Health and Democracy

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I Introduction

In spite of the inexorable march of democracy around the globe, just how democratic institutions affect human well-being is open to debate. The evidence that democracy promotes prosperity is neither strong nor robust. Moreover which aspects of policy making and human well-being are promoted by democracies is still a subject of debate.[1]

Even if correlations between democracy and outcome measures can be found, there is an overriding difficulty of interpreting them as causal effects. Whether democracy matters *per se* or simply serves as a proxy for societal and political development presents a difficult problem for research in this area. Thinkers such as Lipset (1959) have argued that democracy can thrive only when conditions are right. If this is correct, then becoming democratic may only serve as a proxy for these hard-to-measure cultural and societal preconditions.

This paper explores these issues further by reconsidering the link between democracy and health using panel data from a cross-section of countries. The

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[1] See, for example, Mulligan et al (2004). Sen (1999) emphasises the intrinsic benefits of democracy in addition to the search for instrumental policy and stability gains that are normally the subject of economic analyses.

data show a strong (conditional) correlation between life expectancy and democracy. This relationship is strongest for the decades of the 1960s and 1970s and is robust to controlling for the initial level of human capital as well as political histories. The data also suggest that health policy interventions are superior in democracies.

The remainder of the paper is organized as follows. In the next section, we discuss some background issues. In Section III, we present the results and the possible interpretations of these empirical findings. Section IV concludes.

II Background

Human history has witnessed remarkable increases in life expectancy alongside increases in prosperity. Preston (1975) showed that this relationship is non-linear with the largest gains in life expectancy being associated with increases in income per capita at low incomes. Crudely speaking, these increases in life expectancy can be traced to three factors. First, there are reductions in malnutrition and improvements in infrastructure such as clean water supply and improved sanitation facilities. Second, there is medical intervention through control (due to immunization and insecticides) and treatment of infectious diseases using antibiotics. Third, there are improvements in knowledge and lifestyle. All three of these are associated with increases in prosperity although the direction of causation is hard to establish.[2]

Of particular importance in recent history is the increased use of insecticides and antibiotics which lead to remarkable increases in life expectancy in the post war period (see, for example, Gwatkin (1980)). Preston (1975 and 1980) attributes the upward shift in the non-linear relationship between life expectancy and per capita income in the 20th century to social policy measures, especially vector control and immunization, undertaken in less developed countries. Deaton (2004) attributes this wave of mortality reduction which hit the third world after World War II to "the globalization of knowledge, facilitated by local political, economic, and educational conditions."(page 109).[3] The literature to date has focused more on the latter influences (education and economics) rather than the political foundations of increased life expectancy.

[2]See Acemoglu and Johnson (2005) for a recent attemp to establish whether increases in life expectancy were a cause of increased prosperity.

[3]The role of knowledge is further emphasised in Mokyr (2002).

As a background, Figure 1 presents the"Preston Curve" for mid-way through our data period (1982) showing the link between life-expectancy and income per capita. The curve shown here is fitted non-parametrically. The Figure labels the democracies and autocracies differently to get a feel for whether they have different levels of life-expectancy. The importance of controlling for income is apparent here as most very poor countries are autocracies while all very rich countries are democracies.

There are three main theoretical differences between democracies and autocracies that we might expect to influence health issues. The first concerns representation. Acemoglu and Robinson (2005) focus on who controls political office, modeling autocracy as a dictatorship of the rich and democracy as a dictatorship of the poor or middle classes. On this view, health indicators will improve if public health is more of a priority for groups who dominate under a democracy compared to those who gain political influence in an autocracy. An effect on health seems plausible on this view to the extent that the rich have less interest in public solutions to health problems.[4]

A second view of the difference between democracy and autocracy emphasizes accountability structures. Democracies demand accountability to a broad set of citizens at regular intervals whereas autocrats are accountable only to a smaller group such as the military.[5] Moreover, autocrats typically repress political opposition and the media to stifle public policy debate. This view also predicts that greater attention will be paid to health issues in democracies since failure to do so should result in leaders being removed from office – this link being weaker in autocracies.

A third difference between democracies and autocracies concerns the process of political selection with democracies having stronger mechanisms for selecting competent and honest leaders to implement policy. To the extent that health interventions are supported by skilled and incorruptible political leaders, then democracies should lead to better health outcomes than autocracies.

There are conflicting views about whether democracy affects policy and economic performance. Przeworski and Limongi (1993) review empirical research on the effect of democracy on economic growth, concluding that the

[4]This view is borne out in discussions of investments in public health measures historically; see, for example, Szreter (1988) for a discussion of Great Britain.

[5]Bueno de Mesquita et al. (2002) argue that, given the total amount of government expenditures, the larger the number of people whose support is required for the government to stay in power, the higher the level of public goods provided by the government.

correlation is weak and not robust. Persson and Tabellini (2005) try a novel econometric approach finding some support for the proposition that persistent democracy is associated with improvements in economic performance.[6]

There is a small literature that looks at the relationship between life expectancy and democracy in cross-country data. Franco et al (2004) report a positive correlation between life expectancy and democracy. (See also Govindaraj and Rannan-Eliya (1994).) Lake and Baum (2001) relate democracy to a variety of public health interventions.

III Evidence

We use panel data across countries from the 1960s to the 2000s.[7] We begin by showing that there is a strong and robust link between life expectancy at birth and democracy after controlling for income. Our basic specification uses data for every fifth year between 1962 and 2002. We estimate an equation of the form:

$$h_{srt} = \alpha_r + \beta_t + \gamma_1 d_{srt} + \gamma_2 D_{srt} + \theta_1 y_{srt} + \theta_2 \left(y_{srt}\right)^2 + \mathbf{x}_{srt}^{'}\boldsymbol{\lambda} + \varepsilon_{srt} \qquad (1)$$

where h_{srt} is some health indicator in country s in region r in year t, α_r is a region dummy variable, β_t is a year dummy variable, y_{srt} is income per capita in country s in region r averaged over years $t-4$ to t,[8] and $\mathbf{x}_{srt}$ are other (in practice time invariant) exogenous variables such as legal origins and political history.[9] The variables (d_{srt}, D_{srt}) are measures of democracy. The first is a contemporaneous measure denoting the fraction of democratic years between year $t-4$ and t while D_{srt} is a longer-term one denoting the

[6] See also Papaioannou and Siourounis (2005) and Rodrik and Wacziarg (2005) for the argument that democratization is associated with subsequent growth.

[7] Our measure of democracy is from the Polity IV data base. Following Persson (2005) and Persson and Tabellini (2005), a country is defined as democratic if variable POLITY2 is positive. See the Data Appendix for the definitions, sources, and construction of variables used in the analysis. For descriptive statistics, see Appendix Tables 1 to 3.

[8] As we know from the work of Preston (1975) and others, there is a strong correlation between income and life expectancy with a non-linear effect. This is illustrated in Figure 1.

