Democratic capital: The nexus of political and economic change*

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Abstract

We study the joint dynamics of economic and political change, with theory and historical data. Democratic capital – measured by a nation's historical experience with democracy and by the incidence of democracy in its neighborhood – reduces the exit rate from democracy and raises the exit rate from autocracy. A higher stock of democratic capital stimulates growth by increasing the stability of democracies. Heterogeneous effects of democracy induce endogenous sorting of countries into political regimes, which can account for observed systematic differences between democracies and autocracies. Our results suggest a virtuous circle, where the accumulation of physical and democratic capital reinforce each other, promoting economic development jointly with the consolidation of democracy.

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1 Introduction

In the past two hundred years, the world has undergone dramatic economic change, as a large number of countries have seen economic growth take off. But these takeoffs have occurred at different points in time and not always at a sustained pace, while many countries have not yet seen any takeoff at all. This change and its unequal incidence has produced huge differences in today's living standards across countries.

During the same time, the world has also undergone dramatic political change, as a large number of countries have seen the introduction of democracy. But these democratizations have occurred at different points in time and not always in a consolidated way, while many countries have not yet seen any democratization at all. This change and its unequal incidence has produced huge difference in today's democratic experience across countries.

Figure 1 plots living standards – GDP per capita – against democratic experience – years of democracy since 1800 – in the year 2000 (see Section 5 for details on the underlying data). Evidently, the two measures are positively correlated. Perhaps the most striking aspect of the graph is the triangular property: the highest incomes are basically the same at all levels of democratic experience, while the lowest incomes are monotonically rising with democratic experience. Long democratic experience appears to be a sufficient, but not a necessary, condition for high income.

What historical forces may have produced these patterns in the data? By pure logic, a positive relation has three possible explanations, namely income has fostered democracy, democracy has fostered income, or some other factor(s) has produced a spurious correlation. Economists, political scientists and historians have considered these three explanations, with different degrees of force and backing up their argument by different amounts of data. We review selected parts of the resulting literatures in Section 2. Despite the importance of the issues and a large number of studies, it is fair to say that our theoretical and empirical understanding of the dynamic interactions between economic and political change remain poorly understood.

In this paper, we bring three new ideas to the study of this dynamic interaction. The first idea concerns the economic effects of political regimes. If democracy influences economic performance, this almost by definition influences the returns to investment. Through investment, the prospects of future democracy becomes a crucial determinant of current economic performance, well before any actual regime change takes place. Empirically, we argue that

one must look beyond the current political regime, to expectations about its stability. However simple, this insight is often overlooked in existing empirical studies. Focusing on actual regime transitions and disregarding whether they are expected or unexpected leads to biased estimates.

The second idea concerns the consolidation of democracy. The latter requires that citizens learn to cherish and respect democracy as a method of government. A common perception of democracy as a valuable form of government will not pop up overnight, or in a vacuum, but through a slow accumulation of a stock of civic and social assets that we call "democratic capital". Empirically, we argue that the accumulation of democratic capital takes place through a country's learning from its own historical experience or from its neighboring countries.

Combining these two ideas leads to the possibility of a virtuous circle of democratic experience and economic development. Suppose a country (randomly) enters into democracy. If democracy persists, democratic experience keeps accumulating which, in turn, makes a backlash into autocracy less likely. If democracy is indeed more productive, the greater likelihood of democratic survival raises the expected return to investment, which feeds on to economic growth. If – in addition – higher income makes a transition into autocracy less likely, this adds yet another positive feedback loop.

Our third new idea concerns endogenous and non-random selection into different political regimes. The economic effects of transitions between autocracy and democracy are likely to vary across countries and time. If so, we expect countries with large gains from democracy to be over-represented among existing democracies and under-represented among existing autocracies. Such systematic sorting produces different comparative statics in samples of democracies and autocracies. Empirically, we argue that one should expect heterogenous estimation results in these two samples.

To confront these ideas with data, we also go beyond the existing literature which relies on implicit theory. By contrast, we use an explicit model to identify the complicated two-way interactions in the data. To that end, Section 3 lays out an overlapping-generations model of economic and political change. Economic growth is driven by investment, which depends on expected returns, which depend on the probability of regime change. The probability of regime change is determined in a global game, where individual citizens decide whether to participate in defending democracy (or attacking autocracy). This decision reflects society's endowment of democratic capital. In equilibrium, higher democratic capital implies a lower probability of au-

tocracy in the future and therefore an *indirect* effect on economic growth, but no direct effect. We show that the comparative statics of the model depend on how beneficial a transition into democracy is for economic activity.

In Section 4, we consider the equilibrium sorting into different political regimes of countries with different economic gains from transitions into democracy. Due to sorting, GDP per capita and the probability of democracy are different functions of observed variables in the sample of current democracies than in a sample of current autocracies. We work out the specific empirical predictions of the model, when endogenous sample selection is taken into account.

The existing empirical literature relies either on cross-sectional data, or on panel data beginning in 1960. To understand the rich dynamics of economic and political change, we prefer a very long time horizon even at the cost of data availability. We exploit the Maddison and Polity IV data sets to construct an unbalanced panel with at most 155 countries and annual data for at most 180 years. These data are discussed in Section 5, which also describes how to give operational contents to the concept of democratic capital.

The key theoretical predictions hold up when taken to the data. In Section 6, we present empirical results on political transitions. Our estimates show that democratic capital indeed explains the probability of exit from democracy: the probability of exit from democratic regimes goes down with two forms of democratic capital, as well as with the level of real income. Similarly, the exit rate out of autocracy increases in two forms of democratic capital, but shows no response to income.

In Section 7, we proceed to economic growth. We find that the estimated probability of autocracy reduces economic growth in democracy, but has little (or positive) effect on economic growth in autocracy. Moreover, we show that democratic capital has a stronger effect on growth in the sample of democracies than in the sample of autocracies. The results are not only statistically robust but also quantitatively important.

2 Related literature

A vast literature has studied the link between democracy and growth, and the determinants of democracy, although these two issues have often been studied separately. Przeworski et al. (2000) and De Mesquita et al. (2003) are among few systematic studies addressing both issues together. The compre-

hensive study by Przeworski et al is mainly confined to the postwar period, yet the main empirical results are largely consistent with the results presented in this paper, although the details of the analysis and the identifying assumptions differ from our own. In particular, they conclude that higher income increases the survival of democracy, but has no effect on the survival of autocracy, that a history of democratic instability helps predict regime transitions, and the international political climate has an impact on the stability of democracy. This is in line with our findings on the effect of domestic and foreign democratic capital on regime transitions. On the reverse link from political regime to growth, the main conclusion of Przeworski et al is that political instability hurts growth, particularly under autocracy.

How economic development and other factors determine the onset or survival of, democracy is the subject of many books and articles. Among recent contributions, Boix (2003) focuses on the redistributive consequences of alternative political regimes, while Barro (1999), Boix and Stokes (2003), Acemoglu, Johnson, Robinson and Yared (2005a and b) and Glaeser, Ponzetto and Shleifer (2005) discuss the effect of economic development and education on democracy, reaching different conclusions. These studies mainly focus on the postwar period and not on variables similar to our notion of democratic capital (see Section 5 for more discussion and comparison with our results).

We are not first to stress civic engagement and cultural attitudes in shaping the functioning of political institutions, and how some kind of "social capital" can be acquired over time under specific political institutions. Important precursors include Almond and Verba (1963), Lipset (1959) and, more recently, Putnam (1993), Inglehart and Welzel (2005) and Hadenius and Teorell (2005). But our empirical methodology is very different from these studies. In particular, democratic capital refers to variables that influence the stability of democratic regimes without direct effects on economic outcomes. The importance of culture in economic (as opposed to political) development is discussed, with a different methodology, in Tabellini (2005).

Several political scientists have discussed masses vs. elites in regime transitions – see Collier (1999), Geddes (1999), and Bermeo (2003). Opp (1999) and Gibson (1997) use survey data to document how citizens' decisions to participate in the uprise against socialist autocracies at the turn of the 1990s involved strategic and social considerations similar to those in our theoretical model.

How democracy – or political regimes, more generally – shape economic development, is the subject of an equally large literature. Here, the findings

are, essentially, all over the place. Barro (1996), Helliwell (1994), Londregan and Poole (1990), Przeworski and Limongi (1993), and Mulligan and Sala-I-Martin (2004) exploit cross-country variation (or pooled time-series and cross-country data for the post-war period), and find no robust effect of democracy on economic growth. On the other hand, Roll and Talbot (2003), Jones and Olken (2005), Papaioannou and Siourounis (2004), Giavazzi and Tabellini (2005) and Rodrik and Wacziarg (2005) exploit within-country variation, and generally find a positive average effect of democracy on economic outcomes (with relevant heterogeneity amongst episodes of democratization).

These papers do not consider if regime transitions were expected or unexpected, however. An exception is Londregan and Poole (1990), who attempt to estimate the effect of political instability and find no evidence that growth is affected by past coups or current coup propensity. Importantly, Gerring, Bond, Barndt and Moreno (2005) show that democratic history (besides the current regime) has an effect on economic performance. While these authors do not provide the same economic interpretation as we do, their empirical results are consistent with our reduced-form results.

Finally, at a general level, our analysis of sorting relates to analyses in other branches of economics. The classic is Becker (1973), who considers conditions for assortative matching in the marriage market. More recent applications include the dynamic analysis of how individuals are sorted to firms on the basis of productivity (Shimer and Smith, 2000), and how CEOs are sorted to firms on the basis of talent and profitability (Gabaix and Landier, 2006). Eeckhout and Jovanovich (2007) bring sorting models to the macroeconomic study of development. But in their study, as in the rest of the literature, sorting takes place at the level of individual agents.

3 A model of political and economic change

We first set up a model of political regime transitions and economic growth. Our goal is not theory for its own sake, but a set of testable predictions, identification and specification assumptions. In the long historical sample we use, available time varying data include only income per capita, the political regime and a few other variables. Because of this, we leave out many possible mechanisms and formulate our model under the maxim: "if you can't measure it, don't' model it". Moreover, a simple model allows us to take heterogeneity seriously. Specifically, we can study endogenous sorting of

countries into different political regimes and how this shapes the equilibrium relations between key variables in our empirical work.

In this section, we describe the economic and political equilibrium for a given country. In the next section, we show how countries sort themselves into political regimes given their idiosyncratic features, and discuss the empirical predictions of the model once we take endogenous sorting into account.

3.1 Economic structure

Consider a standard overlapping generations economy with a continuum of members in each generation and constant population of mass unity. Aggregate production per old worker in period t is given by a simple Ak model:

$$y_t^o = A(a_t)k_t \ , \tag{1}$$

where k_t is capital per old person and A is a measure of capital productivity, which we refer to as productivity, for short. We allow different levels of productivity in democracy, denoted by $a_t = 0$, and autocracy, denoted by $a_t = 1$. Specifically, we set $A(0) = 1 + \theta$ and $A(1) = 1$. As θ is constant over time, productivity also remains constant conditional on the political regime. Differences in productivity across political regimes could reflect economic policy priorities leading to more or less efficient economic outcomes, but we leave the sources of these productivity differences implicit. Below we allow countries to have different values of θ, to capture the idea that democracy may work better in some social or political environments than in others. For now, we describe the political and economic equilibrium of a country with a given $\theta \lesseqgtr 0$.

Each young person has constant exogenous income w. Adding this to income per old, GDP per capita becomes

$$y_t = A(a_t)k_t + w \ . \tag{2}$$

The young in period $t-1$ have quasi-linear preferences over consumption when young and old. Given these preferences, each young individual in period $t-1$ chooses how much to save in the form of capital k_t, to maximize her expected utility:

$$E_{t-1}(v_t) = V(w - k_t) + E_{t-1}[A(a_t)]k_t \ , \tag{3}$$

where the expectations operator is taken over future political regimes, a_t, and V is a concave function with $V_c(0) \to \infty$ and $V_c(w) < 1 + \theta$. Clearly, the expected rate of return and hence expected productivity in period t will play a crucial role in these individual investment decisions.

3.2 Events in each time period

There are two state variables at the beginning of period t, namely k_t, the capital stock accumulated in period $t-1$, and a_{t-1} the political regime in the previous period. The following sequence of political and economic events takes place in period t.

1. With probability χ, $0 < \chi < 1$, an opportunity arises to change the current regime (i.e., an attempted coup under democracy, or an attempted uprise against the dictator under autocracy). With probability $1-\chi$, no such opportunity arises.

2. If an attempted coup or uprise is realized, each old individual (indexed by j) makes an individual decision whether to participate in the defense of democracy (resist the coup or support the uprise).[1] This decision is based on an individual-specific and noisy signal about the cost m_t^j and the perceived benefit of participation in successful defense b_t.

3. The probability that a democratic regime survives a coup, or an autocratic regime falls after an uprise, is equal to s_t, the proportion of the old that participates in the defense of democracy.

4. Depending on the political regime realized in period t, the current value of productivity, $A(a_t)$, is realized.

5. Each young individual makes investment decisions for next period, $t+1$, based on returns expected in $t+1$.

3.3 Political structure

What is the equilibrium behavior of agents at stage 2, when nature has instigated a coup or uprise at stage 1. Let μ_t be the true individual cost of participating in the defense of democracy. This cost is borne irrespective of whether the coup fails or not (uprise succeeds or not). Agent j observes a noisy signal of this cost:

$$m_t^j = \mu_t + \nu_t^j ,$$

[1] We asume that the young do no take part in the defense of democracy. This assumption simplifies the analysis but can be relaxed at the cost of additional algebra.

where ν_t^j is drawn from a normal distribution. Each agent holds the (improper) prior that μ_t has a uniform distribution on the real line.

