Political Regime Changes and the Turning Points of Economic Growth

Yaroslava Babych*

current version: September 2008

The George Washington University
Department of Economics
2115 G Street, NW Monroe Hall 340
Washington, DC 20052
e-mail: ybabych@gwu.edu

Abstract

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

I also find similar non-linearity in the coefficients for trade openness and the quality of political institutions. In particular, the increase in the initial level of the country's democratization matters for growth, but only for countries with already high democracy scores. I also discuss the "forecast skill" of the model and find evidence that the model developed in the paper does significantly better in predicting the onset of growth takeoffs, than the baseline constant probability forecast.

*I would like to thank Graciela Kaminsky for the invaluable help in the preparation of this paper; Aleksandra Markovic, Rei Odawara, Julia Bersch, Mauricio Olivera, Juan Jimenez, and the participants of the International Finance Seminar group for their helpful and insightful comments.

1 Introduction

How do political institutions affect economic growth? Are representative systems of governance more effectual at securing economic prosperity than the autocratic systems? The debate surrounding these issues is not new - the economic studies examining the connection between political regimes and the growth performance date back to 1960s.[1] In recent years, however, there has emerged a large and growing body of empirical literature investigating the complex links between political transitions and economic outcomes. These studies seek to examine the role that democratic institutions play in fostering growth, and to some extent, the role of economic growth (trade, financial openness) in promoting transition to representative political systems.

In part, this interest is due to the tectonic political shifts experienced by many countries in the late 1980s-early 1990s (e.g. the former members of the Warsaw Pact and the former USSR). So far these events raised more questions than they have provided answers about the complex relationship between political institutions and economic growth. Why is it, for example, that Poland, Hungary, Slovakia, and the Baltic states have gone through remarkable economic transformations following the stable political changes, while Romania, Moldova, Ukraine, Georgia remained democratic, yet failed to experience consistently high rates of growth? Why is it that a number of countries in the region (e.g. Belarus, Kyrgyzstan, Tajikistan, Kazakhstan) experienced varying degrees of political reversals from democracy back to the autocratic system of governance, with or without gains in growth?

In order to address these questions, we first need to establish an appropriate framework for analyzing the countries's growth histories. In this respect, the recent empirical studies on the growth and political institutions nexus may be grouped into two broad categories. Studies in the first category primarily look at how political regime changes affect and are affected by key economic factors: trade openness, financial openness and the average growth rate of income per capita.[2] The second group of studies focuses mainly on the turning points in the

[1] For example studies done by Samuel Huntington (1968) [16]; Schweinitz, Karl Jr., 1964 [41]. For a comprehensive review of studies on democracy-growth nexus see Przeworski and Limongi (1993) survey paper [36].

[2] For example Milanovic(2005) [29]; Przeworski and Limongi (1993); Lopez-Cordova and Meissner (2005) [24]; Eichengreen (2006) [12]; Papaioannou and Siourounis (2004) [35] - these

countries' economic history, seeking to uncover the nature of growth takeoffs as well as growth slowdowns.[3]

The main difference between these strands of literature lies in their treatment of economic growth. Jerzmanowski (2006), for example, points out that the studies in the former category often analyze the impact of political institutions on the the cross-country average growth rates, or on the linear time trend of growth. The latter group, however, views long-term growth as a changing sequence of different growth states, rather than simply a linear trend. The possible economic states include growth takeoffs, periods of stable and sustained growth, slowdowns, stagnations and crises. This framework seems to be particularly relevant for analyzing growth patterns in developing countries, emerging markets, and even developed economies over particularly long periods of time, when the structural breaks in the growth trends are more prominent.

Growth takeoffs have received particular attention in the literature, with recent papers by Hausmann, Pritchett and Rodrik (2005), Aizenman and Spiegel (2007) [1] investigating the link between takeoffs, economic reform, and political regime changes. The goal of these studies is to define takeoffs as the episodes of sustained, rapid and accelerating growth and to analyze the impact of various institutional and economic factors on the probability that the country escapes a poverty trap and enters a period of sustained growth.

My paper contributes to the analysis of growth takeoffs by addressing the following questions: How do we define rapid and accelerating growth episodes, particularly in the context of the historical data, spanning more than a century of growth history? Do political regime changes, be they democratic or autocratic, help induce the takeoffs; and to what extent do political regime changes as well as other key variables such as trade openness, government expenditure, education and investment help predict their onset? Finally, do political regime changes affect the probability of growth takeoffs differently at different levels of key variables - such as the "level" of a country's democratization, trade openness and the level of per capita income?

In this paper the principle method for identifying growth takeoffs is based

---

studies are reviewed later in the paper.

[3] Hausmann, Pritchett and Rodrik (2005) [14]; Jones and Olken (2008) [20]; Jerzmanowski (2006) [19].

on the methodology originally developed by Hausmann, Pritchett and Rodrick (2005). The methodology is modified in order to make it applicable for the analysis of the historical data. The paper also expands the time series dimension of the country sample normally used in the literature, to include growth episodes in the 19th and the beginning of the 20th century. In order to assess how various economic and political factors may have influenced the probability of a growth takeoff initiation, the paper uses a unique set of historical data compiled from a wide range of sources. The additional explanatory variables include measures of government size and trade openness, investment in physical capital, proxies for educational attainment of the labor force, quality of country's political institutions, dummy variables for financial crises, etc.

The other important contribution of this paper is relating the literature on political institutions-growth nexus to the mainly theoretical "threshold effects in growth" literature introduced by Azariadis and Drazen (1990) [2]. I use methodology developed by Hansen(1999) to test for non-linearity and identify the thresholds at which key economic variables influence coefficients in the regression. The purpose of these tests is to see whether political transitions affect growth differently in countries with different levels of income per capita, different levels of trade openness and quality of political institutions.

The main results of the paper are in line with earlier studies, in particular the findings of Hausmann et al. (2005) [14]. I find that both negative (autocratic) and positive (democratic) enduring political regime changes have a significant and positive effect on the probability that a country experiences a growth takeoff, once the impact of financial crises is taken into account. In addition, I find the following evidence in support of the "threshold effects": I find that the coefficient on democratic regime changes is positive and significant only for countries that have reached a certain level of GDP per capita. Below that level, the effect of democratic regime changes on the probability of growth takeoffs cannot be distinguished from zero.

