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# Explaining the Gastil Democracy Index

## Using the Polity scale for comparison

The following is a small note meant as an accompanying note to three other papers, which try to explain an index of democracy. Three indices of democracy exist of which the two are listed in table 1.

Table 1. The three indices measuring the degree of democracy

| Index: | Home: | Start | Countries | Scale | Scale | Conversion |
|---|---|---|---|---|---|---|
| 1. Gastil, $\gamma$ | Freedom House | 1972 | 171 plus | Min 7 | Max 1 | $\Pi = (40 - 10\gamma)/3$ |
| 2. Polity, $\Pi$ | Center for Intern. Dev. and Conflict Management, Univ. of Maryland | 1800 | 52 from 1900, now 160 | Min -10 | Max 10 | $4 - 0.3\Pi = \gamma$ |

Note: *Min* is for full dictatorship, and *max* is for full democracy. The conversions are endpoint consistent.

Index 1 is analyzed in Paldam (2004) and Borooah and Paldam (2005). Index 2 is analyzed in Jensen and Paldam (2005). We want to estimate models as:

(1) $\quad \gamma_{it}^{T} = \alpha + \beta^{T}\gamma_{it-1} + \delta^{T}y_{it-1} + \lambda_1 OW_i + \lambda_2 Oil_{it} + \lambda_3 Mu_i + \lambda_4 Co_i + \lambda_5 Tr_6 + u_{it}$, or

(2) $\quad \gamma_{it}^{T} = \alpha + \varphi^{T}y_{it-1} + \lambda_1 OW_i + \lambda_2 Oil_{it} + \lambda_3 Mu_i + \lambda_4 Co_i + \lambda_5 Tr_6 + u_{it}$

with the variables:

(1) $\quad \gamma_{it}^{T}$, average $\gamma$-score for a period of $T$ years from $t$ to $t+T$. Range from -10 to +10.

(2) $\quad \gamma_{it-1}$, initial $\gamma$-score for the year before each period starts. Integer range -10 and +10.

(3) $\quad y_{it-1}$, log to initial gdp, i.e. GDP per capita for the year before each period starts. We use the natural logarithm to the data from Maddison (2003).

(4) $\quad OW_i$, the Old West is western countries that were high income countries by the World Bank definition throughout the period covered.

(5)      $Oil_{it}$, countries where more than 50% of export are oil and gas.

(6)      $Mu_i$, countries with a majority of Muslims. If it is dubious if the criterion is fulfilled (e.g. in the case of Nigeria and Sudan) we use the secondary criterion that the government is Muslim (so that Nigeria is non-Muslim, while Sudan is Muslim).

(7)      $Co_i$, countries with a communist government, include Cambodia, Laos, Sandinist Nicaragua and Cuba.

(8)      $Tr_i$, countries under transition from communism.

Variables 4 to 8 are binary dummies, which are 1 if the event occurs and zero else.

Two problems have to be addressed: (i) The indices are related to development in the sense that as countries go through the Grand Transition democracy results, so the connection to gdp is broad. (ii) The indices have strong inertia: The degree of democracy tends to stay unchanged for some time. To asses the inertia we calculate the following persistence measures for the two indices, $x = \gamma, \Pi$:

(3)  $Cor_i(x_t, x_{t+j})$, for $j = 1,...20$         cross country persistence function

(4)  $Cor_i(x_t, x_{t+1}^T)$, for $N = 1,...20$     cross country persistence between intial and average $x^T$

(5)  $Avr_i(cor(x_{it}, x_{it+1}))$, for $j = 0,...30$   average autocorrelation function

