Revisiting the Democracy-Growth Nexus: New Evidence from a Dynamic Common Correlated Effects Approach*

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Abstract

This paper presents new evidence on the nexus between democracy and growth employing the dynamic common correlated effects (DCCE) approach advanced by Chudik and Pesaran (2015) which is robust to both parameter heterogeneity and cross-section dependence. The DCCE results indicate a positive and statistically significant effect of democracy on economic growth, with a point estimate between approximately 1.5-2% depending on the specification. We complement our estimates with a battery of diagnostic tests for heterogeneity and cross-section dependence that corroborate the use of the DCCE approach.

Keywords: democracy, economic growth, common correlated effects, heterogeneity, cross section dependence.

JEL Classification: C23, C33, C38

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1 Introduction

The question of whether democracy is beneficial for economic growth has spurred a large theoretical and empirical literature over the past five decades (see, e.g., Doucouliagos and Ulubaşoğlu, 2008, for a review). While proponents of democracy argue that political rights and civil liberties are necessary to preserve the motivation of citizens to work and invest while maintaining an effective allocation of resources in the marketplace, opponents promote the view that democracies are vulnerable to popular demands at the expense of profitable investments and are unable to suppress ethnic, religious and class conflicts that are detrimental to growth. There is also a third so-called "skeptic view" that points to the importance of the institutional structure in facilitating growth rather than the regimes per se. The literature does not appear to have reached a consensus yet among these different views.

In an influential recent article, Acemoglu et al. (2017, ANRR henceforth) take a major step forward by empirically examining the effect of democracy on economic growth based on a new comprehensive panel dataset covering 175 countries over the period 1960-2010. Their analysis employs standard dynamic panel data estimation methods such as within groups and Arellano-Bond GMM as well as the more recent bias-correction approach proposed by Hahn et al. (2002). These methods assume that the model parameters are homogeneous across countries and rule out strong cross section dependence among the countries.[1] The baseline estimates reported in ANRR suggest that democracy has a positive and statistically significant effect on economic growth, with GDP per capita being approximately 20% higher in the 25 years following a permanent democratization.

This paper reconsiders the nexus between democracy and growth using a recently proposed econometric approach that allows for both parameter heterogeneity and strong cross section dependence. Parameter heterogeneity can arise from economic, cultural and political institutional differences across countries. As shown in Pesaran and Smith (1995), pooled estimators are biased in a dynamic model with random coefficients. On the other hand, strong cross section dependence can emanate from common global shocks that affect different countries to different degrees. This notion of dependence is distinct from spatially correlated shocks that essentially capture weak dependence (see Chudik et al., 2011). Chudik and Pesaran (2015) demonstrate through Monte Carlo experiments the serious biases associated with the within groups estimator in the presence of strong cross section dependence. Our

[1] An exception is when the dependence is not country-specific in which case a specification that includes time fixed effects (as in ANRR) is sufficient to address the issue.

analysis employs the dynamic common correlated effects (DCCE) approach proposed by Chudik and Pesaran (2015) that models the cross section dependence in terms of a small (unknown) number of unobserved common factors with heterogeneous loadings. The DCCE estimator is computed by augmenting the dynamic panel regression with cross-sectional averages of the current and lagged values of the dependent variable and regressors. Our findings confirm the statistically significant positive effect of democracy on growth documented in ANRR, with a DCCE point estimate between approximately 1.5-2%, depending on the specification. We complement our estimates with a battery of diagnostic tests for heterogeneity and cross-section dependence that corroborate the use of the DCCE approach in evaluating the effect of democracy on growth.

The rest of the paper is organized as follows. Section 2 lays out the econometric framework and the DCCE estimation procedure. Section 3 presents the empirical results. Section 4 concludes. Appendix A reports results from a set of diagnostic tests for parameter heterogeneity and cross-section dependence as well as estimates of the degree of cross section dependence using the approach proposed by Bailey et al. (2016).

