresponds to the average temperature level, $\Delta temp$ corresponds to the yearly percentage change in average temperature and $\Delta rain$ denotes the yearly percentage change in average rainfall. Precipitation and temperature data are sourced from the TYN CY 1.1 data set of Mitchell *et al.* (2004), which was constructed by geographically locating meteorological stations according to grids of 0.5^o latitude and longitude, allocating grid boxes to countries, and calculating the mean of grid boxes for each country. The weather data are available to 2000, limiting the IV estimation period to 1970 – 2000.

Following Burke and Leigh (2010), in order to increase the explanatory power of our instruments, we interact rainfall variation with the share of the labor force in the agricultural sector and the share of cropland that does not have irrigation (both measured in 1995). We also interact change in temperature and temperature level with the 1995 share of the labor force in agriculture to allow the effect of temperature variation on economic growth to be larger in countries that are more dependent on agriculture. Nevertheless, Dell *et al.* (2012) show that the impact of temperature may be very important in industry as well.

Due to the difficulty of using interaction terms with possibly endogenous covariates, we perform sub-sample analyses to test our main hypothesis. We divide the sample into two groups according to regulatory quality, where one group has regulatory quality below the median and the other has regulatory quality above the median. We then implement the two-step instrumental variable procedure on the two groups separately. Overall, F tests on excluded instruments suggest that the instruments are weak in many specifications. Experimentation with first-step fixed effects regressions revealed that the ability of weather variation to explain economic growth varies substantially across levels of development depending on the type of shock, a finding consistent with Dell *et al.* (2012). Following this finding, we defined four development quartile dummies, α_q, and interacted them with each of the instruments in order to account for the differential impacts that weather variation may have on economic growth across different development levels. As a result, when interacted with weather variables (three) this corresponds to the estimation of three first stage coefficient for each development quartile (twelve coefficients). Formally, our first step writes

$$shock_{it} = \beta_0 + \sum_{q=1}^{4} \beta_q \alpha_q temp_{it} + \sum_{q=1}^{4} \beta_{5+q} \alpha_q \Delta temp_{it} + \sum_{q=1}^{4} \beta_{9+q} \alpha_q \Delta rain_{it} + \sum_{n=14} \beta_n X_n + \alpha_i + \alpha_t + \mu_{it} \tag{13}$$

This leads to a substantial improvement of the strength of our instruments as indicated by F tests on excluded first-step instruments for both subgroups of countries (good and bad regulation). We then estimate the impact of exogenous variation in our economic shock variable in the second stage, i.e., for the two subgroups we estimate

$$\Pr(protest_{it} = 1) = \beta_0 + \beta_1 \times \widehat{shock}_{it} + \sum_{n=2} \beta_n X_n + \alpha_i + \alpha_t + \mu_{it} \tag{14}$$

Comparison of the effects of negative growth shocks for the good and bad regulation subgroups supports our theory, whether using LPM of 2SLS estimation techniques. Moreover, the results are robust to the use of a variety of identifications of our macro shock variable.

Finally, we estimate the impact of costly political action, namely mass protest, on the probability of leadership transition in autocracies and emerging democracies. It is not new in the literature to consider protest as a crude manner of aggregating political preferences about the autocrat as votes do in democracies for incumbent politicians. The threat of revolt, or costly political action, as a way of removing autocrats from power is now wildly accepted in the theoretical literature (Kuran, 1989; Bueno de Mesquita, 2010; Ellis and Fender, 2010). The impact of protest on the probability of "irregular" leadership transitions has not been systematically tested empirically, however.[23] We use the unique data set on leaders from Goemans *et al.* (2009), who define an irregular transition as "when the leader was removed in contravention of explicit rules and established conventions." We exclude irregular transitions that occurred when a leader died due to natural causes.[24] Formally, we estimate the following relation.

$$\Pr(turnover_{it} = 1) = \beta_0 + \beta_1 \times protest_{it} + \sum_{n=2} \beta_n X_n + \alpha_i + \alpha_t + \mu_{it} \tag{15}$$

The dependent variable, $turnover_{it}$, takes value one when there is an irregular change in

[23] A notable exception is Kricheli *et al.* (2011).

