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A study of the causality between income and the Gastil democracy index

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A study of the causality between income and the Gastil democracy index

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Abstract

The paper considers the transformation of the political system as countries pass through the Grand Transition from a poor developing country to a wealthy developed country. In the process most countries change from an authoritarian to a democratic political system. This is shown by using the Gastil democracy index from Freedom House. First, the basic pattern of correlations reveals that a good deal of the short- to medium-run causality appears to be from democracy to income. Then a set of extreme biogeographic instruments is used to demonstrate that the long-run causality is from income to democracy. The long-run result survives various robustness tests. We show how the Grand Transition view resolves the seeming contradiction between the long-run and the short- to medium-run effects.

Keywords: Paths of development, democracy, biogeography
JEL: B25, O1

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1. Introduction

It has often been discussed how economic and political developments interact. Two data series are considered to study the relation: Income measured by GDP per capita, and democracy measured by the Gastil index. We show that a strong relation exists between the two data series. This should be no surprise.

However, the pattern of causality is controversial for five reasons, of which (1) and (2) are the focus of the present paper: (1) The two data series have different statistical properties that make their interaction tricky to analyze: income changes gradually and persistently, while the degree of democracy changes step-wise. (2) Different theories predict a different direction of causality between income and democracy, so there are theoretical priors.[3] (3) Empirical studies apparently produce contradictory results for different time horizons.[4] (4) US-centricity of the literature is a problem because the US has been a glaring exception with relative democracy since its independence in 1783, when the country had a standard of living much like Kenya today. (5) It would be morally better if the causality were from democracy to growth, so there is a moral prior as well.

The paper proceeds as follows. Section 2 considers the short to medium term by means of a simple correlation analysis. We find that the relation between income and democracy is statistically strong; that it is mainly from democracy to income in the short run; and that part of the income adjustment occurs with a considerable lag. Section 3 considers the long-run causality by a procedure developed in Gundlach and Paldam (2008a). It shows that causality is exclusively from income to democracy in the long run. Section 4 studies the robustness of the testing procedure in three different ways that are largely confirming the basic finding. Section 5 suggests how the Grand Transition view may help to resolve the contradiction between the long-run and the short- to medium-run effects.

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3. Paldam and Gundlach (2008) survey recent contributions to the literature and demonstrate that the main competing views on development give different predictions for the direction of causality. This discussion is not repeated in the present paper.

4. To understand changes in democracy, we consider a time horizon of less than 10 years as the short run and time horizons of up to 50 years as the medium run. In the present paper, the long run actually extends to a time horizon of a handful of centuries.

2. The pattern in the data

The two key variables, income and democracy, are defined as follows:

(a) ***Income***, *y*, is the natural logarithm of GDP per capita from the Maddison data set for the years 1972-2005, with 2003-2005 as our update based on World Bank data.

(b) ***Democracy***, *G*, is the average of democratic rights and civil liberties of the Gastil index from Freedom House for the years 1972-2006.[5] The original scale is used; it goes from 7 points for full dictatorship to 1 point for full democracy.

2.1 The basic correlations

The data set used has 5071 pair-wise observations for income and democracy.[6] The number of countries grows from 126 in 1972 to 176 in the 1990s and then falls to 163 countries in more recent years as some counties are slow in making national accounts. Figure 1 shows the joint path of the cross-country averages of income and democracy for 1972-2005, calculated for each year for the maximum available number of countries. Keeping in mind that the composition of countries changes somewhat over time, the joint path of the two variables is close to being linear. The negative slope of the curve in Figure 1 reflects that the Gastil index is scaled to decline when democracy rises with rising income.

Figure 2 shows the annual cross-country correlation of income and democracy. For every year in 1972-2005, the correlation is statistically significant far above the 5% level, and the movements in the coefficient of correlation are insignificant.[7] The average correlation is -0.595 ±0.014, where the interval of uncertainty is twice the standard error of the 34 correlations. Taken together, Figures 1 and 2 suggest that our measures of income and democracy are strongly correlated across countries and over time.

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5. As in most studies using this index, it is distributed to give a value for every year even when one year is missing in the published data. The index was originally developed by Raymond Gastil for Freedom House.

6. The data are available from http://www.martin.paldam.dk under *working papers* and *democracy project*.

7. Two concepts of significance are used. (Si1) merges the observations into one set and uses the significance points for one correlation, see Figure 2. The 5% level on the figure is ±0.12 for N = 160. (Si2) uses the standard error for the variation of correlations, see Figure 3. The significance levels assume that the two distributions are normal. We have re-calculated Figures 2 and 3 using Kendall's τ as well. They look very similar to the figures included and have similarly high levels of significance. The Kendall-τ-figures are included in the data documentation.