2 The Dynamic Common Correlated Effects (DCCE) Approach

Consider the dynamic panel data model

$$y_{it} = \alpha_i + \sum_{j=1}^{p} \gamma_{ij} y_{t-j} + \beta_i D_{it} + u_{it} \tag{1}$$

$$u_{it} = \lambda_i' f_t + \varepsilon_{it} \tag{2}$$

for $i = 1, ..., N$ and $t = p+1, ..., T$, where y_{it} is the log of GDP per capita (or the growth rate) in country i at time t and D_{it} is a dummy variable which equals unity if country i is democratic at period t and zero otherwise. The α_i denote the country fixed effects representing the time-invariant country characteristics. The error u_{it} is composed of a common component $\lambda_i' f_t$ and an idiosyncratic component ε_{it}. Here, f_t represents a $(m \times 1)$ vector of unobserved common factors and λ_i denotes a $(m \times 1)$ vector of associated factor loadings. The number of factors m is assumed unknown. The factors are allowed to be correlated with the dichotomous democracy measure. The traditional dynamic panel framework adopted by ANRR can be obtained as a special case of (1) and (2) by setting $\lambda_i = \lambda$, $\beta_i = \beta$ for all i and $\gamma_{ij} = \gamma_j$ for all i and $j = 1, ..., p$.

Chudik and Pesaran (2015) consider consistent estimation of the means of the parameters in (1). They propose proxying for the common factors by augmenting the regression (1) with cross-sectional averages of y_{it} and D_{it}:

$$y_{it} = \alpha_i + \sum_{j=1}^{p} \gamma_{ij} y_{t-j} + \beta_i D_{it} + \sum_{l=0}^{q_T} \delta_i'(L)\bar{z}_{t-l} + e_{it} \tag{3}$$

where $\bar{z}_t = N^{-1}\sum_{i=1}^{N} z_{it}$, $z_{it} = (y_{it}, D_{it})'$ and q_T, the number of lags of cross-sectional averages included, is assumed to grow with the sample size at a particular rate: $q_T \to \infty$ and $q_T^3/T \to \kappa$, with $0 < \kappa < \infty$.[2]

Denote $\pi_i = (\gamma_{i1}, ..., \gamma_{ip}, \beta_i)'$. The common correlated effects mean group (CCEMG) estimator of $\pi = E(\pi_i)$ is given by

$$\hat{\pi} = N^{-1}\sum_{i=1}^{N} \hat{\pi}_i$$

where $\hat{\pi}_i$ is the ordinary least squares estimate of π_i from (3). Chudik and Pesaran (2015) establish the consistency of $\hat{\pi}$ under two alternative sets of assumptions. The first set consists of a rank condition on the matrix of factor loadings which, in the current context, requires that the number of factors $m \leq 2$. The second set does not require the rank condition but assumes that the factors are serially uncorrelated. In both cases, $\hat{\pi}$ is shown to be $\sqrt{N}$-consistent and its asymptotic variance can be estimated by

$$\widehat{\sum} = (N-1)^{-1}\sum_{i=1}^{N} (\hat{\pi}_i - \hat{\pi})(\hat{\pi}_i - \hat{\pi})'$$

In order to correct the small sample bias of $\hat{\pi}$, a "half-panel jackknife" procedure is adopted in which the bias-corrected estimator is obtained as

$$\widetilde{\pi} = 2\hat{\pi} - 0.5(\hat{\pi}_a + \hat{\pi}_b)$$

where $\hat{\pi}_a$ denotes the CCEMG estimator computed over the period $t = 1, ..., [T/2]$, and $\hat{\pi}_b$ is the CCEMG estimator computed over the period $t = [T/2] + 1, ..., T$. Based on Monte Carlo experiments, Chudik and Pesaran (2015) propose using the jackknife bias corrected estimates for the coefficients of the lagged dependent variable while the uncorrected estimate is preferred for the coefficient on democracy.[3] As per their recommendation, we set $q_T = [T^{1/3}]$.

[2]While the theoretical analysis in Chudik and Pesaran (2015) allows weighted cross-sectional averages, their Monte Carlo experiments are based on simple averages.

[3]The authors also consider bias correction based on recursive mean adjustment which is, however, dominated by the jackknife.