Each old individual perceives a personal "social" benefit, b_t, of participating in defense of democracy (the benefit is defined below). This benefit is enjoyed only if the defense succeeds. Thus, the expected benefit from participation is $b_t s_t$, where s_t by our assumption above is the probability that democracy succeeds. Each individual old agent treats the probability of success as independent of her own participation. When individual j does not participate, she bears no cost and gets no social benefit of the defense. Thus, we normalize the utility from non-participation to 0.[2]

In this notation, the expected net gain from participation in defense of democracy for individual j is:

$$E(b_t - \mu_t) = b_t s_t - m_t^j \ .$$

Under these assumptions, old individuals play a global game with incomplete information, which fulfills the conditions **A1-A5** in Morris and Shin (2002, Section 2.2.1). By their results, all individuals follow an identical strategy $\sigma(m_t^j)$ of participating ($\sigma = 1$), or not ($\sigma = 0$), based upon a unique cutoff value for their signal:

$$\sigma(m_t^j) = \begin{cases} 1 & \text{if} \quad m_t^j < \mu_t^* = \frac{b_t}{2} \\ 0 & \text{if} \quad m_t^j \geq \mu_t^* = \frac{b_t}{2} \ . \end{cases}$$

This strategy reflects a strategic complementarity, but the game nevertheless has a unique equilibrium. In this equilibrium, the fraction of old who defend democracy is:

$$s_t^* = \text{Prob}(\nu < b_t/2 - \mu_t) \equiv \Phi(b_t/2 - \mu_t) \ , \tag{4}$$

where $\Phi(\cdot)$ is the c.d.f. of the normally distributed noise ν.

[2] An individual can gain (or lose) economically as an individual investor if the defense succeeds. But this individual gain does not determine the decision to participate, because atomistic individuals treat the probability of success as parametric. Thus, the benefit b is the preceived social benefit of participating in a successful defense of democracy, not to be confused with the material economic benefit of actually preventing the coup. This is an important difference between pariticipation in a political event and participation in, say, a speculative attack against a bank or a fixed exchange rate regime; in this latter situation, participation in a speculative attack also entails direct economic consequences for the individual investors (which differ depending on whether the attack fails or succeeds).

Empirically, we want to relate political transitions to past political history and the level of economic development. To achieve this ambitious goal in our simple model, we assume a benefit b_t of participating in a defense of democracy from two sources. First, the benefit is larger the greater is the perceived value of living in a democratic society when entering the period. We label this value democratic capital, d. In the theory part, we assume this is just a known parameter. In the empirical part, we assume each country's democratic capital develops over time in pace with democratic experience at home and democratic experience abroad (these assumptions are made precise in Section 5). Second, each old individual (altruistically) internalizes the true economic benefit of being in democracy rather than autocracy on behalf of her fellow group of citizens. Given the economic model in Section 3.1, this welfare difference is just θk_t. The total benefit from the defense of democracy (or the overthrow of a dictator) is thus:

$$b_t = d + \theta k_t \ . \tag{5}$$

3.4 Equilibrium political transitions

The results in the previous subsection allow us to write the equilibrium stochastic process for the political regime in period t as

$$a_t^* = \begin{cases} 1 & \text{with Prob } p_t^* \\ 0 & \text{with Prob } 1 - p_t^* \ , \end{cases} \tag{6}$$

where the equilibrium probability of autocracy in period t is

$$p_t^* = \begin{cases} \chi(1 - E_{t-1}[s_t^* | k_t^*;\ \theta,\ d]) & \text{if} \quad a_{t-1} = 0 \\ 1 - \chi E_{t-1}[s_t^* | k_t^*;\ \theta,\ d] & \text{if} \quad a_{t-1} = 1 \ , \end{cases} \tag{7}$$

and where the expectations operator is taken over the random variable μ_t, conditional on the the state variable a_{t-1} and the (perfectly foreseen) equilibrium value of future capital k_t^*

Substituting from equations (4)-(5) into (7), the equilibrium probability of autocracy in period t is a function of the capital stock in place at the beginning of t and the political regime in $t-1$:

$$p_t^* = P(k_t^*, a_{t-1};\ \theta, d) \ . \tag{8}$$

Since this probability is strictly decreasing in the benefit of fighting for democracy, b_t, by (5) we immediately have the following results:

Lemma 1 *The equilibrium probability of autocracy is decreasing in democratic capital, $P_d < 0$, and in the productivity gains from democracy $P_\theta < 0$. It is increasing or decreasing in the equilibrium capital stock, k_t^*, depending on whether productivity is higher or lower in democracy than in autocracy: $P_k \lesseqgtr 0$ as $\theta \gtreqless 0$.*

Intuitively, whatever raises the benefit of fighting for democracy, b_t, reduces the probability of autocracy.

Finally, the lagged regime enters P as the underlying hazard rates are regime-dependent. In particular, the equilibrium probability of autocracy is affected by the lagged regime through a constant:

$$P(k_t^*, 1;\ \theta, d) = P(k_t^*, 0; \theta, d) + (1 - \chi) \tag{9}$$

As the opportunity of changing the regime comes with probability $\chi < 1$, political regimes are persistent: the probability of autocracy is higher when starting under autocracy ($a_{t-1} = 1$) rather than democracy ($a_{t-1} = 0$).

3.5 Equilibrium capital accumulation

To close the model, consider how individual investments map into equilibrium capital. Given (3), the first-order condition for optimal investment by a young individual in period $t-1$ is:

$$-V_c(w - k_t) + E_{t-1}[A(a_t)|a_{t-1}] = 0\ , \tag{10}$$

where the expectation refers to the uncertain political regime a_t. Individual investors take the behavior of other individuals as given. By (8) and (6) and our earlier assumptions, the expected return for an investor in period $t-1$ is:

$$E_{t-1}[A(a_t)|a_{t-1}] = 1 + (1 - p_t^*)\theta\ . \tag{11}$$

Combining (10) and (11), and setting $k_t = k_t^*$, we can implicitly define the equilibrium capital stock in period t:

$$-V_c(w - k_t^*) + (1 + (1 - p_t^*)\theta) = 0\ . \tag{12}$$

The boundary conditions on $V_c(\cdot)$ and the concavity of $V(\cdot)$ imply that a unique equilibrium with positive capital exists Since the young's income is a parameter – and not a variable determined by contemporaneous capital

– the dynamics are simple. For a constant probability of regime change p_t^* the economy converges to a constant level of capital (and GDP) in just one period.

Applying the implicit function theorem to (12), we can write the equilibrium capital stock in period t as

$$k_t^* = K(p_t^*;\ \theta,\ w) \tag{13}$$

and verify that:

Lemma 2 *The equilibrium capital stock is increasing in the last period's income of the young, $K_w > 0$, and (if $p_t^* < 1$) in the productivity gain to democracy, $K_\theta > 0$. It is increasing or decreasing in the probability of autocracy, depending on the sign of θ, $K_p \lesseqgtr 0$ as $\theta \gtreqless 0$.*

Intuitively, a higher wage in the past period raises savings, and a better economy under democracy raises the returns to investment. If democracy has higher productivity ($\theta > 0$), a higher probability of autocracy reduces the expected return of investment, and vice versa.

3.6 Politico-economic equilibrium

The structural equations of the model (8) and (13) jointly determine equilibrium capital accumulation and, via (6), the (stochastic) equilibrium evolution of the political regime, as a function of parameters (θ, d, w) and the predetermined political regime (a_{t-1}). These equations imply an "exclusion restriction": democratic capital d does not influence capital accumulation directly, but only through the probability of autocracy, p_t^*. We rely on this restriction to identify the effect of p_t^* on income in in the empirical analysis to follow.[3]

Equations (8) and (13) can be solved jointly, to obtain the "recursive reduced form":

$$\begin{aligned} p_t^* &= \widetilde{P}(a_{t-1};\ \theta, d, w) \\ k_t^* &= \widetilde{K}(a_{t-1}; \theta, d, w)\ . \end{aligned} \tag{14}$$

[3]The theory has other restrictions - for instance that income when young, w does not affect the probability of regime change directly, but only through the capital stock k_t^*. As shown in a prior version of the paper, however, these additional implications are not robust to using a standard necolassical production function with decreasing marginal returns to labor and capital.

Under the additional assumption $1/|K_p| > |P_k|$, we obtain the following comparative statics results (see the Appendix):

Lemma 3 *The reduced-form expressions* $\widetilde{P}$ *and* $\widetilde{K}$ *have properties:* (i) $\widetilde{P}_d < 0$, $\widetilde{K}_d \gtreqless 0$ *as* $\theta \gtreqless 0$,(ii) $\widetilde{K}_w > 0$, $\tilde{P}_w \lesseqgtr 0$ *as* $\theta \gtreqless 0$, (iii) $\tilde{P}_\theta < 0$ *if* $\theta > \widehat{\theta}_t$, *where* $\widehat{\theta}_t < 0$, *and* (iv) $\widetilde{P}(1;\ \theta, d, w) = \widetilde{P}(0;\ \theta, d, w) + (1-\chi) > \widetilde{P}(0;\ \theta, d, w)$.

By statement (i), higher democratic capital always reduces the probability of autocracy. This is really the same intuition as in the structural form above: higher democratic capital increases the benefit of fighting for democracy. The, induced effect on next period physical capital accumulation, however, depends on whether democracy is more ($\theta > 0$) or less ($\theta < 0$) productive than autocracy.

Clause (ii) says higher income when young always increases physical capital accumulation, since it increases savings. The induced effect on the probability of autocracy is ambiguous, however. If democracy is more productive than autocracy ($\theta > 0$), the old have stronger incentives to defend democracy, as the economic stakes are higher (cf. (5)). If democracy is less productive than autocracy ($\theta < 0$), the reverse is true: as the economy gets richer, this dampens the incentives of the old to defend democracy.

According to (iii), unless autocracy is much more productive than democracy (i.e., $\theta > \widehat{\theta}_t$, where $\widehat{\theta}_t < 0$), a higher relative productivity of democracy reduces the probability of autocracy, because citizens are more willing to defend democracy.

Finally, (iv) (that follows directly from (9)) restates the political persistence result: the probability of autocracy is always strictly higher when starting under autocracy. Also, by this statement, the three previous comparative statics results apply irrespective of the lagged regime.

4 Taking the model to data

In the empirical analysis, we test some comparative statics results based on observable counterparts to the parameters of interest. We are unable to observe the relative productivity under democracy and autocracy – the parameter θ. When θ differs across countries, an important issue arises: countries will systematically sort themselves into different political regimes. Countries

where democracy is more (less) productive will find themselves more (less) often in democracy. Because the comparative statics depend on the level of θ, this has important implications for the empirical predictions and the estimation strategy. To guide the empirical analysis, this section derives the testable implications of the model taking endogenous sorting into account.

4.1 Equilibrium sorting into regimes

To obtain tractable analytic solutions, assume that the world has a continuum of countries that sum to 1. In a fraction λ (strictly between 0 and 1) of them, gains from democracy are high so the parameter θ takes a positive value, $\theta = \overline{\theta} > 0$. The remaining fraction $1 - \lambda$, instead, is economically better off under autocracy, with $\theta = \underline{\theta} < 0$. We assume throughout that $\overline{\theta} \geq -\underline{\theta}$

To study the dynamics of sorting, it is useful to adapt the notation introduced above. Define as $\overline{p}^a$ (respectively $\underline{p}^a$) the equilibrium probability that a country with $\theta = \overline{\theta}$ (resp. with $\theta = \underline{\theta}$) is autocratic in t, given that in $t-1$ it was in regime $a_{t-1} = 0, 1$. By Lemma 3 and the law of large numbers:

$$\begin{aligned} \overline{p}^a &= \widetilde{P}(a_{t-1};\ \overline{\theta}, d, w),\ a_{t-1} = 0, 1 \\ \underline{p}^a &= \widetilde{P}(a_{t-1};\ \underline{\theta}, d, w),\ a_{t-1} = 0, 1\ . \end{aligned} \tag{15}$$

These probabilities are constant over time, as are the corresponding probabilities $\underline{p}^a$ for countries with lower productivity under democracy. Lemma 3 says that $\overline{p}^a < \underline{p}^a$ if $\underline{\theta} > \widehat{\theta}$, which we assume throughout. In words, starting from any political regime, the probability of autocracy is higher for countries economically better off in that regime. Finally, the persistence result in Lemma 3 says that $\overline{p}^1 = \overline{p}^0 + (1 - \chi)$, and similarly, $\underline{p}^1 = \underline{p}^0 + (1 - \chi)$.

How do countries with different values of θ sort themselves into political regimes over time? Let $\overline{n}_t^a$ (resp. $\underline{n}_t^a$) denote the fraction of countries with $\theta = \overline{\theta}$ (resp $\theta = \underline{\theta}$) that have regime a in period t. By assumption, the $\overline{\theta}$ countries sum to λ, while the $\underline{\theta}$ countries sum to $1 - \lambda$. Given that countries can only be in one regime, we have:

$$\begin{aligned} \overline{n}_t^0 &= \lambda - \overline{n}_t^1 \\ \underline{n}_t^0 &= 1 - \lambda - \underline{n}_t^1\ . \end{aligned} \tag{16}$$

Hence, it is sufficient to characterize the law of motion for each productivity type in one regime, say autocracy. The dynamics of the shares within

autocracy is:

$$\begin{aligned} \overline{n}_t^1 &= \overline{n}_{t-1}^1 \overline{p}^1 + (\lambda - \overline{n}_{t-1}^1)\overline{p}^0 \\ \underline{n}_t^1 &= \underline{n}_{t-1}^1 \underline{p}^1 + (1 - \lambda - \underline{n}_{t-1}^1)\underline{p}^0 \ . \end{aligned} \tag{17}$$

For each productivity type, the first term on the right hand side corresponds to former autocracies that remain under autocracy, and the second term corresponds to former democracies that switch to autocracy. As already noted, $\overline{p}^1 = \overline{p}^0 + (1-\chi)$. Solving (17) for a steady-state with constant shares, we have:

$$\overline{n}^1 = \frac{\lambda \overline{p}^0}{\chi}, \qquad \underline{n}^1 = \frac{(1-\lambda)\underline{p}^0}{\chi} \ . \tag{18}$$

Note that $\overline{n}^1$ is always smaller than λ, because $\overline{p}^1 = \overline{p}^0 + (1-\chi)$ implies $\chi > \overline{p}^0$. Moreover, (17) implies that the steady state is dynamically stable with monotonic convergence.