Figure 1. Cross-country averages of income and democracy, 1972-2005

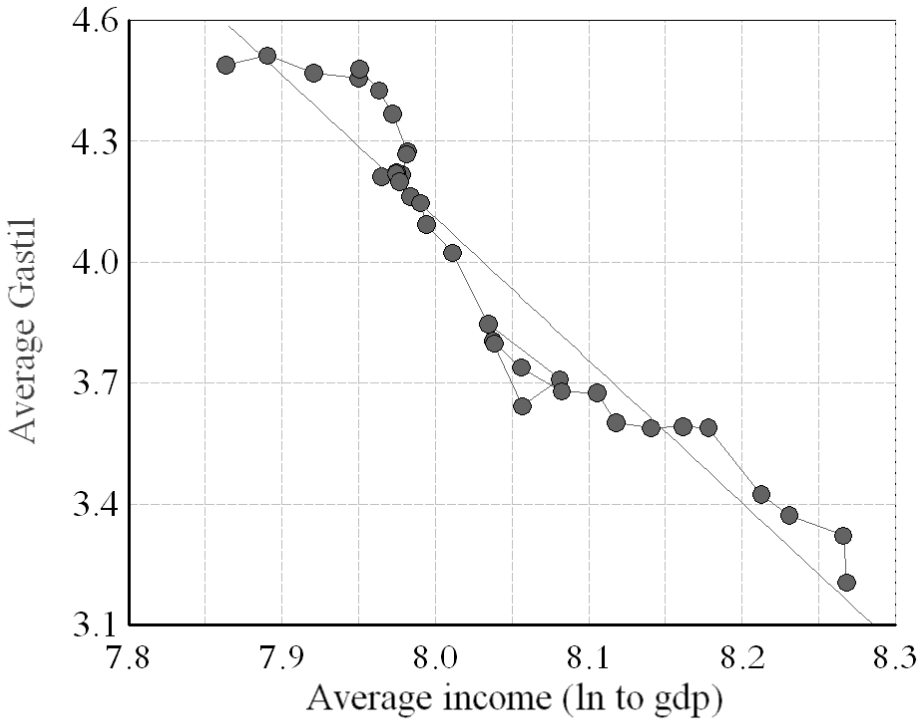
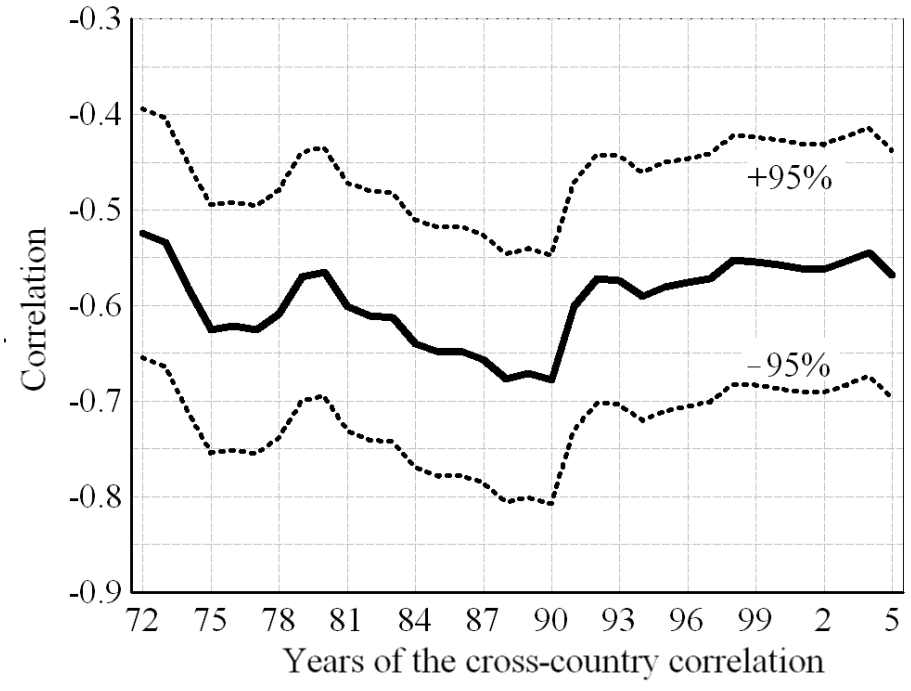


Figure 2. The annual cross-country correlation of income and democracy, 1972-05



2.2 Some details of the data

The Gastil index is defined and measured discretely on a scale with 13 possible values. The two components of the Gastil index are given as an integer from 1 to 7; the averaging adds the 6 midpoints between the 7 integers. The choice of scale reflects two measurement problems: (a) No "natural" scale exists for a democracy index. The index is made by an aggregation of a (large) number of different indicators to obtain a "continuous" scale. The aggregation seems reasonable, but it is basically arbitrary. Fortunately, the scores for the different indicators are correlated so the aggregation is fairly robust.[8] (b) The measurement precision is clearly larger than 1 point of the scale of the Gastil index, but perhaps smaller than 2 points, so the Gastil index is imprecise, but probably fairly linear.

The two data series have different time series properties. The income data usually change every year, but only by a few percent, so income is an almost continuous variable.

Table 1. The structure of the observations for the Gastil index, 1972-2006

Basic counts		Number of changes		Descriptive statistics	
Observations	5679	No change	4202	Average	3.94
Countries	176	Change	1301	Median	4
First differences	5503	Consecutive	469	St. Dev	2.05
		Numerical size of changes			
Change	Number	Change	Number	Change	Number
0.5 points	904	2.5 points	26	4.5 points	1
1 points	248	3 points	6	5 points	3
1.5 points	70	3.5 points	6	5.5 points	0
2 points	30	4 points	6	6 points	1

Note: Consecutive means that one change is followed by another next year

The Gastil index changes less frequently, but by a larger amount, as shown in Table 1. The average score is 3.94. The data contain 5503 pairs of consecutive years for the Gastil index, which remains unchanged in 76.4% and changes in 23.6% percent of the years. But then the average change is 0.78 points, which is 19.8% of the average score of 3.94 points. If the Gastil index changes, it often does so a couple of years in a row, so the average spell of

8. The main competitor to the Gastil index is the Polity index, see Marshall and Jaggers (2006). It is independently compiled using a different methodology. However, for overlapping countries and years the correlation between the two indices is always around -0.9, but the two indices differ considerably for some countries such as Iran and Russia. Gundlach and Paldam (2008a) is a parallel study of the relation between income and democracy using the Polity index.

stability is about 6 years.[9] For some countries – notably the Western ones – the Gastil index is flat at 1 with maybe half a point less during some crises and a later return to 1. So for these countries the index contains little information about political dynamics. Most of the action in the index is midway from the ends of the scale (see Figure 5.2 in Paldam, 2007).

Overall, the relation analyzed is between an almost continuous variable and a variable with large steps. This has important implications for a theoretical account of the observed correlation and for the specification of the empirical model, which is further discussed in Section 3.

2.3 Leads and lags in the income-democracy correlation

The Gastil data covers the 35 years from 1972 to 2006, and we consider the income data for 34 years (1972-2005), so a matrix of (35 *x* 34) = 1190 correlations between income and democracy can be calculated. Table 2 shows how these correlations have been organized to generate the correlogram of Figure 3. There is only one correlation that has democracy leading income by 33 years ("Gastil first"), namely the correlation of the income data for 2005 with the Gastil data for 1972. Two correlations have democracy leading income by 32 years, etc. The black line in Figure 3 represents the average of the correlation coefficients that can be calculated for a given time interval between the two measures, which is surrounded by twice the standard error calculated from the number of correlations employed.

