# Income and Democracy:

# Lipset's Law Revisited

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**Abstract**

We revisit Lipset's law, which posits a positive and significant relationship between income and democracy. Using dynamic and heterogeneous panel data estimation techniques, we find a significant and negative relationship between income and democracy: higher/lower incomes per capita hinder/trigger democratization. We thus challenge the recent empirical literature that found no such significant relationship. We attribute this result to the nature of the tax base, and exploit additional sources of heterogeneity. Decomposing overall income per capita into its resource and non-resource components, we find that the coefficient on the latter is positive and significant while that on the former is significant but negative.

Keywords: Income, democracy, Dynamic panel data, parameter heterogeneity, Cross-section dependence.
JEL Classification: C23, O11, O17, O55

## 1. **Introduction**

Writing in 1959, Seymour Martin Lipset reported a strong and positive correlation between income per capita and democracy in a global cross section of nations (Lipset 1959). Doing so, he not only lay the foundations of modernization theory in comparative politics but also defined a major portion of the contemporary agenda in political economy, with its focus on the relationship between political institutions and economic development.[a1]

Lipset's finding invites a dynamic and causal interpretation. And it was therefore startling when estimating Markov transition models, Przeworski *et al*. (2000) failed to find a significant relationship between the level of income per capita and the likelihood of transition to democracy. While (Boix and Stokes 2003) and (Epstein *et al*. 2006) have challenged Przeworski et al.'s finding, it has subsequently been replicated by (Acemoglu, Johnson, Robinson and Yared[a2] 2008) (henceforth AJRY). In our contribution , we focus on this last article and challenge ~~their~~ their result.

In doing so, we report the presence, rather than the absence, of a significant statistical relationship between income and democracy. But the relationship we find is negative. To be noted is that AJRY also reported, but failed to comment upon, negative coefficients in their estimates.[1] Because we employ different methods, we can have greater confidence in these findings than do they, and therefore report them.

[1] Table 2, cols. 3,4 8, and 9; Table 3, cols 2,3,4,8; and Table 4, cols 1,2, 4,5,8, and 9.

We take as our point of departure the important critique of (Grundlach and Paldam 2009) (GP hereafter), who argue that by including annual and country fixed effects AJRY purged from their panels useful information, thereby predisposing them to fail in their search for a relationship between income and democracy. In mounting this critique, GP highlight an important methodological dilemma: Including country specific fixed effects purges informative variation from the data; but excluding them introduces omitted variable bias. We confront – and surmount – this dilemma. Employing an augmented version of the Pooled Mean Group (PMG) estimator of Pesaran *et al.* (1999) we account for both country and year effects while relaxing the assumption of cross-sectional parameter homogeneity. Even while controlling for (time-invariant) omitted variables, we thereby extract information from sources of variation that were previously ignored, thereby eluding the dilemma that stymied previous research.

In addition, inspired by the literature on the "rentier state" (Mahdavy 1970; Beblawi and Giacomi 1987; Chaudry 1994) and the "political resource curse" (Barro 1996; Ross 1999, 2001), we decompose overall per capita income and find that the source as well as the level of income matters: the larger the portion originating from natural resource rents, the lower the level of democracy.

## 2. Additional Background

Given its central place in the literature, Lipset's law claims the central position in this paper. Our research resonates with two other literatures as well, however. One, which has already been mentioned, addresses the resource curse; the second focuses on the relationship between economic growth and political instability.

**The Resource Curse:** As noted by Ross (2001), in "rentier states", governments with large oil revenues reduce the level of political discontent by maintaining low taxes and high levels of public benefits. In addition, they spend more on internal security, forestalling the formation of political organizations inclined to demand political rights. Lastly, as, Ross states: "if resource-led growth does not lead to higher education levels and greater occupational specialization", as has commonly been the case,~~,~~" it should also fail to bring about democracy" (Ross, 2001, p.336/337).

High income might co-vary with low levels of democratization for a second reason: growth reversals might spark political protests which result in the overthrow of incumbent regimes (Burke and Leigh 2012). In the case of democracies, one party might supplant another in power; but in the case of authoritarian governments, the authoritarian regime might give way to a democracy, leading to an emerging relationship between low national income and democratic governance.

Haggard and Kaufman (1997) provide qualitative evidence that growth declines weaken authoritarian regimes, reducing their ability to trade political benefits for political deference (see also Geddes, 1999). Burke and Leigh (2012) offer a game theoretic model that illustrates how economic contractions can reduce the opportunity costs of political protest, including demands for ~~political~~ democratic reforms. And in their survey of the literature on growth, Alesina and Perrotti (1994) offer data on the average annual per capita rate of growth of GDP ~~years~~ with and without government changes, documenting that income growth is lower in years with government change, still lower in years with major change, and lowest in years with coups. They conclude that "transitions from dictatorship to democracy, being associated with sociopolitical instability, should

typically be periods of low growth"(Alesina and Perotti 1994, p[RB3]; see also {Londregan and Poole, 1990 #263[RB4]}. Over time, this channel too would yield a relationship between low income and democracy.

While this work targets "Lipset's law" and thus the *long-run* relationship between income per capita and democracy, it relates to these literatures as well.

## 3. Data and Methods

Before ~~revisiting~~ testing Lipset's law, we first introduce our data and our methods.

### *Data*

We use the Penn World Tables' (PWT 6.3) chain weighted real GDP per capita series and the Polity IV democracy index which distributes over a range spanning the interval between perfect autocracies (score of -10) and perfect democracies (score of 10). Figure 1 shows that on average incomes and polity scores have risen over time. While incomes have grown relatively smoothly, in the late 1980s, the polity index jumped discontinuously from -0.4 in 1989 to 1.9 in 1992. As seen in Figure 2, there are important regional differences in the movement toward democracy. Latin America democratized prior to the fall of Communism. Africa and the Middle East both democratized after 1990; their polity scores then diverged, with those in Sub-Saharan Africa improving more rapidly.

