**Democratic Trajectories in the Third Wave: Aligning Theory and Methods**

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**Supplementary Materials**

Table S1. Conventional Assumptions about the Temporality of Fixed Effects, Hybrid, and Latent Growth Curve, Time-Series Cross-Sectional Models

|  |  |  |  |
| --- | --- | --- | --- |
| **Estimator:** | **Fixed-Effects** | **Hybrid (random- and-fixed effects)** | **Latent Growth Curve Models** |
| *How do conditions inherited at the time of the democratic transition that remain stable affect subsequent democratization?* | Because the inherited conditions are time invariant, their effects cannot be modeled. | Inherited conditions affect the beginning and the subsequent level of democracy. However, this effect is assumed to be constant over time.  | Inherited conditions affect the initial level of democracy and subsequent regime trajectories.  |
| *Can independent variables have enduring effects on levels of democracy?* | No. Effects are short-lived (affect a single year), irrespective of the lag structure.\* | Yes. The mean score for independent variables over time affects the mean level of democracy for each country, but their impact is stable over time. | Yes. The mean score for independent variables over time affects outcomes. Their impact can set positive or negative trajectories over time.  |
| *Can independent variables have enduring effects on regime trajectories over time?* | No. If time-varying influences are removed, cases regress to their means (determined by unobserved conditions). | No. If time-varying influences are removed, cases regress to their means (determined by cross-sectional covariates). | Yes. If time-varying influences are removed, cases regress to their latent trajectories (determined by cross-sectional covariates). |
| *Is the causal process assumed to be stationary?* | Yes. The stable reversionary levels are given by (unexplained) unit effects.\*\* | Yes. The stable reversionary levels are given by time-invariant covariates and by the average levels of time-varying covariates. | No. A latent trajectory is determined by time-invariant covariates and by average levels of time-varying covariates.\*\*\* |

\* Dynamic panel models assume a lasting effect of independent variables through the lagged dependent variable, but this effect decays over time, converging to zero.

\*\* Two-way fixed-effects models alternatively assume common (parallel) trends for all cases, but the causal process driven by relevant independent variables is still taken to be stationary.

\*\*\* The process is assumed to be trend-stationary (i.e., regressing to the trajectory).

Table S2. Descriptive Statistics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Mean | Min. | Max. | SD | N |
| *Level-1 variables* |  |  |  |  |  |
| Liberal democracy | 55.4 | 12.6 | 87.0 | 16.6 | 1730 |
| Growth (annual %) | 2.3 | -40.7 | 59.9 | 4.6 | 1675 |
| Per capita GDP (thousands) | 6.6 | 0.3 | 32.3 | 6.6 | 1682 |
| Gini index | 41.5 | 21.2 | 74.3 | 10.3 | 1630 |
| State capacity | 50.0 | 33.2 | 85.0 | 10.0 | 1731 |
| Region (% democratic) | 51.3 | 10.3 | 79.4 | 12.7 | 1731 |
| Age of the regime (t) | 11.5 | 0.0 | 42.0 | 9.0 | 1731 |
| *Level-2 variables* |  |  |  |  |  |
| Growth (unit mean) | 1.6 | -19.3 | 6.1 | 3.4 | 102 |
| Per capita GDP (unit mean) | 4.8 | 0.3 | 25.3 | 5.1 | 102 |
| Gini index (unit mean) | 41.7 | 25.2 | 72.4 | 9.2 | 99 |
| State capacity (unit mean) | 52.5 | 37.8 | 80.1 | 10.5 | 103 |
| Region (unit mean) | 49.8 | 11.2 | 67.1 | 9.6 | 103 |
| First year of democracy | 1996 | 1975 | 2013 | 9.3 | 103 |

Table S3. Alternative Polynomial Specifications for the Latent Growth Curve

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Order of *T* | N | ll(model) | Parameters | AIC | BIC | % changein BIC |
| 0 (no curve) | 1,730 | -5524.13 | 3 | 11054.26 | 11070.63 |  |
| 1 | 1,730 | -5310.39 | 5 | 10630.77 | 10658.05 | -3.73 |
| 2 | 1,730 | -4987.43 | 7 | 9988.86 | 10027.05 | -5.92 |
| 3  | 1,730 | -4973.04 | 9 | 9964.09 | 10013.19 | -0.14 |
| 4 | 1,730 | -4914.89 | 11 | 9851.77 | 9911.79 | -1.01 |
| 5 | 1,730 | -4886.94 | 13 | 9799.87 | 9870.80 | -0.41 |

*Note*: the table reflects the performance of models without covariates, using alternative transformations of *T* to capture the shape of the latent growth curve. The model of order 0, included for reference, is a random effects model without a time trend.

