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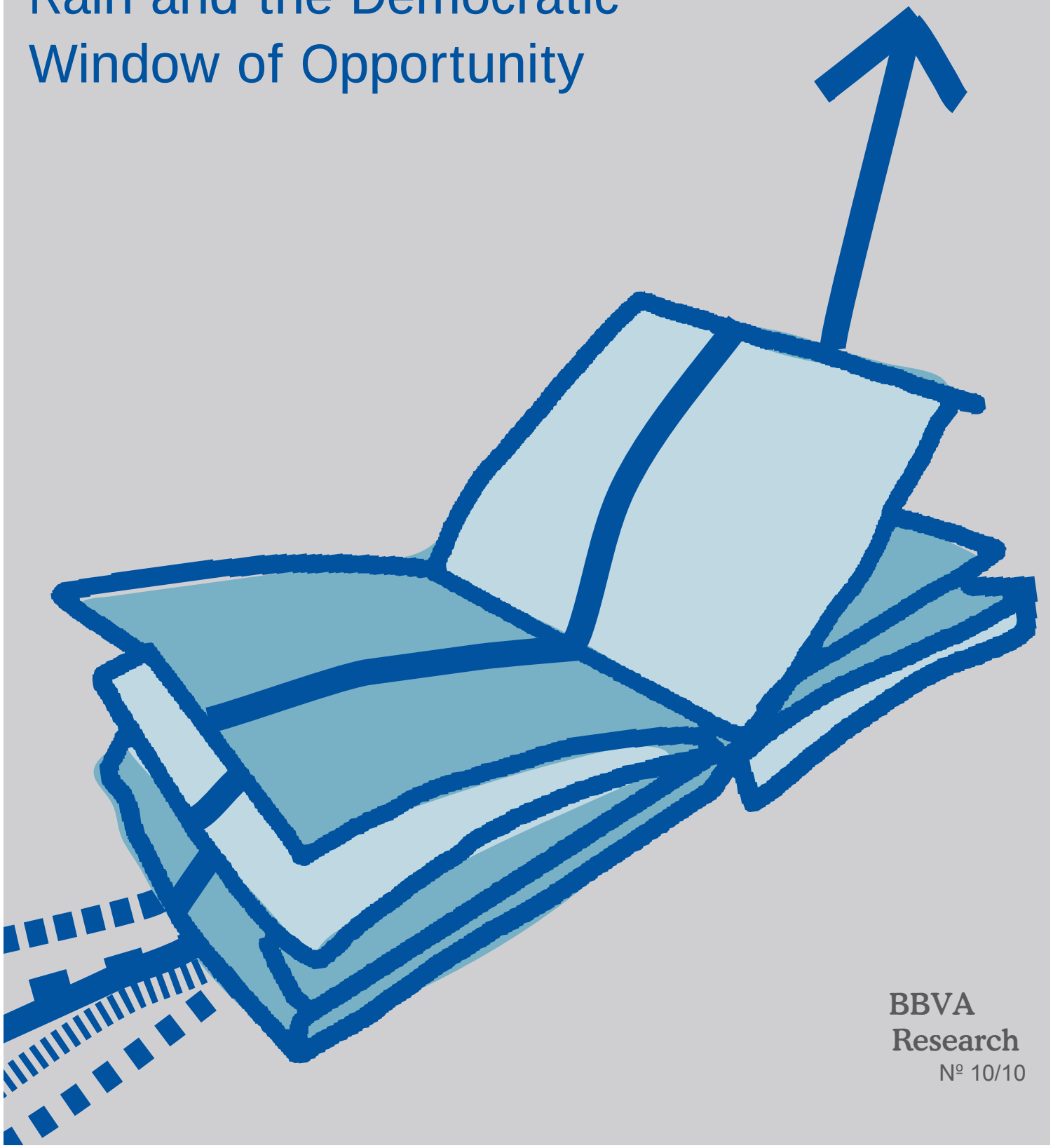

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Rain and the Democratic Window of Opportunity

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Abstract

According to the economic approach to political transitions, transitory negative economic shocks can open a window of opportunity for democratic improvement. Testing the theory requires a source of transitory shocks to the aggregate economy. We use rainfall shocks in Sub-Saharan African countries and find that negative rainfall shocks are followed by significant improvement in democratic institutions. Instrumental variable estimates indicate that following a transitory negative income shock of 1 percent, democracy scores improve by 0.9 percentage points and the probability of a democratic transition increases by 1.3 percentage points.

Key words*:* democratization, transitory economic shocks

JEL codes: O0, P0

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1. Introduction

What triggers democratic change? At least since Lipset (1959), it has been argued that democratic change tends to be sparked off by economic recessions (see also Huntington, 1991; Haggard and Kaufmann, 1995). Acemoglu and Robinson's (2001, 2006) theory of political transition provides an explanation. Transitory, negative economic shocks give rise to a window of opportunity for citizens to contest power, as the cost of fighting ruling autocratic regimes is relatively low. When citizens reject policy changes that are easy to renege upon once the window closes, autocratic regimes must make democratic concessions to avoid costly repression. Hence, democratic change is seen as a concession of ruling autocratic regimes when citizens' opportunity cost of contesting power is temporarily low.[1]

Testing the window-of-opportunity effect of transitory economic shocks on political institutions is difficult. The key issue is singling out aggregate economic shocks that are transitory. Another concern is that economic changes may reflect shocks to expectations about future democratization; for example, income levels may rise when countries are more likely to be freed from expropriatory autocratic regimes. Empirical analysis of the window-of-opportunity theory of democratic change therefore requires observing transitory, exogenous shocks to aggregate economic activity. We argue that yearly rainfall shocks in Sub-Saharan African countries satisfy these requirements. This results in a probably unique opportunity to test the theory by examining whether democratic improvement tends to follow negative rainfall shocks.

Our main measure of democratic institutions is the revised combined Polity IV project score (Marshall and Jaggers, 2005). The Polity score is based on the competitiveness of

[1] Lipset and Huntington argue that recessions lead to autocratic regimes losing legitimacy which ends up increasing the probability of democratic change.

political participation, the openness and competitiveness of executive recruitment, and constraints on the executive. Polity attempts to capture not only outcomes but also procedural rules. The extent to which this goal is achieved is debated, but even critics of Polity argue that it is probably the best of the democracy measures used in the literature (e.g. Glaeser et al., 2004).

The data show some striking instances of democratic improvement following negative rainfall shocks in Sub-Saharan Africa. Madagascar transited from autocracy to free democratic elections following a severe drought in 1990. Droughts also preceded free and competitive elections in Mali in 1992 and the multi-party constitution in Mozambique in 1994. Figure 1 shows the evolution of the Polity score for ten Sub-Saharan African countries where democratic improvement was preceded by droughts, defined as rainfall levels below the 20^{th} percentile (higher scores denote more democratic institutions). Another interesting aspect of the Sub-Saharan African data is that there are twice as many democratic transitions following droughts than following rainfall levels above the 80^{th} percentile.