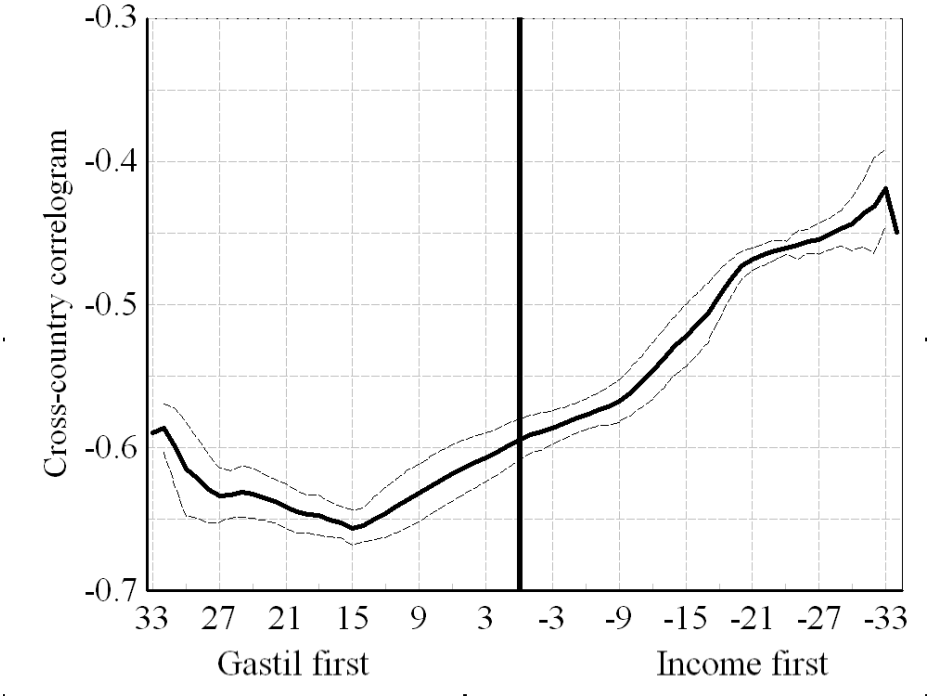
Table 2. All possible income-democracy correlations, 1972-2006

	Lag	Correlations Number	Correlations used
Gastil first	33 years	1	(y_{2005}, G_{1972})
Gastil first	32 years	2	(y_{2004}, G_{1972}), (y_{2005}, G_{1973})
…	…	…	…
Gastil first	1 year	33	(y_{1973}, G_{1972}), (y_{1974}, G_{1973}), … , (y_{2005}, G_{2004})
Contemporaneous	0	34	(y_{1972}, G_{1972}), (y_{1973}, G_{1973}), … , (y_{2005}, G_{2005})
Income first	1 year	34	(y_{1972}, G_{1973}), (y_{1973}, G_{1974}), … , (y_{2005}, G_{2006})
…	…	…	…
Income first	33 years	2	(y_{1972}, G_{2005}), (y_{1973}, G_{2006})
Income first	34 years	1	(y_{1972}, G_{2006})

9. This calculation is based on a count of all spells of unchanged scores in the data. It has to be assessed how the calculation is affected by the broken spells due the short period available for each country.

The basic idea of the correlogram is to see how the cross-country correlation between democracy and income is affected by alternative time intervals. If the correlation is higher when the measure of income precedes the measure of democracy ("Income first"), causality is more likely to run from income to democracy. And if the correlation is higher when the measure of democracy precedes the measure of income ("Gastil first"), causality is more likely to run from democracy to income.

Figure 3. Correlogram for average income democracy correlations



Note: See text for an explanation of terms.

The first point to note is that all 68 average correlation coefficients are larger in absolute value than 0.4, so the relation is statistically significant for all time intervals considered. This can only mean that there is a long-run relation between income and democracy (or a third factor that drives both data series). In our reading, Figure 3 confirms the validity of a cross-country estimation approach which is meant to uncover the long-run relation between income and democracy (see Section 3).

Secondly, the most and the least negative sections of the curve are significantly different. The correlation peaks on the left hand side, where the Gastil index precedes income, with a time interval of 15 years. Our interpretation of Figure 3 is that there is

causality from democracy to income. When democracy changes, income also changes, but often with a considerable lag.[10]

This analysis is not a formal test of causality, but an indication only. The indication is that it might be easier to argue that causality runs from democracy to income rather than the other way round, though causality is clearly both ways. This is the reverse of the result found by using Granger causality testing, as in Brunk, Caldeira, and Lewis-Beck (1987) and in Paldam and Gundlach (2008). Obviously, something complex is going on in the data. To sort it out, we need to look at the long run.

2.4 A correlation of -0.6 allows for much unexplained variation

Figure 4 is a scatter plot for the 176 countries of our sample, with average income (1972-2005) at the horizontal axis, and the average Gastil index (1972-2006) at the vertical axis.

Figure 4. Average Gastil index and average income
The line shown is a Kernel regression as per the text

10. In Borooah and Paldam (2007), a similar slow pattern of adjustment is found from estimating dynamic regression models on panel data. An income jump in the average sample country is estimated to cause an adjustment of democracy with only 50% of the adjustment taking place after 20 years.

The figure makes two points: (i) The Kernel regression demonstrates that the slope is not due to the extreme ends of the distribution. Even for a small bandwidth as 0.5, the Kernel-line has a fairly constant negative slope throughout the range.[11] (ii) The correlation is -0.64. The figure visualizes what a correlation of -0.64 means. It leaves ample space for unexplained variation due to all kinds of cross-country historical accidents and cultural differences.

Paldam (2007) and Borooah and Paldam (2007) study the influence of a dozen possible explanations (using a variety of tools) of the deviations around the central pattern. Most potential explanatory variables turn out to be statistically insignificant once the relation is controlled for income.

However, Communisms and Islam both give significantly less democracy than other countries at the same level of income. Oil countries also have significantly less democracy for a given level of income. It obviously matters if the high income is generated by a resource rent or by development through the Grand Transition, which is a complex set of changes in all fields of society.[12] By contrast, it is also clear by examples such as the United States, Israel and India that some countries can acquire democracy at a low income level and still grow. So the relation between income and democracy is surely not a perfect one, but appears to reflect a general pattern with interesting deviations at both ends.