Table S4. Nested Growth Curve Models

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | S4.1 | Baseline | S4.2 | Between | 1.3 | Within |
|  | b | (s.e.) | b | (s.e.) | b | (s.e.) |
| **Within Effects** |  |  |  |  |  |  |
| Economic growth |  |  |  |  | -0.0 | (0.0) |
| Per cap GDP (ths) |  |  |  |  | -0.2 | (0.2) |
| Gini index |  |  |  |  | -0.1\* | (0.0) |
| State capacity |  |  |  |  | -0.1 | (0.1) |
| Regional democracy |  |  |  |  | -0.0 | (0.0) |
| **Between Effects** |  |  |  |  |  |  |
| Growth (mean) |  |  | 1.1\* | (0.4) | 1.1\* | (0.4) |
| Per cap GDP (mean) |  |  | 1.2\* | (0.3) | 1.1\* | (0.3) |
| Gini index (mean) |  |  | -0.2 | (0.1) | -0.2 | (0.1) |
| State capacity (mean) |  |  | -0.1 | (0.1) | -0.1 | (0.1) |
| Regional democracy (mean) |  |  | 0.0 | (0.1) | 0.0 | (0.1) |
| First year of democracy |  |  | -0.3 | (0.2) | -0.3 | (0.2) |
| **Latent Trend** |  |  |  |  |  |  |
| Years (since transition) | -0.0 | (0.3) | 69.6 | (48.2) | 67.0 | (47.7) |
|  \*Growth (mean) |  |  | 0.4\* | (0.1) | 0.4\* | (0.1) |
|  \*Per cap GDP (mean) |  |  | 0.1 | (0.1) | 0.1 | (0.1) |
|  \*Gini index (mean) |  |  | 0.0 | (0.0) | 0.0 | (0.0) |
|  \*State capacity (mean) |  |  | 0.0 | (0.0) | 0.0 | (0.0) |
|  \*Regional democracy (mean) |  |  | 0.0 | (0.0) | 0.0 | (0.0) |
|  \*First year of democracy |  |  | -0.0 | (0.0) | -0.0 | (0.0) |
| Years^2 | -0.0\* | (0.0) | 5.0 | (3.3) | 5.5 | (3.2) |
|  \*Growth (mean) |  |  | 0.0 | (0.0) | -0.0 | (0.0) |
|  \*Per cap GDP (mean) |  |  | -0.0 | (0.0) | -0.0 | (0.0) |
|  \*Gini index (mean) |  |  | -0.0 | (0.0) | -0.0 | (0.0) |
|  \*State capacity (mean) |  |  | -0.0 | (0.0) | -0.0 | (0.0) |
|  \*Regional democracy (mean) |  |  | -0.0 | (0.0) | -0.0 | (0.0) |
|  \*First year of democracy |  |  | -0.0 | (0.0) | -0.0 | (0.0) |
| Years^3 | -0.0 | (0.0) | -0.1 | (0.1) | -0.1 | (0.1) |
|  \*Growth (mean) |  |  | 0.0 | (0.0) | 0.0 | (0.0) |
|  \*Per cap GDP (mean) |  |  | 0.0 | (0.0) | 0.0 | (0.0) |
|  \*Gini index (mean) |  |  | 0.0 | (0.0) | 0.0 | (0.0) |
|  \*State capacity (mean) |  |  | 0.0 | (0.0) | 0.0 | (0.0) |
|  \*Regional democracy (mean) |  |  | 0.0\* | (0.0) | 0.0\* | (0.0) |
|  \*First year of democracy |  |  | 0.0 | (0.0) | 0.0 | (0.0) |
| Intercept | 46.5\* | (1.4) | 612.8\* | (300.3) | 603.2\* | (299.6) |
| Variance [% change] |  |  |  |  |  |  |
| Years  | 5.2 |  | 1.9 | [-63.1] | 1.9 | [-3.1] |
| Years^2 | 0.005 |  | 0.002 | [-50.5] | 0.002 | [-4.4] |
| Years^3 | 0.000002 |  | 0.000001 | [-63.5] | 0.000001 | [-15.2] |
| Intercept | 192.7 |  | 99.8 | [-48.2] | 98.5 | [-1.3] |
| Residual | 8.6 |  | 9.1 | [6.3] | 9.1 | [0.0] |
| N | 1595 |  | 1595 |  | 1595 |  |

\* p < .05 (Most figures rounded to one decimal point for reasons of space).

