Democracy, Diversification, and Growth Reversals

Cuberes, David and Jerzmanowski, Michal

Clemson University

October 2008

Democracy, Diversification, and Growth Reversals

David Cuberes
Department of Economics
Clemson University

Michal Jerzmanowski*
Department of Economics
Clemson University

October 2008

Economic Journal, forthcoming

Abstract

There is much evidence that less democratic countries experience more high-frequency growth volatility. In this paper we report a similar finding about volatility in the medium term: we find evidence that reversals of trend-growth are sharper and more frequent in non-democracies. Motivated by this evidence, we construct a model in which non-democracies have high barriers of entry for new firms. This leads to less sectoral diversification and so, in an uncertain environment, to larger growth swings in less democratic countries. We present empirical evidence that confirms the positive relation between democracy and industrial diversification.

*Contact: mjerzma@clemson.edu. We thank Scott Baier, Robert Barro, Bentley Coffey, Bill Dougan, David Gordon, Benjamin Olken, Todd Schoellman, Andrew Scott, Robert Tamura, Kevin Tsui, two anonymous referees, and seminar participants at Clemson University, Syracuse University, University at Buffalo, University of Pittsburgh, the 2006 NEUDC Conference at Cornell University, the 2008 SNDE Meetings in San Francisco, and University of Warwick for useful comments. Bill West provided helpful research assistance. Financial support from the Clemson University 2006 CBBS Summer Research Grant is gratefully acknowledged. All remaining errors are ours.

Economists have always been interested in the relation between long-run economic outcomes and democracy. Evidence of democracy's direct impact on growth is mixed (Persson and Tabellini, 2006), but there exists strong evidence that democratic countries are less volatile (Rodrik, 2000). The existing literature usually measures volatility of per-capita GDP growth as the standard deviation of annual growth rates. However, recently researchers have begun paying more attention to large shifts in trend-growth (Pritchett, 2000; Hausmann et al., 2005; Jerzmanowski, 2006a; Jones and Olken, 2008). This new literature focuses on medium-term changes in growth. For example, Hausmann et al. (2005) find many episodes of growth accelerations during 1950-2000, even in countries that have under-performed during this period in terms of average growth. Of course, low average long- term growth coupled with periods of fast growth implies that there must also be offsetting periods of stagnation or even negative growth. While this research is not directly motivated by standard growth-volatility questions, it suggests that much of the volatility of the growth process, especially for developing countries, comes from medium-term changes in the trend rather than from high frequency shocks; i.e., there is a lot of "trend volatility."[1]

In this paper, we ask whether trend-volatility is lower in more democratic countries. That is, unlike the existing literature on volatility and democracy, we do not measure volatility as the standard deviation of annual growth rates, which confounds business-cycle fluctuations, crises, and changes in the trend. Instead, we identify and study patterns in changes to only the trend (growth accelerations and slowdowns) and ask whether these patterns depend on the level of democracy.[2]

We start by identifying and documenting structural breaks in the growth process using two alternative statistical approaches. Next we analyze the patterns in trend-growth changes. In particular, we estimate: (i) how the magnitude of trend-growth changes varies with the degree of the country's democracy, and (ii) whether democracy affects the likelihood of experiencing large trend-growth swings.

We find evidence of frequent medium-term reversals of growth; that is, periods of exceptionally high growth are, on average, followed by periods of exceptionally low growth, and vice versa. This is a different phenomenon from regression to the mean, whereby very high growth is followed by slower growth and very low growth is followed by faster growth as the process converges to some long-run equilibrium growth rate. What we observe is that

[1]Aguiar and Gopinath (2007) argue that trend volatility helps explain some of business cycle characteristics in emerging economies.

[2]Some papers attempt to separate out crises – episodes of large output drop – from cyclical volatility around the trend (Acemoglu et al., 2003; Hnatkovska and Loayza, 2005), but they do not consider changes in trend-growth.

growth rates are not monotone; rather, they cycle between high and low (or even negative) values. We also find that the propensity to experience large swings of trend-growth is not uniform across countries – less democratic countries are more susceptible to it. When compared with factors commonly associated with volatility, such as measures of quality of institutions, macroeconomic policies, and financial development, as well as income level, we find that democracy is the most robust predictor of a country's propensity for growth reversals. Finally, we test whether our results can be explained by the fact that countries which rely heavily on natural resources tend to be less democratic and also exposed to large shocks (in the form of large swings of world prices of the resources they export). While shocks to prices of natural resources appear to contribute to the propensity for growth reversals, they do not account for the effect of democracy.

Motivated by these findings, we present a model of democracy and diversification with risky technologies. We show that non-democracies, with higher barriers to entry of new firms, suffer from greater sectoral concentration and experience (infrequent but large) up-and-down cycles, i.e., episodes when a period of very fast growth is followed by a decline or a severe slowdown. This is the only model that we are aware of that explains non-democracies' high propensity for *both* growth disasters and spectacular growth accelerations. Besides explaining our main findings, the model also predicts that non-democracies will be less diversified and that barriers to entry of new firms will be at least partly responsible for the medium-term growth reversals we document. We provide evidence consistent with both of these predictions.

The paper is organized as follows. Section 1 briefly reviews the literature related to our work. The data, structural break detection, and our main empirical findings are described in Section 2. Section 3 presents the theoretical model. The main tests of the theory are displayed in Section 4. Finally, Section 5 concludes.

1. Related Literature

Our paper relates to several branches of the literature. First, it contributes to the relatively unexplored study of within-country variation in growth. One of the first papers to formally consider this variation is Easterly et al. (1993). They show that growth rates are not highly correlated across decades, indicating that growth is not very persistent, unlike many growth "fundamentals" (institutions, policies, education, etc.). Pritchett (2000; 2006) observes that in most developing countries, a single time trend does not accurately characterize the evolution of GDP per capita.[3] Hausmann et al. (2005) look for growth accelerations

[3]The impact of democracy and different macro policies on the probability of switching between regimes of fast growth and

during 1950-2000 and find many such episodes, even in countries that have under-performed during this period in terms of average growth. Jones and Olken (2008) extend their analysis to include both accelerations and decelerations in growth experiences. They identify growth transitions using the Bai-Perron test, an approach we follow in this paper, and decompose them into transitions of physical capital accumulation and total factor productivity growth.[4]

Second, we contribute to the literature on democracy and volatility. Several papers document that non-democracies experience more growth volatility (Rodrik, 1997, 2000; Quinn and Woolley, 2001; and Mobarak, 2005). Most papers in this literature measure volatility as the standard deviation of annual growth in GDP per capita, which does not allow one to distinguish between medium-term trend changes and high-frequency fluctuations.[5] Given the new evidence showing that trend-breaks are frequent, we investigate the relation between democracy and this aspect of volatility. A related approach is taken by Rodrik (1999), who shows that the growth slowdowns of the 1970s were larger in non-democracies. However, he allows for only one (and usually negative) trend-break per country and so does not study growth accelerations, which we find are common and large among non-democracies.

Third, the relation between barriers to entry and aggregate economic outcomes has been studied theoretically by Parente and Prescott (1994; 1999), Krusell and Rios-Rull (1996), and Galor et al. (2006), among others. On the empirical side, Djankov et al. (2002) study barriers to entry across a wide sample of countries. Among other results, they present evidence that costs of entry for new firms are lower in democracies.[6] We use this finding, which finds a theoretical explanation in Acemoglu (2008), as the starting point of our model of industrial concentration and democracy, which we use to explain growth reversals.

Finally, the model we propose also relates to the literature on diversification and growth. Our setup closely follows Acemoglu and Zilibotti (1997), but it introduces different political regimes. Koren and Tenreyro (2007a) study possible explanations of the stylized fact that less developed countries are more volatile than developed ones. One of their conclusions is that as countries develop, their productive structure moves from more to less volatile.

stagnation is studied in Jerzmanowski (2006b). Among other findings, this paper reports that democracy has a moderating effect on the growth process; it lowers the propensity for crises but also limits the frequency of episodes of very rapid growth. This result is consistent with the one presented in this paper, namely that less democratic countries are more prone to growth cycles – periods of rapid growth followed by an equally dramatic collapse.

[4]Easterly (2006) also uses the Bai-Perron test to identify episodes of permanent growth take-off, i.e., growth permanently transiting from zero to a positive value, which he interprets as evidence of an emergence from a poverty trap. He finds very few such episodes. This is consistent with our findings that growth accelerations, especially in non-democratic countries, are ultimately reversed. See also Berg et al. (2008).

[5]One exception is Hnatkovska and Loayza (2005), who show that large crises are an important source of volatility for developing countries. See also Aguiar and Gopinath (2007).

[6]Perotti and Volpin (2007) also find that countries with more accountable political institutions have better investor protection and lower entry costs.

This also occurs in our model, because as countries accumulate more capital, wages and savings go up and they can afford to open a larger number of risky sectors, and hence their economy becomes more stable. Imbs and Wacziarg (2003) present empirical evidence showing that the sectoral concentration follows a U-shaped pattern; i.e., as countries develop, they first diversify their economy, but later on they specialize again. In our model, the level of democracy (via the resulting level of barriers to entry) determines diversification. We provide empirical support for this prediction.

2. Empirical Analysis

2.1. Detection of Structural Breaks

Consider the following simple model

$$y_t = \alpha_s + g_s t + \varepsilon_t \text{ for } t_{s-1} < t \leq t_s, \forall t = 1, ...T, \tag{1}$$

where y_t represents the logarithm of real output per worker relative to the United States, which is taken to be the technological leader. The variable t indexes time, and it is multiplied by the constant trend growth g_s. Finally, ε_t is a white noise error term.[7] That is, between two break dates t_{s-1} and t_s output per worker grows at a constant rate g_s relative to the technological frontier. Each time a break occurs, there is a change in one or both of the parameters – the trend-growth rate and the intercept. We focus our attention on the former.

One could also use the absolute level of output per worker. However, in an interdependent world, the growth of any individual country depends importantly on knowledge spillovers from other countries, mainly the technology leaders (Howitt, 2000; Klenow and Rodriguez-Clare, 2005). Growth of individual countries is thus a function of the rate of expansion of the technology frontier, as well as the domestic policies and institutions, which create or limit incentives for adoption of frontier technology. We are interested in changes in growth that stem from changes in the country-specific component of the growth process, and for this reason, we choose to study growth of output relative to the technology frontier. For instance, we do not aim to capture growth shifts common to all countries, such as those following the oil shocks of the 1970s. Instead, our focus is on breaks that drive individual countries closer to or further away from the world technological frontier.[8]

---

[7] We estimate the model augmenting equation (1) with the lagged level of income on the right-hand side, as well as using first differences of the equation. However both of these approaches appear to miss many important breaks. Details are available upon request.

[8] Using absolute income does not change the qualitative results of the paper. From now on, we refer to "relative growth" simply as "growth," keeping in mind that all statements are relative to the U.S. Essentially, to convert the numbers to absolute growth, one should add 2%, which is roughly the average growth rate of the U.S. over the last 100 years.

The structural break test developed by Bai and Perron (1998) enables us to identify the break points – t_s 's, as well as the within-regime parameters of the growth process – α_s's and g_s's. To distinguish medium-term changes in growth from standard business cycles, we impose a minimum period of ten years between breaks, although the results are not sensitive to the exact choice of minimum distance between breaks.

We use data on real output per worker from the Penn World Table (Heston et al., 2006) for the period 1950-2000. We find a total of 208 breaks, which corresponds to 1.8 breaks per country. Of these breaks, 49% represent increases in the growth rate. Figure 1 shows the case of Argentina. The Bai-Perron methodology finds two structural breaks. The first break occurs around 1980, and it corresponds to a large decline in Argentina's growth rate, which moves from positive (catching up to the U.S.) to negative (falling behind it). The second break occurs around 1990, and this time growth becomes less negative without changing its sign. The graph also shows the confidence intervals of these estimated breaks.

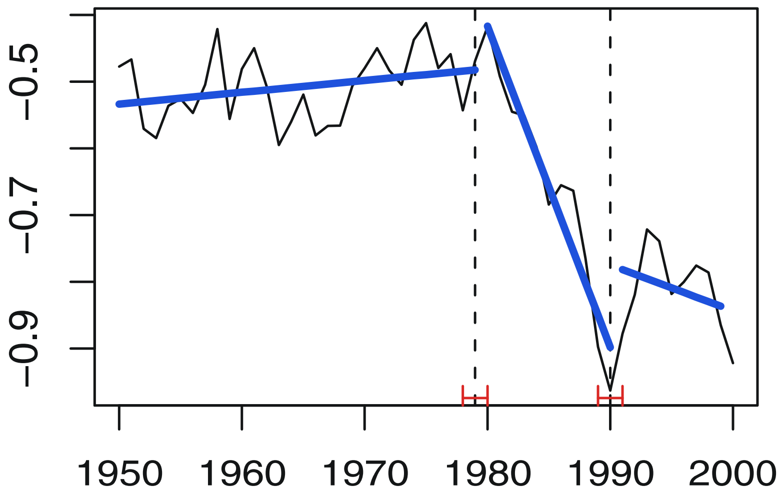


Fig. 1: *Argentina's Trend Breaks*

Notes. Argentina's log real output per worker relative to the US. Bai-Perron break dates are indicated by the vertical dashed lines. The solid lines show the estimate of the trend part of $y_t = \alpha_s + g_s t$. The figure also shows the confidence intervals around the estimated break dates.

