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Do Political Regime Changes Help Predict Growth Takeoffs?

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Abstract

Do political regime changes as well as the quality of political institutions help predict the turning points in a country's growth history? I show that controlling for a variety of economic factors, both democratic and autocratic regime changes help predict growth "takeoffs". However, I find evidence that countries with low levels of income per capita benefit less from democratizations. This threshold level of income is estimated using Hansen's threshold regression methodology.

The threshold regression approach also reveals non-linearities in the effect of trade openness and level of political development on growth. In particular, I find that countries in the mid-range of trade openness benefit the most from an increase in trade volumes.

In addition, the paper presents a methodology for identifying growth takeoffs which defines takeoffs relative to country's own economic history while taking into account the historical growth conditions in the rest of the world.

Keywords: economic growth; growth takeoffs; democratization; regime change; threshold effects

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Section I. Introduction

Are democracies more effectual in securing economic prosperity than the autocratic systems? The link between political institutions and economic growth has been the subject of an ongoing debate since at least the 1960s (S. Huntington (1968); K. Schweinitz (1964)).

Of particular interest to researchers and policy makers is the role of institutional factors in the transitions to sustained long run growth. The typical frameworks for studying the effect of institutions on growth are cross-section or panel data regressions on long-term growth averages and trends (Barro (1991), Rodrik and Wacziarg (2005), Durham (1999)).

In recent years, however, considerable attention was given to the phenomena of growth takeoffs. This interest has been driven in part by the intent to explore takeoffs as the additional source of variation present in the data in order to uncover the drivers of economic growth (Hausmann, Pritchett and Rodrik (2005)), and in part by the observation that for most countries switching between growth regimes, including periods of accelerating growth, stagnations and collapses, is a more typical pattern of development than a smooth exponential trend growth (Jerzmanowski (2006), Pritchett (2000)).

Historically, the advanced economies of Western Europe, UK, US and Canada are known to have gone through prolonged periods of accelerating growth during the initial phases of industrialization in the 19th century. France, Netherlands, UK, Sweden, Denmark, have experienced marked increases in their growth rates in the 1840s-1850s. Canada and the United States in the 1870s and the1890s have seen their growth rates increase by as much as 4.5 - 5.5% during the takeoff periods. Among the more recent examples, the emerging economies of East Asia – Thailand, Malaysia, Singapore, Korea - sustained the episodes of remarkably high and accelerating growth rates in the 1960s –1970s.

The nature of growth accelerations and the link between political institutions and takeoffs, was investigated in the empirical studies by Hausmann, Pritchett and Rodrik (2005) and Aizenman and Spiegel (2007), Jones and Olken (2008). The measures of political institutions are found to be generally positively associated with economic accelerations, yet the findings highlight the ambiguity in the effect of political regime transitions on growth outcomes.

Hausmann Pritchett and Rodrik's (2005) (HPR (2005)), for example, find that both democratic and autocratic regime changes predict the initiation of growth acceleration episodes. However, the effect of democratic regime changes vanishes when applied to the sample of only developing countries. Clearly, the results disguise a richer relationship between political transitions and growth.

The question is not only to what extent do institutional changes contribute to the timing of takeoffs, but also whether there exist non-linearities in the effect of political regime changes on growth accelerations. For example, in countries with lower GDP per capita the effect of democratizations on growth might be very different than in the countries with higher levels of per capita income.

Another important challenge concerns the criteria for defining growth takeoffs in a way that consistently captures growth episodes throughout the country's history.

This paper adds to the existing literature in several important ways. First, I improve on the existing criteria for identifying the on-start of takeoffs by introducing the method which defines the takeoff phenomena relative to country's own economic history while in the same time taking into account the historical growth conditions in the rest of the world.

While the methodology established in the literature (HPR (2005), Aizenman and Spiegel (2007)) generally works well for data after 1960s, the criteria presented in this paper apply better to the historical data. In particular, I am able to capture a set of well-known 19th century growth acceleration episodes, such as the period of rapid growth, which started in the United Kingdom in the 1840s and was associated with the political and economic reforms of the early Victorian era.

Secondly, I estimate the effect of political transitions on growth takeoffs in a historical context, using a panel data set of 61 Western and Eastern European countries, North America, Latin America, Asia and Oceania (full list provided in the Appendix). For a handful of countries, the time frame spans nearly two centuries, 1820 - 2003, while for most countries in the sample the data becomes available from the 1900s. I identify 154 growth takeoff episodes initiating as early as 1842, with the last acceleration episodes occurring in 1996.

I employ a distributed lag probit model to estimate the effect of political regime changes on the probability of growth takeoff initiations while controlling for a set of relevant economic and institutional factors – openness to trade, government expenditure, investment, proxies for financial openness, human capital accumulation, quality of political institutions, etc.

The results indicate that both autocratic and democratic regime changes are positive predictors of growth takeoffs. However, the effect of democratic regime changes on the probability of takeoffs is found to be smaller as compared to the effect of autocratic regime changes. Moreover, in the baseline specification the effect of the democratic regime shifts is not statistically significant.

This result can be explained in part by the presence of the non-linearities in the effect of regime changes on growth. Interacting democratic regime changes with financial crisis variable shows that financial cataclysms occurring simultaneously with democratic political transitions significantly impair the chances of a growth takeoff initiation.

In addition, democratic regime changes can have a different effect on countries' growth prospect depending on the country's level of economic development prior to the point of political transition. To address this problem, I use Hansen (1999) threshold regression methodology to identify whether variables such as trade openness, political regime changes and the levels of GDP per capita have non-linear effect on growth takeoffs.

I find that the effect of trade openness on growth takeoff initiation is largest for trade volumes in the mid-range (from 0.63 to 0.79 as a share of GDP), and smallest for the levels of trade openness below and above these thresholds. An increase in the level of democratization matters for growth, but only for countries with already high democracy scores.

Moreover, I find that the effect of democratic regime changes on growth takeoffs becomes statistically and economically significant only for countries with the level of GDP per capita above $5,698 (measured in 1990 international dollars). Below this level, the effect of democratic regime changes is not significantly different from zero. In contrast, no threshold effects were present for autocratic regime changes.

In part, this can be explained by considering that democratic regime changes in poor countries with already weak economic structure may add to the existing economic uncertainty, whereas less pluralistic, autocratic regimes may be perceived as more stable.

The paper is organized as follows: Section II reviews the evidence on the link between democratization and economic growth and introduces the methodology for identifying growth takeoffs. Section III presents the baseline econometric model and the methodology for identifying threshold effects on growth takeoffs. Estimation results and their economic interpretation are described in Section IV. Section V concludes.

Section II. Political institutions and growth outcomes

Empirical studies by Przeworski and Limongi (1993), Barro (1996), Tavares and Wacziarg (2001), Rodrik and Wacziarg (2005) examining the effect of democratization on long-run and short-run average growth rates find at best a weak positive association between democratization and growth.

The result is most likely due to the significant variation in growth outcomes associated with transitions to democracy (Persson and Tabellini (2006), Milanovic (2005)). This is true in particular for developing countries. Moreover, growth itself is unlikely to follow a smooth linear trend over extended periods of time. Throughout the history of development, countries have experienced growth takeoffs and growth collapses, punctuated by the periods of stable and sustained growth, or the periods of stagnation (Jerzmanowsi (2006)). Thus studying these growth phenomena is likely to provide a more nuanced view of the relationship between institutions and economic growth outcomes, than simply examining average growth trends.

Moreover, these events can also provide a valuable insight into the institutional determinants of sustained growth. Especially considering that the pattern of GDP per capita development in Western Europe, Asia, Latin America over the last 200 years points towards the growth acceleration episodes as being gateways to stable and sustained growth (Acemoglu (2009)). United Kingdom, Netherlands, France, United States, and now South Korea, India and China, have in different times of their development history experienced episodes

of substantial growth accelerations, and have since achieved or are likely to achieve stable growth trajectories.

In the spirit of these arguments, Jerzmanowski (2006), Jones and Olken (2008) considered primarily the changes in growth regimes and the characteristics associated with those changes, finding that stronger democratic institutions were associated with higher probability of entering sustained growth regime following a takeoff. Growth takeoffs, or growth acceleration episodes, in particular were examined by Hausmann Pritchett and Rodrik (2005), Aizenman and Speigel (2010).

Hausmann Pritchett and Rodrik (HPR 2005) looked specifically into the relationship between democratic and autocratic regime changes and the probability of the growth takeoffs, finding a significant positive association between both types of regime changes and the takeoffs.