[24] Though, as Goemans *et al.* (2009) note, in some cases it may be difficult to distinguish between a natural death and an assassination.

political leadership of country i in year t and zero otherwise. We also include country and time dummies to control for unobservable differences across countries and time periods. We first estimate this relation using the standard linear probabilistic model (LPM) and then using logit models for limited dependent variables. Since the impact of protest on turnover is not the main focus of the paper, we do not deal with endogeneity issues, beyond reporting some specifications that include lagged dependent variables.

Table 1 provides the main descriptive statistics of our variables.

3.2 Results

The baseline panel consists of countries that have lagged *polity* scores of less than 4, which includes countries that are characterized as autocracies and emerging democracies. Tables 2 – 5 investigate the main hypothesis of our model, that negative growth shocks increase the probability of protests and that the effect is stronger in countries with relatively worse regulation. Tables 2 and 3 present OLS results and tables 4 and 5 use 2SLS to correct for any possible reverse causality bias. The regressions that do not use instrumental variable techniques (tables 2 and 3) include more observations than the 2SLS regressions that follow (tables 4 and 5), since data for the weather instruments are only available up to 2000. For comparability, the pertinent OLS analogues to the 2SLS regressions are estimated for the same sample as the 2SLS estimates in tables 4 and 5. Throughout the analysis, standard errors have been clustered at the country level and all regressions include country and year fixed effects.

The first column of table 2 presents the simplest possible test of this hypothesis by interacting our negative growth variable with our measure of regulatory quality.[25] The estimates indicate that negative growth rates make protests more likely and the effect is highly statistically significant. Moreover, the effect of the growth shocks are mitigated when regulatory quality is better, as indicated by the statistically significantly negative coefficient estimate on the interaction term. The result is consistent with our theoretical predictions and robust to the inclusion of several important control variables. Column 2 presents results from our baseline specification, which controls for a country-specific development variable (*develop*), average education levels (*education*), demographics (*old*), and the quality of political institutions (*polity*). The coefficient estimates are quite stable to the inclusion of these additional regressors, which will be our standard battery of control variables throughout the rest of the paper. Column 3 demonstrates

[25] Recall that $negative\_growth$ is $-1 \times growth$ if $growth \leq 0$ and 0 otherwise.

that the coefficient estimates on *negative_growth* and *negative_growth* $\times$ *regulation* are stable upon inclusion of a lagged dependent variable. To be sure that the estimates for the interaction term are not being driven by development level, rather than regulatory quality, columns 4 and 5 also interact the shock variable with proxies for development level.[26] Again, the coefficient estimates on *negative_growth* and *negative_growth* $\times$ *regulation* are stable upon inclusion of these additional interaction terms. Finally, columns 5 – 9 in table 2 present similar tests of our main hypothesis, but use sub-sample analysis rather than interaction terms. We include these columns to make the OLS results comparable to the 2SLS regressions that follow, where the use of interaction terms with potentially endogenous co-variates is notoriously difficult. In all of the sub-sample comparisons, we divide the relevant sample in half at the median regulatory quality score and use our standard battery of controls. As expected after the results of the first five columns, the results in columns 6 and 7 demonstrate that negative growth rates statistically significantly increase the probability of having at least one protest in the "bad regulation" sub-sample, but have no effect on the probability that protests occur in the "good regulation" sub-sample. Columns 8 and 9 provide similar results using a logit model instead of OLS. All in all, the results from table 2 support our main theoretical prediction, that negative economic shocks lead to costly political action when the shocks are informative about the quality of the leaderships regulatory policies.

Table 3 extends our analysis to consider different identifications of our costly political action dependent variable, as well as different identifications of our economic shock explanatory variable. All of the regressions include our standard battery of control variables, but to conserve space, we only report the coefficient estimates for the shock variables and for the interaction terms, when used. As economic shock explanatory variables, panels A – D use, respectively, *negative_growth*, *truncated_shock*, *binary_shock* and *growth*. Columns 1 – 3 present regressions where *protest* is the dependent variable. *big_protest* is the dependent variable in columns 4-6 and *count_protest* is the dependent variable in columns 7 – 9. In each series of regressions, we first present a regression using the full sample that includes an interaction term before presenting regressions over