Table S4 reports three nested models: a growth-curve model without any covariates (S4.1), the same model with only level-2 covariates (S4.2), and the full model reported in the body of the paper (Model 1.3 in Table 1). In order to assess the contribution of our approach focused on the inclusion of level-2 country averages, the bottom panel of the table compares the variance of random components across the three models. The inclusion of level-2 averages accounts for almost 50% of the variance in country intercepts, and between 50 and 60% of the variance in latent trajectories. The inclusion of additional level-1 predictors, however, barely improves the performance of Model S4.2. A likelihood ratio test comparing Models S4.1 and S4.2 rejects the null (Chi2[24] = 113.90, p < .01), while a likelihood ratio test comparing Models S4.2 and 2.3 shows no improvement in the goodness of fit (Chi2[5] = 8.83, p < .12). Thus, the inclusion of the country averages accounts for the explanatory power of Model 1.3.

Table S5. Extended Fixed-Effects Models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | (1.3) | (S5.1) | (S5.2) | (S5.3) |
| Within Effects | Growth Curve | TWFE | Cumulative growth | Dynamic panel |
| Economic growth | -0.027 | -0.065\* | -0.006 | -0.018 |
|  | (0.021) | (0.032) | (0.036) | (0.018) |
| Per capita GDP (thousands) | -0.206 | 0.150 | 0.313\* | -0.164\* |
|  | (0.161) | (0.091) | (0.063) | (0.037) |
| Gini index | -0.079\* | -0.045 | -0.028 | 0.011 |
|  | (0.035) | (0.040) | (0.040) | (0.025) |
| State capacity | -0.059 | 0.104 | 0.035 | 0.035 |
|  | (0.066) | (0.063) | (0.060) | (0.037) |
| Regional democracy | -0.002 | 0.066\* | 0.100\* | -0.012 |
|  | (0.018) | (0.018) | (0.016) | (0.010) |
| Cumulative growth, mean |  |  | -0.102 |  |
|  |  |  | (0.089) |  |
| Democracy, t-1 |  |  |  | 0.851\* |
|  |  |  |  | (0.018) |
| Intercept | 603.198\* | 30.933\* | 47.850\* | 7.866\* |
|  | (299.629) | (6.337) | (3.804) | (2.470) |
| Regime fixed effects | No | Yes | Yes | Yes |
| Year fixed effects | No | Yes | No | No |
| Latent growth curve | Yes | No | No | No |
| RMSE | 2.795 | 4.653 | 4.840 | 2.799 |
| Change in RMSE (%) |  | 66.5 | 73.2 | 0.1 |
| N | 1595 | 1595 | 1595 | 1509 |

Entries are within-effects coefficients (standard errors). \* *p* < 0.05

Note: *Cumulative growth* reflects the average growth rate between *t* = 0 and *t*.

Table S5 compares the performance of the growth curve model (1.3, in Table 1) against three extended fixed-effects models: a two-way fixed-effects model including year fixed effects; a model including the average rate of economic growth up to time *t* as a time-varying covariate, and a dynamic panel model including a lagged dependent variable. Model 1.3 outperforms the alternatives: the root mean squared error increases by 66% in the two-way fixed-effects model, by 73% in the cumulative growth model, and even (barely) by 0.1% in the dynamic panel model.

**Addressing Potential Endogeneity in Growth Curve Models**

As discussed in the main body of the paper, one of the plausible mechanisms explaining cumulative effects involves reverse causation, or the possibility that democracy itself conditions the rate of economic growth. Several studies have documented this possibility (Acemoglu et al. 2008; 2019; Colagrossi et al. 2020; Przeworski et al. 2000). This possibility introduces potential endogeneity bias in our estimates. Such bias is less relevant if we only seek to *predict* democratic trajectories, but it is a source of concern if we seek to estimate the *causal effect* of economic growth on democratic trajectories.