Our empirical analysis yields a statistically significant link between negative rainfall shocks and subsequent improvements in the Polity score. This continues to be the case when we consider improvements in the Polity sub-scores for the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraints on the executive. When we examine transitions from autocracy to democracy as defined by Persson and Tabellini (2003) and Epstein et al. (2006), we also find that they are more likely following negative rainfall shocks. The democratic improvement experienced by Sub-Saharan African countries following negative rainfall shocks is consistent with Acemoglu

and Robinson's theory of political transitions as negative rainfall shocks lead to transitory drops in GDP in our data.[2]

When citizens' cost of contesting power is proportional to income, as in Acemoglu and Robinson's theory of political transitions, we can push the empirical analysis further and estimate the window-of-opportunity effect of transitory income shocks on democratic institutions using an instrumental variables approach. Our instrumental variables estimates indicate that a transitory negative income shock of 1 percent is followed by an improvement in the Polity score of around 0.9 percentage points. The executive constraints score improves by 1 percentage point; the political competition score by 0.8 percentage points; and the openness and competitiveness of executive recruitment score by 0.9 percentage points. When we consider transitions from autocracy to democracy, we find that a transitory negative income shock of 1 percent increases the probability of a transition to democracy by around 1.3 percentage points. These estimates reflect the effect of negative transitory income shocks on democratic improvement under the assumption (exclusion restriction) that rainfall shocks affect democratic change only through their effect on GDP. This condition would not be satisfied if rainfall had a direct effect on the cost of contesting autocratic rule.[3]

[2] A positive effect of rainfall on the GDP of Sub-Saharan African countries is also reported by Benson and Clay (1998); Miguel et al. (2004); and Barrios and Bertinelli (2008). Benson and Clay report annual time-series evidence for six Sub-Saharan African countries between 1970 and 1992, and Miguel et al. report annual time-series evidence based on an analysis of 41 Sub-Saharan African countries for the 1981-1999 period. Our analysis extends the sample further and also differs in that we control for common year effects (shocks that affect all Sub-Saharan African countries) and check on the robustness of the rainfall-GDP link. Barrios and Bertinelli examine the effect of rainfall on GDP growth averaged over five-year periods.

[3] For example, road flooding could make it more costly for citizens to coordinate against autocratic regimes. In this case, negative rainfall shocks could lead to democratic improvement because of their direct (negative) effect on the cost of contesting power or because of their (indirect, negative) effect through income. Hence, direct negative effects of rainfall on the cost of contesting power imply that our instrumental variables estimates cannot be interpreted as the effect of transitory income shocks. Our reduced-form regressions continue to constitute a valid test of the window-of-opportunity theory however (this is true as long as the total—direct plus indirect—effect of negative rainfall shocks is a reduction of the cost of contesting autocratic regimes).

If rainfall shocks open a window of opportunity for democratic change because of their effect on GDP, rainfall shocks should have a weak effect on democratic change in countries where the GDP effect of rainfall shocks is weak because agricultural sectors are (relatively) small. This is consistent with our finding of a statistically insignificant effect of rainfall shocks on GDP and democratic institutions in countries with agricultural GDP shares below the sample median.[4] The result that rainfall shocks have an insignificant effect on democratic change in the sample where they have an insignificant GDP effect also suggests that rainfall does not have (strong) direct effects on democratic change.

Our work fits into the literature on the economic determinants of democratic change. One of the most thoroughly investigated issues is the modernization hypothesis, which posits a positive link between income and democracy (Lipset, 1959). For empirical work see, for example, Przeworski and Limongi (1997); Barro (1999); Przeworski et al. (2000); and Epstein et al. (2006). This literature has found evidence of a positive link between income and democracy, but recent work by Acemoglu et al. (2008, 2009) indicates that this relationship is absent when one focuses on within-country variation using fixed effects specifications (as we do). Our work differs from the modernization literature in that we are interested in democratic change following transitory economic shocks. It is for this reason that we rely on rainfall variation as a source of transitory shocks to the aggregate economy. Haggard and Kaufman (1995), Geddes (1999), Berger and Spoerer (2001), and Acemoglu and Robinson (2006) also document democratic improvement following negative economic shocks. Methodologically, our work is related to Paxson (1992), which appears to be the first paper using rainfall shocks to test theoretical implications of transitory economic shocks.[5]

[4] In countries with above-median agricultural sectors, on the other hand, negative rainfall shocks lead to a statistically significant drop in GDP and a significant improvement in democratic institutions.

[5] Paxson's objective is to test the validity of the permanent income hypothesis (see also Fafchamps et al., 1998). Miguel et al. (2004) examine the link between year-to-year rainfall growth, income growth, and civil conflict. Their aim is to re-examine empirical work arguing that civil conflict is

The remainder of this paper is organized as follows. Section 2 discusses data and measurement, Section 3 presents the estimation framework, and Section 4 our results. Section 5 concludes.

2. Data and Measurement

Our main measure of democratic institutions is the revised combined Polity score (Polity2) of the Polity IV database (Marshall and Jaggers, 2005). This variable combines scores for constraints on the chief executive, the competitiveness of political participation, and the openness and competitiveness of executive recruitment. It ranges from -10 to +10, with higher values indicating more democratic institutions. Polity2 is based on the combined Polity score but modified for time series analysis. In particular, changes in the combined Polity score during so-called transition periods are prorated across the span of the transition. Transitions refer to periods where new institutions are planned, legally constituted, and put into effect. Democratic and quasi-democratic polities are particularly likely to be preceded by such transition periods (Marshall and Jaggers, 2005). Moreover, Polity2 also assigns a score of zero (which Polity IV refers to as neutral) to so-called interregnum periods, which are periods where polities cannot exercise effective authority over at least half their established territory.

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caused by low income growth using instrumental variables (for an early contribution to the civil conflict literature see Collier and Hoeffler, 1998). Burke and Leigh (2008) use a similar approach to estimate the effect of income growth on democratic transitions. Miguel et al.'s approach cannot be used to test the democratic window-of-opportunity theory. This is because Miguel et al.'s approach tests whether civil conflict outbreak is more likely following years where rainfall turned out to be low compared to rainfall in previous years. What matters for the window-of-opportunity theory is whether rainfall is low compared to expected future rainfall, not compared to past rainfall. The Supplementary Appendix (available as a separate document at www.antoniociccone.eu) shows that the effect of year-to-year rainfall growth on democratic improvement in Sub-Saharan Africa is statistically insignificant, significantly positive, or significantly negative, depending on the measure of democracy used.

We perform a separate empirical analysis of the so-called Polity IV concept variables for constraints on the chief executive, political competition, and the openness and competitiveness of executive recruitment. Constraints on the executive is a measure of the extent of institutionalized constraints on the decision making powers of chief executives and ranges from 1 to 7, with greater values indicating tighter constraints. Political competition measures the extent to which alternative preferences for policy and leadership can be pursued in the political arena. This indicator ranges from 1 to 10, with greater values denoting more competition. Finally, the openness and competitiveness of executive recruitment measures the extent to which the politically active population has an opportunity to attain the position of chief executive through a regularized process and the degree to which prevailing modes of advancement give subordinates equal opportunities to become superordinates. It ranges from 1 to 8, with greater values indicating more open and competitive executive recruitment. In using these variables we follow the revised combined Polity score in prorating changes during a transition across its span. We treat interregnum periods as missing values, as it is unclear what score they should be assigned (in contrast to the combined Polity variable, the Polity concept variables do not have a score that Polity IV considers as neutral). To facilitate the comparison of results for Polity2 with those for the Polity concept variables, we present results for a modified version of Polity2 where we drop interregnum periods.

We also consider the effect of rainfall and income shocks on transitions to democracy. Persson and Tabellini (2003, 2006, 2008) as well as the Polity IV manual consider countries to be democracies if their Polity2 score is strictly positive; other Polity2 scores correspond to non-democracies. To capture transitions to democracy, we define a year t democratic transition indicator variable for country c that is unity if and only if democratic improvements between t-1 and t lead to the country being upgraded to democracy; if the

country already is a democracy at *t*-1, the year *t* indicator is not defined. Transitions away from democracy are defined analogously. The Polity IV manual and Epstein et al. (2006) further separate democracies into partial democracies, with Polity2 scores 1 to 6, and full democracies, with Polity2 scores 7 to 10. To analyze the effects of rainfall and income shocks on democratic improvement using this classification, we define a year *t* democratization step indicator variable for country *c* that is unity if and only if democratic improvements between *t*-1 and *t* lead to the country being upgraded to partial or full democracy; if the country already is a full democracy at *t*-1, the year *t* indicator is not defined. In addition, we examine the effect of rainfall shocks on coups d'état in democracies. Polity IV defines coups d'état as a forceful seizure of executive authority and office by a dissident/opposition faction within the country's ruling or political elites that results in a substantial change in the executive leadership and the policies of the prior regime (although not necessarily in the nature of regime authority or mode of governance). Based on this information, we define a year *t* coups d'état in democracies indicator variable for country *c* that is unity if and only if the country is a democracy and there has been a coup d'état; if the country is a non-democracy in year *t* the indicator is not defined. Our main measures of political change are summarized in Table 1.