I also find that openness to trade and the quality of political institutions influence the way in which political regime changes affect the probability of growth takeoffs. In particular, an increase in the 5-year average of a country's democratization index (a proxy for quality of political institutions) has a positive and significant effect of the probability of growth takeoffs - but only for countries with already high levels of the democratization index. The effect of trade openness on growth probability is non-linear and highest for countries that lie between the 78th and 87th percentile of the sample. Below and above those levels, the volume of trade effect on growth is smaller, but still significant and positive.

Another result of the paper is that infant mortality rate (proxy for educational attainment of the labor force), government expenditure, volume of trade, and initial level of GDP per capita all significantly influence the probability of a country entering a phase of rapid growth. The signs of these effects are consistent with the theory. In particular, higher government expenditure and infant mortality rate reduce the probability of a growth takeoff[4], while volume of trade[5], and the initial average level of GDP per capita[6] significantly increase the probability that a country will experience a rapid growth episode.

The rest of the paper is organized as follows: Section 2 analyzes recent empirical literature on the institutions - growth nexus and discusses a set of challenges and limitations pertaining to data availability, endogeneity, and sample selection bias problems. Section 3 examines the methodology for identifying growth takeoff episodes in the historical context as well as the technique for identifying the threshold effects in panel data. Section 4 presents the base empirical

[4]Robert J. Barro (1991) [5] points to a negative empirical relationship between growth and the size of government. See also Tavares and Wacziarg (2006) [44] 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.
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 paper, 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 historic time-series.

[5]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.

[6]I use both 1-year lag of GDP per capita and a 4-year average of GDP/capita (lagged 2 periods) to control for the level of income effect. While 1-year lag of per capita income has significant negative effect on growth take-off probabilities, the 4-year average has a significant positive effect. This result highlights the importance of initial conditions for the country's growth performance. The supporting empirical evidence can be found for example in Danny Quah (1993). The author estimates the transitional probabilities for countries moving between income quintiles. His results suggest that richer countries face very high likelihood of remaining rich, while very poor countries similarly high likelihood of remaining poor.

model for predicting growth acceleration episodes as well as a set of extensions to the base model. In this section I also discuss the results of the threshold estimation for political regime change variable, and evaluate the accuracy of forecasts generated by the model. Section 5 concludes.

2 Recent Empirical Literature: Research Challenges and Limitations

The first obvious challenge for researchers studying the link between democracy and growth is the definition of democratization. The need to trace more precisely just how representative the country's political institutions are, calls for a measure which can distinguish minutely between various political regime characteristics.

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 [28]. 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 Polity index can be used to illustrate what is known as "three waves of democratization" in the past two hundred years [17](Figure 1 gives an illustration of the "three waves"). The first wave of democratization took place between 1800-1922 and saw the rise of representative system of governance in the United Kingdom, Sweden, Norway and France, to name a few. The second wave 1945-1960s corresponded to the period following World War II and before the rise of autocratic regimes in Africa and some countries of Latin America.

The third wave of democratization, mid-1970s to 2000, started with the fall of the autocratic regimes in Portugal and Spain, and was followed by the disintegration of the Soviet Union and subsequent democratization of the former Warsaw Pact countries and some of the former republics of the USSR.

Whether the three waves of democratization have been associated with higher rates of income per capita growth, is one of the central questions raised in the literature on the institutions-growth nexus. The notable recent contributions include papers by Milanovic (2005), Przeworski and Limongi (1993), Tavares and Wacziarg (2001), Papaioannou and Siourounis (2004). In addition, a number of authors explore the two way link between globalization (trade and financial openness) and democratic regime changes (e.g. Lopez-Cordova and Meissner (2005) [24], Eichengreen (2006)).

Typically, the growth-democracy link is explored via dynamic growth regressions with the indicators of political structure as independent variables. (Milanovic (2005), Tavares and Wacziarg (2001) [44] an Papaioannou and Siourounis (2004)). The authors of these studies take particular care to deal with issues of endogeneity between democracy and growth. For example, Tavares and Wacziarg (2001) recognize that democracy might not have a direct effect on growth, but may rather affect growth through a series of channels - such as education, inequality, public expenditure and capital accumulation. The goal of the study is to estimate the effect of democratization on these channel variables and then in turn the effect of the channel variables on growth. To deal with the issue of endogeneity, the authors use three-stage least squares procedure on a system of reduced-form equations (one equation for each of the channel variables plus one growth equation). The results indicate that growth is positively affected by education and physical capital accumulation. Democracy, in turn, is found to increase human capital accumulation and decrease physical investment. The overall effect of democracy on growth, taking into account the various channel variables, is found to be moderately negative.

Similar care to control for endogeneity is taken in the works by Eichengreen (2006) [11], Lopez-Cordova and Meissner (2005), who study the link between trade/financial openness and democratization. Lopez-Cordova and Meissner, for example, look at whether globalization of trade promotes democracy. The authors address endogeneity by instrumenting trade openness with a set of gravity equation variables, such as population, geographic area, distance from trading partners, whether countries share a border or a common language, whether a country is landlocked, etc. The results of their estimation, which encompasses 115 countries and time period from 1870-2000, indicate that countries with greater propensity to trade also had more representative political institutions.

Eichengreen (2006), on the other hand, assesses both sides of the possible causal relationship between democracy and globalization. The author estimates two regression specifications - one with trade and financial openness as dependent variables, and one with the various democracy indicators as the dependent variable. He deals with the issue of endogeneity by carefully selecting a set of instruments for each set of endogenous explanatory variables [7]. The results suggests that there is significant and positive relationship running both ways from democracy to globalization and from globalization to democracy.