[26] Regulatory quality may be serving as a proxy for development level, so if growth shocks are more likely to lead to protests in less developed economies, then the interaction term may not be isolating the effect of regulatory quality. From the added interaction terms, it appears that growth shocks are more likely to lead to protests where economic development is relatively higher. Reassuringly, the coefficient estimates on the regulation interaction term remain statistically significant and relatively stable when the additional interaction terms are included.

sub-samples divided by regulatory quality. The results from table 2 are remarkably robust to these alternative specifications of the dependent variable and economic shock variable. Costly mass political actions are strongly correlated with negative growth shocks, and the effect is weaker in countries with relatively better regulatory quality. Indeed, the sub-sample analysis make this point starkly. In all specifications considered, negative growth shocks are associated with a statistically significant increase in the probability of mass protests in the bad regulation sub-sample, but have no effect in the good regulation sub-sample.

There are two interesting features of these results related to the coefficients of our controls. First, in all specifications the coefficient of *polity* is significantly negative. This is consistent with the view that in more democratic countries individuals express their dissatisfaction with their government through voting rather than costly political action. Second, protests occurring in the previous year increase the probability of current protests. This is consistent with the bandwagon effects of protests described in Lohmann (1994b) or Kuran (1989).

Table 4 introduces instrumental variables into the analysis. To conserve space, for all of the 2SLS results, we present only the second-stage estimates. To evaluate the strength of the instruments used in the first-stage estimations, we present the Wald F-statistic suggested by Kleibergen and Paap (2007) and the corresponding critical values proposed by Stock and Yogo (2005). We also provide the standard overidentification text due to Hansen in order to assess the validity of our instruments. In all specifications, the Hansen test fails to reject the null hypothesis that the instruments are exogenous. Table 4 considers our standard dependent variable, *protest*, and our standard economic shock variable, *negative_growth*. Since the weather data we use is only available up to 2000, our sample is reduced by about 200 observations from that used in the previous two tables. Columns 1 and 2 of table 4 repeats our baseline OLS sub-sample regressions using the sample for which we have weather data to make the OLS estimates directly comparable to the 2SLS estimates. Columns 3 and 4 present results from a 2SLS regression, where we use un-interacted weather instruments in the first stage as described in equation (12). In both the bad and good regulation sub-samples, the instrumented variation in *negative_growth* does not have a statistically significant impact on the probability that protests occur. From an econometric standpoint, this is not terribly revealing since the instruments are quite weak, with first stage F-statistics well below the critical values proposed by Stock and Yogo (2005).

The work of Dell *et al.* (2012), while not explicitly focused on the use of weather variables as instruments for economic growth, suggests that variation in the weather may not be a suitable instrument for samples that include countries at different stages of the development process. Since the relation between weather variation and economic growth varies by development level depending on the weather variable considered, not tailoring the instruments to account for this may result in weak instruments, as is the case in our sample of countries.[27] Once we interact the weather instruments with development quartile (in our sample), the first-stage regression, as presented in equation (13), yield excluded instruments that are very strong. Columns 4 – 8 of table 4 present second stage results when we use our strong weather instruments. Columns 7 and 8 differ only in that they include a lagged dependent variable. The results are qualitatively consistent with our OLS analysis. Negative growth experiences statistically significantly increase the probability of mass protests in the bad regulation sub-sample, but has no effect in the good regulation sub-sample. To get a sense of the economic significance of the estimates, consider the coefficient estimate for *negative_growth* from the bad regulation sub-sample in column 5. In this bad regulation sub-sample, the unconditional probability that $protest = 1$ is 0.195, the unconditional mean value for *negative_growth* is 1.822 and the mean of *negative_growth* conditional on growth being negative is 4.560. The statistically significant point estimate of 0.0657 implies that an average (conditional average) negative growth shock increases the probability of mass protests by 11.97 (29.96) percentage points.[28] By contrast, in the good regulation sub-sample, the unconditional probability that $protest = 1$ is 0.260, but the variation in *protest* cannot be explained by exogenous negative growth shocks.

Finally, in table 5, we present 2SLS results using our strong instruments to identify exogenous variation in our alternative specifications of the negative economic shock, respectively, *truncated_shock*, *binary_shock* and *growth*. The Wald F-statistics indicate that the interacted weather variables are strong instruments for *truncated_shock* and *growth*, but not for *binary_shock*. We also include the relevant OLS estimates for

[27]It is worth noting that the strength of an instrument can depend crucially on the sample. We began our analysis using the data set of Burke and Leigh (2010). Interested in the role of regulatory quality, we added to this data on regulatory quality from the Fraser Institute. The time period and country coverage of the Fraser Institute data were both smaller than the Burke and Leigh (2010) sample, so we dropped countries and years for which we did not have data from both sources. On this completely arbitrary (random) reduction of the sample, the instruments that are strong in the sample used by Burke and Leigh (2010) become quite weak in our reduced sample.