The country-year rainfall data come from the National Aeronautics and Space Administration (NASA) Global Precipitation Climatology Project (GPCP). NASA GPCP rainfall precipitation estimates are a combination of rainfall data obtained from gauge stations, and microwave, infrared, and sounder data observed by satellites. Specifically, NASA GPCP combines special sensor microwave imager emission and scattering algorithms, a geostationary orbital environmental satellite precipitation index, an outgoing longwave precipitation index, information from Tiros operational vertical sounders and National Oceanic and Atmospheric Administration polar orbiting satellites, and rainfall data

from gauge stations to obtain monthly rainfall estimates on a 2.5°x2.5° latitude-longitude grid. A detailed explanation on how gauge data is merged with satellite data is provided in Adler et al. (2003).[6] In comparison to rainfall data based exclusively on information collected by gauge stations, there are two main advantages of the GPCP data. First, the GPCP rainfall data are less likely to suffer from classical measurement error due to the sparseness of operating gauge stations in Sub-Saharan African countries (especially after 1990).[7] Moreover, rainfall estimates based only on gauge measurement are more likely to suffer from non-classical measurement error because the number of operating gauges (and hence rainfall estimates) may be affected by socio-economic conditions.[8] The GPCP rainfall data are available from 1979 onwards.

Real income per capita data are taken from the Penn World Tables 6.2 (Heston et al., 2006), which is available up to 2004. Table 2 contains summary statistics for key data.

3. Estimation Framework

Our first-stage equation relates log income per capita ($\log y_{c,t}$) to a country-specific time trend ($\alpha_c + \beta_c t$), time-varying shocks that affect all Sub-Saharan African countries (ϕ_t), and country-specific rainfall levels ($\log Rain_{c,t}$),

[6] The data are available at http://precip.gsfc.nasa.gov. For a validation study of the GPCP satellite-based rainfall data see Nicholson et al. (2003).

[7] Matsuura and Willmott (2007) provide gauge-based rainfall estimates for a large part of the world and a long time period. The spatial gauge density underlying their rainfall estimates for Sub-Saharan African countries appears to be relatively good for the 1960s and 1970s but declines thereafter. For example, while the average number of gauges per country is 40 in the 1960s, gauge stations per country drop to 32 in the 1980s, 18 in the 1990s, and 8 after 2000. As a result, gauge coverage after 1990 is unsatisfactory according to the criteria of the World Meteorological Organization (1985) and Rudolf et al. (1994).

[8] For example, a regression of the Matsuura and Willmott rainfall estimates on lagged per capita GDP yields a statistically significant, negative effect for the 1980-2004 period we focus on (lagged per capita GDP also has a significant effect on the number of reporting gauges in the Matsuura and Willmott dataset). By contrast, lagged GDP has no significant effect on GPCP rainfall.

(1) $$\log y_{c,t} = \alpha_c + \beta_c t + \phi_t + \gamma \log Rain_{c,t} + v_{c,t},$$

where $v_{c,t}$ is a disturbance term. This equation allows us to examine whether country-specific income fluctuations are driven by country-specific rainfall shocks.

Our reduced-form equation maintains the same right-hand-side explanatory variables but uses the measures of democratic change summarized in Table 1 on the left-hand side. Our main measure of democratic change is the change in the Polity2 score between *t* and *t*+1, $\Delta D_{c,t} = D_{c,t+1} - D_{c,t}$ where $D_{c,t}$ refers to the year *t* Polity2 score of country *c*. But we also present results for the democratic transition indicators, transitions away from democracy, and coups d'état in democracies.[9]

To examine the effect of transitory income shocks on democratic change, we estimate

(2) $$\Delta D_{c,t} = c \log y_{c,t-1} + a_c + b_c t + f_t + e_{c,t},$$

where $e_{c,t}$ is a disturbance term. The coefficient c captures the effect of country-specific, transitory income shocks on democratic change, as we are controlling for country-specific income trends ($a_c + b_c t$) and global income shocks (f_t). The main estimation method is two-stage least squares with log rainfall in *t*-1 as excluded instrument.

To analyze democratic change in response to country-specific recessions, we construct a recession indicator that is unity if and only if income is below the country-specific trend for reasons other than shocks affecting all Sub-Saharan African countries. Formally, we estimate

[9] We use linear specifications as non-linear (e.g. probit, logit) specifications do not converge when we control for fixed effects (this is a general problem of these estimators, see Angrist and Krueger, 2001, and Wooldridge, 2002, for example). Probit with fixed effects is also inconsistent due to the incidental parameter problem. Consistent slope estimates can be obtained using conditional fixed effects logit, which yields qualitatively the same results as the linear probability model (the magnitude of estimates cannot be compared without knowing the distribution of fixed effects, see Wooldridge, 2002). The main drawback of conditional fixed effects logit is that estimates do not converge when we include country time trends and year effects.

(3) $$\log y_{c,t} = \alpha_c + \beta_c t + \phi_t + \eta_{c,t}$$

and define a recession dummy that is unity if the estimated residual is negative, $\hat{\eta}_{c,t} < 0$, and zero otherwise. We then replace $\log y$ on the right-hand side of (2) by this dummy to estimate democratic change in response to country-specific recessions.

4. Empirical Results

Table 3, column (1) estimates the reduced-form equation for the change in the Polity score. We report least squares estimates and Huber robust standard errors clustered at the country level (in brackets). All our results refer to the 1980-2004 period.[10] The results show that negative rainfall shocks at *t*-1 are followed by statistically significant democratic improvement. According to the estimate, 10 percent lower rainfall levels lead to an improvement of 0.146 points in the Polity2 score (statistically significant at the 95 percent confidence level). Given the [-10,10] range of Polity2, this corresponds to an improvement of 0.73 percentage points.

Table 3, column (2) estimates the same specification as column (1) but codes interregnum years as missing observations (which is why the number of observations drops to 902) to make the results more readily comparable with our analysis for Polity sub-scores in columns (3)-(5). This strengthens our main result somewhat, as the effect of negative rainfall shocks is now stronger both quantitatively and statistically.

Table 3, columns (3)-(5) estimate the effect of rainfall shocks on the change in the Polity sub-scores for constraints on the executive, political competition, and the openness and competitiveness of executive recruitment. The results show that negative *t*-1 rainfall shocks lead to significant democratic improvement in all three dimensions. 10 percent lower rainfall

[10] The first Polity observation used corresponds to 1980 but the first rainfall observation to 1979 (the starting date of the rainfall data), as our specifications include rainfall levels at *t* and *t*-1.

levels result in an improvement of 0.046 points in the executive constraints score (statistically significant at the 90 percent confidence level); as this score has a [1,7] range, a 0.046 points improvement amounts to a tightening of executive constraints by 0.77 percentage points. The political competition and executive recruitment scores increase by 0.578 and 0.485 points respectively (both are statistically significant at the 95 percent confidence level); this amounts to 0.64 and 0.69 percentage points of their respective ranges (political competition has a [1,10] range and executive recruitment a [1,8] range).

Table 4 contains the effect of rainfall on GDP per capita and the probability of a country-specific recession. Column (1) shows the effect of contemporaneous rainfall on GDP per capita controlling for country fixed effects, country-specific time trends, and shocks common to Sub-Saharan African countries. 10 percent lower rainfall levels lead to a 7.9 percent drop in income per capita (statistically significant at the 99 percent confidence level). Columns (2) and (3) augment the specification in column (1) by lagged rainfall levels.[11] In column (2) we find that rainfall at *t*-1 has a positive but statistically insignificant effect on GDP. Column (3) also includes rainfall at *t*-2 and finds that the effect is small and also statistically insignificant. In column (4), we check whether the effect of rainfall shocks depends on countries' Polity score, but find the relevant interaction to be small and statistically insignificant.