A very valuable contribution of these studies is undoubtedly in identifying the channels through which democracy may affect growth, as well as the role of trade and financial openness in promoting democratic change. However, several caveats are in order. First, the above mentioned studies largely do not address the sample selection bias problem - one of the main criticisms put forward by Przeworski and Limongi (1993) [36]. The authors of the survey note for example, that short-term results are likely to be biased toward showing a positive influence of reversals to autocracies on the countries' growth performance. This is because democracies have a better chance of enduring through economic downturns, as they provide an avenue for changing the government without changing the regime. Autocracies, on the other hand, are unlikely to endure through very bad times, and are therefore more closely associated with positive growth outcomes.

The long-run estimations seem to confirm the idea that democracy is good for growth, yet, this result may only stand because there were very few reversals to autocracy in the past 30 years (the usual time span of the studies), and not enough data is available to draw conclusions on what the growth outcomes would have been, had the countries remained autocratic or reverted back to

[7] Eichengreen (2006) for example instruments trade openness with gravity equation variables. Financial openness is instrumented with a set of variables that influence capital account policies, such as inflation, budget deficit, country size, number of other countries with capital controls, etc. Democracy is instrumented with colonial history variables, indicators of prior transitions to dictatorships, natural resource endowments of the countries, etc.

autocracy. Secondly, the analysis of trend growth may sometimes be problematic in developing countries, where "growth miracles" are often coupled with "growth disasters", and the number of structural breaks in the growth series is typically higher than in the developed economies.

One way to address the structural break criticism is to focus attention on the turning points of a country's growth performance rather than on the growth trends. This is the approach taken in the papers by Hausmann, Pritchett and Rodrik (2005), Jones and Olken (2008), Jerzmanowski (2006). Hausmann, Pritchett and Rodrik in particular focus on identifying the periods of growth takeoffs - the rapid and accelerating growth episodes in a country's economic history and further investigate whether political regime changes help predict the onstart of the episodes. Jones and Olken, on the other hand, analyze both the the upturns and the downturns in a country's growth patterns to determine whether these changes are associated with changes in the quality of institutions. Michal Jerzmanowski extends the idea further by modeling growth as a Markov switching process between different growth regimes, such as takeoffs, periods of sustained growth, stagnations and crises. He looks at whether the quality of institutions affects the probability of a transition between the growth states.

The findings of these studies are mutually consistent. The Hausmann, Pritchett and Rodrik 2005 study(later in the paper - HPR) reports, for example, that positive as well as negative regime changes are statistically significant predictors of growth acceleration episodes.[8] However, when the regression is run on the sample of only developing countries, the predictive power of positive political regime change becomes insignificant across different specifications. Negative regime change coefficients are still significant and positive. This finding seems to point in the direction of a possible "threshold effect" – i.e. at some particular (low) level of income per capita positive regime changes may lose their predictive power for growth takeoffs.

In the same time, Jerzmanowski (2006) finds that institutional quality significantly influences the probability of a country switching between growth regimes. For example, a country with weak institutions may briefly enter a period of high growth, but is more likely to revert back to stagnation. Jones

[8] Yet, having gone through a political regime change or through economic reforms does not guarantee that the country will experience a period of accelerating growth. Most of political regime changes are not followed by growth takeoffs.

and Olken (2008) report a positive, yet non-significant association between the measures of institutional quality and growth.

Looking at a country's growth history from the perspective of changes in growth regimes and analyzing growth takeoff episodes rather than growth trends, allows the authors to deal with the problem of frequent structural breaks in the growth series. In addition, this approach helps circumvent the sample selection bias problem. Largely because the question of the studies is not whether democratic regimes are better or worse for growth performance, but rather whether growth takeoff episodes can be in part explained by institutional changes. Changing the focus in this way works, because while dynamic growth regressions may find that democratic regime changes are associated with modest average increases in the growth rate, it does not necessarily follow that democratizations are associated with the periods of prolonged and accelerating growth.

One of the drawbacks of this group of studies, however, is that they for the most part (with the exception of the HPR (2005) paper) rely on the indexes of corruption and the rule of law to measure institutional quality. Therefore, the analyzed sample period is usually restricted to begin in the 1970s, when the data become available for a wide sample of countries. Another question the above mentioned studies overlook, is whether the effect of political transitions on growth is non-linear. In particular, whether for countries with otherwise similar characteristics the effects of political regime changes might be different depending on the country's level of GDP per capita, education, trade openness, etc.

The idea was originally introduced by Azariadis and Drazen (1990) and has since been developed mainly in the theoretical literature. In particular, Azariadis and Drazen suggested that growth rates among countries differ for different levels of "threshold variables" such as human capital accumulation. If the return on human capital investment depends on the overall level of human capital accumulation, then for low levels of the overall accumulation, it may not pay to invest in costly but productive training. In my paper I extend this idea to analyze the effects of political regime changes on the probability of growth takeoffs.

3 Methodology

3.1 Identifying growth acceleration episodes.

The first step in analyzing the effect of institutional changes on the probability of growth takeoffs, is to develop a proper methodology for identifying the episodes of rapid and accelerating growth. Jones and Olken (2008) in particular, use Bai-Perron (1998, 2003) [3, 4] method to test for structural breaks in the GDP growth series. The problem with this method is the danger of identifying too many breaks that are simply "recoveries" from a bad shock. HPR (2005) [14] propose a methodology that filters out such recoveries. In the same time they seek to ensure that the identified periods are long enough (at least 8 years), and that the pace of growth is such as to allow the country to catch up with its rich industrialized counterparts.