--- Figures 1&2 about here ---

Our sample includes 105 countries. Its size and composition is limited by the method we employ. Because the heterogeneous PMG estimator (discussed below) computes coefficients for each country separately, we can include only countries with long time series[2] and must exclude countries with no time variation in the dependent variable.[3]

When we disaggregate our sample by sources of income, we use the United Nations Statistics Division National Accounts Database. The data are available for 104 out of the 105 countries in our sample, but run only from 1970-2007. The data classify GDP into several categories, one of which includes Mining and Quarrying. We use this category as a measure of resource wealth. Data description in terms of definition and sources are provided in Table D of the Appendix.

## *Methods*

The PMG estimator allows intercepts, slope coefficients and error variances to vary across panel members. More specifically, it allows the short-run coefficients to vary across countries, while restricting long-run relationships to be homogeneous. In the context of this research, the estimator "assumes" that in the short run – or while adjusting to a common long-run equilibrium – each country's political institutions respond differently to income shocks.

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[2] The countries we lose in this respect are: Armenia, Azerbaijan, Belarus, Croatia, Czech Republic, Eritrea, Estonia, Georgia, Kyrgyzstan, Kazakhstan, Latvia, Lithuania, Macedonia, Moldova, Namibia, Russia, Slovak Republic, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, and Yemen.

3 The countries dropped include the consistent democracies (perfect constant score of 10) (namely Australia, Austria, Belgium, Canada, Costa Rica, Denmark, Finland, Ireland, Italy, Japan, New Zealand, Norway, Netherlands, Sweden, Switzerland, United Kingdom, United States) and the consistent non-democracies (with constant score of -10 or less; namely: Bhutan, Cuba (-7), Libya (-7), Qatar, Saudi Arabia, Singapore (-2), Vietnam (-7), and UAE (-8)).

Because it allows for heterogeneous intercepts, the PMG estimator can incorporate country-specific fixed effects. But because it estimates the model for each country separately, it can not allow the inclusion of year fixed effects. To correct for potential cross-section dependence in the estimated errors, we – as do Binder and Offermanns (2007) – therefore augment the model with the cross-sectional averages of the dependent variable and regressors.

## *Particular Issues*

We are particularly concerned with the possibility of error arising from two sources: unobserved sources of time specific heterogeneity and endogeneity bias.

**Time Specific Heterogeneity:** Given rapid increases in the global integration of financial and product markets, an economic shock could affect all units of a given cross section of a global sample. Heterogeneity would then introduce cross-section dependence in the errors of panel members, i.e. the errors would become contemporaneously correlated. In addition, if the same latent factor affects regressors and errors, ~~,~~the shock could be correlated with regressors, rendering conventional regressors inconsistent (Coakley, Fuertes & Smith, 2006).

Given the difficulty of model~~l~~ing error arising from cross-section dependence in panel data, few have attempted to do so (Phillips & Moon, 1999). As the PMG estimator estimates the model separately for each cross-section, we cannot employ time dummies to account for common temporal effects. Nor can we ~~assume cross-sectional independence or~~ impose cross-section dependence ~~-~~by demeaning the model's variables.

If the slope parameters of the true model are indeed homogeneous across panel members and countries hence respond in the same way to ~~the unobserved~~ common ~~factors~~shocks, then demeaning completely removes their effect. If instead, coefficients on factors differ across groups, ~~,~~ then demeaning reduces but does not eliminate~~,~~ the common time-specific effects (Pesaran et al. 1999). Indeed, Pedroni (1999, p. 657) argues, when the true model is heterogeneous, demeaning introduces data dependencies into the estimated residuals, and hence bias and inefficiency into the parameter estimates.

We are reluctant to assume common country responses to global factors and wish to employ PMG estimation to capture country-specific differences in short-run adjustments to them. Where cross-section dependence[RB5] due to common factors is detected, we therefore refrain from extracting the common factors prior to estimation and instead proxy for them by adding additional control variables.

**Endogeneity**. In Table 1 we present Granger causality tests. The data suggest the presence of reverse causality for our sample, which, if unattended, would introduce endogeneity bias in our estimates of the coefficient on income.

--- Table 1 about here ---

To minimize the resultant bias and to ensure that the regression residuals are serially uncorrelated, we therefore augment our model with lags of the regressors and dependent variable. Pesaran (1997) and Pesaran and Shin (1999) show that, for inference on the

long-run parameters, sufficient augmentation of the order of the ARDL model can simultaneously correct for the problem of residual serial correlation and endogenous regressors. In choosing the optimal lag structure, we apply the Akaike Information Criterion (AIC) or the Schwartz Bayesian Criterion (SBC)). In doing so, we are constrained to a maximum of three lags by our time series dimension and number of our regressors.[4] Note that any remaining bias works against our conclusion: since our estimates yield negative signs, the coefficients should be even more negative once this bias is taken into account.