3 Empirical Results

Our empirical analysis is based on a balanced sample of countries appearing in the dataset compiled by ANRR.[4] Each country in our sample has experienced a change in democratic status at least once. The reason for concentrating on this subsample is that the CCEMG estimator is based on country-wise time series regressions so that if a country's democratic status remains unchanged over the sample period, it cannot be separately identified from the country-specific effect α_i. This constraint combined with the focus on a balanced sample led us to a set of 41 countries over the period 1975-2010.[5] ANRR report results based on three estimators: the fixed effects or within groups (WG) estimator, the Arellano-Bond GMM (AB) estimator and the Hahn, Hausman and Kuersteiner (HHK) bias-corrected instrumental variables estimator. They also present estimates of the long run effect of democracy and the effect after 25 years (say the medium run effect) for each of the estimators. ANRR consider four choices of the lag order p: 1,2,4,8. Since the DCCE approach is based on country-specific time series regressions, we only consider $p = 1, 2, 4$ out of a degrees of freedom consideration.

Table 1 presents our findings based on the three estimators considered by ANRR where Panel A reports the results for GDP measured in levels while Panel B refers to GDP growth. Considering first the estimates in Panel A, the effect of democracy is smaller for a given estimator and lag order, relative to the original ANRR estimates. For instance, with $p = 4$, the WG estimate is about .48% while the corresponding estimate in ANRR is .78%. The medium and long run effects are also smaller. These differences reflect the fact that our analysis is based on a smaller balanced sample. Among the three estimators, for a given lag specification, the immediate effect on democracy as well as the medium and long run effects are largest for WG and smallest for HHK based on the current dataset. Given the possibility of a unit root for the data in levels as indicated by the high persistence estimates, Panel B presents the results based on the growth rate of GDP. Again, the effect of democracy is smaller than the original ANRR estimates. This is true for the current period effect as well as the medium and long run effects. Relative to the results in levels, the parameter estimates are

[4]The focus on a balanced sample is due to the fact that the DCCE estimator is derived assuming a balanced sample and its statistical properties are known in this case. To the best of our knowledge, the corresponding properties in the unbalanced case are yet unknown.

[5]The countries are: Argentina, Burundi, Benin, Bangladesh, Bolivia, Brazil, Central African Rep., Chile, Dominican Republic, Ecuador, Spain, Ghana, Gambia, Guatemala, Honduras, Hungary, Indonesia, Kenya, Lesotho, Madagascar, Mexico, Mali, Mauritania, Malawi, Niger, Nigeria, Nicaragua, Nepal, Pakistan, Peru, Philippines, Portugal, Sudan, Senegal, Sierra Leone, Thailand, Turkey, Uruguay, Venezuela, South Africa, Zambia.

more similar between the three estimation methods. The differences are particularly small between the WG and AB estimates, with the instantaneous effects ranging between 63% and .69% regardless of the number of lags used. Finally, as expected, the estimates of the persistence parameter are much lower (<.15 in all cases) than the corresponding estimates from the specification in levels.

Table 2 presents results obtained from two estimation methods: (1) the mean group (MG) estimate that is obtained by taking the average of the country-specific effects from least squares time series regressions estimated separately for each country; (2) the DCCE estimate that accounts for both parameter heterogeneity and cross section dependence. The role of the MG estimate is to isolate the impact of parameter heterogeneity from that of cross section dependence. The MG estimates are all bias-uncorrected. The standard errors for the MG and DCCE estimates are computed nonparametrically based on the standard deviation of the country-specific estimates. The medium and long run effects are based on bias-uncorrected estimates.

The results for GDP in levels are reported in Panel A of Table 2. The MG estimates of the current period effect of democracy are considerably larger than those reported in Table 1. The lowest MG estimate across the three specifications is about 1.71% while the highest among the homogeneous estimators is about .58%. Further, the MG estimates are all statistically significant at the 1% level. The medium and long run effects are also markedly larger across the three lag orders relative to those reported in Table 1.[6] For example, the estimated medium run effects range between 0.9%-8.6% for the homogeneous estimators while the MG estimates are all between 22-25%. These results indicate that parameter heterogeneity can have a substantial impact on the estimated effect of democracy. Turning to the DCCE estimates, the current period effects are between 1.5%-2% and broadly comparable to the corresponding MG estimates although for $p = 2$, the MG effect is somewhat more pronounced (∼1.87%) than the DCCE effect (∼1.51%). The magnitude of the DCCE medium and long run effects are strongly dependent on the lag order employed with the estimated effects being much larger (∼38%) when $p = 1$. When $p = 2$ or 4, the WG estimates from Table 1 are larger than the corresponding DCCE estimates while the opposite is true when $p = 1$.