In the HPR methodology, the growth rate, $g_{t,t+n}$, is defined as the growth rate at time t over horizon n. For example an 8-year average growth rate would be denoted as $g_{t,t+7}$. The average growth rate is derived from the least squares regression of a log GDP per capita over n-year period on a constant and a time trend:

$$ln(y_{t+i}) = a + g_{t,t+n} \times t, \quad \text{where i = 0,...n}$$

The change in the average growth rate at time t is defined as:

$$\Delta g_{t,n} = g_{t,t+n} - g_{t-n,t}$$

For n=7, for example, $\Delta g_{t,n}$ can be interpreted as telling how much the forward looking eight year average growth rate decreased or increases, as compared to the growth rate in the eight years prior to time t. A growth episode in HPR paper is considered to be a rapid growth episode when the following three conditions are met:

1. $g_{t,t+n} \geq 3.5\%$ – growth is rapid
2. $\Delta g_{t,n} \geq 2\%$ – growth is accelerating

3. $y_{t+n} \geq max\{y_i\}$ for $i \leq t$ – ruling out the "growth recovery" episodes

The last condition requires that GDP per capita at the end of the growth episode is greater than the maximum value of GDP per capita in all the previous time periods. The year of the rapid growth episode initiation is determined as follows: in the case when several consecutive years meet the criteria for the onset of a rapid growth episode, linear spline regressions are fitted through the series with a break in one of the years of interest. The *initiation year* is determined by the regression with the highest F-statistic.

While this method is simple and effective, its main weakness is the arbitrariness. Why should the "rapid growth episode" be starting at a particular value of 3.5%? Why should be "catching up" growth rate be 2%? HPR argue this is because 2% is the average rate of growth for OECD countries starting from 1970s. Although this explanation seems reasonable, it may be a problem for researchers working with historical data. The average growth rates of GDP per capita were around 1-1.5% in the 19th century. In view of these considerations, I propose the following modified set of conditions to deal with this methodological issue.

Historical method for identifying growth takeoff episodes:

1. If $g_{t,t+n} \geq 1$ standard deviation above the mean of $g_{0,t}$ (i.e. the growth rate from t =0 up to time t) – growth is rapid

2. If $g_{t,n} \geq$ average growth rate of countries in the top 50th income percentile (updated every 20 years from the start of the sample) – growth is accelerating. This condition has the advantage of accounting for historic differences in average growth rates.

3. If $y_{t+n} \geq max\{y_i\}$, where $i \leq t$. This condition is the same as in the HPR analysis.

A set of examples of rapid growth episodes identified under the Historic method, are given in Figure 2 panel a-d. The vertical lines represent the approximated starting years of rapid growth episodes for four different countries.

3.2 Predicting growth acceleration episodes: Base Model

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

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

Here $Y_{i,t}$ 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 flaws in the data or inconsistencies in the identification.

$D_{i,t}$ — dummy indicators of financial crises.

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

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

$\bar{Z}_{\bar{i},t-1}$ — cross-section averages of the explanatory variables for a given year.

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

$$Y_{i,t} = \mu_i + \beta_1' X_{i,t} \times I(q_{i,t} \leq \gamma) + \beta_2' X_{i,t} \times I(q_{i,t} > \gamma) + e_{i,t} \qquad (2)$$

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(.), 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.

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.[9]

For the purpose of this paper the threshold regression model will take the following form:

$$\begin{aligned} Y_{i,t} = \quad & \alpha + \beta_1' X_{i,t-1} \times I(q_{i,t-1} \leq \gamma) + \beta_2' X_{i,t-1} \times I(q_{i,t-1} > \gamma) + \beta_3' D_{i,t-1} + \\ & + \beta_4' \sum_{k=1}^{n} Z_{i,t-k} + \beta_5' (\sum_{n}^{d} Z_{i,t-n+1})/d + \beta_6' \bar{Z}_{\bar{i},t-1} + (u_i + e_{i,t}) \qquad (3) \end{aligned}$$

Where $X_{i,t-1}$ 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

[9] 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) [26].

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 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.

$$Y_{i,t} = \alpha + \beta_1' X_{i,t-1} + \beta_2' Z_{i,t-1} \times I(Z_{i,t-1} \leq \gamma) + \beta_3' Z_{i,t-1} \times I(Z_{i,t-1} > \gamma) + \\ + \beta_4' D_{i,t-1} + \beta_5' \sum_{k=1}^{n} Z_{i,t-k} + \beta_6' (\sum_{n}^{d} Z_{i,t-n+1})/d + \beta_7' \bar{Z}_{t-1} + (u_i + e_{i,t}) \quad (4)$$

In the paper 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.

4 Results

4.1 Identifying growth acceleration episodes

I applied both the HPR method and the Historical method for identifying growth takeoffs to the dataset of 54 countries covering time period from 1820-2003. The full list of growth acceleration episode dates identified by both methods is given in Table 2 of the Appendix. The table also provides the 8-year average growth before and after the time of the episode initiation.

In addition, Tables 3.1 and 3.2 summarize the differences between the two methods. Table 3.1 indicates that the Historic method identifies a significant proportion of the episodes, which are also captured by the HPR methodology. For example, eleven out of thirteen growth takeoff episodes (about 85%) identified under the HPR methodology before 1914 are also captured by the Historical method. However, only 28% of the episodes identified under the Historic methodology in the same time period are captured by the HPR method. This suggests that the former method overlaps with the HPR methodology and yet captures a number of new episodes, which would otherwise be ignored (for example, UK 1842, the year that marked a period economic expansion in the United Kingdom, after key pro-trade legislative acts were passed by the Parliament; Netherlands 1845 and 1860 periods of growth, which saw significant expansion of Dutch capital oversees).

The difference between the two methods is especially pronounced in the period between 1870 (the year when a number of Latin American countries as well as Canada, US, Japan and New Zealand enter the sample - see Table 1) and the year of 1945. Table 3.2 shows the cumulative distribution of episodes over time. As expected, the Historical method dominates the HPR method mostly between 1870-1945 when the identification criteria outlined by the HPR method would have been too restrictive.

4.2 Base Model

4.2.1 Variables

The base model is a random-effects probit model given by equation (1). Following HPR (2005), I define the dependent variable as a 0-1 dummy, which takes the value of 1 in the year t of the initiation of the rapid growth episode as well as in the years t-1 and t+1 around the episode. The time window safeguards against the possibility of capturing the initiation date imprecisely, due to the flaws in the data or methodological inconsistencies. The explanatory variables in the regression can be grouped into the following categories:

1. Political change and quality of political institutions variables, which include the country's 5 year average Polity score and two variables capturing the start of positive and negative regime change episodes.
   The average Polity score serves as a measure of advancement of representative political system in the country and a proxy for institutional quality. As noted in the methodology section, the advantage of using a 5-year average of the Polity score is that this measure is less sensitive to the transitory changes in political institutions. The binary indicators take the value of

1 in the year of a positive/negative enduring regime change[10] as well as year t-1 and t+1 around the episode.