[9] Legal origin dummies effectively control for the effects of communist regimes on health outcomes (see Govindaraj and Rannan-Eliya 1994) as legal origin classification includes socialist law. La Porta et al. (1999) find that legal origins are significantly correlated with infant mortality and democracy.

fraction of democratic years since 1956 until year t.[10] The variable ε_{srt} is an error for which we compute robust standard errors clustered at the country level.

The main concern in interpreting results stems from the possibility that, as argued by Lipset (1959), there are social and cultural factors that evolve and make it easier for democratic institutions to be supported. Thus:

$$d_{srt} = a_r + b_t + \kappa_1 y_{srt} + \kappa_2 \left(y_{srt}\right)^2 + \mathbf{x}_{sr}^{'}\boldsymbol{\mu} + \mathbf{z}_{srt}^{'}\boldsymbol{\rho} + \eta_{srt}$$

where $\mathbf{z}_{srt}$ is a vector of factors that evolve and make it easier to sustain democratic institutions. If such factors exist, then we would spuriously attribute a direct effect of democracy on outcomes that is really due to $\mathbf{z}_{srt}$.

Table 1 presents the basic results. In column (1), we look solely at the partial relationship with contemporaneous democracy finding that being democratic is associated with a 3.5 year increase in life expectancy. In column (2) we add income per capita measures. After controlling for income, the democracy effect falls to around two years, but remains positive and significant. Column (3) adds the fraction of democratic years since 1956. The data suggest that it is more permanent democratic transitions that matter and the contemporaneous democracy effect is no longer significant, although an F-test indicates that the two democracy variables are jointly significant. The point estimate suggests that a country that has been democratic for the whole period from 1956 through year t has a life expectancy that is more than five years higher than a country that has been autocratic since 1956. To put this in perspective, this point estimate "explains" 3.5 of the 13.7 year life expectancy difference between Ghana (democratic for 11 out of 47 years) and the U.S.A. (always democratic) in 2002. Column (4) reports the results for a different measure of democracy available due to Boix and Rosato (2001).[11] The main results hold up in this case.[12] Column (5) shows that

[10] Keefer (2005) (young versus old democracies) and Persson and Tabellini (2005) (democratic capital) argue that longer-lived democratic experience is important. We choose 1956 as infant mortality data begins in 1960 (see column (5) of Table 1).

[11] Boix and Rosato (2001), who extend the democracy dataset constructed by Przeworski et al. (2000), define a country as a democracy if the following three conditions are satisfied: (1) the legislature is elected in multiparty elections; (2) the executive is elected in a multicandidate election or elected by the legislature satisfying condition (1); (3) at least 50 percent of adult men have the right to vote. Compared to POLITY IV, this measure of democracy heavily depends on political contestation, putting less weight on political participation and on executive constraints.

[12] The number of observations goes down since Boix and Rosato (2001)'s data covers

the result holds when we look at infant mortality rather than life-expectancy. It indicates that countries that have always been democratic since 1956 have fewer infants dying before reaching one year of age by about 17 per 1000 live births (about one-fourth of the sample mean) than countries that have been continuously autocratic since 1956.

The remaining columns in Table 1 look at the possibility that democracy is correlated with pre-existing values and hence not picking up an institutional effect. In column (6) we add measures of political history – specifically the fraction of years between 1900 and 1955 for which the country was democratic and the fraction of years in the same period for which the country was a colony. These are not significant and the effect of democratic years since 1956 remains. This holds true even if we allow the history to affect the time trend in life expectancy in column (7). Thus, it is difficult to argue that we are picking up long lived differences in values that are related to prior democratic experience.

Column (8) controls for the stock of education in the population aged over 15 in 1960 using Barro and Lee (2000)'s data. Prerequisites for democracy are likely to be correlated with human capital and Glaeser et al. (2005) have recently argued that education affects the sustainability of democratic institutions. Education is positively related to life expectancy. However, the democracy variable remains positive and significant although a little smaller in size (by about one year compared to column (3)). In column (9), we allow the initial level of education to affect the time trend in life expectancy. Countries with more education in 1960 tend to have smaller trend increases in life expectancy but the proportion of democratic years since 1956 remains significant.

In Table 2, we explore in greater detail where the democracy effect is coming from.[13] First, we allow the democracy effect (γ_1 in equation (1)) to be different across time periods by estimating separate year effects for democracies and non-democracies. The results reported in column (1) reveal that the significant differences obtain for the early part of our sample and disappear in the later period. Figure 2 plots the estimated year effects

only years until 1994. The number of countries in the sample goes down even though Boix and Rosato (2001), unlike POLITY IV, include the least populous countries, because countries for which income is observed only in the late 1990s in the Penn World Table are all dropped in column (4).

[13]Note that we do not include the longer-term democracy variable, D_{rst}, as a regressor in Table 2.

for democracies and autocracies. This shows that the upward trend in life expectancy disappear in the 1990s for both democracies and autocracies. These results are consistent with a view that the 1960s and 1970s were a key period in mortality decline (Gwatkin (1980)), coupled with an additional observation that democracies were quicker to adopting mortality reducing technologies.[14]

Column (2) of Table 2 shows that the democracy effect is identified primarily from middle and lower income countries as opposed to the very poorest and richest countries. This reflects the fact that most very low income countries have tended to be autocracies and rich countries tend to be democracies so we simple observe no variation in these cases.[15]

Table 3 explores in more detail the source of identification.[16] The first column shows that the result is not robust to including country fixed effects.[17] If most of the identification is coming from cross-sectional differences between countries that are permanent in nature, we will not find anything in the fixed effects regressions. However, it could also be symptomatic of there being common omitted factors, such as culture and institutions, driving both democracy and life-expectancy.[18] We divide the sample into those countries that have been either continuously democratic or autocratic over the entire period (no regime change) and those that have switched at some point (switching regimes). Using the basic specification, the original effect shows up in both sub-samples as shown in columns (2) and (3). In column (4), we show that there is no effect when we exploit only within-country variation in the group of countries that switched regime. Columns (5) and (6) show that, when we concentrate on those countries that have had a single democratic transition which has not subsequently been reversed, then we do get

[14] As shown in Appendix Table 1, the average life expectancy goes up in the 1990s. This, combined with Figure 2, suggests that increases in life expectancy in the 1990s are mainly due to income growth (Figure 2 shows year fixed effects after controlling for income).

[15] In fact, we cannot reject the equality of coefficients on all the intereaction terms.

[16] We drop the short term measure of democracy, d_{srt}, from our specifications in the following.

[17] We need to be cautious in interpreting fixed effects estimates as their consistency requires strict exogeneity: regressors are orthogonal to the errors at all leads and lags.

[18] Acemoglu et al (2005) have argued that the relationship between income and democracy is suspect on the basis of its non-robustness to the inclusion of country fixed effects. Acemogul et al (2004) makes a similar claim in respect of the link from education to democracy.

an effect of being democratic once again.[19] In column (5), this is identified solely from the 21 countries that have been in the data set throughout the period whereas column (6) is an unbalanced panel including, for example, some countries that were formed after the break-up of the Soviet Union and Yugoslavia.