Figure1. Persistence measures in the Gastil index 135-154 countries 1972-2004

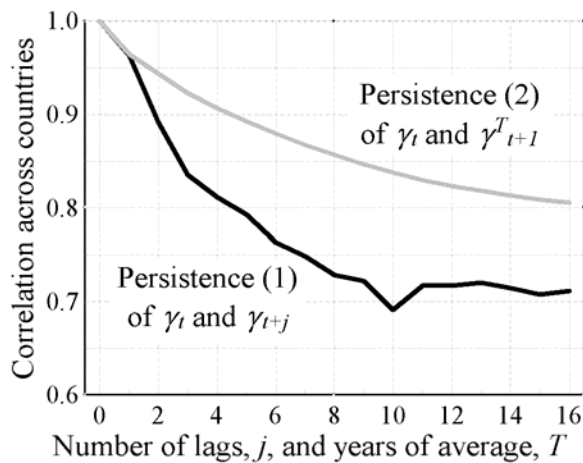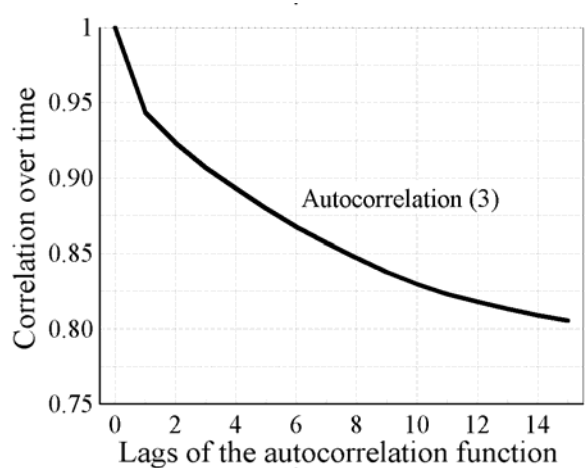Figure 1a. Cross-country persistence          Figure 1b. Average autocorrelation function



Note: Calculated on stacked data, with 289 observations compared with the initial years 1972 and 1988.

In order to explain average $\gamma_{it}^T$ by initial $\gamma_{t-1}$ it is important that $T$ is so large that the two terms are not so correlated as to generate a unit root destroying the estimate. From figures 1 and 2 it is obvious that to a correlation between the two that is no higher than 0.80, we need to choose $T = 20$ for the Polity index (and even then it is rather too high) and $T = 16$ for the Gastil index.

The key variables have the following relation:

(6a) $\quad \gamma_{it}^T = \alpha_{(i)}^T + \beta^T \gamma_{it-1} + \delta^T y_{it-1} + u_t$ $\qquad$ as estimated

(6b) $\quad \gamma_i^\infty = \dfrac{\alpha^T}{1-\beta^T} + \dfrac{\delta^T}{1-\beta^T} y_i = \alpha^\infty + \delta^\infty y_i$ $\quad$ gives the implied steady state values

(6c) $\quad \gamma_{it}^T = \alpha_{(i)} + \varphi^T y_{it-1} + u_t$ $\qquad$ as estimated. Here $\varphi^T \to \delta^\infty$, for large $T$'s

It follows that if $T$ is too small then $\beta \approx 1$ and $\delta^T \to 0$.

Figure 2. Persistence measures in the Polity index 52 countries 1900-2003

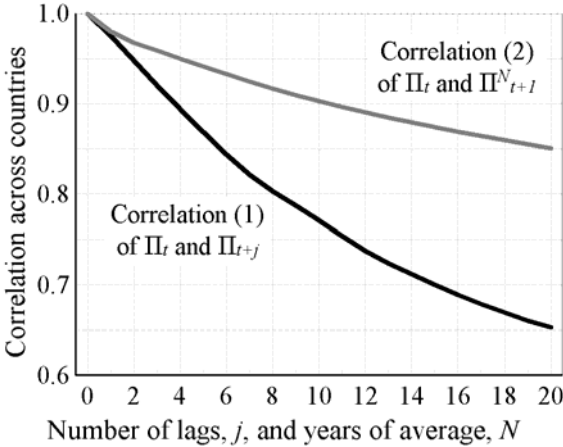Figure 2a. Cross-country persistence $\qquad$ Figure 2b. Average autocorrelation function
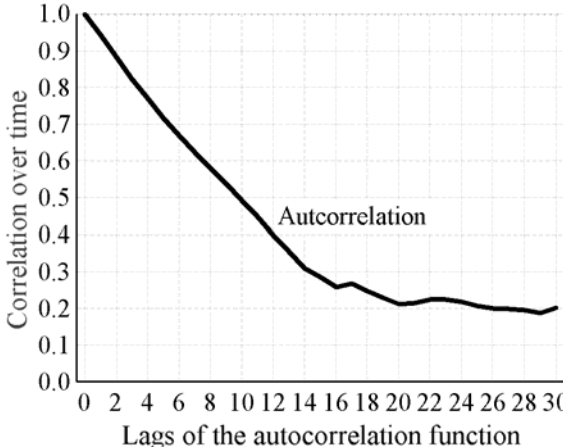


For $T = 16$ we get two period for the Gastil Index only: That is 1972 and 1988 are used as the two initial years and the two 16 year periods are Per 1: 1973 to 1988, and Per 2: 1989 to 2003. This is a great year for the break, as it corresponds almost perfectly with the collapse of communism in Eastern Europe and the beak up of two federations of states: the Soviet Union that became 15 new countries and Yugoslavia that became 5 countries. The gdp-data used are the Maddison data that does have a couple of estimates of the gdp for the members of both old unions so that we can estimate data for all the new countries for 1998.