2. Economic variables include: a measure of trade openness (a country's volume of trade expressed as a share of GDP), a measure of the size of government (total government expenditure as a share of GDP), investment as a share of GDP, and log GDP per capita expressed in 1990 international dollars. In addition, I include a financial crisis dummy, which takes the value of 1 in the year when a country is involved in a financial or a banking crisis, as well as in years t-1 and t+1 around that year.
   The model also includes 3 and 4 year averages of all the continuous economic variables mentioned above. In addition, a 4 year average of the infant mortality rate is included in the regression. This variable serves as a proxy for country's human capital accumulation. The measure was chosen over more the traditional ones (such as years of schooling or literacy rate) primarily because it is available for longer periods of time for historic data, and because empirical studies point to a strong link between health indicators (such as infant mortality rate) and literacy rates[11].

3. Time averages of political and economic variables. In order to partially control for period specific effects I introduce the cross-section year specific averages of all continuous political and economic variables in the model. Since the time period for most countries in the sample is relatively long, including year dummy variables in the regression is expensive in terms of the degrees of freedom lost.

4.2.2 Base model results and economic interpretation

The coefficients, standard errors and corresponding marginal effects for the base model regression are reported in Table 4 (columns 1-3) of the Appendix. All the marginal effects are evaluated at sample means for continuous variables, and for discreet changes of dummy variables from zero to one. In the model specified above, the political regime change variables have the coefficient signs and magnitudes consistent with the findings of HPR (2005).

[10] definition is provided in section A2 of the Data Appendix
[11] For example, Zakir and Wunnava (1999) [45]

The results in Table 4 (1-3) 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, however, 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. This is consistent with the HPR findings, where the negative regime change effect is about 3.7 larger than the positive effect.

While the results seem to suggest that movement toward autocratic rule has a larger positive impact on growth, and alternative interpretation may be offered. Enduring positive regime changes possibly rely less on economic 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 seems to be consistent with some recent findings. For example, Ranciere, Tornell and Westermann (2004) [38] argue that economies, which have experienced occasional crises, have grown on average faster than countries with smooth credit conditions. They 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.

4.3 Extensions of the Base Model: Results and Interpretation

4.3.1 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 4, column 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 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 4, column 5 - 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.

4.3.2 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.[12] 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 4, column 6 shows the marginal effects of the regression, which includes the variables for the rate of return and a lag of the 3-year average

[12]For example Calvo and Reinhart in their paper *Capital Flows to Latin America: Is There Evidence of Contagion Effects?* (1996) [39] 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) [42] suggests that high large-country interest rates are associated with lower GDP growth in the other countries.

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 still does not alter the results of the base model significantly.

4.3.3 Threshold effects

The results presented so far give the idea of how political regime change as well as level of development of political institutions influence the probability of growth takeoffs. Yet, we need 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 (3) and (4) of Section 3.

Table 5 provides the marginal effects of the threshold regression estimation. Table 6 panels a-d gives the estimated p-value for various thresholds. As one can see from Table 6, we 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).

The effects on the probability of growth takeoffs (presented in column 3 of Table 5) 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 6-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 5, 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 (3) Section 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 6-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 5, 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.

4.3.4 Evaluating a growth takeoff probability forecasts

How well does the model developed in the paper predict probability of growth takeoffs? Figure 3 a-d plots the model's predicted probability that rapid growth=1 for select countries. The vertical bars are the actual realizations of rapid growth episodes. First, note that predicted probabilities of growth takeoff realization are very low, rarely rising above 50%. This is not unusual for models predicting rare events[13].

The relative accuracy or "skill" of the model's forecast in this case is best evaluated by comparing it with "unconditional forecast" - i.e. the simple ratio of the number of rapid growth initiation years to the total number of observation years in the sample. The "unconditional forecast" probability that the country will experience a growth takeoff in any given year is therefore 234/2760 = 0.08478.

Does the model's forecast do better in predicting growth takeoffs relative to the unconditional forecast -and if so, how much better? Below I discuss several relevant forecast evaluation scores, closely following the methodology described in Lahiri and Wang (2006).

A common measure of forecast accuracy in economics is the mean squared error or the forecast, $MSE(p,x) = \frac{1}{NT}\sum_{i=1}^{N}\sum_{t=1}^{T}(p_{i,t} - x_{i,t})^2$, where $p_{i,t}$ is the model's predicted probability, and $x_{i,t}$ is the 0-1 realization indicator of the rapid growth event for country i at time t. MSE ranges from 0 to 1, with 0 corresponding to a perfect forecast. Yet, the relative forecast performance is better measured with the 0-1 Skill Score

$$SS = 1 - \frac{MSE(p,x)}{MSE(\mu,x)}$$

where μ is the "unconditional forecast", a constant probability of the event. The Skill Score compares the MSE of the model with the MSE generated by the "unconditional forecast" probability - the higher SS, the higher is the "value added" of the model's forecast. SS can be interpreted as the percent improvement of the model's forecast relative the "unconditional forecast". It is evident

[13]See detailed discussion in Lahiri and Wang (2006) [23]

from Table 7 that the Skill Score of the model is very modest, only 5.45% improvement in forecast relative to the unconditional forecast. This is not an unexpected result.[14] To understand the reason we need to look at how well the model predicts takeoff initiation times versus "tranquil" times. The skill scores in Table 7 suggest that the model improves the forecast of takeoff times by nearly 10%, but worsens the forecast of non-growth times by almost 37%. The constant probability "unconditional forecast" is obviously assigning a very high probability to non-growth episodes and does better in predicting zeros than the model's forecast.