3. The long run: Development potential (DP) and actual income

Sorting out the direction of the long-run causality between income and democracy would ideally require a set of instrumental variables that identify the *potential* income of a country; i.e., the level of income that is unaffected by the realized degree of democracy. Such instrument variables will be called a DP-set. Section 3.1 presents a handful of related DP-sets and justifies the choices being made. Section 3.2 shows how these DP-set sorts out long-run causality, while Section 3.3 discusses the robustness of the basic result over time.

3.1 Some candidates for the set of DP variables

Many theories have been presented to suggest what causes development in the long run, but few of these long-run theories are open to rigorous empirical investigation. The most

11. The kink around 8.5 is consistent with our findings in Table 4 in Paldam and Gundlach (2008, p 83).
12. Income and development are not precisely the same, even though income happens to be a fine proxy for development.

suggestive empirical approaches are probably Boserup (1965) with a focus on agricultural development and Diamond (1997) with a focus on geographic and biological constraints. Other influential studies are, Hall and Jones (1999), Pommeranz (2000), Sachs and Warner (2001), Acemoglu, Johnson, and Robinson (2001), Williamson (2006), and Clark (2007).

Diamond's book inspired Hibbs and Olsson (2004, 2005) to compile an amazing set of DP variables, which we have supplemented as suggested by other recent empirical studies. The appendix lists all the variables and their sources. Note that most of the variables are measuring exogenous geographical facts and the biological preconditions before the start of recorded history. So these variables can be taken to be truly exogenous conditions for long-run development. The studies that first used these DP variables demonstrate a statistically significant correlation with modern cross-country levels of income. This statistical property and the fact that most of our DP variables are exogenous in the perspective of a thousand years or more allow us to use them as instruments for modern income levels; i.e. to predict income levels that are independent of the level of democracy between 1972 and 2006.[13]

Diamond discusses development in the world until about the year 1500 – that is, before the medium-term growth rate reached 0.2% in any country. A take-off to modern economic growth (Rostow, 1960) occurred from about 1800, when an increasing number of countries acquired medium-term growth rates in excess of 1%. The unified growth theory by O. Galor (and various coauthors) is an attempt to integrate the pre-take-off period with modern economic growth into one consistent theory, see Galor (2005) for a survey. Unified growth theory claims that development becomes inevitable once technological change starts back in prehistoric times and human capital is being accumulated until a critical mass is reached that allows the economy to take off from Malthusian stagnation to a modern growth regime. Thus, unified growth theory provides a theoretical justification for the use of the extreme DP variables as our instruments in our empirical specifications. The justification is developed in more detail in Gundlach and Paldam (2008a).

3.2 Our basic result for 1995: Income can fully explain democracy in the long run

We attempt to single out the direction of long-run causality between income and democracy by comparing the results of two cross-country regressions. Both regressions explain the democracy index for a cross-section of countries. One regression uses *actual* cross-country

13. Other variables listed in the appendix with a shorter time horizon of exogeneity, such as measures of religious affiliation, are also correlated with modern income levels and are used as control variables, see Section 3.3.

income levels to explain democracy (OLS estimates); the other uses the *potential* cross-country income identified by our set of DP variables to explain democracy (IV estimates). For our samples of countries, which vary between 100-143 observations, the two regressions give much the same results. This is our key result – it is given in Table 3.

All the various combinations of the DP variables work rather well as instruments. The first stage partial R-squared is reasonably high, the Cragg-Donald test statistic (first stage F-statistic) is well beyond the critical value for weak instruments. The Sargan test for overidentification does not signal that one of the instruments may directly belong into the estimation equation, except in column (3). All five instrumentations perform quite similarly in terms of the size and the statistical significance of the estimated income coefficient.

We consider the first principal components of the two measures of biogeography to be the preferable instrumental variables. Hence, specification (4) is used for the robustness tests that follow below.

The major finding from the specifications in Table 3 is that the OLS income coefficients are *not* statistically significantly different from the IV income coefficients. That is, the OLS estimates are obviously *not* upwardly biased by reverse causality from democracy to income. Taking the results in Table 3 at face value, the long-run causality runs entirely from income to democracy, with no long-run causality the other way round as observed for the short to medium run. Moreover, the estimated effect appears to be quantitatively important.

Table 3. The estimated effect of income on the degree of democracy

	Dependent variable: Gastil index, *G*				
	(1)	(2)	(3)	(4)	(5)
No. of obs. (countries)	104	104	107	104	146
	The OLS estimates				
Income, *y* (actual)	-0.97 (0.12)	-0.97 (0.12)	-1.02 (0.11)	-0.97 (0.12)	-1.08 (0.11)
Adjusted R^2	0.39	0.39	0.45	0.39	0.38
	The corresponding IV estimates				
Income, *y* (instrumented)	-0.89 (0.18)	-0.99 (0.16)	-1.20 (0.15)	-0.97 (0.18)	-1.02 (0.17)
Instruments	*animals, plants*	*axis, size, climate*	*bioavg, geoav*	*biofpc, geofpc*	*coast, frost, maleco*
First stage partial R^2	0.43	0.53	0.54	0.44	0.46
CD F-statistic	37.76	36.88	61.41	39.69	39.65
CD critical value (size)	19.93 (10%)	22.30 (10%)	19.93 (10%)	19.93 (10%)	22.30 (10%)
Sargan test (p-value)	2.11 (0.15)	1.17 (0.56)	5.44 (0.02)	2.32 (0.0.13)	3.26 (0.20)