## *The Model*

To summarize formally, let $d_{it}$ represent democracy and $y_{it}$ represent income per capita for country $i$ at time $t$, and $\bar{y}_t = N^{-1}\sum_{i=1}^{N} y_{it}$, $\bar{d}_t = N^{-1}\sum_{i=1}^{N} d_{it}$ respectively represent their cross-sectional averages. The ECM with $p$ lags on both the dependent and explanatory variables then is:

$$\Delta d_{it} = \varphi_i(d_{i,t-1} - \mu_i - \beta y_{it} - \eta \bar{y}_t - \alpha \bar{d}_t) + \sum_{j=1}^{p-1} \lambda_{ij} \Delta d_{i,t-j} + \sum_{j=0}^{p-1} \delta_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{p-1} \nu_{ij} \Delta \bar{d}_{i,t-j} + \sum_{j=0}^{p-1} \omega_{ij} \Delta \bar{y}_{i,t-j} + \varepsilon_{it} \quad (1)$$

Crucially, the error term $\varepsilon_{it}$ is identically and independently distributed across i and t even in the presence of common time effects. Country intercepts -- unobserved country heterogeneity – are captured by the term $\mu_i$.

[4] To illustrate: Using SBC, we determine the lag order for each country, subject to a maximum lag of three; we then impose a homogeneous lag structure, using the most common of the country-specific lag orders. Note that another advantage of using the PMG ARDL approach is that there is no need for pre-testing our variables for the presence of unit roots. Pesaran et al. (1999) show the consistency of the PMG estimator in the case of I(0) and I(1) regressors.

The second part of equation (1) includes the lagged changes of income and democracy; the coefficients represent the short-run adjustment terms and are assumed to vary across countries. We do not report the short-run coefficients below. The first part of equation (1) captures the common long-run relationship between income and democracy. The slope coefficients -- $\beta, \eta$, and $\alpha$ -- measure the long-run response of democracy to income, world income and world democracy. $\varphi$ is the error correction coefficient and indicates the speed of adjustment If the system is dynamically stable and converges to a long-run equilibrium, then this coefficient will be negative and less than one in absolute value. We report these long-run coefficients below.

Starting with an initial estimate of the long-run parameters, the PMG estimator calculated estimates of error-correction and other short-run coefficients (including country-specific intercepts and error variances) as the averages of the estimated parameters for each cross-section. It then employs these average estimates to update its estimates of the long-run parameters, repeating the process until convergence is achieved.

Note that we also report (in Table 5) the mean group (MG) estimator (Pesaran and Smith, 1995) which allows for complete (short-run and long-run) parameter heterogeneity across panel cross-sections. If the slope coefficients are heterogeneous, the MG estimator is consistent. Since our cross-sectional dimension is large, the MG estimator is less likely to be biased by outliers. The mean group estimator does not take into account that some economic conditions tend to be common across countries in the long run, however. The PMG estimator does, and so captures efficiency gains from assuming common long-run relationships while at the same time allowing for heterogeneous short-run dynamics. Using the difference between the two sets of

estimates, we employ a Hausman-type test to assess the assumption of long-run homogeneity.

## 4. Estimation and Results

We begin by employing an extended version of our dataset to reproduce the results of AJRY and GP. This dataset includes, in addition to our overall sample, all the countries that were dropped due to the restrictions imposed by PMG (as discussed above). This results in a sample of 153 countries for the annual data panel, and 129 countries for the five- and ten-year data panels, over the 1960-2000 period. As did AJRY, we find (Table 2, columns 1-3) that the coefficient on the income variable is positive and significant, when estimated from pooled data using ordinary least squares, but does not significantly differ from zero when including time and country fixed effects[5]. We also find that when we estimate their model employing our smaller PMG sample (Table 2, columns 4-6), their findings remain unchanged. Insofar as our results differ from those of earlier researchers, then, it is not because we are making use of different data. We next provide econometric evidence in support of that.

--- Table 2 about here ---

Table 3[a6] presents the major (PMG) results derived from our model. Our results are reported in the first column of Table 3, while MG estimates appear in the second. The Hausman test in column 3 result testifies to the validity of the long-run homogeneity

[5] We only report results from the annual sample. We also reproduced but chose not to report their results with 5-year and 10-year data, as we believe that in these much shorter samples the lagged dependent variable bias (Nickell, 1981) when including fixed effects is large.

restrictions imposed by the PMG estimator.[6] The coefficients generated by the pooled mean estimator suggest *that income is negatively and significantly related to democracy*. Given that the model is linear log, they suggest that a 10% *increase* in per capita income leads in the long run to a roughly 0.12 unit *decrease* on the polity scale. While AJRY report negative coefficients for the relationship between income and democracy, they refrain from commenting upon them, perhaps because they find them implausible. We, however, can confidently conclude that not only is there no positive relationship between income and democracy in global samples; the relationship is negative.

In contrast to the coefficients on per capita income, those on global changes in output and democratization over the sample period *positively* affected the level of democracy: both are significant; and large. When the global democracy score increases by one unit, the democracy score improves by an average of 0.8 units; and on average, a 10% increase in world income improves the democracy score by 0.3 units.

The error correction coefficient is significant; it suggests about 26 percent of error correction in the single-period response of democracy to a departure from its long-run equilibrium value as predicted by the level of per capita income. These results are robust to the optimal lag selection criterion (AIC vs. SBC), to the number of lags, to the cross-sectional demeaning of the data, and to whether Sub-Saharan Africa is included or not in the overall sample (see {Fayad, 2011 #2130[RB7]}).

--- Table 3 about here ---

[6] More specifically, the difference between both MG and PMG estimators is used to compute a Hausman-type statistic. Under the null hypothesis of long-run parameter homogeneity, both estimators are consistent, but the PMG is more efficient. When the true long-run parameters are instead heterogeneous, the MG estimator remains consistent while the PMG loses consistency.