The studies mentioned above typically consider the years of 1950– 2000 as the relevant time horizon to study the effect of institutions on growth takeoffs. What has been missing from the literature so far is the longer historical view of the growth acceleration episodes and the clear criteria for identifying these growth events.[1]

2.1. Identifying growth takeoff episodes

Methodology

The accepted approach to identifying growth takeoff episodes ((HPR 2005), Aizenman and Spiegel (2010)) is to define them as the episodes in the country's economic history when the output per capita growth is rapid (in relation to a benchmark growth rate of 3.5% over the specified time horizon) and accelerating (the increase in the growth rate relative to the pre-takeoff period over the same time horizon of 2%). In addition, such episodes must be long enough to rule out the fluctuations due to temporary fluctuations, and result in

[1] The 19th century in particular is rich in the examples of takeoffs associated with the beginning of the second wave of industrial revolution. In the same time, significant political changes happened in this period – the world was undergoing what has been termed in the political science as the "first wave of democratization" (Huntington (1993)). Thus, studying the relationship between political institutions and growth necessitates using a longer historical time frame.

significant increase in the level of GDP per capita to rule out the mere recoveries from bad shocks. Such approach has worked well in identifying major known growth acceleration episodes in both developing and developed countries in the period from 1957-1992, when the average GDP per capita growth of industrialized countries was around 2 percent[2].

However, in the historical context, when the average growth of GDP per capita in the then developing industrial powers was at most 1.5 percent, the benchmark accepted in the literature would exclude the historical growth episodes brought about by the second industrial revolution. It would exclude the takeoffs in the countries such as Netherlands and France, and even marginally the well-known period of rapid economic growth in the United Kingdom, which started in the 1840s and coincided with the political and economic liberalization reforms of the early Victorian era.

To deal with these methodological issues, I propose the following approach:

Historical method criteria for identifying growth takeoff episodes[3]

1. Growth is rapid if $g_{t,t+n} \geq 1$ standard deviation above the mean of $g_{0,t}$ (i.e. the average growth rate from time t over the relevant horizon n is greater than one standard deviation of the average growth rate from time t=0 up to time t).
2. Growth is accelerating if $\Delta g_{t,n}$ (the increase in the average growth rate over the time horizon n relative to the pre-takeoff period) is greater than the average growth rate of countries in the top 50th income percentile[4]. This condition has the advantage of accounting for historical average growth rates around the world.
3. $y_{t,n} \geq max\{y_i\}$, where i ≤ t. This condition, the same as in HPR analysis, requires the GDP per capita at the end of the growth episode to be greater than the highest value of GDP per capita for the country prior to

[2] Other ways to identify takeoff episodes have been used in the literature. Jones and Olken (2008), for example, use the Bai-Perron (1998) structural break method to define both the up- and down-turns. The problem with using this method is the inclusion of many pseudo-takeoffs, which are simply recoveries from bad shocks.

[3] Notation is the same as in the HPR 2005.

[4] The average growth rate of countries in the sample's top 50th income percentile is updated every 20 years.

the growth episode. The requirement helps rule out the mere recoveries from negative shocks.

Overall, the Historical method outlined above is consistent with the standard benchmark identification methodology of HPR (2005). However, the results are significantly different when applied to the historical data, with the Historical method capturing larger share of takeoff episodes in the 19th and beginning of the 20th centuries. The detailed comparison is provided in the Appendix of the paper (Figure 1).

2.2 Characteristics of growth takeoffs in the historical perspective – data and the stylized facts.

In light of these criteria, what can be said about the countries experience with growth accelerations? As far as the relationship between takeoffs and the quality of the country's political institutions - are growth takeoffs more likely in countries that have moved towards democracy or towards a more autocratic regime? Can we claim that growth takeoffs are associated with higher standards of living, or do they merely reflect instability in economic development? Are takeoffs transitory, or do they typically put the country on a path towards sustained growth?

Finally, what can be said about the relationship between growth takeoffs and such important correlates of growth as investment, trade openness, level of GDP per capita? The data described below tells the story.

Data

The analysis of takeoff episodes is based on the annual GDP data from Angus Maddison historical statistics, which includes the countries in Western Europe, Eastern Europe, Central Asia, Asia and Oceania and the Americas. While a handful of European countries have data available as far as 1820s, most country's GDP data is available after 1900. The full list of countries and the time they enter the sample is given in Table 1 in the Appendix.

Growth takeoffs across income quintiles

Growth takeoffs prominently feature in the developing countries' growth

history, which can be evidenced by the fact that the industrialized countries like United States, United Kingdom, France, Netherlands did experience significant number of takeoffs in the earlier stages of development (see Table 2 for the timing of takeoffs).

The first question to ask is the following: are countries with higher probability of growth takeoffs on average better off than the countries, where such probability is low? The answer is far from obvious, as higher probability of growth takeoffs may be indicative of economic instability. This would be the case of countries where frequent growth spurts are followed by growth collapses.

The evidence, however, suggests that takeoffs are important in the context of the country's overall economic development. Countries with GDP per capita in the top 40% of the income distribution have on average higher unconditional probability of experiencing a growth takeoff than countries in the lowest 40 percent. Figure 2 illustrates this point.

It must be noted, however, that frequent takeoffs are not necessarily correlated with the highest standards of living. In fact, the highest unconditional probability of growth takeoffs occurs among the countries in the 3rd income quintile – such as Chile, Argentina, Venezuela, Portugal, Spain and Ireland. Are takeoffs indeed the path to stable and sustained growth for most countries, or are they the symptoms of economic instability?

Sustainability of takeoffs over time

One way to assess the sustainability of a growth takeoff is to see whether the growth rates beyond the initial 8 years have remained at the level that would allow the country to catch up with the most developed countries in the sample. Once again, the "catching-up" rate of growth would depend on the average historical growth rates in the high-income countries.

The results presented in Table 5 suggest that while overall over 62% of growth takeoffs were sustained for an additional 8-year period, the results varied across regions and particularly across time. Interestingly, all of the takeoffs originating in Eastern and Central European countries in the 60s and 70s were sustained, as well as 80% of the takeoffs initiated between 1900 and

1950. In the same time, these countries experienced relatively few takeoff episodes.

Latin American countries experienced relatively high number of takeoffs after 1900 and before 1950. Around 70% of these episodes were sustained beyond the initial 8 years. The sustainability of takeoff episodes took a hit after 1950s, when only half of the episodes lasted beyond the initial 8-year period. For Western Europe, takeoff sustainability was highest after World War II period (at 92%), whereas in the 19th century only about 32% of takeoffs originating in Western Europe were sustained. (This was most likely due to the long depression of the 1890s , which heralded the end of the "Gilded Age" era brought about by the second industrial revolution).

Takeoffs across regions and time[5].

The Historical method identifies overall 154 growth takeoff episodes[6]. Nearly half of all takeoffs occur in the period between 1900 and 1950, driven by Western Europe in the post-depression and post-war periods, and the Latin American countries. Only about one third of takeoff episodes occur in the second half of the 20th century, and around 20% of the takeoff episodes occur prior to 1900. By region, Western Europe accounts for about half of the existing takeoffs in all time periods, while Latin American countries account for slightly more than 20% of takeoffs.

The average growth rate during the 8-year takeoff periods over the entire sample is 4.78%, and the average acceleration 4.29%. The takeoff growth rate, however, varies significantly through time. Prior to 1870 the average growth rate after the takeoff initiation date was only 2.6%, and 3.05% between 1870 and 1900. (See Table 4)

The regional variations in growth reveal that in the years prior to 1950s the highest average takeoff growth rates were actually among the Eastern European countries (6.19%, driven by a few fast growing countries, including the USSR). United States, Canada, Australia and New Zealand were also enjoying

[5] The full list of growth acceleration episode dates and the 8-year average growth rates before and after the episode initiation is given in Table 2.
[6] Table 3 presents the distribution of the episodes across time and regions.

high growth takeoff rates of about 5.12%, and Latin America was following closely behind with 4.81%. After the 1950s, however, the Asian countries were the fastest growing group, with takeoff average growth rates at 7.35% lead by Singapore, Japan, Malaysia and Thailand. Latin America, on the other hand, had relatively few takeoff episodes with average growth rates of 4.43%, while in Eastern Europe takeoff growth rates stood at 5.77% over the same period.

Takeoffs, Investment, Trade and the levels of GDP per capita.

Undoubtedly, the initial levels of GDP per capita, trade openness and investment are important correlates of growth rates - but what about growth acceleration episodes? Do takeoff economies have high investment rates as a share of GDP? Are they more open to trade, or do they tend to have low trade volumes? Last but not least, do takeoffs tend to occur in relatively poor or relatively rich countries? The answer is not quite clear-cut.

While growth rates are typically positively correlated with the rates of investment (Acemoglu (2009), Barro (1991)), takeoff episodes need not be. Since takeoffs seem to be a feature of middle to high-income economies (Figure 1), in these countries the difference in growth rates before and after the takeoff may be due to increase in the level of productivity rather than increase in the rate of savings out of the total output. The data shows (Table 6) that average investment rate as a share of GDP during the last 4 years for the 8-year takeoff episodes was about 0.1878, not very different from the unconditional mean of investment as a share of GDP for the entire sample. In the second half of the 20th century the countries experiencing a growth takeoff were investing at the rate of 0.2373, versus the average of 0.2286 investment rate as a share of GDP for the same period. In the same time, it is clear that the countries' average investment rates were much lower in the time period prior to the takeoff initiation than in the last 4 years of the takeoff.

