Income and democracy: evidence from system GMM estimates*

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Abstract

Does higher income cause democracy? Accounting for the dynamic nature and high persistence of income and democracy, we find a statistically significant positive relation between income and democracy for a postwar period sample of up to 150 countries. Our results are robust across different measures of democracy and instrumentation strategies.

Keywords: income; democracy; dynamic panel estimators
JEL-Codes: O1, C33, D72, E21

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1 Introduction

Higher levels of income cause the establishment of democratic regimes. This cornerstone of "modernization theory" (see Lipset, 1959) is increasingly accepted by economists and political scientists alike. Reviewing the existing literature reveals that the empirical evidence overwhelmingly supports modernization theory.[1] However, a recent paper by Acemoglu et al. (2008) argues that the empirically observed correlation is spurious. They show that the relationship between democracy and income breaks down when controlling for country and time-fixed effects using a postwar period (1960–2000) sample of countries. Instead, both democracy and higher income are caused by underlying changes in institutional arrangements and are contingent on specific historic events. This alternative view is dubbed the "critical junctures hypothesis" (for a short review see Acemoglu et al., 2009).

Empirical evidence supporting modernization theory relies on SUR regressions, fixed effects and non-linear panel specifications whereas Acemoglu et al. (2008) employ the dynamic panel estimator by Arellano and Bond (1991). All these studies do not take into account the high persistence of income and democracy.

We therefore follow Arellano and Bover (1995) as well as Blundell and Bond (1998) and present empirical evidence using system GMM which performs well with highly persistent data under mild assumptions. We show that even in the smaller postwar period sample with up to 150 countries used by Acemoglu et al. (2008), we find a statistically significant positive relation between income and democracy.[2]

2 Econometric methods and data

Acemoglu et al. (2008) estimate the following dynamic panel model:

$$d_{it} = \alpha d_{it-1} + \gamma y_{it-1} + \mathbf{x}'_{it-1}\boldsymbol{\beta} + \delta_i + \mu_t + u_{it}, \tag{1}$$

where d_{it} is the democracy level of country i, y_{it-1} is the lagged log GDP per capita, $\mathbf{x}_{it-1}$ is a vector of lagged control variables, δ_i and μ_t denote sets of country dummies and time effects and u_{it} is an error term with $E(u_{it}) = 0$ for all i and t.

[1] For example, Barro (1999) uses a SUR regression framework, Gundlach and Paldam (2009) use repeated cross-sectional analysis, Corvalan (2010) uses a panel probit estimator, Boix (2011) and Treisman (2011) use a fixed effects panel estimator, Benhabib et al. (2011) use non-linear panel estimators and Moral-Benito and Bartolucci (2011) use the Arellano and Bond (1991) estimator as well as a limited information maximum likelihood approach (LIML).

[2] In a similar fashion, Bobba and Coviello (2007) show that the estimated effect of education on democracy changes its sign when using system GMM.

Acemoglu et al. (2008) use the difference GMM estimator as proposed by Arellano and Bond (1991) to estimate Equation (1).[3] However, this estimator suffers from potentially huge small sample bias when the number of time periods is small and the dependent variable is highly persistent (see Alonso-Borrego and Arellano, 1999). The literature tries to mitigate this persistence by using five year intervals or averages. This reduces the number of observations considerably, while income and democracy are still substantially persistent. We follow Arellano and Bover (1995) and Blundell and Bond (1998) and present system GMM estimates which circumvent the finite sample bias if one accepts a mild stationarity assumption.[4]

The asymptotic efficiency gains of the additional orthogonality conditions of the system GMM estimator do not come without a cost: The number of instruments increases exponentially with the number of time periods which leads to finite sample bias and increases the likelihood of false positive results as well as suspiciously high pass rates of specification tests like the Hansen (1982) J-test (see Roodman, 2009b). We follow Roodman (2009b) and also present results with a collapsed instrument matrix and use only two lags for both the difference and system GMM estimators.[5] We use Windmeijer (2005) finite sample corrected standard errors.