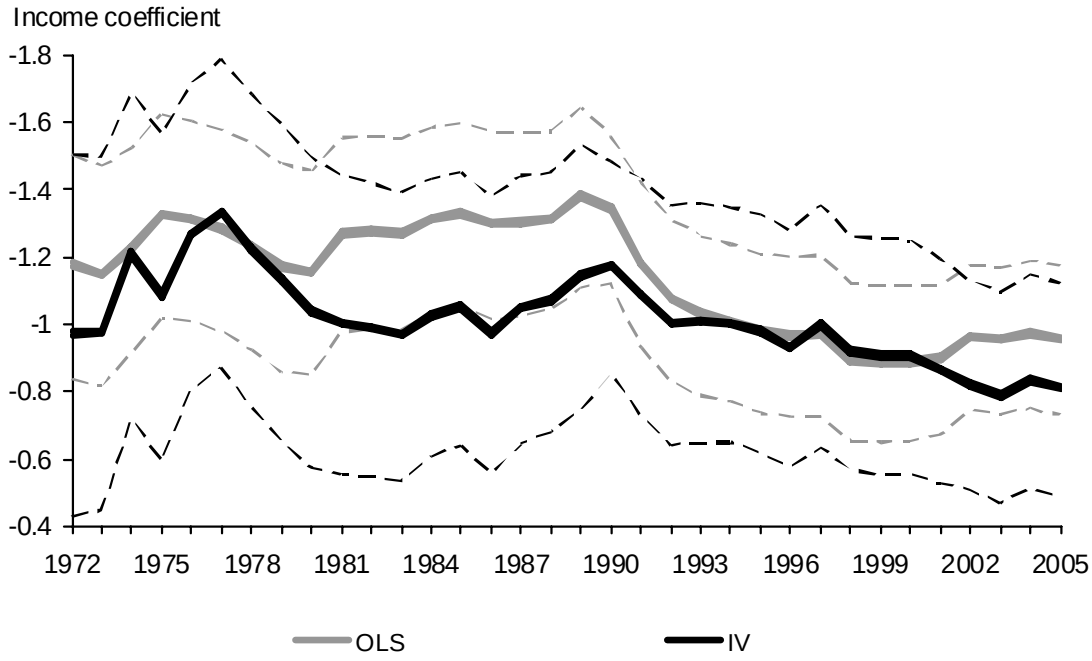
Notes: All observations for 1995 or the next available year; standard errors in parentheses. All specifications include a constant term (not reported). A Cragg-Donald (CD) F-statistic below the critical value (10 percent maximal size) indicates that the instruments are weak. The Sargan test for overidentification tests the joint null hypothesis that the instruments are valid and correctly excluded from the estimate.

For instance, the difference in log GDP per capita between Kenya and Thailand, which are countries that are close to the 25 percentile and the 75 percentile of the distribution in our sample, is about 1.86 points. An OLS/IV coefficient of about -1, as in our preferred specification (4) in Table 3, thus predicts a difference in the Gastil democracy score of 1.86 points. The actual difference in the Gastil score for the two countries is 3 points, so our estimated income effect accounts for about 60 percent of the observed difference in the degree of democracy between Kenya and Thailand.

3.3 The results for all available years: 1972-2005

Table 3 only looks at 1995, but model (4) has also been estimated for all other years where the Gastil index is available. The relative stability of the OLS and IV regression results is shown in Figure 5. The estimates of the two income coefficients are represented by the black (IV) and the grey (OLS) lines for all years from 1972-2005, and the dashed lines represent two respective standard errors around the estimates.

Figure 5. The IV and the OLS income coefficients, 1972-2005



For a number of years, both lines are within both intervals of one standard deviation, and both lines are almost always within two standard deviations of each other. This confirms that it does not matter which year is used to derive our basic cross-section result: The difference between the OLS and the IV estimates is always statistically insignificant. Moreover, a horizontal line can be drawn within both significance intervals, so the hypothesis that the true long-run coefficient is constant at about –1.1 cannot be rejected.

4. Robustness

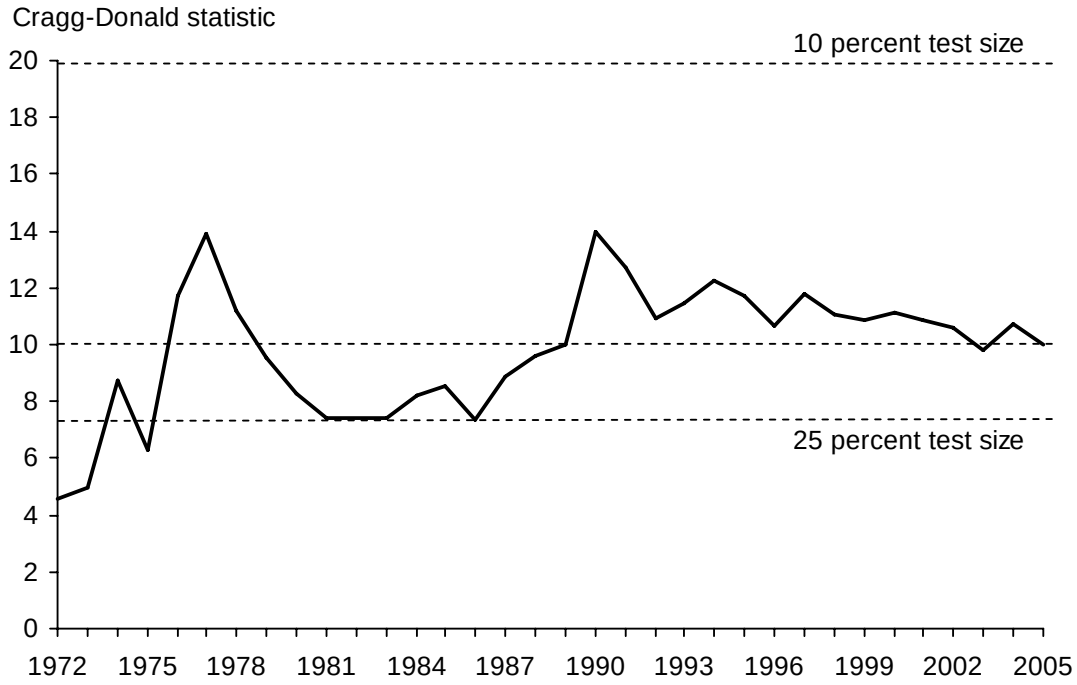
The conclusion till now is that income can fully explain democracy in the long run. This is a very strong conclusion, and before it is accepted, a few objections will be considered. The robustness of the long-run causality from income to democracy is tested in three ways: (1) by running the model for reverse causality; (2) by including 10 alternative control variables; and (3) by including fixed effects.

4.1 Reverse regression: The strong instruments do not work

The reverse regressions explain income by potential democracy, which is democracy instrumented with the DP variables. If potential democracy works as well as actual democracy in

the reverse regression, it will no longer be possible to disentangle the main direction of causality between income and democracy.