As the probability of autocracy is higher for the countries more productive in that regime ($\overline{p}^a < \underline{p}^a$), countries sort themselves accordingly over time. Thus, relative to the world average, low-θ countries will be over-represented among the autocracies and under-represented among the democracies, and vice versa for high-θ countries. In our notation, the world ratio of high-θ to low-θ countries is $\lambda/(1-\lambda)$. Equations (16-18) imply:

Lemma 4 *In the steady state,* $\overline{n}^0/\ \underline{n}^0 > \lambda/(1-\lambda) > \overline{n}^1/\ \underline{n}^1$. *The same is true for any time period* t, *if countries start out randomly allocated across political regimes.*

The second part of Lemma 4 follows immediately from monotonic convergence to the steady state, because a random initial allocation corresponds to the odds ratio $\lambda/(1-\lambda)$.

4.2 Empirical predictions

In this subsection we formulate testable predictions. Because countries endogenous sort themselves by (unobservable) type θ and because the comparative statics depend on θ, we generally get systematic differences by (observable) political regime. Hence, in most of our empirical work we estimate the relevant parameters separately for countries under democracy and autocracy. Throughout, we assume the world is close enough to the steady state – or

started from a random allocation of countries to political regimes – so that we can invoke Lemma 4.

One concern in going from model to data is that we observe per capita income, y, rather than the physical capital stock, k, or wage income, w. However, using the model expression for GDP per capita, namely $y_t = A(a_t)k_t + w$, we can re-express the model predictions in terms of observables. Our dependent variables of interest are the probability of regime changes, p_t^*, and GDP per capita, y_t.

We treat parameters d and w as observable; they appear as independent variables in the empirical analysis. Section 5 discusses how we measure democratic capital, d. Wage income, w, corresponds to lagged income in the data, since it affects k_t (and hence y_t and p_t^*) through the young's investment in period $t-1$ (recall (10)). From here, we therefore refer to w as lagged income. The type-parameters θ and share-parameter λ are treated as genuinely unobserved. Due to non-random selection into democracies and autocracies, however, results in these subsamples may give us indirect information about the unobservable parameters.

Let x be the vector of the observable variables of interest, democratic capital (d) and lagged income (w). Let $\frac{\partial p_t^a}{\partial x}$ denote the average effect of x on the probability of autocracy in t, in the samples of democracies ($a = 0$) and autocracies ($a = 1$) in $t-1$. The *reduced form* expressions imply:

$$\frac{\partial p_t^a}{\partial x} = \frac{\overline{n}_{t-1}^a}{\overline{n}_{t-1}^a + \underline{n}_{t-1}^a} \widetilde{P}_x(a_{t-1}; \overline{\theta}, x) + \frac{\underline{n}_{t-1}^a}{\overline{n}_{t-1}^a + \underline{n}_{t-1}^a} \widetilde{P}_x(a_{t-1}; \underline{\theta}, x), \quad a_{t-1} = 0, 1 \tag{19}$$

where $\widetilde{P}_x$ denotes the (vector of) partial derivative(s) of $\widetilde{P}(\cdot)$ with respect to x, namely w and d, and the weights on each type in regime a reflect that we are conditioning on the political regime in $t-1$.

The first step in the empirical analysis is to estimate these partial effects of x from the reduced form expressions $\widetilde{P}(\cdot)$ in each of the two samples. Lemmata 3 and 4 imply:

Prediction 1 *(a) Democratic capital decreases the probability of autocracy in the samples corresponding to both political regimes:* $\frac{\partial p_t^a}{\partial d} < 0$ for $a_{t-1} = 0, 1$. *(b) Lagged income has a smaller algebraic effect on the probability of autocracy in the democracy sample than in the autocracy sample:* $\frac{\partial p_t^0}{\partial w} < \frac{\partial p_t^1}{\partial w}$. *(c) Higher lagged income can increase or decrease the probability of autocracy in both samples:* $\frac{\partial p_t^a}{\partial w} \lesseqgtr 0$ for $a_{t-1} = 0, 1$.

But if λ is large enough, higher lagged income reduces the probability of autocracy in the sample of democracies (or even in both samples).

Prediction (1a) follows from Lemma 3, as higher democratic capital reduces the probability of autocracy irrespective of the value of θ. Prediction (1b) is about the relative effects of lagged income in democracy and autocracy. By Lemma 3, $\widetilde{P}_w \lesseqgtr 0$ as $\theta \gtreqless 0$. Intuitively, higher lagged income raises investment. The higher capital stock raises the value of defending democracy if $\theta = \overline{\theta} > 0$, but has the opposite effect if $\theta = \underline{\theta} < 0$. By sorting, however, more $\overline{\theta}$ countries find themselves under democracy than under autocracy, so (by Lemma 4) the weight on the first term in (19) is bigger under democracy. Since the weights in each regime add up to one and $\widetilde{P}_w(0;\theta,d,w) = \widetilde{P}_w(1;\theta,d,w)$ (by Lemma 3), the algebraic effect is smaller in the sample of democracies than in autocracies. Finally, prediction (1c) is about the *sign* of lagged income in (19). Again, the derivative with respect to w has a negative first term and a positive second term. The weight on the negative term $(\frac{\overline{n}^a_{t-1}}{\overline{n}^a_{t-1}+\underline{n}^a_{t-1}})$ is increasing in λ, while the weight on the positive term $(\frac{\underline{n}^a_{t-1}}{\overline{n}^a_{t-1}+\underline{n}^a_{t-1}})$ is decreasing in λ. By continuity, the exists a value of λ, say λ^a, such that the two effects exactly cancel out. For $\lambda > \lambda^a$, $\frac{\partial p^a_t}{\partial w} < 0$. By part (b), $\lambda^1 > \lambda^0$.

According to the model, a finding that higher lagged income reduces the risk of exit from democracy thus constitutes indirect evidence that, in a sufficiently large number of countries, democracy is favorable to economic development, i.e., λ is "high enough".

Next, let $\frac{\partial y^a_t}{\partial p^*_t}$ denote the average effect on period t income of the probability of autocracy in t, in the samples of countries in state $a = 0, 1$ in period t. The *structural form* (13) implies the following average effect in the two regimes:

$$\frac{\partial y^a_t}{\partial p^*_t} = \frac{\overline{n}^a_t}{\overline{n}^a_t + \underline{n}^a_t} A(a_t) K_p(p^*_t;\ \overline{\theta}, w) + \frac{\underline{n}^a_t}{\overline{n_t}^a + \underline{n}^a_t} A(a_t) K_p(p^*_t;\ \underline{\theta}, w),\ a_t = 0, 1 \tag{20}$$

Our second step in the empirical part is to estimate this structural-form expression separately in the sample of democracies and autocracies.[4] As further discussed below, we may identify the effect of expected regime changes

[4] In the empirical analysis the dependent variabe is actually the growth rate rather than the level of income (see Section 6).

on per-capita income by the exclusion restriction that democratic capital, d, does not enter the structural form $K(\cdot)$, except through p_t^*. Lemmata 3 and 4 imply:

Prediction 2 (a) *The probability of autocracy has a smaller algebraic effect on income in the democracy sample than in the autocracy sample:* $\frac{\partial y_t^0}{\partial p_t^*} < \frac{\partial y_t^1}{\partial p_t^*}$. (b) *A higher probability of autocracy can increase or decrease income in both samples:* $\frac{\partial y_t^a}{\partial p_t^*} \gtrless 0$. *But if* λ *is large enough, a higher probability of autocracy decreases income in the sample of democracies* (*or even in both samples*).

Prediction 2 follows from Lemmata 2 and 4, by analogous arguments as in the proof of Prediction 1. By part (b), a finding that the probability of autocracy decreases growth is indirect evidence that, on average, democracy is favorable to economic development.

Finally, the *reduced form* of the model implies how democratic capital, d, influences per capita income in each regime as well as in the full sample of countries. Our third step in the analysis is to estimate a reduced form for the sample of all countries, where we also condition on the political regime in period $t-1$.

In analogous notation, the average effect of democratic capital on income, in each sample, is:

$$\frac{\partial y_t^a}{\partial d} = \frac{\overline{n}_{t-1}^a}{\overline{n}_{t-1}^a + \underline{n}_{t-1}^a} A(a_t) \widetilde{K_d}(a_{t-1}; \overline{\theta}, d, w) + \frac{\underline{n}_{t-1}^a}{\overline{n}_{t-1}^a + \underline{n}_{t-1}^a} A(a_t) \widetilde{K_d}(a_{t-1}; \underline{\theta}, d, w) \ . \tag{21}$$

Lemmata 3 and 4 imply:

Prediction 3 (a) *Democratic capital has a larger effect on income in the democracy sample than in the autocracy sample:* $\frac{\partial y_t^0}{\partial d} > \frac{\partial y_t^1}{\partial d}$. (b) *Higher democratic capital can increase or decrease income in both samples:* $\frac{\partial y_t^a}{\partial d} \gtrless 0$. *But if* λ *is large enough, democratic capital raises income in the sample of democracies* (*or even in both samples*).

The prediction follows applying the same logic as in the proofs of Predictions 1 and 2. In analogy with these predictions, a finding that democratic capital raises growth in democracies or all countries is indirect evidence that democracy stimulates development, in a large share of countries.

Finally, the model has a few additional empirical implications. One is that conventional tests of how democracy affects growth are likely to be biased. To see this, consider an autocracy, where the productivity gain of democracy is positive ($\theta = \overline{\theta}$). In such a country, mounting expectations of a transition towards democracy gradually raises expected returns (as p_t^* is falling) and the resulting investment response gradually raises income. When the regime transition occurs, income goes up, but much of the income adjustment has already taken place. An econometrician estimating how actual regime changes affects income or growth – say, by difference-in-differences of income on a democracy indicator – will thus underestimate the true effect. Our tests of Prediction 2 will establish a link from *expected* regime changes to growth, but we will not consider (directly) the effect of *actual* regime changes. Persson and Tabellini (2006 a and b) do carry out such analyses, however, and find that the estimated effect of actual transitions into democracy is higher when expected regime changes are taken into account.

5 Data

We use annual data on economic development and political regimes for as many countries as far back as possible. The resulting panel is unbalanced, because of data availability and because countries only enter the panel in the year of independence. The Data Appendix gives detailed definitions and sources of all our variables.

We observe output (GDP) per capita, $y_{i,t}$ for country i and year t. The source is Maddison 2001, who reports uninterrupted data from 2000 backwards for most countries, as far back as to 1870 for a number of countries, and to 1820 for a few countries. We express per-capita output in terms of natural logs.

The political regime in country i and year t, $a_{i,t}$ is defined in two alternative ways. As in the model, we treat the regime as a binary variable. Our main definition of democracy is based on Polity IV data, available for all countries above 1/2 million inhabitants from 1800 until 2000. Specifically, we set $a_{i,t} = 1$ if the *polity*2 variable takes a strictly positive value, and $a_{i,t} = 0$ otherwise. This variable has a maximum of 10 and a minimum of -10, depending on the status of six different aspects of political institutions, with a focus on executive powers, executive selection and the freedom of elections. Regime transitions by this definition entail a rather generous

definition of democracy, relative to others in the literature, but have the advantage of capturing non-gradual transformations of the political regime (for many countries, large step changes in the underlying variable *polity*2 are concentrated around 0).

Our second definition is based on Boix and Rosato's (2001) extension of the measure constructed by Przeworski et al (2000). This democracy measure is more narrow than the Polity variable, and emphasizes the turnover of political power in free and fair elections. This binary variable is available from 1800 until 1994. In a few cases, the Boix and Rosato variable is missing while the Polity IV variable is not (for instance, Boix and Rosato do not attempt to code transition years, while *polity*2 interpolates such years). In such cases, we supplement the Boix and Rosato definition with the Polity IV definition.

According to both measures, the historical development of democracy varies a great deal across countries. Some nations, such as Afghanistan, China, and Morocco, never experience a transition into democracy. Others, like Australia and Canada, start out as democracies right at independence and never experience an autocratic period. Yet others, such as Costa Rica and Denmark, start out autocratic and then make a single irreversible transition into democracy. Many countries have a more eventful history, however, with repeated intermittent spells of democracy and autocracy. According to the Polity IV measure, Guatemala is the most extreme, having gone through six periods each of democracy and autocracy since independence in 1839.

The intersection of the economic and political data give us annual data for about 150 countries over at most 180 years.

5.1 How to measure democratic capital?

To test Predictions 1-3 in Section 4, we need an operational definition of democratic capital, d_t. In the model, democratic capital is a stock of civic values that affects people's willingness to stand up for democracy, but does not directly affect their investment behavior.

For a narrow set of countries and a shorter time period, one could think of imaginative ways of measuring democratic capital. Keeping with the sparse data in our long historical panel, however, we create two variables by making specific assumptions about democratic capital accumulation.

The first is called *domestic* democratic capital, denoted by $z_{i,t}$. We assume this component accumulates over time, as members of society gradually gain

experience with democracy. This idea has intuitive appeal. A number of mechanisms could make a long-standing democracy more resilient to a coup than a short-standing one, including build-up of formal and informal institutions from political parties to social norms. The same institutions would make the re-institution of democracy more likely in a nation having lapsed back into autocracy. Since such institutions could also directly impact on public policies, we do *not* impose the exclusion restriction that this domestic component of democratic capital *only* influences economic outcomes through the probability of regime change.