Recall that GP found that when country fixed effects alone were included in the model, the coefficient on lagged income per capita was significant and positive. As did AJRY[7], they[8] too reported a negative coefficient for income in models which include both country and annual dummies. Our results take this finding one step further: When we use the more efficient PMG estimator, this negative coefficient becomes significant. [9]

## *Discussion*

When pondering the difference between our findings and those of AJRY, it is useful to turn to Table 4, which reports the results we secure when we employ the pooled error correction OLS model to regress democracy on its lags and on the level of income per capita (also with lags)[10] while using the PMG sample. As can be seen, we then get negative and significant long-run coefficients on income per capita in our PMG sample, and the magnitudes are similar to our long-run PMG coefficients (discussed below). However, estimating the pooled error correction model while using the AJRY (bigger) sample[11] yields long-run coefficients on income per capita that are insignificant, regardless of the number of lags[12].

--- Table 4 about here ---

The difference between our results and those of AJRY thus arise from 1) our estimation methods, which exploit both the dynamic and heterogeneous properties of the data and 2) our samples, which exclude both consistent autocracies and consistent democracies, as

[7] Table 2, cols. 3,4 and 8; Table 3, cols 2,3,4,8; and Table 4, cols 1,2,8,4.
[8] Column 1 in Tables 3 and 4.
[9] When we run the PMG without accounting for time effects, the coefficient on income per capita is instead positive and significant.
[10] And which includes country and year fixed effects.
[11] Which, unlike our own, includes countries with no time-variation in democracy variable;
[12] There is also evidence in this sample that democracy and income per capita are I(1) and cointegrated.

noted above. The differences in the samples prove consequential: by restricting our sample to country-years that experienced changes in both their incomes and polity scores, i.e. countries that witnessed movements either away or towards more democracy, we are able to detect the relationship between income and democracy, one that turned out to be significantly negative.[13] Both the sample choice and the methodology thus led us to our results[14].

## 5. Digging Deeper

In this section, we explore the possible impact of additional sources of variation: variation in the composition of the national income and regional relationships between income and democracy.

**The Composition of the Economy:** Returning to the literature on the "rentier state" (Mahdavy 1970; Beblawi and Giacomi 1987; Chaudry 1994) and the "resource curse" (Barro 1996; Ross 1999, 2001), we augment our baseline regression with the World Bank measure of natural resource rents as a percent of GDP. [15] Doing so reduces our overall sample to 98 countries over the period 1970-2007. As seen in Table 5, we too find a negative and significant coefficient for the relationship between resource rents and democracy.

[13] This relationship was also picked up by a simple pooled (non-heterogeneous) OLS error correction model.

[14] In relation to Figure 2, where global income and democracy appear to be negatively correlated up to 1985, we check whether our results on the negative relationship between income and democracy are driven by the pre-1985 period. Estimating both the PMG and the pooled OLS ECM for the sub-period 1985-2007, our results are maintained, with the only difference that global output in the PMG model is now significantly *negatively* related to democracy.

[15] In our case, any oil dummy would be absorbed in the country fixed effects.

Table 6 decomposes national income into two components: that deriving from natural resources and that deriving from other sources. Our sample now consists of the 102 countries over the period 1970-2007. To highlight the results of interest, we refrain from reporting the coefficients on the cross-sectional averages. Column 1 of Table 6 reproduces the specification employed in Table 4, but estimated from the current sample. The coefficients of interest remain roughly the same as that in Table 4. Columns 2, 3, and 4 report the PMG coefficient on resource and non-resource GDP per capita, first separately and then combined. The results confirm that it is *only* the resource proportion of income per capita that is negatively and significantly related to democracy.

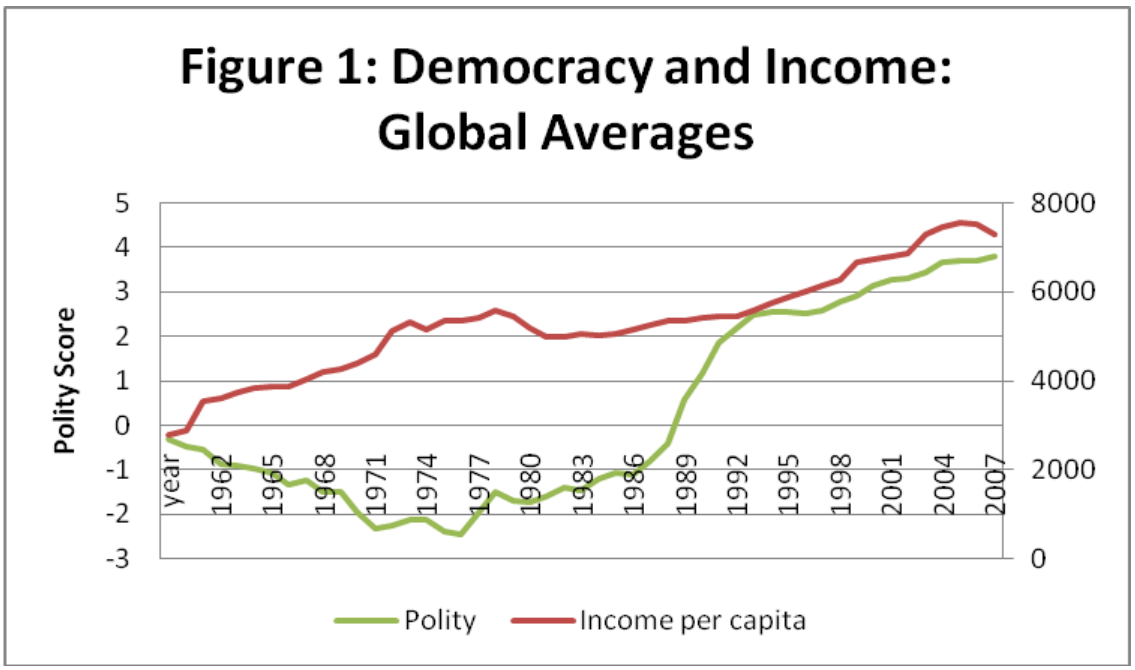
**6. Conclusion**

In this article we have scrutinized ~~"~~"Lipset's l~~L~~aw~~"~~", which states that there is a positive and significant relationship between income and democracy and that higher incomes lead to democratization (Lipset, 1959). ~~"~~"Lipset's ~~L~~l~~aw~~_~~"~~"is commonly regarded as the foundation of modernization theory in comparative politics and the debate over its shapes the contemporary agenda in development economics, with its focus on the relationship between political institutions and economic development.