Figure 6. Reverse causality: DP variables as instruments for democracy



Note: The line represents the Cragg-Donald statistic (first stage F-statistic) for weak instruments derived from cross-country regressions of income on democracy for each year in 1972-2005, where democracy is instrumented by our preferred set of DP variables (*biofpc* and *geofpc*). The critical values for a Cragg Donald test for weak instruments are 19.93 for a 10 percent maximal size of the test and 7.25 for a 25 percent maximal size of the test.

Figure 6 shows the results of the main test of instrument validity for the reverse regression for all years from 1972 to 2005, for the preferred model using *biofpc* and *geofpc* as the instruments. According to the Cragg-Donald test for weak instruments, a value of the test statistic that is larger than 20 allows us to consider instruments as strong (that is, to reject the hypothesis of weak instruments), whereas a value of the test statistic that is smaller than 7 would point to the presence of weak instruments (that is, to reject strong instruments). We find that the value of the Cragg Donald test statistic is substantially below 20 and does not significantly exceed 10 on average for the reverse regressions for the years 1972-2005. A test statistic of 10 has been initially suggested by Staiger and Stock (1997) as a critical value to reject instruments as weak. Hence, taken together, the test statistics reveal that our preferred instruments do not work as strong instruments for democracy in the reverse model.

This suggests to us that our basic regressions of democracy on income actually identify the dominating causal effect from income to democracy.

4.2 Controlling for 10 socio-political and ethno-cultural variables gives the same results

As a further robustness test, ten socio-political and ethno-cultural control variables are considered in Tables 4 and 5. These control variables are chosen because they are often used in cross-country regressions to represent long-run effects. However, they proxy for a shorter time horizon than our preferred DP variables, which proxy for pre-historic conditions.

The four socio-political control variables included in Table 4 are the share of mining in GDP (*mining*), the Gini coefficient (*gini*), and the relative numbers of deaths by homicide (*homicavg*) and by suicide (*suicide*). These variables may be interpreted as capturing cross-country differences the availability of resource rents, the degree of income inequality, the prevalence of violent conflict among individuals, or the disposition for psychic depression. We speculate that each of these measures may affect the degree of democracy in ways that are independent of our income measure.

Table 4. The effect of additional socio-political variables

	Dependent variable: Gastil index, *G*			
	(1)	(2)	(3)	(4)
No. of obs. (countries)	96	73	63	40
Control used in column	*Mining*	*Gini*	*Homicavg*	*Suicide*
	The OLS regressions, including one control			
Income, *y*	-0.95 (0.12)	-1.05 (0.14)	-1.17 (0.18)	-1.05 (0.21)
Control (of column)	-1.65 (1.98)	0.01 (0.02)	-0.00 (0.01)	-0.03 (0.02)
Adjusted R^2	0.39	0.45	0.41	0.53
	The corresponding IV estimates: *y* is instrumented with *biofpc* and *geofpc*			
Income, *y*	-0.91 (0.17)	-0.98 (0.24)	-1.39 (0.29)	-1.36 (0.35)
Control (of column)	-1.61 (1.96)	0.01 (0.02)	-0.01 (0.01)	-0.02 (0.02)
First stage partial R^2	0.47	0.35	0.35	0.37
CD F-statistic	41.22	18.77	16.01	10.77
CD critical value (size)	19.93 (10%)	11.59 (15%)	11.59 (15%)	8.75 (20%)
Sargan test (p-value)	1.62 (0.20)	2.02 (0.16)	1.30(0.25)	0.76 (0.38)

Notes: See Table 3.

Table 4 shows that, conditional on instrumented income, none of these variables is statistically significantly correlated with the degree of democracy. Moreover, the inclusion of each of these variables does not significantly affect the size of the estimated income

effect. The Cragg-Donald test for weak instruments does not perform as well in these specifications as in Table 3, but the first stage partial R^2 remains relatively high, and the Sargan test statistic does not reject the exclusion restriction. The key observation is that there is still no difference between the two (OLS and IV) income coefficients, even when these controls are added.

Table 5. The effect of additional ethno-cultural variables

	Dependent variable: Gastil index, *G*					
	(1)	(2)	(3)	(4)	(5)	(6)
No. of obs. (countries)	100	104	104	104	104	104
Control used in column	*Ethnoel*	*Lofre*	*Loeng*	*Prot*	*Romcat*	*Muslim*
	The OLS regressions, including one control					
Income, *y*	-1.00 (0.15)	-0.96 (0.12)	-0.97 (0.12)	-0.91 (0.12)	-0.93 (0.12)	-0.82 (0.12)
Control (of column)	-0.29 (0.55)	0.27 (0.27)	-0.02 (0.30)	-1.77 (0.63)	-0.58 (0.38)	1.52 (0.43)
Adjusted R^2	0.38	0.39	0.38	0.43	0.40	0.45
	The corresponding IV estimates: *y* is instrumented with *biofpc* and *geofpc*					
Income, *y*	-1.00 (0.28)	-0.93 (0.18)	-0.97 (0.18)	-0.92 (0.18)	-0.99 (0.17)	-0.95 (0.17)
Control (of column)	-0.29 (0.74)	0.28 (0.27)	-0.02 (0.31)	-1.75 (0.64)	-0.54 (0.38)	1.36 (0.45)
First stage partial R^2	0.28	0.43	0.43	0.44	0.51	0.51
CD F-statistic	18.78	38.07	36.97	38.87	51.32	51.32
CD critical value (size)	11.59 (15%)	19.93 (10%)	19.93 (10%)	19.93 (10%)	19.93 (10%)	19.93 (10%)
Sargan test (p-value)	1.88 (0.17)	2.21 (0.14)	2.35 (0.13)	1.71 (0.19)	1.99 (0.16)	0.70 (0.40)

Notes: See Table 3.

Our six ethno-cultural control variables included in Table 5 are an index of ethno-linguistic fractionalization (*ethnoel*), dummies for French or English legal origins (*lofre* and *loeng*), and the share of the population that has Protestant, Roman-catholic, or Muslim religious beliefs (*prot*, *romcat*, *muslim*). These variables have been used as controls in many other papers. Here we speculate that the degree of ethnic and linguistic diversity, the origin of the legal framework of a country, or the adherence to a large religious community may affect democracy in ways that are independent of our income measure.