Table 4 looks for evidence of differences in policy priorities between democracies and autocracies.[20] In columns (1) and (2), we investigate the difference in sanitation and clean water supply between democratic and non-democratic countries. These two health infrastructures prevent deaths caused by diarrhea, typhoid, and cholera. We see that the percentage of the population with access to improved sanitation facilities and improved water sources is higher by about 15 points (25 percent of the sample mean) and about 11 points (14 percent of the sample mean), respectively, in permanent democracies since 1956 than in permanent autocracies.

In columns (3) and (4), we explore the relationship between democracy and immunization. The latter is mostly a preventive measure against airborne infectious diseases.[21] We find that the percentage of children aged 12 to 23 months who received DPT (diphtheria, pertussis, and tetanus) vaccination before the age of one is higher by about 9 points (more than 10% of the sample mean) in democracies compared to autocracies. For measles vaccination, democracy variables are not significant while former colonies have lower immunization rates.[22]

Finally, column (5) investigates the relationship between democracy and government health expenditures per capita (excluding expenditures on water and sanitation provision). The specification is the same as in columns (3) and (4) with data being available for the year 2000 only. Here we find that the government in a permanent democracy during 1956 to 1995 spends around

[19] This result does not, however, survive clustering of the standard errors at the country level.

[20] Note that we do not cluster standard errors for Table 3 due to the limited time span of the sample.

[21] As immunization data is observed annually, we replace h_{srt} in equation (1) with a health indicator averaged over the period from $t-4$ to t, where t is a five year interval between 1985 and 2000. We also substitute D_{srt-5} for D_{srt} to avoid the overlap between the two democracy variables.

[22] Lake and Baum (2001) find a similar result (significant for DPT but insignificant for measles). Gauri and Khaleghian (2002) find that, after controlling for country fixed effects, the democracy effect on immunization is positive among poorest countries but decreases with per capita income and eventually becomes negative among middle-income countries.

160 dollars (in purchasing power parity terms) per person more on health than the one in a permanent autocracy.[23]

In Table 5, we undertake some further robustness checks by including exogenous variables that might be thought to affect either the disease environment or the ease of public action. In column (1), we introduce the malaria ecology index of Kiszewski et al. (2004). The higher this index, the more likely malaria is transmitted due to ecological factors. This is negatively correlated with life expectancy as we might expect. In column (2), we control for European settler mortality in the 19th century as in Acemoglu et al. (2001).[24] This is correlated with lower life expectancy today though the magnitute is very small.[25] Column (3) includes the ethnic fractionalization index studied in Alesina et al. (2003).[26] Higher ethnic fractionalization is correlated with lower life expectancy.[27] In column (4), we control for the incidence of armed conflicts using the Armed Conflict Dataset by Gleditsch et al. (2002). Wars are negatively correlated with life expectancy. Finally, column (5) adds the mineral exporter dummy (time-invariant), constructed from World Development Indicators, to the set of controls.[28] Mineral exporting countries have lower life expectancy. In all cases, the democracy effect that we identified in Table 1 remains significant.

Finally, Table 6 looks at more disaggregated measures of democracy. Column (1) explores whether disaggregating democracies into presidential and parliamentary regimes yields differential correlations with life expectancy. Column (2) does the same analysis for proportional representation and majoritarian electoral rules. In neither case is there a significant difference

[23] The fact that countries that were democratic between 1900 and 1955 spend around 200 dollars more per capita than those that were continuously autocratic suggests that democratic experience may well be picking up long-lived cultural/political trends as well as health investments.

[24] In their subsequent research, Acemoglu et al. (2005) argue that European settler mortality is associated with the evolution of democracy as well as long-run economic development.

[25] Settler mortality is measured as the number of deaths per 1000 settlers.

[26] Aghion et al. (2004) theoretically argue that increased polarization of preference leads to the adoption of a Constitution in which political leaders are more insulated. They also find some empirical support for this claim by using the same index of ethnic fractionalization.

[27] Alesina et al. (2003) find that infant mortality is higher in ethnically more fractionalized countries.

[28] Ross (2001) provides a panel cross-country evidence that mineral exporting countries are more likely to be non-democratic.

between these different forms of democracy. In column (5), we disaggregate democracy in POLITY IV's three sub-indices. There is suggestive evidence that the correlation driven by there being higher executive competition in democracies. However, given the relatively high correlations between these components, one should not "over-interpret" the significance of this finding.

IV Concluding Comments

Our results suggest that there is a robust correlation between democratic institutions and health, resulting in greater life expectancy in democracies. The results suggest that it is a pro-longed exposure to democracy that matters. However, without truly exogenous variation in constitutional differences, the concern that this represents omitted cultural and social variables remains. Still, the fact that these results are robust to including education and political history as regressors is encouraging to the interpretation of this effect as telling us something about the impact of institutions of policy making.

The results contribute to a growing body of the literature that takes political economy factors seriously in understanding human well-being. The challenge now is to take this agenda beyond broad cross-country comparisons and into the detailed workings of political and bureaucratic behavior under different systems of government.

V Data Appendix

V.1 Dependent Variables

Life expectancy at birth (in years) is obtained from *World Development Indicators* (September 2005). We only use the data for every fifth year between 1962 and 2002 as observations for a large number of countries are available in these years. (We do not use the data for years 1990 and 2003, in which a large number of observations are also available, in order to maintain consistency in the data structure.)

Infant mortality (per 1,000 live births) is obtained from *World Development Indicators* (September 2005). For the same reason as for life expectancy, we only use the data for every tenth year between 1960 and 2000. (We do not use the data for 1995 and 2003 despite the availability for a large number of countries for the same reason as above.)

Sanitation (in percentage of the population with access to improved sanitation facilities) and clean water (in percentage of the population with access to improved water sources) are obtained from *World Development Indicators* (September 2005). The data is only available for 1990 and 2002.

DPT and measles immunization (in percentage of children aged 12 to 23 months who received vaccination before reaching the age of one) are obtained from *World Development Indicators* (September 2005). The data is available annualy from 1980 through 2003. We calculate the averages over five-year periods beginning in 1981, throwing away the data for 1980, 2001, 2002, and 2003.

Government health expenditures per capita (in constant 1996 international dollars) are obtained as follows. The data in current international dollars is obtained from *World Health Reports* 2002 (Annex Table 5 for 1996 figures), 2004 (Annex Table 6 for 1997), and 2005 (Annex Table 6 for 1998 to 2000), all downloaded at the World Health Organization website (http://www.who.int/whr/annexes/en/index.html). In order to separate the effect of inflation, these figures are deflated by the GDP deflator obtained from the Penn World Table 6.1 (by dividing nominal GDP per capita (variable CGDP) by real GDP per capita (variable RGDPCH)). These drop some observations of government health expenditures due to the lack of GDP data in the Penn World Table. Then the average over 1996-2000 is calculated.