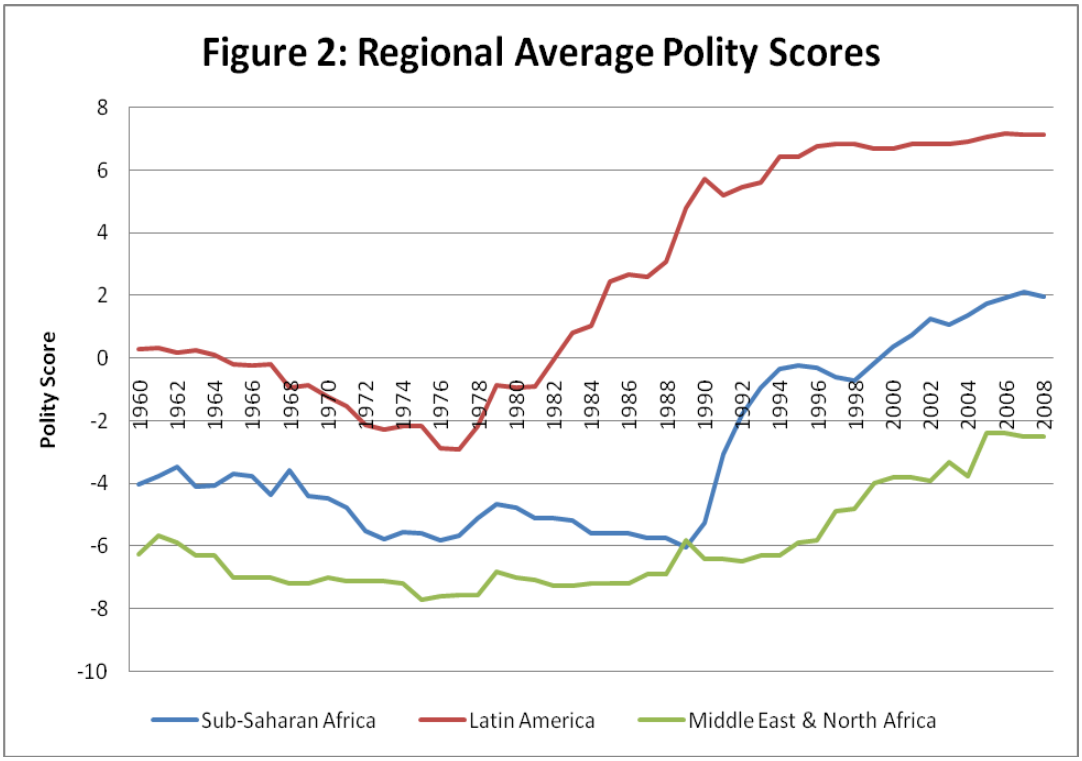
We revisit this debate and use dynamic panel data methods to examine the direction of causation as well as the short and long run relationship between democracy and income. Our tests fail to establish the direction of causality: income 'Granger' causes democracy and *vice versa*. With this in mind, we turned to modelling democracy as a function of income. We use the augmented PMG estimator (Pesaran *et al*, 1999) which enables us to examine the short/long run relationship while allowing for country and year effects as

well as for parameter heterogeneity across panel members. Accounting for the dynamics, we then find a significant and negative relationship between income and democracy. Doing so, we draw information from two sources of variation overlooked by previous scholars. One is cross country variation in the short term responses to income shocks; another is variation in the structure and composition of income. In countries that receive little or no income from resources the relationship between democracy and income is positive and significant. In resource rich countries, the reverse is true. In countries that are rich because abundantly endowed, higher incomes bear a negative relationship with democracy.

## Figures




Note: The sample of countries used in this Figure is constant across time.




Note: The sample of countries used in this Figure is constant across time.

## Tables

**Table 1: Granger causality tests**

| | | Overall sample | | |
|---|---|---|---|---|
| **Null hypothesis** | **Observations** | **Lags** | **F-stat** | **Probability** |
| **Democracy does not Granger cause income** | 4532 | 3 | 5.472 | 0.001 |
| **Income does not Granger cause democracy** | 4532 | 3 | 6.870 | 0.000 |

**Note:** In testing whether democracy Granger causes income, income is regressed on lags of income and democracy, and the reported F-stat is a Wald-type test of the joint significance of all estimated coefficients on such lags. We also report the probability of rejecting the null hypothesis.

**Table 2: Reproducing AJRY with pooled OLS and fixed effects; Annual data 1960-2000**

| Dep var: $Dem_t$ | Pooled | FE | FE | Pooled | FE | FE |
|---|---|---|---|---|---|---|
| | AJRY sample | | | PMG sample | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| $Dem_{t-1}$ | 0.961<br>(0.004) | 0.897<br>(0.011) | 0.863<br>(0.013) | 0.949<br>(0.005) | 0.898<br>(0.011) | 0.854<br>(0.013) |
| Log GDP per $capita_{t-1}$ | 0.114<br>(0.027) | 0.407<br>(0.112) | -0.110<br>(0.116) | 0.161<br>(0.038) | 0.522<br>(0.140) | 0.002<br>(0.130) |
| Obs | 4933 | 4933 | 4933 | 3836 | 3836 | 3836 |
| Countries | 153 | 153 | 153 | 105 | 105 | 105 |
| R-squared | 0.94 | 0.94 | 0.94 | 0.91 | 0.80 | 0.81 |
| Country FE | NO | YES | YES | NO | YES | YES |
| Time FE | NO | NO | YES | NO | NO | YES |

**Notes:** Robust standard errors in parentheses. All regressions include a constant. AJRY baselines specification includes year dummies and their distinction between pooled and fixed effects estimation is based on whether country fixed effects are included or not. We do not report regression results for when only annual dummies are accounted for but find that just like the AJRY results, the coefficient on lagged income per capita in this case is positive and significant and does not significantly differ in magnitude from its counterpart with no year and country dummies.