Similar pattern emerges when examining the volume of trade as a share of GDP around the takeoff episodes. In the overall sample, the share of trade in GDP is 0.4642, which is comparable to the volume of trade in the last 4 years of the episode (see Table 7). However, in the second half of the 20th century, in particular after 1969 trade played a larger role. The trade volume share in GDP

was on average 0.7106 in the last 4 years of the episode – significantly larger, when compared to the 0.5865 in the 4 years prior to the start of the episode and the 0.61886 average for the entire post-1969 period.

Finally, the income per capita profiles of the takeoff economies indicates that on average takeoff countries start out with GDP per capita on the level slightly below but comparable with the average GDP per capita in the sample. This may be due to the cyclical effect – typically takeoffs initiations start at or close to the trough of the business cycle. (Table 8). In the last 4 years of the 8-year episode these countries typically catch up or are slightly above the average level of GDP per capita in the sample.

2.3 Political regime changes and growth takeoffs.

It is natural to think of political regime changes as precursors to growth takeoffs. After all, the very fact that a country suddenly starts growing faster than ever before, indicates that a constraint or a set of constraints on growth has been relaxed. An abrupt shift in the countries' political structure can bring about such institutional changes.

In the base regression sample there are 78 episodes of takeoffs. 12 of them (about 15.4% of the total) were proceeded by positive enduring regime change[7] and 16 (around 20.5% of the total) were proceeded by negative enduring regime change. This appears to be consistent with the findings in the takeoff literature (HPR) that takeoffs are correlated with both positive and negative regime changes. The result is hardly surprising, if we consider that both types of political systems impose certain costs as well as benefits on the economy in the short and the long run.

On the benefit side, democracies tend to improve growth through human capital accumulation, lowering income inequality (Tavares and Wacziarg (2001)). Democratic regimes are also more likely to give voice to the emerging entrepreneurial class enabling them to enact business-friendly laws (an illustrative example is the economic growth takeoff in the United Kingdom in the 1840s, which was proceeded by political reforms allowing the newly emerging

[7] Positive enduring regime change is defined as a 3 point increase in the Polity IV index, which was sustained for at least five years beyond the time of the change.

and economically powerful merchant class to represent their political interest in the parliament).

On the cost side, representative political institutions, especially in weak economies, are often associated with political deadlocks, inability to pass important legislation, and difficulty in enforcing laws. Government budget deficits may increase, ineffective populists reforms may redistribute wealth and discourage private investment[8].

The benefits of autocratic regimes lie in their presumably superior ability – relative to new democracies - to enact and enforce laws. In weak economies this may initially provide certain measure of much needed stability. After all, the rule of law, as a measure of institutional strength, seems to be highly correlated with growth outcomes (Rigobon and Rodrik (2005)). However, in the long run autocratic rule by decree can certainly be costly. The costs are associated with inflexibility of the autocratic systems. Laws and regulations, which favor certain entrenched economic interest impose high efficiency costs on the society, leading to stagnation and ultimately may spark popular resistance against the regime (the ousting of the Pinochet regimes in Chile, the Arab Spring of 2011 and the Color Revolutions in the former USSR illustrate this point). [9]

In light of the debate about the effects of political institutions on economic growth, it is clearly not enough to say that both types of political regime changes can spark growth accelerations. Democratic regime changes, on their own, may be unlikely to result in accelerated growth unless certain important aspects of the economy are in order. Therefore, one would expect to observe a significantly non-linear effect of democratization on growth takeoffs.

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[8] Robert J. Barro (1991) points to a negative empirical relationship between growth and the size of government. See also Tavares and Wacziarg (2005) for the review of empirical and theoretical studies on this link. Most of the studies agree that government's impact on growth involves a trade-off between the negative effect of distortionary taxation and the benefits associated with redistribution

[9] Overall it must be noted that there are 117 episodes of positive enduring regime change in the working sample, and 65 episodes of negative enduring regime change. Thus, only relatively few democratic regime changes result in takeoffs. The same can be said – to a lesser extent about autocratic regime changes.

My task in this paper is to examine the nature of these non-linearities and describe the conditions under which the democratic regime changes may be successful in brining about growth takeoffs.

In the section that follows I discuss the measure of political institutions used in this paper, introduce the baseline econometric model and the threshold methodology for identifying the potential non-linear effects of democratization on growth.

Section III. Measuring political regime changes and their effect on growth takeoffs. Threshold methodology

3.1 Polity IV index

In the political science literature, democratization is generally defined as the movement toward the establishment of representative political systems, such as a parliamentary system of governance; movement toward limiting the powers of a chief executive and toward a greater openness and competitiveness of political participation.

Today, one of the most detailed indexes of political liberalization is the index developed by Polity IV project (Marshall and Jaggers (2002)). The Polity index is a composite of scores assigned to the different features of a country's political system - such as competitiveness of political participation, constraint on the power of the chief executive, openness of political participation, etc. The scores are combined to rank countries on the scale from -10 to +10, with -10 corresponding the full autocracy and +10 to full democracy as defined in the project.

The advantage of Polity IV index is the broad time coverage[10], as well as the methodology for analyzing the features of the political system which carry over between different time periods and historical eras.

In this paper I define a positive enduring regime change as an at least 3-point increase in the country's Polity IV index in the course of 1 year, which is sustained for a minimum of five years. Negative enduring regime change is defined as a 3-point decrease in the Polity IV index with the above conditions in place.

[10] Polity IV index starts from 1800, or the year of the creation of the state, whereas another frequently used index, the Freedom House Freedom in the World index, starts from 1973

3.2 The determinants of growth acceleration episodes. The base model

To identify predictors of growth acceleration episodes, I estimate a distributed-lag random effects probit model of the following form:

$$Y_{i,t} = \alpha + \beta_1' X_{i,t-1} + \beta_2' D_{i,t-1} + \beta_3' \sum_{k=1}^{n} Z_{i,t-k} + \beta_4' \left(\sum_{n}^{d} Z_{i,t-n+1} \right) / d + \beta_5' \overline{Z}_{\tilde{\imath},t-1} + (u_i + e_{i,t}) \quad (1.1)$$

Where $Y_{i,t}$ is a 0-1 binary variable which takes the value of 1 at the time of the onset of the growth acceleration episode, as well as in the years t-1 and t+1 around the episode. The wider time window helps safeguard against the possibility of identifying the start of a growth takeoff imprecisely, due to potential flaws in the data.

$X_{i,t}$ - a set of political regime change variables. These are binary indicators that take a value of 1 in the year a negative or positive regime change episode was initiated as well as in the years t-1 and t+1 around the episode.

$D_{i,t}$ - a dummy indicators for the years of financial crises. This indicator is introduced to capture the effects of financial liberalization.

$Z_{i,t}$ - a set of economic variables, such as volume of trade[11], total government expenditure, investment (all expressed as a share of GDP); along with the proxy for human capital[12] and log of GDP per capita income.

$\overline{Z}_{\tilde{\imath},t-1}$ - cross-section averages of the explanatory variables for a given year.

In order to partially control for endogeneity[13], all explanatory variables enter the regression with lags. Another important feature of the model is the

[11] A positive relationship between volume of trade and growth has been documented in numerous studies, including Dollar and Kraay (2002), Papaioannou and Siourounis (2005). Robert Lucas in his 1993 Econometrica paper "Making a Miracle" discusses the theoretical foundation of trade-growth link.

[12] Educational attainment traditionally serves as a proxy for human capital accumulation. A positive link between educational attainment and growth has been documented by numerous empirical studies. However, educational attainment as measured by years of schooling is far from an ideal proxy for human capital. Some researchers (e.g. Papaioannou and Siourounis (2005)) use health variables, such as life expectancy, in its stead. In this chapter, however, I use infant mortality rate rather than life expectancy, since this measure is available for a wide spectrum of countries and has relatively long historical time-series. The link between educational attainment and health outcomes has been well established in the literature (Easterlin (2000), Hebert, Herz and Landon (1994), Zakir and Wunnava (1999)).

inclusion of the distributed lags of independent variables. The lags as well as the lagged time averages of explanatory variables (3-4 years), help capture the effects on growth that are manifested over time, in a period of several years.

The model also controls for period effects by using year specific averages of the explanatory variables across the entire sample. Otherwise, introducing year dummies would have been too expensive in terms of the loss of degrees of freedom in the model.

3.3 Identifying threshold effects

A simple econometric methodology proposed by Hansen (1999) allows one to see whether the effects of trade openness, quality of political institutions, and political regime changes on growth are non-linear. In particular, whether political regime changes affect the probability of takeoffs differently depending on a country's level of GDP per capita, and whether the effect of trade openness varies substantially at different levels of the trade volume.

