Democracy, Diversification, and Growth Reversals

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Abstract

Several studies have documented a negative relationship between democracy and volatility. The latter is usually measured at high frequency – as the standard deviation of annual GDP growth rates. On the other hand, growth researchers have recently focused on the medium term and documented frequent shifts in the trend-growth process within countries. In this paper we aim to connect these two strands of the literature: we ask whether trend-volatility is also lower in more democratic countries. We find evidence of a common pattern in less democratic countries – there appear to be frequent medium term reversals of growth, i.e. episodes when a period of exceptionally high growth is followed by a period of exceptionally low or even negative growth, and vice versa. 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. 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: fewer sectors are operated but more resources are channeled to each. In an uncertain environment this leads to infrequent but large growth accelerations when one of the few sectors operated is successful. However, these accelerations are followed by large declines when fortunes change in favor of the missing sectors. We present empirical evidence that confirms the positive relationship between democracy and industrial diversification.

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1 Introduction

Economists have always been interested in the relationship between long run economic outcomes and democracy. The evidence of the direct impact of democracy on growth is mixed (Persson and Tabellini 2006) but there exists strong evidence that democratic countries are less volatile (Rodrik 1999a). 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 the large shifts in the 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 underperformed 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 the 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 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.[3] Next we analyze the patterns in trend-growth changes.

[1] Aguiar and Gopinath (2007) argue that accounting for trend volatility significantly improves the fit of international real business cycle models in emerging economies.

[2] Some papers have attempted 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.

[3] We follow the approach of Jones and Olken (2008) and employ the Bai-Perron test to detect structural breaks in growth

In particular we estimate: (i) how the magnitude of trend-growth changes varies with the degree of democracy of the country, and (ii) whether democracy affect the likelihood of experiencing really 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 growth rates are not monotone, i.e. 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 where a period of very fast growth is followed by a decline or a 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

(see Ben-David et al. 2003). Because this is an asymptotic test and the time series dimension of our data is not very large (around 40 observations) we confirm our findings with a more robust Bayesian approach, following Wang and Zivot (2000).

these predictions.

The paper is organized as follows. Section 2 briefly reviews the literature related to our work. The data, structural break detection, and our main empirical findings are described in Section 3. Section 4 presents the theoretical model. The main tests of the theory are displayed in Section 5. Finally, Section 6 concludes.

2 Related Literature

Our paper relates to several branches of the literature. First, it contributes to the relatively unexplored study of the 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.[4] Hausmann et al. (2005) look for growth accelerations 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.[5]

Second, we contribute to the literature on democracy and volatility. Several papers have documented that non-democracies experience more growth volatility (Rodrik 1999a & 1997, 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

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

[5]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 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).

to distinguish between medium term trend changes and high frequency fluctuations. [6] Given the new evidence showing that trend-breaks are frequent, we investigate the relationship between democracy and this aspect of volatility. A related approach is taken by Rodrik (1999b) who shows that the growth slowdowns of 1970's 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 relationship 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.[7] 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.

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.[8] 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. This occurs also in our model since, as countries accumulate more capital, wages and saving go up and they can afford opening a larger number of risky sectors and hence their economy becomes more stable.

Imbs and Wacziarg (2003) present empirical evidence showing that 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.

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

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

[8] We highlight the differences between the two models in Section 4.

Finally, we are related to the surprisingly limited literature that formally models periods of negative growth. Acemoglu and Zilibotti (1997) generate negative growth in a context similar to ours, although there industrial concentration is not due to the presence of barriers to entry but to the lack of capital to invest in a large number of sectors that undermines the ability of entrepreneurs to diversify risk. Other papers that model negative growth are McDermott (2007), Artige et al. (2004), and Tornell (1997).

3 Empirical Analysis

3.1 Detection of Structural Breaks

Consider the following simple model

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

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.[9] 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 – which we assume is given by the U.S. 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 of the former.

One could also use the absolute level of output per worker. However, in an interdependent world 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,

[9] 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.

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 or further away from the world technological frontier.[10]

The structural break test developed by Bai and Perron (1998) allows 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.[11] In order to distinguish the 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 3.1 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).[12] The second break occurs around 1990 and this time growth becomes less negative without changing sign. The graph also shows the confidence intervals of these estimated breaks.

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

[10]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, all this means is that to convert the numbers to absolute growth one should add 2%, which is roughly the average growth rate of the U.S. in the last hundred years.

[11]The Bai-Perron test for structural breaks is implemented by an algorithm that searches all possible sets of breaks and calculates a goodness-of-fit measure for each combination. According to this measure, there exists an optimal number of structural breaks in a given time series. This number is found when, by adding a new break, the improvement in fit is not larger than the improvement caused by an arbitrarily small change in the error term. The dynamic programming algorithm that finds these breaks is an efficient way to compare possible combinations of dates and achieve a minimum global sum of squared residuals. There are several criteria one can use to pick the number of breaks; we use the Bayesian Information Criterion.

[12]Interestingly, this economic disaster occurred in the middle of Argentina's most recent military dictatorship (1976-1983).