These results, however, do not mean that the model's forecast cannot be useful. One way of presenting predicted probability forecasts is by converting probabilities to odds ratios. The Odds ratio is essentially the ratio of Forecast odds (the odds in favor of the event, as determined by the model) to Unconditional rate odds (the odds in favor of the event as determined by the unconditional forecast). For example, the Unconditional rate odds, UO in this case = 0.08478/(1-0.08478) = 0.0926335. If the Forecast odds, FO in a particular year = 0.18/(1-0.18) = 0.2195. The Odds ratio = FO/UO = 2.369. This means that the odds in favor of the event as predicted by the forecast are nearly 2.4 times greater than the odds generated by the simple constant rate prediction. (See Figure 4 panel a-d for an illustration).

If the odds ratio is high, it is a signal that the rare event in question is very likely. A forecasting rule may be designed in such case. For example, if the odds ratio rises above a certain threshold (say, FO/UO =2) we predict that the growth takeoff will be initiated. Below this threshold, we predict a "tranquil" year. The performance of various forecasting rules can be compared using "skill scores", which evaluate the number of hits and misses, correct predictions and false alarms generated by the rule. Let's define:

X - number of "hits" - predictions of a growth takeoff at time t, when the actual realization = 1

Y - number of "misses" - prediction of no-growth at time t, when the actual realization = 1

[14] HPR study points out that despite significant correlations with political regime change variables, growth takeoffs are very difficult to predict.

Z - number of "false alarms" - predictions of growth takeoff at time t, when actual realization =0

W - number of "correct zero predictions" - prediction of tranquil year in time t, when the actual realization = 0

The forecast skill measures, the Kuiper Skill score (KSS), the Heidke Skill score (HSS), and the Odds Ratio Skill score (ORSS) are then defined as follows:

KSS = (X*W - Y*Z)/{(X+Y)×(Z+W)} - this measure ranges from a -1 to +1, with +1 corresponding to "perfect skill" of the forecast

HSS = 2*(X*W - Y*Z)/{(X+Y)×(Y+W)+(X+Z)×(Z+W)} - this is a -1 to +1 measure with a similar interpretation. HSS, however, values correct prediction of ones more than the correct predictions of zeros, as compared to the KSS. Both KSS and HSS are commonly used in evaluating rare events, for example in meteorological forecasts.

ORSS = (θ -1)/(θ+1), where θ= (X*W)/(Y*Z) - also a -1 to +1 skill ratio with +1 corresponding to "perfect skill" of the forecast.

The Odds Ratio Skill can be tested to determine whether the skill of the model's forecast significantly outperforms the unconditional forecast of the event. Lahiri and Wang (2006) suggest the following test: log (Odds ratio) = (log(X) + log(W)) - (log(Z) + log(Y)) is approximately normally distributed with standard error $\frac{1}{\sqrt{n}}$, where n = 1/X + 1/Z + 1/Y + 1/W. If the log odds ratio is more than 1.96 standard errors away from zero, this would indicate that the skill score is statistically significant on a 5% level. Hence, it is unlikely that the difference between the model's forecast and the unconditional forecast is due to chance.

Table 9 presents the result of all three skill scores associated with different thresholds and several definitions of "hits" and "misses". The skill scores indicate that forecast rules based on the probabilities given by the model generate significantly better predictions than the constant probability forecast alone.

5 Conclusion

In this paper I ask whether political regime changes and the overall quality of political institutions are associated the turning points in a country's economic history. I estimate a random effects probit model based on the sample of 54 countries from 1834-2003. The findings indicate that political regime changes as well the quality of political institutions help predict growth takeoffs. In particular, both democratic and autocratic enduring 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. In addition, I find that trade openness, and the initial income per capita level increase the probability of a growth 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.

Further, the paper presents 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 effects of trade openness and the quality of political institutions are also non-linear. In particular, international trade benefits growth the most in the countries which fall in the mid-range of trade openness. In the same time, the increase in the level of democratization helps mostly the countries with already well developed democratic institutions. In addition, I use several alternative forecast skill indicators to assess how well the model developed in the paper can predict growth takeoffs. I conclude that the model does significantly better in predicting the occurrence of rare events, such as the turning points in a country's economic history, than the baseline constant probability forecast.

The paper opens the avenues for future research into the nature of growth-political institutions nexus. In particular, what are the possible sources of threshold effects in growth? Do threshold effects play a role in determining the duration of growth takeoff episodes? Does the country's "political neighborhood" have an effect on the probability of a growth takeoff initiation? These and other question remain open to future investigation.

References

[1] Joshua Aizenman and Mark Spiegel. Takeoffs. Working Paper 13084, National Bureau of Economic Research, May 2007.

[2] Costas Azariadis and Allan Drazen. Threshold externalities in economic development. *The Quarterly Journal of Economics*, 105(2):501–26, May 1990.

[3] Jushan Bai and Pierre Perron. Estimating and testing linear models with multiple structural changes. *Econometrica*, 66(1):47–78, January 1998.

[4] Jushan Bai and Pierre Perron. Computation and analysis of multiple structural change models. *Journal of Applied Econometrics*, 18(1):1–22, 2003.

[5] Robert J. Barro. Economic growth in a cross section of countries. *The Quarterly Journal of Economics*, 106(2), May 1991.

[6] OECD Health Data, 2004. http://www.oecd.org/health/healthdata.

[7] Oxford Latin American Economic History Database. available at: http://oxlad.qeh.ox.ac.uk/index.php.

[8] Leandro Prados de la Escosura. *El progreso economico de Espana: (1850-2000)*. Madrid: Fundacion BBV, 2003.

[9] David Dollar and Aart Kraay. Institutions, trade and growth. *Journal of Monetary Economics*, 50(1):133–162, 2003.

[10] Richard A. Easterlin. The worldwide standard of living since 1800. *The Journal of Economic Perspectives*, 14(1):7–26, Winter 2000.

[11] Barry Eichengreen. Democracy and globalization. Working Paper 12450, National Bureau of Economic Research, August 2006.

[12] Barry Eichengreen and Michael D. Bordo. Crises now and then: What lessons from the last era of financial globalization? Working Paper 8716, National Bureau of Economic Research, January 2002.

[13] Bruce E. Hansen. Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics*, 93(2):345–368, December 1999.