V.2 Democracy Variables

A country-year is treated as democratic if variable POLITY2 in the POLITY IV dataset version 2003[29] is more than zero[30]. This variable is missing if a country is not independent or occupied by foreign forces (for example, Bosnia and Herzegovina since 1995, Cambodia during 1979-87, Lebanon since 1990, Syria during 1958-1960). We treat such a case as a colony, excluded from the sample,[31] although we use this information when we construct a political history variable (see below). Also note that the POLITY IV data excludes countries with the population of less than 500,000. This drops some countries with life expectancy observations (e.g. small island nations in the Caribbean).

We make adjustments to the POLITY2 variable for the following countries.

1. Burundi: Assign the value of 0 in 2002. POLITY 2 is missing for Burundi in 2002 due to the regime transition.[32] We treat it as non-democratic.

2. Peru: Assign the value of 5 in 2000. This is simply a data entry error by the POLITY IV.

3. Former Soviet Union republics: Assign the values of Soviet Union before their independence in the early 1990s. For three Baltic countries, we do not replace their POLITY2 values during their independence from around 1920 through 1944.

4. Czech and Slovak Republics: Assign the values of Czechoslovakia before 1993.

5. Former Yugoslav republics: Assign the values of Yugoslavia before their independence in the early 1990s.

[29] Downloaded at http://www.cidcm.umd.edu/inscr/polity

[30] Persson (2005) and Persson and Tabellini (2005) adopt the same definition of democracy. Epstein et al. (2003) define country-years with POLITY2 equal to 8 or higher as "full democracies" and those with POLITY2 larger than 0 and less than 8 as "partial democracies".

[31] Data on life expectancy and infant mortality is available for some countries during the pre-independence years or foreign occupation. We do not use such observations in the analysis in order to avoid confounding the effects of autocracy and colonial rules.

[32] See page 16 of Marshall and Jaggers (2002).

6. Eritrea: Assign the values of Ethiopia during 1952-1992. We do not extend this modification beyond the year of 1952 because Eritrea was an Italian colony until 1941, a British colony from 1941 to 1945, and then a United Nations protectorate until Ethiopia officially federated it in 1952.

7. Bangladesh: Assign the values of Pakistan before independence in 1972.

8. Vietnam: Assign the values of North Vietnam before the unification in 1976. The choice of North Vietnam instead of South Vietnam does not matter as both Vietnams were always autocratic.

9. North Korea and South Korea: Assign the POLITY2 values of Korea during 1900-1910.

Our short-term democracy measure for year t (DEMOCRACY since t-4 or d_{srt} in equation (1)) is constructed by dividing the number of democratic years between years $t-4$ and t by five. Note that in this calculation, the years under colonial rules are included in the denominator. If a country became independent in, say, year $t-1$ and has been democratic for two years till year t, then DEMOCRACY since $t-4$ takes a value of 0.4.

The long-term democracy measure for year t (DEMOCRACY since 1956 or D_{srt} in equation (1)) is constructed by dividing the sum of democratic years between years 1956 and t by $t-1955$. Note that for countries that have been democratic since its independence in the middle of the sample period (e.g. Papua New Guinea, which became independent in 1975) this measure is not 1 because they were not democratic but a colony until the year of independence. Note also that the long-term democracy measure is missing for Germany because East Germany was non-democratic while West Germany was democratic since 1956 until the unification in 1990.[33]

V.3 Political History Variables

Political history variables are constructed by using the POLITY IV dataset for years 1900 to 1955. Note that these variables are missing for Germany and Yemen. East Germany had a different political history from West Germany

[33] Yemen avoids this problem as both North Yemen and South Yemen were non-democratic or under colonial rules between 1956 and the unification in 1990. The same holds true for Vietnam.

during 1949 to 1955. North Yemen became independent in 1918 while the year of independence for South Yemen is 1967.

DEMOCRACY for 1900-1955 is obtained for each country by dividing the sum of democratic years between 1900 and 1955 inclusive by 56.

COLONY for 1900-1955 is obtained for each country by dividing the sum of colonial years (defined as years for which POLITY2 is missing) during 1900 to 1955 inclusive by 56.

V.4 Other Controls

INCOME, defined as real GDP per capita averaged over years $t-4$ to t (in thousand constant 1996 international dollars), is constructed as follows. Variable RGDPCH in the Penn World Table 6.1[34] is divided by 1000 to match with life expectancy, which is always a two-digit figure, and then averaged over years $t-4$ to t. Unless observations are missing for all the five years, we keep observations and add them up and divide it by the number of available observations.[35]

SCHOOLING, the average years of schooling in the population aged over 15, in 1960 is obtained from Barro and Lee (2000)'s dataset.[36] The variable name in the original dataset is TYR15.[37]

Legal origin dummies (British, German, Scandinavian, Socialist) are obtained from La Porta et al. (1999).[38] In addition, we treat the legal origin of East Timor (not included in La Portal et al (1999)'s analysis but included in our sample for Column (1) of Table 1) as French.[39]

Region dummies are constructed according to the World Bank's region

[34] Downloaded at http://pwt.econ.upenn.edu

[35] Several countries in the Penn World Table 6.1 have observations only in 1996. For such countries, INCOME is not missing for years 1996 to 2000, with its value equal to per capita income in 1996.

[36] Downloaded at http://www.cid.harvard.edu/ciddata/ciddata.html

[37] We do not use the panel data set format file downloadable on the website, because it drops some observations available in the original appendix tables of Barro and Lee (2000).

[38] The data file is downloaded at Andrei Shleifer's website (http://post.economics.harvard.edu/faculty/shleifer/data.html).

[39] As the income data is not available, East Timor drops from the sample for other regressions. According to CIA World Factbook 2005 (http://www.cia.gov/cia/publications/factbook), "UN-drafted legal system based on Indonesian law remains in place but will be replaced by civil and penal codes based on Portuguese law (2004)". Both Indonesia and Portugal are of French legal origin.

classification (East Asia and Pacific, Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, South Asia, and Sub-Saharan Africa). For the list of countries in each region, see the World Bank's website (www.worldbank.org/countries). For countries not receiving the World Bank loans in 2005, we assign them into either of these six regions in the following way: Australia, Brunei, Japan, Myammar, New Zealand, North Korea, and Singapore are included in East Asia and Pacific; Bahamas, Barbados, and Cuba in Latin America and the Caribbean. The rest of the countries are grouped as Western Europe and North America. Note that the World Bank groups former Soviet bloc countries plus Turkey as Europe and Central Asia and that their definition of Middle East and North Africa includes Malta and Djibouti. We do not reclassify these countries.

V.5 Variables not used for the AER Papers and Proceedings version

The alternative democracy measure is obtained from Boix and Rosato (2001). Variable DEMOCRACY in their dataset is a dummy equal to 1 if a country-year is democratic. We drop observations if variable SOVEREIGN (a dummy for independence) is 0.[40] We make the same adjustment to variable DEMOCRACY for former Soviet Union republics, Czech and Slovak Republics, former Yugoslav republics, Eritrea, Bangladesh, Vietnam, North Korea and South Korea as described above. Then the short-term and long-term democracy measures are constructed exactly in the same way as above.