Moving to results for the GDP growth rate presented in Panel B of Table 2, we find that the MG estimates are larger than the homogeneous estimates in Table 1, echoing the findings

[6] To compute the medium and long run effects using the MG estimator, we eliminated three countries Pakistan, Sierra Leone and Sudan as the country-specific effects in these cases were implausibly large and negative which dominated the average based on all countries. The DCCE estimates are, however, computed using all countries.

obtained from the data in levels. While the DCCE estimates are comparable in magnitude to the MG estimates when $p < 4$, the DCCE estimates are more notable with $p = 4$. The current period DCCE effects lie between 1.46%-1.65% while the corresponding range for the MG estimate is 1.42%-1.59%. In contrast to the results in levels, the DCCE estimates based on the growth rate are much less sensitive to the number of lags of the dependent variable used in the estimation.

In summary, the foregoing results suggest that parameter heterogeneity and cross section dependence can have important implications for the impact of democracy on economic growth and the DCCE framework appears to provide a useful extension to traditional dynamic panel approaches that can be used to quantify the influence of these features when evaluating the economic consequences of democratization.

4 Conclusion

This paper investigates the robustness of the democracy-growth relationship using an econometric approach that accounts for the twin features of parameter heterogeneity and cross section dependence. The estimates show that the finding of a positive and statistically significant effect of democracy on growth is robust to the presence of these features. It is important to stress, however, that our findings are specific to the dataset under consideration and do not necessarily generalize to countries outside our sample.

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Appendix A: Supplementary Results

This appendix contains supplementary results pertaining to formal diagnostic tests for parameter heterogeneity and cross section dependence (Section A.1) and estimates of the degree of cross section dependence (Section A.2).

A.1 Diagnostic Tests

In order to motivate the use of Chudik and Pesaran's (2015) dynamic common correlated effects (DCCE) approach, we conduct a set of diagnostic tests for parameter heterogeneity and cross section dependence, the two potential features of the data that the approach is designed to account for. When testing for the presence of one of these features, it is important to allow for the presence of the other so that the outcome of the test is not affected by model misspecification emanating from ignoring one of these features. We therefore test for parameter heterogeneity while allowing for cross section dependence and vice-versa. We only briefly describe the tests here and refer the reader to the original papers for details.

First, we conduct tests of the null hypothesis of slope homogeneity that allow for the potential presence of cross section dependence through an interactive fixed effects specification. Two procedures are employed in this regard: (1) the LM test of Su and Chen (2013) that is based on testing if the slope coefficients in the regression of the restricted (imposing homogeneity) residuals on the observable regressors are zero; (2) the Swamy-type test of Ando and Bai (2015) that is calculated from the dispersion of country-specific slope estimates from a pooled estimate, both of which are obtained from estimating an interactive effects model. The pooled estimate is taken to be the mean of the individual slope estimates. Both tests possess a standard normal limiting distribution under the null hypothesis. The results are presented in Panel A of Table A.1. When GDP is measured in levels, both tests are significant across the three lag order specifications at the 1% level, except the Su and Chen test with four lags that rejects only at the 5% level. For GDP growth, the evidence against slope homogeneity is weaker when based on the Su and Chen test although the Ando and Bai test still rejects the null at the 1% level in all cases.

Next, we consider procedures for testing cross section dependence. We use two tests to this end: (1) Pesaran's (2015) CD test which is based on estimated pairwise error correlations that allows for weak cross section dependence under the null hypothesis; (2) Castagnetti et al.'s (2015) test for homogeneous factor loadings computed using the maximum deviation of the estimated loadings from its mean so that the factor structure reduces to a time effect under the null hypothesis. To construct the CD test, the residuals are obtained from country-wise estimation of the dynamic heterogeneous model (1) which entails estimating N country-specific time series least squares regressions. The test has a standard normal limiting distribution under the null hypothesis so that standard critical values can be used. To construct the test based on factor loadings, we employ the DCCE estimates to obtain the residuals in the first step which are then used to estimate the factor loadings by principal components in a second step. The critical values of the test are obtained from the Gumbel distribution. The results are presented in Panel B of Table A.1. Regardless of whether GDP is measured in levels or first differences, both tests comprehensively reject the null hypothesis for all three lag order specifications.

