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A farewell to critical junctures:

Sorting out long-run causality of income and democracy

Erich Gundlach and Martin Paldam

UNIVERSITY OF AARHUS
BUILDING 1322 - 8000 AARHUS C - DENMARK ☎ +45 8942 1133

Kiel and Aarhus

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Sorting out long-run causality of income and democracy

Erich Gundlach, Kiel Institute for the World Economy, Germany[1]

Martin Paldam, School of Economics and Management, University of Aarhus, Denmark[2]

Abstract

We consider the empirical relevance of two opposing hypotheses on the causality between income and democracy: The Democratic Transition claims that rising incomes cause a transition to democracy, whereas the Critical Junctures hypothesis denies this causal relation. Our empirical strategy is justified by Unified Growth Theory, which hypothesizes that the present international income differences have roots in the prehistoric past. Thus, we use prehistoric measures of biogeography as instruments for modern income levels, and find a large long-run causal effect of income on the degree of democracy. This result rejects the Critical Junctures hypothesis, which is an important part of the Primacy of Institutions view.

Keywords Long-run growth, democracy, unified growth theory, biogeography

JEL: B25, O1

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1. Address: Kiel Institute for the World Economy, P.O. Box 4309, D-24100 Kiel, Germany.
E-mail: erich.gundlach@ifw-kiel.de.
2. Address: School of Economics and Management, University of Aarhus, Building 1322, DK-8000 Aarhus C, Denmark.
E-mail: mpaldam@econ.au.dk.

1. Introduction

The pattern of causality between income and democracy has long been a bone of contention among economists and political scientists. Sorting out causality is difficult because it is easy to point to cases supporting both directions, and there might well be simultaneity (see e.g. Lipset 1959 and Moore 1966). We concentrate on causality in the long run, and consider the cross-country pattern in income and democracy today as a product of history. The two variables are highly correlated across countries for all years of the 20th century (see section 2), so there is an obvious relationship to be understood.

We consider two testable and opposing hypotheses on the long-run causality between the two variables. Both hypotheses are parts of a larger view on development, which is a complex framework that only allows partial tests, see Paldam and Gundlach (2008).

The oldest hypothesis is the one of a *Democratic Transition.* It claims that the political development in the long-run is a consequence of overall development. It is a part of the *Grand Transition* view, which goes back to Clark (1951) and Kuznets (1965, 1966). It interprets long-run development as an interacting set of transitions in many fields and thus sees development as a band of variation around a basic path.[3]

The newest hypothesis is the one of *Critical Junctures*, which is a part of the *Primacy of Institutions* view. It goes back to Douglas North and has been developed in a series of papers by Acemoglu, Johnson, and Robinson (surveyed in their 2005a). Both income and democracy are held to be driven by the power structure of the political system. Hence, countries that make different political decisions at critical historical junctures are predicted to embark on different paths of development. Consequently, the main direction of causality runs from the political system to economic development, and the observed correlation between income and democracy can not be due to causality from income to democracy.[4]

Hence, if we find a clear long-run causality explaining the pattern of democracy by income, we content that the Democratic Transition hypothesis is confirmed. However, if it is rejected, we content that the Critical Junctures hypothesis holds. Causality tests often give unclear and weak results. Fortunately, this is not the case in the present paper.

3. The transitions of mortality, fertility, urbanization, human capital and the sectoral composition of the economy are standard textbook material. The Grand Transition includes transitions in fields with no obvious connection to the economy, such as in gender roles, corruption, and religiosity; see e.g. Paldam (2007b). Paldam and Gundlach (2008) demonstrate that the Democratic Transition can be understood as the basic theory of demand and supply.
4. See Acemoglu, Johnson, Robinson and Yared (2005b, 2007). It appears that the Critical Junctions hypothesis is a key part of the whole Primacy of Institutions view, but we shall not at present discuss the full framework.

To test the two hypotheses, we use the biogeography variables that are compiled by Hibbs and Olsson (2004, 2005). They are all exogenous in the perspective of recorded history, so they are a set of really extreme variables, as the reader can ascertain from Appendix A.

Our main test compares two explanations of the present cross-country pattern of democracy. The first is a one stage estimate that explains the democracy pattern by present income. The second is a two stage estimate, where stage 1 "simulates" a set of *institution free* income measures by instrumenting income with the said biogeography variables, and stage 2 explains the democracy pattern by the institution free incomes. The key result of the analysis is that the two explanations of the democracy pattern are equally good.

We claim that this proves that the long-run causality is *exclusively* from income to democracy, and that critical junctures play no role in the long run. Proving a convincing long-run one-way causality between the basic economic and political aggregate comes close to finding the Holy Grail of economic and political history! Our paper hence makes a strong claim, so we try to make all steps in the analysis fully transparent and easy to replicate.

The paper represents political institutions and economic development with one variable each – we believe that we have chosen the best representations, but it is still clear that our strong results apply to only two variables. Appendix C takes a brief look at some related indices, to see how reasonable it is to hold the discussion within the frames chosen.

Section 2 introduces the data series for the degree of democracy and the level of development, and explains the context of our empirical strategy. It also motivates this empirical strategy as an implication of Unified Growth Theory (Galor, 2005). Section 3 presents our basic test. Section 4 includes a number of robustness tests that leave our basic result intact. Section 5 contains the conclusion. The measures of biogeography and all other variables used in the paper are listed in Appendix A. Appendix B is a correlation matrix, while Appendix C considers some additional institutional indices. We should mention that since we have just published a discussion of the literature (Paldam and Gundlach 2008), the present paper only cites the large literature to the extent it is needed for our own analysis.

2. Basic data and empirical strategy

We first present the income and democracy data and show how correlated they are. Then we return to the discussion of causality and the theoretical justification for the extreme biogeography variables used as instruments.