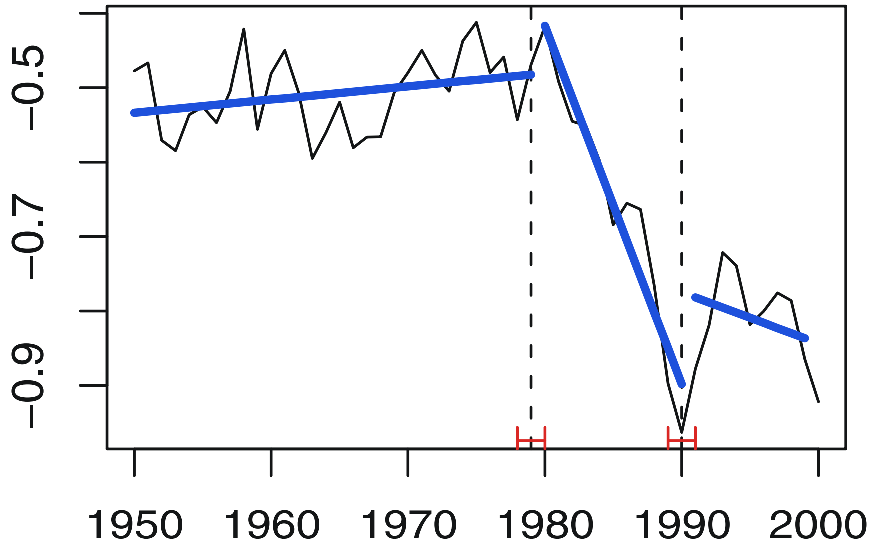

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Figure 1: Path of Argentina's log real output per worker relative to the United States. Bai-Perron break dates are indicated by the vertical dashed lines. The solid lines show the estimate of the trend part of $y_t = \alpha_s + g_s t$. The figure also shows the confidence intervals around the estimated break dates.

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 times.

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. This is particularly important for measuring volatility at high frequencies.[13] 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 somehow larger and more persistent in less democratic countries. This is possible, however we note that one could make a similar argument for poor

[13]For example Ramey and Ramey (1995) restrict their study to the OECD countries to limit the influence of measurement error on their measure of volatility.

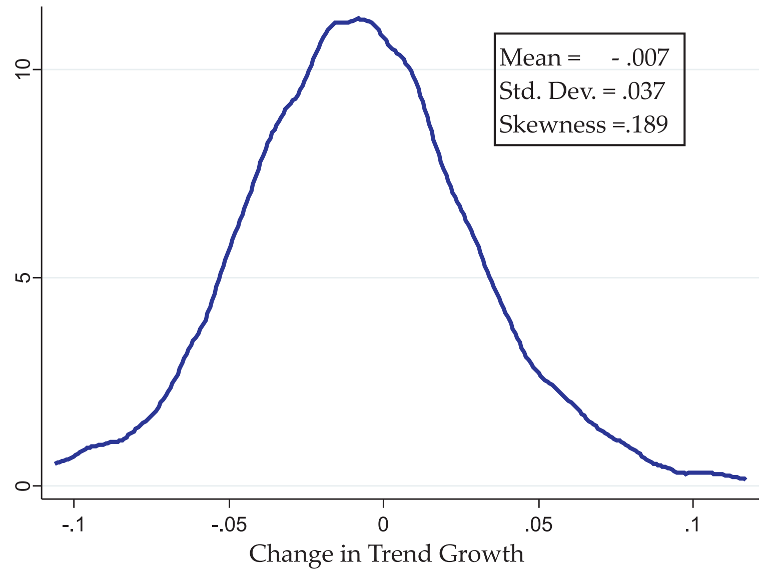


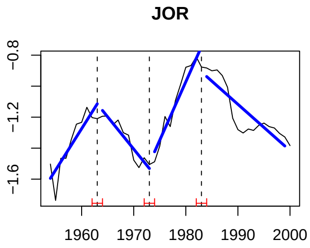
Figure 2: Kernel density plot of the distribution of trend-growth changes.

countries and we do not find that poor countries tend to experience more growth reversals. We do however acknowledge 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.

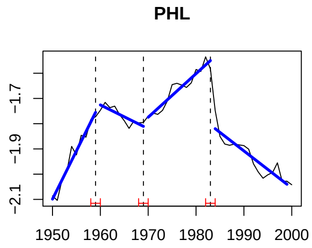
3.2 Growth Reversals and Democracy

Figure 2 below 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 trend 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 the it. Figure 3 shows some examples of such reversals.

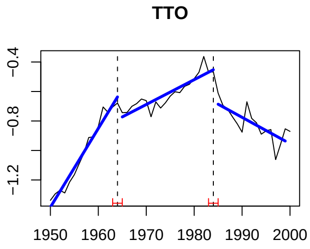
In the remainder of this section we investigate quantitatively how common is the phenomenon of "volatility of trend" seen in Figure 3 and whether it is more ubiquitous among non-democracies as is the case with the usual measure of volatility – the standard deviation of annual growth rates.



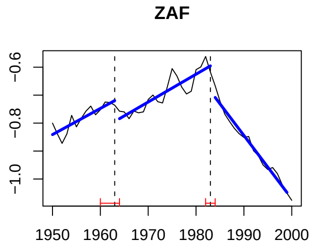
(a) Jordan



(b) Philippines



(c) Trinidad and Tobago



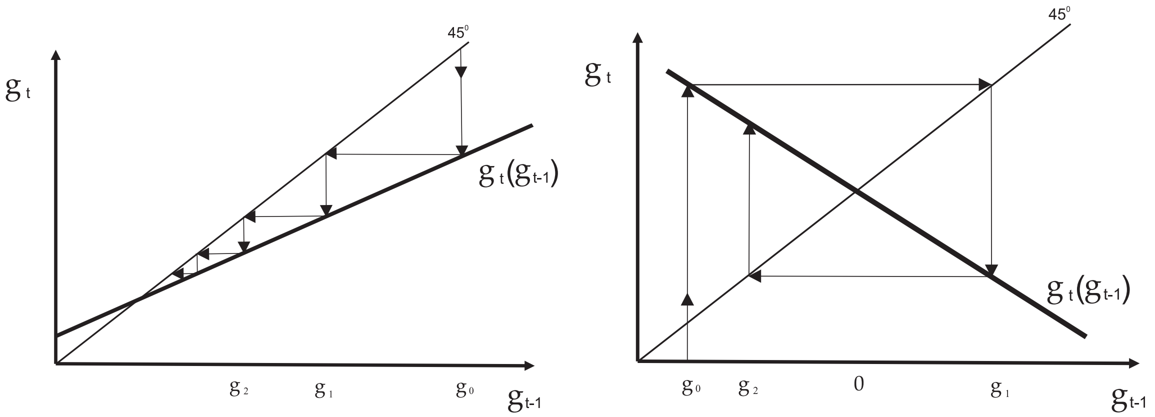
(d) South Africa

Figure 3: Examples of growth reversals.