A.2 Estimates of the Degree of Cross Section Dependence

Here we present estimates of the exponent or degree of cross section dependence using the approach proposed by Bailey et al. (2016). In particular, these authors propose a bias-corrected estimate of α, where α denote the rate at which the largest eigenvalue of the covariance matrix of the data grows with the cross-section sample size (N) with $1/2 < \alpha \leq 1$. The closer α is to unity, the higher is the degree of cross-section dependence and hence the more plausible is the presence of a common factor structure relative to a spatial structure. Table A.2 reports the estimate for each lag order specification when GDP is measured in levels or first differences. The results are suggestive of strong cross section dependence, with the exponent estimates in the range [.79,.83]. The estimates appear to be quite robust to the lag order as well as to the way in which GDP is measured.

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Table 1: The effect of democracy on GDP [WG, AB & HHK estimates]

Panel A	[GDP in levels]								
	WG, lag1	WG, lag2	WG, lag4	AB, lag1	AB, lag2	AB, lag4	HHK, lag1	HHK, lag2	HHK, lag4
Democracy	0.584	0.488	0.482	0.259	0.200	0.185	0.259	0.135	0.083
	(0.391)	(0.360)	(0.365)	(0.426)	(0.391)	(0.400)	(0.409)	(0.382)	(0.383)
Longrun effect	11.935	9.589	9.509	4.095	3.305	3.059	3.442	1.735	1.009
	(8.569)	(7.484)	(7.606)	(6.881)	(6.535)	(6.710)	(5.663)	(5.007)	(4.688)
Effect of democracy after 25 years	8.528	7.496	7.383	3.296	2.768	2.525	2.956	1.541	0.917
	(5.877)	(5.670)	(5.761)	(5.482)	(5.438)	(5.507)	(4.790)	(4.428)	(4.256)
Persistence of GDP process	0.951***	0.949***	0.949***	0.937***	0.939***	0.940***	0.925***	0.922***	0.918***
	(0.008)	(0.008)	(0.007)	(0.010)	(0.009)	(0.009)	(0.013)	(0.013)	(0.014)
Panel B	[GDP in growth]								
	WG, lag1	WG, lag2	WG, lag4	AB, lag1	AB, lag2	AB, lag4	HHK, lag1	HHK, lag2	HHK, lag4
Democracy	0.687*	0.674*	0.638*	0.691*	0.673*	0.639	0.552	0.488	0.495
	(0.354)	(0.367)	(0.370)	(0.379)	(0.392)	(0.392)	(0.481)	(0.469)	(0.535)
Longrun effect	0.785*	0.734*	0.665*	0.804*	0.758*	0.685	0.630	0.570	0.580
	(0.406)	(0.408)	(0.393)	(0.442)	(0.452)	(0.432)	(0.562)	(0.558)	(0.660)
Effect of democracy after 25 years	19.508*	18.320*	16.716*	19.963*	18.872*	17.202*	15.650	14.126	14.399
	(10.094)	(10.157)	(9.858)	(10.968)	(11.235)	(10.817)	(13.945)	(13.812)	(16.271)
Persistence of GDP process	0.124***	0.082*	0.040	0.140***	0.111**	0.067	0.122	0.143	0.146
	(0.038)	(0.049)	(0.061)	(0.038)	(0.046)	(0.064)	(0.078)	(0.097)	(0.148)
Observations	1476	1476	1476	1476	1476	1476	1476	1476	1476
Countries in sample	41	41	41	41	41	41	41	41	41

Notes: This table presents estimates of the effect of democracy on GDP per capita in levels and the growth rate of GDP using the balanced sample of 41 countries over 1975-2010. The reported coefficient on democracy is multiplied by 100. All specifications include a full set of country and year fixed effects. The estimators are denoted as: WG = Within groups; AB = Arellan-Bond GMM; HHK = Hahn et al. (2002) bias corrected estimator. We use *, ** and *** to denote significance at the 10%, 5% and 1% level, respectively.