To define domestic democratic capital, we need to specify how a particular historical path in country i up to year t, $\{a_{i,t-\tau}\}_{\tau=0}^{\tau=t_0}$, maps into a value of $z_{i,t}$. We are agnostic about functional form. The simplest assumption is that democratic capital accumulates in years of democracy, and depreciates geometrically, at the rate $(1-\delta)$, in years of autocracy: $z_{i,t} = (1-a_{i,t})+\delta z_{i,t-1}$. In this case, we can solve backwards to obtain (assuming $z_{i,t_0} = 0$):

$$z(\delta)_{i,t} = (1-\delta)\sum_{\tau=0}^{\tau=t_0}(1-a_{i,t-\tau})\delta^{\tau-1} \ , \tag{22}$$

where t_0 is either the year of independence or 1800, whichever comes last. Thus, democratic experience is more valuable the closer it is to the present. Note that uninterrupted democracy makes democratic capital eventually converge to a steady-state value. We use the notation $z(\delta)$ to emphasize the dependence on the depreciation rate, and multiply with $(1-\delta)$ such that the resulting expression is scaled to $[0,1]$. As further discussed below, δ is estimated from the data.

Figure 2 illustrates the time path of domestic democratic capital for two countries, Spain and Sweden, given two depreciation rates: $\delta = 0.94$ (in part a) and 0.99 (in part b), the maximum and minimum values we estimate below.[5] As the political history of the two countries is very different, so is the time path of their domestic democratic capital. Sweden gains democratic status in 1910, and uninterrupted democracy brings continued accumulation until 2000. Spain becomes a democracy in the early 1870s, but its volatile political history implies a highly non-monotonic path of democratic capital. The two panels illustrate the effects of the depreciation rate $1-\delta$. The higher depreciation rate of 0.06 in Fig 2a makes the paths of domestic democratic

[5]The definition of democracy used in Figure 1 is that by Polity IV.

capital steeper – during democracy, as well as autocracy – compared to Figure 2b where the depreciation rate is 0.01. A higher depreciation rate makes the Spanish relapses into autocracy more costly and, as a result, Sweden's domestic democratic capital catches up with that of Spain around 1930, rather than around 1950. Moreover, in Figure 2a Sweden has more or less converged to the democratic steady state (of 1) by the year 2000, whereas it has 40% of the way to go in Figure 2b.

The second component of democratic capital is based on democratic conditions abroad. It is easy to imagine how the experience with democracy in foreign, neighboring countries could spill over into greater domestic appreciation of democracy and greater willingness to defend these values; think about the orange revolution in the Ukraine. As we do not directly observe these spill-overs, however, we have to define a parsimonious measure given our data. The variable *foreign* democratic capital, labeled f_t, measures a country's "closeness to democracy", given the incidence of democracy in neighboring countries. We tried different specifications with alternative sets of weights corresponding to closeness in terms of geography, history or culture. The results below are based on geography and the Polity IV democracy data.

Specifically, for country i and year t, we define $f_{i,t}$ by

$$f(\rho)_{i,t} = \sum_{j \neq i} (1 - a_{j,t}) \varpi(\rho)_t^{i,j}, \tag{23}$$

where $a_{j,t}$ is a measure of the degree of democracy in country j in year t and the weight $\varpi(\rho)_t^{i,j}$ measures the distance i and j, with a weight that drops to zero for distance outside radius ρ. The dependence on time reflects the varying number of countries in the sample, and the dependence on ρ is emphasized by the notation $f(\rho)$. Like δ, ρ is estimated from the data. Finally, we replace $(1 - a_{j,t})$ by country j's continuous *polity*2 score and divide by 10, such that the resulting expression is scaled to $[0, 1]$.[6]

Figure 3 illustrates the time path of foreign democratic capital in two countries, Belgium and Chile, when $\rho = 1$, so every country j in the world

[6]Specifically, let $D^{i,j}$ be the (time-invariant) great circle distance between the capitals in i and j, D be half the length of the equator, and N_t be the number of independent countries in the world with a *polity*2 score in year t. Then, we impose $\varpi(\rho)_t^{i,j} = (1 - \frac{D^{i,j}}{D})/N_t$ if $\frac{D^{i,j}}{D} \leq \rho$, and $\varpi(\rho)_t^{i,j} = 0$ if $\frac{D^{i,j}}{D} > \rho$.

is included in the neighborhood.[7] The two variables share a general time pattern, reflecting the gradual adoption of democracy throughout the 19th century and three waves of democratization in the 20th century (see Huntington, 1991). Why is Belgium's foreign democratic capital more variable than that of Chile's? Because Belgium is closer to the coincident deteriorations – in the interwar period – and improvements – in the early 1900s and the 1990s – of democratic conditions across Europe, whereas Chile is closer to the more dispersed political transitions in Latin America.

It is appropriate to ask whether our bold assumptions about democratic capital give us measures that indeed pick up anything close to citizens' assessments of the value of democracy. Reassuringly, both components of democratic capital are strongly correlated with citizens' opinions about the value of democracy as a form of government in a large cross section of countries. In the late 1990s, the World Value Surveys asked individuals of about 60 developing and developed countries to rank (on a 1 to 4 scale) their agreement with the following statement: "Democracy may have problems but it's better than any other form of government". The average response in each country is a rough measure of how much democracy is appreciated.[8]

In column 1 of Table 1, we regress the average country responses against domestic and foreign democratic capital in 1999. Both components are strongly and significantly correlated with appreciation of democracy. The remaining columns of Table 1 show that the correlation persists and becomes stronger as we control for economic development, the current political regime and human capital (gauged by average school attainment as in Barro and Lee, 2000), all measured in 1999. Figure 4 shows that the correlations behind the estimates in Table 1 (column 4) are not due to outliers. Interestingly, columns 3 and 4 of the table suggest that the appreciation of democratic form of government is higher in autocracies than in democracies, once we control for democratic capital. These estimates confirm that our measures of democratic capital are not empty. Individuals value democracy more if they live in a country with long democratic experience and if they

[7]Since $f(\rho)_{i,t}$ is only defined by the neighbors of country i, we can draw the (hypothetical) foreign democractic capital of Belgium and Chile before the years in which they become independent nations (in 1830 and 1818, repectively).

[8]In the World Value Surveys, a value of 1 corresponds to strong agreement, while 4 corresponds to strong disagreement with the statement in the text. In Table 1 and Figure 3 below, we measure the appreciation of democracy as 4 minus the country average response (times a 100); thus, higher values correspond to more appreciation for democracy.

are surrounded by other democracies, irrespective of economic development, average education and the current political regime.

Below, we assume that foreign (though not domestic) democratic capital influences the willingness of citizens to stand up for democracy, but has no direct effect on growth. This exclusion restriction cannot be tested, but we can at least look at the correlation between democratic capital and other growth-promoting institutions, exploiting a widely used measure of property right protection (also based on perceptions data). The variable *Government Anti Diversion Policies* ($GADP$) is used by Hall and Jones (1999) and many others in the macroeconomic development literature to capture the effect of institutions on economic development. Controlling for per-capita income, current democracy, and (in column 7) human capital, no positive correlation is left between perceptions of property rights protection and democratic capital. If anything, foreign democratic capital appears to be negatively – not positively – correlated with the protection of property rights. This reassures us that the assumed exclusion restriction may not be grossly inconsistent with the data.

We now study how democratic capital and other variables explain political and economic change in our long historical panel.

6 Political transitions

In this section, we study transitions from democracy into autocracy and vice versa, using yearly data back to the 1800s. Specifically, we test Prediction 1 in Section 4, estimating the probability of exit from democracy and exit from autocracy. We test all three part of Prediction 1, viz.: (a) *The effect of democratic capital in both regimes.* Higher democratic capital (measured by its domestic and foreign components) reduces the probability of autocracy, irrespective of the current regime. (b) *The relative effect of per capita income under democracy vs. autocracy.* If democracy has heterogenous effects across countries and if we are close to the steady state (or started from a random initial allocation of regimes) so sorting has taken place, higher per capita income has a smaller algebraic effect on the probability of autocracy in the democracy sample than in the autocracy sample. (c) *The absolute effect of per capita income.* If democracy is more productive than autocracy in a large enough share of countries – the fraction λ with $\theta = \bar{\theta} > 0$ in the model – higher per capita income reduces the probability of autocracy, for countries

currently in democracy.

6.1 Econometric specification

Which econometric specification do we bring to the data? To take right-censoring of our data on political regimes into account, we estimate the risk of exit from the current regime – i.e., a hazard rate, h_t^a, where a denotes the regime in year $t-1$. In the notation of the model, we estimate $h_t^0 = \tilde{P}(\cdot)$ and $h_t^1 = 1 - \tilde{P}(\cdot)$ for the countries that were democracies (resp. autocracies) in year $t-1$. Following the distributional assumption (about ν) in the model, the hazard rates are specified as probit. We replace d with domestic and foreign democratic capital, $z(\delta)_{i,t-1}$ and $f(\rho)_{i,t-1}$, as defined in the Section 5, and we replace w with lagged income $y_{i,t-1}$. In some specifications, we also include a number of fixed and time varying controls $\mathbf{x}_{i,t}$ to reflect country-specific probabilities of a coup or an uprise, corresponding to the parameter χ in the model. Thus, we estimate spell-specific hazard rates of the form:

$$h_{i,t}^a = H^a(z(\delta)_{i,t-1},\ f(\rho)_{i,t-1},\ y_{i,t-1},\ \mathbf{x}_{i,t}) + \psi_{i,t},\quad a = 0, 1\ , \tag{24}$$

where $\psi_{i,t}$ is an error term.

How do we carry out the estimation? Our democratic-capital variables are only defined up to parameters δ and ρ, which enter both hazard rates. Using the definitions in (22) and (23) and imposing the constraint that δ and ρ be equal across the two hazard rates, we obtain a well-defined likelihood function. With many regime shifts for a number of countries and many country pairs, the likelihood is highly non-linear. To find the maximum likelihood values, we first fix the values for δ and ρ, estimate all the other parameters, and compute the value of the likelihood function. We then repeat this procedure for a large range of values of δ and ρ, always re-estimating the other parameters as we vary δ and ρ. This way, we create an envelope to the likelihood function over δ and ρ. Finally, we select the values of δ and ρ (and other parameters) at the maximum of the envelope likelihood function. This yields maximum likelihood estimates of all coefficients of interest, except that the estimated standard errors treat the parameters δ and ρ as known (rather than estimated).

For ρ, this iterative procedure always yields the same maximum independently of specification, namely $\rho = 1$, i.e., each country's neighborhood includes all countries in the world (although with weights declining in dis-

tance). For δ, the maximum value depends on the specification of the hazard rates, but always lies in the interval $[0.94, 0.99]$ – see further below.

6.2 Basic results

The most parsimonious specification only includes the variables of interest: domestic and foreign democratic capital and lagged per-capita income. With this specification, the maximum likelihood estimate of the depreciation rate of democratic capital is $\delta = 0.94$ (and the neighborhood radius $\rho = 1$). Table 2 report the effects on the probability of autocracy, out of democracy and autocracy, respectively. Column 1 reports the estimates of the hazard rate out of democracy, while column 2 refers to the *negative of* the hazard rate out of autocracy. The same convention applies to the rest of Table 2 and to Table 3.

The estimated coefficients on both components of democratic capital are highly statistically significant and have the expected sign from Prediction 1(a): democratic capital reduces the probability of autocracy next year, conditional on being in democracy (column 1) as well as in autocracy (column 2) this year.

A higher income level significantly decreases the probability of switching from democracy to autocracy. According to the model, Prediction 1(c), this is indirect evidence that democracy is more productive than autocracy for a large enough fraction λ of countries. This income effect is much weaker and not significantly different from zero in the autocracy sample, however (column 2). The asymmetric income effect out of democracy vs. autocracy is consistent with Prediction 1(b) and reproduces earlier findings by Przeworski et al (2000) and (conditional on the specification) by Acemoglu et al (2005b). As discussed in Section 4, a weaker income effect under autocracy is indeed implied by the theoretical model, under endogenous sorting of countries into political regimes according to their productivity. We do not formally test prediction that the estimated coefficients of income are different in the two regressions, as we don't have an estimate of the covariance between the error terms of these two equations. The 99% confidence intervals of the two estimated coefficients do not overlap, however. Thus, equality of the coefficients would be rejected, unless the covariance between the two estimates were negative and large in absolute value.

In terms of our model, the column 1 and 2 specifications assume that the opportunity to change the regime is the same across countries and time:

i.e., parameter χ is the same for all i and t. We relax this in columns 3-6 by adding other regressors: indicators for years t in which country i was at war (contemporaneous and lagged once); a flexible polynomial in time to capture worldwide trends in the incidence of democracy and autocracy (results are robust to replacing the polynomials with indicators for 20-year periods); several indicators for fixed country characteristics such as legal and colonial history, geographic location, how democratic the country was when it first became independent (or the *polity*2 score when it first became available), an indicator for the few countries that switched regimes more than 5 times. While columns 3 and 4 use the Polity IV definition of democracy, columns 5 and 6 use the Boix and Rosato definition for an otherwise almost identical specification of the hazard rates (full details are provided in the note to Table 2 and variables are defined in the data appendix). With this specification, the maximum likelihood value estimate of the depreciation rate of democratic capital is $\delta = 0.99$ (columns 3 and 4) and $\delta = 0.97$ (columns 5 and 6), respectively.

Evidently, the results on democratic capital and income from the most parsimonious specifications hold up very well. In particular, democratic capital always reduces the probability of autocracy, in both regimes, while income reduces the probability of autocracy in democracies, but in autocracies.[9] Among the other results (not reported), wars are destabilizing both for democracies and autocracies, but the effect of war on autocracies manifests itself one year after the war, while it is contemporaneous in democracies. Countries starting out with stronger constraints on the executive are more stable as democracies, but no less stable as autocracies (given domestic democratic capital). Most of the other historical or geographic dummy variables have statistically significant coefficients, as do the first and second component of the polynomial in time. These results are robust to alternative specifications with similar controls.