A threshold regression model described by Hansen takes the following form:

$$Y_{i,t} = \mu_i + \beta_1' X_{i,t-1} \times I(q_{i,t-1} \le \gamma) + \beta_2' X_{i,t-1} \times I(q_{i,t-1} > \gamma) + e_{i,t} \quad (1.2)$$

Here $Y_{i,t}$ is the dependent variable; $X_{i,t}$ a vector of regressors, and $q_{i,t}$ - the threshold variable. The indicator function, $I(\cdot)$, effectively divides the observations into two regimes, distinguished by the different regression slopes β_1 and β_2; γ is the threshold value of $q_{i,t}$ - this value needs to be estimated.

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[13] Endogeneity is a serious concern in all studies linking political institutions and growth. One of the potential sources of endogeneity is the omitted variable bias: for example, variables such as government expenditure which can be high in the times military conflict, can impact both political regime changes and growth. I aim at minimizing the bias by considering a variety of standard growth determinants in addition to democratization.

The possibility of feedback effect running from growth to democratization should also be considered. In particular, growth patterns (or expectations of future growth) may give rise to a political regime change in earlier periods. This however, becomes less likely given the nature of growth takeoffs. Since takeoffs develop and are sustained over a number of years, they are generally hard to anticipate. Given the difficulty with finding suitable instruments for democratization in the historical context, I adopt the approach that aims at minimizing the feedback effect by including the lagged values of dependent variables in the regression.

In a random effects probit regression, γ can be estimated through a grid-search procedure, picking the value that maximizes the log-likelihood function. To avoid putting too few observations into the threshold, a minimal set of observations must lie in both regimes (1-5% of the total number of observations). With threshold value γ thus determined, one can test $H_0 : \beta_1 = \beta_2$, using the likelihood ratio test. The p-values have to be constructed using bootstrap method, since the likelihood ratio test statistic has a non-standard distribution[14].

For the purpose of the current analysis, the threshold regression model will take the following form:

$$Y_{i,t} = \alpha + \beta_1' X_{i,t-1} \times I(q_{i,t-1} \le \gamma) + \beta_2' X_{i,t-1} \times I(q_{i,t-1} > \gamma) + \beta_3' D_{i,t-1} + \\ + \beta_4' \sum_{k=1}^{n} Z_{i,t-k} + \beta_5' (\sum_{n}^{d} Z_{i,t-n+1}) / d + \beta_6' \bar{Z}_{\bar{i},t-1} + (u_i + e_{i,t}) \quad (1.3)$$

where $X_{i,t}$ is the lagged value of the political regime change indicator and $q_{i,t}$ is the threshold variable of interest (i.e. log GDP per capita; total government expenditure; volume of trade, etc.).

According to the hypothesis, if the threshold variable is for example, log GDP per capita level, the coefficient β_1 should not be significantly different from zero, while the coefficient β_2 should be significant and positive. This would indicate that a positive political regime changes is not likely to benefit the country's growth if the initial level of per capita income is too low. In other words, below a certain threshold level of income, positive regime changes do not help predict growth takeoffs.

A special case of the threshold regression model (equation 1.4) is when the variable in question serves as its own threshold variable. This would allow us to test if the observations in the sample can be split at some value of the variable in question and test for the significance of the difference in coefficients.

[14] Since under the null hypothesis, the threshold is not identified, the classical test statistic has non-standard distribution and requires bootstrap estimation - Hansen (1999). The bootstrap sample for probit model is constructed using methods outlined in MacKinnon (2006).

$$Y_{i,t} = \alpha + \beta_1' X_{i,t-1} + \beta_2' Z_{i,t-1} \times I(Z_{i,t-1} \le \gamma) + \beta_3' Z_{i,t-1} \times I(Z_{i,t-1} > \gamma) + \beta_4' D_{i,t-1} + \\ + \beta_5' \sum_{k=1}^{n} Z_{i,t-k} + \beta_6' (\sum_{n}^{d} Z_{i,t-n+1}) / d + \beta_7' \overline{Z}_{\tilde{\imath},t-1} + (u_i + e_{i,t}) \quad (1.4)$$

I use the observations on the volume of trade and the 5-year average of country's Polity score to test for the presence and the optimal number of such breaks; and to determine at which values of the variables these breaks occur.

Section IV. Results

4.1 Base model.

The coefficients, standard errors and corresponding marginal effects for the base model regression are reported in Table 9 (columns 1-2). All the marginal effects are evaluated at sample means for continuous variables, and for discreet changes of dummy variables from zero to one.

The results in Table 9 (1-2) indicate that both positive and negative regime changes positively influence the probability that a country experiences a growth takeoff. In the base model specification, however, positive enduring regime changes do not appear to influence the probability of rapid growth episode initiation significantly. (Negative enduring regime change coefficients, on the other hand, are significant and positive). This lack of significance can be explained by the presence of threshold effects. For part of the sample, positive enduring regime changes may have a negative effect on the probability of growth takeoff; while in the other part of the sample this effect may be positive. Indeed, the threshold regression estimations presented later in this section lend support to this hypothesis.

In the base model specification, a positive enduring regime change increases the probability of growth takeoff by approximately 2.38 percentage points. The negative enduring regime change increases the probability by about 6.65 percent. The effect of the negative regime change on the probability of growth is 2.8 times larger[15].

While the results seem to suggest that movement toward autocratic rule has a larger positive impact on growth, an alternative interpretation may be offered. Enduring positive regime changes possibly rely less on economic

[15] This is consistent with the HPR (2005) findings, where the negative regime change effect is about 3.7 larger than the positive effect.

growth to sustain themselves than do autocratic regimes. In this respect, it is interesting to look at another measure of institutional quality discussed above - the 5-year average Polity score. The impact is evaluated at the sample mean, which is at 4.11 points - about the level of Finland in the 1930s, Russia in 1998, Malaysia in 1980s or Greece in 1960s.

The marginal effects calculations suggest that all else equal, an increase of the 5-year average polity score at t-1 from sample mean to the maximum 10 point score, increases the probability of growth takeoff by about 1.7%. For a more modest 4-point increase in average polity score (from 4.11 to 8.11 - about the level of France and the United Kingdom in early 1900s, Argentina in 1989, Bulgaria in late 1990s) the probability of growth takeoff increases by 1.12 percentage points.

As for the economic variables, a 10% increase in the Trade Openness (from 0.494 sample mean - about the level of Volume of Trade (VOT) as a share of GDP for the United Kingdom in 1897 - to 0.544 - about the level of the UK in 1909) at t-1 would increase the probability of growth takeoff at time t by approximately 0.74%. Similarly, a one standard deviation increase from the mean VOT (from 0.494 to 0.892 - about the level of Hungary in 1996) would lead to on average 8.7% increase in the probability of growth takeoff.

The marginal effects coefficients also suggest that one standard deviation increase in the 4-year average of log GDP per capita (corresponding to an increase from $5,131.27 per capita to $11,045.52 per capita income - roughly the difference between Portugal and Germany in 1970) at t-2 would result in a 61% increase of the probability that a growth episode will be initiated in the year t. Alternatively, for countries otherwise similar, the country with income per capita 1 standard deviation above the mean has much higher chances of experiencing a growth episode than the country whose income per capita is at the sample mean. In the same time, a more modest $400 increase above the mean income per capita would lead to an approximately 2.5 percentage point increase in the probability of a growth takeoff.

Other variables in the regression have signs consistent with theory: an increase in 3-year average of total Government Expenditure as a share of GDP (from 0.187 to 0.304) would lead to decline in the growth takeoff probability by

1.56%. An increase in the 4-year average of infant mortality rate at t-1 (from 64.8 deaths per 1000 live births to 123.5 - roughly the difference between Denmark and Spain in 1939) would result in about 1.9% decrease in the probability of growth takeoff in the next period.

The coefficients in front of year-specific means of explanatory variables can be interpreted as follows: a one standard deviation increase in "average democracy" in the world (from 3.1 points to 5.5 points on the polity scale) leads to a 1.43 percentage point increase in the probability that a growth takeoff will be experienced by any given country. The base regression coefficients also suggest that the impact of average "world democracy" is twice the impact of "own democracy" on the probability of growth takeoff episode initiation.

The impact of higher infant mortality rate in the world at time t-1 is significant and negative. The impacts of higher trade openness in the world, as well as the country's own investment/GDP ratio, and GDP per capita at time t-1 are also significant and negative (this can be attributed to cyclical fluctuations - as the growth episodes are usually initiated when economies are starting to recover from a recession).

An interesting result is the significant and positive effect of financial crisis on the probability of a growth takeoff. This result is consistent with the empirical findings of Ranciere, Tornell and Westermann (2004) who argue that economies, which have experienced occasional crises, have grown on average faster than countries with smooth credit conditions[16].