**Table 3: Augmented PMG estimation; Overall sample (N=105); 1955-2007**

**Dependent variable: Polity IV Measure of Democracy**

| **Long-run Coefficients** | **PMG**<br>**1** | **MG**<br>**2** | **Hausman Test**<br>**3** |
|---|---|---|---|
| **Log Income per Capita** | -1.239***<br>(0.153) | 0.390<br>(1.368) | 1.44<br>[0.23] |
| **World Democracy** | 0.800***<br>(0.029) | 0.926***<br>(0.143) | 0.80<br>[0.37] |
| **World Output** | 3.059***<br>(0.547) | 0.293<br>(2.958) | 0.90<br>[0.34] |
| | Joint Hausman test | | 2.39<br>[0.50] |
| **Error Correction Coefficient** | -0.264***<br>(0.029) | -0.469***<br>(0.034) | |

**Notes:** All equations include a constant country-specific term. Numbers reported in parentheses are standard errors. Numbers reported in brackets are p-values. ***, **, and * indicate significance respectively at the 1, 5, and 10 percent levels. We use the Schwartz Bayesian optimal lag selection Criterion subject to a maximum lag of three. World democracy and world output are respectively the cross-sectional averages of democracy and output, which we take as proxies of the common unobserved global shocks.

**Table 4: Pooled error correction model by OLS with country and year fixed effects on the PMG sample (1960-2007; N=105)**

| **Dependent var: Democracy** | **Lags=2** | **Lags=3** | **Lags=4** | **Lags=4** |
|---|---|---|---|---|
| **Long-run coefficient** | | | | |
| Log of income per capita | -1.325* (p-value=0.07) | -1.236 (p-value=0.11) | -1.595* (p-value=0.07) | -1.683* (p-value=0.06) |
| **Error correction coefficient** | -0.141*** | -0.145*** | -0.142*** | -0.144*** |
| **R-squared** | 0.85 | 0.85 | 0.85 | 0.85 |
| **Countries** | 105 | 105 | 105 | 105 |
| **Observations** | 4453 | 4348 | 4243 | 4138 |
| **Country and year FE** | YES | YES | YES | YES |

**Note:** we do not report the short-coefficients on income per capita (which are statistically insignificant). For a model with say 2 lags on democracy (with respective coefficients $\alpha_1$ and $\alpha_2$) and with the level of income per capita as well as its 2 lags (with respective coefficients $\beta$, $\beta_1$ and $\beta_2$) on the right side, the long-run coefficient on income per capita is $\frac{\beta+\beta_1+\beta_2}{1-\alpha_1-\alpha_2}$. The p-values for the long-run coefficients are calculated with the non-linear test procedure "testnl" in Stata, and indicate the level of significance at which we can reject that the long run-coefficient is zero.

**Table 5: Augmented PMG estimation; Overall sample (N=98); 1970-2007**

**Dependent variable: Polity IV Measure of Democracy**

| **Long-run Coefficients** | **PMG**<br>**1** | **MG**<br>**2** | **Hausman Test**<br>**3** |
|---|---|---|---|
| **Log Income per Capita** | -0.651***<br>(0.157) | -2.500<br>(4.726) | 0.19<br>[0.67] |
| **Natural Resource Rents to GDP** | -0.021***<br>(0.005) | -0.141<br>(1.440) | 0.01<br>[0.93] |
| **World Democracy** | 1.211***<br>(0.035) | 1.225***<br>(0.322) | 0.00<br>[0.97] |
| **World Output** | -8.554***<br>(1.268) | -4.031<br>(5.799) | 0.64<br>[0.42] |
| **World Rents** | 0.201***<br>(0.038) | -0.241<br>(0.382) | 1.35<br>[0.25] |
| | Joint Hausman test | | 4.20<br>[0.52] |
| **Error Correction Coefficient** | -0.355***<br>(0.039) | -0.664***<br>(0.057) | |

**Notes:** All equations include a constant country-specific term. Numbers reported in parentheses are standard errors. Numbers reported in brackets are p-values. ***, **, and * indicate significance respectively at the 1, 5, and 10 percent levels. We use the Schwartz Bayesian optimal lag selection Criterion subject to a maximum lag of three. World democracy, world output and world rents are respectively the cross-sectional averages of democracy, output, and natural resource rents to GDP which we take as proxies of the common unobserved global shocks

**Table 6: Augmented PMG estimation; Overall sample (N=102); 1970-2007**

| Dependent variable: Polity IV Measure of Democracy | | | | |
|---|---|---|---|---|
| **Long-run PMG Coefficients** | **1** | **2** | **3** | **4** |
| **Log Income per Capita** | -1.228*** | | | |
| | (0.259) | | | |
| **Log of Resource GDP per Capita** | | -0.306*** | | -0.295*** |
| | | (0.081) | | (0.081) |
| **Log of Non-Resource GDP per Capita** | | | 0.710** | 0.518* |
| | | | (0.271) | (0.272) |
| **Error Correction Coefficient** | -0.305*** | -0.248*** | 0.245*** | -0.307*** |
| | (0.034) | (0.029) | (0.030) | (0.034) |

**Notes:** All equations include a constant country-specific term. Numbers reported in parentheses are standard errors. Numbers reported in brackets are p-values.***, **, and * indicate significance respectively at the 1, 5, and 10 percent levels. We use the Schwartz Bayesian optimal lag selection Criterion. All regressions include cross-sectional averages of the dependent variable and all regressors. Hausman test results for the coefficients of interest, not reported here, fail to reject the null of long-run cross-section parameter homogeneity.