Table 2: The effect of democracy on GDP [Mean Group & DCCE estimates]

Panel A	[GDP in levels]					
	MG, lag1	MG, lag2	MG, lag4	CCE, lag1	CCE, lag2	CCE, lag4
Democracy	1.861***	1.868***	1.715***	1.926**	1.514*	1.693*
	(0.425)	(0.409)	(0.459)	(0.808)	(0.824)	(0.872)
Longrun effect on GDP	23.798	44.965***	110.728*	38.214	5.375	5.992
	(19.819)	(11.715)	(58.092)	(24.761)	(3.500)	(3.990)
Effect of democracy after 25 years	24.816***	23.313***	22.480**	10.185	2.680	2.204
	(8.066)	(8.229)	(9.292)	(7.186)	(3.962)	4.029
Persistence	0.948***	0.935***	0.932***	0.948***	0.898***	1.059***
	(0.012)	(0.012)	(0.014)	(0.062)	(0.075)	(0.122)
Panel B	[GDP in growth]					
	MG, lag1	MG, lag2	MG, lag4	CCE, lag1	CCE, lag2	CCE, lag4
Democracy	1.585***	1.504***	1.428***	1.545**	1.463**	1.642**
	(0.368)	(0.363)	(0.370)	(0.661)	(0.703)	(0.827)
Longrun effect on GDP growth rate	1.897***	1.675***	1.533***	1.805**	1.734**	2.087**
	(0.468)	(0.415)	(0.378)	(0.702)	(0.743)	(0.916)
Effect of democracy after 25 years	46.769***	41.309***	37.198***	44.448**	42.314**	48.109**
	(11.518)	(10.260)	(9.360)	(17.342)	(18.178)	(21.115)
Persistence of growth rate process	0.161***	0.105***	0.076	0.194***	0.181**	0.446***
	(0.041)	(0.049)	(0.064)	(0.065)	(0.091)	(0.163)
Observations	1476	1476	1476	1476	1476	1476
Countries in sample	41	41	41	41	41	41

Notes: This table presents the mean group (MG) and the dynamic common correlated effects (DCCE) estimates of the effect of democracy on log GDP per capita and the growth rate of GDP. The reported coefficient on democracy is multiplied by 100. To compute the long run effects using the MG estimator, we eliminated three countries, Pakistan, Sierra Leone, and Sudan, as the country-specfic effects in these cases were implausible. The DCCE estimates are computed using all 41 countries. We use *, ** and *** to denote significance at the 10%, 5% and 1% level, respectively.

Table A.1: Diagnostic tests

Panel A Slope heterogeneity tests: Dependent variable	GDP level		GDP growth	
	Su and Chen (2013)	Ando and Bai (2015)	Su and Chen (2013)	Ando and Bai (2015)
one GDP lag	2.758***	39.344***	1.685*	12.210***
two GDP lags	2.966***	44.125***	1.797*	19.145***
four GDP lags	2.447**	52.818***	1.482	36.407***

Panel B Cross section dependence tests: Dependent variable	GDP level		GDP growth	
	Pesaran (2015)	Castagnetti et al. (2015)	Pesaran (2015)	Castagnetti et al. (2015)
one GDP lag	17.425***	33.580***	16.403***	55.022***
two GDP lags	17.433***	31.282***	16.188***	52.850***
four GDP lags	17.456***	33.997***	16.203***	58.374***

Notes: This table reports results of diagnostic tests for parameter heterogeneity and cross-sectional dependence. Panel A presents the Su and Chen (2013) and Ando and Bai (2015) tests for slope heterogeneity. The critical values for both tests are obtained from the standard normal distribution. Panel B reports the Pesaran (2015) CD test and the Castagnetti et al. (2015) test for cross-sectional dependence. The critical values of the former are obtained from the standard normal distribution and those of the latter are obtained from the Gumbel distribution. We use *, ** and *** to denote significance at the 10%, 5% and 1% level, respectively.

Table A.2: Estimates of the degree of cross-sectional dependence

Dependent variable	GDP level	GDP growth
one GDP lag	0.834	0.803
two GDP lags	0.797	0.794
four GDP lags	0.801	0.791

Notes: This table reports the degree of cross-sectional dependence suggested by Bailey et al. (2016). The estimates are calculated from equation (13) in that paper.