4.2 Extensions of the Base Model: Results and Interpretation. Interaction Terms

I consider several extensions to the base model described above. One of them is to introduce interactions terms that would capture the effects of positive and negative enduring regime changes during the times of economics crisis. Table 9, (columns 3-4) presents the marginal effects of 1 standard deviation change from the sample mean. The asteriscs indicate the significance level of the corresponding regression coefficients. The coefficient for the interaction term of

[16] The authors develop a model in which credit market imperfections generate borrowing constraints and low growth, and show that a country on a more risky path will grow faster but will also experience occasional self-fulfilling crises.

Crisis and Positive enduring regime change is significant and negative, suggesting that democratic regime changes during the time of economic crises actually decrease the likelihood of growth takeoff episode starting in the next period. In the same time, introducing the interaction term has made the coefficient for positive enduring regime change positive and significant, increasing the marginal effect of change to 5.85 percentage points. Other coefficients in the model are not significantly changed.

The results suggest that crises significantly dampen the impact of democratic change on the likelihood of growth takeoffs. Why would the financial crisis play such a role during positive regime changes as opposed to negative regime changes, as suggested by the data? One of the likely explanations is that every political regime change brings about uncertainty. Democratic regime changes, especially in the time of economic turmoil, may be perceived as brining about less stability than do autocratic regime changes.

In this respect it would be interesting to see whether during crisis times countries with more representative political institutions have greater chances of experiencing a rapid growth episode. I introduce another interaction term to the regression - crisis with 5-year polity average. The interaction term is significant and positive suggesting that in the time of economic crisis, higher polity score helps increase the probability of growth takeoffs. The results are summarized in Table 9, column 4 - a 3.6-point increase in the country's average polity score helps increase the probability of growth takeoff by about 1.5% in the post-crisis time.

4.3 Controlling for economic conditions in the rest of the world

The base model attempts to control for global economic conditions (such as exceptionally high or low value of global investment or trade at time t-1) by way of introducing year-specific world averages of the main economic variables. Another way of taking into account external economic conditions is by introducing variables that capture economic performance in the largest economies in the world. For example, recent research suggests that the country's capital flows as well as growth rates may be affected by interest rates

in the US. In particular, higher interest rates in the US may lead to capital outflows from other countries[17].

By the same argument, one might expect that a period of high growth in a large country would lead to capital inflow from the rest of the world and will be associated with a period of capital outflow from other countries.

Table 9, column 5 shows the marginal effects of the regression, which includes the variables for the rate of return and a lag of the 3-year average growth rate in the UK (before 1913) or the US (after 1913). United Kingdom and United States are dropped from the sample. The results suggest that the 3-year average growth rate in the large economy has a significant negative effect on the probability of a country experiencing a growth takeoff; yet, controlling for these external conditions does not alter the results of the base model significantly.

4.4 Threshold effects

The results presented so far give the idea of how political regime changes as well as level of development of political institutions influence the probability of growth takeoffs. Yet, one needs to test for the non-linearity in the regression coefficients; in particular since the impact of political regime change may differ for countries with different levels of democracy, GDP per capita, degrees of trade openness. The impact of trade openness and quality of political institutions on growth may also be different for different levels of these variables. To test these hypotheses I estimate the threshold regressions as shown in equation (1.3) and (1.4).

Table 10 provides the marginal effects of the threshold regression estimation. Table 11 panels a-d gives the estimated p-value for various thresholds. As can be seen from Table 11, one cannot reject the presence of at least two thresholds in the Volume of Trade (VOT) variable. The sample is optimally split at 87th and 78th percentile of VOT. (This corresponds to VOT level of 0.79 and 0.63 as a share of GDP).

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[17] For example Calvo and Reinhart in their paper *Capital Flows to Latin America: Is There Evidence of Contagion Effects?* (1996) suggest that higher interest rates in the US are significantly associated with capital outflows from Latin America. Another paper by Giovanni and Shambaugh *The Impact of Foreign Interest Rates on the Economy: The Role of the Exchange Rate Regime* (2006) suggests that high large-country interest rates are associated with lower GDP growth in the other countries.

The effects on the probability of growth takeoffs (presented in column 3 of Table 10) are significantly different for different levels of trade openness. For a small increase in the volume of trade away from the mean, the impact on the probability of growth takeoff is largest when VOT as a share of GDP is between 0.63 and 0.79. (Nearly 1.66 times larger than when the VOT is above 79% of GDP level; and 1.45 larger than the effect of VOT below 63% of GDP). For example, the rising VOT is likely to have a stronger impact on the probability of growth takeoff in countries such as Belgium in early 1960s (VOT 0.67) than in countries such as Norway (VOT 0.82) or Canada (VOT 0.29) in the same period.

Another hypothesis I am interested in testing is whether countries that already have higher average polity score (hence, stronger political institutions from the start) benefit more from an increase in the quality of political institutions than do countries characterized by lower average polity score.

The results in Table 11-a support the presence of one threshold in the 5-year Polity average at 68th percentile or 9-point average Polity score level.

The coefficients in Table 10, column 2 suggest that above the 9-point level an increase in the 5-year average of polity score from 9.2 to the maximum of 10 points would increase the likelihood of growth takeoff by 0.78%. This would correspond to an increase from the polity score level of Portugal and Spain in 1983-84 to that of the UK or the US.

Finally, I test the hypothesis that political regime changes affect countries' growth prospects differently, depending on the level of per capita GDP. I estimate a threshold model described by equation (1.3), where the sample split variable, $Z_{i,t}$ is positive/negative regime change dummy, and the threshold variable, $q_{i,t}$ is log GDP per capita.

According to the result shown in Table 11-c, we cannot reject the hypothesis of one threshold at the 69th percentile of log GDP per capita (corresponding to $5,698.17 per capita income expressed in 1990 international dollars) for positive political regime change.

The results from a threshold regression (Table 10, column 1) indicate that a positive regime change (defined here as a 3 point increase in Polity score in less than 3 years) positively and significantly affects the chances of a growth

takeoff, but only for countries above $5,698 per capita income (such as for example Chile in 1990s, Spain in 1983, Uruguay in 1989). Below this level of income, the estimated effect is negative but not statistically significant.

This result confirms the original hypothesis that a richer country might benefit democratic regime changes, while pro-democratic revolutions in poor countries may not have a beneficial impact on growth.

In the same time, level of per capita income does not seem to matter for the coefficient on negative regime changes.

Section V. Conclusion

There is a lack of agreement among researchers on whether political regime changes, in particular movements towards more representative political systems, are beneficial for long-term growth prospects of a country. Democratization can be viewed as either a destabilizing force, or on the contrary, as a catalyst for economic reform.

In this paper, I use the framework of growth takeoffs to explore the link between political regime changes and long-term growth. Using an unbalanced panel of 57 countries, I identify 154 growth takeoff episodes starting as early as 1842. I find that both democratic and autocratic regime changes, as well as the initial level of democratization significantly increase the probability that a country will enter a period of sustained and rapid growth.

Further, I present evidence in favor of the "threshold effects" in growth. In particular, I find that countries with income per capita below a certain threshold level do not benefit from democratic regime changes to the same extent as their richer counterparts. The threshold is estimated to be at the income level of $5,698 per person (measured in 1990 international dollars). For countries below this threshold, the coefficient of the democratic regime change is negative, but not significantly different from zero. I also find that the impact of the autocratic regime changes on takeoff probability is positive, but in contrast to the finding on democratization, not subject to threshold effects.

The results are hardly surprising, considering that political turmoil typically brings about much uncertainty about the economic future of the country. For countries with limited democratic experience and already weak institutional frameworks, movements toward pluralistic systems of governance

may lead to higher levels of uncertainty and economic destabilization. The newly minted democratic governments might not be able to effectively enact reforms or enforce the rule of law, in contrast to the less pluralistic regimes.

Yet, the findings of the paper suggest that establishing stronger democratic institutions can prove stabilizing in the long run. In particular, during the times of financial crisis, higher levels of democratization help increase the probability that a country will experience a growth takeoff episode.

In addition, I find that trade openness, and the initial level of income per capita increase the probability of a takeoff initiation. In the same time, an increase in government expenditure as a share of GDP and infant mortality rate (a proxy for educational attainment of the labor force), reduce this probability.

The effect of trade openness on takeoffs is found to be non-linear. In particular, international trade benefits growth the most in the countries that fall in the mid-range of trade openness.

An interesting finding of the paper is that financial crises, while dampening the effect of democratic regime changes on growth takeoffs, are overall positive predictors the growth acceleration episodes. Intuitively, financial crises variable may be capturing the effect of financial openness on economic growth. A closer look at the nature of interaction between growth takeoffs, financial openness and financial crises remains an open question and an avenue for further research.