However, the ethno-linguistic or legal control variables generate no statistically significant effect, neither directly nor indirectly. Only the share of the population with Protestant religious belief is statistically significantly positively correlated with the degree of democracy, and the share of the population with Muslim religious belief is statistically

significantly negatively correlated with democracy.[14] In both specifications with religious beliefs, the size of the estimated income effect is statistically not significantly different from the results in Table 3, and there is no evidence of weak instruments (Cragg Donald statistic) or a rejection of the exclusion restriction (Sargan statistic). Once again, our key result holds: The two income coefficients do not differ.[15]

4.3 Fixed effects estimates

One objection against our result for the long run is that the relevant control variables may not be included. Hence, our income variable could identify idiosyncratic factors that show up in a cross section approach but are otherwise unrelated to the effect of income on the degree of democracy within a country. This possibility is addressed by estimating the relation between income and democracy with country-fixed effects for a panel data set for the years 1973, 1989, and 2005. These years mark important watersheds in recent economic history and otherwise cover the available Gastil data.

Table 6. Fixed effects estimates

	Dependent variable: Gastil index, *G*					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
No. of observations.	444	283	444	283	444	283
No. of countries	177	156	177	156	177	156
Income, *y*	-0.98 (0.21)	-0.95 (0.29)	-0.97 (0.09)	-1.15 (0.11)	-0.20 (0.23)	-0.77 (0.30)
Years included	73, 89, 05	73, 89	73, 89, 05	73, 89	73, 89, 05	73, 89
Country-fixed effects	Yes	yes	no	no	yes	yes
Time-fixed effects	No	no	yes	yes	yes	yes
F-test (p-value)	3.39 (0.00)	5.10 (0.00)	-	-	3.81 (0.00)	5.16 (0.00)

Columns (1a) and (1b) of Table 6 show that the effect of income on democracy that is derived from the within-country variation, i.e., with country-fixed effects, is not significantly different from the previous cross-country estimates. The same result holds when time dummies are used to control for the within-country variation (columns 2a and 2b). The apparent similarity of the two estimates suggests that we are actually identifying the effect of income on democracy, and neither a spurious cross-country relation nor a simple time trend.

14. For similar results, see Borooah and Paldam (2007).
15. For a comparison of the income effects derived with the Gastil index and the Polity index, see Appendix B

Since income appears to be strongly correlated with democracy across countries and over time, it is probably no surprise that the income effect becomes small and statistically insignificant if both country- and time-fixed effects are included (columns 3a and 3b).[16] However, if the panel data are restricted to the time before the demise of socialism, which brought an exogenous increase in the average cross-country democracy score, income does have a statistically significant effect on democracy even in the presence of country- and time-fixed effects (column 3b), whereas the inclusion of only one of the fixed effects reproduces a statistically significant income effect of the same size as for the full panel data set, and as in Tables 3-5.

5. Conclusion: Solving the puzzle

Section 2 has shown that in the shorter run causality between income and democracy goes both ways, but that it is stronger from democracy to income. Section 3 has shown that in the long run causality from income to democracy dominates to the extent that it is dubious if there is any reverse causality from democracy to income. These empirical results appear to be contradictory, but they are not according to the Grand Transition view.

The Grand Transition view presented in Paldam and Gundlach (2008) sees development as an interdependent set of transitions in economics, politics, and culture. For any given level of development, there is an optimal level of a broad range of economic, political, and cultural variables. If the observed pattern gets too far away from the optimal pattern predicted by the Grand Transition view, the mismatch becomes a brake for further development. Then pressures accumulate that finally bring about the desired change, and society adjusts along a transition path until the long-run equilibrium path is reached. With regard to income and democracy, our hypothesis is that the political system can be interpreted as a long-run output "variable" that is strongly constrained by the status quo, and thus may get far away from the optimal level that is determined by income.

However, the political system is also an important input factor for development, and hence it may become a serious brake, "causing" a slowdown of growth when it is not adjusted. If it is adjusted because the gap between the actual and the optimal level of democracy has become too large, this causes income to return to its steady state path and

16. This is demonstrated in a recent paper by Acemogly et al. (2008). Gundlach and Paldam (2008b) show that this is an unreasonable procedure.

thus to grow faster than before. Hence in the short to medium run, the political adjustment apparently causes extra growth. Yet from a long-run perspective, the political adjustment is an endogenous reaction to the widening gap between actual and potential economic development. Consequently, the long-run direction of causality from income to democracy is held to be a restriction that underlies the short-run adjustment of income to a change in democracy.

The conceptual distinction between adjustment in the short run and in the long run appears to be relevant for assessing the prospects for democratic change in countries with different levels of development. Our summary of the data suggests that there are wide margins for idiosyncratic factors and historical accidents that may shape the performance of an individual country. However, the data also suggests that it would be a grave error to ignore the long-run restriction that underlies the relation between the level of development and the relative degree of democracy. We think that imposing high-income-style democracy on a country with low-income-style economic, political, and cultural traditions is unlikely to succeed.