Although we do not intend to settle the direction of causality between economic growth and democracy in this article, this section illustrates potential solutions to endogeneity in the application of latent growth curve models. A feasible two-stage estimator for our growth curve model must address not only the conventional problem of finding a valid instrument, but also how to incorporate this instrument to a procedure in which the endogenous variable is centered, and its unit average is interacted with multiple transformations of the time trend. We address the two problems below.

**Instrument for Economic Growth**. The literature has used multiple instruments for economic growth, including geographic conditions, policy shocks, and historical legacies. We identify an instrument consistent with the theoretical framework outlined in the body of the paper. Assume that, in a context of reverse causality, economic performance *g*it is shaped by the institutional context *d*it-1, and by a short-term economic shock uit, such that *g*it = α + β*d*it-1 + uit. We estimate this equation using OLS, under the strong assumption that any correlation between democracy at *t*-1 and economic growth at time *t* is driven by the effects of the institutional context on economic performance, captured by coefficient β.[[1]](#footnote-1) The error term of this equation, uit, captures *residual growth*, the proportion of economic growth that cannot be attributed to the democratic environment. We treat residual growth as a valid instrument for the purpose of addressing reverse causation. The instrument is relevant because, by construction, it is correlated with the endogenous variable (r = .99). It also meets the exclusion restriction *if we assume that reverse causality is the sole source of endogeneity*, because uit only affects the dependent variable *d*it as a component of *g*it, and because it has been “purged” of any influence of *d*it-1.

If we accept that error term uit represents “residual” economic growth we can, in principle, treat this as a (partial) indicator of our main independent variable. Table S6 compares the results of our original growth curve model (1.3 in Table 1) against an alternative model using this “purged” measure. In Model S6.1, all items referring to economic growth (the centered variable, the level-2 mean, and the three interactions with time) are calculated using residual growth (uit) rather than the observed change in per capita GDP (*g*it). The results are consistent across both models.[[2]](#footnote-2)

Table A6. Growth Curve Models with Instrumental Variables

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 1.3 |  | S6.1 |  | S6.2 |  |
|  | Original Table 1 |  | Residual growth |  | 2SRI |  |
|  | b | se | b | se | B | se |
| **Within Effects** |  |  |  |  |  |  |
| Economic growth | -0.03 | (0.02) | -0.04\* | (0.02) | -0.03 | (0.02) |
| Per capita GDP (thousands) | -0.21 | (0.16) | -0.23 | (0.15) | -0.57\* | (0.12) |
| Gini index | -0.08\* | (0.04) | -0.06 | (0.03) | 0.08\* | (0.03) |
| State capacity | -0.06 | (0.07) | -0.03 | (0.07) | 0.29\* | (0.05) |
| Regional democracy | -0.00 | (0.02) | -0.00 | (0.02) | -0.03 | (0.01) |
| **Between Effects** |  |  |  |  |  |  |
| Growth (mean) | 1.06\* | (0.40) | 1.20\* | (0.48) | 0.94\* | (0.24) |
| Per cap GDP (mean) | 1.11\* | (0.34) | 1.19\* | (0.38) | 1.36\* | (0.18) |
| Gini index (mean) | -0.19 | (0.13) | -0.22 | (0.15) | -0.08 | (0.07) |
| State capacity (mean) | -0.10 | (0.14) | -0.07 | (0.16) | 0.04 | (0.08) |
| Regional democracy (mean) | 0.01 | (0.13) | 0.16 | (0.15) | 0.18\* | (0.07) |
| First year of democracy | -0.28 | (0.15) | -0.34\* | (0.17) | -0.23\* | (0.08) |
| **Latent Trend** |  |  |  |  |  |  |
| Years since transition | 67.00 | (47.73) | 38.56 | (46.68) | -8.81 | (21.45) |
|  \*Growth (mean) | 0.40\* | (0.09) | 0.29\* | (0.10) | 0.10 | (0.06) |
|  \*Per cap GDP (mean) | 0.07 | (0.05) | 0.08 | (0.05) | 0.02 | (0.02) |
|  \*Gini index (mean) | 0.04 | (0.02) | 0.05\* | (0.02) | -0.01 | (0.01) |
|  \*State capacity (mean) | 0.01 | (0.02) | 0.01 | (0.03) | -0.03\* | (0.01) |
|  \*Regional democracy (mean) | 0.04 | (0.02) | -0.01 | (0.02) | 0.02 | (0.01) |
|  \*First year of democracy | -0.04 | (0.02) | -0.02 | (0.02) | 0.01 | (0.01) |
| Years^2 | 5.51 | (3.25) | 5.05 | (3.70) | 5.67\* | (1.66) |
|  \*Growth (mean) | -0.00 | (0.01) | 0.00 | (0.01) | -0.00 | (0.00) |
|  \*Per cap GDP (mean) | -0.00 | (0.00) | -0.00 | (0.00) | 0.00 | (0.00) |
|  \*Gini index (mean) | -0.00 | (0.00) | -0.00 | (0.00) | 0.00\* | (0.00) |
|  \*State capacity (mean) | -0.00 | (0.00) | 0.00 | (0.00) | -0.00 | (0.00) |
|  \*Regional democracy (mean) | -0.00 | (0.00) | 0.00 | (0.00) | -0.01\* | (0.00) |
|  \*First year of democracy | -0.00 | (0.00) | -0.00 | (0.00) | -0.00\* | (0.00) |
| Years^3 | -0.09 | (0.10) | -0.01 | (0.11) | -0.22\* | (0.04) |
|  \*Growth (mean) | 0.00 | (0.00) | 0.00 | (0.00) | 0.00 | (0.00) |
|  \*Per cap GDP (mean) | 0.00 | (0.00) | 0.00 | (0.00) | -0.00 | (0.00) |
|  \*Gini index (mean) | 0.00 | (0.00) | 0.00 | (0.00) | -0.00\* | (0.00) |
|  \*State capacity (mean) | 0.00 | (0.00) | 0.00 | (0.00) | 0.00\* | (0.00) |
|  \*Regional democracy (mean) | 0.00\* | (0.00) | 0.00 | (0.00) | 0.00\* | (0.00) |
|  \*First year of democracy | 0.00 | (0.00) | 0.00 | (0.00) | 0.00\* | (0.00) |
| Control function |  |  |  |  | 35.28\* | (0.94) |
| Intercept | 603.20\* | (299.63) | 732.43\* | (336.70) | 492.65\* | (158.27) |
| N | 1595 |  | 1509 |  | 1509 |  |