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 relationship 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 predicting the growth rate after it; there is no memory across breaks. If $\hat{\beta}_1 \in (0, 1)$ then there is monotonic convergence in growth rates. This is a reversion-to-the-mean dynamics, 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.[14]



(a) Monotonic Convergence (b) Cycling

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

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.[15] 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 since t is not calendar 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

[14]Note that if we also included income level as an additional regressor, as we do in the actual specification estimated (with a coefficient β_2), and found $\beta_2 < 0$, growth would follow standard convergence dynamics; the intercept would shift down over time and the long run steady state would be zero growth (or constant gap relative to the U.S. income).

[15]Again, if $\hat{\beta}_2 < 0$, the eventual steady state exhibits zero (relative) growth.

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

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

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 in 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 half million total population. The measure we use in the analysis is *polity2* which is an average of the autocracy and the democracy score. It ranges from -10 to 10 (-10 = high autocracy; 10 = high democracy) and it includes specific indexes meant to capture constraints on the executive, the degree of political competition, effectiveness of legislature, etc. Here too, we take the average over 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, since our regressions include a lagged dependent variable, the fixed-effects estimation of (3) is inconsistent. To address this the last two columns use the GMM estimator, one-equation and system, respectively.[16]

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. On the other hand the interaction with income is insignificant suggesting that it is in fact democracy, not income, what mitigates medium term cycles.[17]

[16]Arellano and Bond (1991) derive a generalized method-of-moments 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 (or per capita) 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 correlation of y with past shocks to g but rule out correlation 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 an addition to an equation in levels – this is the system GMM estimator reported in the last column.

[17]These results are robust to including the duration of the previous growth regime as an additional control.

Finally, note that the Hansen test in the last two columns indicate 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 more trend volatility for Argentina than for western democracies.

	Fixed Effects	Pooled OLS	GMM	System GMM Growth before Break
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

Table 1: Magnitude of growth breaks; estimates of equation (3). Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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. In order 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 favor of our hypothesis

	Fixed Effects	Pooled OLS	GMM	System GMM Growth before Break
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)

Table 2: Magnitude of growth breaks; estimates of equation (3) with bootstrapped standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

that less democratic countries experience significant growth reversals. This new finding is not driven by the methodology used or by the fact that we use estimates from our first stage in our dynamic regression.

The above approach relied 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 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, fixed effects estimation in a probit leads to inconsistent estimates of all parameters (Wooldridge 2002) so we instead report a random effects probit estimates (column 2).[18] We repeat both estimations with a time trend instead of year effects in columns 3 and 4.

The effect of the democracy is negative across all specifications and, except in column

[18]Fixed effect estimation is possible with a logit but it requires a strick erogeneity assumption on all right hand side variables, which income does not satisfy in our model since it depends on past shocks to the reversal process. See Wooldridge (2002).

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
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

Table 3: Probit regression of large trend-growth swings. Panel A shows the results for the change-of-sign definition while in Panel B we use the above/below average definition; pooled and random effects (RE) estimates. Standard errors in parentheses. *† $p < 0.12$,* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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 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 thirteen commodities with the weights being their shares in the country's GDP.[19]

A: Cycles +/-	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: Cycles 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

Table 4: Probit regression of large trend-growth swings; Controlling for Oil exporters. Panel A shows the results for the change-of-sign definition while in Panel B we use the above/below average definition; pooled and random effects (RE) estimates. Standard errors in parentheses. *† $p < 0.12$,* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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 prices shocks on the other hand, 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 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

[19]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.

	Pooled	RE	Pooled	RE
A: Cycles +/-				
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)
Resources	0.157	0.172	0.196	0.210*
	(0.127)	(0.122)	(0.128)	(0.112)
N	328	559	559	559
B: Cycles 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)
Resources	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

Table 5: Probit regression of large trend-growth swings with natural resource price shocks. Panel A shows the results for the above/below average definition while in Panel B we use the change-of-sign definition; pooled and random effects (RE) estimates. Standard errors in parentheses. *† $p < 0.12$,* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

the propensity for growth reversals.[20]

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.[21] We regress this measure on the overall number of breaks, initial income, as well as our 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

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

[21]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 due to the fact there are significantly fewer countries that experienced at least one change of sign growth reversal from which to identify the effects.

(Eth. Frac.) from Easterly and Levine (1998), 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).

	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

Table 6: Determinants of growth reversals. A regression 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. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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 (exchange rate policies, inflation). However, Acemoglu et al. (2003) show that once they control for institutions the effect of policies on volatility disappears. Rodrik (1999a, 1999b) 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 Ziliboti 1997).[22] Since democracy can be argued to foster many of these outcomes (for example, 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

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

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.

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

Table 7: Determinants of growth reversals. A regression of number of cycle breaks on democracy, income, number of breaks and a set of variables common in empirical growth volatility studies: rule of law, corruption, ethno-lingustic fractionalization, openness, financial development, real exchange overvaluation, and inflation. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Many variables have the expected sign (at least when included in isolation – Table 6) but they are rarely significant.[23] More importantly, democracy is always negative, significant and the magnitude of the coefficient doesn't 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 that the channel is not through the effect of democracy on some well-recognized determinant of volatility.

[23] 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.

4 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.[24] 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 good production, can be produced using many risky technologies. The riskiness comes from 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 allows an entrepreneur to diversify some of the risk but is costly since there are fixed costs associated with opening up new business. These entry barriers lead entrepreneurs to operate fewer sectors but allocate more resources to each of them. As we explain below, following theoretical arguments and empirical evidence, we assume that in non-democratic countries entry barriers are higher. It follows that in those 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 of a lot of resources are allocated to this sector. However, there will also be a dramatic collapse when fortunes turn in favor of sectors that are absent. The low degree of diversification means this will occur sooner rather than later.

4.1 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 labor 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

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

producers. Only some agents (skilled) can operate the more profitable (and riskier) capital-good technologies.

