Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

Ifo Working Papers

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Ifo Working Paper No. 118

December 2011

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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 model specifications and instrument sets.

JEL Classification: O1, C33, D72, E21.
Keywords: Income, democracy, dynamic panel estimators.

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* Funding from the Leibniz-Gemeinschaft (WGL) under project "Pakt 2009 Globalisierungsnetzwerk" is gratefully acknowledged. The usual disclaimer applies.

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 Identification assumptions

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

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

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.

Acemoglu et al. (2008) use the difference GMM estimator as proposed by Arellano and Bond (1991) to estimate Equation (1). This estimator is

[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).

based upon the following orthogonality conditions:[2]

$$E(d_{it-s}\Delta u_{it}) = 0 \quad \text{for} \quad t = 3, ..., T \quad \text{and} \quad 2 \leq s \leq T-1, \qquad (2)$$

where d_{it-s} are suitable lags of the dependent variable. In essence, the second and further lags of the dependent variable are used as an instrument for the residual of Equation (1) in differences.

However, this estimator suffers from potentially huge small sample bias when the number of time periods is small and the dependent variable shows a high degree of persistence (see Alonso-Borrego and Arellano, 1999). A standard procedure in the literature to mitigate the persistence in the data is to rely on 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 estimates of Equation (1) using system GMM which circumvents the finite sample bias if one is willing to assume a mild stationarity assumption on the initial conditions of the underlying data generating process.[3] In addition to the moment conditions specified in Equation (2) this estimator uses the following moment conditions:

$$E(\Delta d_{it-1}(\delta_i + u_{it})) = 0 \quad \text{for} \quad t = 3, ..., T, \qquad (3)$$

i.e., we use lagged first-differences of the dependent variable to construct the orthogonality conditions for the error term of Equation (1) in levels. Additional orthogonality conditions for both difference and system GMM arise from suitable lags of the lagged explanatory variables in levels which can be treated as either endogenous, predetermined or strictly exogenous.

The asymptotic efficiency gains brought about by the additional orthogonality conditions of the system GMM estimator do not come without a cost: The number of instruments tends to increase exponentially with the number of time periods. This proliferation of instruments leads to a finite sample bias due to the overfitting of endogenous variables and increases the likelihood of false positive results and suspiciously high pass rates of specification tests like the Hansen (1982) J-test, a routinely used statistic to check the validity of a dynamic panel model (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.[4] We also employ the Windmeijer (2005) finite sample correction for standard errors.

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

[3]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.

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

3 Results

Table 1 reports the baseline results of estimation of Equation (1) across various estimators. We employ an unbalanced panel with five-year interval data from 1960 to 2000 taken from Acemoglu et al. (2008). The dependent variable is the Augmented Freedom House Political Rights Index from 0 to 1. Column (1) shows the results of the pooled OLS estimator and column (2) shows the results of the fixed effects (within) OLS estimator. Both regressions use robust standard errors clustered by country. These estimates are informative because they provide the lower and upper bound for the autoregressive coefficient for democracy (for details see Bond, 2002). As can be seen, this 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 in the pooled OLS model and no systematic influence in the fixed effects specification.

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 bound 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 show an estimated autoregressive coefficient 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.[5]

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

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

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 restriction necessary for system GMM given in Equation (3). 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 Tables 2 and 3 we check the robustness of our results against inclusion of additional external instruments as used by Acemoglu et al. (2008). In Table 2, we use the trade-weighted world-income of the respective country as an additional external instrument. We report the one- and two-step difference GMM estimates alongside the system GMM estimates with otherwise similar specifications as in Table 1. Again, the autocorrelation parameter is statistically significant and of similar magnitude. Most importantly, as in Table 1 the coefficient of lagged GDP per capita changes its sign going from the difference GMM to the system GMM estimates when using the world-income share as additional instrument. In the system GMM estimates, it turns out to be positive and significant again. Again, all the specification tests indicate a well-specified model.

In Table 3 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 lagged GDP per capita variable when moving from difference to system GMM estimates. The model specification tests also indicate a well-specified model across the different specifications. Only the Hansen tests for the system GMM estimates using the collapsed instrument matrix in column (5) reject the null of the validity of the overidentifying restrictions. However, the tests for autocorrelation in the lagged disturbances indicate that the model is well specified. This could well be due to the 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 potentially causal relationship between income and democracy, one has to account for the dynamic nature and the high persistence of the data. Employing system GMM estimators, we reexamine the nexus between income and democracy. We find a statistically significant positive relation between income and democracy for a postwar period sample of up to 150 countries. We check the robustness of our results with respect to model specification and instrumentation strategies.

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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 $Democracy_t$				
$Democracy_{t-1}$	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: Trade-weighted world income instrument

	Diff-1 GMM (AJRY) (1)	Diff-2 GMM (2)	Diff-2 GMM END (3)	Sys-2 GMM END (4)	Sys-2 GMM END CL (5)
	Dependent variable is $Democracy_t$				
$Democracy_{t-1}$	0.478***	0.521***	0.427***	0.547***	0.578***
	(0.094)	(0.112)	(0.086)	(0.053)	(0.066)
Log GDP per $capita_{t-1}$	-0.133*	-0.027	-0.117**	0.110***	0.128***
	(0.077)	(0.064)	(0.052)	(0.023)	(0.024)
Instruments	55	55	91	109	17
Hansen J-test	[0.191]	[0.191]	[0.144]	[0.158]	[0.597]
Diff-in-Hansen test				[0.185]	[0.331]
AR(1)	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	[0.502]	[0.472]	[0.604]	[0.367]	[0.320]
Observations	812	812	812	895	895
Countries	122	122	122	124	124

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. All GMM regressions use robust standard errors and treat the lagged democracy measure as predetermined as well as the lagged 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.

Table 3: Savings rate instrument

	Diff-1 GMM (AJRY) (1)	Diff-2 GMM (2)	Diff-2 GMM END (3)	Sys-2 GMM END (4)	Sys-2 GMM END CL (5)
	Dependent variable is $Democracy_t$				
$Democracy_{t-1}$	0.427***	0.376***	0.367***	0.584***	0.575***
	(0.100)	(0.116)	(0.093)	(0.054)	(0.072)
$Log\ GDP\ per\ capita_{t-1}$	-0.228**	-0.104	-0.148**	0.110***	0.114***
	(0.102)	(0.078)	(0.068)	(0.018)	(0.023)
Instruments	53	53	89	107	16
Hansen J-test	[0.343]	[0.343]	[0.263]	[0.213]	[0.058]
Diff-in-Hansen test				[0.630]	[0.037]
AR(1)	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	[0.719]	[0.825]	[0.844]	[0.441]	[0.436]
Observations	764	764	764	891	891
Countries	124	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 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 as well as the second lag of the savings rate 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.

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