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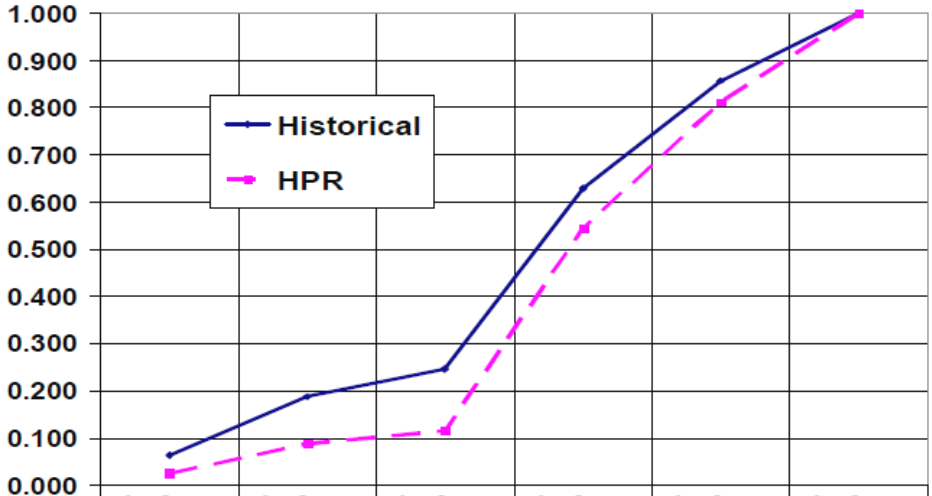
Appendix

Tables and Figures

Comparison of HPR(2005) and the Historical method for takeoff identification.

Figure 1 Growth Acceleration episodes

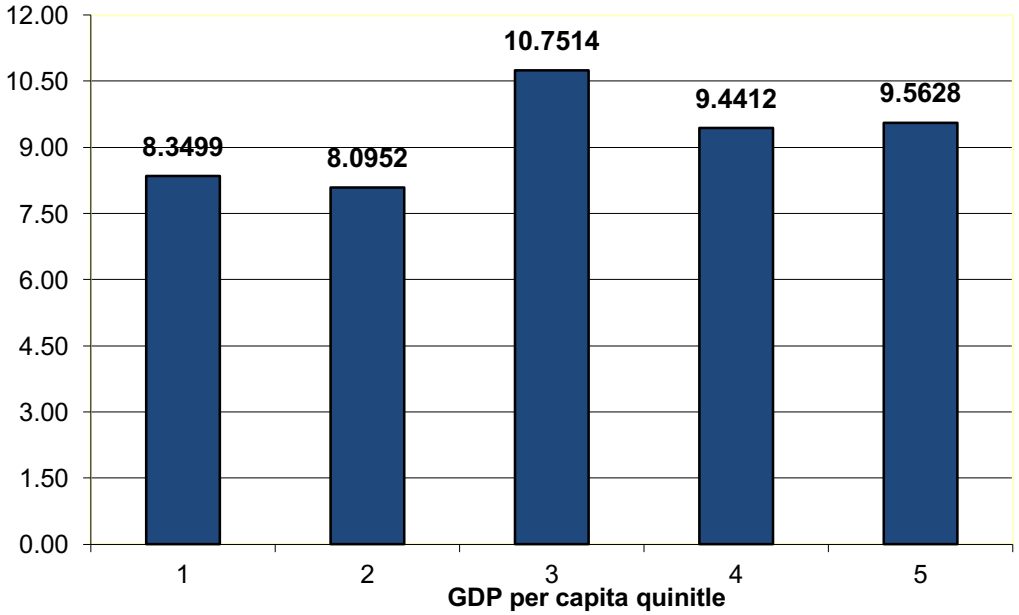
Cumulative distribution over time of growth acceleration episodes (identified under the HPR and the Historical methods) [5]



	before 1870	before 1900	before 1914	before 1945	before 1970	before 2003
Historical	0.065	0.188	0.247	0.630	0.857	1.000
HPR	0.027	0.089	0.116	0.545	0.813	1.000

[5] Ratio of the number of episodes to date divided by the total number of episodes identified by the Fgiven method

Figure 2 Unconditional probability of growth takeoffs by income quintiles



Unconditional probability of a growth takeoff calculated as the number of takeoff initiation years divided by the number of total country-year observations - averaged over the countries in each income quintile. Income quintiles are based on the average GDP per capita levels of income in the last 20 years of the sample (1983-2003). The sample is restricted to countries with at least 20 years of country-year observations.

Table 1 *Expansion of the sample*

Year	Number of countries in the sample	Countries
1820	4	Netherlands, France, Sweden, Denmark
1830	5	United Kingdom
1846	6	Belgium
1850	9	Switzerland, Spain, Prussia
1860	11	Italy, Finland
1865	13	Norway, Portugal
1868		Germany
1870	20	Austria, New Zealand, Canada, United States, Brazil, Uruguay, Japan
1900	26	Argentina, Chile, Colombia, Mexico, Peru, Venezuela
1901	27	Australia
1920	29	Czechoslovakia, Yugoslavia
1921	31	Ireland, Greece
1923	32	Turkey
1924	34	Bulgaria, Hungary
1926	35	Romania
1928	36	USSR
1935	37	Philippines
1929	38	Poland
1945	39	Indonesia
1950	41	Albania, Thailand
1957	42	Malaysia
1959	43	Singapore
1990	57	Serbia-Montenegro, Slovenia, Macedonia, Croatia, Bosnia, Czech Republic, Slovakia, Armenia, Azerbaijan, Belarus, Moldova, Ukraine, Estonia, Latvia, Lithuania, Russia, Georgia

Table 2 *Rapid growth episodes: average growth before and after the on-start of the episode*[18]

The Americas	Episode start	Growth before	Growth after	The Americas	Episode start	Growth before	Growth after
United States	1877	0.0070	0.0402	Uruguay	1881		0.0385
	1896	0.0040	0.0380		**1905****		**0.0488**
	1922	0.0115	0.0249		1923		0.0423
	1938	0.0329	0.1178		1943		0.0469
	1961	0.0111	0.0396		**1973***		**0.0388**
					1988**		**0.0258**
Canada	1877	-0.0007	0.0446		1990		0.0400
	1896	0.0016	0.0567				
	1921	-0.0263	0.0576	Argentina	1921		0.0264
	1937	-0.0006	0.0894		1942		0.0323
	1949	-0.0034	0.0252		1964		0.0328
	1962		0.0365		1990		0.0400
	1996		0.0279				
				Europe West			
Mexico	**1936***		**0.0229**	UK	**1842****		**0.0348**
					1893		0.0241
Colombia	1923		0.0315		1910		0.0256
	1933**		**0.0325**		1922		0.0238
	1943		0.0259		1936		0.0413
	1967		0.0390		1950		0.0228
					1982		0.0359
Venezuela	**1907***		**0.0369**	Ireland	1946		0.0308
	1922*		**0.1633**		1958		0.0401
	1932		0.0775		1994		0.0840
	1942**		**0.1384**				
				Netherlands	**1845****		**0.0136**
Peru	**1922***		**0.0473**		1860		0.0187
	1931**		**0.0483**		1879		0.0259
	1948		0.0378		1896		0.0114
	1959		0.0448		1921		0.0382
					1944		0.1357
Brazil	1905		0.0162		1984		0.0236
	1916		0.0406				
	1931		0.0379	Belgium	1918		0.0674
	1945		0.0312		1943		0.0488
	1955		0.0442		1959		0.0423
	1967*		**0.0715**				
				France	**1853***		**0.0262**
Chile	1922		0.0337		1887		0.0225
	1974*		**0.0403**		1906		0.0239
	1990**		**0.0663**		1918		0.0801
					1932		0.0222
					1944		0.1291

[18] * denotes the growth episode that occurred within 5 years after a negative enduring regime change .
** denotes the growth episode that occurred within 5 years after a positive enduring regime change .