We employ an unbalanced panel with five-year interval data from 1960 to 2000 taken from Acemoglu et al. (2008). We use two different measures for democracy: the Freedom House index and the composite Polity IV index. The Freedom House index is normalized between zero and one, with one corresponding to the most democratic institutions. It uses data from the non-governmental organization Freedom House and is augmented by data taken from Bollen (2001) for the years 1950, 1955, 1960 and 1965. It is constructed from a checklist of questions concerning both political and civil rights, such as free and fair elections and the prevalence of the rule of law.[6] The main advantage of this index is its broad coverage of countries. For reasons of comparison, we follow Acemoglu et al. (2008) and use the Freedom House index as our main measure of democracy.

The Freedom House index is not without problems. One issue is that it includes too many components, such as socio-economic rights, freedom from war and freedom from gross socioeconomic inequalities, thus leading to a maximalist definition of democracy potentially harming its discriminatory

[3] For a good textbook treatment of (dynamic) panel estimators see Baltagi (2008).

[4] Specifically, the deviations from the long-run mean of the dependent variable have to be uncorrelated with the stationary individual-specific long-run mean itself (see Blundell and Bond, 1998). As there are no a priori reasons to believe that the speed of change in a country's political system is related to its current level of democracy this stationarity condition does not seem unduly restrictive.

[5] All GMM estimations are carried out using the `xtabond2` package in Stata (see Roodman, 2009a).

[6] For more information see http://freedomhouse.org/report/freedom-world/freedom-world-2012.

power. Another problem is that the exact coding rules for the indicator are not made publicly available. We therefore contrast our results with an alternative minimalist measure of democracy, the Polity IV index from the Polity IV research project.[7] The composite Polity IV index is also normalized between zero and one, with one corresponding again to the most democratic institutions. It combines the scores of democracy and autocracy indices to a single regime indicator including information on competitiveness of political participation and constraints on the chief executive.[8]

3 Results

Table 1 reports the baseline results of estimation of Equation (1) using the Freedom House index as dependent variable. Column (1) and (2) show the results of the pooled OLS and fixed effects (within) OLS estimator. Both regressions use robust standard errors clustered by country. These estimates provide the lower and upper bound for the autoregressive coefficient (for details see Bond, 2002). The lower bound is equal to 0.379 whereas the upper bound is 0.706. Both are positive and highly statistically significant. Concerning lagged log GDP per capita we find a positive and significant effect for pooled OLS and no systematic influence using fixed effects.

Columns (3) to (5) employ difference GMM estimators. In column (3) the results from the one-step difference GMM estimator are reported, whereas in columns (4) and (5) we report the results from the two-step difference GMM estimator. All GMM regressions use robust standard errors and treat the lagged democracy measure as predetermined. In the two-step GMM estimates, the Windmeijer (2005) finite sample correction for standard errors is employed. In column (5) also log GDP per capita is treated as endogenous. Note that column (3) reproduces column (2) in Table 2 of Acemoglu et al. (2008). While in all difference GMM estimates the autoregressive coefficient lies within the bounds given by columns (1) and (2), the sign of the coefficient for lagged log GDP per capita becomes negative and weakly significant. However, as motivated in the introduction and when discussing our identification strategy, the one- and two-step differenced GMM estimators do not take into account the high persistence of income and democracy.

We therefore present system GMM estimates in columns (6) to (8). Whereas column (6) reproduces column (5) using the system GMM estimator, column (7) follows the advice given in Roodman (2009b) and collapses the instrument matrix and only uses two lags as instruments. Column (8) includes lagged log population, lagged education and lagged age structure as additional controls. All specifications estimate an autoregressive coeffi-

[7] For more information see http://www.systemicpeace.org/polity/polity4.htm.