4.2 Production

In the model economy there is a competitive final good sector which combines labor and intermediate capital good according to a Cobb-Douglas production function.

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

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

Labor 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.

4.3 Saving

When agents are young they work in the final good 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.[25] Saving is thus given by

$$S_t = s\, w_t$$

When old, the agents transform their saving into capital which they then rent out to the final good producers. They have the following choices available to transform savings into capital: (1) investing in a safe sector which transform a unit of savings into $\phi > 0$ units of capital or (2) invest in risky sectors which, if successful, return A units of capital per unit of savings invested, where $A > \phi$, if operated by a skilled agent and $A = 0$ otherwise. The

[25] 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.

evolution of capital is shown in Figure 5 (μ indicates the fraction of savings allocated to the safe technology)

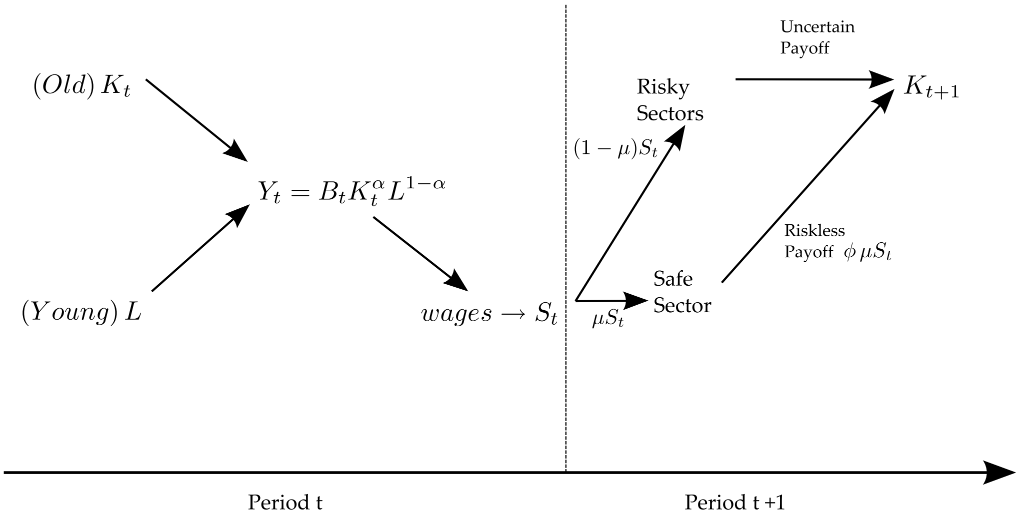


Figure 5: Schematics of capital accumulation. Capital from old agents and labor from young ones is used to produce the final good. A fraction of the wage proceeds are saved by the young who then use these savings to produce capital. Capital production can be achieved through safe or risky technologies.

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 (for example, because of a change in terms of trade, weather shock, etc.) she receives a return of A on every 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 the risky technologies opens up a measure n of sectors and succeeds (i.e. one of the technologies operated pays off) with probability n/N.[26] 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 saving allocated $(1-\mu)S$, since projects are symmetric. We also allow for 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.[27]

[26] 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 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.

[27] For example, if an entrepreneur opens a shoe and a textile factories but shoe manufacturing turns out much more profitable, it is reasonable to think that the textile factory buildings can be used to manufacture shoes but the textile machines cannot.

The total return from a successful sector is therefore given by

$$A\frac{(1-\mu)S_t}{n}n^{1-\rho} \tag{4}$$

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-all risky capital is sector-specific- while a value of $\rho = 0$ implies no savings allocated to risky sectors needs to be committed before uncertainty is resolved. We assume $0 < \rho < 1$.

4.4 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.[28] 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 this cost takes the form of a reduction in the savings allocated to risky sectors, that is an agents who allocates $(1-\mu)S_t$ to n risky sectors only gets to invest $(1-\mu)S_t - \psi n$ in actual productive projects.

Since the entrepreneurial productivity of unskilled agents is zero 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

[28] 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 have to 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.

(linear) utility of period two consumption which is equivalent to maximizing expected capital holdings K_t^S

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

The first term represents the constant and exogenous return ϕ on the fraction μ of saving allocated to the safe sector. The second term is the expected (with probability n/N) return A on the saving (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 $\phi - \frac{n_t}{N}\frac{A}{n_t^\rho} < 0$ and $\mu_t = 1$ otherwise (see Figure 9(a) in the Appendix.) The first order condition for n can be solved to obtain

$$\mu_t = 1 - \frac{(2-\rho)}{S_t(1-\rho)} n_t \, \psi \equiv \Psi(n)$$

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

$$n^* = S_t \frac{1-\rho}{(2-\rho)\psi} \tag{5}$$

In what follows we assume that the interior solution, if it exists, is preferred to the corner solution.[29]

4.5 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, reflected by a higher value of ψ. This assumption is supported empirically by the findings of

[29] This will be the case for a sufficiently large value of saving (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 since $\bar{n}$ is independent of S and n^* is increasing in S, the interior solution always exists for high enough wages. See the Appendix for more details.

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 in order to keep wages artificially low. In Aghion et al. (2008) democracy and political rights enhance the freedom of entry in 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 the lack of accountability of non-democratic governments 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.[30]

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, since 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. 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.

[30] It is important to recognize that we do not argue that certain (or all, in the case of Figure 10(b)) 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 of Figure 10(b) may be very similar to goods produced in the economy of Figure 10(a) but they are manufactured using traditional, small scale technologies not subject to large productivity gains.