Appendix A: Definitions and sources of variables used in the tables

Dependent variable and main explanatory variable used in all tables	
G	The average of democratic rights and civil liberties of the Gastil index from Freedom House. Souce: The Freedom House homepage: http://www.freedomhouse.org/
y	Natural logarithm of GDP per capita, measured in 1990 international Geary-Khamis dollars. Source: Maddison (2003) and Maddison homepage: http://www.ggdc.net/maddison/
Instruments used in Table 2. Table 3 only uses *biofpc* and *geofpc*.	
animals	Number of domesticable big mammals, weighing more than 45 kilos, which are believed to have been present in prehistory in various regions of the world. Source: Olsson and Hibbs (2005).
bioavg	Average of *plants* and *animals*, where each variable was first normalized by dividing by its maximum value. Source: Hibbs and Olsson (2004).
biofpc	The first principal component of *plants* and *animals*. Source: Olsson and Hibbs (2005).
maleco	Measure of malaria ecology; combines climatic factors and biological properties of the regionally dominant malaria vector into an index of the stability of malaria transmission (malaria ecology); the index is measured on a highly disaggregated sub-national level and then averaged for the entire country and weighted by population. Source: Kiszewski and Sachs et al. (2004), here taken from www.earth.columbia.edu/about/director/malaria/index.html#datasets (data as of 27 October 2003).
plants	Number of annual perennial wild grasses known to have existed in various regions of the world in prehistory, with a mean kernel weight exceeding 10 milligrams. Source: Olsson and Hibbs (2005).
axis	Relative East-West orientation of a country, measured as east-west distance (longitudinal degrees) divided by north-south distance (latitudinal degrees). Source: Olsson and Hibbs (2005).
climate	A ranking of climates according to how favorable they are to agriculture, based on the Köppen classification. Source: Olsson and Hibbs (2005).
coast	Proportion of land area within 100 km of the sea coast. Source: McArthur and Sachs (2001).
frost	Proportion of a country's land receiving five or more frost days in that country's winter, defined as December through February in the Northern hemisphere and June through August in the Southern hemisphere. Source: Masters and McMillan (2001).
geoavg	Average of *climate*, *lat*, and *axis*, where each variable was first normalized by dividing by its maximum value. Source: Hibbs and Olsson (2004).
geofpc	The first principal component of *climate*, *lat*, *axis* and *size*. Source: Olsson and Hibbs (2005).
lat	Distance from the equator as measured by the absolute value of country-specific latitude in degrees divided by 90 to place it on a [0,1] scale. Source: Hall and Jones (1999).
size	The size of the landmass to which the country belongs, in millions of square kilometers (a country may belong to Eurasia or it may be a small island). Source: Olsson and Hibbs (2005).

continued next page

Socio-political control variables used in Table 4	
mining	Share of GDP in the mining and quarrying sector, approx. 1988. Source: Hall and Jones (1999).
gini	Gini coefficient, approx. 1990. Source: Deininger and Squire (1996).
homicavg	Total intentional completed homicides per 100,000 population, average for 1990-2000. Source: UNODC (2005).
suicide	Total number of suicides per 100,000 population, estimates for early 1990s. Source: Parker (1997).
Ethno-cultural control variables used in Table 5	
ethnoel	Average value of five different indices of ethnolinguistic fractionalization: the probability that two randomly selected persons from a given country: (i) will not belong to the same ethnolinguistic group, (ii) will speak different languages, (iii) will not speak the same language; (iv) the percentage share of the population not speaking the official language; (v) and the percentage share of the population not speaking the most widely used language. Source: La Porta et al. (1998).
loeng	Dummy for English Common Law legal origin of the Company Law. Source: La Porta et al. 1998.
lofre	Dummy for French legal origin of the Commercial Code: La Porta et al. 1998.
muslim	Share of the population with Muslim religious belief. Source: La Porta et al. (1998).
prot	Share of the population with protestant religious belief. Source: La Porta et al. (1998).
romcat	Share of the population with roman-catholic religious belief. Source: La Porta et al. (1998).

Appendix B: Comparing income effects on the Gastil and the Polity index

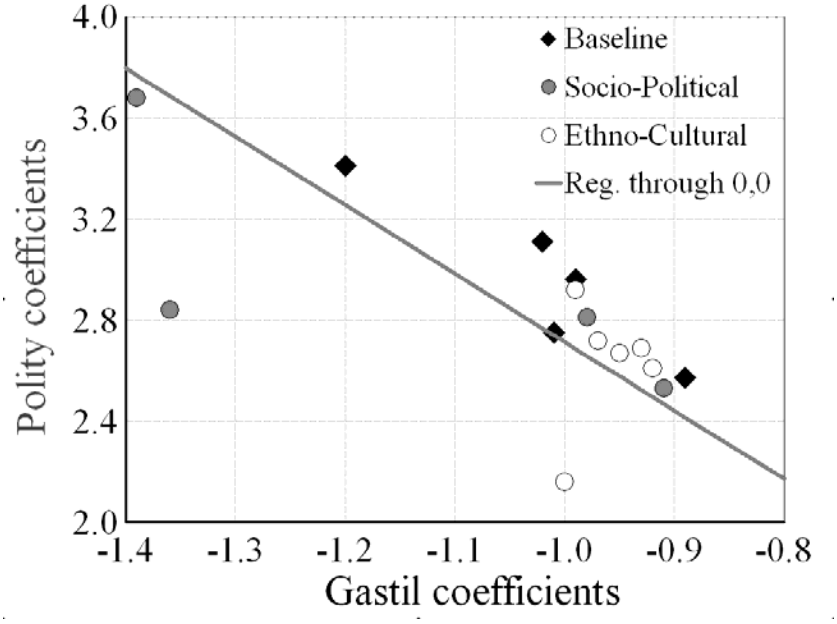
Our regressions with the Gastil index produce results that are very similar to the ones for the Polity index reported in Gundlach and Paldam (2008a). Table A1 shows the two sets of IV income coefficients derived from the baseline specification and from the specifications with additional control variables, which are given in Tables 3-5 for the Gastil index and in Gundlach and Paldam (2008a, Tables 1-3) for the Polity index. Figure A1 is a scatter plot of the two coefficients. Since the Gastil (G) and the Polity (P) index are related as $G = 4 - 3P/10$ or $P = (40 - 10G)/3$, the two estimated income effects should be proportional, except for the variation that results from the different samples used for the estimation.

Table A1. Gastil vs. Polity: A comparison of the main IV income effects

	Index	Reference	(1)	(2)	(3)	(4)	(5)	(6)	Average
Baseline	Gastil	Table 3	-0.89	-0.99	-1.20	-1.01	-1.02		-1.03
	Polity	Table 1*	2.57	2.96	3.41	2.75	3.11		2.96
Socio-political	Gastil	Table 4	-0.91	-0.98	-1.39	-1.36			-1.16
	Polity	Table 2*	2.53	2.81	3.68	2.84			2.97
Ethno-cultural	Gastil	Table 5	-1.00	-0.93	-0.97	-0.92	-0.99	-0.95	-0.96
	Polity	Table 3*	2.16	2.69	2.72	2.61	2.92	2.67	2.63

Note: The reference with a * is to Gundlach and Paldam (2008a) giving the Polity results.

Figure A1. Gastil vs. Polity income effects



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