## Appendix

**Table A: List of countries and time periods with available Polity and GDP per capita data**

| | | | |
|---|---|---|---|
| Afghanistan | 1970-2000 | Kenya | 1963-2007 |
| Albania | 1970-2007 | Korea, Rep. | 1955-2007 |
| Algeria | 1962-2007 | Kuwait | 1970-2007 |
| Angola | 1975-2007 | Laos | 1970-2007 |
| Argentina | 1955-2007 | Lebanon | 1970-2007 |
| Bahrain | 1971-2006 | Lesotho | 1966-2007 |
| Bangladesh | 1972-2007 | Liberia | 1955-2007 |
| Benin | 1960-2007 | Madagascar | 1960-2007 |
| Bolivia | 1955-2007 | Malawi | 1964-2007 |
| Botswana | 1966-2007 | Malaysia | 1957-2007 |
| Brazil | 1955-2007 | Mali | 1960-2007 |
| Bulgaria | 1955-2007 | Mauritania | 1960-2007 |
| Burkina Faso | 1960-2007 | Mauritius | 1968-2007 |
| Burundi | 1962-2007 | Mexico | 1955-2007 |
| Cambodia | 1970-2007 | Mongolia | 1955-2007 |
| Cameroon | 1960-2007 | Morocco | 1956-2007 |
| Central African Rep | 1960-2007 | Mozambique | 1975-2007 |
| Chad | 1960-2007 | Nepal | 1955-2007 |
| Chile | 1955-2007 | Nicaragua | 1955-2007 |
| China | 1955-2007 | Niger | 1960-2007 |
| Colombia | 1955-2007 | Nigeria | 1960-2007 |
| Comoros | 1975-2007 | Oman | 1955-2007 |
| Congo, Dem. Rep. | 1960-2007 | Pakistan | 1955-2007 |
| Congo, Rep. | 1960-2007 | Panama | 1955-2007 |
| Cote d'Ivoire | 1960-2007 | Paraguay | 1955-2007 |
| Cyprus | 1960-2007 | Peru | 1955-2007 |
| Djibouti | 1977-2007 | Philippines | 1955-2007 |
| Dominican Republic | 1955-2007 | Poland | 1970-2007 |
| Ecuador | 1955-2007 | Portugal | 1955-2007 |
| Egypt, Arab Rep. | 1955-2007 | Romania | 1955-2007 |
| El Salvador | 1955-2007 | Rwanda | 1961-2007 |
| Equatorial Guinea | 1968-2007 | Senegal | 1960-2007 |

| | | | |
|---|---|---|---|
| Ethiopia | 1955-2007 | Sierra Leone | 1961-2007 |
| Fiji | 1970-2007 | Solomon Islands | 1978-2007 |
| France | 1955-2007 | Somalia | 1970-2007 |
| Gabon | 1960-2007 | South Africa | 1955-2007 |
| Gambia | 1965-2007 | Spain | 1955-2007 |
| Ghana | 1960-2007 | Sri Lanka | 1955-2007 |
| Greece | 1955-2007 | Sudan | 1956-2007 |
| Guatemala | 1955-2007 | Swaziland | 1970-2007 |
| Guinea | 1958-2007 | Syrian Arab Rep | 1961-2007 |
| Guinea-Bissau | 1974-2007 | Tanzania | 1961-2007 |
| Guyana | 1966-2007 | Thailand | 1955-2007 |
| Haiti | 1955-2007 | Togo | 1960-2007 |
| Honduras | 1955-2007 | Trinidad & Tobago | 1962-2007 |
| Hungary | 1957-2007 | Tunisia | 1961-2007 |
| India | 1955-2007 | Turkey | 1955-2007 |
| Indonesia | 1955-2007 | Uganda | 1962-2007 |
| Iraq | 1970-2002 | Uruguay | 1955-2007 |
| Iran, Islamic Rep. | 1955-2007 | Venezuela, RB | 1955-2007 |
| Israel | 1955-2007 | Zambia | 1964-2007 |
| Jamaica | 1959-2007 | Zimbabwe | 1970-2007 |
| Jordan | 1955-2007 | | |

**Table B: Descriptive Statistics**

| Variables | Obs | Countries | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| | | | Table 1 | | | |
| **Polity** | 5085 | 105 | -0.95 | 6.90 | -10.00 | 10.00 |
| **Log of Real GDP per Capita** | 5076 | 105 | 8.02 | 0.97 | 5.03 | 11.49 |
| | | | Table 2 | | | |
| **Polity** | 3693 | 98 | -0.44 | 7.02 | -10.00 | 10.00 |
| **Log of Real GDP per Capita** | 3723 | 98 | 8.13 | 0.99 | 5.03 | 11.49 |
| **Rents to GDP** | 3724 | 98 | 7.68 | 13.46 | 0.00 | 116.54 |
| | | | Table 3 | | | |
| **Polity** | 3834 | 102 | -0.36 | 7.01 | -10.00 | 10.00 |
| **Log of Real GDP per Capita** | 3875 | 102 | 8.14 | 0.99 | 5.03 | 11.49 |
| **Log of Resource GDP per Capita** | 3869 | 102 | 5.15 | 1.80 | -2.38 | 11.08 |
| **Log of non-Resource GDP per Capita** | 3875 | 102 | 8.01 | 0.95 | 5.02 | 10.54 |
| **Share of Resource GDP** | 3876 | 102 | 10.00 | 13.92 | 0.00 | 92.39 |