Overall, exit from democracy is more successfully explained than exit from autocracy. The pseudo R-square (i.e., roughly the percent increment in the number of correctly predicted outcomes in the model, relative to a model with only a constant) is about 22% for exit out of democracy, and about half of that out of autocracy. But the estimated *annual* probabilities

[9] Again, the 99% (resp. 95%) confidence intervals of the estimated coefficients for income in columns 3 and 4 (resp. columns 5 and 6) don't overlap, which implies that we would not be able to reject equality of coefficients unless their covariance was negative and large in absolute value.

of transitions are not very high. Figure 5 shows frequency distributions of the estimated probabilities, based on the specifications in columns 3 and 4 of Table 2. Although the probability of exit from democracy (autocracy) can be as high as 50% (30%) for some observations, most of the probability mass is concentrated between 0 and 10%, with average hazard rates around 2 -3%.

On average, political transitions are thus relatively rare, making both political regimes quite stable. But the determinants of interest have quite substantial effects on the annual probability of transition. By the point estimates in columns 3 and 4, a one-time jump of domestic democratic capital from its minimum of 0 to its maximum of 1 on average would reduce the probability of autocracy by almost 2 percentage points conditional on being under democracy, and by almost 5 percentage points conditional on being under autocracy, i.e., close to or above the average transition probabilities in the sample. According to the same estimates, a hike in foreign democratic capital of about 0.4 – corresponding to the change in European countries from 1970 to 2000 (cf. Figure 3) – reduces the probability of autocracy by about 2 and 3.5 percentage points, under democracy and autocracy, respectively.

6.3 Unobserved heterogeneity and human capital

The regressions behind Table 2 pool spells from all countries together and thus exploit both within and across country variation. This raises an important concern familiar from labor economics: state dependence vs. unobserved heterogeneity. Domestic democratic capital summarizes the history of democracy in each country. Perhaps the significant coefficient of this variable is just hiding unobserved heterogeneity, like the relative productivity parameter θ in our model. Indeed, if unobserved heterogeneous effects of democracy produce sorting (as suggested by the asymmetric income effect out of democracy vs. autocracy), the estimated coefficient of the domestic component of democratic capital would be biased upwards. The reason is that countries for which democracy is more productive find themselves in that state more often.

As a first check, we estimate a random effect model. The row labeled "LR-test" in Table 2 reports the p-value of a likelihood-ratio test of the random effects against our basic pooled specification (i.e., a test of the nul that the share of the variance explained by the random country effects is zero). As shown by the results in columns 1 and 2, this test has bite: we can reject the absence of no random country effects. With the more comprehensive

specification in columns 3-6, however, the test statistic is no longer statistically significant, suggesting that random country effects do not explain a significant fraction of the variance. Although this test relies on a specific functional form of the hazard function, the results are robust to alternative functional forms.[10]

The LR-test refers to random and time-invariant omitted variables orthogonal to the other regressors. But unobserved and heterogeneous productivity effects of democracy are likely correlated with domestic democratic capital, which would make the random-effect estimates inconsistent. To allow for a country effect correlated with some of the regressors, we have also estimated the hazard rates by conditional logit, including country fixed effects. This way we estimate the coefficients of interest from the within-country variation only, exploiting the countries that have *completed* at least one spell in the relevant regime. Unfortunately, this dramatically restricts the sample. When estimating the risk of exit from democracy, we cannot make use of all long-lived democracies, which never leave their last democratic spell (the fixed country effect predicts non-exit perfectly). Correspondingly, we lose all countries experiencing one long spell of autocracy without ever becoming democracies. Such a systematic selection of the sample is clearly unattractive. Nevertheless, some – but not all – of the results reported in Table 2 are robust to this estimation method. Specifically: (i) The effect of foreign democratic capital on both hazard rates is very robust. (ii) The negative effect of per-capita income on the hazard rate out of democracy is very robust, and per-capita income now becomes significant, with the expected sign also under autocracy. These findings contrast with those of Acemoglu, Robinson and Yared (2005b), although these authors use as the dependent value the full discrete (21-step) polity2 score rather than a binary indicator. (iii) The effect of domestic democratic capital on both regimes is not robust, however (the estimated coefficient changes sign and is significant in both hazard rates). While this result likely reflects the drastic sample selection, it also suggests that the estimated effect of domestic democratic capital reported

[10]The LR tests in Table 2 are based on estimates of a random effects logit (vs. a pooled logit), which is consistent with a proportional hazard model with a logistic hazard and a normally distributed random country effect (see e.g., Jenkins, 2004). Similar results are obtained with a complementary loglog hazard model. In these random effects estimates, both components of democratic capital remain highly significant in the hazard functions out of democracy, while foreign (but not domestic) democratic capital remains significant in the hazard function out of autocracy.

in Table 2 could be biased upwards (in absolute value). Our estimates may thus reflect a mixture of state dependence and unobserved heterogeneity.

If the estimated coefficient of domestic democratic capital *only* reflected unobserved heterogeneity, rather than true state dependence, we should find that distant democratic experience has similar effects as the more recent one. Our estimate of a depreciation rate in the range of 1% to 6% contradicts this (although we did not estimate standard errors for $1 - \delta$). To further assess the contribution of distant vs. recent democratic experience, column 1 of Table 3 estimates the risk of exit from democracy, replacing domestic democratic capital with two components. "Current domestic democratic capital" is the amount accumulated in the current democratic spell, i.e., this variable starts off at zero at the beginning of each new democratic spell. "Past democratic capital" is the remaining component, i.e., domestic democratic capital minus the current component. Only the current component is statistically significant, while more distant democratic history does not seem to matter, suggesting that domestic democratic capital does indeed pick up some true state dependence and not just time-invariant unobserved heterogeneity.

We then ask the same question about the risk of remaining under autocracy. Here, we cannot decompose democratic capital into current and past, because no democratic capital is accumulated under autocracy. Instead, in column 2 we add the duration of the current autocratic spell as a regressor to our basic specification. The duration of the current spell is not statistically significant, while domestic democratic capital retains its sign and significance. Thus, the data suggest that distant democratic experience helps explain exit from autocracy, while duration of the current democratic spell makes democracies more stable. This asymmetry is consistent with the formulation of the model, where democratic capital – by definition – can never help trigger the first democratic transition in a country that starts out as an autocracy.

Finally, we ask whether the results are robust to controlling for human capital, measured by time-varying indicators of education. Already Lipset (1959) and Almond and Verba (1963) pointed to the correlation between education and attitudes towards democracy. Recently Glaeser et al. (2005) present additional evidence of such a correlation, motivated by a theoretical model where education increases the participation of citizens in support of democracy. We use annual data referring to population above 25 years of age, constructed in Persson (2005) by interpolating the five-year observations from Barro and Lee (2000). This measure of human capital, available only from 1960 onwards, is closely correlated with domestic democratic capital, on the

order of 0.6 in the entire sample of countries. Columns 3 and 4 of Table 3 show the results for our most parsimonious specification, identical to that in columns 1 and 2 of Table 2, except for the shorter sample period and the addition of human capital (we retain $\delta = 0.94$ as in Table 2). The estimate is indeed statistically significant with the expected sign: education reduces the probability of autocracy, irrespective of the current regime. Our two measures of democratic capital remain significant both under democracy and autocracy, however, and the point estimates are even higher in absolute value than in Table 2. The effect of income on the probability of regime change also remains unaffected. In particular, the asymmetric effect of income on the probability of regime change under democracy vs. autocracy continues to hold.

7 Economic growth

In this section, we use our panel to estimate structural and reduced forms corresponding to the economic part of our theoretical model. The first subsection deals with democratic and autocratic regimes separately, looking at the effect of regime expectations on growth. The second subsection considers the full sample and estimates the reduced form, asking whether democratic capital influences economic growth.

7.1 Within regimes – structural form

Motivated by Proposition 2, we estimate the effect of the expected regime on growth. Specifically, we test (a): *The relative effect of expected autocracy in democracy vs. autocracy.* With sorting according to heterogeneous economic effects of democracy, a higher probability of autocracy has an (algebraically) smaller effect on growth in the sample of democracies than in the sample of autocracies. We also test (b): *The absolute effect of expected autocracy.* If democracy is more productive than autocracy for a large enough share of countries, a higher probability of autocracy reduces economic growth for the sample of current democracies (or even in the current autocracies).

7.1.1 Econometric specification

We estimate by OLS a linear version of (20), expressed in first differences. Since income is measured in logs, the dependent variable is yearly economic

growth. To allow for conditional convergence, we always include lagged income, $y_{i,t-1}$. The probability that country i finds itself in autocracy in period t is obtained from the predicted hazard rates estimated in Section 5 (columns 3 and 4 of Table 2), and is denoted by $\hat{p}^a_{i,t}$, where a refers to the regime in period $t-1$.

We start with the parsimonious formulation directly suggested by the model. But to remove the effect of omitted variables – such as θ in the model – that vary only by country or years, in subsequent specifications we then include country and year fixed effects, α_i and ϕ_t respectively, as well as a vector of additional regressors, $\mathbf{x}_{i,t}$, defined below. Thus, we estimate a version of the following equation regime by regime:

$$y_{i,t}-y_{i,t-1}=\gamma^a\widehat{p}^a_{i,t}+\beta y_{i,t-1}+\boldsymbol{\sigma}\mathbf{x}_{i,t}+\omega z_{i,t}+\alpha_i+\phi_t+\varepsilon_{i,t},\ \ a_t=a_{t-1}=0,1 \quad (25)$$

When country and year fixed effects are included, the parameter of interest, γ^a, is only identified by the country-specific time variation in the estimated probability of autocracy. By the specification of the hazard rate, this variation is due to four sources: indicators for wars and lagged wars, time variation in the domestic and foreign components of democratic capital, and lagged income. To take care of the likely direct effect of wars on growth, the vector $\mathbf{x}_{i,t}$ includes the two war indicators. Since years of democratic experience may directly influence economic growth, for instance through the accumulation of human capital or by inducing specific policy outcomes, we also include the domestic component of democratic capital $z_{i,t}$ among the regressors.

We identify parameter γ by the restriction that the foreign component of democratic capital $f_{i,t}$ can be excluded from the right-hand side of (25) – and by the functional-form assumption implicit in the hazard rates. The exclusion restriction hinges on the incidence of democracy in neighboring countries being uncorrelated with domestic growth. This may pose a problem if (i) nearby democracies have higher incomes than nearby autocracies, and (ii) higher incomes abroad generate higher domestic growth (say trough international trade). To remove this concern, $\mathbf{x}_{i,t}$ includes a measure of foreign income for country i in year t, defined as:

$$y^f_{i,t}=\sum_{j\neq i}\varpi(\rho)^{i,j}_t y_{j,t}\ , \quad (26)$$

where the bilateral weights $\varpi(\rho)^{i,j}_t$ are *identical* to the weights used in the

definition of foreign democratic capital (i.e., they decline geometrically in geographic distance).

Another possible concern is that during years of political transitions, the probability of a coup is high at the same time as growth suffers because of disruptions or political violence. It is not obvious why this should be a serious concern: by construction, our *estimated* hazard rates are just functions of the same variables as those in our growth regressions plus the two excluded components of democratic capital. Nevertheless, to ensure that our estimates are not driven by transition years, we also include in $\mathbf{x}_{i,t}$ an indicator for transition years (the year of entry in autocracy or democracy, as well as the preceding year).

Finally, in the 1990s many socialist regimes in Central and Eastern Europe did not only undergo political transformations, but also a deep change of their economic systems which also affected their growth process. To avoid confounding these economic and political transitions, we include in $\mathbf{x}_{i,t}$ a dummy variable equal to unity after 1989 in the former socialist countries of Central and Eastern Europe, and in the Asian provinces of the former Soviet Union (only in the regressions under autocracy, as the dummy is collinear with other regressors under democracy).

7.1.2 Results

Columns 1 and 2 in Table 4 display estimates from the parsimonious specification of (25), omitting fixed effects as well as control vector $\mathbf{x}_{i,t}$, in the sample of democracies and autocracies respectively. Throughout we report Huber-White robust standard errors adjusted for possible heteroskedasticity, but do not adjust the standard errors for the fact that $\widehat{p}^{a}_{i,t}$ is a generated regressor.[11]

The coefficient of interest, γ^a, is negative under democracy but positive under autocracy, and both estimates are statistically significant. Thus, a higher probability of autocracy is harmful for growth under democracy, but increases growth under autocracy. The first finding is consistent with the theory, Prediction 2(c), under the maintained assumption that the fraction λ of countries benefiting from democracy is large enough. The finding that $\widehat{p}^{a}_{i,t}$ has a larger (algebraic) effect in autocracy than in democracy is also consistent with the theory, Prediction 2(b), and can be interpreted as due

[11] Under the null hypothesis that $\gamma^a = 0$, the standard errors are still correctly estimated and thus, the t-statistics are still valid tests of the null.

to endogenous sorting. Both findings reinforce the inference discussed in the previous section, on the effects of income on the probability of regime transition. The theory has no unambiguous prediction on the sign of γ^a under autocracy. But a positive estimated coefficient suggests that productivity gains from autocracy, for the countries that are more frequently in autocracy, are about as high as the productivity gains from democracy, for the countries that are more frequently in that regime.[12]

The remaining columns show how these basic results survive a more general specification, with fixed effects and the full set of control variables. Column 3 in Table 4 refers to democracies. The coefficient on the probability of autocracy is highly significant with a negative sign, as expected. Also as expected, lagged income now has a negative and statistically significant coefficient, indicating income convergence of about 4% per year. The estimated coefficient on domestic democratic capital is positive but not statistically significant, and the results are unaffected if this variable is omitted. Finally, the estimated coefficients on transition years and foreign income (not shown) are respectively positive and negative, although only the latter is statistically significant.