4.6 Dynamics

Consider an economy with $\bar{n} < n^* < N$ so that all skilled agents (L_s) allocate the entirety of their savings to the risky technologies. Capital stock evolves according to the following process: if one of the open risky sectors is successful, i.e. the economy is *lucky*, the capital stock is K^L 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 is K^U equal to only the output of the safe sector. Using the fact that that $w_t = (1-\alpha)K_t^\alpha$ we have

$$K_{t+1} = \begin{cases} K^L(K_t) = L_u s(1-\alpha)K_t^\alpha \phi + L_s \frac{A(s(1-\alpha)K_t^\alpha - \psi n^*((1-\alpha)K_t^\alpha))}{n^*((1-\alpha)K_t^\alpha)^\rho} & \text{with prob.} \quad \frac{n^*}{N} \\ K^U(K_t) = L_u s(1-\alpha)K_t^\alpha \phi & \text{with prob.} \quad 1-\frac{n^*}{N} \end{cases} \tag{6}$$

Notice that, given 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 (5), 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 case one of the operated sectors pays off. Of course, the probability that one of the sectors pays off is lower since fewer of them are operated and the expected capital stock is in fact lower in the high barrier economy.[31] 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*

[31] This dynamics holds for large enough barriers so that $n^* < N$. To characterize the model fully we also have to 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.

resources concentrated in fewer sectors.

Using the equation for n^* (5) 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 $1 - n^*(K_t)/N$. Result 2 above implies that the K^L schedule is higher for non-democracies but the probability of being on it lower.[32]

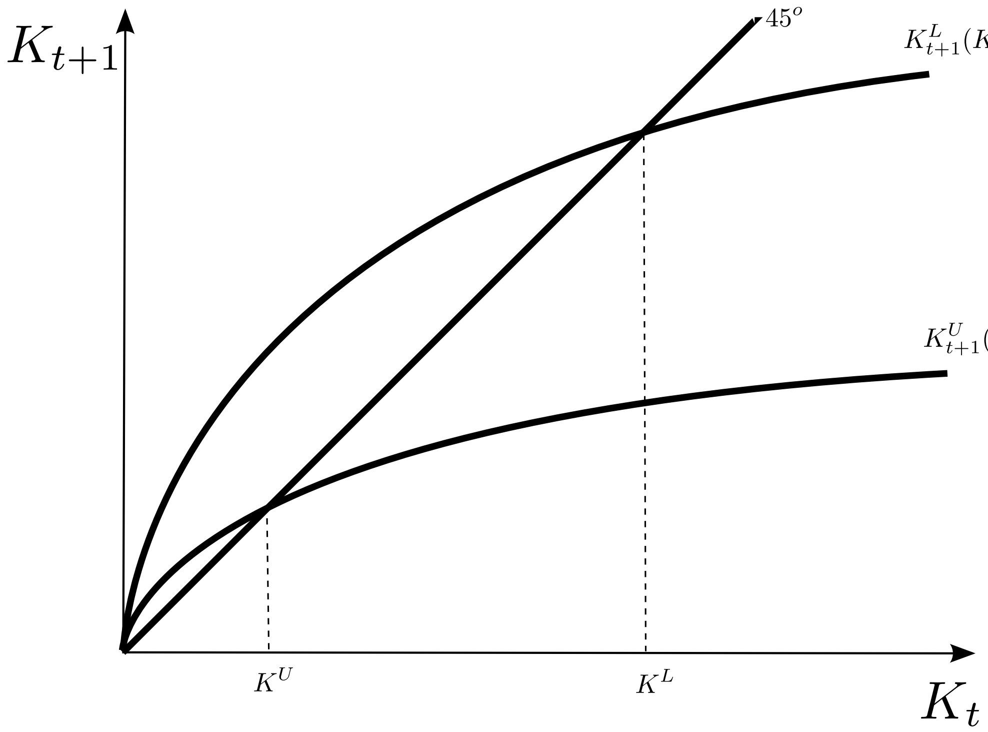


Figure 6: Model dynamics: For any given capital stock K_t the next period capital will be given by the $K^L(K_t)$ schedule with probability $n^*(K_t)/N$ and $K^U(K_t)$ schedule with probability $1 - n^*(K_t)/N$.

Imagine an economy with the 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 followed it would simply move up along the $K^L(K_t)$ schedule to the high capital steady state K^L. Alternatively, imagine an economy 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

[32]Notice that the K^U schedule does not depend on ψ and, since this is the only parameter that differs between democracies and non-democracies, the schedule is the same in the two regimes.

will follow a random process switching between dynamics associated with the two curves.[33] 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 K^L schedule. This increase is rapid because a lot of resources are allocated to each operated sector. With high probability, however, this episode is likely to 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) on the other hand 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 since 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 is likely to be followed by a rebound as one of the operated sectors is successful and the economy reverts to the K^L schedule.*

These results are illustrated in Figure 7. Finally, recall that as an economy gets 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 (growth of the term B in the production function because then even high-ψ economies will eventually accumulate enough capital that they will open all sectors and will no longer undergo growth reversals. If growth

[33]Note that the transition probabilities change over time since, every time the capital stock changes so do wages and saving and thus n^*.

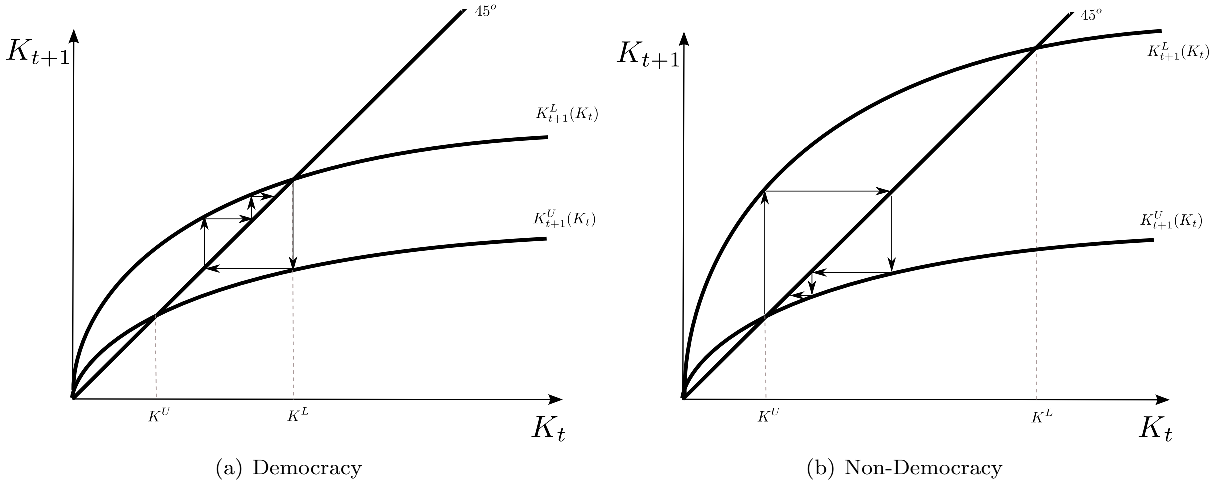


Figure 7: Medium term growth cycles. Panel (a):Democracy; Panel (b):Non-Democracy.

of B (convergence to the world technology frontier) is not too fast this process may take a long time.