2.1 Income and democracy indices

The two main data series used in this paper are the polity index and income (per capita). Both data series are available for a large number of countries and over a time horizon of about 200 years for some countries.

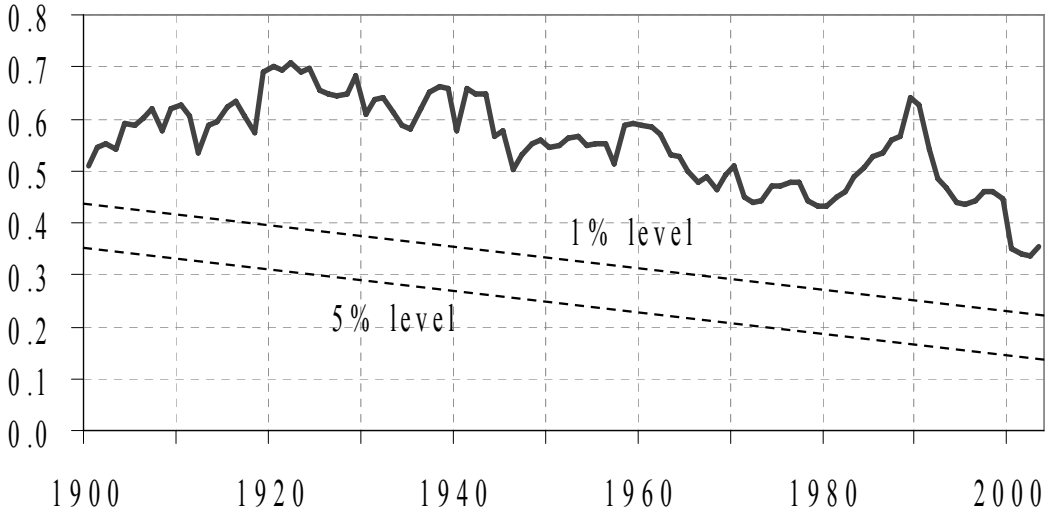
(i) *The polity index*, *P*, measures the degree of democracy of the political system of a country by a scale ranging from -10 for a fully authoritarian regime to +10 for a fully democratic one (see Marshall and Jaggers, 2006).

(ii) *Income*, *y*, is the natural logarithm of GDP per capita income, measured in constant international dollars, and taken from the Maddison data set (see Maddison 2003).

We take these measures of income and democracy to be the best aggregate measures available for the economic and political development, though both have many weaknesses at the conceptual level as well as at the measurement level.

Figure 1 shows the annual correlation between the two variables throughout the 20th century. For each year, all available observations have been used. The result of this mechanical exercise is abundantly clear: there is a strong correlation between the degree of democracy and the level of income across countries. The correlation has been statistically significant above the 1% level for each and every year of the 20th century.

Figure 1. The annual correlation between income and democracy, 1900-2003



Notes: There are only about 30 observation pairs in the first years compared to about 150 observation pairs in the last years of the 20th century. The increase in the number of observations is reflected in the declining slope of the curve of correlation points and the corresponding decline of the (interpolated) level of correlation that is necessary in order to pass conventional levels of statistical significance.

2.2 Two problems for the Democratic Transition view[5]

The first problem is what long-run causality really means. A theoretical answer may be that in the steady state, one variable causes another. This is not an operational answer. We therefore turn to the case analyzed.

We consider the relation between two variables: One is the democracy variable, P, which is constant most years. When it moves, it does so in a discrete step. The other variable is income, y, which changes every year, though normally only by 1-2%.

Imagine that P adjusts to y, in the long run, but that y can be temporarily kept back by a slow adjustment of P. Since the adjustment of P is stepwise, some of the steps will be large, and before the adjustment, y will be held back. After the adjustment, y will quickly catch up.

In this case, we say that variable y is the primary variable, and that the whole of the long-run causality is from y to P. However, in the short to medium-run there are interactions between the two variables that will look like a complex pattern of simultaneous interactions. We may even say that the long-run causality works through short-run simultaneity.

Our analysis aims at catching long-run causality by concentrating on the cross-country pattern. This means that we do not reject studies that find a complex interaction process (see, e.g., Persson and Tabellini, 2006), or case studies that show that growth is slowed down by the lack of political reform, and that it picks up after the reform.

The second problem is that the Democratic Transition hypothesis uses income as the primary variable. Income is an aggregate that appears problematic in that role. It works as a catch-all-variable – a "kitchen sink" – for the whole set of transitions that together constitute development. This is not satisfactory, and we have gone one – very long – step further, using biogeography factors as primary variables for development. This is because we want to go back before all existing institutions come about – and they have roots going down more than 500 years.

To justify this modeling strategy, we need a theoretical framework that explains development both during the "Malthusian" stagnation before the industrial revolution and during modern economic growth. The theory should be able to explain the present large income differences between countries without invoking changes in the institutions of a country as explanatory factors. In addition, we would like the long-run growth theory to point to biogeography factors as possible primary variables that can be used to estimate the long-run variation in incomes.

5. The democratic transition is also known as Lipset's Law or the Modernization hypothesis (Lipset, 1959).

2.3 A theoretical approach to the long run

Without such a theory, our key result would be just a strange empirical regularity resting on a black box. However, the Unified Growth Theory of Galor (see his survey 2005) has many of the elements needed.

The Unified Growth Theory holds that the apparent stability of the last few centuries of the Malthusian era saw a slow but steady growth of the population and subtle but important changes in the composition of the population that led to the Industrial Revolution (Galor and Moav 2002). The simplest methodology for generating a phase transition from stagnation to sustained growth would be to hypothesize a major shock in an environment characterized by multiple locally stable equilibrium. Such a methodology is in conflict with the interpretation of the Industrial Revolution as a gradual process; see, e.g., Clark (2007) and Mokyr (2002).