The estimated coefficient on the probability of a transition out of democracy is about -12. This looks large: if the probability of a transition to autocracy were to jump from 0 to 1, the impact on growth would be a fall by 12 percentage points. As discussed in connection with Figure 5, however, the range of variation of the estimated hazard rates within regimes is small. Let us consider the experiments discussed in Section 4. Suppose domestic democratic capital were to increase from its minimum of 0 to its maximum of 1, cutting the hazard rate out of democracy by about 2 percentage points. Given the point estimates in column 3, this would raise yearly growth by 0.25 percentage points, and – with a convergence rate of 0.04 – long-run income by over 6 percent. An increase in foreign democratic capital by 0.4 units, the difference in Europe between the 1970s and the present time (cf. Figure 2), would also cut the hazard rate out of democracy by just below 2 percentage

[12] Przeworski et al (2000) also find that the probability of remaining under autocracy increases growth in the countries currently under autocracy. Again, without an estimate for the covariance we cannot formally test equality of the coefficients of the probability of autocracy in columns 1 and 2. But once more, the 99% confidence intervals do not overlap, so that we would reject of equality unless the covariance was negative and large in absolute value.

points and have a similar effect on long-run income.[13]

As already discussed, identification hinges on the exclusion restriction that foreign democratic capital has no direct effect on growth. In column 4, we gauge the validity of this assumption by adding foreign democratic capital linearly, something we can do because democratic capital enters the predicted hazard rate in a highly non-linear fashion (i.e., the identification relies on functional form). While the coefficients on the hazard rate and the other variables are basically unaltered, the two components of democratic capital are neither individually nor jointly significant (cf. the F-statistic in column 2).

These results are robust. They hold for a wide range of estimates for the value of δ in our definition of democratic capital (for δ between 0.94 and 0.99), and if we add non-parametric time trends by continents (interactions between year and continent indicators) to allow for omitted variables influencing the time profile of growth in different ways across groups of countries.

Columns 5 and 6 of the table show corresponding estimates for autocracies. Here, the fit is generally worse (the adjusted R-square drops considerably), but the basic result from column 2 is robust. The probability of autocracy has a larger (algebraic) effect on growth than in the sample of democracies, as predicted under endogenous sorting, and the effect is actually positive and marginally significant.[14] These estimates are less precise and less robust than those under democracy, and the estimated coefficient on the probability of autocracy becomes statistically insignificant (though still positive) if we include interactions between year indicators and continent indicators.

Using the alternative definition of democracy by Boix and Rosato yields similar results.[15] The probability of autocracy has a negative effect on growth under democracy, and a positive effect under autocracy. The effect in democracies is again more precisely estimated (and statistically significant) than that within autocracies.

[13] These computations hold the current political regime constant, and thus neglect the fact that changing democratic capital would have additional economic effects through actual (as opposed to only expected) regime changes.

[14] Once more, the 99% confidence intervals of the estimated effects of the probability of autocracy on growth, under democracy vs autocracy, do not overlap.

[15] Here, we use the hazard rates estimated in columns 5 and 6 of Table 2.

7.2 Across regimes – reduced form

We now consider the full sample, pooling together observations under democracy and autocracy. We refrain from estimating the structural form across political regimes, because regime transitions are endogenous and we don't have reliable instruments for the current regime. Moreover, since transitions are rare, the estimated probability of autocracy is highly collinear with the actual political regime, which makes it difficult to disentangle the effects of actual vs. expected political transitions.

Instead we test Prediction 3 about the reduced form. (a) *The relative effect of democratic capital on growth in democracies and autocracies.* Sorting implies that democratic capital (domestic or foreign) has a larger effect on growth for countries that in the previous period were under democracy, compared to those that were under autocracy. (b) *The absolute effect of democratic capital on growth.* Higher democratic capital raises economic growth in democracy (or even under autocracy) if democracy stimulates development in a sufficiently large number of countries. Indeed, these effects should be stronger the higher is the share of countries where democracy brings about economic gains (parameter λ in the model).

7.2.1 Econometric specification

The econometric specification is similar to that of the previous subsection. But here we replace the estimated probability of autocracy in (25), $\hat{p}^a_{i,t}$, with both components of (domestic and foreign) of democratic capital. Moreover, we estimate over the full sample rather than separately across regimes. To check whether democratic capital has differential growth effects depending on the previous period political regime, we interact it with lagged democracy, possibly also including the lagged democracy indicator on its own, $(1-a_{t-1})$, to avoid identifying differential effects of democratic capital from an exclusion restriction. The specification of the vector of control variables $\mathbf{x}_{i,t}$ is otherwise the same as in the previous subsection.

We report specifications with and without dummy variables for transition years. On the one hand, such dummies are a virtue: transition years are typically associated with unusual volatility and uncertainty, so including them decreases the risk of confounding effects. On the other hand, they are a vice: we identify the parameters of interest from country-specific time variation which is maximized around the transition, so including transition

years removes useful variation in democratic capital around regime changes.

7.2.2 Results

Results are reported in Table 5. We start out with a specification including country and year fixed effects and the relevant covariates. Columns 1 and 2 report the simplest reduced form (with and without transition years), constraining the coefficients of democratic capital to be the same under lagged democracy and lagged autocracy. Domestic democratic capital has a positive and significant estimated coefficient, as would be expected, by Prediction 3(b), if there are enough countries for which democracy is productive. Foreign democratic capital, on the other hand, has a negative estimated coefficient not significantly different from zero.

Columns 3 and 4 allow the coefficients of democratic capital to differ by lagged political regime, with and without controls for transition years. Consistent with the earlier results and the presence of sorting, Prediction 3(a), a positive effect of democratic capital is only present among democracies in the past year. The domestic component of democratic capital has a larger or more precisely estimated coefficient than the foreign one.

Finally, columns 5 and 6 add the lagged democracy indicator on its own. This is more demanding on the data, because of collinearity (the correlation between lagged democracy and domestic democratic capital is close to 0.8). Nevertheless, the results in previous columns hold up pretty well, particularly when the transition-year dummy is excluded. Again, these findings support the hypothesis that becoming a democracy on average leads to an improvement in growth, and that countries sort themselves into political regimes by the relative productivity of democracy.

The point estimates imply powerful effects of domestic democratic capital on growth and long-run income in democracy. Suppose we reconsider the experiments discussed in Sections 5 and 6.1 above. Given the estimated convergence rates and coefficients of domestic democratic capital in columns 3 to 5, a switch from 0 to 1, from minimum to maximum domestic democratic capital, would raise long-run income in a democracy by more than 75%.[16] Note that here, unlike in Section 5, unobserved heterogeneity is not an issue, since we include fixed country effects.

[16] These computations neglect the additional long run effects of democratic capital on actual regime changes, operating through the lagged democracy variable.

These results are robust to measuring democratic capital with higher values of the depreciation rate $(1-\delta)$, or to the inclusion of non-parametric continental growth trends. Overall, the findings confirm that the positive effect of democratic capital within democracies is reasonably robust and quantitatively relevant. It is a third piece of evidence that, on average, democracy is better for growth than autocracy.

8 Conclusions

What determines the consolidation of democracy? We have highlighted the role of *democratic capital*. Being surrounded by well-functioning democracies and having a long tradition of democratic rule are major determinants of democratic stability. Moreover, the risk of exit from democracy goes down with the level of economic development, while development does not seem to influence the probability of abandoning autocracy.

Does democracy influence the path of economic development? Our results suggest that the *expectations* of future political regimes play an important role. The risk of exit from democracy hurts economic growth. Moreover, through its effect on the consolidation of democracy, democratic capital has a robust positive effect on growth. Altogether, these findings suggest that being a long-lived consolidated democracy is important for economic development.

Thus, our results indeed point to a virtuous circle, as mentioned in the introduction. Having long-time democratic experience favors economic development through physical capital acumulation, which helps further consolidate democracy. This, in turn, leads to the accumulation of more democratic capital, with additional positive effects on income and democratic stability.

These results help explain the triangular pattern in Figure 1, where experience with democracy appears to be a sufficient condition for economic development. We can think about the countries in the right part of the graph, with high incomes and long democratic experience, as the result of positive feedback effects between physical and democratic capital accumulation in the virtuous circle suggested by our theory and empirical results. Getting into such a virtuous circle is difficult, however, because democratic stability is hard to achieve instantaneously.

The evidence also points to systematic asymmetries between autocracies and democracies. First, higher income makes democracies more stable, but does not make dictators more precarious. Second, while the probability of

switching from democracy to autocracy hurts growth, the probability of remaining under autocracy has no effect on growth, or – if anything – a positive effect. Third, the positive influence of democratic capital on growth is due to democracies, not to autocracies. As explained by the theoretical model, these asymmetries are consistent with democracy having heterogeneous effects on productivity in different countries, and are implied by endogenous sorting of countries into political regimes on the basis of economic expediency.

Heterogeneous effects of democracy across countries also help account for another aspect of Figure 1, namely why long democratic experience, although sufficient, is not a necessary condition for economic development. Such heterogeneity is consistent with the occurrence of highly successful autocracies, like Singapore, that have never experienced democratic forms of government. In particular, the pattern in the leftmost part of the graph, where countries with little or no democratic experience are found at all income levels, squares well with the empirical result that high income does not promote transition from autocracy to democracy.

As always, inferences are conditional on identifying assumptions. An important caveat concerns the effects of the domestic component of democratic capital on regime transitions. This component measures the time spent under democracy in the (possibly distant) past. In attributing a full causal effect to domestic democratic capital, we must assume that no unobserved variables make some democracies more stable than others. Given the role of unobserved heterogeneity and sorting in our model, we are likely to over-estimate the true causal effect of domestic democratic capital in the consolidation of democracy. In our estimated hazard rates, this variable is likely to capture a mix of unobserved heterogeneity and state dependence. Note that (time-invariant) unobserved heterogeneity is not an issue in the growth regressions, however, where we identify the effects from country-specific time variation in the data.

The second important identifying assumption is that the foreign component of democratic capital does not directly affect economic growth, conditional on covariates in the regression. This is credible, since our estimates only exploit within country variation and foreign income is one of the included regressors.

Our findings suggest avenues for future research. One is to understand more deeply the sources of heterogeneity in the economic gains from democracy. Such a task is easier for democratic regimes, where we can exploit a large literature in comparative politics on a variety of democratic institu-

tions, such as the electoral rule (majoritarian vs. proportional), the form of government (presidential vs. parliamentary), and the degree of centralization (federal vs. unitary). These institutions may entail different degrees of political participation. If democratic capital accumulates through active participation, its accumulation and depreciation rates may systematically differ across forms of democracy. But the empirical findings suggest that understanding the differences between various types of autocracies may be even more important.[17] Persson and Tabellini (2007) take one step towards addressing this problem, by focusing explicitly on heterogeneous effects of regime transitions, combining a difference-in-difference approach with semi-parametric methods based on the propensity score.

A related avenue for future research is to sharpen the notion of democratic capital. Can we better understand just which values and norms are essential and how these relate to cultural and social attitudes of the population at large? How important is education in the accumulation of these values and norms? Does democratic consolidation require a rising middle class with democratic values? Just how essential are independent media in mobilizing support for democracy? Telling these forces apart and pinpointing their roles in democratic capital accumulation is an important priority for further work.

[17] See here the analysis by Acemoglu and Robinson (2005) and the references they cite.

9 Appendix

Proof of Lemma 3 Applying the implicit function theorem to (8) and (13), we have:

$$\begin{aligned} \tilde{P}_d &= \frac{P_d}{\Delta} \qquad \tilde{K}_d = \frac{P_d}{\Delta}\frac{\theta}{V_{cc}} \\ \tilde{P}_w &= \frac{P_k}{\Delta} \qquad \tilde{K}_w = \frac{1}{\Delta} \ , \end{aligned}$$

where

$$\Delta = 1 - P_k \ K_p \ .$$

If $|P_k| \ |K_p| < 1$, $\Delta > 0$. By Lemmata 1 and 2, parts (i) and (ii) of Lemma 4 follow. To prove part (iii), repeat the above procedure to get:

$$\tilde{P}_\theta = -\frac{1}{\Delta}\left\{\frac{(1-p_t^*)P_k}{V_{cc}} + \frac{\chi k_t^* E_{t-1}\phi(b_t/2-\mu_t)}{2}\right\} \ , \tag{27}$$

where the derivation of (8) imply:

$$P_k = -\chi\theta E_{t-1}\phi(b_t/2-\mu_t)/2 \ . \tag{28}$$

Inserting (27) in (28), we obtain:

$$\tilde{P}_\theta = \frac{\chi}{2\Delta}E_{t-1}\phi(b_t/2-\mu_t)/2\left\{\frac{(1-p_t^*)\theta}{V_{cc}} - k_t^*\right\} \ .$$

Thus, $\tilde{P}_\theta < 0$ if $\Delta > 0$ and $\theta > \hat{\theta}_t \equiv \frac{k_t^* V_{cc}}{1-p_t^*}$, where $\hat{\theta}_t < 0$. Finally, part (iv) follows directly from (9). QED

Variable definitions and data sources The following is a list of the variables we use and their sources:

Africa: Regional dummy variable, equal to 1 if a country is in Africa, 0 otherwise.

Asia_middle east: Regional dummy variable, equal to 1 if a country is in the Middle East, 0 otherwise.

Current domestic democratic capital: Domestic democratic capital accumulated during the current democratic spell. It equals 0 over autocratic spells. Over democratic spells, the variable is equal to the difference between

the value of *Domestic democratic capital* in the current year and its value at the end of the previous spell. Source: authors' calculations on Polity IV Project.

Democracy: Binary variable that captures the state of democracy of country i in year t. This measure is defined in two ways. In columns 1 to 4 of Table 2 and in Tables 3 and 6, *Democracy* is equal to 1 if the variable *polity*2 in the Polity IV data set is strictly positive, and zero if *polity*2 is 0 or negative. In columns 5 and 6 of Table 2, the *Democracy* index is defined as in Boix and Rosato's (2001) extension of the index constructed by Przeworski et al (2000). This definition emphasizes the turnover of political power in fair and free elections, and is available from 1800 until 1994. Sources: Boix and Rosato (2001); Polity IV Project.