Table 2. Estimates of the model: $\gamma_{it}^{16} = \alpha + \beta^{16}\gamma_{it-1} + \delta^{16}y_{it-1} + u_t$

| | Model with initial level | | | Full adjustment enforced | | |
|---|---|---|---|---|---|---|
| | Period 1 | Period 2 | All years | Period 1 | Period 2 | All years |
| | 73-88 | 89-04 | 73-04 | 73-88 | 89-04 | 73-04 |
| Constant | **-11.45** | **-9.59** | **-11.01** | **-30.44** | **-26.85** | **-29.06** |
| | (-5.0) | (-3.0) | (-5.5) | (-9.2) | (-8.7) | (-12.8) |
| Gastil init | **0.72** | **0.55** | **0.63** | | | |
| | (15.9) | (8.9) | (15.7) | | | |
| Ln y init | **1.41** | **1.34** | **1.44** | **3.65** | **3.36** | **3.56** |
| | (5.0) | (3.5) | (5.9) | (8.7) | (8.9) | (12.7) |
| $R^2$ adjusted | 0.78 | 0.56 | 0.65 | 0.36 | 0.34 | 0.36 |
| N | 135 | 154 | 289 | 135 | 154 | 289 |
| | | | | Missing to steady state | | |
| $\delta^{\infty} = \delta^{16}/(1-\beta^{16})$ | 5.04 | 2.98 | 3.89 | | | |
| $(\delta^{\infty} - \varphi^{16})/\delta^{\infty}$ | | | | 28% | -13% | 9% |

Table 3. Estimates of $\gamma_{it}^{16} = \alpha + \beta^{16}\gamma_{it-1} + \delta^{16}y_{it-1} + \lambda_1 OW_i + \lambda_3 Mu_i + u_t$

| | Period 1 | Period 2 | All years | Period 1 | Period 2 | All years |
|---|---|---|---|---|---|---|
| | 73-88 | 89-04 | 73-04 | 73-88 | 89-04 | 73-04 |
| Constant | **-8.93** | **-7.42** | **-9.08** | **-16.84** | **-15.38** | **-17.49** |
| | (-3.9) | (-2.5) | (-4.6) | (-5.2) | (-5.0) | (-7.7) |
| Gastil init | **0.63** | **0.44** | **0.54** | | | |
| | (12.6) | (6.9) | (12.4) | | | |
| Ln y init | **1.05** | **1.17** | **1.24** | **1.81** | **2.03** | **2.11** |
| | (3.6) | (3.3) | (5.0) | (4.3) | (5.3) | (7.3) |
| Old West | **3.31** | 1.56 | **2.01** | **9.58** | **5.58** | **7.10** |
| | (3.2) | (1.2) | (2.3) | (7.0) | (4.3) | (7.3) |
| Muslim | **-1.19** | **-4.17** | **-2.72** | **-1.79** | **-4.96** | **-3.50** |
| | (-2.1) | (-6.1) | (-5.6) | (-2.1) | (-6.4) | (-5.9) |
| $R^2$ adjusted | 0.80 | 0.65 | 0.69 | 0.56 | 0.54 | 0.53 |
| N | 135 | 154 | 289 | 135 | 154 | 289 |
| | Implied steady state effect of income | | | Missing to steady state | | |
| $\delta^{\infty} = \delta^{16}/(1-\beta^{16})$ | 2.84 | 2.09 | 2.70 | | | |
| $(\delta^{\infty} - \varphi^{16})/\delta^{\infty}$ | | | | 36% | 3% | 22% |

Table 4. Estimates of $\gamma_{it}^{16} = \alpha + \beta^{16}\gamma_{it-1} + \delta^{16}y_{it-1} + \lambda_1 OW_i + \lambda_2 Oil_{it} + \lambda_3 Mu_i + \lambda_4 Co_i + \lambda_5 Tr_6 + u_t$