The theory hypothesizes that the transition from stagnation to growth can be captured by a single dynamical system if the set of steady-state equilibriums and their stability are altered qualitatively in the process of development due to latent state variables such as human capital formation, which ultimately change the qualitative structure of the dynamical system. According to this view, changes in the quality of the institutional framework (or their absence) may support or hinder the transition, but they are neither necessary nor sufficient to explain why there has been sustained growth of per capita income in the world economy over the last 200 years, but not before, in all of human history.

Our empirical identification strategy relies on a chain of empirical arguments that have been developed by Diamond (1997) and Clark (2007).[6] Thus, in just one model it is possible to capture the era of Malthusian stagnation, the transition to a state of economic and population growth that triggered a demographic transition, and the era of sustained growth of per capita income. According to this view, long-run growth is an inevitable consequence of changes in the size and the composition of the population, which may have biological (Galor and Moav, 2002) and geographical (Diamond, 1997)[7] roots. Thus, instrumenting the level of income with measures of biogeography will produce a measure of the exogenous (institution-free) variation in income that is needed to explain the democratic transition.

6. Clark (2007) builds on Unified Growth Theory, especially the evolutionary growth model of Galor and Moav (2002). He provides a fine account of the historical facts that can be explained by the theory.

7. Diamond (1997) identifies prehistoric biogeographic conditions that have been conducive for the development of stable agricultural societies, but he is in conflict with Unified Growth Theory in his assessment of the effects of population growth on agricultural technical change. For an early theory of agricultural development that is in line with Unified Growth Theory, see Boserup (1965).

2.4 The biogeographic data for the very long run

According to Diamond (1997), prehistoric biogeographic conditions explain why the transition from a hunter-gatherer society to an agrarian society started earlier in some regions of the world than in others, and why it sometimes did not start at all. One condition for a sustainable early transition is the availability of plants that can be domesticated, and the productivity of these plants. Both conditions are believed to have varied widely across the prehistoric world, with at least five and probably nine areas with independent agricultural development (Diamond 1997, p. 99). The Near East or Fertile Crescent of Southwest Asia has been identified as the earliest site for a string of further developments beyond agriculture, such as cities, writing, and empires (Diamond 1997, p. 135).

Similar to the availability of domesticable plants, the availability of domesticable large mammals as a source of food and as a means of transport and warfare differed substantially across the world in prehistoric times. For instance, no large mammal has ever been domesticated in Sub-Saharan Africa, and most large mammals became extinct in the Americas when the continent was invaded by human hunter-gatherers from Asia. As is self-evident, it will make a difference for military success whether the turkey is the major domesticated animal and horses are not known, or vice versa. More generally, areas with domesticated plants and mammals could support larger populations, and larger populations developed into more complex societies.

An additional factor that has spurred or hindered such developments is geography. Regular climatic variation with dry and wet seasons and moderate temperatures is obviously beneficial for agricultural development, as is a large landmass that spreads horizontally rather than vertically because climatic zones change faster along a north-south axis than along an east-west axis. This implies that all else constant, agricultural innovations like new domesticated plants could spread more easily across Eurasia than across the Americas or Sub-Saharan Africa, and in small isolated places like New Guinea they could not spread at all. Hence, the prehistoric potential for developing rather stable complex agrarian societies with large populations was much stronger in some regions of the world than in others.

In addition, the co-evolution of domesticated plants that were partly used to feed domesticated mammals brought a further advantage for prehistoric societies with favorable biogeographic conditions. Their populations developed at least partial resistance against a number of diseases that may have spread from domesticated animals to humans.[8] Thus,

8. Populations living closely with domesticated animals may have suffered from regular outbreaks of diseases like smallpox, measles, influenza, and typhus, but human populations living without close contact to various

according to Diamond (1997), Europe (Eurasia) conquered the Americas and not the other way round because of plants, animals, germs, continental axis, and size, despite comparable levels of per capita income on both continents.

The question not resolved by Diamond (1997) refers to the ultimate factors that explain persistent economic growth since about 1800, first in Europe and its offshoots and later in East Asia and other parts of the world. All available facts point to a more or less constant per capita income that may have differed in levels across the world, but remained trendless throughout all of human history until 200 years ago. Galor and Moav (2002) suggest that natural selection on humans during the seeming stability in terms of per capita income of the Malthusian era provides an answer for the emergence of the Industrial Revolution.

Their growth theory is supported by the historical facts presented by Clark (2007), who suggests that a long history of an institutionally more or less stable society with settled agriculture, as exemplified by England from about 1200 to the beginning of the Industrial Revolution, initiated behavioral changes in the population that ultimately led to the demise of the Malthusian straightjacket of diminishing returns. According to Clark (2007), the main mechanism for this latent development was that the rich had persistently more surviving descendants than the poor. So there was strong and permanent downward social mobility, which may have helped to spread middle class behavior throughout the society.[9]

2.5 From the theoretical considerations to our test

Many of the arguments in sections 2.3 and 2.4 are speculative, but the authors cited do provide a wealth of illuminating detail and a good deal of formal modeling to back up their argument. Our conclusion from this line of reasoning is that the prehistoric variation in measures of biogeographic conditions could be correlated with the modern variation of per capita income. [10]

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domesticated animals, and therefore without resistance against the germs that carries the diseases, would be virtually wiped out on first contact, as happened as the consequence of European colonization.

9. This Malthusian mechanism appears to have changed the average behavior towards less violence and more working hours, with effective institutions adjusting to the changes in behavioral norms. Hence, slow but steady changes in the composition of the population over a long time span of at least 500 years may help us understand why an Industrial Revolution occurred, and why in England and Europe it appears that beneath the seeming stagnation of the Malthusian era, economically unsuccessful behavior literally died out under the stable conditions provided by settled agriculture.

10. Some of the economically most successful countries are "Western Offshoots" (Maddison) with only small remaining shares of the indigenous population in the total population, so a priori one cannot expect a particularly strong correlation between initial biogeographic conditions and present levels of income if these countries are included in our samples.