[11] The Supplementary Appendix contains a series of robustness checks of the first-stage relationship. In particular, we re-estimate the first-stage regression using rainfall levels rather than log-levels; specify the first-stage relationship in first differences rather than levels; control for temperature; check for non-linearities; drop the top 1 percent rainfall observations; account for potential spatial correlation of rainfall; and use a variety of different approaches to calculate standard errors. We also use the Matsuura and Willmott (2007) rainfall data and find a first-stage effect of rainfall shocks on GDP for (pre-1990) periods where spatial gauge density is relatively good, see footnote 7. The Matsuura and Willmott rainfall estimates do not yield a first-stage effect for the 1980-2004 period we focus on however. We think that this is most likely due to the unsatisfactory gauge density in the second half of this time period.

Table 4, columns (5)-(8) consider the effect of rainfall levels on our country-specific recession indicator. This indicator is unity if and only if income falls below trend for reasons other than shocks common to all Sub-Saharan African countries. The interpretation of the coefficient on log rainfall levels at *t* in column (5) is that 10 percent lower rainfall levels raise the probability of a recession by 3.9 percentage points (statistically significant at the 99 percent confidence level). Columns (6)-(8) show that the effect dies out within two years and that there is no statistically significant heterogeneity according to Polity scores.

To provide a useful graphical way to check whether our (linear) specifications miss important aspects of the data, we re-estimate the first-stage and the reduced-form relationships using non-parametric local polynomial estimators. Figure 2A presents the non-parametric local polynomial estimates for the first-stage relationship between rainfall and per capita GDP. We use an Epanechnikov kernel and select the bandwidth as suggested by cross-validation criteria.[12] It turns out that the relationship is monotonically increasing except for large positive rainfall shocks, where the relationship is estimated to be hump-shaped.[13] The hump is very imprecisely estimated however because less than 1 percent of rainfall observations are to the right of its peak.[14] (In the Supplementary Appendix we present estimates of the first-stage and reduced-form relationships excluding the top 1 percent rainfall observations, which yield results that are slightly stronger statistically.) Figure 2B uses the same approach to obtain non-parametric local polynomial estimates for the reduced-form relationship between rainfall and Polity change. This relationship is monotonically decreasing over the whole range.

[12] See Bowman and Azzalini (1997). Intuitively, cross validation amounts to choosing the bandwidth to minimize the mean-square error.

[13] We also present non-parametric local polynomial estimates using half and twice the bandwidth recommended by cross validation in the Supplementary Appendix.

[14] The Supplementary Appendix tests for non-linearities by including dummy variables for rainfall levels above or below certain percentiles. These dummy variables turn out to be small and statistically insignificant while the linear effect remains statistically significant.

Table 5 presents two-stage least squares (2SLS) estimates of the effect of transitory income shocks on the Polity score. These estimates assume that rainfall shocks affect democratic change only through their effect on GDP.[15] The top panel contains second-stage estimates and the bottom panel the corresponding first-stage estimates. The result in column (1) indicates that a transitory 1-percent negative income shock at *t*-1 leads to an improvement of the Polity2 score of 0.18 points, an increase of 0.9 percentage points given the [-10,10] range of the score.[16] This effect is statistically significant at the 95 percent confidence level (we report p-values in square brackets just below the estimates).[17] The improvement following a transitory 1-percent negative income shock is estimated to be somewhat larger in column (2) where we drop observations corresponding to interregnum periods (the effect continues to be statistically significant at the 95 percent confidence level).[18]

For comparison we show the results using least squares for the world sample (the largest possible sample for 1980-2004) and Sub-Saharan Africa in columns (3) and (4) respectively. The least squares estimates have the same sign as the 2SLS estimates, but are much smaller

[15] In the Supplementary Appendix we examine whether the effect of rainfall shocks on democratic change could be through government expenditures, military expenditures, or consumer prices (rather than GDP per capita). Our analysis does not yield a statistically significant effect of rainfall shocks on these variables however. In the case of military expenditures, this could be because limited data force us to work with a quite reduced sub-sample. (However, interestingly, we do find a statistically significant effect of rainfall on GDP per capita and democratic change even in this reduced sub-sample.)

[16] In the Supplementary Appendix, we show that the effect of year *t* income shocks is statistically insignificant.

[17] The p-values in square brackets below 2SLS estimates are based on the Anderson-Rubin test of statistical significance. A key property of this test is that it is robust to weak instruments. 2SLS standard errors, on the other hand, are not robust to weak instruments, and inference based on 2SLS standard errors can be very misleading as a result. See Andrews and Stock (2005) for a review of these issues. The power properties of the Anderson-Rubin test are also good (it is a uniformly most powerful unbiased test under certain conditions). We implement a version of the Anderson-Rubin test that is robust to heteroskedasticity and arbitrary within-country correlation of the residuals.

[18] In the Supplementary Appendix, we show that results are similar when we measure democratic institutions using the Freedom House (2007) political rights indicator, but with a somewhat different timing compared to the Polity findings.

in absolute value and statistically insignificant. For example, in the world sample, a transitory negative income shock of 1 percent leads to an improvement in Polity scores of less than one-hundredth of a percentage point; for Sub-Saharan Africa, the effect is less than one-twentieth of a percentage point.[19] The result that the least squares effect of income shocks is larger than the instrumental variables estimate is most likely explained by three factors.[20] First, the window-of-opportunity theory of democratic change stresses transitory economic shocks; permanent shocks change the balance of power permanently and will therefore allow citizens to demand and obtain future policy concessions in the absence of democratic reforms. When we instrument income shocks using rainfall shocks, we isolate transitory income shocks. Hence, the stronger—in absolute value—negative estimate in column (1) compared to (4) is consistent with theory. Second, the income estimates in the Penn World Tables contain a substantial amount of noise, especially for Sub-Saharan African countries (e.g. Heston, 1994; Deaton, 2005). Moreover, classical measurement error would affect our least squares estimate in column (4), but not our instrumental variables estimate in (1) as long as noise in the income estimates is uncorrelated with noise in the rainfall estimates. Classical measurement error could therefore lead to the least squares estimate in (4) being attenuated relative to the instrumental variables estimate in (1). A third reason why our least squares estimate in (4) exceeds our instrumental variables estimate in (1) could be that democratic reforms are partly anticipated, and that this leads to increases in income before reforms are actually in place. This would bias the least squares estimate upward but leave the instrumental variables estimate unaffected.

[19] A formal test yields that there is no statistically significant difference between the results for the world sample and for Sub-Saharan Africa.

[20] A Hausman test rejects the equality of the least squares estimate in column (4) and the two-stage least squares estimate in column (1) at the 90 percent confidence level.

Table 6 uses our recession dummy to examine democratic change in response to country-specific recessions. The top panel presents our 2SLS estimates and the bottom panel first-stage estimates. Columns (1) and (2) contain 2SLS effects for the Polity score. In column (1) we find that recessions increase the score by 18 percentage points (statistically significant at the 95 percent confidence level). The effect is somewhat larger when we exclude interregnum periods in column (2). Columns (3) and (4) show that least squares estimates are much smaller, whether we consider the world sample or Sub-Saharan Africa only. Columns (5)-(7) contain 2SLS results for the Polity sub-scores. We obtain that following recessions, the score for executive constraints improves by 19 percentage points (statistically significant at the 90 percent confidence level); the score for political competition by 17 percentage points (statistically significant at the 95 percent confidence level); and the score for the openness and competitiveness of executive recruitment by 17 percentage points (statistically significant at the 90 percent confidence level).