One concern about the Bai-Perron test of structural breaks is that it relies on asymptotic properties. Since we use relatively short time series throughout the analysis, one may be concerned about inference based on asymptotic results. To check the robustness of our break detection results, we employ a Bayesian approach based on Wang and Zivot (2000) to estimate these breaks and compare our results with the ones obtained using the Bai-Perron method. Our comparison focuses on the years at which breaks occur with each method. The average difference (in absolute value) between the two estimates is 0.33 years, and its standard deviation is 3.23. In 67% of the cases, the break dates are identical, and the difference is no larger than 5 years 92% of the time.

We conclude from this exercise that the sample size does not significantly affect our results when we use the Bai-Perron technique to estimate break dates, and so in what follows we use these dates. We also note that this finding, along with recent Monte Carlo results by Jones and Olken (2008), can be taken as reassurance that despite possible problems, the Bai-Perron methodology does quite well when applied to cross-country growth data.

Another concern with measuring growth changes (or with cross-country growth empirics in general) is measurement error in national output series.[9] This is particularly important for measuring volatility at high frequencies. Our measure of volatility is a medium-term one: For an episode to be detected as say, a period of faster growth, it takes more than one unusually high data point. But of course if the measurement error is large enough and, especially if it is persistent, our procedure could be biased. One may also worry about our main results if measurement error is somewhat larger and more persistent in less democratic countries. This is possible; however, we note that one could make a similar argument for poor countries, and we do not find that poor countries tend to experience more growth reversals. We do acknowledge, however, that measurement error is a potential source of bias for the literature studying within-country growth variation, including our paper, and a systematic study of the robustness of various approaches for detecting growth breaks to measurement error is needed.

2.2. Growth Reversals and Democracy

Figure 2 presents the smoothed distribution of changes in trend growth at the time of a break for our entire sample of countries. Clearly, there is a lot of "trend-volatility", i.e., sharp changes of trend growth in both directions are common. Note that the distribution is slightly skewed to the right (the skewness coefficient is 0.19), indicating that large negative changes in trends are more common; that is, countries that have been growing fast relative to the U.S. and catching up following a break often grow much slower and fall behind it. Figure 3 shows some examples of such reversals.

In the remainder of this section, we investigate quantitatively whether trend volatility illustrated in Figure 3 is more common and more pronounced in non-democracies, as is the case with the usual measure of volatility – the standard deviation of annual growth rates.

[9]For example, Ramey and Ramey (1995) restrict their study to Organisation for Economic Co-operation and Development (OECD) countries to limit the influence of measurement error on their measure of volatility.

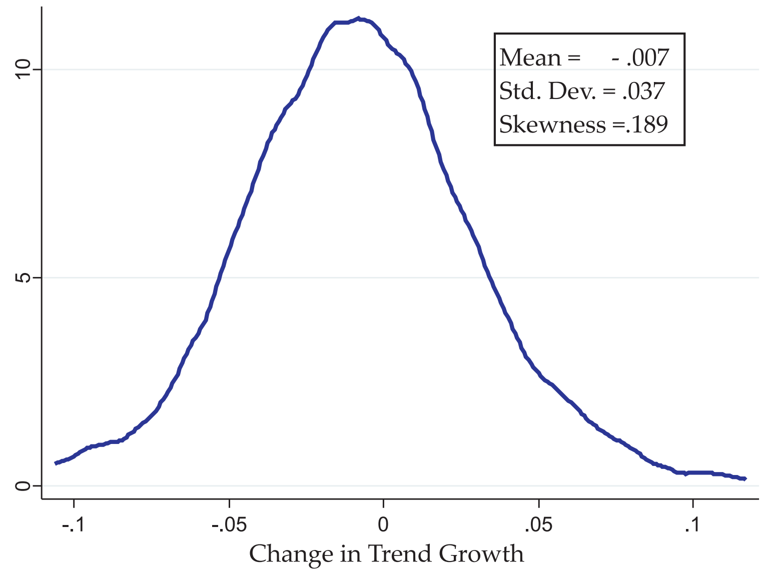


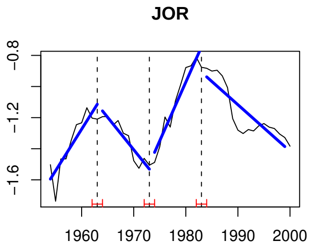
Fig. 2: *Kernel Density of Trend-growth Changes*

Our first approach is to estimate the following regression

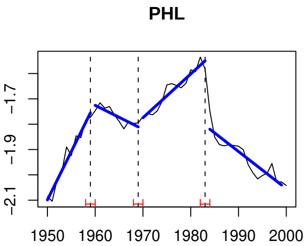
$$g_{is+1} = \beta_0 + \beta_1 g_{is} + \varepsilon_{is+1}, \tag{2}$$

where g_{is} represents the growth rate in regime s for country i estimated from (1). We are interested in the coefficient β_1, i.e., the existence and direction of a relation between pre-break and post-break growth rates. The basic idea of this approach is as follows. Depending on the value of the β_1 parameter, we can have three interesting cases. First, if $\hat{\beta}_1 = 0$ then, on average, the growth rate before a break does not help predict the growth rate after it. If $\hat{\beta}_1 \in (0, 1)$ then there is monotonic convergence in growth rates. This is a reversion-to-the-mean dynamic; i.e., exceptionally fast growers before the break still grow fast after the break, just slightly less so; in the long run, there is convergence to the steady state. Figure 4(a) illustrates the dynamics of this system for the case where initial growth is above the long-run equilibrium value. When interpreting the figure, recall that "periods" here are not calendar years but break dates. Thus growth may remain constant for a long period of time, but when a break occurs, the adjustment is as illustrated in the figure, i.e., for $\hat{\beta}_1 \in (0, 1)$ we have a monotonic evolution of growth rates over time.

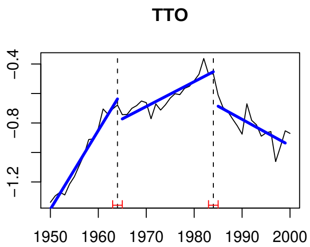
Finally, if $\hat{\beta}_1 \in (-1, 0)$, the dynamic system is illustrated in Figure 4(b). Here there is also convergence to the long-run steady state. In this case, however, growth is not monotonic; it exhibits cycles. Periods of high growth are followed by periods of low or even negative growth and vice versa, as in the examples of Figure 3. Again, because t is not calendar



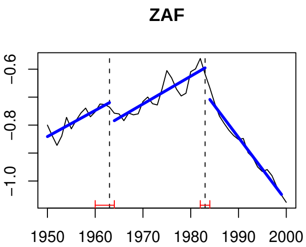
(a) Jordan



(b) Philippines

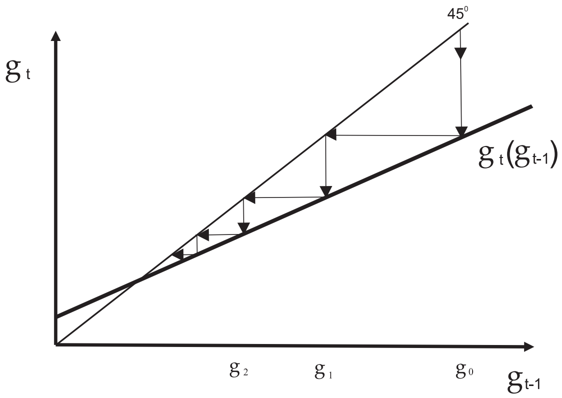


(c) Trinidad and Tobago

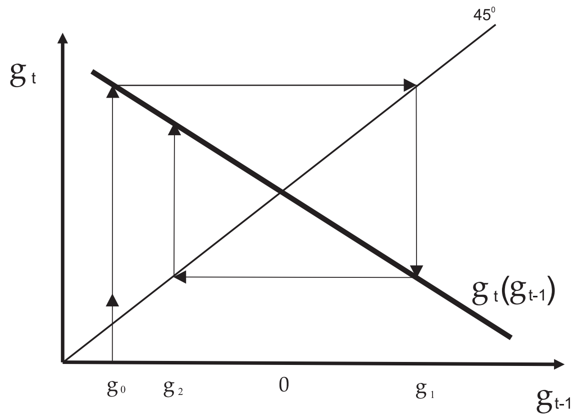


(d) South Africa

Fig. 3: *Examples of Growth Reversals*



(a) Monotonic Convergence



(b) Cycling

Fig. 4: *Panel (a): Monotonic convergence in growth rates ($\hat{\beta}_1 \in (0, 1)$). Panel (b): Growth reversals ($\hat{\beta}_1 \in (-1, 0)$).*

time but the time of a break, growth may remain constant and, say, above the long-run equilibrium value for a long time, but when a growth transition occurs, it is to a rate below the long-run equilibrium. If the equilibrium growth rate is zero, as in Figure 4(b), then much of the cycling would be from positive growth to negative growth, with higher positive growth rates followed by more severe collapses; the economy would go from growth miracle to growth disaster. We refer to the case of $\hat{\beta}_1 \in (-1, 0)$ as growth "reversals" or "cycles".

Our hypothesis is that the magnitude of the swings in trend-growth depends on the level of democracy. In terms of the above model, this means that the least democratic countries would have a large and negative β_1, while high-democracy countries would have $\beta_1 \geq 0$. To test this, we allow β_1 to depend on the level of democracy and income (to avoid attributing to democracy the effect of income, as the two are highly correlated). We thus estimate

$$g_{is+1} = \beta_0 + \beta_{11} g_{is} + \beta_{12} D_{is+1} g_{is} + \beta_{13} y_{is+1} g_{is} + \beta_2 y_{is+1} + \beta_3 D_{is+1} + \varepsilon_{is+1}, \qquad (3)$$

where y_{is+1} is the average of (log of) real per-worker output, relative to the U.S. over the 5-year period prior to the break "into" growth regime $s+1$. We take these averages to smooth out any abnormal change in GDP during the year of the break. D_{is+1} is the log of our measure of democracy. This variable, obtained from the Polity IV database from Marshall and Jaggers (2002), records several regime characteristics for every independent state above a half-million total population. The measure we use in the analysis is *polity2*, which is an average of autocracy and democracy scores. It ranges from -10 to 10 (-10 = high autocracy; 10 = high democracy) and includes specific indexes meant to capture constraints on the executive, the degree of political competition, the legislature's effectiveness, etc. Here too, we take the average over the five years prior to the break. Finally, ε_{is+1} is a white noise error term.

We use several methods to estimate equation (3). We start with a simple fixed-effects and pooled OLS estimation. The results are reported in the first two columns of Table 1. However, because our regressions include a lagged dependent variable, the fixed-effects estimation of (3) is inconsistent. To address this, the last two columns use the generalized method-of-moments (GMM) estimator, one-equation and system, respectively.[10]

The coefficient on growth before the break is negative and significant (with the exception of pooled OLS), indicating the tendency for growth reversals to occur at the time of structural breaks. Additionally, the interaction of growth before the break and democracy is positive and significant, supporting our hypothesis that in more democratic countries, the phenomenon of reversals is less pronounced. In contrast, the interaction with income is non-significant, suggesting that it is in fact democracy, not income, that mitigates medium-term

[10] Arellano and Bond (1991) derive a GMM estimator that uses suitably lagged levels of the dependent and predetermined right-hand side variables as instruments for the equation in first differences. In our case, we treat the level of per-worker GDP relative to U.S. GDP as predetermined, i.e., $E(y_{is-l}\Delta\varepsilon_{is}) = 0$ for $l \geq 1$ – that is, we allow for the correlation of y with past shocks to g but rule out correlations with future and contemporaneous shocks. We also assume no serial correlation in ε. Blundell and Bond (1998) extend this method to a system GMM estimator, where lagged first differences are used to instrument in addition to an equation in levels – this is the system GMM estimator reported in the last column.

Table 1: *Magnitude of Growth Reversals*

	Fixed Effects	Pooled OLS	GMM	System GMM
Growth before Break	-1.103***	-0.453	-1.157***	-0.992***
	(0.332)	(0.320)	(0.361)	(0.323)
Democracy × Growth Before Break	0.485*	0.573**	0.764*	1.014***
	(0.265)	(0.258)	(0.398)	(0.329)
Democracy × Income	-0.184	-0.050	-0.182	-0.154
	(0.194)	(0.080)	(0.177)	(0.138)
Initial Income	-0.014	0.002	-0.011	0.003
	(0.017)	(0.003)	(0.034)	(0.007)
Democracy	-0.028	0.000	-0.014	-0.005
	(0.019)	(0.009)	(0.016)	(0.014)
Hansen p-value			0.20	0.26
R^2	0.49	0.15		
N	197	197	95	197

Notes. Estimates of equation (3). Robust standard errors in parentheses. $*p < 0.10$, $**p < 0.05$, $***p < 0.01$.

cycles. Finally, note that the Hansen test in the last two columns indicates that one cannot reject the hypothesis that the instruments used are valid.

The magnitude of the estimated effect of democracy is large. At the highest level of democracy (western democracies) the total coefficient on pre-break growth is -.18 compared with, for example, -.65 at the level of democracy in 1980 in Argentina, a country that was ruled by a military dictatorship in that year. This is a large difference in the slope of the line in Figure 4(b), implying much larger trend volatility for Argentina than for western democracies.