Taken at face value, it appears inconceivable that the selected measures of biogeography can possibly work. Yet they work rather well as the reader will see. We have two explanations: (i) We mainly look at a single cross-section of countries, so we are indeed aiming at the very long run,[11] and (ii) our selected instruments appear to be justified by Unified Growth Theory, which so far provides the only growth model that is consistent with historical facts about the Malthusian era *and* the era of modern growth.

Also, we should add that Olsson and Hibbs (2005) show that their biogeographic variables do provide an amazingly good explanation of the cross-country pattern of incomes. Hence, we feel that there is both theoretical and empirical justification behind our use of these variables to generate institution free incomes demanded by our tests.

3. Specification of the testing model and the main result

Our basic equation is given by

$$P_i = \alpha + \beta y_i + \mathrm{X}_i'\gamma + \varepsilon_i, \qquad (1)$$

where P is the degree of democracy in country i in a given year, y is the natural logarithm of GDP per capita in constant international dollars, X_i' is a matrix of other covariates, α is a regression constant, ε is an error term, and β is the coefficient of interest that measures the long-run effect of income on democracy.

3.1 The underlying structure

The two major problems with estimating equation (1) are omitted variables, which we address in the next section, and reverse causality. As motivated by our empirical strategy, we use prehistoric measures of biogeography to identify the exogenous part of the variation in actual cross-country incomes. More formally, we have the additional equations

$$y_i = \lambda_1 + \eta_1 \, popchange_i + \mathrm{X}_i'\gamma_1 + u_{1i}, \qquad (2)$$

$$popchange_i = \lambda_2 + \eta_2 \, agristab_i + \mathrm{X}_i'\gamma_2 + u_{2i}, \text{ and} \qquad (3)$$

11. The level of development (income) for a cross-section of countries at a given point in time reveals the differences in country-specific rates of long-run growth, given that all countries had similar income levels about 200 years ago. From the 15th century until about 1800, the West did grow by 0.1 to 0.15% per year according to Maddison (2003), while the rest of the world had zero economic growth. The West was thus ahead by about two times in income when modern economic growth started.

$$agristab_i = \lambda_3 + \eta_3 biogeo_i + \mathrm{X}_i'\gamma_3 + u_{3i}, \quad (4)$$

where λ_j are regression constants, η_j are parameters, and u_{ji} are error terms; *popchange* is a measure of the changes in the composition of the population that developed slowly but steadily in the Malthusian era before the onset of the Industrial Revolution, *agristab* is a measure of the long-run institutional stability of agrarian societies in the Malthusian era, and *biogeo* is a measure of biogeographic conditions that prevailed at the time of the Neolithic revolution.

Although we lack information to estimate equations (2)-(4), we can nevertheless employ measures of biogeography as instruments for the actual level of income if such measures have no direct impact on the observed degree of democracy and if they are sufficiently correlated with modern cross-country income levels. Both conditions appear to be satisfied, as argued above. Hence, we are confident that our instruments can be used to derive a measure of income that is not affected by the contemporary quality of the institutional framework of a country.

3.2 The main result (Table 1)

Our main estimation results for equation (1) are reported in Table 1, where we present specifications with alternative sets of instruments but do not include any control variables. All specifications refer to a single cross-section of countries for the year 1995, which has been selected to maximize data points. The number of observations (countries) in each column of Table 1 is limited by the available data points for the instrumental variables.

The reader should first note that all of our specifications pass the Cragg-Donald test for weak instruments and the Sargan test for overidentifying restrictions. The partial R^2s for the first stage are as high as about 0.5. Hence, all specifications in Table 1 satisfy the statistical preconditions for instrumental variables (IV) regressions.

We find a large and statistically significant effect of our instrumented measure of income on the degree of democracy. Our preferred specification is column (4), which uses the first principal components of four measures of geographic conditions and two measures of biological conditions.[12]

12. Compared to columns (1), (2), and (4), column (3) includes additional country observations on the Western offsprings Australia, Canada, New Zealand, and the United States (plus Germany). In the Western offsprings, only a small share of the indigenous population has remained in the total population, and the present income is higher than would be predicted on the basis of the prehistoric biological and geographic conditions. However, their inclusion does not lead to statistically different results. Column (5) uses a different set of instruments,

Table 1. The estimated effect of income on the degree of democracy

	Dependent variable: *P*				
	(1)	(2)	(3)	(4)	(5)
No. of obs. (countries)	101	101	106	101	142
y (IV)	2.57 (0.68)	2.96 (0.61)	3.41 (0.57)	2.75 (0.67)	3.11 (0.64)
Instruments	*animals, plants*	*axis, size, climate*	*bioavg, geoav*	*biofpc, geofpc*	*coast, frost, maleco*
First stage partial R^2	0.43	0.54	0.53	0.44	0.48
CD F-statistic	37.44	37.95	57.49	37.98	42.12
CD critical value (size)	19.93 (10%)	22.30 (10%)	19.93 (10%)	19.93 (10%)	22.30 (10%)
Sargan test (p-value)	0.04 (0.85)	1.49 (0.47)	3.33 (0.07)	1.73 (0.19)	0.59 (0.75)
y (OLS)	2.83 (0.45)	2.83 (0.45)	2.89 (0.42)	2.83 (0.45)	2.67 (0.44)
Adjusted R^2	0.28	0.28	0.31	0.28	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.

The estimated coefficient on income is about 2.8. What this means can be illustrated by an example. Ghana is close to the 25th percentile of the income measure in our sample (7.05), and Thailand is close to the 75th percentile (8.79). The income difference between Thailand and Ghana predicts a $(8.79 - 7.05)\cdot 2.8 \approx 4.9$ Polity-point difference between the countries. The actual difference in 1995 is 10 Polity points, so the estimate explains about half of the observed difference in the said democracy-index of the two countries.