Table 7 examines how results change when we include the lagged Polity score into the analysis. Columns (1) and (2) consider the reduced-form effect of rainfall shocks on the change in the Polity2 score. Column (1) gives least squares results, while column (2) contains system-GMM (Blundell-Bond, 1998) estimates. Both estimators yield an effect of *t*-1 rainfall shocks that is very similar to our baseline result in Table 3, column (1). Columns (3) and (4) contain 2SLS estimates of the effect of income shocks on changes in the Polity score, and columns (5)-(8) add additional Polity lags on the right-hand-side of the estimating equation. Results are again very similar to our earlier baseline estimates.[21]

Table 8, column (1) shows our reduced-form estimates of the effect of rainfall shocks on the probability of democratization based on the definition of Persson and Tabellini (2003,

[21] In the Supplementary Appendix we show that results are robust to putting the Polity level on the left-hand side of the estimating equation.

2006, 2008) and the Polity IV project. The results indicate that negative *t*-1 rainfall shocks lead to a significant increase in the probability of a political transition to democracy between *t* and *t*+1 (statistically significant at the 95 percent confidence level). The point estimate implies that 10 percent lower rainfall levels increase the probability of democratization by 1.25 percentage points.[22] Column (2) repeats the analysis using the democratization step indicator based on the Epstein et al. (2006) and Polity IV trichotomous classification of polities. Now 10 percent lower rainfall levels lead to an increase in the probability of a step towards democracy by 1.4 percentage points (statistically significant at the 95 percent confidence level).

Columns (3) and (4) estimate the effects of rainfall shocks on the probability of transitions away from democracy (autocratic transitions) and coups d'état in democracies. The point estimates in column (3) indicate that autocratic transitions are more likely following positive *t*-1 rainfall shocks. The effect is actually larger in absolute value than for democratic transitions in column (1), but the effect is very imprecisely estimated and therefore statistically insignificant. For coups d'état in democracies, the effect of rainfall shocks is small and statistically insignificant.[23]

Table 9 summarizes our findings on the effect of income shocks on transitions to democracy. Column (1) contains least squares estimates for the Persson and Tabellini and Polity IV based democratization indicator. This yields a very small and statistically insignificant effect of income shocks on democratic transitions. Moreover, the effect has the

[22] In an earlier working paper version (see Brückner and Ciccone, 2008) we showed that there is also a significantly positive effect of negative rainfall shocks on the probability of a transition to democracy when using the Przeworski et al. (2000) democracy indicator.

[23] The sample of autocratic transitions and coups d'état in democracies is much smaller than the sample of democratic transitions. It is also interesting to note that Acemoglu and Robinson's theory of political transitions is consistent with an asymmetry between democratic transitions and autocratic transitions/coups d'état; in particular, the theory is consistent with negative shocks leading to permanent democratic change.

wrong sign from the point of view of the democratic window-of-opportunity effect, as negative income shocks decrease the probability of a democratic transition. But the 2SLS estimate in column (2) indicates that negative income shocks lead to a statistically significant increase in the probability of a democratic transition (statistically significant at the 95 percent confidence level). The point estimate implies that a transitory negative income shock of 1 percent increases the probability of democratization by 1.2 percentage points. Column (3) shows that following recessions, the probability of a democratic transition increases by 23.5 percentage points (statistically significant at the 95 percent confidence level).[24]

The results using the Epstein et al. and Polity IV based democratization step indicator in columns (4)-(6) are similar. Least squares estimates in column (4) yield a very small and statistically insignificant effect. But 2SLS estimates in columns (5) and (6) yield that negative income shocks trigger movements towards democracy. For example, according to column (5), a transitory negative income shock of 1 percent increases the probability of a step towards democracy by 1.4 percentage points (statistically significant at the 95 percent confidence level). Column (6) indicates that a step towards democracy is 27.9 percentage points more likely following a recession (statistically significant at the 95 percent confidence level).

If rainfall shocks open a window of opportunity for democratic change through their effect on GDP, rainfall shocks should have a weak effect on democratic change in countries where rainfall shocks have a weak effect on GDP. And if rainfall shocks affect GDP through their effect on agricultural output, the GDP effect of rainfall shocks should be weaker in

[24] Bratton and van de Walle (1997) discuss democratic transitions in Africa over the 1988-1994 period and argue that transitions are largely explained by domestic political forces rather than by domestic economic conditions. Our results indicate that country-specific economic factors did play a role over the 1980-2004 period (there are too few transitions for the 1988-1994 period for statistical analysis).

countries with (relatively) smaller agricultural sectors.[25] We therefore use data from the World Development Indicators (2009) to calculate the average agricultural GDP share over the 1980-2004 period for each country in our sample, and then divide countries into those with an agricultural GDP share below the median and those with an agricultural GDP share above the median.[26] Table 10, Panel A examines the effect of rainfall shocks on GDP per capita and democratic change for countries with a below-median agricultural share. It turns out that the effect of rainfall shocks on GDP per capita is statistically insignificant, see column (1), and that the effect of rainfall shocks on democratic change is also statistically insignificant, see columns (2)-(5). This result is consistent with rainfall shocks affecting democratic institutions through income. The finding also suggests that rainfall does not have (strong) direct effects on democratic change. Panel B shows the results for countries with agricultural sectors above the median. Rainfall has a significantly positive effect on GDP and a significantly negative effect on democratic improvement, and both effects are stronger in absolute value than for countries with a below-median agricultural share.[27]

5. Conclusions

It has long been argued that democratic change is often triggered by economic recessions. The economic approach to political change (Acemoglu and Robinson, 2001, 2006) provides a rationale. Political change is more likely following negative, transitory economic shocks

[25] The Supplementary Appendix shows that rainfall has a highly statistically significant, positive effect on agricultural output in our sample (see Dell, Jones, and Olken, 2008, for evidence on the positive effect of rainfall on agricultural value added in a wider sample of countries).

[26] The median in our sample is 34 percent. The average agricultural share of below-median (above-median) countries is 18 (44) percent.

[27] We also tried including interactions of rain with the agricultural share in the first-stage and reduced-form regressions. This yielded stronger effects in absolute value in countries with larger agricultural sectors, but the interactions were statistically insignificant. This is most likely a reflection of measurement error in Sub-Saharan African countries' national accounts statistics (e.g. Heston, 1994; Deaton, 2005).

because opportunity costs of contesting power are temporarily low. Empirical tests of economic theories of political change are difficult—we rarely have clean measures of the theoretical driving forces—and the window-of-opportunity hypothesis of democratic change is not an exception. Testing the theory requires a source of transitory shocks to the aggregate economy. Our approach relies on country-specific rainfall shocks in Sub-Saharan Africa, where such shocks have a significant but transitory impact on GDP. Our reduced-form analysis yields that negative rainfall shocks lead to significant democratic change and, in particular, a tightening of executive constraints, greater political competition, and a more open and competitive executive recruitment. Our instrumental variables results indicate that improvements in democratic institutions triggered by transitory negative income shocks can be substantial. For example, rainfall-driven recessions are followed by an improvement in the score for executive constraints of 19 percentage points; the score for political competition of 17 percentage points; and the score for the openness and competitiveness of executive recruitment of 17 percentage points.