[28]The 95 percent confidence interval on the second stage estimate on instrumented variation in *negative_growth* is [0.0171, 0.1143], suggesting that the average negative growth rate (conditional on growth being negative) could increase the probability of mass protest by between 7.80 and 52.12 percentage points.

the same sample so as to observe the degree of bias when we do not instrument for exogenous variation in negative growth shocks. The first column indicates that in the bad regulation sub-sample, an additional percentage point of negative growth beyond the country-specific truncation point (mean growth rate less one standard deviation) increases the probability of mass protest by more than 17 percentage points. As before, the effect in the good regulation sub-sample is statistically zero. Columns 3 and 4 demonstrate that there is no statistically significant impact when we specify growth shocks with the binary shock variable, even in the bad regulation sample, though we note that the signs of the point estimates are going in the right direction. Again, the insignificance of these estimates is likely due to the fact that the instruments are weaker for this specification of negative growth shocks. We suppose that this is due to the binary nature of the economic shock variable used in these regressions. Finally, columns 5 and 6 simply use the per capita growth rate as the explanatory variable to be instrumented. Our interacted weather variables are strong instruments for *growth* in both the bad and good regulation sub-samples, and the estimates present further evidence of our paper's main empirical point. Negative growth experiences lead to mass protests in societies where the leadership has put in place bad regulatory policies, but not in societies with a good regulatory environment. Also note that the effects are much stronger in the IV regressions than the OLS estimates. This is consistent with our intuition that protests also negatively affect economic growth.

The regression results presented in table 6 do not include regulatory quality as an explanatory variable, and thus include more countries (hence observations) than the previous regressions since regulatory quality data was not available for all of the countries in the panel. Table 6 presents results on the impact that protests have on "irregular" leadership transitions, using the political leaders data set of Goemans *et al.* (2009). In explaining variation in the binary dependent variable, table 6 presents OLS and logit models. For both of the estimation techniques, we present a column of results from a regression without a lagged dependent variable and a column of results from a regression that includes a lagged dependent variable. In each column, we present the results from three regressions: the first row uses the binary *protest* as the explanatory variable, the second uses the binary *big_protest* and third uses the number of protests, *count_protest*, as the explanatory variable. With reference to the first column, in country-year observations where at least one protest occurred, the probability of an irregular leadership transition is nearly 4.8 percentage points higher than in county-year observations where no protests occurred. Having three or more protests increases the probability of an irregular transition by more than 21 percentage points. These estimates are both statistically and economically significant. In the sample considered for the OLS regressions the unconditional probability of an irregular transition is 0.0702. The result is robust to the inclusion of a lagged dependent variable, with the coefficient estimates changing only slightly. Moreover, the result is robust to estimation using a logit model. Thus, costly political action (protests) increases the probability of a leadership transition, as supposed in the model.

4 Conclusion

In this paper we have considered an alternative channel through which economic shocks can lead to costly political action. This channel is that economic shocks provide information about the quality of political institutions. When better institutions cause economic growth to be more robust against shocks, a negative shock will less likely lead to poor economic performance. Therefore, when individuals see a negative outcome they will revise upward their probability that an autocrat has chosen bad institutions to capture rents. We present a theoretical model that captures this information transmission mechanism of economic shocks. This model implies two predictions which we test empirically. The first implication is that low levels of growth, i.e. an economic shock, is associated with a higher probability of protest. The second is that such shocks will have a smaller effect in countries with better institutions, which we associate with less regulation.

Our empirical estimation supports both of these predictions. Using data on protests and defining several macro shock measures we show that averse shocks lead to protest depending on the level of anti-competitive regulation. When dividing the sample into good and bad regulation subsamples, economic shocks only have a statistically significant impact on protest in the bad regulation group. Our results are robust to different estimation techniques and specifications. In particular, we use weather variables as instruments for the economic shock. We use temperature and rainfall instruments which reveal a downward bias of the OLS estimate of the effect of shocks on protest. Our results are economically significant. A one-percentage point increase in negative growth per capita results in a 6.5% point increase in the probability of a protest, which corresponds to 50% of the unconditional probability of a protest.