Malaria ecology index due to Kiszewski et al. (2004) is downloaded at Jeffrey Sachs's website.[41] The index measures the potential intensity of malaria transmission, uncolored by clinical externalities. The higher the index, the more intense the potential malaria transmission. The minimum value is zero while the maximum is about 31.55 (Burkina Faso).

European settler mortality in the 19th century is obtained from Appendix Table A2 of Acemoglu et al. (2001). It measures the annualized number of deaths among 1,000 European settlers where each death is replaced with a new settler.

Ethnic fractionalization index due to Alesina et al. (2003) is downloaded

[40] Variable DEMOCRACY in Boix and Rosato (2001) is 0 either if a country is independent and nondemocratic or if a country is not independent.

[41] http://www.earthinstitute.columbia.edu/about/director/malaria/index.html

at William Easterly's website.[42] It measures the probability that two randomly chosen persons in a country belong to different ethnic groups.

The incidence of wars is a dummy variable equal to 1 if the government of a country is a primary actor in a war (defined as armed conflicts with at least 1000 battle-related deaths per year). The data source is the Armed Conflict Dataset Version 3-2005b (see Gleditsch et al. (2002) and Strand et al. (2005)), downloaded at its website.[43] The dummy variable is created so that it is equal to 1 if variable LOCATION in the monadic dataset is 3.

Mineral exporter is a dummy variable equal to 1 if the gross value of mineral exports as percentages of GDP averaged over 1960-2002 is larger than 8 percent. The gross value of mineral exports as percentages of GDP is constructed as follows by using data obtained from *World Development Indicators* (September 2005). Fuel exports and ores and metals exports (as percentages of merchandise export) are each multiplied by merchandise exports (in current US dollars) and divided by GDP (in current US dollars). For Singapore, fuel exports is set at 0.01, following Ross (2001).[44] Each of the resulting values is then averaged for each country over the period from 1960 (the earliest year in which the data is available) through 2002 whenever the data is available for at least one year. The mineral exporter dummy is set to be 1 if the sum of these two average values exceeds 8.

Forms of democracy variables used in Columns (1) and (2) of Table 6 are constructed as follows. For the period between 1956 and 2002, each country-year with variable POLITY2 being positive is assigned with forms of government and electoral systems according to Table 4 of Persson (2005). As Persson (2005) only code countries experiencing constitutional reforms during 1962 to 1998, we then use Table A1 of Persson and Tabellini (2004) for coding non-reforming countries as long as their POLITY2 variable is positive. This leaves several country-years uncoded. For these cases, we rely on the Database of Political Institutions version 2004 (Beck et al. 2001), downloaded from Philip Keefer's website.[45] Specifically, a country-year is coded as presidential if variable SYSTEM is 0 or 1, as parliamentary if variable SYSTEM is 2, as majoritarian if HOUSESYS is 1, and as proportional if HOUSESYS is 0. This still leaves some country-years uncoded. In such

[42] http://www.nyu.edu/fas/institute/dri/Easterly/Research.html

[43] http://www.prio.no/cscw/armedconflict

[44] Ross (2001) also corrects fuel export figures for Trinidad and Tobago. Unlike Singapore, however, it does produce oil. (Its average net fuel export is around 20 percent).

[45] http://econ.worldbank.org/staff/pkeefer

cases, we use Table A1 of Cheibub et al. (2004) for forms of government and Golder (2005)'s electoral system dataset, downloaded at Matt Golder's website,[46] for electoral systems. Based on the latter dataset, we code a country-year as majoritarian if variable ELECSYSTEM_TYPE is 1 and as proportional if ELECSYSTEM_TYPE is 2 or 3. In the end, we are unable to code the following country-years: Benin from 1960 to 1962, Comoros in 1975, Equatorial Guinea in 1968, Nepal in 1959, Niger from 1999 to 2002 for the electoral system, Pakistan from 1956 to 1957, Syria from 1956 to 1957, and East Timor in 2002 for the electoral system. We treat them as non-democratic in the analysis of columns (1) and (2) of Table 6. As in the construction of democracy measures, coding for Pakistan and Czechoslovakia is used for pre-independence years of Bangladesh and Czech and Slovak Republics, respectively.

The above coding procedure gives four dummy variables (two for forms of government, and two for electoral systems). Then for each of the four variables, we construct the long-term (since 1956) measures just as we did for the democracy measures (see above).

Dimensions of democracy variables used in Column (3) of Table 6 are constructed from the POLITY IV dataset. First, variables EXREC, XCONST, and POLCOMP are adjusted for Bangladesh and Czech and Slovak Republics as we did for variable POLITY2 (see above). We then make these variables missing if they are -66 (foreign occupation) so that missing country-years for these variables are the same as for variable POLITY2.[47] From these three variables, we construct three dummy variables as follows. EXECUTIVE COMPETITION is a dummy variable coded as 1 if variable EXREC is 6 or higher. EXECUTIVE CONSTRAINT is a dummy variable equal to 1 if variable XCONST is 4 or higher. POLITICAL PARTICIPATION is a dummy variable equal to 1 if variable POLCOMP is 7 or higher. Note that each of the three conditions for creating the dummy variables corresponds to the addition of a positive number to variable POLITY2.[48] As we define democracy as having a positive POLITY2 score, this is likely to be the best, albeit admittedly crude, way of decomposing the measure of democracy by the POLITY IV dataset. Then for each of the three dummy variables, we construct the long-term measures in the same way as we did for the democ-

[46] http://homepages.nyu.edu/~mrg217/elections.html

[47] See page 16 of Marshall and Jaggers (2002).

[48] See Marshall and Jaggers (2002), especially pages 13-15 and tables 3.1 and 3.2.

racy measures.

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Table 1: Health and Democracy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable:		Life Expectancy at Birth			Infant Mortality		Life Expectancy at Birth		
DEMOCRACY since *t*-4	3.55***	2.44**	-0.24	-0.78	-2.09				
	[1.26]	[0.96]	[1.14]	[1.68]	[5.36]				
INCOME		1.75***	1.61***	2.08***	-9.19***	1.62***	1.61***	1.48***	1.45***
		[0.22]	[0.22]	[0.29]	[1.15]	[0.23]	[0.23]	[0.26]	[0.25]
INCOME squared		-0.05***	-0.05***	-0.08***	0.32***	-0.05***	-0.05***	-0.05***	-0.04***
		[0.01]	[0.01]	[0.01]	[0.04]	[0.01]	[0.01]	[0.01]	[0.01]
DEMOCRACY since 1956			5.39***	4.88**	-17.41**	5.49***	5.45***	4.09**	4.10**
			[1.65]	[2.26]	[8.17]	[1.45]	[1.46]	[1.60]	[1.61]
DEMOCRACY during 1900-1955						-0.92	-0.05	-2.98	-3.21
						[1.59]	[2.37]	[1.97]	[2.00]
COLONY during 1900-1955						0.57	1.97	1.71	1.78
						[1.13]	[1.86]	[1.25]	[1.26]
(DEMOCRACY during 1900-1995)*TREND							-0.20		
							[0.38]		
(COLONY during 1900-1955)*TREND							-0.34		
							[0.29]		
Average years of schooling aged over 15 in 1960								1.19***	1.49***
								[0.41]	[0.44]
(Average years of schooling aged over 15 in 1960)*TREND									-0.09**
									[0.04]
F-test: *F* value			7.297	3.910	4.482				
p-value			0.001	0.022	0.013				
Controls:									
Legal Origin Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Region Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Countries	160	146	145	136	146	144	144	92	92
Observations	1309	999	996	764	543	993	993	752	752
Adjusted R^2	0.991	0.994	0.994	0.994	0.921	0.994	0.995	0.995	0.995