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Table 1. Measures of Political Transitions

Variable	Description	Source
ΔPolity2	The *t* to *t*+1 change in the revised combined Polity score. The maximum range of this variable is from -20 to 20. Positive (negative) values indicate an improvement (deterioration) in democracy. We also analyze the effect on Polity scores after excluding interregnum periods.	Polity IV database (Marshall and Jaggers, 2005)
ΔExrec	The *t* to *t*+1 change in the executive recruitment concept (Polity IV) score. The maximum range of this variable is from -7 to 7. Positive (negative) values indicate an improvement (deterioration) in the executive recruitment concept.	Polity IV database (Marshall and Jaggers, 2005)
ΔPolcomp	The *t* to *t*+1 change in the political competition concept (Polity IV) score. The maximum range of this variable is from -9 to 9. Positive (negative) values indicate an improvement (deterioration) in the political competition concept.	Polity IV database (Marshall and Jaggers, 2005)
ΔExconst	The *t* to *t*+1 change in the executive constraint concept (Polity IV) score. The maximum range of this variable is from -5 to 5. Positive (negative) values indicate an improvement (deterioration) in the executive constraint concept.	Polity IV database (Marshall and Jaggers, 2005)
Democratic Transition	Indicator variable that is equal to unity in year *t* if and only if the country is a democracy in *t* but a non-democracy in *t*-1 (the year *t* indicator is not defined if the country is a democracy in *t*-1).	Polity IV database (Marshall and Jaggers, 2005)
Democratization Step	Indicator variable that is equal to unity in year *t* if and only if the country is upgraded to either a partial or full democracy between *t*-1 and *t* (the year *t* indicator is not defined if the country is a full democracy in *t*-1).	Polity IV database (Marshall and Jaggers, 2005)
Autocratic Transition	Indicator variable that is equal to unity in year *t* if and only if the country is a non-democracy in *t* but a democracy in *t*-1 (the year *t* indicator is not defined if the country is a non-democracy in *t*-1).	Polity IV database (Marshall and Jaggers, 2005)
Coup in Democracy	Indicator variable that is unity if and only if in period *t* there was a coup d'état in countries that have strictly positive Polity2 scores (democracies).	Polity IV database (Marshall and Jaggers, 2005)

Table 2. Descriptive Statistics

A. Measures of Political Transitions			
	Mean	Std. Dev.	Observations
Revised Combined Polity IV Democracy Score (Polity2)	-2.458	5.668	955
Executive Constraints (Exconst)	2.911	1.768	910
Political Competition (Polcomp)	3.842	3.110	910
Executive Recruitment (Exrec)	4.802	1.915	910
Democracy Indicator	0.279	0.449	955
Democratic Transition Indicator	0.036	0.186	700
Democratization Step Indicator	0.035	0.183	867
Autocratic Transition Indicator	0.055	0.238	255
Coup in Democracy Indicator	0.106	0.308	255
B. GDP and Rainfall			
Real Per Capita GDP	1585.14	1732.38	955
Rainfall (mm per year)	980.39	501.41	955

Table 3. Rainfall and Polity Change

	ΔPolity2		ΔExconst	ΔPolcomp	ΔExrec
	(1)	(2)	(3)	(4)	(5)
	LS	LS	LS	LS	LS
Log Rainfall, t	0.261	0.031	0.093	-0.153	0.091
	(0.347)	(0.381)	(0.111)	(0.152)	(0.171)
Log Rainfall, t-1	-1.461**	-1.660**	-0.459*	-0.578**	-0.485**
	(0.723)	(0.740)	(0.256)	(0.286)	(0.244)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes
Common Time Effect	Yes	Yes	Yes	Yes	Yes
Observations	955	902	902	902	902

Note: The method of estimation is least squares; Huber robust standard errors (in parentheses) are clustered at the country level. The dependent variable in columns (1)-(2) is the *t* to *t*+1 change in the revised combined Polity score (*Polity2*); column (2) excludes observations that correspond to interregnum periods. The dependent variable in columns (3)-(5) is the *t* to *t*+1 change in Polity IV sub-scores that reflect changes in a country's constraints on the executive (*Exconst)*, political competition (*Polcomp*), and executive recruitment (*Exrec*). The range of the dependent variables is as follows: *Polity2* [-10,10], *Exconst* [1,7], *Polcomp* [1,10], and *Exrec* [1,8]. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 4. Rainfall, Per Capita GDP, and Country Specific Recessions

	Log GDP				Country Specific Recession			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LS	LS	LS	LS	LS	LS	LS	LS
Log Rainfall, t	0.079***	0.075***	0.076***	0.082***	-0.399***	-0.382***	-0.383***	-0.376**
	(0.029)	(0.026)	(0.027)	(0.030)	(0.140)	(0.127)	(0.130)	(0.154)
Log Rainfall, t-1		0.048	0.046			-0.191	-0.189	
		(0.032)	(0.029)			(0.139)	(0.125)	
Log Rainfall, t-2			0.010				-0.018	
			(0.035)				(0.147)	
Log Rainfall, t* Polity2, t				0.001				0.005
				(0.003)				(0.013)
Polity2, t				-0.002				-0.048
				(0.021)				(0.091)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Common Time Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	955	955	955	955	955	955	955	955

Note: The method of estimation is least squares; Huber robust standard errors (in parentheses) are clustered at the country level. The dependent variable in columns (1)-(4) is log real per capita GDP (PWT 6.2). The dependent variable in columns (5)-(8) is an indicator variable (*Country Specific Recession*) that is unity if and only if per capita GDP falls below the country-specific time trend for reasons other than shocks affecting all Sub-Saharan countries (see equation (3) in the main text). *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 5. Income Shocks and Polity Change

	Δ Polity2				ΔExconst	ΔPolcomp	ΔExrec
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	2SLS	2SLS	LS	LS	2SLS	2SLS	2SLS
Log GDP, t-1	-18.021** [0.049]	-21.410** [0.026]	-0.045 [0.901]	-0.836 [0.139]	-5.809* [0.073]	-7.680** [0.037]	-6.137* [0.054]
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Common Time Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	955	902	3191	955	902	902	902
	First Stage for Log GDP Per Capita, t-1						
Log Rainfall, t-1	0.079*** (0.029)	0.077*** (0.029)			0.077*** (0.029)	0.077*** (0.029)	0.077*** (0.029)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Common Time Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	955	902	3191	955	902	902	902

Note: The method of estimation for the first-stage regressions in the bottom panel is least squares; below the least squares estimates we report Huber robust (in parentheses) standard errors that are clustered at the country level. The method of estimation used in the top panel is two-stage least squares in columns (1)-(2) and (5)-(7); below the two-stage least squares estimates we report p-values [in square brackets] based on the Anderson-Rubin test of statistical significance. A key property of this test is that it is robust to weak instruments; 2SLS standard errors are not robust to weak instruments, and inference based on 2SLS can be very misleading as a result. See Andrews and Stock (2005) for a review of these issues. We implement a version of the Anderson-Rubin test that is robust to heteroskedasticity and arbitrary within-country correlation of the residuals. For comparison with the two-stage least squares estimates, the top panel also reports least squares estimates for the world sample (in column (3)) and the Sub-Saharan African sample (in column (4)) with p-values that are robust to heteroskedasticity and arbitrary within-country correlation below the estimates. The dependent variable in the top panel, columns (1)-(4) is the *t* to *t*+1 change in the revised combined Polity score (*Polity2*); column (2) excludes observations that correspond to interregnum periods. The dependent variable in the top panel, columns (5)-(7) is the *t* to *t*+1 change in Polity IV sub-scores of constraints on the executive (*Exconst)*, political competition (*Polcomp*), and executive recruitment (*Exrec*). The range of the dependent variables is as follows: *Polity2* [-10,10], *Exconst* [1,7], *Polcomp* [1,10], and *Exrec* [1,8]. The dependent variable in the bottom panel is the log of real per capita GDP. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 6. Country Specific Recessions and Polity Change

	Δ Polity2				ΔExconst	ΔPolcomp	ΔExrec
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	2SLS	2SLS	LS	LS	2SLS	2SLS	2SLS
Country Specific Recession, t-1	3.584** [0.049]	4.166** [0.026]	-0.085 [0.149]	0.199* [0.085]	1.130* [0.073]	1.494** [0.037]	1.194* [0.054]
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Common Time Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	955	902	3191	955	902	902	902
	First Stage for Country Specific Recession, t-1						
Log Rainfall, t-1	-0.399*** (0.140)	-0.398*** (0.141)			-0.398*** (0.141)	-0.398*** (0.141)	-0.398*** (0.141)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Common Time Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	955	902	3191	955	902	902	902