Because the observations used in the above regression are estimates from the first stage (Bai-Perron estimation), one may worry about the magnitude of the standard errors in the second-stage regression. To account for this, we bootstrap the standard errors by sampling (with replacement) from our original sample of countries and re-estimating each equation 10,000 times. We then use the standard deviation of the resulting estimates as the standard errors. The results are displayed in Table 2. With the exception of the interaction term in the FE estimation, all parameters retain significance at conventional levels.

We conclude from this exercise that there is strong evidence in favour of our hypothesis that less democratic countries experience significant growth reversals. This new finding is not driven by the methodology used nor by the fact that we use estimates from our first

Table 2: *Magnitude of Growth Reversals (Bootstrapped)*

	Fixed Effects	Pooled OLS	GMM	System GMM
Growth before Break	-1.103*	-0.453	-1.157**	-0.992*
	(.613)	(.377)	(.587)	(.576)
Democracy × Growth Before Break	0.485	0.573**	0.764*	1.014**
	(.456)	(0.258)	(.471)	(.451)
Democracy × Income	-0.184	-0.050	-0.182	-0.154
	(.207)	(.100)	(.223)	(.183)

Notes. Estimates of equation (3) with bootstrapped standard errors in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

stage in our dynamic regression.

The above approach relies on estimating the magnitude of growth swings and its relation to democracy. Alternatively, we can classify some episodes as reversals (large swings in trend growth) and estimate the probability that they occur as a function of democracy. The definition we adopt is that a break is a *reversal* if growth goes from above (below) the country's average growth during the sample period to below (above) average. As an alternative, we also define a reversal as a break when growth changes its sign (i.e., goes from positive to negative or the reverse). Having classified each break, we use a probit regression to estimate the probability that a country undergoes a growth reversal as a function of its democracy score and income level. The probit results are shown in Table 3. Panel A shows the results for the change-of-sign definition, while in Panel B we use the above/below average definition. For each definition, we run four specifications. Our main specification (column 1) is a pooled probit with year effects. As is well known, a fixed effects estimation in a probit leads to inconsistent estimates of all parameters (Wooldridge 2002), so we instead report random effects probit estimates (column 2). We repeat both estimations with a time trend instead of year effects in columns 3 and 4.

The effect of democracy is negative across all specifications and, except in column 1 of Panel B, quite precisely estimated. Notice that income seems to lack any explanatory power for growth reversals; that is, more democratic countries are less likely to experience large trend-growth rate swings, while, conditional on democracy, richer countries are not.

There is a well-known argument that countries which rely heavily on natural resources tend to be less democratic (see Tsui, 2008 for an empirical analysis for the case of oil). If this is indeed the case, and given the fact that world prices of most natural resources tend to fluctuate a lot, one could expect to find that less democratic countries undergo large growth

Table 3: *Probability of Growth Reversals.*

Panel A: Cycles +/-	Pooled	RE	Pooled	RE
Democracy	-0.232**	-0.241*	-0.196**	-0.209**
	(0.114)	(0.124)	(0.097)	(0.106)
Income	0.038	0.034	0.041	0.041
	(0.090)	(0.103)	(0.082)	(0.092)
N	367	625	625	625
Panel B: Cycles above/below				
Democracy	-0.172	-0.172*†	-0.166*	-0.166*
	(0.111)	(0.106)	(0.093)	(0.089)
Income	0.057	0.057	0.043	0.043
	(0.085)	(0.090)	(0.078)	(0.078)
N	364	625	625	625
Time Effects	YES	YES	NO	NO
Trend	NO	NO	YES	YES

Notes. Probit Regressions. Panel A: change-of-sign definition, Panel B: above/below long run trend definition; pooled and random effects (RE) estimates. Standard errors in parentheses. *† $p < 0.12$, *$p < 0.10$, **$p < 0.05$, *** $p < 0.01$.

swings. To test this possibility, we again use the probit model, but we extend the specification to include two natural resource-related variables. First, we control for oil exports by including an oil-exporter dummy. Next, we add a variable that measures the absolute value of the change in the price of a country's main natural resource exports. Specifically, we use the change in (log) 5-year moving average of the weighted average price of 13 commodities, with the weights being their shares in the country's GDP.[11]

Controlling for oil exporters in Table 4 does not change the result, and the oil dummy itself does not appear to matter for propensity to experience growth reversals. Commodity price shocks, in contrast, as can be seen in Table 5, seem to hold some explanatory power for large growth swings; however, they do not eliminate the effect of democracy. Thus

[11]The fuel exporter dummy (mainly oil) comes from the World Bank Research Datasets (Social Indicators and Fixed Factors available at http://econ.worldbank.org). The commodities used in the second control are hard and brown coal, oil, bauxite, copper, gold, iron, nickel, lead, phosphate, silver, tin, and zinc. See Bolt et al. (2002) for more details.

Table 4: *Probability of Growth Reversals, Controlling for Oil Exporters*

A: Reversals +/-	Pooled	RE	Pooled	RE
Democracy	-0.237*	-0.209**	-0.245*	-0.223**
	(0.122)	(0.105)	(0.129)	(0.111)
Income	0.042	0.052	0.038	0.052
	(0.093)	(0.084)	(0.108)	(0.095)
Oil	-0.045	-0.125	-0.045	-0.140
	(0.327)	(0.305)	(0.376)	(0.338)
N	367	625	625	625
B: Reversals above/below				
Democracy	-0.181	-0.183*	-0.181*†	-0.183*
	(0.118)	(0.101)	(0.111)	(0.094)
Income	0.065	0.056	0.065	0.056
	(0.088)	(0.080)	(0.094)	(0.082)
Oil	-0.095	-0.160	-0.095	-0.160
	(0.334)	(0.300)	(0.338)	(0.296)
N	364	625	625	625
Time Effects	YES	YES	NO	NO
Trend	NO	NO	YES	YES

Notes. Probit Regressions. Panel A: change-of-sign definition, Panel B: above/below long run trend definition; pooled and random effects (RE) estimates. Standard errors in parentheses. *† $p < 0.12$, *$p < 0.10$, **$p < 0.05$, *** $p < 0.01$.

while the commonly believed link between shocks to prices of natural resources and growth volatility also appears to exist in the medium-term, democracy has an independent effect on the propensity for growth reversals.[12]

Finally, we present a simple horse-race between democracy and other institutional quality/macro policy variables. Our left-hand side variable is the number of growth reversals (as defined in the probit analysis above) experienced by a country during the sample period.[13] We regress this measure on the overall number of breaks, initial income, as well as our

[12] See Dehn et al. (2005) for an analysis of the effect of commodity price fluctuations on short-term GDP volatility.

[13] We use the above/below average growth definition of reversal here. For the change of sign definition, the results are similar but less precisely estimated. This is because there are significantly fewer countries that experienced at least one change of sign growth reversal from which to identify the effects.

Table 5: *Probability of Growth Reversals, Controlling for Natural Resource Price Shocks*

A: Reversals +/-	Pooled	RE	Pooled	RE
Democracy	-0.224*	-0.230*	-0.190*	-0.206*
	(0.118)	(0.137)	(0.102)	(0.117)
Income	-0.016	-0.020	0.008	0.014
	(0.094)	(0.116)	(0.086)	(0.102)
Price Shocks	0.157	0.172	0.196	0.210*
	(0.127)	(0.122)	(0.128)	(0.112)
N	328	559	559	559
B: Reversals above/below				
Democracy	-0.217*	-0.217*	-0.212**	-0.212**
	(0.116)	(0.114)	(0.098)	(0.097)
Income	0.003	0.003	0.006	0.006
	(0.090)	(0.097)	(0.082)	(0.085)
Price Shocks	0.144	0.144	0.203*†	0.203**
	(0.132)	(0.109)	(0.125)	(0.102)
N	328	559	559	559
Time Effects	YES	YES	NO	NO
Trend	NO	NO	YES	YES

Notes. Probit Regressions. Panel A: change-of-sign definition, Panel B: above/below long run trend definition; pooled and random effects (RE) estimates. Standard errors in parentheses. *† $p < 0.12$, *$p < 0.10$, **$p < 0.05$, *** $p < 0.01$.

measure of democracy and the following explanatory variables: rule of law (Law), index of corruption (Corr.) both from Kaufmann et al. (2003); ethno-linguistic fictionalization (Eth. Frac.) from Easterly and Levine (1998), the Sachs-Warner openness index (Open) from Sachs and Warner (1997), financial development (Fin. Dev), exchange rate overvaluation and average inflation rate from the World Bank Development Indicators (2005).

We include these variables because, besides being frequently used in cross-country growth regressions (see Barro and Sala-i-Martin, 2003), they have also been used in the study of volatility. Several studies have attributed volatility of output to bad macroeconomic policies (e.g., exchange rate policies, inflation). However, Acemoglu et al. (2003) show that once

Table 6: *Determinants of the Number of Growth Reversals.*

	Law	Corr.	Eth. Frac.	Open	Fin. Dev.	Overval.	Infl.
Democracy	-1.391*	-1.358*	-1.338*	-1.702**	-1.496**	-1.465**	-1.464**
	(0.785)	(0.781)	(0.766)	(0.734)	(0.701)	(0.714)	(0.731)
x	-0.005	-0.017	0.022	0.212	-0.250	-0.247	0.040
	(0.118)	(0.115)	(0.323)	(0.299)	(0.309)	(0.313)	(0.232)
No. of Breaks	0.458***	0.456***	0.456***	0.420***	0.464***	0.476***	0.478***
	(0.126)	(0.126)	(0.126)	(0.128)	(0.125)	(0.124)	(0.128)
Initial Income	-0.000	0.007	-0.019	-0.023	0.032	-0.057	-0.032
	(0.125)	(0.130)	(0.125)	(0.113)	(0.115)	(0.119)	(0.118)
Constant	1.567	1.471	1.680	2.105**	1.511*	2.183**	1.887**
	(1.122)	(1.186)	(1.030)	(0.917)	(0.841)	(0.842)	(0.833)
R^2	0.17	0.17	0.17	0.19	0.19	0.23	0.19
N	74	74	72	73	73	63	69

Notes. Cross-section OLS regressions of number of growth reversals on democracy, income, number of breaks, and a set of variables common in empirical growth studies: rule of law, corruption, ethno-linguistic fractionalization, openness, financial development, real exchange overvaluation, and inflation. The row labeled "x" reports the coefficient on the variable corresponding to column heading. Standard errors in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

they control for institutions, the effect of policies on volatility disappears. Rodrik (1999, 2000) argues that countries with less internal conflict (e.g., lower ethnic fractionalization) cope better with adverse shocks. Finally, well-developed financial markets can be expected to facilitate a reduction in growth volatility (see Acemoglu and Zilibotti, 1997).[14] Since democracy can be argued to foster many of these outcomes (e.g., by increasing the accountability of policymakers and thus eliminating extreme policy outcomes or providing better conflict resolution mechanisms) we control for each of them in our regressions to help us pin down the channel through which democracy works. Tables 6 and 7 display the results when we include each variable in isolation and one additional regressor at a time, respectively.

Many variables have the expected sign (at least when included in isolation – Table 6), but few are significant.[15] More importantly, democracy is always negative and significant, and the magnitude of the coefficient does not change very much regardless of which additional controls are included. We take this as further evidence that countries with more democratic political systems are less likely to experience large swings in trend-growth and

[14]Indeed, in the model we propose later, we assume an absence of credit markets because if they existed, agents would diversify risk and the economy would not experience growth reversals.

[15]Consistent with Acemoglu and Zilibotti (1997), financial development, especially in Table 7, is negative and significant or close to significant, but its inclusion does not reduce the magnitude or significance of the democracy coefficient.

Table 7: *Determinants of the Number of Growth Reversals.*

Democracy	-1.391*	-1.383*	-1.497*	-1.509*	-1.608*	-1.645**	-1.621*
	(0.785)	(0.790)	(0.852)	(0.857)	(0.858)	(0.815)	(0.834)
Rule of Law	-0.005	0.125	0.222	0.137	0.300	0.918**	0.961**
	(0.118)	(0.392)	(0.395)	(0.432)	(0.451)	(0.446)	(0.460)
Corruption		-0.133	-0.168	-0.122	-0.207	-0.670*	-0.675
		(0.383)	(0.381)	(0.394)	(0.398)	(0.391)	(0.407)
Ethno-linguistic Frac.			0.061	0.052	0.037	0.060	0.104
			(0.333)	(0.336)	(0.335)	(0.332)	(0.347)
Openness				0.189	0.160	-0.138	-0.131
				(0.373)	(0.372)	(0.351)	(0.366)
Financial Development					-0.439	-0.678*	-0.662
					(0.361)	(0.391)	(0.397)
Real Ex.Rate Overval.						-0.107	-0.167
						(0.308)	(0.327)
Inflation							0.193
							(0.265)
No. of Breaks	0.458***	0.455***	0.458***	0.434***	0.474***	0.552***	0.560***
	(0.126)	(0.127)	(0.128)	(0.137)	(0.141)	(0.137)	(0.140)
Initial Income	-0.000	0.015	-0.020	-0.029	-0.005	-0.059	-0.096
	(0.125)	(0.134)	(0.145)	(0.147)	(0.148)	(0.154)	(0.165)
Constant	1.567	1.423	1.818	1.906	1.901	2.477*	2.689*
	(1.122)	(1.203)	(1.349)	(1.368)	(1.363)	(1.403)	(1.480)
R^2	0.168	0.157	0.152	0.142	0.149	0.262	0.252
N	74	74	72	72	72	61	60

Notes. Cross-section OLS regressions of number of growth reversals on democracy, income, number of breaks, and a set of variables common in empirical growth studies: rule of law, corruption, ethno-linguistic fractionalization, openness, financial development, real exchange overvaluation, and inflation. Standard errors in parentheses. $^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

that the channel is not through the effect of democracy on some well-recognized determinant of volatility.