\* *p* < 0.05 (Variance components omitted to save space)

**Two Stage Residual Inclusion**. The reduced-form equation implemented in Model S6.1 is intuitive because uit is a partial component of growth, rather than a more traditional exogenous instrument. But for general purposes, we need an estimator able to accommodate traditional instruments. Conventional two-stage least squares (2SLS) is not practical, because our growth curve estimator requires multiple transformations of the endogenous variable (centering, extracting the unit means, and interacting the unit means with the time trend) that demand a large number of instruments (Wooldridge 2015, 429). As a feasible alternative, we propose the use of a two-stage residual inclusion (2SRI) estimator (Terza et al. 2008). While 2SLS substitutes the endogenous variable with the predicted value of the first-stage equation, 2SRI preserves the endogenous variable and adds the residual of the first-stage equation as a control function in the second-stage equation. In the canonical case, the estimate of both approaches is equivalent, but the 2SRI estimator offers a more parsimonious way to account for endogeneity when the endogenous variable interacts with several exogenous variables.

Model S6.2 reflects the results of a 2SRI estimation in which the instrument *residual growth*, plus all the exogenous predictors (including their level-2 means and interactions), are used to predict the rate of economic growth in the first-stage equation. The residual of this equation is then introduced as a control function in the second-stage equation, corresponding to the growth curve model. The results track closely the estimates of our original Model 2.3.

To compare the results of the three models, Figure S1 displays simulated democratic trajectories for two hypothetical regimes with 1% and 5% average growth rates, based on Models 2.3, S6.1, and S6.2. Although the predictions vary somewhat (with 2SRI showing the narrower gap between the two cases) all figures reflect a stronger democratic trajectory in contexts of sustained economic performance.

Figure S1. Predicted Democratic Trajectories in Endogeneity Models



Note: Simulations based on models 1.3, S6.1, and S6.2 in Table S6. The figure for model 1.3 is equivalent to Figure 2.1 in the main body of the paper.

**References**

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1. The OLS results are *g*it = 1.14 + 0.02(*d*it-1) + uit , with both estimates significant at p < .001 [↑](#footnote-ref-1)
2. To facilitate the estimation, we do not bootstrap the standard errors in models S6.1 and S6.2, since the p-values for individual coefficients are not particularly informative. [↑](#footnote-ref-2)