Europe West	Episode start	Growth before	Growth after		Episode start	Growth before	Growth after
Spain	1870		0.0365	Romania	1960		0.0597
	1896		0.0251	USSR	1942		0.1128
	1920		0.0230				
	1950		0.0454	Albania	**1996****		**0.0577**
	1960		0.0812				
	1984**		**0.0405**	*Europe North*			
	1996		0.0388	Finland	1868		0.0231
					1892		0.0386
Switzerland	1883		0.0325		**1918****		**0.0712**
	1892		0.0275		1931*		0.0541
	1918		0.0486		**1948****		**0.0381**
	1943		0.0650		1958		0.0478
					1967		0.0561
Portugal	1880		0.0236		1993		0.0416
	1894		0.0271				
	1918**		**0.0381**	Sweden	1842		0.0143
	1942		0.0273		1853		0.0264
	1959		0.0597		1867		0.0450
	1984		0.0524		1891		0.0246
					1923**		**0.0395**
Germany	**1923****		**0.0524**		1932		0.0479
	1932		0.0700		1958		0.0446
	1951		0.0711		1996		0.0284
Austria	**1922****		**0.0406**	Norway	1909		0.0317
	1934		0.0657		1926		0.0293
	1950		0.0664		1944		0.0661
					1991		0.0375
Italy	1881		0.0157	Denmark	1842		0.0214
	1902**		**0.0432**		1921		0.0255
	1911		0.0540		1941		0.0447
	1933*		**0.0303**		1958		0.0421
	1945		0.0965		1958		0.0421
Europe East/South				*Asia/Oceania*			
Poland	1992		0.0558	Japan	1888		0.0304
					1914		0.0433
Hungary	1948		0.0446		1934		0.0545
	1956		0.0495		1951		0.0629
	1996**		**0.0455**		1960		0.0839
Czechoslovakia	1934		0.0587	Thailand	**1961***		**0.0520**
	1953		0.0543		1986		0.0885
Yugoslavia	**1932***		**0.0335**	Malaysia	**1972***		**0.0564**
	1943		0.0591		1987		0.0689
	1957		0.0563				
				Singapore	**1966***		**0.1118**
Greece	**1931****		**0.0319**				
	1963		0.0680	Indonesia	1967		0.0766
					1988		0.0606
Bulgaria	1945		0.0924				
	1956		0.0707	Australia	1918		0.0277
					1931		0.0451
				New Zealand	1899		0.0316
					1932		0.0668

Table 3 *Summary of episodes by region and time period, % of the total number of episodes*

	Asia	Europe West	Europe East	Latin America	Western Offshoots[19]	Total %	Total episodes
Before 1870	0	6.49	0	0	0	6.49	10
1871-1900	0.65	7.79	0	0.65	3.25	12.34	19
1901-1950	1.3	24.68	4.55	13.64	5.19	49.35	76
1951-2002	5.84	11.69	5.84	6.49	1.95	31.82	49
Total %	7.79	50.65	10.39	20.78	10.39	100	
Total episodes	12	78	16	32	16		154

Table 4 *Average 8-year growth after takeoff initiation by region*

Time period	Western Europe	Eastern Europe	Asia	Western Offshoots	Latin America	All countries
Before 1950	0.0474	0.0577	0.0735	0.0323	0.0443	0.0452
After 1950	0.041	0.0619	0.0427	0.0512	0.0481	0.0529

Table 5 Growth takeoffs, share of sustained episodes (of the total number of takeoff episodes)

Time	Western Europe	Eastern Europe	Asia	Western Offshoots	Latin America	All countries
1850-1900	0.318	n.a	1	0.8	1.0	0.448
1901-1950	0.605	0.8	0.5	0.5	0.714	0.635
1951-1988	0.923	1	0.56	0.5	0.5	0.737
All time periods	0.575	0.90	0.583	0.6	0.667	0.624

[19] US, Canada, Australia, New Zealand

Table 6 *Average Investment as a share of GDP and Takeoff episodes*

Here and the subsequent tables: *** significant on 1% level ; ** significant on the 5% level; * significant on 10% level

Time period	(1) Investment/GDP ratio Sample average	(2) Investment/GDP ratio Last 4 years of the 8-year takeoff episode	(3) Investment/GDP ratio 4 years before the takeoff episode	(4) Difference (2) - (3)
1840-1875	0.1036	0.1035	0.0857	0.0179***
1876-1900	0.1174	0.1267	0.0999	0.0268***
1901-1968	0.1737	0.1915	0.1585	0.0330***
1969-2003	0.2281	0.2323	0.2060	0.0263***

Table 7 *Average Volume of Trade as a share of GDP and Takeoff episodes*

Time period	(1) VOT/GDP ratio Sample average	(2) VOT/GDP ratio Last 4 years of the 8-year takeoff episode	(3) VOT/GDP ratio 4 years before the takeoff episode	(4) Difference (2) - (3)
1840-1875	0.3742	0.4347	0.3057	0.1290**
1876-1900	**0.3985**	**0.3907**	**0.4030**	-0.0123
1901-1968	0.3499	0.3661	0.3438	0.0224
1969-2003	0.64288	0.7218	0.5656	0.1562***

Table 8 *Average log GDP per capita as a share of GDP and Takeoff episodes*

Time period	(1) log GDP per capita Sample average	(2) log GDP per capita Last 4 years of the 8-year takeoff episode	(3) log GDP per capita 4 years before the takeoff episode	(4) Difference (2) - (3)
1840-1875	7.4274	7.4591	7.3566	0.1025**
1876-1900	7.6332	7.8090	7.6453	0.1636**
1901-1968	8.0672	8.2213	7.9513	0.2699***
1969-2003	8.9748	9.1336	8.8494	0.2841***

Table 9 *Base Model with Interaction Terms*

Dependent variable: year of the takeoff episode initiation: 0-1 binary variable	[1]	[2]	[3]	[4]	[5]
Variables	*Marginal effects*	*Marginal effects, 1 st. dev.* [20]	*Marginal effects, 1 st. dev.*	*Marginal effects, 1 st. dev.*	*Marginal effects, 1 st. dev.*
Positive regime change (t-1)	1.6261	2.3834	5.8531*	6.2039*	7.2273**
Negative regime change (t-1)	4.4375**	6.6504**	7.1988*	7.6120	6.9713*
Polity 5 year average (t-1)	0.0054***	1.4330***	1.9970***	2.1146*	2.3082***
Control variables					
Crisis (t-1)	1.9893**	2.3209**	2.8648**	3.0620	1.7484
Trade openness (t-1)	0.1423**	8.6521**	9.2400**	9.6986**	9.5665*
Trade openness (t-2)	-0.0250	-0.9082	-0.9595	-1.0213	-0.2703
Trade openness 3 year average (t-3)	-0.0910	-2.6217	-2.7020	-2.8877	-3.0122
Investment (t-1)	-0.5952***	-2.9718***	-2.9394***	-3.1434***	-3.2584***
Investment (t-2)	0.2008	1.5792	1.4575	1.5447	1.6127
Investment 3 year average (t-3)	-0.0507	-0.3406	-0.2853	-0.3032	0.3976
Government expenditure 3 year average (t-3)	-0.1567***	-1.5609***	-1.6145***	-1.7208***	-1.7194**
Log GDP (t-1)	-0.3247***	-5.0084***	-4.9241***	-5.3131***	-5.0741***
Log GDP 4 year average (t-2)	0.2786***	61.3875***	61.7271***	62.6743***	46.8658***
Infant mortality 4 year average (t-1)	-0.3909**	-1.9093**	-1.9020**	-2.0286***	-1.6856
Time control variables					
Log GDP $\bar{t}$, (t-1)	-0.0611	-2.5773	-2.7074	-2.8935	-2.9132
Trade Openness $\bar{t}$, (t-1)	-0.1384**	-1.8952**	-1.7931**	-1.9119***	-0.5965
Government Expenditure $\bar{t}$, (t-1)	0.0546	0.3953	0.4755	0.5325	0.6470
Investment $\bar{t}$ (t-1)	-0.1334	-0.5957	-0.5008	-0.5325	-1.4603
Polity $\bar{t}$, (t-1)	0.0054*	1.4330*	1.2927	1.3704	1.0632
Infant mortality $\bar{t}$, (t-1)	-0.9955***	-3.4214***	-3.4465***	-3.6915***	-3.9411***
Crisis*Positive regime change (t-1)			-3.4847*	-3.3773	-3.7486*
Crisis*Negative regime change (t-1)			0.0401	1.0551	0.5590
Crisis* Polity 5 year average (t-1)				1.5185***	
Rate of return (UK, US)(t-1)					0.2569
Growth rate (UK, US) (t-1)					0.7559**
Constant					
Observations	2760	2760	2760	2760	2351

[20] Calculated at the sample means of continuous variables. Marginal effects 1 std. dev. Indicate a change in the probability of rapid growth episode initiation when the variable increases by 1 standard deviation from the mean (change from 0 to 1 for the binary variables).