[14] Ricardo Hausmann, Lant Pritchett, and Dani Rodrik. Growth accelerations. *Journal of Economic Growth*, 10(4):303–329, December 2005.

[15] E. Hebert J.R. Hertz and J. Landon. Social and environmental factors and life expectancy, infant mortality, and maternal mortality rates: results of a cross-national comparison. *Social Science and Medicine*, 39(1):105–14, 1994.

[16] Samuel Huntington. *Political Order in Changing Societies*. New Haven: Yale University Press, 1968.

[17] Samuel Huntington. *The Third Wave: Democratization in the Late Twentieth Century*. Oklahoma: University of Oklahoma Press, 1993.

[18] IFS. International financial statistics [computer file], 1948-present. Washington, D.C; available at: http://www.imf.org.

[19] Michal Jerzmanowski. Empirics of hills, plateaus, mountains and plains: A markov-switching approach to growth. *Journal of Development Economics*, 81(2):357–385, December 2006.

[20] Benjamin F. Jones and Benjamin A. Olken. The anatomy of start-stop growth. *Review of Economics and Statistics*, 90(3):582–587, 2008.

[21] Graciela L. Kaminsky and Carmen M. Reinhart. The twin crises: The causes of banking and balance-of-payments problems. *American Economic Review*, 89(3):473–500, June 1999.

[22] Charles Kindelberger. *Manias, Panics and Crashes: A History of Financial Crises*. ohn Wiley & Sons, Inc., 1996.

[23] Kajal Lahiri and J. Geogre Wang. Subjective probability forecasts for recessions. *Business Economics*, 41(2):26–37, April 2006.

[24] J. Ernesto Lopez-Cordova and Christopher M. Meissner. The globalization of trade and democracy, 1870-2000. Working Paper 11117, National Bureau of Economic Research, February 2005.

[25] Robert E. Jr. Lucas. Making a miracle. *Econometrica*, 61(2):251–272, March 1993.

[26] James G. MacKinnon. Bootstrap methods in econometrics. *Economic Record*, 82(s.1):S2–S18, 2006. Queen's University, Kingston, Ontario, Canada.

[27] Angus Maddison. *Contours of the World Economy 1-2030 AD: Essays in Macro-Economic History*. Oxford University Press, USA, November 2007.

[28] Monty G. Marshall and Keith Jaggers. Polity iv dataset [computer file; version p4v2001], updated: 2002. available at http://www.cidcm.umd.edu/inscr/polity/.

[29] Branko Milanovic. The modern world: The effect of democracy, colonialism and war on economic growth 1820-2000. Unpublished manuscript. Available at SSRN: http://ssrn.com/abstract=812144, August 2005.

[30] B.R. Mitchell. *International historical statistics : Africa, Asia and Oceania, 1750-1993*. London : Macmillan Reference ; New York, N.Y. : Stockton Press, 4th edition, 1998.

[31] B.R. Mitchell. *International historical statistics : Europe, 1750-1993*. London : Macmillan Reference ; New York, N.Y. : Stockton Press, 4th edition, 1998.

[32] B.R. Mitchell. *International historical statistics : The Americas, 1750-1993*. London : Macmillan Reference ; New York, N.Y. : Stockton Press, 4th edition, 1998.

[33] A.B. Nunes, E. Mata, and N. Valerio. Portuguese economic growth 1833-1985. *Journal or European Economic History*, XVIII(2):291330, 1989.

[34] National Accounts of the Netherlands 1800-1913. data available at: http://nationalaccounts.niwi.knaw.nl/start.htm.

[35] Elias Papaioannou and Gregorios Siourounis. Democratization and growth. *SSRN eLibrary*, 2004.

[36] Adam Przeworski and Fernando Limongi. Political regimes and economic growth. *The Journal of Economic Perspectives*, 7(3):51–69, 1993.

[37] Danny Quah. Galton's fallacy and tests of the convergence hypothesis. *The Scandinavian Journal of Economics*, 95(4):427–443, December 1993.

[38] Romain Ranciere, Aaron Tornell, and Frank Westermann. Crises and growth: A re-evaluation. Economics Working Papers 852, Department of Economics and Business, Universitat Pompeu Fabra, May 2002.

[39] Carmen Reinhart and Sara Calvo. Capital flows to latin america: Is there evidence of contagion effects? MPRA Paper 7124, University Library of Munich, Germany, 1996.

[40] Lars G Sandberg. The case of the impoverished sophisticate: Human capital and swedish economic growth before world war i. *The Journal of Economic History*, 39(1):225–241, March 1979.

[41] Karl Schweinitz Jr. *Industrialization and Democracy.* New York: Free Press, 1964.

[42] Jay C. Shambaugh and Julian di Giovanni. The impact of foreign interest rates on the economy: The role of the exchange rate regime. Discussion Paper Series iiisdp116, The Institute for International Integration Studies, April 2006.

[43] Christian Suter. *Debt Cycles in the World-Economy.* Westview Press, 1992.

[44] Jose Tavares and Romain Wacziarg. How democracy affects growth. *European Economic Review*, 45(8):1341–1378, August 2001.

[45] Mohammed Zakir and Phanindra V. Wunnava. Factors affecting infant mortality rates: Evidence from cross-sectional data. *Applied Economics Letters*, 6(5):271–73, May 1999.

A Data Appendix

A.1 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
Infant mortality rate until 1993

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). *El progreso economico de Espana, 1850-2000.* Madrid: Fundacion BBVA - source for 1850-1959 data on GDP at current prices, Investment, Imports, Exports, Government Expenditure, GDP deflator.

Portugal: Nunes, Mata and Valerio "Portuguese Economic Growth 1833-1985", *Journal or European Economic History* XVIII/2 (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, Charles *Manias, Panics and Crashes: A History of Financial Crises* (1996) John Wiley & Sons, Inc.
   Suter, Christian *Debt Cycles in the World-Economy* (1992) Westview Press
   Eichengreen, Barry and Michael Bordo "Crises Now and Then: What Lessons from the Last Era of Financial Globalization?" NBER Working Paper No.8716, (jan. 2002)
   Graciela L. Kaminsky, Carmen M. Reinhart "The Twin Crises: The Causes of Banking and Balance-Of-Payments Problems" *American Economic Review*, Vol. 89, No. 3 (Jun., 1999), pp. 473-500

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/

A.2 Definitions

1. Polity: An index variable (Polity IV dataset) defined as the level of country's democracy score (index from 0 to +10) minus the country's autocracy score (index from 0 to +10). The resulting polity scale ranges from -10 (strongly autocratic) to +10 (strongly autocratic).