The bottom section of the table presents the OLS results for comparison with the IV results. The adjusted R-squared of the OLS regression indicates that 20-30 percent of the cross-country sample variation in the degree of democracy in 1995 is associated with the cross-country variation in (log) GDP per capita.

The key finding in the paper is that we can not reject that the OLS estimates of the income coefficient are the same as the IV estimates. The OLS-estimates are even smaller than the IV-estimates on average. This finding implies that whatever the institutional history of the countries and irrespective of the critical junctions passed on the way, the long-run outcome is essentially the same. And it is explained fairly well by income.[13]

which may identify the exogenous variation in income through their effect on agricultural productivity (*frost*), human capital formation (*maleco*), and international trade (*coast*), but the results are not statistically significantly different from columns (1)-(4).

13. We have also recalculated Table 1 in the reverse to see if Polity instrumented with the biogeographic variables can explain income as well as Polity in the OLS regression – it actually can, but here the Cragg-Donald test rejects the instruments. These regressions are available from the authors.

4. Robustness and consistency of the main result

One possible objection to the main result in Table 1 is that somehow the OLS results are skewed due to omitted variables. We check the robustness of the results by adding 10 controls, one at the time to avoid the multicollinearity problem. Our controls are either socio-political (see 4.1) or ethno-cultural (see 42.) variables. They are chosen to have an effect on the degree of democracy which is independent of the income effect or may even dominate the presumed income effect.[14] The results presented in Tables 2 and 3 are based on a specification with our preferred instrumental variables – the first principal components of the measures of biogeography – that is, column (4) of Table 1.

Appendix B shows the pairwise correlations between our control variables and our measures of income and democracy. The variables chosen are significantly correlated to democracy or income in all but one case. Since our instruments for income are extreme, it is possible that the control variables may change the estimates.

The second set of experiments deals with consistency of the result over time. The result in Table 1 is found for the cross-country pattern of democracy in 1995. However, we have these data for two centuries, and we can analyze if they are robust over time and if the long-run pattern is consistent both within and between countries. The logic of the tests is discussed in 4.3, and the results are presented in 4.4.

4.1 Four socio-political control variables (Table 2)

The four socio-political control variables included in Table 2 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 vary widely across countries, and they are all significantly correlated to either polity or income in Appendix B. They measure the availability of resource rents, the degree of income inequality, the prevalence of violent conflict among individuals, or the disposition for psychic depression.[15] We speculate that each of these measures may be correlated with the degree of democracy in ways that are independent of our income measure.

14. For our purpose, it is less important whether the additional control variables are actually exogenous. We are mainly interested in the robustness of our estimated income coefficient.

15. Sachs and Warner (1995) use the share of mining in GDP, and Borooah and Paldam (2007) use the share of oil production in GDP as a control for resource rent. Uslaner (2002) claims that a low gini coefficient furthers democracy.

Table 2. The effect of additional socio-political variables

	Dependent variable: *P*			
	(1)	(2)	(3)	(4)
No. of obs. (countries)	93	72	61	39
y (IV)	2.53 (0.66)	2.81 (0.97)	3.68 (1.18)	2.84 (1.36)
Mining	5.60 (7.84)			
Gini		0.02 (0.07)		
Homicavg			0.05 (0.05)	
Suicide				0.03 (0.07)
First stage partial R^2	0.47	0.33	0.34	0.35
CD F-statistic	39.02	16.83	15.00	9.60
CD critical value (size)	19.93 (10%)	11.59 (15%)	11.59 (15%)	8.75 (20%)
Sargan test (p-value)	1.22 (0.27)	0.90 (0.34)	0.64 (0.42)	1.01 (0.32)
y (OLS)	2.79 (0.46)	3.01 (0.57)	3.27 (0.71)	2.85 (0.84)
Adjusted R^2	0.27	0.28	0.24	0.28

Notes: See Table 1. In the IV regressions, biofpc and geofpc are used as instruments, as in column (4) of Table 1. OLS results are conditional on the inclusion of the control variable.

We find that conditional on the level of instrumented income, none of these variables are statistically significantly correlated with the degree of democracy. Moreover, the inclusion of each of these variables does not affect the size of the estimated income effect in a statistically significant way. The Cragg-Donald test for weak instruments does not perform as well in these specifications as in Table 1, but the Sargan test statistic does not reject the exclusion restriction, and the first stage partial R^2 remains relatively high.

The key observation is that there is still no difference between the coefficients to *y* (IV) and *y* (OLS), even when these controls are added

4.2 Six ethno-linguistic control variables

The six ethno-cultural control variables included in Table 3 are the index of ethno-linguistic fractionalization (*ethnoel*), dummies for French or English legal origins (*lofre* and *loeng*), and the share of the population that has certain religious beliefs (*prot*, *romcat*, *muslim*). The reader will know that these variables have been used in other papers.

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 be correlated with democracy independent of the measure of income.

As before, we do not find any statistically significant direct or indirect effect of the ethno-linguistic or legal control variables. But we find that conditional on the level of instru-

mented income, the share of the population with the two Christian beliefs is positively correlated with the degree of democracy, and the share of the population with Muslim belief is negatively correlated with democracy.[16] In both specifications with religious beliefs, the size of the estimated income effect is statistically not significantly different from the results in Table 1, and there is no evidence for weak instruments (CD F-statistic) or a rejection of the exclusion restriction (Sargan statistic). Once again, our key result holds: The coefficients to *y* (IV) and *y* (OLS) are not different.