| | Period 1 73-88 | Period 2 89-04 | All years 73-04 | Period 1 73-88 | Period 2 89-04 | All years 73-04 |
|---|---|---|---|---|---|---|
| Constant | **-10.04** | **-12.48** | **-13.04** | **-11.05** | **-6.03** | **-8.94** |
| | (-3.8) | (-4.0) | (-6.1) | (-4.4) | (-1.8) | (-4.2) |
| Gastil init | **0.63** | **0.47** | **0.54** | **0.55** | **0.42** | **0.49** |
| | (12.3) | (7.1) | (12.2) | (10.8) | (6.2) | (11.3) |
| Ln y init | **1.16** | **1.74** | **1.70** | **1.38** | **1.02** | **1.25** |
| | (3.3) | (4.4) | (6.2) | (4.1) | (2.4) | (4.5) |
| Oil | -0.73 | **-4.48** | **-3.07** | -0.80 | **-2.59** | **-1.81** |
| | (-0.8) | (-4.6) | (-4.5) | (-0.9) | (-2.8) | (-2.8) |
| Old West | **3.35** | 0.72 | 1.51 | **2.90** | 1.78 | **2.15** |
| | (3.0) | (0.5) | (1.6) | (2.8) | (1.5) | (2.6) |
| Muslim | | | | **-1.63** | **-3.95** | **-2.82** |
| | | | | (-2.8) | (-6.0) | (-6.1) |
| Communist | | | | **-3.25** | **-6.80** | **-4.81** |
| | | | | (-4.0) | (-4.7) | (-6.3) |
| Transition | | | | n.a. | 1.55 | **2.42** |
| | | | | | (1.7) | (3.4) |
| R² adjusted | 0.79 | 0.62 | 0.68 | 0.82 | 0.72 | 0.76 |
| N | 135 | 154 | 289 | 135 | 154 | 289 |
| Implied steady state effect of income $\delta^\infty = \delta^{16}/(1-\beta^{16})$ | | | | | | |
| $\delta^\infty$ | 3.14 | 3.28 | 3.7 | 3.07 | 1.76 | 2.46 |

Table 2 shows that initial Gastil, $\gamma_{it-1}$ and average Gastil, $\gamma_{it}^T$, can both be in the equation for $T$ = 16, as predicted from the graphs on Figure 1.

**Controls for possible problems**

As in Jensen and Paldam (2005) we control the estimate for various potential problems. Table 5 are SURE estimates permitting: (i) Residual autocorrelation that makes the estimates more efficient as the reader can see, but not different. (ii) They allow us to check if the estimates for the two periods are the same. As in the Polity-paper this is the case for the first 4 regressors.

Table 5. SURE-estimates for each 16-year period and tests for one coefficient tie

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Period 1 | Period 2 | One coefficient tied | |
| | 1973-88 | 1989-2004 | Estimate | Wald-test |
| Constant | **-11.06** | **-6.07** | **-9.23** | Accept |
| | (-4.5) | (-1.9) | (4.7) | |
| Gastil init | **0.55** | **0.42** | **0.56** | Accept |
| | (11.0) | (6.4) | (11.3) | |
| Ln y init | **1.38** | **1.02** | **1.25** | Accept |
| | (4.3) | (2.5) | (4.8) | |
| Oil | -0.80 | **2.59** | **-1.50** | Accept |
| | (-0.95) | (-2.9) | (-2.6) | |
| Old West | **2.90** | 1.79 | **2.44** | Accept |
| | (-2.9) | (1.5) | (3.1) | |
| Muslim | **-1.64** | **-3.95** | **-2.63** | Reject |
| | (-2.9) | (-6.1) | (6.2) | |
| Communist | **-3.26** | **-6.82** | **-3.99** | Reject |
| | (4.1) | (-4.9) | (5.8) | |
| Transition | n.a. | **1.53** | n.a. | n.a. |
| | | (1.8) | | |
| R$^2$ adjusted | 0.82 | 0.72 | | |
| N | 135 | 154 | | |
| Implied steady state effect of income | | | | |
| $\delta^\infty$ | 3.07 | 1.76 | 2.84 | |

Note:  All models are estimated with SURE. In columns (1) and (2) all coefficients are allowed to be different. Column (6) shows the key result from 5 regressions with one tied coefficient, which is shown. The Wald-test examines if the tie is acceptable or not.

It is interesting that the coefficient to Muslim is different for the two period. It is going up and the rise is obviously significant. It is not so surprising that the coefficient to Communist changes, as the number of countries with communist government falls from 15 to 6 countries.

Table 6 study the effects of other controls. The White regression adjusts the sd's of the estimates for the effects of heteroscedasticity – this turns out not to matter. The Tobit regession adjust for censoring at the end of the scale. This also does not matter.