3. The Model

In this section, we suggest a simple explanation for the above findings. We show that a modification of the Acemoglu and Zilibotti (1997) model has the feature that less democratic countries experience growth reversals like those in Figure 3 – that is, periods of fast growth followed by rapid decelerations.[16] More democratic countries also experience growth breaks, but their magnitude is much smaller, as shown in the empirical results of the previous section.

The idea of the model is straightforward. Capital goods, which are inputs into the final goods production, can be produced using many risky technologies. The riskiness comes from

[16] A mechanism similar to the one emphasized here can be found in Koren and Tenreyro (2007b).

the fact that in a given period, only some technologies or sectors (in the model, literally only one) pay off. Skilled agents save when they are young and later become entrepreneurs and invest their savings to produce capital, which they can then rent out. Investing in more than one risky sector enables an entrepreneur to diversify some of the risk, but it is costly because there are fixed costs associated with opening up new businesses. These entry barriers lead entrepreneurs to operate in fewer sectors but allocate more resources to each of them. As we explain below, following theoretical arguments and empirical evidence, we assume that entry barriers are higher in non-democratic countries. It follows that in these countries production is more concentrated: Fewer sectors are operated, but more resources are invested in each. This generates the possibility of large growth swings. When one of the operated sectors is successful, the increase in output is very large because a lot of resources are allocated to this sector. However, there will also be a dramatic collapse when fortunes turn in favour of sectors that are absent. The low degree of diversification means this will occur sooner rather than later.

3.1. Setup

There are overlapping generations of agents who live for two periods. There is a measure $L = 1$ of two types of agents: skilled (L_s) and unskilled (L_u). When they are young, agents supply labour inelastically, consume, and save. When they are old, they transform their savings into capital, using one of the two available technologies, and rent out the capital to final good producers. Only some agents (skilled) can operate the more profitable (and riskier) capital-good technologies.

3.2. Production

In the model economy, there is a competitive final goods sector that combines labour and intermediate capital goods, according to the Cobb-Douglas production function

$$Y_t = K_t^{\alpha} L^{1-\alpha}, \tag{4}$$

where Y_t and K_t are output and the stock of capital in period t, respectively, and $0 < \alpha < 1$. There is 100% depreciation of capital.

Labour is supplied inelastically by young agents, and capital is produced by a capital-goods sector using savings of the old. This transformation can be achieved in two ways: either by investing in a safe sector or by investing in some of the N risky sectors. In the risky sectors, which can be thought of as entrepreneurial activity, the payoff is uncertain, but if the project is successful, higher than in the safe sector.

3.3. Saving

When agents are young, they work in the final goods sector. As workers, all agents are equally productive irrespective of their skill level. They receive a wage w_t, save a fixed fraction s, and have a linear utility over second-period consumption.[17] Saving is thus given by

$$S_t = s\, w_t. \tag{5}$$

When old, the agents transform their savings into capital, which they then rent out to the final goods producers. They have the following choices available to transform savings into capital: (1) invest in a safe sector, which transforms a unit of savings into $\phi > 0$ units of capital or (2) invest in risky sectors which, if successful (e.g., because of a change in terms of trade, favorable weather shock, etc.), return A units of capital per unit of savings invested, where $A > \phi$, if operated by a skilled agent and $A = 0$ otherwise. The evolution of capital is shown in Figure 5 (μ indicates the fraction of savings allocated to the safe technology)

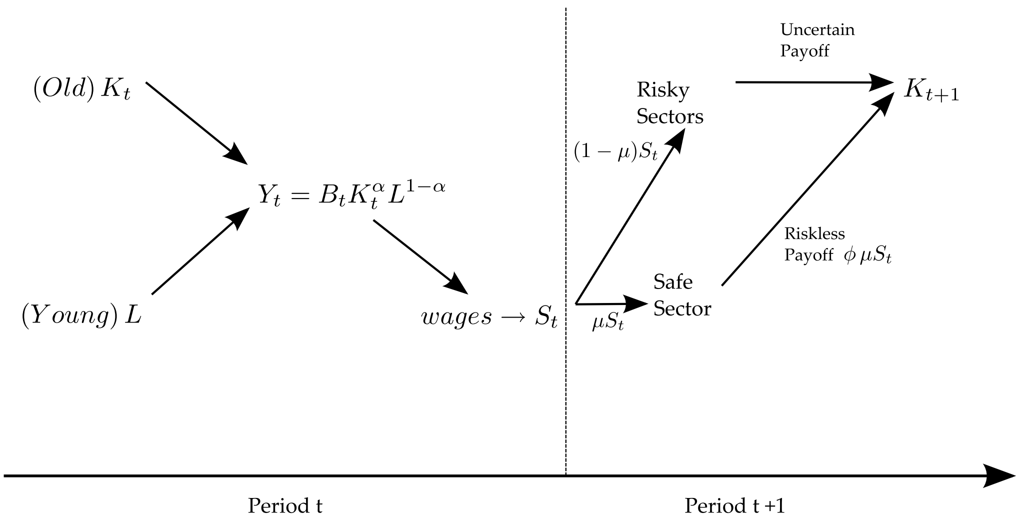


Fig. 5: *Schematics of Capital Accumulation*

Notes. Capital from old agents and labour from young ones is used to produce the final goods. A fraction of the wage proceeds are saved by the young, who then use these savings to produce capital. Capital production can be achieved through safe or risky technologies.

There is a continuum $[0, N]$ of risky sectors available, but only one sector pays off in any given period. If a sector operated by an agent pays off, she receives a return of A on every

[17] A case with log utility and endogenous saving is presented in the Appendix. As we discuss there, the qualitative results are similar, but we cannot obtain closed-form solutions for all the endogenous variables.

unit of savings allocated to that sector. If the sector does not pay off, she receives nothing from that sector. Thus, a skilled agent wishing to take advantage of risky technologies opens up a measure n of sectors and succeeds (i.e., one of the technologies operated pays off) with probability n/N.[18] The skilled agent directs a fraction $1-\mu$ of her savings to risky projects and distributes the resources equally among the n risky projects she operates, with each sector receiving $1/n$ of the total savings allocated $(1-\mu)S$, because projects are symmetric. We also allow resources allocated to risky sectors to be (partially) reversible, i.e., if one of the sectors that a skilled agent has opened becomes successful, she can transfer some of the resources from the other, unsuccessful, risky sectors. The total return from a successful sector is therefore given by

$$A\frac{(1-\mu)S_t}{n}n^{1-\rho}, \tag{6}$$

where the last term $n^{1-\rho}$ captures reversibility, i.e., the ability to reallocate some of the savings after the uncertainty has been resolved. A value of $\rho = 1$ implies no ability to reallocate (i.e., all risky capital is sector-specific), while a value of $\rho = 0$ implies no savings allocated to risky sectors need to be committed before uncertainty is resolved. We assume $0 < \rho < 1$.

3.4. Barriers to Entry and Diversification

So far we have followed Acemoglu and Zilibotti (1997) with some simplification (e.g., linear utility, exogenous saving). Now we introduce our key modification. Unlike in their model, our risky sectors do not have a minimum required scale; instead, we introduce entry costs. This produces similar dynamics, but allows us to appeal to the literature on democracy and barriers to entry to think about the model's prediction regarding different paths of output per capita in democracies and non-democracies. Specifically, we assume that opening up a firm in one of the risky sectors requires paying an entry cost ψ.[19] As we discuss below, this barrier to entry will be the variable distinguishing political regimes – with non-democracies erecting higher barriers to entry of entrepreneurs. We have in mind here a broad concept of cost of entry, including registration and license fees, bribes, time spent on fulfilling bureaucratic requirements, limited access to public infrastructure, etc. For simplicity, we assume that

[18] We assume all skilled agents open up the same sectors. This is merely to simplify the exposition. We could justify it by assuming that sectors are ordered according to complexity and so, on top of the entry barrier introduced below, there is a higher cost of opening higher-indexed sectors. Since the choice of whether to open a sector or not is independent of the choices of other agents, this would lead to all agents opening up identical, lowest-index sectors.

[19] In Acemoglu and Zilibotti (1997), there is a minimum requirement scale for each sector, leading to investment in a limited number of sectors. In our model, there are explicit fixed costs that agents must pay before opening sectors. Another difference between the two setups is that we assume that the fixed cost is the same in all risky sectors, while in their model different sectors have different scale requirements. None of these differences is crucial for our results.

this cost takes the form of a reduction in the savings allocated to risky sectors; that is, an agent who allocates $(1-\mu)S_t$ to n risky sectors only gets to invest $(1-\mu)S_t - \psi n$ in actual productive projects.

Unskilled agents' entrepreneurial productivity is zero, and thus they always allocate all of their savings to the safe sector. The skilled agent will choose her allocation, and how many risky sectors to operate, at the beginning of the second period to maximize her expected (linear) utility of period-two consumption, which is equivalent to maximizing expected capital holdings K_t^S

$$\max_{\{\mu_t, n_t\}} E(K_t^S) = \mu_t S_t \phi + \frac{n_t}{N}\left(\frac{(1-\mu_t)S_t - \psi n_t}{n_t^\rho}\right) A. \tag{7}$$

The first term represents the constant and exogenous return ϕ on the fraction μ of savings allocated to the safe sector. The second term is the expected (with probability n/N) return A on the savings (net of entry costs) allocated per risky sector (with $0 < \rho < 1$ reflecting the degree of reversibility of risky allocations). Given the linearity of the objective function, the choice of μ will be at a corner depending on the relative values of return on the safe (ϕ) and risky ($\frac{n_t}{N}\frac{A}{n_t^\rho}$) investments. In particular, $\mu_t = 0$ if $\Psi(n) \equiv \phi - \frac{n_t}{N}\frac{A}{n_t^\rho} < 0$ and $\mu_t = 1$ otherwise (see Figure 9(a) in the Appendix.) The first- order condition for n can be solved to obtain

$$\mu_t = 1 - \frac{(2-\rho)}{S_t(1-\rho)}\, n_t\, \psi \equiv \Gamma(n). \tag{8}$$

We also define $\bar{n} = (\frac{\phi N}{A})^{1/(1-\rho)}$, the value of n such that for any $n > \bar{n}$ we have $\mu = 0$, i.e., skilled workers invest all of their resources in risky sectors.

It is easy to show (see the Appendix) that when it is optimal to allocate all resources to the risky sectors ($\mu = 0$), the optimal measure of them to operate is n^* given by

$$n^* = S_t \frac{1-\rho}{(2-\rho)\psi}. \tag{9}$$

In what follows, we assume that the interior solution, if it exists, is preferred to the corner solution.[20]

3.5. Political Regimes

We now introduce different political regimes: democracies and non-democracies. Specifically, we assume that non-democracies have higher barriers to entry into the risky sectors,

[20] This will be the case for a sufficiently large value of savings (or wage, since $S = s\,w$) $S > \frac{(2-\rho)\left(\frac{N(2-\rho)\phi}{A}\right)^{\frac{1}{1-\rho}}\psi}{1-\rho}$. Also notice that because $\bar{n}$ is independent of S and n^* is increasing in S, the interior solution always exists for high enough wages.

reflected by a higher value of ψ. This assumption is supported empirically by the findings of Djankov et al. (2002), who show that there is strong evidence that less democratic countries erect higher barriers to entry for firms. Perotti and Volpin (2007) corroborate this finding by presenting evidence that investor protection is worse and entry costs higher in countries with "less accountable political institutions." From a theoretical point of view, Acemoglu (2008) presents a model in which oligarchies block the entry of potentially productive entrepreneurs in the production sector to keep wages artificially low. In Aghion et al. (2008), democracy and political rights enhance the freedom of entry into markets in the most technologically advanced sectors of the economy. In both models, limiting entry leads to stagnation in the long run, but because of non-democratic governments' lack of accountability, these policies persist.

Consider an increase in ψ, the entry barrier. This change makes the Γ schedule steeper without affecting $\bar{n}$ – see Figure 11 in the Appendix. This means that an economy with lower barriers to entry, or a more democratic economy according to our assumption, is more likely to operate risky sectors and the more democratic the economy, the more risky sectors are open for a given value of S (and thus wages). This is summarized in Result 1 below.

Result 1: *Democracies have a more diversified industrial composition: They open up more sectors than non-democracies at the same level of development.*

We also note that because saving S is a constant fraction of wages, as the economy grows, more and more sectors will be opened and ultimately, in a rich enough economy, all N sectors will be operated regardless of ψ.[21] However, as we discuss in the next section, a high level of barriers may limit periods of growth to rapid but relatively short-lived episodes and thus keep the economy from becoming rich and diversified.

