Replication of Bond et al 2001

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```
library(plm)
library(here)
library(pder)
library(data.table)
library(stargazer)
```

```
data("DemocracyIncome", package = "pder")
```

General setting

The econometric model is given as follows:

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

where d_{it} represents the democracy index of country i in year t, α is the autoregressive parameter to be estimated (and which accounts for persistency and mean-reverting dynamics). γ is the parameter on the impact of lagged income y. It is the main parameter of interest in this study. $\boldsymbol{x}'$ contains additional controls, μ_t are time, and δ_i are country fixed effects. The idiosyncratic error is u_{it}.

In the following we replicate the first five models of table 2 in the main paper.

Replication of the main results

Pooled OLS

The POLS model does not consider any country fixed effects (i.e. excludes δ_i):

```
pols_model <- plm(
  democracy ~ lag(democracy) + lag(income), model = "within",
  data = DemocracyIncome, #index = c("country", "year_numeric"),
  subset = sample==1, effect = "time")
pols_model
```

```
##
## Model Formula: democracy ~ lag(democracy) + lag(income)
##
## Coefficients:
## lag(democracy)    lag(income)
##       0.706370       0.072318
```

Within model

The *within*-model is the same as the POLS model but with δ_i included:

```r
within_model <- plm(
  democracy ~ lag(democracy) + lag(income), model = "within",
  data = DemocracyIncome, subset = sample==1, effect = "twoways")
within_model
```

```
##
## Model Formula: democracy ~ lag(democracy) + lag(income)
##
## Coefficients:
## lag(democracy)    lag(income)
##       0.378628       0.010415
```

Anderson-Hsiao

This is an estimation estimates the model from above in differences:

$$\Delta d_{ut} = \alpha \Delta d_{it-1} + \gamma \Delta y_{it-1} + \Delta + \boldsymbol{x}'\boldsymbol{\beta} + \Delta \mu_t + \Delta u_{it}$$

Using differences eliminates the country specific error component δ_i. Nevertheless, Δd_{it-1} and Δy_{it-1} are correlated with u_{it} by construction. To remedy this, y_{it-1} is used as an instrument for Δy_{it-1} and d_{it-2} is used as an instrument for Δd_{it-1}:

```r
ahsiao_model <- plm(
  diff(democracy) ~ lag(diff(democracy)) + lag(diff(income)) |
    lag(democracy, 2) + lag(income, 2),
  data = DemocracyIncome, subset = sample==1,
  model = "within", effect = "time")
ahsiao_model
```

```
##
## Model Formula: diff(democracy) ~ lag(diff(democracy)) + lag(diff(income)) |
##     lag(democracy, 2) + lag(income, 2)
##
## Coefficients:
## lag(diff(democracy))    lag(diff(income))
##              0.46866             -0.10358
```

Arellano Bond

```r
abond_model <- pgmm(
  democracy ~ lag(democracy) + lag(income) | lag(democracy, 2:99) | lag(income, 2),
  data = DemocracyIncome, subset = sample==1, effect = "twoways", model = "twostep")
summary(abond_model)
```

```
## Twoways effects Two steps model
##
## Call:
## pgmm(formula = democracy ~ lag(democracy) + lag(income) | lag(democracy,
##     2:99) | lag(income, 2), data = DemocracyIncome, subset = sample ==
##     1, effect = "twoways", model = "twostep")
##
## Balanced Panel: n = 211, T = 11, N = 2321
##
## Number of Observations Used: 838
```

```
##
## Residuals:
##      Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
## -1.300692 -0.003145  0.000000  0.001891  0.000000  1.078669
##
## Coefficients:
##                  Estimate Std. Error z-value Pr(>|z|)
## lag(democracy) 0.5540073  0.1078303  5.1378 2.78e-07 ***
## lag(income)    0.0018436  0.0605379  0.0305   0.9757
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Sargan test: chisq(44) = 49.8814 (p-value = 0.25098)
## Autocorrelation test (1): normal = -4.457875 (p-value = 8.2776e-06)
## Autocorrelation test (2): normal = 0.8592423 (p-value = 0.39021)
## Wald test for coefficients: chisq(2) = 28.13308 (p-value = 7.78e-07)
## Wald test for time dummies: chisq(9) = 33.6682 (p-value = 0.00010211)
```

```
stargazer(
  pols_model, within_model, ahsiao_model, abond_model)
```

% Table created by stargazer v.5.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harvard.edu
% Date and time: Mon, May 31, 2021 - 18:13:08

Table 1:

	Dependent variable:			
	democracy		diff(democracy)	democracy
	panel linear		*panel linear*	*panel GMM*
	(1)	(2)	(3)	(4)
lag(democracy)	0.706***	0.379***		0.554***
	(0.024)	(0.033)		(0.108)
lag(income)	0.072***	0.010		0.002
	(0.008)	(0.026)		(0.061)
lag(diff(democracy))			0.469***	
			(0.118)	
lag(diff(income))			−0.104	
			(0.305)	
Observations	945	945	838	211
R^2	0.710	0.144	0.058	
Adjusted R^2	0.707	−0.030	0.047	
F Statistic	1,144.606*** (df = 2; 934)	65.819*** (df = 2; 785)	20.878***	
Note:				*p<0.1; **p<0.05; ***p<0.01