[8] For a discussion of existing democracy indices and measurement problems of democracy see Munck and Verkuilen (2002).

cient that lies between the two bounds given in columns (1) and (2). However, lagged log GDP per capita has now a positive and significant effect on democracy. The point estimate of lagged log GDP in the specification given in column (6) is 0.118, implying that a one percent increase of lagged GDP increases the steady-state value of democracy by 0.26 percentage points.[9]

The row for the Hansen J-test reports the p-values for the null hypothesis of the validity of the overidentifying restrictions. In all specifications we do not reject the null hypothesis. The values reported for the Diff-in-Hansen test are the p-values for the validity of the additional moment restrictions necessary for system GMM. Again, we do not reject the null that the additional moment conditions are valid. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first-differenced equation. As expected, there is high first order autocorrelation, and no evidence for significant second order autocorrelation. To sum up, our test statistics hint at a proper specification.

In Table 2 we check the robustness of our results against using the second democracy measure and including additional external instruments as used by Acemoglu et al. (2008). The first three columns reestimate specifications (6) to (8) from Table 1 using the Polity IV index. GDP per capita still turns out to be positive and significant in columns (1) and (2) albeit a bit smaller in magnitude. In specification (3), GDP per capita is still positive but no longer significant. This is similar as in specification (8) of Table 1, where significance was also lower than in specifications (6) and (7). This may well be due to the lower number of observations. The specification tests indicate well-specified models. Hence, the choice of the democracy measure does not influence our qualitative result.

Columns (4) and (5) in Table 2 use the trade-weighted world income of the respective country as an additional external instrument. We report the system GMM estimates as in columns (6) and (7) in Table 1. Again, as in Table 1 the coefficient of GDP per capita changes its sign going from the difference GMM (not reported) to the system GMM estimates. With system GMM, it turns out to be positive and significant again. Again, all the specification tests indicate a well-specified model. In columns (6) and (7) we use the second lag of the savings rate of the countries as an additional external instrument instead. Here, we again find a change in the sign from negative to positive on the GDP per capita variable when moving from difference (not reported) to system GMM estimates. The model specification tests also indicate a well-specified model across the different specifications. Only the Diff-in-Hansen test for the system GMM estimates using the collapsed instrument matrix in column (7) rejects the null of the validity of the additional overidentifying restrictions. However, the autocorrelation tests indicate that the model is well specified. This could well be due to the

[9] The long-run effect is calculated as $\gamma/(1-\alpha)$.

use of the collapsed instruments as the asymptotic behavior of this ad hoc method is not well understood (see Roodman, 2009b). As the Hansen tests are known to have weak power and all results are in line with our previous ones, we still believe that we have properly identified the influence of GDP on democracy.

4 Conclusions

When studying the relationship between income and democracy, one has to account for the dynamic nature and the high persistence of the data. Employing system GMM, we find a significant positive relation between income and democracy for a postwar period sample of up to 150 countries. Our results are robust to different measures of democracy and instrument sets.

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Table 1: Baseline results

	Pooled OLS (1)	FE OLS (2)	Diff-1 GMM (AJRY) (3)	Diff-2 GMM (4)	Diff-2 GMM END (5)	Sys-2 GMM END (6)	Sys-2 GMM END CL (7)	Sys-2 GMM END CL (8)
	Dependent variable is $Democracy_t$ (Freedom House index)							
$Democracy_{t-1}$	0.706***	0.379***	0.489***	0.528***	0.432***	0.548***	0.568***	0.546***
	(0.035)	(0.051)	(0.085)	(0.105)	(0.085)	(0.053)	(0.063)	(0.076)
$Log\ GDP\ per\ capita_{t-1}$	0.072***	0.010	-0.129*	-0.012	-0.097*	0.118***	0.136***	0.110*
	(0.010)	(0.035)	(0.076)	(0.065)	(0.053)	(0.020)	(0.023)	(0.060)
Controls	No	No	No	No	No	No	No	Yes
Instruments			55	55	90	108	16	21
Hansen J-test			[0.260]	[0.260]	[0.273]	[0.131]	[0.778]	[0.614]
Diff-in-Hansen test						[0.298]	[0.791]	[0.268]
AR(1)			[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)			[0.448]	[0.421]	[0.540]	[0.332]	[0.297]	[0.875]
Observations	945	945	838	838	838	945	945	676
Countries	150	150	127	127	127	150	150	95