3.6. Dynamics

Consider an economy with $\bar{n} < n^* < N$ so that all skilled agents (L_s) allocate the entirety of their savings to risky technologies. Capital stock evolves according to the following process: If one of the operated risky sectors is successful, the economy is said to be in the *lucky* state. In this state, the capital stock, denoted by K^L, is equal to the output of the safe sector $L_u s w_t \phi$, where all the unskilled (L_u) agents allocate savings, plus the output of the risky sector $L_s A(sw_t - \psi n^*(w_t))/n^*(w_t)^\rho$. This happens with probability n^*/N. Otherwise capital

[21] It is important to recognize that we do not argue that certain sectors are completely missing from an economy. Rather we think of there being traditional (small-scale home-produced, for example) ways of manufacturing a good – which we classify as safe technologies – as well as modern, large-scale ways, which we model as risky but potentially very productive technologies. That is, goods produced in the economy without any risky sectors may be very similar to goods produced in the economy which operates riksy sectors, but they are manufactured using traditional, small-scale technologies not subject to large productivity gains.

is K^U equal to only the output of the safe sector. Using the fact that $w_t = (1-\alpha)K_t^\alpha$ we have

$$K_{t+1} = \begin{cases} K^L(K_t) = L_u s(1-\alpha)K_t^\alpha \phi + L_s \frac{A(s(1-\alpha)K_t^\alpha - \psi n^*((1-\alpha)K_t^\alpha))}{n^*((1-\alpha)K_t^\alpha)^\rho} & \text{with prob.} \quad \frac{n^*}{N} \\ K^U(K_t) = L_u s(1-\alpha)K_t^\alpha \phi & \text{with prob.} \quad 1 - \frac{n^*}{N} \end{cases}. \tag{10}$$

Notice that, given the previous period's capital, when a high-ψ economy is lucky, i.e., one of the risky sectors pays off, its capital stock is higher, that is $dK^L/d\psi > 0$, as long as $n^* < N$. This follows because of a *concentration effect*: With higher barriers to entry, fewer sectors are operated but more savings are allocated to each, and as a result, when one of the sectors operated pays off, the resulting capital good output is higher. To see this formally, note that the extra capital when the economy is in the lucky state is given by $A\left(\frac{S-\psi n}{n^\rho}\right)$ and that, from equation (9), the product ψn^* is independent of ψ. It follows that, ceteris paribus, a higher entry barrier – by reducing the number of risky sectors in operation n – increases capital per sector and thus the total capital stock in the lucky state. Of course, the probability that the lucky state is lower because fewer sectors are operated and the expected capital stock is lower in the high barrier economy. This is summarized in the following result:

Result 2: *Non-democracies are less likely to have a risky sector pay off, but when this occurs their growth is higher than in democracies. This happens because non-democracies have their resources concentrated in fewer sectors.*

Using the equation (9) for n^*, it is easy to show that the dynamics of capital can be represented by the diagram in Figure 6. For any given capital stock, K_t the next period capital will be given by the $K^L(K_t)$ schedule with probability $n^*(K_t)/N$ and $K^U(K_t)$ schedule with probability $1 - n^*(K_t)/N$.[22] Result 2 above implies that the K^L schedule is higher for non-democracies, but the probability of being on it is lower.

Imagine an economy with a history of always being in the lucky state, i.e., one of the operated sectors paying off. Such a history is of course very unlikely if ψ is large (and n^* low relative to N), but a hypothetical economy that follows it would simply move up along the $K^L(K_t)$ schedule to the high capital steady state K^L. Alternatively, imagine an economy

[22]This dynamic holds for large enough barriers, so that $n^* < N$. To characterize the model fully, we also must consider the dynamics when $n^* > N$ and all sectors are operated. In short, what happens is that fully diversified economies converge to a deterministic steady state, with capital stock inversely related to the level of barriers. Our main focus is on economies that are not fully diversified, so we restrict our attention to the case $n^* < N$. See the Appendix for more details.

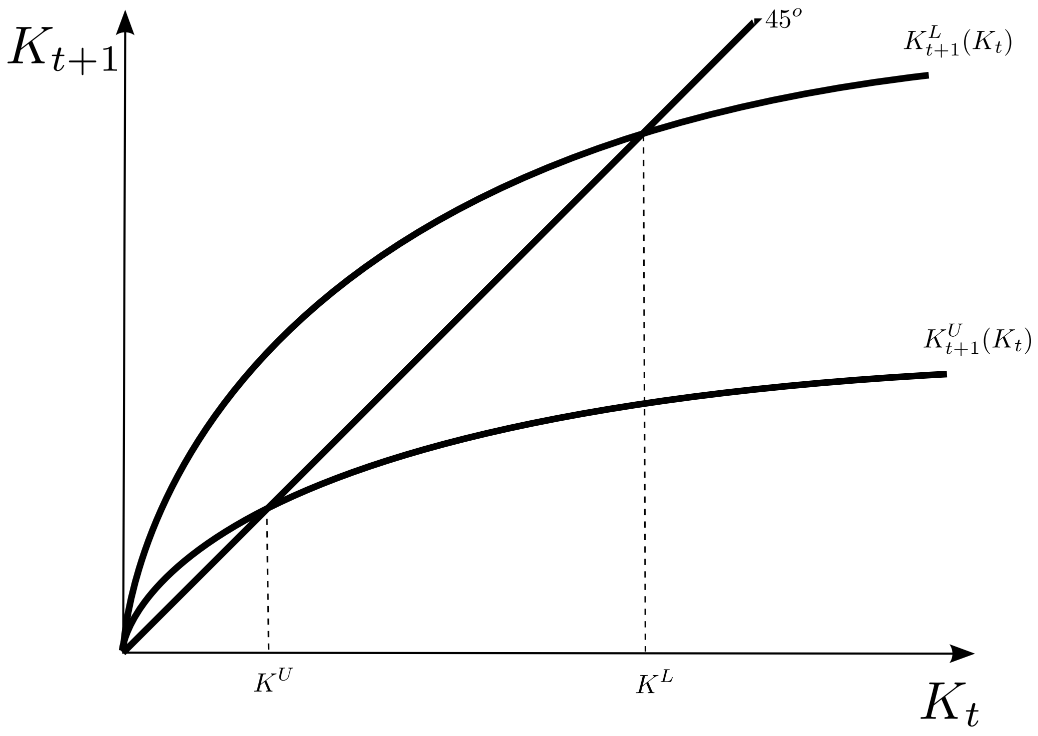


Fig. 6: *Model Dynamics*
Notes. For any given capital stock K_t, the next period capital will be given by the $K^L(K_t)$ schedule with probability $n^*(K_t)/N$ and $K^U(K_t)$ schedule with probability $1 - n^*(K_t)/N$.

that is persistently unlucky and no risky sectors ever pay off. This economy would follow the $K^U(K_t)$ schedule to the low capital steady state K^U. In practice, an economies' capital stock follows a random process, switching between dynamics associated with the two curves. However, we can expect an average high-ψ country (low democracy) to spend most of the time around the K^U steady state. This leads us to the following result.

Result 3a: *A non-democracy will experience infrequent, but large up-and-down output swings. In particular, there will be infrequent episodes when output increases as one of the operated sectors is successful and the economy jumps to the K^L schedule. This increase is rapid because a lot of resources are allocated to each operated sector. With high probability, however, this episode will be followed by a period of decline, as none of the operated sectors is successful and the economy reverts to the K^U schedule.*

Result 3b states that an average low-ψ country (high democracy), in contrast, can be expected to spend most of its time growing and converging to K^L. As long as $n^* < N$, its output will occasionally drop, but the decline will not be very large because the K^U and K^L schedules are not far apart.

Result 3b: *A democracy will experience infrequent and small down-and-up output swings.*

In particular, there will be infrequent episodes when output decreases, as none of the operated sectors is successful and the economy falls to K^L schedule. With high probability, however, this episode will be followed by a rebound, as one of the operated sectors is successful and the economy reverts to the K^L schedule.

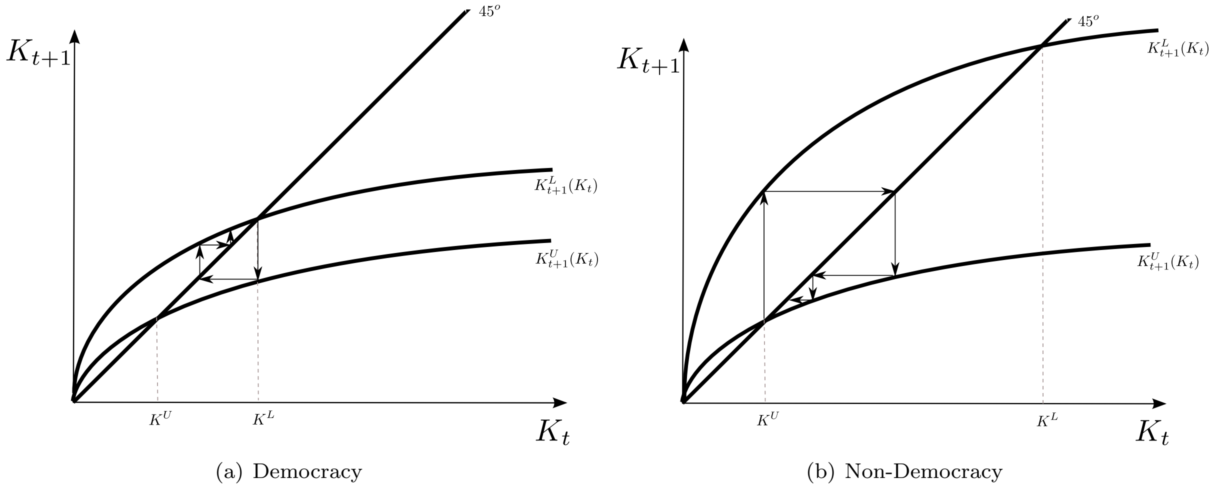


Fig. 7: *Medium term growth reversals. Panel (a): Democracy; Panel (b): Non-Democracy.*

These results are illustrated in Figure 7. Finally, recall that as an economy becomes richer, barriers to entry matter less. As described in the Appendix, there is a threshold level of capital K^* such that for capital stocks beyond it, all N sectors are open and the economy is always on the K^L schedule and converges to the high steady state. This effect becomes important once we allow for exogenous productivity growth because then even high-ψ economies will eventually accumulate enough capital such that they will open all sectors and will no longer undergo growth reversals. However, if growth of productivity (convergence to the world technology frontier) is not very fast, this process may take a long time.

Finally, note that in the context of our model, one should be careful a conclusion that trend-volatility is detrimental to. While it is true that countries with the lowest barriers to entry enjoy the most stability and are the richest, it is also true that countries with extremely high barriers to entry are stable – they operate no risky technologies, almost never experience growth accelerations, and remain in the low steady state. That is, while trend-volatility is a symptom of an underlying problem (high entry barriers), each episode of an acceleration is a period during which the country's fortunes are (temporarily) good.

4. Tests of the Model

4.1. Growth Reversals

Our model predicts that less democratic countries will experience rapid growth accelerations followed by dramatic slowdowns and vice versa. As we established in Section 2.2, the evidence is consistent with this prediction: the less democratic the country, the larger the magnitude of growth reversals at the time of the break and the greater the probability of experiencing a large growth swing. Figure 8 illustrates this again by showing the (kernel smoothed) densities of the magnitude of growth changes at the time of the break for democracies and democracies where we draw the line between the two groups at the median of our democracy measure.

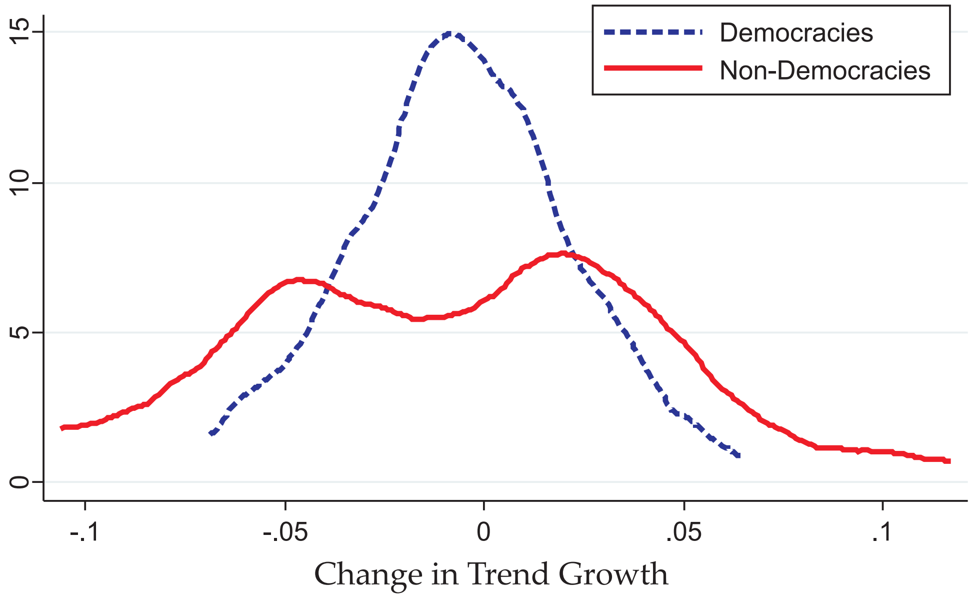


Fig. 8: *Kernel Density of Trend-Growth Changes; Democracies vs. Non-democracies.*

Clearly both groups experience trend changes, but it is also apparent that for democracies these changes are usually small (mode close to zero), while for non-democracies they are most commonly large in either the positive or negative direction (bi-modal distribution), and much more often very large (fat tails).