Table 10 *Threshold effects*

Dependent variable: year of the takeoff episode initiation: 0-1 binary variable *Variables*	[1] *Marginal effects*	[2] *Marginal effects, 1 st. dev.* [21]	[3] *Marginal effects, 1 st. dev.*
Crisis $_{(t-1)}$	2.2212**	4.0017**	2.3611**
Positive regime change $_{(t-1)}$		4.8003	2.0053
Positive regime change $_{(t-1)}$ (log gdp ≤ 8.6479)	-1.0870		
Positive regime change $_{(t-1)}$ (log gdp > 8.6479)	15.9597***		
Negative regime change $_{(t-1)}$	6.6885**	11.7406**	6.5214*
Polity $_{5 \text{ year average } (t-1)}$	1.8780***		1.7790***
Polity $_{5 \text{ year average } (t-1)}$ (Polity ≤ 9)		0.8518	
Polity $_{5 \text{ year average } (t-1)}$ (Polity > 9)		0.0876***	
Trade openness $_{(t-1)}$	8.4601**	12.5615*	
Trade openness $_{(t-1)}$ (VOT ≤ 0.6343)			3.9243**
Trade openness $_{(t-1)}$ (VOT > 0.6343 ≤ 0.7949)			5.4240***
Trade openness $_{(t-1)}$ (VOT > 0.7949)			10.9985*
Trade openness $_{(t-2)}$	-1.1262	-1.5470	-0.9009
Trade openness $_{3 \text{ year average } (t-3)}$	-2.5866	-4.3838	-2.5615
Investment $_{(t-1)}$	-3.0098***	-5.4181***	-2.8644***
Investment $_{(t-2)}$	1.5058	2.4665	1.8336
Investment $_{3 \text{ year average } (t-3)}$	-0.3173	-0.4427	-0.3699***
Government expenditure $_{3 \text{ year average } (t-3)}$	-1.5970***	-2.7705***	-1.4737**
Log GDP $_{(t-1)}$	-4.9496***	--9.6804***	-4.7304***
Log GDP $_{4 \text{ year average } (t-2)}$	60.7004***	70.3858***	61.9930***
Infant mortality $_{4 \text{ year average } (t-1)}$	-1.7850***	-2.0604	-1.7966*
Time control variables			
Log GDP $\bar{t}_{,(t-1)}$	-2.9080	-2.9512	-2.0065
Trade Openness $\bar{t}_{,(t-1)}$	-1.8932	-3.1841**	-2.0366***
Government Expenditure $\bar{t}_{,(t-1)}$	0.4280	0.3273	0.1735
Investment $\bar{t}_{(t-1)}$	-0.7232	-1.0651	-0.9150
Polity $\bar{t}_{,(t-1)}$	1.4052***	2.6540	1.3979*
Infant mortality $\bar{t}_{,(t-1)}$	-3.5515***	-5.8499	-3.2469***
Observations	2760	2760	2760

[21] Calculated at the sample means of continuous variables. Marginal effects 1 std. dev. Indicate a change in the probability of rapid growth episode initiation when the variable increases by 1 standard deviation from the mean (change from 0 to 1 for the binary variables).

Table 11 *Sample split variable: Polity 5 -year average*

Threshold variable: Polity 5-year average

	Estimate (threshold- Polity score)	Percentile	Bootstrap p-value
1st Threshold	9	68	0.033**
2nd Threshold	7	59	0.267

Table 12 Sample split variable: Volume of Trade

Threshold variable: Volume of Trade

	Estimate (threshold -Volume of Trade as share of GDP)	Percentile	Bootstrap p-value
1st Threshold	0.7949	87	0.047**
2nd Threshold	0.6343	78	0.066*
3rd Threshold	0.2828	30	0.170

Table 13 Sample split variable: Positive Enduring Regime Change

Threshold variable: log GDP per capita

	Estimate (threshold log GDP per capita)	Percentile	Bootstrap p-value
1st Threshold	8.6479	69	0.077*
2nd Threshold	7.5895	23	0.1262

Table 14 Sample split variable: Negative Enduring Regime Change (t-1)

Threshold variable: log GDP per capita

	Estimate (threshold log GDP per capita)	Percentile	Bootstrap p-value
1st Threshold	7.467011	18	0.2085

Table 15 *Summary Statistics*

Variable	**Obs.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Growth rate	4673	0.0198	0.0264	-0.1471	0.2053
Volume of Trade	4043	0.4682	0.3935	0.0116	3.6988
Government Expenditure	3751	0.1880	0.1352	0.0002	1.1382
Investment	3842	0.1859	0.0732	-0.0542	0.5288
Infant mortality rate	4336	0.0769	0.0655	0.0022	0.3920
Log GDP per capita	5078	8.2613	0.8268	6.4317	10.2763
VOT 3-year average	3882	0.4628	0.3854	0.0163	3.5234
Investment 3-year average	3695	0.1861	0.0713	-0.0382	0.4758
Government Expend. 3-year av.	3586	0.1850	0.1302	0.0127	0.9920
Log GDP 4 year av.	4870	8.2610	0.8152	6.5232	10.2604
Infant mortality 4 year av.	4098	0.0765	0.0641	0.0027	0.3145
Polity 5 year av.	4758	2.6407	6.9863	-10	10
Log GDP $\bar{t}$	5147	8.2594	0.5771	7.1746	9.1709
VOT $\bar{t}$	5147	0.4488	0.1731	0.1716	0.9596
Infant mortality $\bar{t}$	5147	0.0831	0.0557	0.0076	0.2090
Government Expenditure $\bar{t}$	5147	0.1811	0.0720	0.0713	0.2989
Investment $\bar{t}$	5147	0.1758	0.0494	0.0715	0.2540
Polity $\bar{t}$	5147	2.6855	2.7417	-7	7.9286

Data Sources

1. All GDP per capita data comes from Angus Maddison *Historical Statistics for the World Economy 1-2003 AD* available at: http://www.ggdc.net/maddison/

2. B.R. Mitchell *International Historical Statistics Europe 1750-1993* and B.R. Mitchell *International Historical Statistics Africa, Asia & Oceania 1750-1993* - sources for European and Asian countries data on: GDP at current prices data until 1948-50; Gross capital formation until 1948-50; Total Central Government Expenditure until 1948-50; Exports, Imports until 1948 -50; Wholesale prices index until 1948-50.

3. B.R. Mitchell *International Historical Statistics the Americas 1750-1993* - source for the US (until 1948) and Brazil (until 1900) data on: GDP at current prices; gross capital formation; total central government expenditure; exports; imports; wholesale price index; Infant mortality rate - US, Latin American countries until 1993.

4. Oxford Latin American Economic History Database - source for Latin American countries data 1900-2000 on: GDP at current prices; gross domestic fixed investment; central government expenditure; exports; imports; implicit GDP deflator. Data available at: http://oxlad.qeh.ox.ac.uk/index.php

5. International Financial Statistics (IFS) - all countries after 1948-1950 data on: GDP at current prices; gross fixed capital formation, government expenditure, exports, imports, GDP deflator.

6. World Development Indicators (WDI) - all countries data on infant mortality rates after 1993 (and for earlier dates if missing from Mitchell)

7. OECD (2004), HEALTH DATA 2004, 1st edition: http://www.oecd.org/health/healthdata - Supplementary data source for OECD countries infant mortality rates from 1960 (if missing from Mitchell).

8. Other supplementary data sources for select countries:

Netherlands: National Accounts of the Netherlands 1800-1913 available at: http://nationalaccounts.niwi.knaw.nl/start.htm - source for 1820-1913 data on: GDP at current prices, investment, imports, exports, public expenditure, GDP deflator

Norway: Norges Bank Historical Data: source for 1830-2001 data on: GDP at current prices, gross investment, \\imports, exports, government consumption, GDP deflator.

Spain: Prados de la Escosura, L. (2003). - source for 1850-1959 data on GDP at current prices, Investment, Imports, Exports, Government Expenditure, GDP deflator.

Portugal: Nunes and Valerio (1989) - source for 1833-1950 data on exports, imports, GDP at current prices, GDP deflator, public expenditure.

9. Sources of data on currency, banking and debt crises:
Kindelberger (1996); Suter (1992); Bordo and Eichengreen (2002);
Kaminsky and Reinhart (1999);

10. Marshall, Monty G. and Keith Jaggers. *Polity IV Dataset (Computer File; Version p4v2001)*. College Park, MD: Center for International Development and Conflict Management, University of Maryland, 2002 - source of political regime change data and democracy (polity) indicators. All countries 1820-2001 available at: http://www.cidcm.umd.edu/inscr/polity

Data Coverage

There are overall 61 countries in the dataset. Since some European countries leave the sample as others enter, there are at most 57 countries in the sample in any given year. In addition, because of data availability the working sample for the base model is reduced to 54 countries.

Western/Northern Europe: United Kingdom, Ireland, Netherlands, Belgium, France, Switzerland, Spain, Portugal, Prussia, Germany, Austria, Italy, Finland, Sweden, Norway, Denmark.

Eastern Europe/Central Asia: Poland, Hungary, Czechoslovakia, Czech Republic, Slovakia, Albania, Macedonia, Croatia, Yugoslavia, Serbia-Montenegro, Bosnia, Slovenia, Greece, Bulgaria, Moldova, Romania, USSR, Russia, Estonia, Latvia, Lithuania, Ukraine, Belarus, Armenia, Georgia, Azerbaijan, Turkey.

Asia/Oceania: Japan, Thailand, Malaysia, Singapore, Philippines, Indonesia, Australia, New Zealand.

The Americas: United States, Canada, Mexico, Colombia, Venezuela, Peru, Brazil, Chile, Argentina, Uruguay.