Table 3. The effect of additional ethno-cultural variables

	Dependent variable: *P*					
	(1)	(2)	(3)	(4)	(5)	(6)
No. of obs. (countries)	97	101	101	101	101	101
y (IV)	2.16 (1.07)	2.69 (0.69)	2.72 (0.70)	2.61 (0.69)	2.92 (0.62)	2.67 (0.64)
Ethnoel	-2.10 (2.93)					
Lofre		-0.31(1.07)				
Loeng			-0.26 (1.22)			
Prot				3.44 (2.63)		
Romcat					3.51 (1.44)	
Muslim						-5.28 (1.73)
First stage partial R^2	0.28	0.43	0.42	0.43	0.51	0.50
CD F-statistic	17.96	35.94	35.65	36.07	49.51	49.19
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)	1.58 (0.21)	1.69 (0.19)	1.70 (0.19)	1.34 (0.25)	1.32 (0.25)	0.32 (0.57)
y (OLS)	2.64 (0.57)	2.82 (0.46)	2.82 (0.46)	2.71 (0.46)	2.57 (0.49)	2.25 (0.46)
Adjusted R^2	0.26	0.27	0.27	0.28	0.32	0.35

Notes: See Table 1. In the IV regressions, biofpc and geofpc are used as instruments, as in column (4) of Table 1. OLS results are conditional on the inclusion of the control variable.

The same pattern of results holds if we run the experiments of Tables 2 and 3 by using the instrumental variables of columns (1), (2), and (5) of Table 1.[17] Overall, we conclude from these findings that adding alternative socio-political or ethno-cultural control variables to our basic specification does not alter our statistically significant and quantitatively important estimate of the long-run effect of income on democracy: most of our point estimates are in the range of 2.5-3.0.

16. For similar results, see Borooah and Paldam (2007). Note that even if the coefficient to *Prot* is insignificant, it is virtually the same as the one to *Romcat*, and both are statistically different to the one to *Muslim*.
17. Detailed results are available upon request.

4.3 Panel estimates of accepting and rejecting the Democratic Transition

We have emphasized that our interest is the long-run effect of income on democracy. Ignoring all problems surrounding measurement error, omitted variables, and reverse causality, the long-run effect can be best estimated from a cross-section of countries.

Once other data sets are used for estimation, the time horizon that is at the center of the empirical analysis has not always been stated clearly in recent contributions to the literature. We think this is a major defect because it should be clear from the outset that a potential long-run effect of income on democracy that can be estimated from pure cross-section data may not show up in panel data based on, say, 5-year averages of all included variables.

The empirical model of income and democracy that has often been used for estimation with panel data is given by:

$$P_{it} = \alpha_{(i)} + \beta^s y_{it} + \delta P_{it-1} + \varepsilon_{it}, \qquad (5)$$

Where $\alpha_{(i)}$ may or may not allow for country heterogeneity, β^s, measures the short-run effect of income on democracy, and δ measures the autoregressive adjustment of democracy over time. In this model, the long-run effect of income on democracy is given by

$$\beta^{\infty} = \beta^s / (1 - \delta) \ . \qquad (6)$$

A key result of the previous literature on income and democracy has been that estimates of β from a model like (1) above are close to the estimates of β^{∞} from models like (5).[18] Thus, equation (5) provides considerable evidence for the democratic transition. As most political systems have long periods of stability, estimates of the annual adjustment parameter δ are very close to 1.

Consequently, if the panel data are constructed with a short time horizon, for instance with 5-year data, equation (5) becomes tricky to estimate because it almost contains a unit root. Furthermore, if the specification also includes fixed effects for countries (and time), the lagged adjustment is likely to dominate the variation of *P*, and the estimate of the income effect on *P* becomes statistically insignificant, as reported by Acemoglu et al. (2005b, 2007). We do not think that evidence based on model (5) with a short time horizon and with fixed

18. Empirical models like equation (5) have been estimated on the Polity index and also on the Gastil index, with and without fixed effects for countries and for time and by using different time periods. For a survey, see Paldam and Gundlach (2008). More details are given in Borooah and Paldam (2007), Paldam (2007) and Jensen and Paldam (2007).

effects can be used to reject the Democratic Transition hypothesis. The Grand Transition view and the democratic transition hypothesis are about long-run changes that do follow a distinct trend.

4.4 Panel regressions of the cross-country pattern (Table 4)

We construct an unbalanced panel data set with cross-sections of countries for selected years that partly reflect data availability in the Polity and the Maddison data sets (1820, 1870, 2003) and otherwise approximate important breaks in the economic history of the 20th century, such as the two world wars (1913, 1938), the begin of the cold war (1950), the end of colonialism (1960), the first oil crisis (1973), and the demise of the Soviet Union (1995).

The panel data may be used for fixed-effects estimation to control for the presumed country heterogeneity. With country fixed effects, we would estimate the expected change in the degree of democracy of *one* country conditional on its observed income levels at different points in time, given by the panel years. However, the long-run effect that we have estimated before equals the expected difference in the degree of democracy between *two* countries conditional on their observed income levels at a given point in time. Both effects may turn out to be of the same size, but a priori this cannot be taken for granted. Hence, we first estimate the effect of income on democracy with the so-called *between-estimator*.

Table 4. Between- and within-estimates of the effect of income on the degree of democracy

	Dependent variable: *P*					
	Between estimates			Within estimates		
	(1)	(2)	(3)	(4)	(5)	(6)
No. of obs.	572	388	236	785	548	236
No. of countries	103	102	84	157	156	84
y	2.85 (0.77)	2.75 (0.60)	4.28 (0.88)	3.15 (0.29)	2.19 (0.56)	4.53 (0.74)
Instruments	yes	yes	no	no	no	no
Fixed effects	no	no	no	country	country	country
Included cross sections	all years	1960/1973/ 1995/20003	1820/1870 1913/1938/ 1950	all years	1960/1973/ 1995/2003	1820/1870/ 1913/1938/ 1950
CD F-statistic	27.55	41.29	-	-	-	-
CD critical value (size)	19.93 (10%)	19.93 (10%)	-	-	-	-
F-test (p-value)	-	-	-	3.96 (0.00)	3.63 (0.00)	2.25 (0.00)

Notes: Standard errors in parentheses. All specifications include a constant term (not reported). In columns (1) and (2), we use our preferred instruments biofpc and geofpc, which pass the Cragg-Donald (CD) test for weak instruments. For the within-estimates (country fixed effects), the F-test rejects the hypothesis that all country-specific constant terms are jointly zero (p-value in parentheses).