**Table C: Share of resource GDP in percent of overall GDP**

| Country | Share of Resource GDP | Country | Share of Resource GDP |
|---|---|---|---|
| Albania | 22.1 | Korea, Rep. | 3.0 |
| Algeria | 31.4 | Kuwait | 48.0 |
| Angola | 39.5 | Laos | 4.6 |
| Argentina | 4.7 | Lebanon | 3.5 |
| Bahrain | 22.4 | Lesotho | 2.9 |
| Bangladesh | 1.4 | Liberia | 12.1 |
| Benin | 1.5 | Madagascar | 1.4 |
| Bolivia | 12.7 | Malawi | 3.3 |
| Botswana | 35.6 | Malaysia | 12.4 |
| Brazil | 3.8 | Mali | 4.3 |
| Bulgaria | 9.8 | Mauritania | 15.2 |
| Burkina Faso | 2.2 | Mauritius | 2.2 |
| Burundi | 0.7 | Mexico | 9.8 |
| Cambodia | 2.3 | Mongolia | 15.5 |
| Cameroon | 6.9 | Morocco | 5.8 |
| Central African Rep | 6.1 | Mozambique | 2.4 |
| Chad | 5.6 | Nepal | 1.3 |
| Chile | 13.4 | Nicaragua | 2.7 |
| Colombia | 6.3 | Niger | 7.3 |
| Comoros | 1.2 | Nigeria | 27.2 |
| Congo, Dem. Rep. | 12.7 | Oman | 47.6 |
| Congo, Rep. | 34.8 | Pakistan | 4.7 |
| Cote d'Ivoire | 2.8 | Panama | 3.1 |
| Cyprus | 3.0 | Paraguay | 1.6 |
| Djibouti | 5.3 | Peru | 12.5 |
| Dominican Republic | 3.3 | Philippines | 3.7 |
| Ecuador | 13.3 | Poland | 8.2 |
| Egypt, Arab Rep. | 8.9 | Portugal | 2.8 |
| El Salvador | 1.9 | Romania | 6.4 |
| Equatorial Guinea | 29.0 | Rwanda | 1.3 |
| Fiji | 3.7 | Senegal | 3.4 |
| France | 2.1 | Sierra Leone | 13.2 |
| Gabon | 42.2 | Solomon Islands | 1.0 |
| Gambia | 1.3 | Somalia | 0.7 |
| Ghana | 4.9 | South Africa | 13.3 |
| Greece | 3.3 | Spain | 2.9 |
| Guatemala | 2.5 | Sri Lanka | 2.6 |
| Guinea | 18.2 | Sudan | 3.1 |

| | | | |
|---|---|---|---|
| Guinea-Bissau | 0.7 | Swaziland | 4.8 |
| Guyana | 13.1 | Syria | 13.0 |
| Haiti | 1.5 | Tanzania | 8.5 |
| Honduras | 2.1 | Thailand | 4.0 |
| Hungary | 7.7 | Togo | 8.4 |
| India | 4.3 | Trinidad & Tobago | 22.2 |
| Indonesia | 12.7 | Tunisia | 7.9 |
| Iran, Islamic Rep. | 20.2 | Turkey | 2.9 |
| Iraq | 77.5 | Uganda | 2.6 |
| Israel | 2.5 | Uruguay | 2.7 |
| Jamaica | 9.0 | Venezuela, RB | 19.5 |
| Jordan | 5.3 | Zambia | 16.5 |
| Kenya | 3.8 | Zimbabwe | 6.7 |

**Source:** UN Statistics Division National Accounts Database which provides data from 1970-2007 on sectoral GDP shares for the following overall categories: 1. Agriculture, hunting, forestry, fishing ; 2. Mining, Manufacturing, Utilities; 3. Manufacturing; 4. Construction; 5. Wholesale, retail trade, restaurants and hotels; 6. Transport, storage and communication; 7. Other Activities. Category 2 (Mining, manufacturing and utilities) is an aggregation of economic activities of a. Mining and quarrying, b. Manufacturing and c. Utilities. The data available allows us to compute Mining, Quarrying and Utilities by subtracting Category 3 (Manufacturing) from Category 2 (Mining, Manufacturing, Utilities). We take this as our proxy of resource GDP. Unfortunately UN data on Mining and Quarrying alone involve short time series dimensions for the countries in the sample which does not allow us to estimate using our PMG method.

**Table D: Data description and sources**

| Variable | Description | Source |
|---|---|---|
| **Income per capita** | Data measured as log real GDP per capita (chain weighted method) from Penn World Tables 6.3. | http://pwt.econ.upenn.edu/ |
| **Democracy** | Polity IV index ranging from -10 for perfect autocracies to +10 for perfect democracies. | http://www.systemicpeace.org/polity/polity4.htm |
| **Natural resource rents** | Expressed in percent of GDP. Rents are measured as the market value of extracted material minus the average extraction cost. Natural resources include bauxite, coal, copper, forest, gold, iron, lead, lignite, natural gas, nickel, oil, phosphates, silver, tin and zinc. | World Bank data: http://go.worldbank.org/OV4R25M150 |
| **Resource and non-resource income shares** | Resource income share is defined as the share of Mining and Quarrying in GDP. Non-resource income constitutes the rest. | United Nations Statistics Division National Accounts Database. |

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