Alternative Title: Economic Shocks and Costly Political Action: The Role of Information.

Alternative Title: Unobservable Rent-Seeking, Economic Shocks, and Social Conflict

Alternative Title: Economic Shocks and Social Conflict Under the Veil of Uncertainty

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Appendix: Tables

Table 1: Summary Statistics for Full Sample

Variable	Mean	Std. Dev.	Min	Max	N
protest	0.1552	0.3622	0	1	2886
big protest	0.0302	0.1710	0	1	2886
count protest	0.3978	1.3751	0	17	2886
growth rate	1.4370	7.5680	-50.4899	90.0670	2426
negative growth	1.8073	4.2576	0	50.4899	2426
truncated shock	0.5930	2.2826	0	37.4454	2426
binary shock	0.1443	0.3514	0	1	2426
regulation	4.9934	1.1499	2.48	8.75	1309
old	3.9047	2.1285	1.0005	14.6488	2910
polity	-6.2660	2.9208	-10	3	2759
turnover	0.0651	0.2467	0	1	3088

Notes: Calculations by the author.

Table 2: Binary Dependent Variable: Political Protest Occurred.

protest	(1) OLS Full sample	(2) OLS Full sample	(3) OLS Full sample	(4) OLS Full sample	(5) OLS Full sample	(6) OLS Bad reg.	(7) OLS Good reg.	(8) Logit Bad reg.	(9) Logit Good reg.
negative growth	0.0433***	0.0396***	0.0374***	0.0390**	0.0410***	0.0153**	0.0060	0.1285***	0.0623
	(0.014)	(0.015)	(0.014)	(0.015)	(0.015)	(0.006)	(0.007)	(0.047)	(0.075)
regulation	0.0420	0.0385	0.0395	0.0446	0.0437	0.0638	-0.0145	0.6566	-0.2341
	(0.039)	(0.037)	(0.033)	(0.037)	(0.038)	(0.080)	(0.081)	(0.691)	(0.645)
regulation×neg_growth	-0.0062**	-0.0061*	-0.0057*	-0.0087**	-0.0061*				
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)				
develop		-0.0010	-0.0009	0.0007	-0.0217	-0.0155	-0.0021	-0.1199	0.0416
		(0.027)	(0.023)	(0.027)	(0.038)	(0.018)	(0.079)	(0.191)	(0.785)
education		0.0005	0.0004	0.0002	0.0006	0.0010	0.0006	0.0157	0.0519
		(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)	(0.024)	(0.040)
old		0.0238	0.0179	0.0248	0.0330	0.0915	-0.0053	0.1474	-0.3354
		(0.037)	(0.033)	(0.038)	(0.039)	(0.059)	(0.066)	(0.586)	(0.589)
polity		-0.0033***	-0.0029***	-0.0034***	-0.0036***	-0.0039***	-0.0031***	-0.0227***	-0.0230**
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.007)	(0.009)
L.protest			0.1383***						
			(0.042)						
educ×neg_growth				0.0004*					
				(0.000)					
develop×neg_growth					0.0163**				
					(0.009)				
constant	0.0462	-0.0240	-0.0086	-0.0402	-0.0991	-0.4969	0.4827	-7.0056**	1.3292
	(0.197)	(0.241)	(0.225)	(0.238)	(0.259)	(0.320)	(0.584)	(3.021)	(4.254)
within R^2	0.0601	0.0752	0.0928	0.0791	0.0784	0.1114	0.0910	0.2762	0.3116
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1214	1213	1213	1213	1213	607	606	514	525

Notes: *, **, and *** indicate significance at 10, 5, and 1 % levels, respectively. The measure of fit reported for the logit regressions is the pseudo-R^2. All standard errors are clustered at the country level.

Table 3: Three Different Dependent Variables and Four Different Shock Measures.