Notes: Base sample – taken from Acemoglu et al. (2008) – is an unbalanced panel spanning from 1960–2000 with data at five-year intervals, where the start date of the panel refers to the dependent variable. The dependent variable is the Augmented Freedom House Political Rights index. Standard errors are in parentheses, p-values in brackets. Pooled and FE OLS regressions use robust standard errors clustered by country. All GMM regressions use robust standard errors and treat the lagged democracy measure as predetermined. In addition to that, regressions with suffix "END" treat lagged log GDP per capita as endogenous and regressions with suffix "CL" follow Roodman (2009b) and collapse the instrument matrix and use only two lags. In the case of two-step GMM, the Windmeijer (2005) finite sample correction for standard errors is employed. In the last column, lagged log population, lagged education (average years of total schooling) and lagged age structure are added as controls. Age structure is specified as median age of the population at $t-1$ and four covariates corresponding to the percent of the population at $t-1$ in the following age groups: 0–15, 15–30, 30–45, and 45–60. *, ** and *** denote significance at the 10%-, 5%- and 1%-level, respectively. The row for the Hansen J-test reports the p-values for the null hypothesis of instrument validity. The values reported for the Diff-in-Hansen test are the p-values for the validity of the additional moment restriction necessary for system GMM. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 2: Robustness checks

	Sys-2 GMM END (1)	Sys-2 GMM END CL (2)	Sys-2 GMM END CL (3)	Sys-2 GMM END (4)	Sys-2 GMM END CL (5)	Sys-2 GMM END (6)	Sys-2 GMM END CL (7)
	Dependent variable is $Democracy_t$						
	Polity IV index			Freedom House index			
				World income instrument		Savings rate instrument	
$Democracy_{t-1}$	0.616***	0.694***	0.735***	0.547***	0.578***	0.584***	0.575***
	(0.071)	(0.080)	(0.082)	(0.053)	(0.066)	(0.054)	(0.072)
$Log\ GDP\ per\ capita_{t-1}$	0.079***	0.067***	0.104	0.110***	0.128***	0.110***	0.114***
	(0.019)	(0.023)	(0.067)	(0.023)	(0.024)	(0.018)	(0.023)
Controls	No	No	Yes	No	No	No	No
Instruments	108	16	21	109	17	107	16
Hansen J-test	[0.139]	[0.379]	[0.207]	[0.158]	[0.597]	[0.213]	[0.058]
Diff-in-Hansen test	[0.859]	[0.167]	[0.068]	[0.185]	[0.331]	[0.630]	[0.037]
AR(1)	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	[0.361]	[0.329]	[0.322]	[0.367]	[0.320]	[0.441]	[0.436]
Observations	854	854	640	895	895	891	891
Countries	136	136	92	124	124	134	134

Notes: Base sample – taken from Acemoglu et al. (2008) – is an unbalanced panel spanning from 1960–2000 with data at five-year intervals, where the start date of the panel refers to the dependent variable. The dependent variable in columns (1)–(3) is the composite Polity IV index, the dependent variable in columns (4)–(7) is the Augmented Freedom House Political Rights index. Standard errors are in parentheses, p-values in brackets. All GMM regressions use robust standard errors and treat the lagged democracy measure as predetermined and either the second lag of the savings rate or trade-weighted world income as additional external instrument. In addition to that, regressions with suffix "END" treat lagged log GDP per capita as endogenous and regressions with suffix "CL" follow Roodman (2009b) and collapse the instrument matrix and use only two lags. In the case of two-step GMM, the Windmeijer (2005) finite sample correction for standard errors is employed. *, ** and *** denote significance at the 10%-, 5%- and 1%-level, respectively. The row for the Hansen J-test reports the p-values for the null hypothesis of instrument validity. The values reported for the Diff-in-Hansen test are the p-values for the validity of the additional moment restriction necessary for system GMM. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.