Notes: Robust standard errors clustered at country level are reported in brackets. The sample years are every fifth year from 1962 through 2002 except for column (5) in which the sample years are every tenth year from 1960 through 2000. The data source for democracy variables is POLITY IV except for column (4), in which Boix and Rosato (2001)'s democracy dataset (available until 1994) is used instead. This drops observations in 1997 and 2002. TREND is a trend variable taking 0 in 1962, 1 in 1967, and so forth. See the data appendix for other variable definitions. Germany is dropped from the sample for columns (3) to (9) because it is difficult to construct DEMOCRACY since 1956. Yemen is dropped from the sample for columns (6) to (9) becuase it is difficult to calculate DEMOCRACY during 1900-1955 and COLONY during 1900-1955. The null for *F*-test is that coefficients on DEMOCRACY since *t*-4 and since 1956 are both zero. *** significant at 1%; ** 5%; * 10%.

Table 2: Democracy and Life Expectancy across Time and Income
(Dependent Variable: Life Expectancy at Birth)

	(1)	(2)
DEMOCRACY*YEAR1962	6.33***	
	[1.39]	
DEMOCRACY*YEAR1967	3.66***	
	[1.25]	
DEMOCRACY*YEAR1972	2.86**	
	[1.31]	
DEMOCRACY*YEAR1977	2.74**	
	[1.26]	
DEMOCRACY*YEAR1982	1.92	
	[1.20]	
DEMOCRACY*YEAR1987	1.08	
	[1.11]	
DEMOCRACY*YEAR1992	1.86*	
	[1.12]	
DEMOCRACY*YEAR1997	1.14	
	[0.99]	
DEMOCRACY*YEAR2002	2.20	
	[1.45]	
DEMOCRACY*HIGHINCOME		1.02
		[1.36]
DEMOCRACY*MIDDLEINCOME		3.28**
		[1.27]
DEMOCRACY*LOWINCOME		3.63**
		[1.43]
DEMOCRACY*VERYLOWINCOME		1.97
		[1.35]
HIGHINCOME		12.48***
		[1.57]
MIDDLEINCOME		7.83***
		[1.42]
LOWINCOME		3.60***
		[1.22]
F-test: F value	3.788	1.334
p-value	0.000	0.266
Controls:		
INCOME	YES	NO
$(INCOME)^2$	YES	NO
Legal Origins	YES	YES
Regions	YES	YES
Year Dummies	YES	YES
Countries	146	146
Observations	999	999
Adjusted R^2	0.994	0.994

Notes: Robust standard errors clustered at country level are reported in brackets. DEMOCRACY is the fraction of democratic years since 4 years ago. HIGHINCOME is a dummy for per capita GDP (averaged during 4 years ago to present) being 10,000 constant 1996 international dollars or more; MIDDLEINCOME for between 5,000 and 10,000; LOWINCOME for between 2,500 and 5,000; and VERYLOWINCOME for less than 2,500. The null for F-test is the equality of all coefficients on the interaction terms between DEMOCRACY and year dummies (for column 1) or income dummies (for column 2). *** indicates 1% signifncance; ** 5%; and * 10%.

Table 3: How Much Does Within-country Variation Matter?

(Dependent Variable: Life Expectancy at Birth)

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	Whole	No Regime Change	Switching Regimes	Switching Regimes	Single Switch to Democracy (Balanced)	Single Switch to Democracy (Unbalanced)
DEMOCRACY	0.08	7.26***	3.72***	0.69	7.65**	6.15*
since 1956	[1.02]	[1.23]	[0.78]	[1.07]	[3.26]	[3.21]
INCOME	0.28*	1.10***	2.19***	0.17	0.37	0.08
	[0.15]	[0.14]	[0.32]	[0.30]	[0.55]	[0.52]
INCOME squared	-0.01***	-0.03***	-0.08***	-0.01	-0.03	-0.02
	[0.00]	[0.00]	[0.02]	[0.01]	[0.03]	[0.03]
Controls:						
Country Dummies	YES	NO	NO	YES	YES	YES
Legal Origins	NO	YES	YES	NO	NO	NO
Regions	NO	YES	YES	NO	NO	NO
Year Dummies	YES	YES	YES	YES	YES	YES
Countries	145	54	91	91	21	38
Observations	996	358	638	638	189	235
Adjusted R^2	0.998	0.997	0.993	0.998	0.998	0.998

Notes: Robust standard errors are reported in brackets. The sample years are every fifth year from 1962 to 2002. Column (2) restricts the sample to countries without regime change (ie. DEMOCRACY since 1956 is either 0 or 1 for the whole sample period). Columns (3) and (4) restrict the sample to countries switching regimes at least once (including independence from the colonial rule) during the sample period. Columns (5) and (6) restrict the sample to countries switching only once from autocracy to democracy during the sample period with Column (5) further restricting the sample to those with observations for all the nine sample years. Germany is always dropped from the sample (see notes for Table 1). *** significant at 1%; ** 5%; * 10%.

Table 4: Democracy and Other Health Outcomes

	(1)	(2)	(3)	(4)	(5)
Dependent variable	Sanitation	Clean Water	Immunization DPT	Immunization Measles	Health Spending
DEMOCRACY since 1956	14.93**	10.76**	8.80**	0.55	161.38*
	[6.72]	[4.70]	[3.53]	[3.30]	[95.28]
DEMOCRACY for 1900-1955	-0.82	-0.38	-0.88	5.78	191.58**
	[6.66]	[4.21]	[4.01]	[4.12]	[75.73]
COLONY for 1900-1955	6.45	-0.82	-4.37	-5.05*	-97.37*
	[4.05]	[3.78]	[2.71]	[3.04]	[53.08]
Controls:					
INCOME	YES	YES	YES	YES	YES
$(INCOME)^2$	YES	YES	YES	YES	YES
Legal Origins	YES	YES	YES	YES	YES
Regions	YES	YES	YES	YES	YES
Year Dummies	YES	YES	YES	YES	YES
Countries	108	112	145	145	145
Observations	183	190	486	484	145
Adjusted R^2	0.957	0.976	0.956	0.959	0.947

Notes : Robust standard errors are reported in brackets. The sample years are 1990 and 2002 for columns (1) and (2), every fifth year during 1985 to 2000 for columns (3) and (4), and 2000 for column (5). For columns (3) to (5), the dependent variable is the mean value over the period from 4 years before to the present year, and DEMOCRACY since 1956 is the value for year t -5. For the same reason as in columns (5) to (8) of Table 1, Germany and Yemen are dropped from the sample. *** significant at 1%; ** 5%; * 10%.