Domestic democratic capital: Defined by expression (22) in the text, which ranges from 0 to 1. We calculated it for different values of the depreciation rate $(1-\delta)$. For each country, the initial value (at the year of independence or at the year 1800, whichever comes last) of domestic democratic capital is assumed to be zero. Domestic democratic capital then accumulates in years of democracy and depreciates geometrically, at a rate $(1-\delta)$, in years of autocracy. Source: authors' calculations on Polity IV Project.

Duration of current autocratic spell: defined as the difference between the current year and the starting year of the current spell. Source: authors' calculations on Polity IV Project.

Duration of current democratic spell: defined as the difference between the current year and the starting year of the current spell. Source: authors' calculations on Polity IV Project.

Esp_colony: Dummy variable equal to 1 if a country is a former Spanish colony, 0 otherwise. Source: Wacziarg (1996).

Foreign Democratic Capital: Defined by expression (23) in the text, divided by 10, such that its value ranges from 0 to 1. It is the weighted average of the continuous variable Polity2 in neighboring countries, taken from the Polity IV data set (see *Democracy*). The weights correspond to the distance between capitals. The index depends on the value of ρ, which identifies the boundaries of what is considered neighborhood. In the regressions showed in the text $\rho = 1$, i.e., all countries in the world are included in the neighborhood. Sources: authors' calculations on Polity IV Project.

Foreign income: Defined by expression (**??**) in the text. It is a weighted average of the log of real per capita output in the neighboring countries, with

weights equal to the distance between capitals. Source: Maddison (2001)

Government Anti Diversion Policies: Index of government's anti-diversion policies, measured over the period 1986-95. It is an equal-weighted average of these five categories: i) law and order, ii) bureaucratic quality, iii) corruption, iv) risk of expropriation and v) government repudiation of contracts (each of these items has higher values for governments with more effective policies towards supporting production) and ranges from 0 to 1. Source: Hall and Jones (1999).

Human capital: Years of schooling of the population above 25 years of age. Annual measure constructed in Persson (2005) by interpolating the five-year observations from Barro and Lee. Sources: Persson, 2005; Barro and Lee, 2000

Initial constraints on the executive: Constraints in the executive in the year of independence (source: Polity IV)

*Initial democracy score: Polity*2 score in the year of independence, when democracy is defined as $polity2 > 0$ (source: Polity IV). Dummy variable equal to 1 if a democracy in the year of independence, when democracy is defined as in Boix and Rosato (2001).

More than five regime switches: Dummy variable equal to 1 for countries that had more than five regime switches between autocracy and democracy, or vice versa since independence.

Past domestic democratic capital: Democratic capital accumulated over previous spells. For autocratic spells, the index is equal to the corresponding value of *Domestic democratic capital.*. For democratic spells, the index is equal to the value of *Domestic democratic capital* at the end of the previous spell, depreciating at a rate $(1 - \delta)$ over the current spell. Source: authors' calculations on Polity IV Project.

Per capita income: log of per real capita output adjusted for purchasing power parity. Source: Maddison (2001).

Period: linear time trend

Period Squared: quadratic time trend

Socialist legal origin: Dummy variable equal to 1 if a country's legal system has socialist origin, 0 otherwise. Source: La Porta et al. (1999)

Socialist transition: Dummy variable equal to 1 after 1989 for former socialist countries in Central and Eastern Europe and the Asian provinces of the former Soviet Union

Thinks democracy is best: Index of individuals' opinions on democracy, defined as the country average of the opinions on the statement "Democracy

may have problems but it's better than any other form of government", as expressed in the World Values Survey (WWS) data set on a 4 point scale, from 1=strongly agree to 4=strongly disagree (question v163 in wave 3 and 4 of the survey). Missing and don't know answers were dropped and the average normalized, so that its value ranges from 0 to 1. Most observations are from the fourth wave of the WWS, in 1999-2000. For a few countries, data refer to the third wave, in 1995. Source: World Values Survey dataset (http://www.worldvaluessurvey.org/services/index.html)

UK_colony: Dummy variable equal to 1 if a country is a former British colony, 0 otherwise. Source: Wacziarg (1996).

War Dummy variable equal to 1 if a country is at war over a certain year, 0 otherwise. A war is defined as any kind of war (internal or external). Source: Correlates of War: http://www.correlatesofwar.org/

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Table 1 Democratic capital and perceptions of democracy and protection of property rights

	(1) Thinks democracy is best system	(2) Thinks democracy is best system	(3) Thinks democracy is best system	(4) Thinks democracy is best system	(5) Thinks democracy is best system	(6) Perception of government anti diversion policies	(7) Perception of government anti diversion policies
Domestic democratic capital	29.14***	42.93**	43.52***	46.22***	46.08***	4.35	2.79
	(10.93)	(16.10)	(11.58)	(15.51)	(13.98)	(5.44)	(5.22)
Foreign democratic capital	263.57**	345.63**	288.26	321.40**	396.89***	-61.76*	-49.29
	(114.77)	(136.94)	(110.58)**	(131.83)	(128.84)	(32.93)	(32.18)
Per capita income		-6.23		-2.29	-1.14	11.82***	9.36***
		(4.92)		(5.01)	(5.82)	(1.05)	(1.59)
Democracy			-20.92***	-19.90**	-3.50	-0.07	-0.12
			(7.77)	(8.34)	(9.42)	(2.30)	(2.50)
Human capital					-19.87**		7.22**
					(7.93)		(2.96)
Number of observations	62	59	61	59	46	113	90
Adj. R-squared	0.17	0.17	0.26	0.23	0.33	0.69	0.74

Notes: Variables explained in text. All specifications estimated by Ordinary Least Squares. Standard errors in brackets: * significant at 10%; ** significant at 5%; *** significant at 1%. All variables measured in 1999, except perception of government anti diversion policies, which is measured in 1997.

Table 2 Probability of autocracy

	(1) From democracy	(2) From autocracy	(3) From democracy	(4) From autocracy	(5) From democracy	(6) From autocracy
Domestic democratic capital	-0.486***	-0.829***	-0.856**	-1.058***	-0.829***	-0.443*
	(0.187)	(0.175)	(0.371)	(0.387)	(0.265)	(0.268)
Foreign democratic capital	-1.104**	-1.921***	-2.359***	-1.836***	-3.289***	-2.216***
	(0.473)	(0.371)	(0.702)	(0.384)	(0.827)	(0.433)
Lagged per capita income	-0.499***	-0.054	-0.412***	0.004	-0.362***	-0.006
	(0.066)	(0.052)	(0.073)	(0.062)	(0.078)	(0.066)
δ, ρ	0.94, 1	0.94, 1	0.99, 1	0.99, 1	0.97, 1	0.97, 1
Covariates	No	No	Yes	Yes	Yes	Yes
Def. of democracy	Polity4	Polity4	Polity4	Polity4	Boix-Rosato	Boix-Rosato
Method	ML Probit	ML Probit	ML Probit	ML Probit	ML Probit	ML Probit
LR-test (p-value)	0.00	0.11	0.37	0.14	1.00	0.44
Number of observations	3848	4420	3786	4349	3969	4115
Pseudo R-square	0.142	0.043	0.225	0.096	0.231	0.119

Notes: Variables explained in text. Robust standard errors in brackets: * denotes significant at 10%; ** significant at 5%; *** significant at 1%. Covariates are indicators for wartime (current year and lagged year), socialist legal origin, British colonial origin, Spanish colonial origin, African location, Middle-Eastern location; in cols 3-4 , scores of democracy and constraints on the executive (both from Polity IV) in first year of independence, in cols 5-6, indicator for democracy (by Boix and Rosato) in first year of independence. LR-test: random-effects panel specification (estimated by panel logit) against null of pooled specification (also estimated by logit) – a high p-value means we cannot reject that unobserved heterogeneity is absent.

Table 3 Probability of autocracy – auxiliary results

	(1) From democracy	(2) From autocracy	(3) From democracy	(4) From autocracy
Domestic democratic capital		-1.105**	- 0.549*	-1.091***
		(0.467)	(0.303)	(0.272)
Foreign democratic capital	- 2.319***	-2.069***	- 1.808**	-2.137***
	(0.700)	(0.455)	(0.750)	(0.492)
Lagged per capita income	- 0.414***	-0.004	- 0.343***	0.087
	(0.074)	(0.068)	(0.112)	(0.086)
Human capital			- 0.495*	-0.338*
			(0.261)	(0.187)
Current democratic capital	-0.983**			
	(0.400)			
Past democratic capital	-0.539			
	(0.573)			
Duration of current spell		0.000		
		(0.001)		
$\delta,\ \rho$	0.99, 1	0.99, 1	0.94, 1	0.94, 1
Covariates	Yes	Yes	No	No
Definition of democracy	Polity	Polity	Polity	Polity
Method	ML Probit	ML Probit	ML Probit	ML Probit
LR-test (p-value)	1.00	0.00	0.24	0.05
Number of observations	3786	4329	1947	1924
Pseudo R-square	0.23	0.12	0.22	0.06

Notes: Variables explained in text. Robust standard errors in brackets: * denotes significant at 10%; ** significant at 5%; *** significant at 1%. Covariates are indicators for wartime (current and lagged year), socialist legal origin, British colonial origin, Spanish colonial origin, African location, Middle-Eastern location, a linear and a quadratic time trend, an indicator for countries that switched regime more than 5 times, polity2 scores of democracy and constraints on the executive in first year of independence. LR-test: random-effects panel specification (estimated by logit) against the null of pooled specification (also estimated by logit) – a high p-value means we cannot reject that unobserved heterogeneity is absent.

Table 4 Growth within political regimes – structural estimates

	(1) Growth in democracies	(2) Growth in autocracies	(3) Growth in democracies	(4) Growth in democracies	(5) Growth in autocracies	(6) Growth in autocracies
Probability of autocracy	- 6.76***	12.56**	- 12.23***	- 12.31***	26.51*	26.94*
	(2.36)	(4.98)	(4.55)	(4.55)	(15.52)	(15.77)
Lagged income per capita	- 0.02	- 0.12	- 4.35***	- 4.41***	- 2.82***	- 2.70***
	(0.11)	(0.17)	(0.62)	(0.62)	(0.55)	(0.57)
Domestic democratic capital			1.70	1.75	0.27	0.16
			(1.62)	(1.62)	(3.65)	(3.64)
Foreign democratic capital				- 4.46		7.92
				(3.83)		(8.45)
Transition years			- 0.82*	- 0.80*	- 1.74***	- 1.59***
			(0.48)	(0.48)	(0.52)	(0.52)
Country and year fixed effects	No	No	Yes	Yes	Yes	Yes
Covariates	No	No	Yes	Yes	Yes	Yes
F-statistic				1.15		0.44
Number of observations	3774	4296	3774	3774	4296	4296
(countries)	(111)	(117)	(111)	(111)	(117)	(117)
Adj. R-squared	0.002	0.003	0.20	0.20	0.12	0.12

Notes: Variables explained in text. Robust standard errors in brackets: * denotes significant at 10%; ** significant at 5%; *** significant at 1%. Democracy defined according to Polity IV. Probability of autocracy for past democracies and autocracies computed from estimates in columns 3 and 4 of Table 2, respectively. Country and year fixed effects included as indicated. Non-displayed covariates are indicators for war years, lagged war years and a measure of foreign income. Columns 5 and 6 also include a dummy variable for years after 1989 in former socialist countries in Central and Eastern Europe and in the Asian provinces in the former Soviet Union. F-statistic is the test statistic for the joint significance of the latter two variables.

Table 5 Growth across political regimes – reduced-form estimates

	(1) Growth	(2) Growth	(3) Growth	(4) Growth	(5) Growth	(6) Growth
Domestic democratic capital	3.34***	2.95***	- 0.24	-0.21	- 0.64	- 0.22
	(1.08)	(1.07)	(1.63)	(1.63)	(1.82)	(1.81)
Foreign democratic capital	- 2.93	- 2.79	- 2.22	- 1.92	- 2.58	- 1.93
	(3.36)	(3.36)	(3.55)	(3.54)	(3.60)	(3.60)
Domestic democratic capital in (lagged) democracy			2.68**	2.40*	3.16**	2.40
			(1.24)	(1.23)	(1.51)	(1.50)
Foreign democratic capital in (lagged) democracy			2.61*	1.84	2.53*	1.84
			(1.39)	(1.31)	(1.43)	(1.43)
Lagged democracy					-0.16	-0.00
					(0.29)	(0.30)
Lagged income per capita	- 2.78***	- 2.81***	- 2.89***	- 2.90***	- 2.89***	- 2.90***
	(0.36)	(0.36)	(0.37)	(0.37)	(0.37)	(0.37)
Transition years		-1.64***		- 1.47***		-1.47***
		(0.37)		(0.35)		(0.35)
Number of observations (countries)	8379	8379	8127	8127	8127	8127
	(149)	(149)	(149)	(149)	(149)	(149)
Adj. R-squared	0.14	0.14	0.14	0.14	0.14	0.14

Notes: Variables explained in text. Robust standard errors in brackets: * denotes significant at 10%; ** significant at 5%; *** significant at 1%. Democracy defined according to Polity IV. Democratic capital variables computed with $\delta = 0.99$ and $\rho = 1.0$, in consistency with the estimates in columns 3 and 4 of Table 2. All specifications include country and year fixed effects, indicators for war years and lagged war years, and an indicator for formerly socialist countries in Central and Eastern Europe and the Asian provinces of the former Soviet Union after 1989.