Columns (1) - (3) of Table 4 show the results for alternatively constrained panel data sets. We use our preferred instruments for the estimation of the full panel data set and for the estimation of the panel data set with years since 1960. In the light of unreported results, which suggest that our instruments do not work for the smaller samples of countries for the years before 1960, we estimate the panel data with the older cross-sections of countries without instrumental variables.[19] For all three specifications, we find a statistically significant effect of income on democracy. The point estimates of the income parameter are similar to our main result of Table 1. For instance, a point estimate of the income parameter of 2.8 is within the 95 percent confidence interval of all three between-estimates.

The same holds for our country fixed-effects estimates for the three alternative panel data sets in columns (4)-(5), with the point estimate in column (6) narrowly outside the 95 percent confidence interval. The F-test reveals that the country-specific constant terms are not jointly equal to zero, so OLS estimation of the panel data would be inappropriate. In addition, we find for each sample pair in columns (1) and (4), (2) and (5), and (3) and (6) that the point estimates of the between-estimator and the fixed-effects estimator are not statistically significantly different from each other, which allows us to interpret our results in a cross-country *and* in a time series context. We think that this final result strongly supports the democratic transition hypothesis. [20]

5 Conclusion: The Democratic Transition

If we take income and the Polity index as the best aggregate representations of the economic and political development, then we have shown that in the long run, the economy dominates. We have added a number of qualifications as regards the short to medium run, but in the long run, institutions and critical junctions do not influence the outcomes as regards the political development.[21]

19. We find that our instrumental variables do not pass the CD test for weak instruments for each cross section of countries for the years before 1960. The apparent reason for this outcome is the limited number of cross-country observations for the earlier years, when many present sovereign states still had the status of a colony. Detailed results are available upon request.

20. Appendix C discusses the possibility that our instruments identify exogenous variation in a broad measure of the institutional framework of country, such that the observed correlation between income and democracy is actually driven by institutional variation rather than by income, as in the Critical Junctures hypothesis. We do not find empirical support for this hypothesis.

21. This has a curious parallel to the classical theory of Economic Determinism that originated from Karl Marx.

Our empirical results suggest that there is a large robust effect of the level of income on the degree of democracy.[22] As is also highlighted by Figure 1, income is certainly not the only determinant of democracy, but it appears to be a rather powerful predictor.

There are two strong and politically important conclusions from our results. The positive conclusion is that countries are likely to transform their political regime towards democracy with rising levels of per capita income. Of course this does not mean that all countries will always become democracies once they have reached a certain level of development, but it seems that the political change towards democracy becomes more likely by getting rich than by staying poor.

However, there is also a downside to our results: We should be pessimistic about attempts to impose a democratic regime in poor countries by outside force. We think that such a regime change cannot be expected to last if a self-contained growth process is missing. The Critical Junctures hypothesis would probably be more optimistic on this point if the change in democracy would reflect a genuine change in the power structure of the political system, but our aggregate results suggest otherwise. We would predict that the degree of democracy of a country is mainly determined by its income level, so the political regime of poor countries is likely to revert to a level of autocracy that is compatible with their level of development.

At the end, we may turn from the specific hypothesis to the broader views: We conclude that we have found a large piece of evidence that the Grand Transition view provides a better understanding of the broad pattern of development than the Primacy of Institutions view.

22. With a point estimate of 2.8, which is within the 95 percent confidence interval of almost all of our results, we would predict that the income difference between the 25th and the 75th percentile of our samples would result in a change of the degree of democracy of 4.7 (OLS) to 4.2 (panel data) score points. This is between one half and one third of the observed difference in the degree of democracy between the 25th and the 75th percentile of our samples.

Appendix A: Definitions and sources of variables by category

Dependent variable and main explanatory variable	
P	Combined polity score. Source: Marshall and Jaggers (2006) and Polity homepage.
y	Natural logarithm of GDP per capita, measured in 1990 international Geary-Khamis dollars. Source: Maddison (2003) and Maddison homepage.
Instrumental variables	
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).
axis	Captures the rate of East-West orientation of a country, measured as east-west distance (longitudinal degrees) divided by north-east distance (latitudinal degrees). 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).
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 cost. Source: taken from 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).
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).
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).
Control variables	
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, the percentage share of the population not speaking the official language, and the percentage share of the population not speaking the most widely used language. Source: La Porta et al. (1998).
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).
loeng, lofre	Legal origin of the Company Law or Commmercial Code of each country, measured by dummies (loeng = English Common Law, lofre = French Commercial Code). Source: La Porta et al. 1998.
mining	Share of GDP in the mining and quarrying sector, approx. 1988. Source: Hall and Jones (1999).
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).
suicide	Total number of suicides per 100,000 population, estimates for early 1990s. Source: Parker (1997).