	(1) OLS Full sample protest	(2) OLS Bad reg. protest	(3) OLS Good reg. protest	(4) OLS Full sample big protest	(5) OLS Bad reg. big protest	(6) OLS Good reg. big protest	(7) Poisson Full sample count	(8) Poisson Bad reg. count	(9) Poisson Good reg. count
Panel A: Negative growth explanatory variable									
negative growth	0.0396***	0.0153**	0.0060	0.0548***	0.0135***	-0.0011	0.2894***	0.1051***	-0.0036
	(0.015)	(0.006)	(0.007)	(0.017)	(0.005)	(0.003)	(0.052)	(0.021)	(0.021)
regulation×neg_growth	-0.0061*			-0.0100***			-0.0466***		
	(0.003)			(0.003)			(0.011)		
within R^2 / Wald χ^2	0.0752	0.1114	0.0910	0.0964	0.1657	0.0990	228.88	166.78	158.30
N	1213	607	606	1213	607	606	1100	516	530
Panel B: Truncated negative growth shock explanatory variable									
truncated shock	0.0560**	0.0260***	0.0008	0.1026***	0.0281***	-0.0032	0.3914***	0.1339***	-0.0239
	(0.026)	(0.009)	(0.013)	(0.027)	(0.009)	(0.006)	(0.071)	(0.029)	(0.031)
regulation×shock	-0.0087			-0.0185***			-0.0646***		
	(0.006)			(0.005)			(0.015)		
within R^2 / Wald χ^2	0.0717	0.1099	0.0895	0.1033	0.1794	0.0994	226.26	166.24	158.95
N	1213	607	606	1213	607	606	1100	516	530
Panel C: Binary negative growth shock explanatory variable									
binary shock	0.2400**	0.0899*	0.0435	0.3152**	0.0842***	0.0057	2.1028***	0.5987***	-0.1330
	(0.116)	(0.047)	(0.049)	(0.125)	(0.030)	(0.030)	(0.464)	(0.173)	(0.169)
regulation×shock	-0.0332			-0.0535**			-0.3409***		
	(0.023)			(0.024)			(0.096)		
within R^2 / Wald χ^2	0.0722	0.1036	0.0906	0.0811	0.1480	0.0989	212.61	154.89	158.51
N	1213	607	606	1213	607	606	1100	516	530
Panel D: Per capita GDP growth rate explanatory variable									
growth rate	-0.0189**	-0.0056*	-0.0025	-0.0239**	-0.0067***	0.0009	-0.1882***	-0.0548***	-0.0021
	(0.009)	(0.003)	(0.004)	(0.011)	(0.002)	(0.002)	(0.037)	(0.015)	(0.015)
regulation×growth	0.0031			0.0042**			0.0289***		
	(0.002)			(0.002)			(0.008)		
within R^2 / Wald χ^2	0.0699	0.1044	0.0902	0.0830	0.1534	0.0992	222.66	157.13	158.31
N	1210	604	606	1210	604	606	1097	513	530
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: *, **, and *** indicate significance at 10, 5, and 1 % levels, respectively. The measure of fit reported for the Poisson regressions is the Wald χ^2. All standard errors are clustered at the country level. Note that there are 3 less observations in panel D, since we removed the upside growth outliers as well.

Table 4: BINARY DEPENDENT VARIABLE: POLITICAL PROTEST OCCURRED. SECOND STAGE OF 2SLS.

protest	(1) OLS Bad reg.	(2) OLS Good reg.	(3) Weak IV Bad reg.	(4) Weak IV Good reg.	(5) Strong IV Bad reg.	(6) Strong IV Good reg.	(7) Strong IV Bad reg.	(8) Strong IV Good reg.
negative growth	0.0158**	0.0097	0.0119	-0.1149	0.0657***	-0.0847	0.0732**	-0.0730
	(0.006)	(0.008)	(0.029)	(0.141)	(0.025)	(0.052)	(0.029)	(0.047)
education	0.0004	0.0012	0.0018	0.0043	0.0008	0.0036	0.0003	0.0031
	(0.003)	(0.004)	(0.003)	(0.006)	(0.003)	(0.004)	(0.003)	(0.004)
old	0.1325*	-0.0518	0.1025	0.0833	0.1731**	0.0508	0.1640**	0.0294
	(0.070)	(0.083)	(0.089)	(0.183)	(0.083)	(0.112)	(0.081)	(0.101)
polity	-0.0052***	-0.0027*	-0.0054***	-0.0043	-0.0027	-0.0039***	-0.0012	-0.0036**
	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)	(0.001)	(0.002)	(0.001)
develop	-0.0021	0.0602	-0.0030	-0.0739	0.0029	-0.0417	0.0047	-0.0200
	(0.024)	(0.109)	(0.022)	(0.178)	(0.030)	(0.135)	(0.033)	(0.123)
L.protest							0.2051***	0.0904
							(0.062)	(0.067)
Within R^2	0.1200	0.0835						
Kleibergen-Paap rk Wald F-stat			1.542	0.822	16.710	9.894	17.785	10.159
Maximum bias c.v.'s (5% / 30%)			9.61/5.60	9.61/5.60	3.54/2.57	3.54/2.57	3.54/2.57	3.54/2.57
Hansen J statistic p-value			0.7794	0.3647	0.3591	0.8329	0.2943	0.8156
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	512	509	512	509	512	509	512	509