Finally, note that in the context of our model one should be careful with statements such as " trend-volatility is bad for growth". While it is true that countries with 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 where fortunes of the country are (temporarily) good.

5 Tests of the Model

5.1 Growth Reversals

Our model predicts that less democratic countries will experience rapid growth accelerations followed by dramatic slowdowns and vice versa. As we have established in Section 3.2 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. Here we illustrate this again by plotting 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.

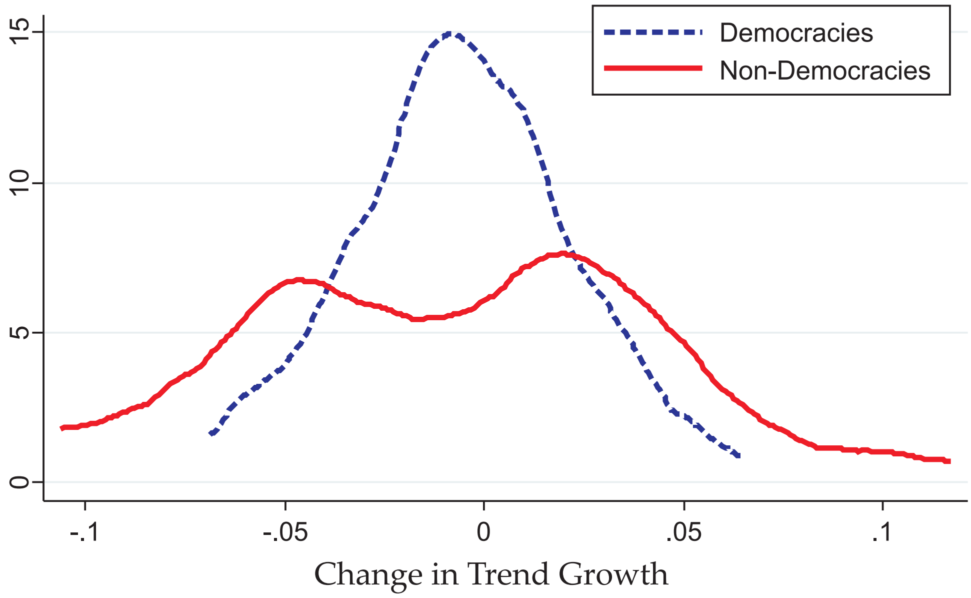


Figure 8: The distribution of changes in trend growth in democracies and non-democracies (kernel smoothed).

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 since our above findings motivated the theory. However our model also makes a new prediction, namely that there is relationship between democracy and industrial concentration. We put this prediction to a test in the next section.

5.2 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 income level of the country. This data set we employ to test the relationship 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:

$$h_{ct} = \alpha + \beta_1 D_{ct} + \beta_2 \ln y_{ct} + \beta_3 \ln y_{ct}^2 + \varepsilon_{ct} \tag{7}$$

where h_{ct} is the Herfindahl-Hirschman index 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). In their study they show that, as countries develop, their economy first becomes more diversified but in later stages it concentrates again.

We estimate (8) by pooled OLS and we cluster the errors by country to account for serial correlation of the errors within countries. We believe it is more reasonable to omit fixed effects since we are ultimately interested in comparing the experience of each country to a common benchmark, the overall average concentration across countries.[34] The results are presented in Table 8.

In the four specifications the coefficient on democracy is negative and significant at conventional levels, indicating that the manufacturing sector in more democratic countries 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 as the dependent variable. Finally, the positive coefficient on the square

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

	Value Added	Output	Value Added	Output
Democracy	-0.159***	-0.166***	-0.111†	-0.121**
	(0.052)	(0.048)	(0.070)	(0.061)
Income			-0.386	-0.623**
			(0.269)	(0.263)
Income 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

Table 8: Democracy and industrial concentration: regression of the Herfindahl-Hirschman index in manufacturing on democracy and GDP per capita. † < 0.12, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

of income– although again significant only when we use output as the dependent variable– confirms the findings of Imbs and Wacziarg (2003).

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

5.3 Back to Reversals

Our model suggests that ultimately non-democracies 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 3.2. Here we reproduce Table 6 where we regressed 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, 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 insignificant 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 put too much weight on this result since the sample size is reduced significantly when we use the Djankov et al. (2002) proxy and the barriers we believe are important are much broader than just official registration costs.[35] 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.

	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

Table 9: Determinants of growth reversals: Barriers to Entry. A regression 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-lingustic fractionalization, openness, financial development, real exchange overvaluation, inflation, and barriers to entry. Standard errors in parentheses. Bottom rows gives the p-value 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 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

[35] In fact running the regression without the barriers variable on the same 53 observations also produces an insignificant estimate of the democracy coefficient although the point estimate is larger (-.95) and the p-value of the test of weather it is non-negative is 0.16.

is too sparse (both in country and year coverage) to repeat our two stage procedure on the full sample. When we re-estimate the 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.[36] The results ares 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 eliminate the effect of democracy. The combination of 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 in more depth the role of concentration in medium term growth swings.

	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

Table 10: Magnitude of growth breaks – effect of concentration; estimates of equation (3) adding manufacturing output concentration measure. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[36]For the single equation GMM this leaves us this only 42 observations and so we omit this specification.