Note: The method of estimation for the first-stage regressions in the bottom panel is least squares; below the least squares estimates we report Huber robust (in parentheses) standard errors that are clustered at the country level. The method of estimation used in the top panel is two-stage least squares in columns (1)-(2) and (5)-(7); below the two-stage least squares estimates we report p-values [in square brackets] based on the Anderson-Rubin test of statistical significance. A key property of this test is that it is robust to weak instruments; 2SLS standard errors are not robust to weak instruments, and inference based on 2SLS can be very misleading as a result. See Andrews and Stock (2005) for a review of these issues. We implement a version of the Anderson-Rubin test that is robust to heteroskedasticity and arbitrary within-country correlation of the residuals. For comparison with the two-stage least squares estimates, the top panel also reports least squares estimates for the world sample (in column (3)) and the Sub-Saharan African sample (in column (4)) with p-values that are robust to heteroskedasticity and arbitrary within-country correlation below the estimates. The dependent variable in the top panel, columns (1)-(4) is the *t* to *t*+1 change in the revised combined Polity score (*Polity2*); column (2) excludes observations that correspond to interregnum periods. The dependent variable in the top panel, columns (5)-(7) is the *t* to *t*+1 change in Polity IV sub-scores of constraints on the executive (*Exconst)*, political competition (*Polcomp*), and executive recruitment (*Exrec*). The range of the dependent variables is as follows: *Polity2* [-10,10], *Exconst* [1,7], *Polcomp* [1,10], and *Exrec* [1,8]. The dependent variable in the bottom panel is a *Country Specific Recession* indicator that is unity if and only if per capita GDP falls below the country-specific time trend for reasons other than shocks affecting all Sub-Saharan countries (see equation (3) in the main text). *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 7. Income Shocks, Polity Change, and Democratic Convergence

	Δ Polity2							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LS	SYS-GMM	2SLS	2SLS	LS	SYS-GMM	2SLS	2SLS
Polity2, t	-0.294***	-0.359***	-0.282***	-0.286***	-0.174***	-0.255***	-0.199***	-0.215***
	(0.023)	(0.037)	[0.000]	[0.000]	(0.034)	(0.041)	[0.000]	[0.000]
Polity2, t-1					-0.171***	-0.154***	-0.120**	-0.102*
					(0.025)	(0.031)	[0.020]	[0.065]
Log Rainfall, t	0.213	-0.024			0.169	-0.275		
	(0.317)	(0.387)			(0.296)	(0.392)		
Log Rainfall, t-1	-1.404**	-1.487**			-1.403**	-1.659**		
	(0.690)	(0.738)			(0.661)	(0.391)		
Log GDP, t-1			-17.360**				-17.416**	
			[0.046]				[0.036]	
Country Specific Recession, t-1				3.450**				3.460**
				[0.046]				[0.036]
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Common Time Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	955	955	955	955	955	955	955	955

Note: The method of estimation in columns (1) and (5) is least squares, in columns (2) and (6) system-GMM (Blundell-Bond), and in columns (3), (4), (7), and (8) two-stage least squares; below the least squares estimates we report Huber robust (in parentheses) standard errors that are clustered at the country level; below the two-stage least squares estimates we report p-values [in square brackets] based on the Anderson-Rubin test of statistical significance. A key property of this test is that it is robust to weak instruments; 2SLS standard errors are not robust to weak instruments, and inference based on 2SLS can be very misleading as a result. See Andrews and Stock (2005) for a review of these issues. We implement a version of the Anderson-Rubin test that is robust to heteroskedasticity and arbitrary within-country correlation of the residuals. The dependent variable is the t to t+1 change in the revised combined Polity score (*Polity2*). The instrumental variable in columns (3)-(4) and (7)-(8) is rainfall. *Country Specific Recession* is an indicator variable that takes on the value of unity if and only if per capita GDP falls below the country-specific time trend for reasons other than shocks affecting all Sub-Saharan countries (see equation (3) in the main text). *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 8. Rainfall and Polity Transitions

	Democratic Transition	Democratization Step	Autocratic Transition	Coup in Democracy
	(1)	(2)	(3)	(4)
	LS	LS	LS	LS
Log Rainfall, t	0.027	0.016	-0.021	-0.005
	(0.034)	(0.027)	(0.048)	(0.089)
Log Rainfall, t-1	-0.125**	-0.140**	0.169	-0.003
	(0.057)	(0.064)	(0.113)	(0.115)
Country Fixed Effect	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes
Common Time Effect	Yes	Yes	Yes	Yes
Observations	700	867	255	255

Note: The method of estimation is least squares; Huber robust standard errors (in parentheses) are clustered at the country level. The dependent variable in column (1) is a *Democratic Transition Indicator* that is equal to unity in year *t* if and only if the country is a democracy in *t* but a non-democracy in *t*-1 (the year *t* indicator is not defined if the country is a democracy in *t*-1). The dependent variable in column (2) is a *Democratization Step Indicator* that is equal to unity in year *t* if and only if the country is upgraded to either a partial or full democracy between *t*-1 and *t* (the year *t* indicator is not defined if the country is a full democracy in *t*-1). The dependent variable in column (3) is an *Autocratic Transition Indicator* that is equal to unity in year *t* if and only if the country is a non-democracy in *t* but a democracy in *t*-1 (the year *t* indicator is not defined if the country is a non-democracy in *t*-1). The dependent variable in column (4) is the incidence of a coup in African countries that were democracies. Coup data is taken from Polity IV, where a coup is defined as a forceful seizure of executive authority and office by a dissident/opposition faction within the country's ruling or political elites that results in a substantial change in the executive leadership and the policies of the prior regime. For further detail on the coding of the dependent variables see the main text, pages 5 and 6. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 9. Income Shocks and Transitions to Democracy

	Democratic Transition			Democratization Step		
	(1)	(2)	(3)	(4)	(5)	(6)
	LS	2SLS	2SLS	LS	2SLS	2SLS
Log GDP, t-1	0.056 (0.058)	-1.285** [0.027]		-0.053 (0.051)	-1.471** [0.029]	
Country Specific Recession, t-1			0.235** [0.027]			0.279** [0.029]
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
Common Time Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	700	700	700	867	867	867
	First Stage for GDP Per Capita / Country Specific Recession, t-1					
Log Rainfall, t-1		0.095*** (0.037)	-0.519*** (0.164)		0.094*** (0.032)	-0.494*** (0.151)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
Common Time Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	700	700	700	867	867	867