That these distributions are consistent with our model is of course not surprising because our above findings motivated the theory. However, our model also makes a new prediction, namely that there is a negative relation between democracy and industrial concentration. We put this prediction to a test in the next section.

4.2. Democracy and Diversification

In this section, we test the hypothesis that non-democracies tend to be less diversified than democracies, even when one controls for the country's income level. The data set we employ to test the relation between industrial concentration and democracy is the Industrial Statistics Database (revision 2) from the United Nations, which contains data on manufacturing at the 3-digit level of disaggregation for the period 1963-2003. The data set covers 181 countries and 29 manufacturing categories. The outcome variables in which we are interested are output and value added across different manufacturing sectors.

We start by calculating the Herfindahl-Hirschman index of concentration for each country. The index for variable $j = 1, 2$ in period t is defined as follows:

$$h_{jt} = \sum_{i=i}^{n} \left(\frac{Y_{ijt}}{Y_{jt}} \right)^2,$$

where Y_{ijt} is the value of variable j in sector i and period t, $Y_{jt} \equiv \sum_{i=1}^{n} Y_{ijt}$, and n is the total number of sectors operating in a given country at a point in time. The Herfindahl-Hirschman index is bounded between $\frac{1}{n}$ and one, with the former representing a completely diversified economy and the latter representing an economy in which all the activity is concentrated in one sector. We estimate the following specification:

$$h_{jct} = \alpha + \beta_1 D_{ct} + \beta_2 \ln y_{ct} + \beta_3 \ln y_{ct}^2 + \varepsilon_{ct}, \tag{11}$$

where h_{jct} is the Herfindahl-Hirschman index of variable j in country c and year t. The variable D is the index of democracy used above, and y is real GDP per worker. We include the square of log income in our regression to account for the increasing portion of the U-shape pattern of specialization documented in Imbs and Wacziarg (2003), who show that as countries develop, their economy first becomes more diversified but concentrates again in later stages.

We estimate (11) by pooled OLS and cluster the errors by country to account for the serial correlation of errors within countries. We believe it is more reasonable to omit fixed effects because we are ultimately interested in comparing the experience of each country to a common benchmark, the overall average concentration across countries.[23] The results are presented in Table 8.

In each of the four specifications, the coefficient on democracy is negative and significant at conventional levels, indicating that the manufacturing sector in more democratic countries

[23] Using fixed effects we obtain similar but less precise estimates.

Table 8: *Democracy and Industrial Concentration*

	Value Added	Output	Value Added	Output
Democracy	-0.159***	-0.166***	-0.111*†	-0.121**
	(0.052)	(0.048)	(0.070)	(0.061)
GDP p.c.			-0.386	-0.623**
			(0.269)	(0.263)
GDP p.c. Squared			0.019	0.034**
			(0.018)	(0.017)
Constant	2.880***	2.739***	4.629***	5.402***
	(0.136)	(0.127)	(1.060)	(1.037)
R^2	0.072	0.084	0.109	0.127
N	2695	2623	2649	2591

Notes. Pooled OLS regression of the Herfindahl-Hirschman index in manufacturing on democracy, GDP per capita, and GDP per capita squared. Standard errors clustered by country. *$\dagger < 0.12$, *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

is indeed less concentrated than in less democratic ones. The negative coefficient on income suggests that richer countries also tend to be more diversified, although it is only significant when we use output to construct our dependent variable. Finally, the positive coefficient on the square of income – although significant only when our measure of concentration is calculated based on sectoral value added – confirms Imbs and Wacziarg's (2003) findings.

Thus, consistent with our model's prediction, less democratic countries have less diversified manufacturing sectors, and this effect is independent of the effect of the level of development on diversification identified previously in the literature.

4.3. Back to Reversals

Our model suggests that non-democracies ultimately experience more severe growth reversals because they erect higher barriers to entry. A direct test of this hypothesis would involve checking if countries with higher barriers experience larger growth reversals. The difficulty with this strategy is that we lack data on barriers to entry for a large span of countries and years. To our knowledge, the most comprehensive data set is the one used in Djankov et al. (2002), which only covers several years in the 1990s, making it impossible to run our dynamic panel specification. We can, in a limited way, explore the effects of barriers to entry on growth reversals using the cross-sectional regression of Section 2.2. Here we reproduce Table 6, where we regress the number of growth reversals on the overall number of structural breaks, initial income, and a set of variables usually thought to affect volatility. Presently, however, we expand the set to include the variable that our model predicts should be related to the propensity for growth reversals – barriers to entry. The measure of barriers is an average of the cost of registering new business, the number of procedures required to register, and the average time it takes to complete them (from Djankov et al., 2002).

As can be seen in the last column of Table 9, the effect of higher barriers on the propensity to cycle is positive, although not significant. Interestingly, including this regressor reduces the size of the coefficient on democracy and renders it nonsignificant, and we cannot reject the hypothesis that the coefficient on democracy is non-negative (values for this test are in the bottom row of the table). We do not give this result too much weight because first, the sample size is reduced significantly when we use the Djankov et al. (2002) proxy, and second, the barriers we believe are important are much broader than just official registration costs.[24] However, we view the fact that the barriers variable appears to account for at least some of the effect of democracy as supportive of the channel predicted by our model.

Table 9: *Determinants of the Number of Growth Reversals; including Barriers to Entry*

	Law	Corr.	Eth. Frac.	Open	Fin. Dev.	Overval.	Infl.	Barriers
Democracy	-1.391*	-1.358*	-1.338*	-1.702**	-1.496**	-1.465**	-1.464**	-0.705
	(0.785)	(0.781)	(0.766)	(0.734)	(0.701)	(0.714)	(0.731)	(0.996)
x	-0.005	-0.017	0.022	0.212	-0.250	-0.247	0.040	0.127
	(0.118)	(0.115)	(0.323)	(0.299)	(0.309)	(0.313)	(0.232)	(0.129)
No. of Breaks	0.458***	0.456***	0.456***	0.420***	0.464***	0.476***	0.478***	0.463***
	(0.126)	(0.126)	(0.126)	(0.128)	(0.125)	(0.124)	(0.128)	(0.138)
Initial Income	-0.000	0.007	-0.019	-0.023	0.032	-0.057	-0.032	-0.062
	(0.125)	(0.130)	(0.125)	(0.113)	(0.115)	(0.119)	(0.118)	(0.128)
Constant	1.567	1.471	1.680	2.105**	1.511*	2.183**	1.887**	1.327
	(1.122)	(1.186)	(1.030)	(0.917)	(0.841)	(0.842)	(0.833)	(0.983)
R^2	0.17	0.17	0.17	0.19	0.19	0.23	0.19	0.19
N	74	74	72	73	73	63	69	53
Demo. < 0								
(p-value)	0.04	0.04	0.04	0.01	0.02	0.02	0.02	0.24

Notes. Cross-section OLS rregression of number of growth reversals on democracy, income, number of breaks and a set of variables common in empirical growth studies: rule of law, corruption, ethno-linguistic fractionalization, openness, financial development, real exchange overvaluation, inflation, and barriers to entry. Standard errors in parentheses. Bottom rows give the p-values of the test that the coefficient on democracy is non-negative. $^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Another, indirect test of our hypothesis would be to check whether countries with a more

[24] In fact, running the regression without the barriers variable on the same 53 observations also produces a nonsignificant estimate of the democracy coefficient, though the point estimate is larger (-.95) and the p-value of the test of whether it is non-negative is 0.16.

concentrated production structure tend to experience more growth reversals, regardless of their level of democracy. Unfortunately, it is again the case that the data on concentration are too sparse (both in country and year coverage) to repeat our two-stage procedure on the full sample. When we re-estimate the main specification including measures (and their interaction with growth before the break) of concentration in value added and output, respectively, the sample size drops roughly by half. The results are shown in Tables 10 and 11.

In four out of the six specifications, the estimated coefficients on the interaction of concentration and pre-break growth are large and negative (suggesting concentration increases the size of growth reversals); however, they are also very imprecisely estimated, and they do not eliminate the effect of democracy. The combination of a reduced sample and the fact that the Herfindahl index in manufacturing is a noisy and imperfect measure of the overall diversification of the economy may be driving the results, and clearly, more work and better data are needed to explore the role of concentration in medium-term growth swings in more depth.

5. Conclusions

There exists convincing evidence that democratic countries are less volatile than non-democratic ones. However, this conclusion is usually reached with respect to volatility as measured by the standard deviation of annual growth rates of per-capita GDP, which includes both low and high frequency fluctuations. Several recent papers document that significant changes in trend-growth, such as growth accelerations that last a decade, or similar periods of negative growth, are quite common (Pritchett, 2000; Hausmann et al., 2005; Jerzmanowski, 2006a; Jones and Olken, 2007). This suggests that much of the volatility of the growth process, especially for developing countries, comes from medium-term changes in the trend rather than from high frequency shocks, i.e., there is a lot of "trend-volatility". In this paper we ask whether democracy also has a stabilizing effect on trend-volatility, i.e. whether more democratic countries experience fewer and milder swings of trend-growth.

We find a common phenomenon of medium-term reversals of growth; that is, periods of exceptionally high growth are, on average, followed by periods of exceptionally low growth, and vice versa. The propensity to experience large swings of trend-growth is not uniform across countries – less democratic countries are more susceptible to it. When compared with factors commonly associated with volatility, such as measures of quality of institutions, macroeconomic policies, and financial development, we find that democracy is the most robust predictor of a country's propensity for growth reversals. Finally, we test whether our

Table 10: *Magnitude of Growth Reversals; including Output Concentration*

	Pooled OLS	Fixed Effects	System GMM
Growth before Break	-1.083***	-1.355**	-1.287***
	(0.295)	(0.525)	(0.353)
Initial Income	0.002	-0.023	-0.001
	(0.004)	(0.025)	(0.008)
Democracy	-0.012	-0.036	-0.012
	(0.010)	(0.024)	(0.016)
Democracy × Growth Before Break	0.895***	0.415	1.002***
	(0.213)	(0.311)	(0.275)
Concentration	-0.054	-0.020	-0.051
	(0.060)	(0.139)	(0.064)
Concentration × Growth Before Break	-1.493	2.871	-1.979
	(1.489)	(4.483)	(1.829)
Democracy × Income	-0.377**	-0.130	-0.470**
	(0.167)	(0.357)	(0.232)
Constant	0.018	0.021	0.016
	(0.014)	(0.053)	(0.023)
Hansen p-value			0.65
R^2	0.147	0.565	
N	114	114	114

Notes. Estimates of equation (3) adding manufacturing output concentration measure. Robust standard errors in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

results can be explained by the fact that countries that rely heavily on natural resources tend to be less democratic and also exposed to large shocks (in the form of large swings of world prices of the resources they export). While shocks to prices of natural resources appear to contribute to the propensity for growth reversals, they do not account for the effect of democracy. Motivated by these findings, we present a model where non-democracies, with higher barriers to entry of new firms, suffer from greater sectoral concentration and experience (infrequent but large) growth swings. This is the only model that we are aware of that explains non-democracies' high propensity for *both* growth disasters and spectacular growth accelerations.

Understanding medium-term patterns in economic growth is important. Because trend-growth changes are frequent and large, they are an important feature of the long-term growth process. Academics, as well as practitioners of development economics, are increasingly realizing the importance of understanding crises and prolonged periods of stagnation (Aizenman and Pinto, 2008). The literature on growth accelerations, however, finds that periods of rapid growth are not uncommon even among countries with low average growth rates and

Table 11: *Magnitude of Growth Reversals; including Value Added Concentration*

	Pooled OLS	Fixed Effects	System GMM
Growth before Break	-0.966***	-1.341**	-1.047***
	(0.298)	(0.563)	(0.345)
Initial Income	0.003	-0.022	0.001
	(0.004)	(0.025)	(0.008)
Democracy	-0.013	-0.038	-0.015
	(0.010)	(0.023)	(0.016)
Democracy × Growth Before Break	0.929***	0.397	1.028***
	(0.185)	(0.330)	(0.231)
Concentration	-0.023	-0.040	-0.024
	(0.039)	(0.115)	(0.045)
Concentration × Growth Before Break	-1.151	1.787	-2.007
	(1.054)	(3.301)	(1.550)
Democracy × Income	-0.253**	-0.164	-0.306**
	(0.109)	(0.330)	(0.133)
Constant	0.018	0.006	0.020
	(0.014)	(0.047)	(0.024)
Hansen p-value			0.51
R^2	0.131	0.570	
N	115	115	115

Notes. Estimates of equation (3) adding manufacturing value added concentration measure. Robust standard errors in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

conclude from this that sustaining – not initiating – growth is the more difficult part of a successful development enterprise (Hausman et al., 2005; Jerzmanowski, 2006b). It seems that most countries can achieve growth with a limited degree of reform or policy change, but the challenge is to understand what makes growth continue. Our results put a different perspective on these findings. Less democratic countries not only fail to sustain growth, but also see its fruits undone by large slowdowns or periods of decline that follow their growth spurts. In fact, the growth spurts themselves can equally correctly be viewed as periods of successfully initiating growth or as symptoms of the underlying weakness of the economy which, by limiting diversification, makes large growth accelerations possible, while at the same time facilitating the dramatic reversals. Here our model suggests that stabilizing the economy through greater diversification will reduce the frequency of dramatic collapses, but at the same time make spectacular accelerations less likely. It also suggests to policymakers that periods of rapid growth, especially in less democratic countries, should not be immediately be viewed as achieving lasting success and that perhaps appropriate policies – foremost, a reduction in barriers to entry – during the boom years could be used to enhance diversification and help the economy avoid a growth reversal. Obviously, more research is needed to fully understand the mechanism of trend-volatility. Such research has the potential to not only contribute to our understanding of economic growth but also inform policy in important ways. As emphasized by Pritchett (2000), from the policymakers' point of view, lessons about medium-term growth are likely much more relevant than those about the long run.