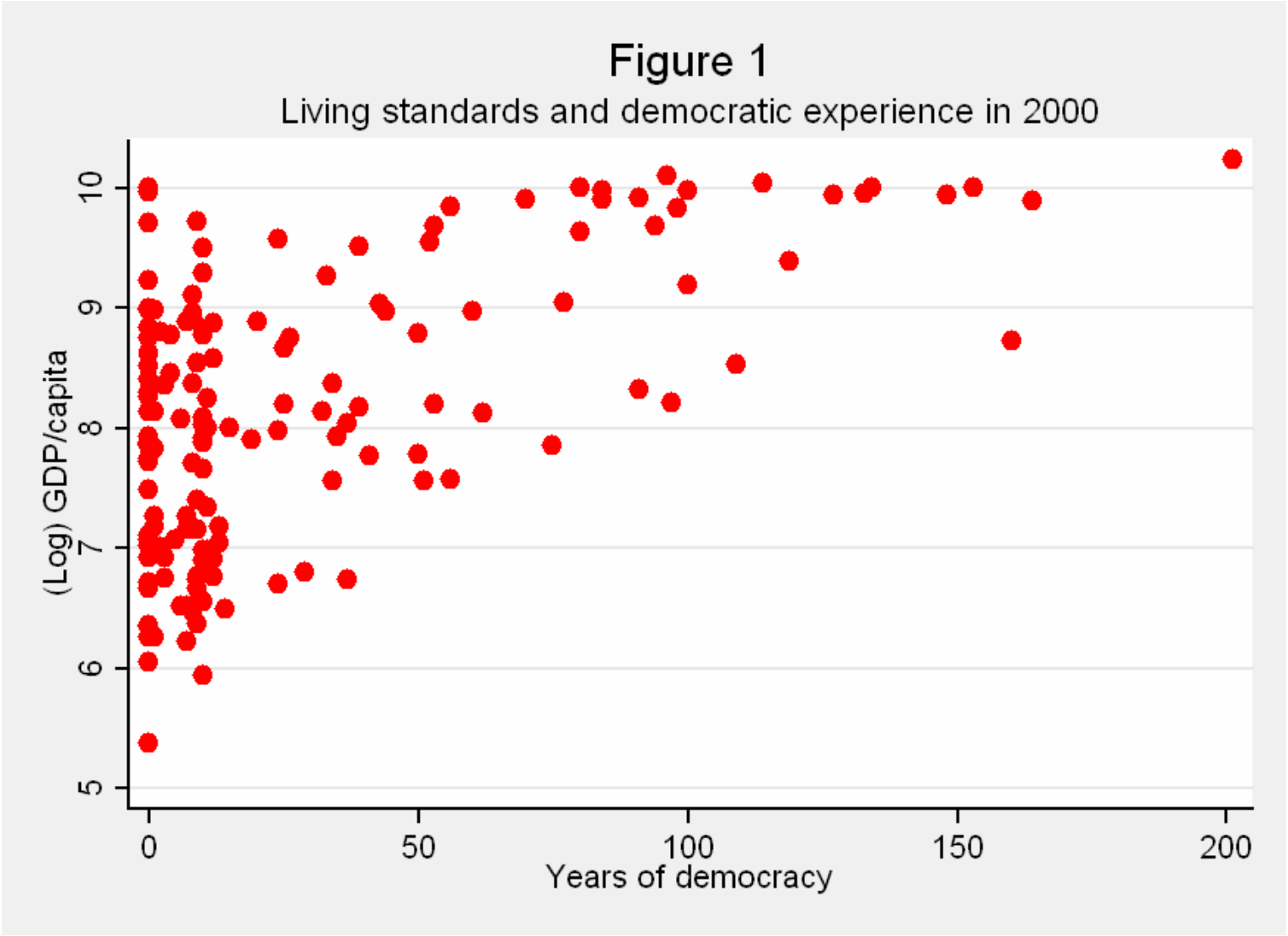
Figure 1
Living standards and democratic experience in 2000
(Log) GDP/capita
5
6
7
8
9
10
0
50
100
150
200
Years of democracy

Figure 2 Domestic democratic capital in two countries

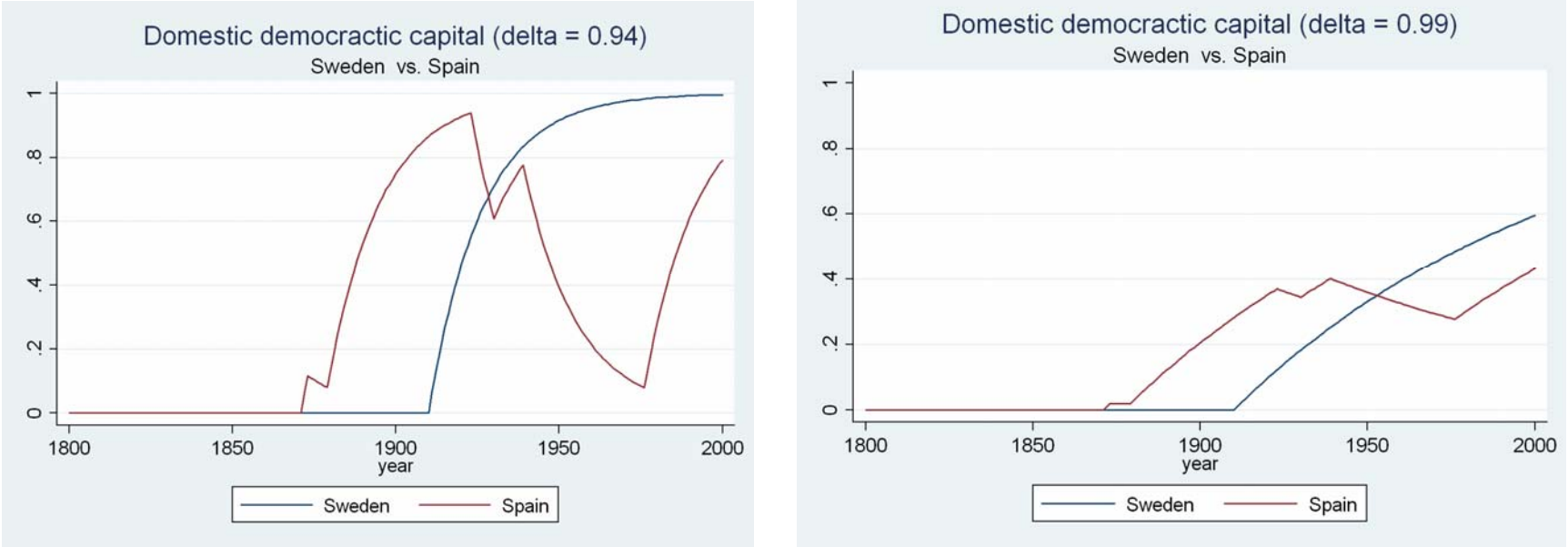

Figure 3 Foreign democratic capital in two countries

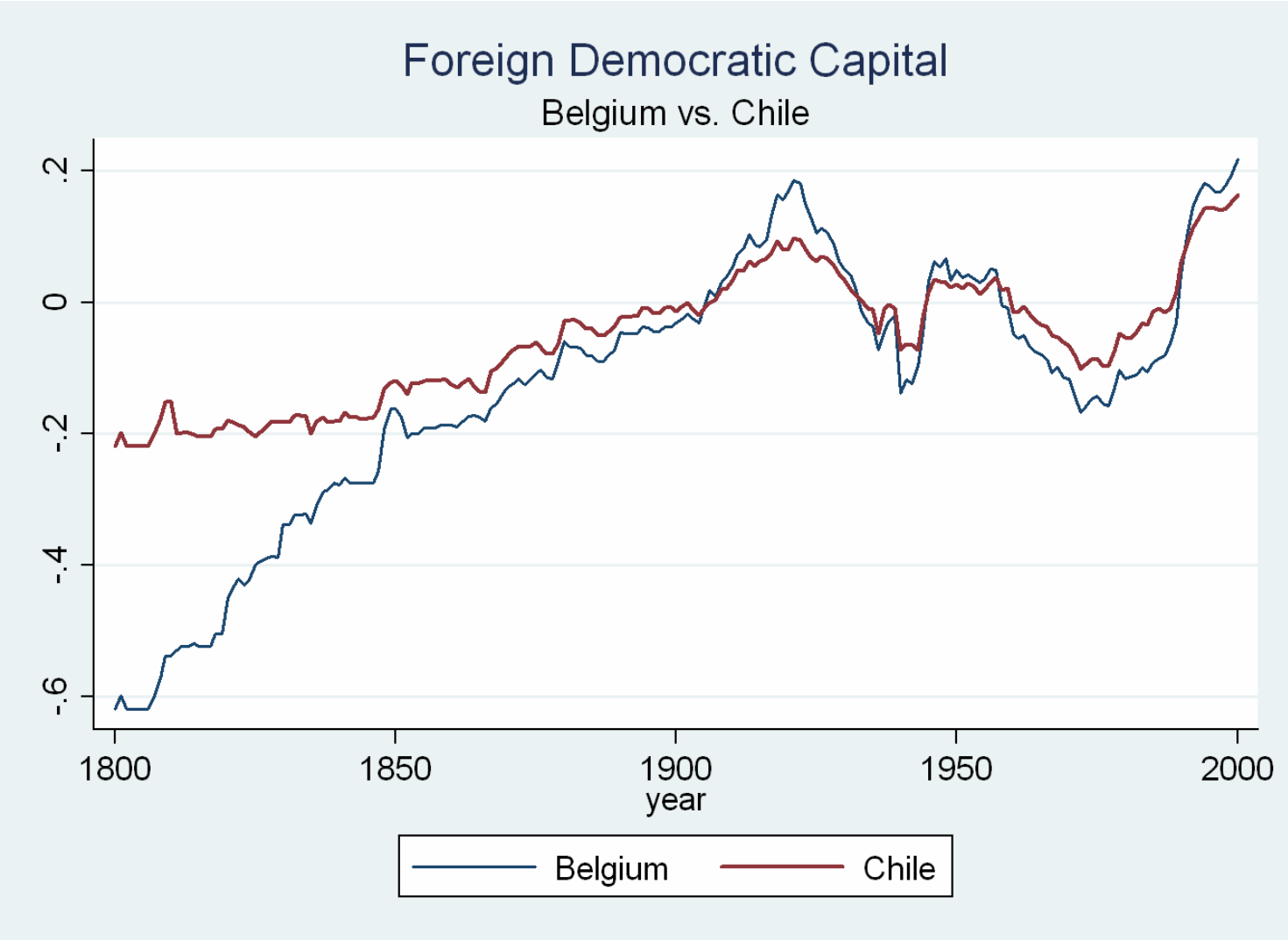

Figure 4 Democratic capital and opinions on democracy

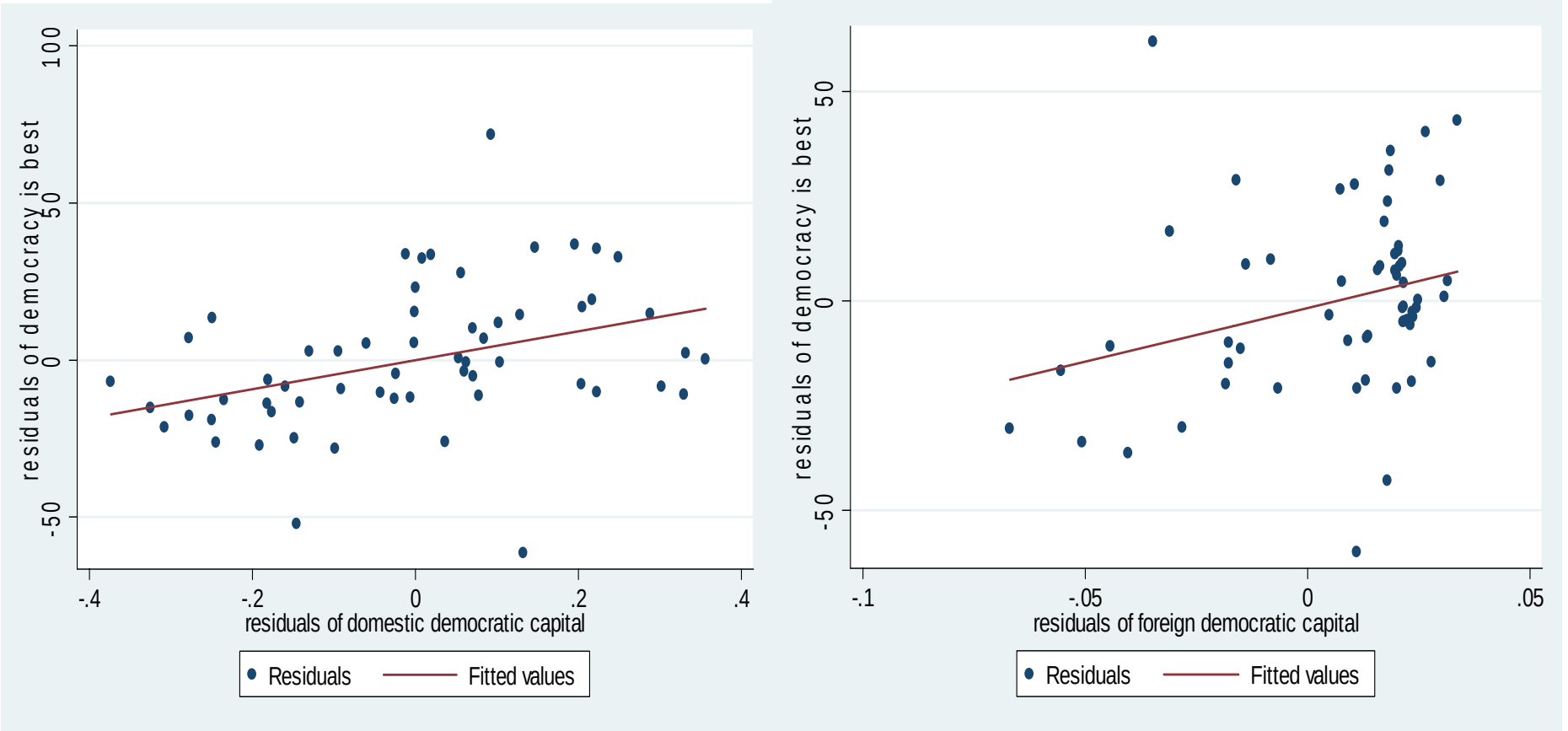

Figure 5 Predicted hazard rates out of political regimes