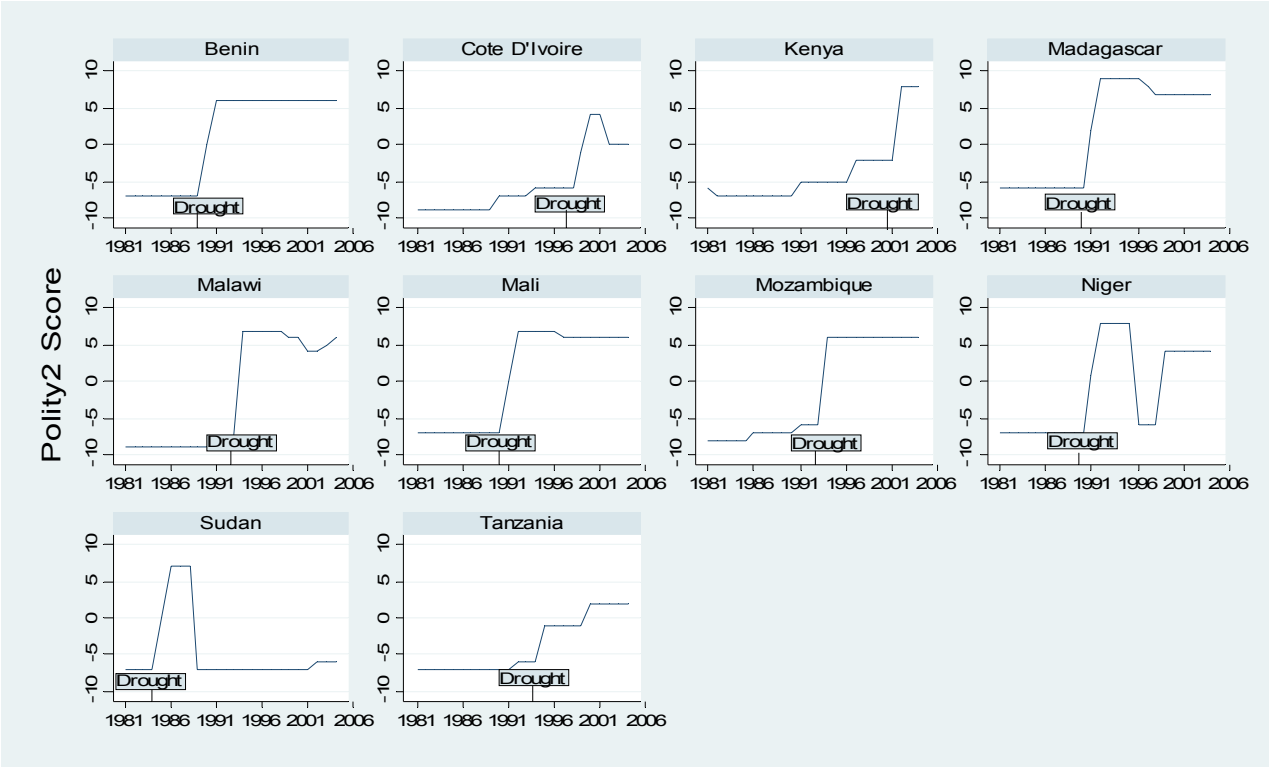
Note: The method of estimation in columns (1) and (4) is least squares and columns (2), (3), (5), and (6) two-stage least squares; below the least squares estimates we report Huber robust (in parentheses) standard errors that are clustered at the country level; below the two-stage least squares estimates we report p-values [in square brackets] based on the Anderson-Rubin test of statistical significance. A key property of this test is that it is robust to weak instruments; 2SLS standard errors are not robust to weak instruments, and inference based on 2SLS can be very misleading as a result. See Andrews and Stock (2005) for a review of these issues. We implement a version of the Anderson-Rubin test that is robust to heteroskedasticity and arbitrary within-country correlation of the residuals. The dependent variable in columns (1)-(3) is a *Democratic Transition Indicator* that is equal to unity in year *t* if and only if the country is a democracy in *t* but a non-democracy in *t*-1 (the year *t* indicator is not defined if the country is a democracy in *t*-1). The dependent variable in columns (4)-(6) is a *Democratization Step Indicator* that is equal to unity in year *t* if and only if the country is upgraded to either a partial or full democracy between *t*-1 and *t* (the year *t* indicator is not defined if the country is a full democracy in *t*-1). For further detail on the coding of the dependent variables see the main text, pages 5 and 6. *Country Specific Recession* is an indicator variable that is unity if and only if per capita GDP falls below the country-specific time trend for reasons other than shocks affecting all Sub-Saharan countries (see equation (3) in the main text). *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 10. Rain, Agriculture, GDP, and Democratic Change

	Log GDP	ΔPolity2		Democratic Transition	Democratic Step
			Panel A: Below the Sample Median		
	(1)	(2)	(3)	(4)	(5)
	LS	LS	LS	LS	LS
Log Rainfall, t	0.031	0.240	0.181	-0.010	0.021
	(0.032)	(0.380)	(0.386)	(0.039)	(0.020)
Log Rainfall, t-1	0.003	-0.885	-1.010	-0.083	-0.042
	(0.036)	(0.734)	(0.730)	(0.084)	(0.067)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes
Common Time Effect	Yes	Yes	Yes	Yes	Yes
Observations	468	468	450	336	396
			Panel B: Above the Sample Median		
	(1)	(2)	(3)	(4)	(5)
	LS	LS	LS	LS	LS
Log Rainfall, t	0.130***	0.519	0.011	0.070	0.021
	(0.045)	(0.685)	(0.840)	(0.070)	(0.049)
Log Rainfall, t-1	0.088	-2.773*	-3.490***	-0.207**	-0.297***
	(0.056)	(1.430)	(1.329)	(0.090)	(0.105)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes
Common Time Effect	Yes	Yes	Yes	Yes	Yes
Observations	487	487	452	364	471

Note: The method of estimation is least squares; Huber robust standard errors (in parentheses) are clustered at the country level. Panel A computes regressions for countries whose 1980-2004 agricultural share in GDP is below sample median; Panel B whose 1980-2004 agricultural share is above sample median. The dependent variable in column (1) is the log of real per capita GDP; in column (2) the dependent variable is the t to t+1 change in the revised combined Polity score (*Polity2*); column (3) excludes observations that correspond to interregnum periods; in column (4) the dependent variable is a *Democratic Transition Indicator* that is equal to unity in year t if and only if the country is a democracy in t but a non-democracy in t-1 (the year t indicator is not defined if the country is a democracy in t-1); in column (5) the dependent variable is a *Democratization Step Indicator* that is equal to unity in year t if and only if the country is upgraded to either a partial or full democracy between t-1 and t (the year t indicator is not defined if the country is a full democracy in t-1). For further detail on the coding of the dependent variables see the main text, pages 5 and 6. The average share of agriculture in GDP is from WDI (2009). *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Figure 1. Time Series Plots of Polity Change and Drought Years



Note: The variable on the y-axis is the *Polity2* score; *Drought* is an indicator variable that is equal to unity if and only if rainfall is below the 20th percentile of the country-specific rainfall distribution.

Figure 2A. Rainfall and Per Capita GDP

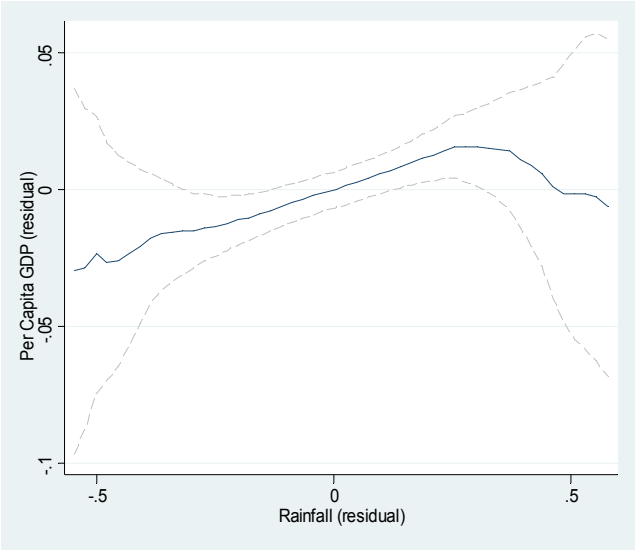
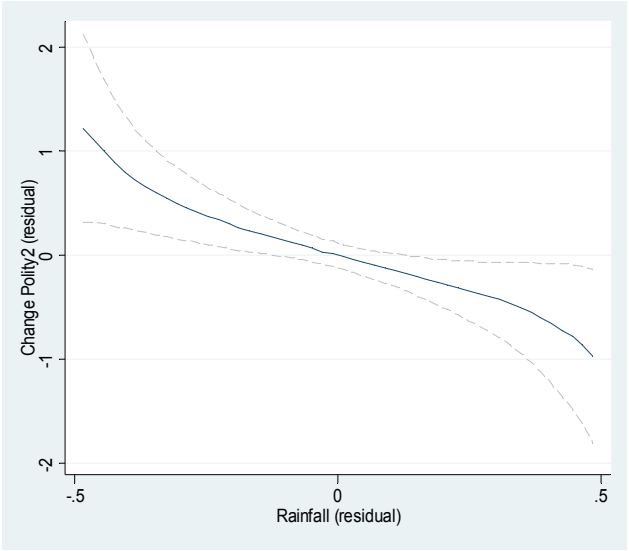


Figure 2B. Rainfall and Polity Change



Note: Non-parametric local polynomial estimates are computed using an Epanechnikov kernel; the bandwidth in Figure 2A (2B) is 0.1 (0.25) as suggested by cross-validation criteria. Dashed lines indicate 95 percent confidence bands.

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