References

[1] Acemoglu, D. (2008). 'Oligarchic versus democratic societies', *Journal of European Economic Association*, vol. 6 (January), pp. 1-44.

[2] Acemoglu, D., Johnson, S., Robinson, J. and Thaichoren, Y. (2003). 'Institutional causes, macroeconomic symptoms: volatility, crises and growth', *Journal of Monetary Economics*, vol. 50(1), pp. 49-123.

[3] Acemoglu, D. and Zilibotti, F. (1997). 'Was Prometheus unbound by chance? Risk diversification and growth', *Journal of Political Economy*, vol. 105(4), pp. 709-51.

[4] Aghion, P., Alesina, A. and Trebbi, F. (2007). 'Democracy, Technology, and Growth', working paper.

[5] Aguiar, M. and Gopinath, G. (2007). 'Emerging market business cycles: the cycle is the trend', *Journal of Political Economy*, vol. 115(1) (February), pp. 69-102.

[6] Aizenman, J. and Pinto, B. (2005). 'Overview', in (J. Aizenman and B. Pinto, eds.), *Managing Economic Volatility and Crises: A Practitioner's Guide*, pp. 1-44, Cambridge: Cambridge University Press.

[7] Arellano, M. and Bond, S. (1991). 'Some tests of specification for panel data', *Review of Economic Studies*, vol. 58(2) (April), pp. 277-97.

[8] Bai, J. and Perron, P. (1998). 'Estimating and testing linear models with multiple structural changes', *Econometrica*, vol. 66, pp. 47-78.

[9] Barro, R. and Sala-i-Martin, X. (2003). *Economic Growth*, 2nd Edition, Cambridge: MIT Press.

[10] Ben-David, D., Lumsdaine, R. and Papell, D. H. (2003). 'Unit roots, postwar slowdowns and long-run growth: evidence from two structural breaks', *Empirical Economics*, (February), pp. 303-19.

[11] Berg, A., Ostry, J. D. and Zettelmeyer, J. (2008). 'What makes growth sustained?', IMF Working Paper No. 08/59, (July).

[12] Bolt, K., Matete, M. and Clemens, M. (2002). 'Manual for calculating adjusted net savings', Environment Department, The World Bank, (September).

[13] Blundell, R. and Bond, S. (1998). 'Initial conditions and moment restrictions in dynamic panel data models', *Journal of Econometrics*, vol. 87(1), pp. 115-43.

[14] Dehn, J., Gilbert, C. and Varangis, P. (2005). 'Agricultural commodity price volatility', in (J. Aizenman and B. Pinto, eds.), *Managing Economic Volatility and Crises: A Practitioner's Guide*, pp. 137-85, Cambridge: Cambridge University Press.

[15] Djankov, S., Laporta, R., López-de-Silanes, F. and Shleifer, A. (2002). 'The regulation of entry', *Quarterly Journal of Economics*, vol. 117(1) (February), pp. 1-37.

[16] Easterly, W. (2006). 'Reliving the 50s: the Big Push, poverty traps, and takeoffs in economic development', *Journal of Economic Growth*, vol. 11(2) (December), pp. 289-318.

[17] Easterly, W., Kremer, M., Pritchett, L. and Summers, L. (1993). 'Good policy or good luck: country growth performance and temporary shocks', *Journal of Monetary Economics*, vol. 32(3) (December), pp. 459-83.

[18] Easterly, W., Levine, R. (1998). 'Troubles with the neighbours: Africa's problems and Africa's opportunities', *Journal of African Economics*, VII, pp. 120-42.

[19] Galor, O., Moav, O. and Vollrath, D. (forthcoming, 2006). 'Inequality in land ownership, the emergence of human capital promoting institutions, and the great divergence', *Review of Economic Studies*.

[20] Hausmann, R., Pritchett, L. and Rodrik, D. (2005). 'Growth Accelerations', *Journal of Economic Growth*, vol. 10(4) (December), pp. 303-29.

[21] Heston, A., Summers, R. and Aten, B. (2006). *Penn World Table Version 6.2*, Center for International Comparison at the University of Pennsylvania (CICUP).

[22] Hnatkovska, V. V. and Loayza, N. (2005). 'Volatility and Growth', in (J. Aizenman and B. Pinto, eds.), *Managing Economic Volatility and Crises: A Practitioner's Guide*, pp. 65-100, Cambridge: Cambridge University Press.

[23] Howitt, P. (2000). 'Endogenous growth and cross-country income differences', *American Economic Review* 90(4) (September), pp. 829-46.

[24] Imbs, J. and Wacziarg, R. (2003). 'Stages of diversification', *American Economic Review*, vol. 93(1) (March), pp. 63-86.

[25] Jerzmanowski, M. (2006a). 'Empirics of hills, plateaus, mountains and plains: a Markov switching approach to growth', *Journal of Development Economics*, vol. 81(2) (December), pp. 357-85.

[26] Jerzmanowski, M. (2006b). 'Acceleration, stagnation and crisis: the role of macro policies in economic growth', working paper, Clemson University.

[27] Jones, B. F. and Olken, B. A. (2008). 'The anatomy of start-stop growth', *Review of Economics and Statistics*, vol. 90(3) (August), pp. 582-87.

[28] Kaufmann, D., Kraay, A. and Mastruzzi, M. (2003). 'Governance matters III: governance indicators for 1996-2002', World Bank Policy Research Working Paper 3106.

[29] Klenow, P. and Rodriguez-Clare, A. (2005). 'Externalities and Growth', in (P. Aghion and S. N. Durlauf, eds.), *Handbook of Economic Growth*, vol. 1A, pp. 817-61, Amsterdam: Elsevier.

[30] Koren, M. and Tenreyro, S. (2007a). 'Volatility and development', *Quarterly Journal of Economics*, vol. 122(1) (February), pp. 243-87.

[31] Koren, M. and Tenreyro, S. (2007b). 'Technological Diversification', working paper.

[32] Krusell, P. and Rios-Rull, J. V. (1996). 'Vested interests in a positive theory of stagnation and growth', *Review of Economic Studies*, vol. 63(2) (April), pp. 301-29.

[33] Marshall, M. G. and Jaggers, K. (2002). 'Polity IV project. Political regime characteristics and transitions, 1800-2002', Integrated Network for Societal Conflict Research (INSCR), Program Center for International Development and Conflict Management (CIDCM), University of Maryland, www.cidcm.umd.edu/inscr/polity.

[34] Mobarak, A. M. (2005). 'Democracy, volatility, and economic development', *Review of Economics and Statistics*, vol. 87(2) (May), pp. 348-61.

[35] Parente, S. and Prescott, E. C. (1994). 'Barriers to technology adoption and development', *Journal of Political Economy*, vol. 102(2), pp. 298-321.

[36] Parente, S. and Prescott, E. C. (1999). 'Monopoly rights: a barrier to riches', *American Economic Review* vol. 89(5) (December), pp. 1216-33.

[37] Perotti, E. and Volpin, P. (2007). 'Investor protection and entry', Tinbergen Institute Discussion Papers 07-006/2, Tinbergen Institute.

[38] Persson, T. and Tabellini, G. (2006). 'Democratic capital: the nexus of political and economic change', CEPR Discussion Paper 5654.

[39] Pritchett, L. (2000). 'Understanding patterns of economic growth: searching for hills among plateaus, mountains, and plains', *The World Bank Economic Review*, vol. 14(2), pp. 221-50.

[40] Pritchett, L. (2006). 'The quest continues', *Finance and Development*, Vol. 43(1) (March).

[41] Quinn, D. and Woolley, J. (2001). 'Democracy and national economic performance: the preference for stability', *American Journal of Political Science*, vol. 45(3), pp. 634-57.

[42] Ramey, G. and Ramey, V. A. (1995). 'Cross-country evidence on the link between volatility and growth', *American Economic Review*, vol. 85(5) (December), pp. 1138-51.

[43] Rodrik, D. (1997). 'Democracy and economic performance', paper prepared for a conference on democratization and economic reform in South Africa, Cape Town, (January), pp. 16-19.

[44] Rodrik, D. (1999). 'Where did all the growth go?', *Journal of Economic Growth*, vol. 4(4) (December), pp. 385-412.

[45] Rodrik, D. (2000). 'Participatory politics, social cooperation, and economic stability', *American Economic Review*, Vol. 90(2) (May), pp. 140-144, Papers and Proceedings of the One Hundred Twelfth Annual Meeting of the American Economic Association.

[46] Sachs, J. D. and Warner, A. M. (1997). 'Sources of slow growth in African economies', *Journal of African Economies*, vol. 6(3), pp. 335-76.

[47] Tsui, K. (2008). 'More oil, less democracy?: theory and evidence from crude oil discoveries', working paper, Clemson University.

[48] United Nations Industrial Development Organization (2006). *Industrial Statistics Database, 3-digit ISIC*, United Nations Industrial Development Organization, Vienna.

[49] Wang, J., and Zivot, E. (2000). 'A Bayesian time series model of multiple structural changes in level, trend, and variance', *Journal of Business and Economic Statistics*, vol. 18(3) (July), pp. 374-386.

[50] Wooldridge J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*, Cambridge: MIT Press.

[51] World Bank (2005). World Development Indicators, Washington, DC: The World Bank.

[52] World Bank Research Datasets. Social Indicators and Fixed Factors, http://econ.wordlbank.org

Appendix

1. The Linear Case

The gap between rates of return, $\Psi(n) \equiv \phi - \frac{n_t}{N}\frac{A}{n_t^{\rho}}$ is a decreasing function of n since, as long as $\rho < 1$, the expected return in the risky sector rises with n. This is illustrated in Figure 9(a).

Note also that $\Psi(0) = \phi > 0 \Rightarrow \mu = 0$, i.e., it is optimal to invest zero resources in the risky technology if no sectors are open and $\Psi(\bar{n}) = 0$ for $\bar{n} = \left(\frac{N\phi}{A}\right)^{\frac{1}{1-\rho}}$, which denotes the indifference point between investing or not in the risky sector. To the left of $\bar{n}$, return from the safe sector dominates entrepreneurial activity and even the skilled agents sets $\mu = 1$. To the right, the reverse is true and optimal allocation of saving involves $\mu = 0$.[25]

As it is stated in the text, the first-order condition for n can be solved to obtain

$$\mu_t = 1 - \frac{(2-\rho)}{S_t(1-\rho)}\, n_t\, \psi \equiv \Gamma(n_t). \tag{12}$$

This relation represents the combinations of n and μ, which ensure the first-order condition for n is satisfied (see Figure 9(b)). The vertical intercept is $\Gamma(0) = 1$ because it can only be optimal to open no risky sectors if no resources are devoted to risky investment ($\mu = 1$). As long as ρ is less than one this relationship is strictly decreasing and satisfies $\Gamma(n^*) = 0$ where $n^* = S_t \frac{1-\rho}{(2-\rho)\psi}$.

The corner solution $\mu = 1$ and $n = 0$ always satisfies the first-order conditions. For there to be an interior solution for n the $\Gamma(n)$ line must intersect the horizontal axis in the region where $\mu = 0$ is the optimal choice, i.e., $n^* > \bar{n}$. If this is the case, the choice $\mu = 0$ and $n = n^*$ satisfies the first-order conditions. This is illustrated in Figure 10.