Institutional variables used in Appendix C

socinf	Index of social infrastructure, calculated from the years that a country is open to international trade, law and order, bureaucratic quality, corruption, risk of expropriation, and government repudiation of contracts. Source: Hall and Jones (1999).
kaufavg	Unweighted average governance indicator for the year 1996, based on six survey measures: voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption. Source: Kaufmann et al. (2004).
exprop	Index of protection against expropriation 1985-1995.Source: Taken from Acemoglu et al (2001).
lnmor	Natural logarithm of settler mortality rates in European colonies in the early 19th century; fourth mortality estimate. Source: Acemoglu et al. (2001)

Appendix B

Table A1. Correlation of Control Variables with Democracy and Income

	P (polity)			*y* (income)		
	Coefficient	p-value	No. of obs.	Coefficient	p-value	No. of obs.
			Socio-economic control variables			
mining	-0.27	0.00	126	0.01	0.87	120
gini	-0.15	0.17	87	-0.31	0.00	85
homicavg	0.03	0.78	94	-0.20	0.05	91
suicide	0.37	0.01	50	0.43	0.00	48
			Ethno-cultural control variables			
ethnoel	-0.28	0.00	128	-0.55	0.00	123
lofre	-0.09	0.27	157	-0.17	0.03	152
loeng	0.03	0.68	157	-0.01	0.86	152
prot	0.32	0.00	155	0.24	0.00	151
romcat	0.40	0.00	157	0.20	0.01	152
muslim	-0.57	0.00	157	-0.26	0.00	152

Note: Coefficient of correlation; the *p*-value gives the level of statistical significance. All observations for 1995 or the next available year.

Appendix C: The simultaneity of income and some other institutions

Income and institutions have developed simultaneously through economic history. One may therefore object that our main result reflects, at least partly, the effect of the institutional power structure on democracy, rather than a pure income effect. For instance, if we delete the regression constants and modify our equation (1) as

$$P_i = \beta y_i + \gamma inst_i + \varepsilon_i, \qquad \text{(A1)}$$

where *inst* is a measure of the institutional structure of a country, and subsequently rewrite equations (2) and (3) as

$$y_i = \eta inst_i + u_i \quad \text{and} \qquad \text{(A2)}$$

$$inst_i = \mu biogeo_i + \nu_i, \qquad \text{(A3)}$$

with η and μ as parameters and u and ν as error terms, then he reduced form follows as

$$P_i = \mu(\beta\eta + \gamma) biogeo + \omega_i \qquad \text{(A4)}$$

with ω_i as a modified error term. The reduced form shows that our main result could reflect, at least in principle, that there is no direct effect of income ($\beta = 0$), but instead an effect of the institutional structure on democracy that works through income ($\gamma > 0$). Since we do not have two independent instruments that would disentangle the separate effects of income and institutions on democracy in equation (A1), we have to rely on indirect estimates to see whether our main result could imply that $\beta = 0$ and $\gamma > 0$, as in the Critical Junctures view.

We estimate equation (A2) by using our preferred instruments (*biofpc*, *geofpc*). If our preferred instruments are too weak to identify the exogenous variation in the measure of institutions, we would have at least indirect evidence that our estimates in Table 1 cannot reflect the effect of institutions on democracy. Put differently, finding that our preferred instruments do not help to predict the effect of institutions on income in equation (A2) would imply that our main result in Table1 is actually due to direct effect of income on democracy ($\beta > 0$), as in the Democratic Transition hypothesis.

Table A2. Estimating the effect of institutions on income

	Dependent variable: *y*					
	(1)	(2)	(3)	(4)	(5)	(6)
No. of obs. (countries)	60	62	47	48	62	69
exprop (IV)	0.96 (0.16)		0.62 (0.26)			
kaufavg (IV)		1.71 (0.22)		1.35 (0.48)	2.69 (1.68)	
socinf (IV)						8.78 (3.90)
Instruments	*lnmort*		*biofpc, geofpc*		*biofpc, geofpc*	
First stage partial R^2	0.27	0.33	0.14	0.11	0.02	0.04
CD F-statistic	21.49	29.82	3.49	2.79	0.59	1.31
CD critical value (size)	16.38	16.38	19.93	19.93	19.93	19.93
Sargan test (p-value)	-	-	0.01 (0.92)	0.36 (0.55)	0.96 (0.33)	1.56 (0.21)
exprop (OLS)	0.54 (0.06)		0.42 (0.09)			
kaufavg (OLS)		1.20 (0.11)		1.29 (0.16)	1.26 (0.15)	
socinf (OLS)						3.86 (0.49)
Adjusted R^2	0.54	0.66	0.30	0.57	0.53	0.48

Notes: See Table 1 and text. The samples are restricted to former European colonies.

The first column in Table A2 reproduces the result reported by Acemoglu et al. (2001) with different income data. There is a strong effect on income of the measure of institutions, here the risk of expropriation (*exprop*), which is identified by the instrumental variable (log) settler mortality in the early 19th century (*lnmort*). There is no evidence for a weak instrument

problem. The same result appears for an alternative measure of institutions, namely the average of six institutional indices (*kaufavg*) that are reported by Kaufmann et al. (2004).

Acemoglu et al. (2001) emphasize that a hypothesis like equation (A2) should be estimated for a sample of former (European) colonies, because only for these countries there is exogenous variation in institutions that would allow for identifying a causal effect on income.[23] Columns (3)-(6) report the results for using our preferred instruments instead of settler mortality. Columns (3) and (4) use the same sample of former colonies as in Acemoglu et al. (2001), columns (5) and (6) use a larger sample of former European colonies and a further measure of institutional quality for comparison, namely an index of the social infrastructure (*socinf*) calculated by Hall and Jones (1999). We find in columns (3)-(6) that our preferred instruments do not pass the Cragg-Donald test for weak instruments, by a wide margin. For the larger samples of former colonies in columns (5) and (6), we find large differences between the IV and the OLS estimates.

We conclude from our results in Table A2 that our preferred instruments are not well suited to identify a causal effect of institutions on democracy that works through income. But our preferred instruments appear to identify a direct causal effect of income on democracy quite well, as reported in Table 1. Hence we maintain that $\beta > 0$, which is in conflict with the Critical Junctures hypotheses.

[23] The Grand Transition hypothesis as motivated by Unified Growth theory would not be estimated for a sample of former colonies. It should explicitly include the countries where the Industrial Revolution started and exclude countries where the indigenous population has been more or less wiped out after colonization, such as the four Western offshoots.

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