Table 5: Further Robustness Checks

(Dependent Variable: Life Expectancy at Birth)

	(1)	(2)	(3)	(4)	(5)
DEMOCRACY	5.33***	5.74***	5.45***	5.58***	5.55***
since 1956	[1.43]	[1.92]	[1.42]	[1.45]	[1.35]
DEMOCRACY	-1.11	-1.63	-1.06	-0.88	-1.19
for 1900-1955	[1.60]	[2.82]	[1.52]	[1.58]	[1.54]
COLONY	1.07	1.11	0.47	0.48	1.15
for 1900-1955	[1.21]	[2.26]	[1.08]	[1.13]	[1.01]
Malaria ecology	-0.14*				
	[0.07]				
Settler mortality		-0.0014**			
		[0.0005]			
Ethnic fractionalization			-2.99**		
			[1.50]		
Incidence of wars				-1.33*	
				[0.69]	
Mineral exporters					-1.88**
					[0.75]
Controls:					
INCOME	YES	YES	YES	YES	YES
$(INCOME)^2$	YES	YES	YES	YES	YES
Legal Origins	YES	YES	YES	YES	YES
Regions	YES	YES	YES	YES	YES
Year Dummies	YES	YES	YES	YES	YES
Countries	143	61	144	144	138
Observations	992	523	993	993	972
Adjusted R^2	0.995	0.994	0.995	0.995	0.995

Notes : Robust standard errors clustered at country level are reported in brackets. See the data appendix for variable definitions. Compared to the sample for column (6) of Table 1, Bahrain drops from the sample for column (1) as the malaria ecology index is unavailable; Cuba, Eritrea, Equatorial Guinea, Laos, Lesotho, and Uzbekistan drop from the sample for column (5) due to unavailability of mineral export data. Germany and Yemen are dropped from the samples for all columns (see notes for Table 1).
***significant at 1%; **5%; *10%.

Table 6: Disaggregating Democracy
(Dependent Variable: Life Expectancy at Birth)

	(1)	(2)	(3)
PRESIDENTIAL	5.04***		
since 1956	[1.55]		
PARLIAMENTAL	5.39***		
since 1956	[1.52]		
MAJORITARIAN		5.63***	
since 1956		[1.52]	
PROPORTIONAL		4.88***	
since 1956		[1.49]	
EXECUTIVE COMPETITION			5.13***
since 1956			[1.66]
EXECUTIVE CONSTRAINT			1.67
since 1956			[2.04]
POLITICAL PARTICIPATION			-1.04
since 1956			[2.12]
F-test	0.068	0.422	2.353
p-value	0.795	0.517	0.099
Controls:			
INCOME	YES	YES	YES
(INCOME)²	YES	YES	YES
Legal Origins	YES	YES	YES
Regions	YES	YES	YES
Year Dummies	YES	YES	YES
Countries	145	145	145
Observations	996	996	996
Adjusted R^2	0.994	0.994	0.995

Notes : Robust standard errors clustered at country level are reported in brackets. See the data appendix for variable definitions. Germany is dropped from the sample (see notes for Table 1). The null for *F*-test is the equality of coefficients on the disaggregated democracy measures (all the coefficients reported in each column of this table). ***significant at 1%; **5%; *10%.

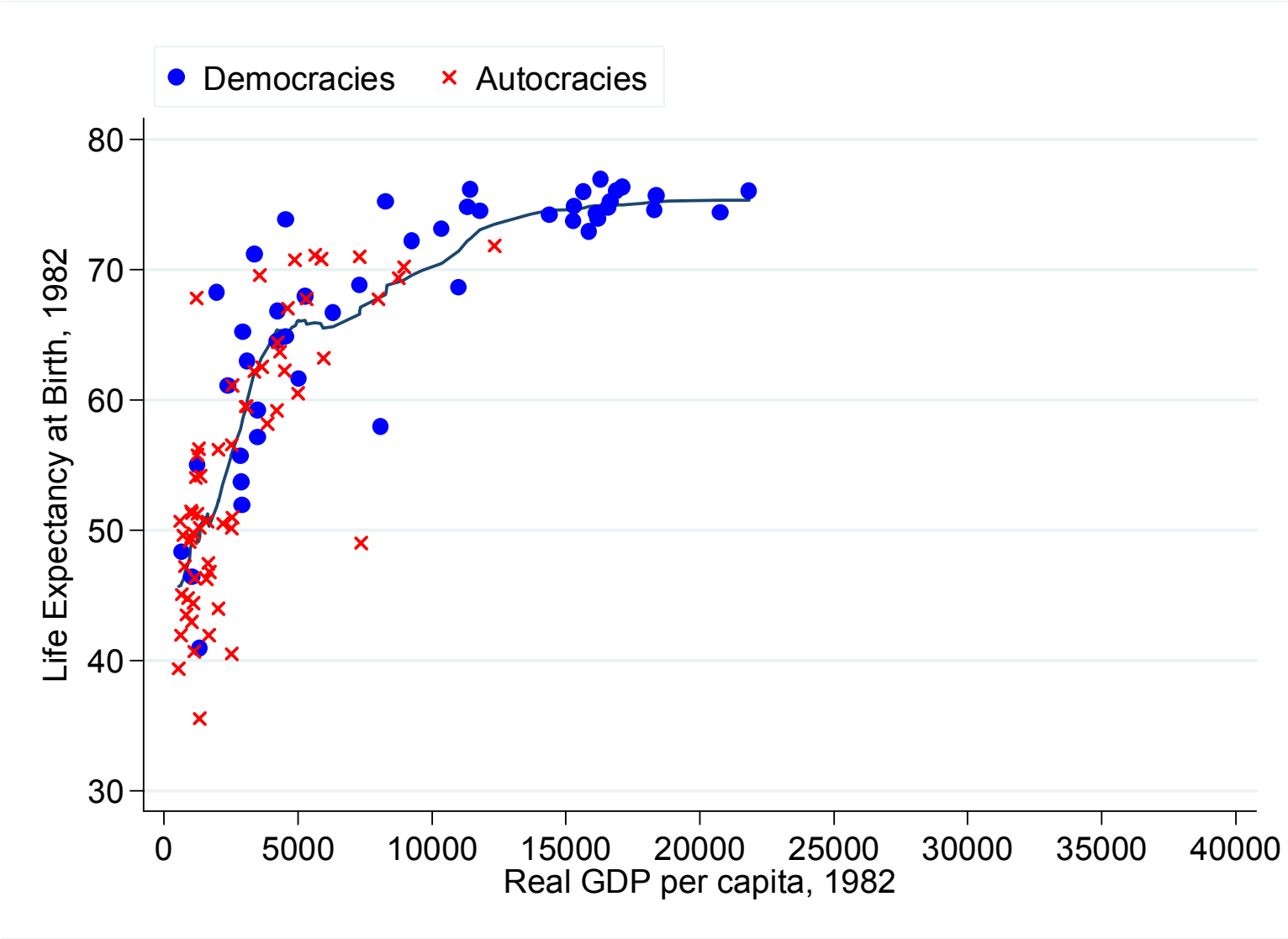

Figure 1: The Preston Curve in 1982

Note: The solid line is a plot of a non-parametric regression using the tricube weighting function with bandwidth 0.2.