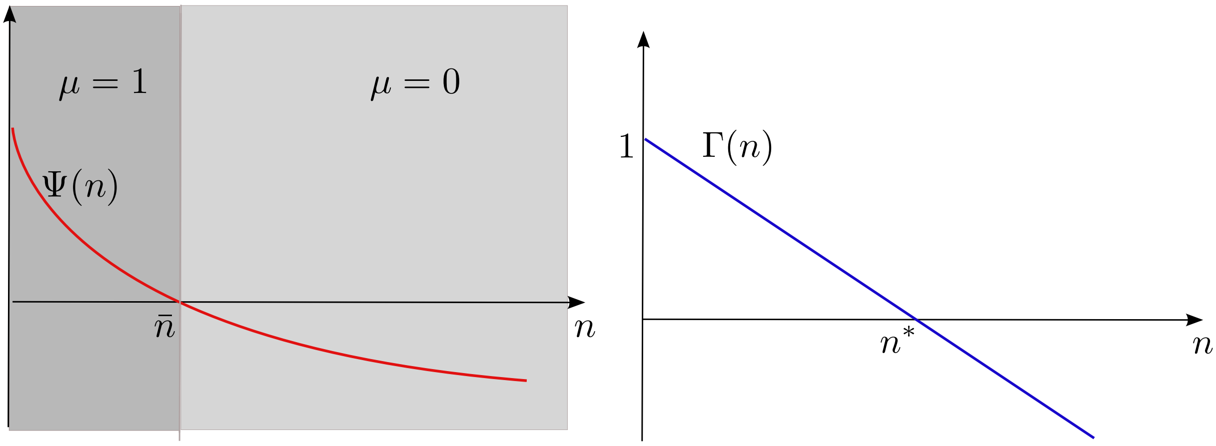
2. The Log Case

Suppose now that the lifetime utility function of any agent is given by

$$U = \log(c_y) + \beta \log(c_o), \tag{13}$$

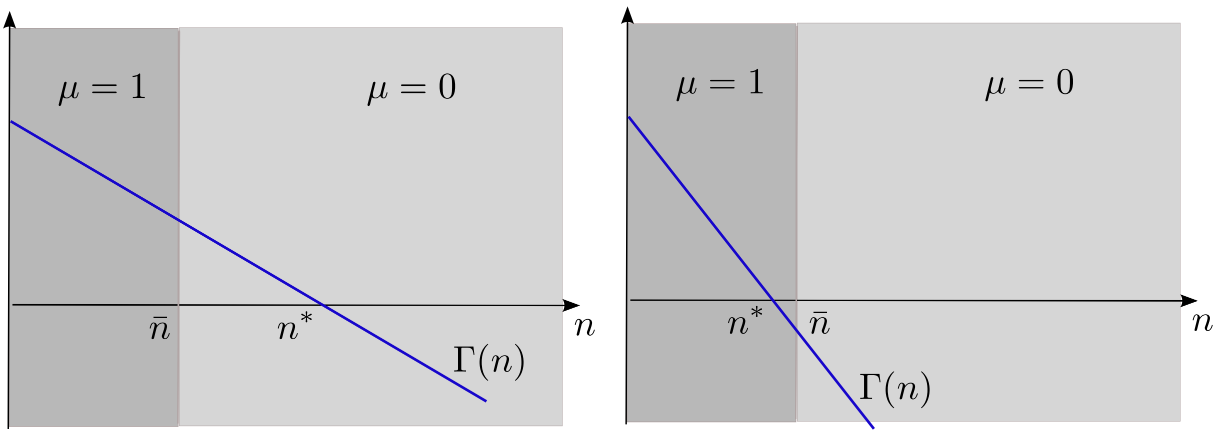
where c_y, c_o represent the agent's consumption when young and old, respectively. The parameter $\beta \in (0,1)$ is its discount of the future.

[25] We assume that for $n = \bar{n}$ the agent chooses $\mu = 0$.



(a) Optimal μ (b) Optimal n

Fig. 9: *Determination of Optimal μ (Panel a) and n (Panel b).*



(a) Interior n (b) No interior n

Fig. 10: *Panel (a): Interior solution for n exists. Panel (b): No interior solution for n.*

2.1. Unskilled Agents

The problem of an unskilled young agent then becomes:

$$\max_{c_y, c_o^L, c_o^U, \mu, n} \log(c_y) + \beta \left\{ \frac{n}{N} \log(c_o^L) + \left(1 - \frac{n}{N}\right) \log(c_o^U) \right\} \tag{14}$$

$$c_y + S = w$$

$$c_o^L = \left\{ \frac{A_u[(1-\mu)S - \psi n]}{n^\rho} + \mu S \phi \right\}$$

$$c_o^U = \mu S \phi,$$

where c_o^L, c_o^U represent consumption of the old agent in the lucky and unlucky states of the world, respectively. As before, by "lucky" we mean that one of the sectors that the old

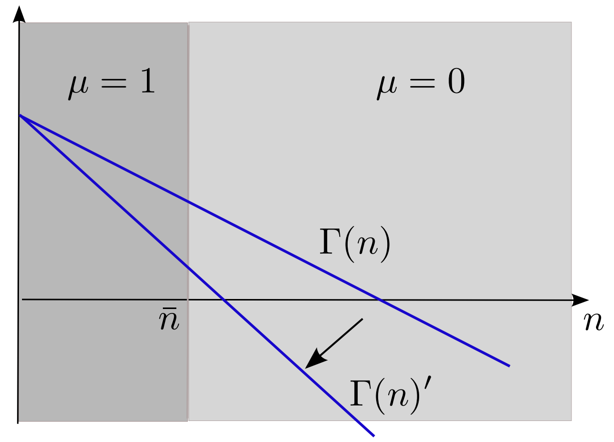


Fig. 11: *The effect of an increase in ψ*

agent operates becomes productive. The first constraint indicates that in the first period the available resources, i.e., wages can be used to either consume or save for the future. The two additional constraints are identical to those of the linear case presented in the main text.

Since we assume unskilled agents are unproductive in the risky sector ($A_u = 0$) the solution to this problem is:

$$\mu^* = 1 \text{ and } S^* = \frac{\beta w}{1+\beta}. \tag{15}$$

Unskilled agents still choose to operate only the safe technology, i.e., they invest all their funds in the safe technology and they save a constant fraction of their wages for the next period.

2.2. Skilled Agents

The problem of a skilled young agent is:

$$\max_{c_y, c_o^L, c_o^U, \mu, n} \log(c_y) + \beta \left\{ \frac{n}{N} \log(c_o^L) + \left(1 - \frac{n}{N}\right) \log(c_o^U) \right\} \tag{16}$$

$$c_y + S = w$$

$$c_o^L = \frac{A_s[(1-\mu)S - \psi n]}{n^\rho} + \mu S \phi$$

$$c_o^U = \mu S \phi.$$

The solution to this problem is given by:

$$\mu^* = \frac{A_s(N-n)(S-\psi n))}{SN(A_S - \phi n^\rho)} \text{ and } S^* = \frac{\beta w + \psi n}{1+\beta}. \tag{17}$$

It is not possible to obtain a closed-form solution for the optimal value of n. However, through numerical simulation, it is easy to confirm that it is indeed inversely related to ψ. The other important point to establish is that increases in ψ increase the amount of resources invested per risky sector – i.e., that the "concentration effect" of the linear case it is also present here. The extra capital from a risky sector that pays off is $A_s\left(\frac{(1-\mu)S-\psi\, n}{n^\rho}\right)$. In our simple model s was exogenous, $\mu = 0$ for the skilled agents, and n was proportional to $1/\psi$ so that $n\psi$ was independent of ψ . Thus it was easy to see that if greater barriers lead to fewer sectors being operated, they must also necessarily lead to more resources being allocated to each. To confirm that this is true in the endogenous saving and log utility case, we again resort to numerical calculations. There are several effects at work now. First, because of risk aversion an increase in ψ, and the subsequent reduction in n will, lead to a lower fraction of resources allocated to risky sectors ($1-\mu$ will fall). On the other hand, because of a precautionary motive, saving will increase (S will rise). These two effects work in opposite directions so that the total resources allocated to risky sectors $(1-\mu)S$ does not change much with ψ. A similar result holds for $n\psi$, which, unlike in the linear case with an exogenous saving rate, is not independent of ψ but again the two terms move in opposite directions. All this means that the numerator of μ^* does not vary much with ψ and the n^ρ in the denominator dominates. We conclude from numerical calculations that, for most parameter values, increases in ψ increase the amount of resources $1-\mu$ invested in the lower number of opened risky sectors.

3. Full Dynamics

There exists a threshold level of capital K^* such that for capital beyond it, wages and savings are high enough so that $n^* > N$ and all sectors are operated regardless of the entry cost. This can be seen from equation (9) and by observing that wages and thus savings S increase with capital stock. This threshold is, of course, increasing with the level of barriers, that is $dK^*/d\psi > 0$.

Figure 12 shows the complete characterization of the $K^L(K_t)$ schedule for two economies with different levels of entry costs (the $K^U(K_t)$ schedule is omitted). The solid line is for the economy with low barriers (ψ_L), while the dashed line is for the economy with high barriers (ψ_H). For K above each of the thresholds, the curves become steeper and have a negative intercept (they can be obtained by substituting n^* for N in equation (10)). Dynamics are given by the outer envelope of the two curves (bold portion of the two curves in the figure). For economies that are below the cutoff (not all sectors are operated), the $K^L(K_t)$ schedule of the economy with higher barriers (dashed line) is above the one for an economy with lower

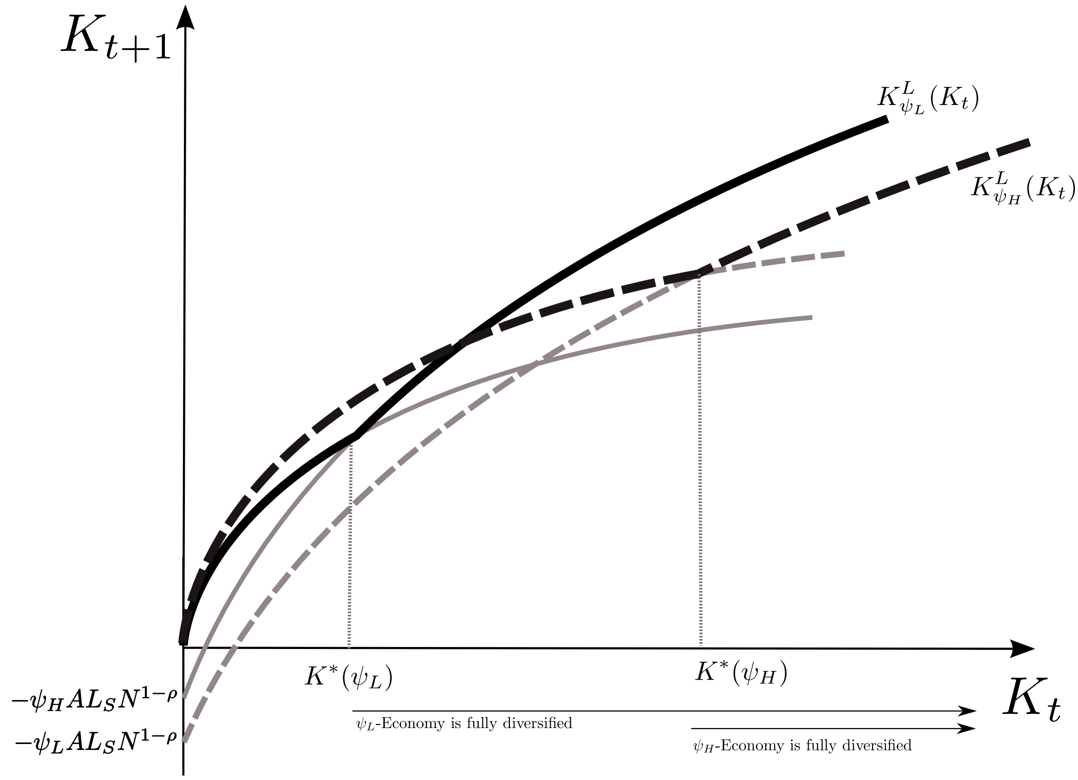
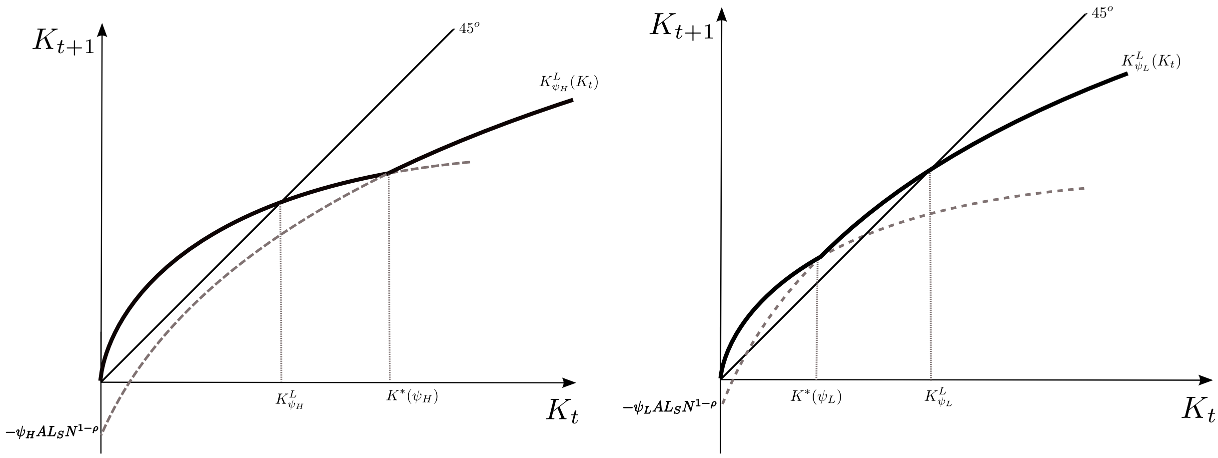


Fig. 12: *The* $K^L(K_t)$ *Schedule*

Notes. Complete characterization of the $K^L(K_t)$ schedule for two economies with different levels of entry costs. The solid line is for the economy with low barriers (ψ_L) while the dashed line is for the economy with high barriers (ψ_H).

barriers (solid line), as was discussed in the main text. For fully diversified economies (those that operate all N sectors) the $K^L(K_t)$ schedule is always higher for the one with lower entry costs. This indicates that higher barriers of entry are bad for capital accumulation and growth once the economy is fully diversified. Figure 13(a) illustrates a case in which an economy with high barriers (non-democracy) never reaches fully diversification because the critical threshold is to the right of its steady state. Figure 13(b), in contrast, represents an economy with low barriers (democracy) that eventually converges to a deterministic steady state (i.e., one with a fully diversified production sector).



(a) Non-Democracy (High ψ)

(b) Democracy (Low ψ)

Fig. 13: *Medium term growth reversals. Panel (a): Non-Democracy; Panel (b):Democracy.*