Notes: *, **, and *** indicate significance at 10, 5, and 1 % levels, respectively. All standard errors are clustered at the country level.

Table 5: Binary Dependent Variable: Political Protest Occurred. Second Stage of 2SLS with Strong Instruments

protest	(1) Bad reg.	(2) Good reg.	(3) Bad reg.	(4) Good reg.	(5) Bad reg.	(6) Good reg.
truncated shock	0.1708***	-0.1850				
	(0.058)	(0.139)				
binary shock			1.2185	-1.3656		
			(0.773)	(1.160)		
growth rate					-0.0389**	0.0537
					(0.019)	(0.058)
education	-0.0011	0.0026	-0.0013	0.0043	0.0013	0.0055
	(0.004)	(0.004)	(0.004)	(0.005)	(0.003)	(0.006)
old	0.2344***	0.0752	0.2949**	0.0070	0.2757**	-0.0208
	(0.088)	(0.139)	(0.133)	(0.133)	(0.120)	(0.090)
polity	-0.0024	-0.0043**	-0.0006	-0.0064*	-0.0036**	-0.0034***
	(0.003)	(0.002)	(0.004)	(0.004)	(0.002)	(0.001)
develop	-0.0143	-0.0522	0.0012	-0.0506	-0.0142	-0.0714
	(0.034)	(0.148)	(0.041)	(0.168)	(0.026)	(0.196)
OLS shock estimate	0.0247***	0.0095	0.0608	0.0772	-0.0062*	-0.0061
for same sample	(0.009)	(0.015)	(0.045)	(0.063)	(0.003)	(0.004)
within R^2						
Wald F-stat	20.585	8.606	2.107	3.474	11.356	9.665
Max bias c.v.'s (5%/30%)	3.54/2.57	3.54/2.57	3.54/2.57	3.54/2.57	3.54/2.57	3.54/2.57
Hansen J stat p-value	0.2855	0.8859	0.3693	0.9700	0.6745	0.5403
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	512	509	512	509	510	509

Notes: *, **, and *** indicate significance at 10, 5, and 1 % levels, respectively. All standard errors are clustered at the country level.

Table 6: Binary Dependent Variable: Irregular Leadership Transitions

transition	(1) OLS	(2) OLS	(3) Logit	(4) Logit	(5) Probit	(6) Probit
protest	0.0479*	0.0450*	0.6595**	0.6428**	0.3393**	0.3301**
	(0.025)	(0.023)	(0.280)	(0.272)	(0.148)	(0.145)
R^2	0.0153	0.0219	0.1585	0.1605	0.1570	0.1588
big protest	0.2141***	0.1996***	1.8771***	1.8620***	0.9799***	0.9688***
	(0.062)	(0.063)	(0.446)	(0.443)	(0.238)	(0.237)
R^2	0.0269	0.0336	0.1707	0.1727	0.1688	0.1705
count protest	0.0195***	0.0188***	0.1659***	0.1624***	0.0902***	0.0886***
	(0.007)	(0.007)	(0.047)	(0.046)	(0.026)	(0.025)
R^2	0.0191	0.0256	0.1601	0.1621	0.1591	0.1609
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Country F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Lagged D.V.	No	Yes	No	Yes	No	Yes
N	2877	2877	1626	1626	1626	1626

Notes: *, **, and *** indicate significance at 10, 5, and 1 % levels, respectively.
All standard errors are clustered at the country level.