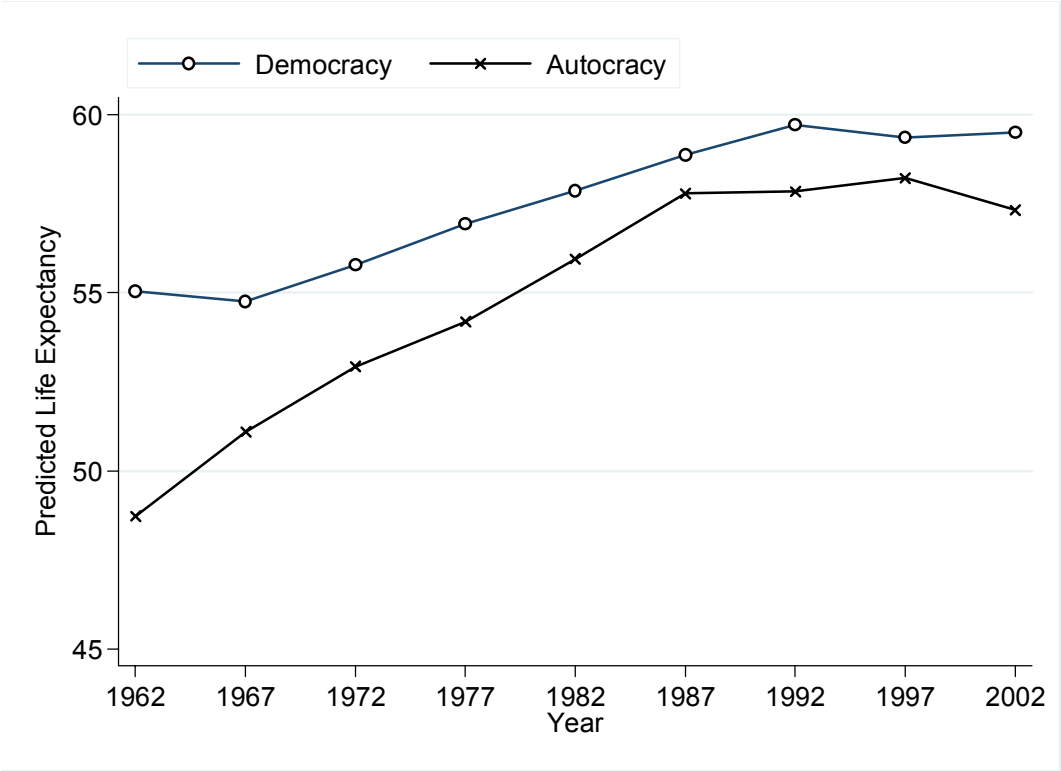

Figure 2: Estimated Year Fixed Effects for Democracy and Autocracy

Notes: Estimated year fixed effects for autocracy is obtained as coefficient estimates on year dummies in a regression of life expectancy on the interaction terms of DEMOCRACY since *t*-4 and year dummies, INCOME, INCOME squared, legal origins, regions, and year dummies for the same sample as in Column (2) of Table 1. Estimated year fixed effects for democracy is obtained by adding coefficient estimates on the interaction terms of year dummies and DEMOCRACY since *t*-4 in the same regression to the estimated fixed effects for autocracy.

Apendix Table 1: Summary Statistics for Main Time-variant Variables

Variables	Whole Sample	INCOME Sample	INCOME Sample			
			1960s	1970s	1980s	1990s
Life Expectancy	60.68	60.48	54.77	57.75	61.22	64.12
	12.05	12.38	12.33	11.64	11.36	12.03
	1309	999	182	205	216	396
DEMOCRACY	0.40	0.51	0.45	0.40	0.43	0.63
since t-4	0.47	0.47	0.47	0.46	0.48	0.45
(by POLITY IV)	1309	999	182	205	216	396
INCOME		5.76	3.77	4.92	5.83	7.06
		6.01	3.61	4.81	5.76	7.16
		999	182	205	216	396

Notes : For each variable, the top row shows the mean, the middle row the standard deviation, and the bottom row the number of observations. "Whole Sample" is the sample used for Column (1) of Table 1; "INCOME Sample" the sample used for Column (2) of Table 1 and Columns (1) and (2) of Table 2. 1960s include years 1962 and 1967; 1970s years 1972 and 1977; 1980s years 1982 and 1987; 1990s years 1992, 1997, and 2002. See the Data Appendix for variable definitions and sources.

Appendix Table 2: Summary Statistics for Other Time-variant Variables

	Mean	Standard Deviation	Observations	Minimum	Maximum
DEMOCRACY since 1956 (POLITY)	0.40	0.40	996	0	1
DEMOCRACY since t-4 (Boix and Rosato)	0.38	0.46	764	0	1
DEMOCRACY since 1956 (Boix and Rosato)	0.34	0.42	764	0	1
Infant Mortality	69.80	53.87	543	2.9	285
Sanitation	58.63	28.85	183	4	100
Clean Water	76.83	20.75	190	20	100
DPT Immunization	70.24	25.39	486	1.2	99
Measles Immunization	68.67	24.02	484	1	99
Health Spending	319.84	470.14	145	4.80	1914.06
Incidence of Wars	0.06	0.24	993	0	1
PRESIDENTIAL since 1956	0.14	0.27	996	0	1
PARLIAMENTARY since 1956	0.25	0.39	996	0	1
MAJORITARIAN since 1956	0.18	0.33	996	0	1
PROPORTIONAL since 1956	0.21	0.35	996	0	1
EXECUTIVE COMPETITION since 1956	0.41	0.40	996	0	1
EXECUTIVE CONSTRAINT since 1956	0.37	0.40	996	0	1
POLITICAL PARTICIPATION since 1956	0.32	0.39	996	0	1

Note : See the Data Appendix for variable definitions and sources.

Appendix Table 3: Summary Statistics for Time-invariant Variables

	Mean	Standard Deviation	Number of Countries	Minimum	Maximum
DEMOCRACY for 1900-1955	0.19	0.32	144	0	1
COLONY for 1900-1955	0.53	0.43	144	0	1
SCHOOLING in 1960	3.63	2.52	92	0.12	9.73
Malaria ecology	3.97	6.81	143	0	31.55
Settler mortality	256.10	481.91	61	8.55	2940
Ethnic fractionalization	0.46	0.25	144	0	0.93
Mineral expoters	0.25	0.43	138	0	1

Note : See the Data Appendix for variable definitions and sources.