Finally, the 2SLS regressions take counter causality into account. The instrument is lagged income. It appears that the 2SLS regression has a small effect on the coefficient to income, so that democracy has a small positive effect on growth as well as the (much larger) effect the other way. It is more puzzling that it might also have an effect on the transition

variable. It does have to do with sample selection, when we have to use lags, as many of the transition countries are new countries where no gdp-data were available. This also applies to the 6 new Muslim countries that used to be parts of the Soviet Union.

Table 6. Other estimates: White, Tobit and 2SLS

| | (1) White | (2) Tobit | (4) 2SLS |
|---|---|---|---|
| Constant | **-8.94** | **-8.54** | **-6.91** |
| | (-4.4) | (3.8) | (3.0) |
| Gastil init | **0.49** | **0.51** | **0.52** |
| | (10.2) | (11.1) | (10.6) |
| Ln y init | **1.25** | **1.21** | **0.98** |
| | (4.8) | (4.1) | (3.3) |
| Oil | **-1.81** | **-1.71** | **-1.67** |
| | (-3.3) | (-2.5) | (-2.75) |
| Old West | **2.14** | **4.35** | **2.40** |
| | (3.3) | (4.5) | (3.46) |
| Muslim | **-2.81** | **-2.89** | **-2.39** |
| | (5.7) | (-6.0) | (-5.0) |
| Communist | **-4.81** | **-5.42** | **-4.52** |
| | (8.5) | (-6.5) | (7.7) |
| Transition | **2.42** | **2.56** | **6.51** |
| | (2.7) | (3.4) | (6.8) |
| $R^2$ adjusted | 0.76 | 0.24[a] | 0.80 |
| N | 289 | 289 | 267 |
| | Implied steady state effect of income | | |
| $\delta^\infty$ | 2.45 | 2.47 | 2.04 |

Note a: Pseudo-$R^2$, not comparable.

**Summary of results:**

The results are clear and very much like the ones obtained in the previous studies, notably in Jensen and Paldam (2005) analyzing the polity index for the whole of the 20th century. For the 7 explanatory variables we get:

$\gamma_{it-1}$, initial $\gamma$-score: Always significant and in the order of 0.5 or perhaps 0.1 smaller than for Polity.

$y_{it-1}$, log to initial gdp: Always significant and positive. In the order of 1.2 to 1.4 and in the steady state where the initial Gastil is eliminated it becomes 2.5 to 3 or about 1 smaller than for Polity.

$OW_i$, the Old West: Always positive and often significant as for Polity.

$Oil_{it}$, oil countries: Always negative and often significant as for Polity.

$Mu_i$, Muslim countries: Always negative and significant. More significant than for Polity.

The only variable that is not stable for the two periods is Muslim, which was unstable in the Polity paper, as well. It is arguable that the act that it is rising, may cause it to be falling in some other period. Hence, it may mean that it is a transitory problem. However, it is rising.

The last two variables were not included in the other Polity paper. Here conclusions are clear too:

$Co_i$, communist countries: Always negative and significant.

$Tr_i$, countries under transition from communism: Always positive and significant.

**References (only to papers in project):**

Borooah, V.K., Paldam, M., 2005. Why is the World Short of Democracy? A Cross-Country Analysis of Barriers to Representative Government. WP School of Econ. and Politics, University of Ulster, UK

Paldam, M., 2005. The big pattern of democracy. A study of the Gastil Index. WP School of Econ. and Management, University of Aarhus, Denmark

Jensen, P.S., Paldam, M., 2005. The pattern of democracy in the 20th century. A study of the Polity Index. WP School of Econ. And Management, University of Aarhus, Denmark

## Appendix table: Some descriptive statistics

Table A1. The data of the regressions

|  | Per 1 1973-88 | Per 2 1989-04 | Total Stacked |
|---|---|---|---|
| N | 135 | 154 | 289 |
| Oil | 18 | 20 | 38 |
| Old West | 18 | 19 | 37 |
| Muslim | 36 | 42 | 78 |
| Communist | 15 | 6 | 21 |
| Now in transition | 0 | 27 | 27 |
| Constant $\gamma$ [a] | 21 | 11 | 31 |
| Of which 10-10[a] | 12 | 10 | 21 |
| Gastil, avr | -1.81 | 0.31 | -0.68 |
| SD | (6.38) | (6.15) | (6.33) |
| Gastil, init | -1.98 | -1.72 | -1.84 |
| SD | (6.56) | (6.42) | (6.54) |
| Init Log y | 7.85 | 8.08 | 7.97 |
| SD | (1.05) | (1.07) | (1.06) |

Note a: Cases where the average Gastil-score is equal to the initial one and of these cases where both are 10.