	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

Table 11: Magnitude of growth breaks – effect of concentration; estimates of equation (3) adding manufacturing value added concentration measure. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6 Conclusions

There exists convincing evidence that democratic countries are less volatile. 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. Recently several papers have documented 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 asked 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 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 presented 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). On the other hand, the literature on growth accelerations has found that periods of rapid growth are not uncommon even among countries with low average growth rates and concluded 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 limited degree of reform or policy change, but the challenge is to understand what makes growth go on. Our results put a different perspective on these findings. Less democratic countries not only fail to sustain growth but in fact 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, specially 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 the 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 the long run.

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Appendix

A 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 $\mu = 0$.[37]

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

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

This relationship represent the combinations of n and μ which ensure the first order condition for n is satisfied (see Figure 9(b)). The vertical intercept is $\Gamma(0) = 1$ since 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

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.[38] This is illustrated in Figure 10.

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

[38] To be precise we should write $n = \min[n^*, N]$.

B The log Case

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

$$U = \log(c_y) + \beta \log(c_o)$$

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.

B.1 Unskilled Agents

The problem of an unskilled young agent then becomes:

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

$$c_y + S = w$$

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

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

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 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:

$$\mu * = 1$$

$$S^* = \frac{\beta w}{1 + \beta}$$

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.

B.2 Skilled Agents

The problem of a skilled young agents is:

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

$$c_y + S = w$$

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

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

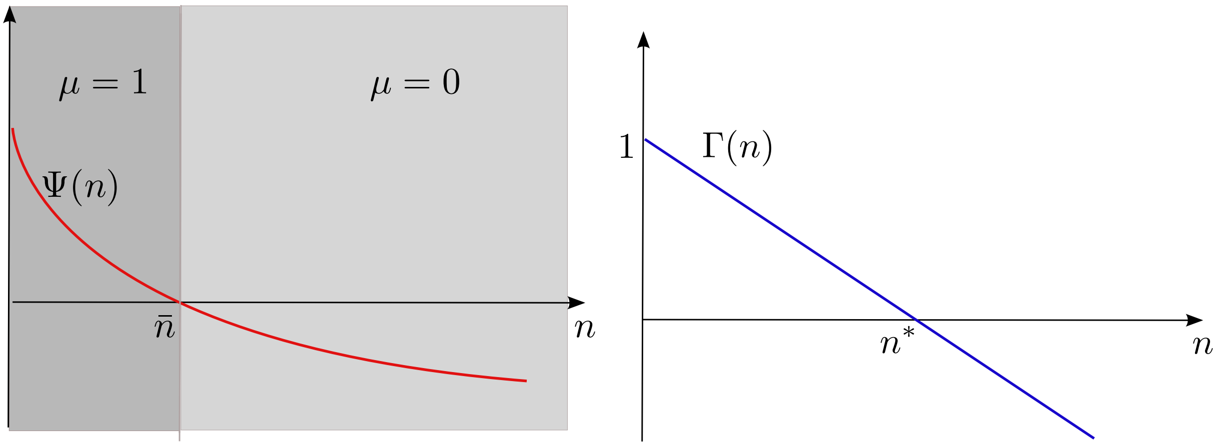
. The solution to this problem is given by:

$$\mu^* = \frac{A_s(N-n)(S-\psi n))}{SN(A_S - \phi n^\rho)}$$

and

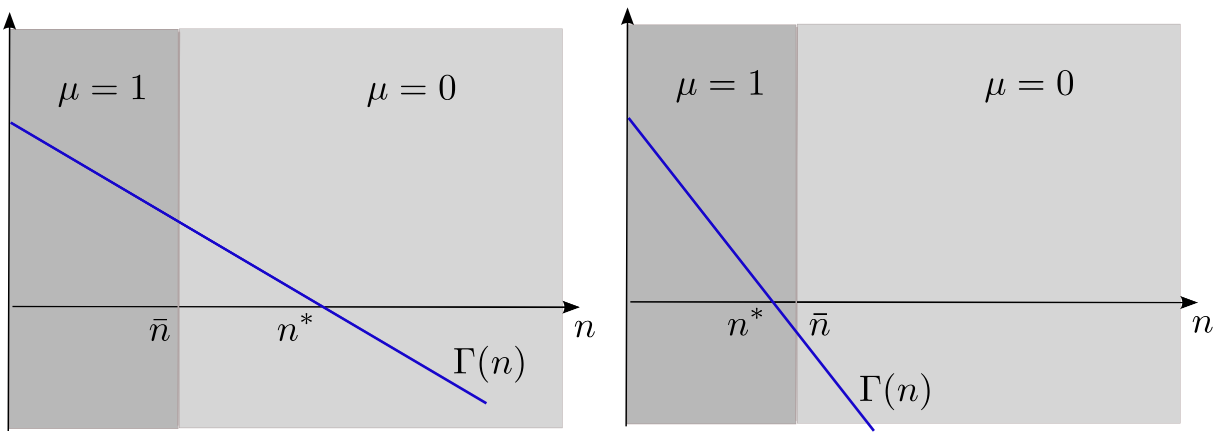
$$S^* = \frac{\beta w + \psi n}{1+\beta}$$

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 less 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 and increase in ψ and 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 $(1-\mu)S$ doesn't change much with ψ. A similar result holds for $n\psi$, which, unlike in the linear case with exogenous saving rate, is not independent of ψ but again the two terms move in opposite direction. All this means that the numerator of μ^* does not vary much with ψ and the n^ρ is 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.[39]



(a) Optimal μ (b) Optimal n

Figure 9: Panel (a): Panel (b):.



(a) Interior n (b) No interior n

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

[39]These simulations are available upon request.

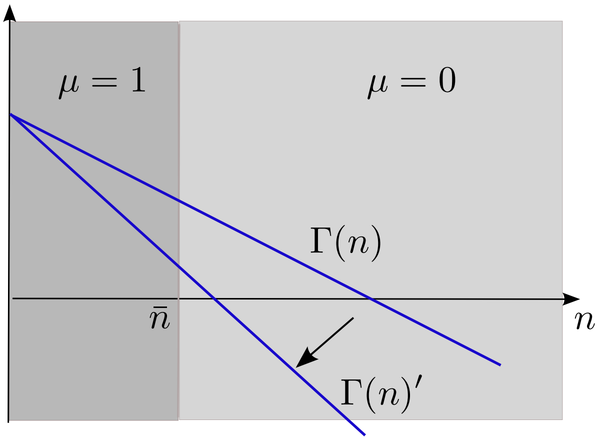


Figure 11: Increase in ψ

C Full Dynamics

There exists a threshold level of capital K^* such that for capital beyond it wages and saving are high enough so that $n^* > N$ and all sectors are operated regardless of the entry cost. This can be seen from equation (5) by observing that wages and thus saving 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 barrier (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 (6)). 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 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 since the critical threshold is to the right of its steady state. Figure 13(b) on the other hand represents

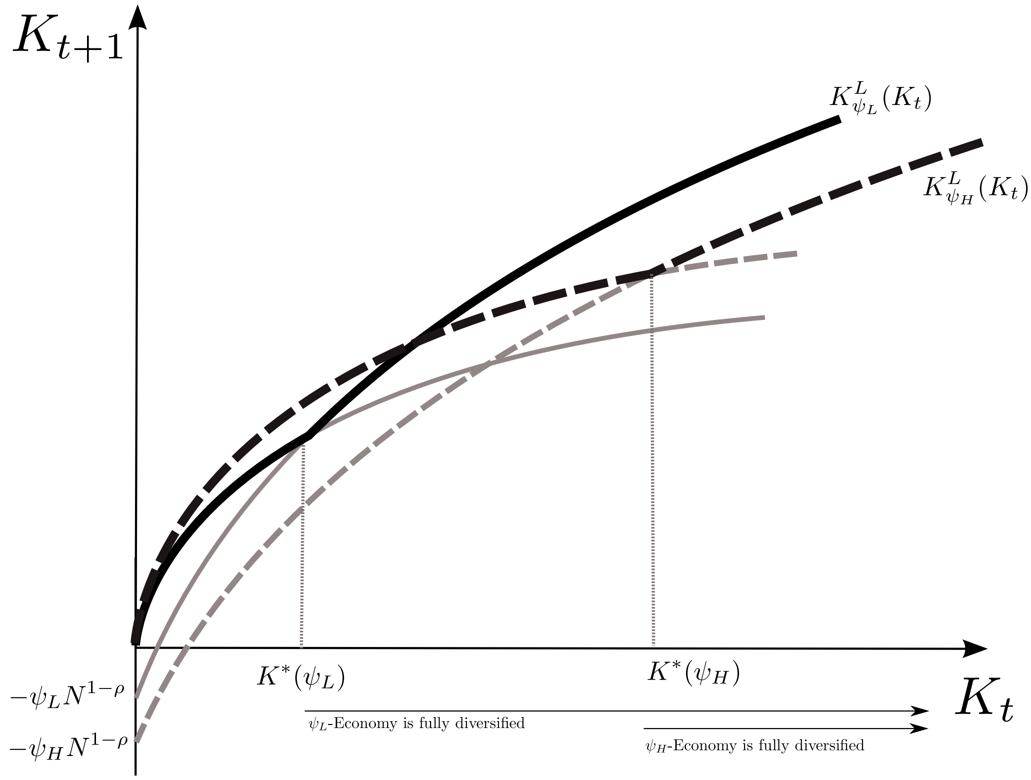
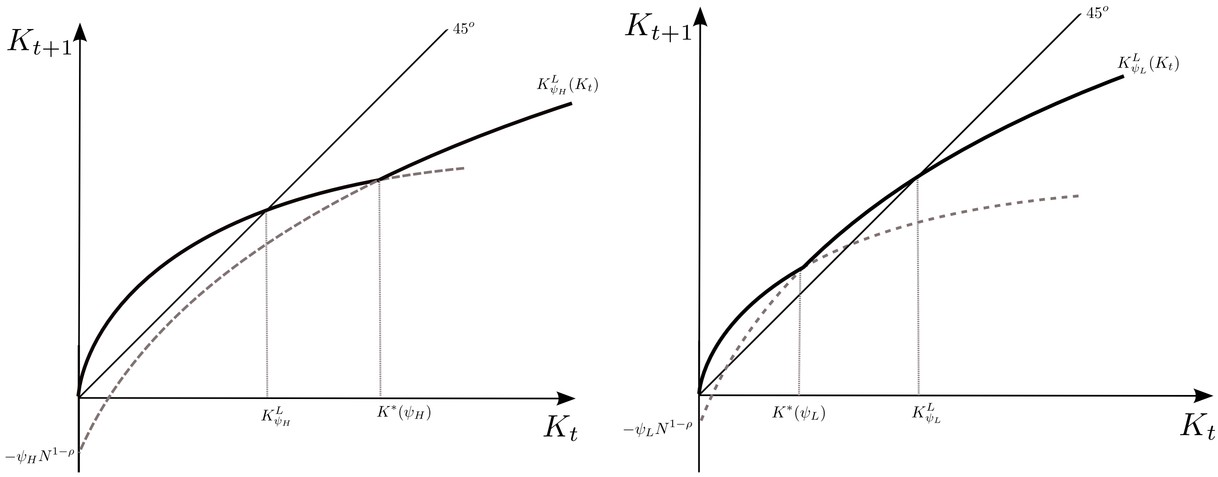


Figure 12: Complete characterization of the $K^L(K_t)$ schedule for two economies with different levels of entry costs. The solid line is for the economy with low barrier (ψ_L) while the dashed line is for the economy with high barriers (ψ_H).

an economy with low barriers (democracy) that eventually converges to a deterministic steady state i.e. with a fully diversified production sector.



(a) Non-Democracy (High ψ)

(b) Democracy (Low ψ)

Figure 13: Medium term growth cycles. Panel (a): Non-Democracy; Panel (b):Democracy.