2. Positive enduring regime change: defined as at least a 3 point increase in the country's polity score which persisted for 5 years or longer.

3. Negative enduring regime change: defined as at least a 3 point decreases in the polity score of a country, which persisted for 5 years or longer.

4. GDP per capita: real GDP per capita expressed in 1990 international dollars.

5. Government Expenditure, TGE: total central government expenditure (or public expenditure) at current prices divided by GDP at current prices.

6. Trade Openness, Volume of Trade, VOT: volume of trade (defined as exports plus imports) at current prices divided by GDP at current prices

7. Investment: gross fixed capital formation (or private investment) at current prices divided by GDP at current prices

8. Infant mortality rate: number of death of infants less than 1 year old per 1000 live births.

9. Crisis - a binary variable that take value 1 in the year that marks the onset of currency, banking or sovereign debt crises. For 19th century the variable also takes value one if the country is a creditor, whose major borrower defaults in that year.

10. Rate of return US/UK - interest rate in the UK (until 1913) or in the US (1913-2003). This variable allows to control for global macroeconomic conditions at time t.

11. Growth rate US/UK - rate of growth in the UK (until 1913) or in the UK (1913-2003). This variable helps control for global macroeconomic conditions at time t.

A.3 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.

B Tables and Figures Appendix

Table 1: Expansion of the sample: years in which GDP per capita data become available

Year	Countries in the sample	GDP PER CAPITA
1820	4	Netherlands
		France
		Sweden
		Denmark
1830	5	United Kingdom
1846	6	Belgium
1850	9	Switzerland
		Spain
		Prussia
1960	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
1935	33	Philippines
1924	35	Bulgaria
		Hungary
1926	36	Romania
1928	37	USSR
1929	38	Poland
1945	39	Indonesia
1950	41	Albania
		Thailand
1957	42	Malaysia
1959	43	Singapore
1990	55	Serbia-Montenegro, Slovenia, Macedonia, Croatia, Bosnia Czech Republic, Slovakia Armenia, Azerbaijan, Belarus, Moldova, Ukraine, Estonia, Latvia, Lithuania, Russia, Georgia

Figure 1: Three Waves of Democratization

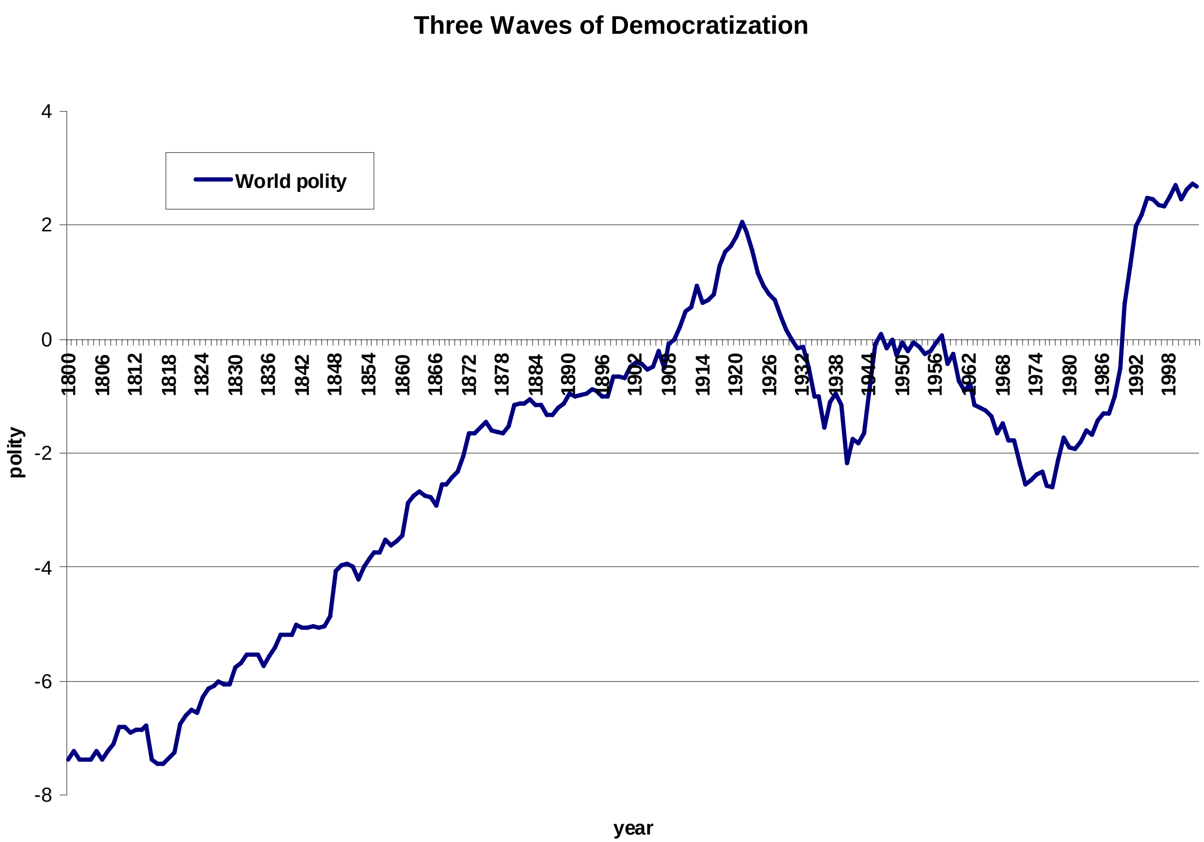


Figure 2: Takeoff episodes

Figure 3: Probability of takeoffs

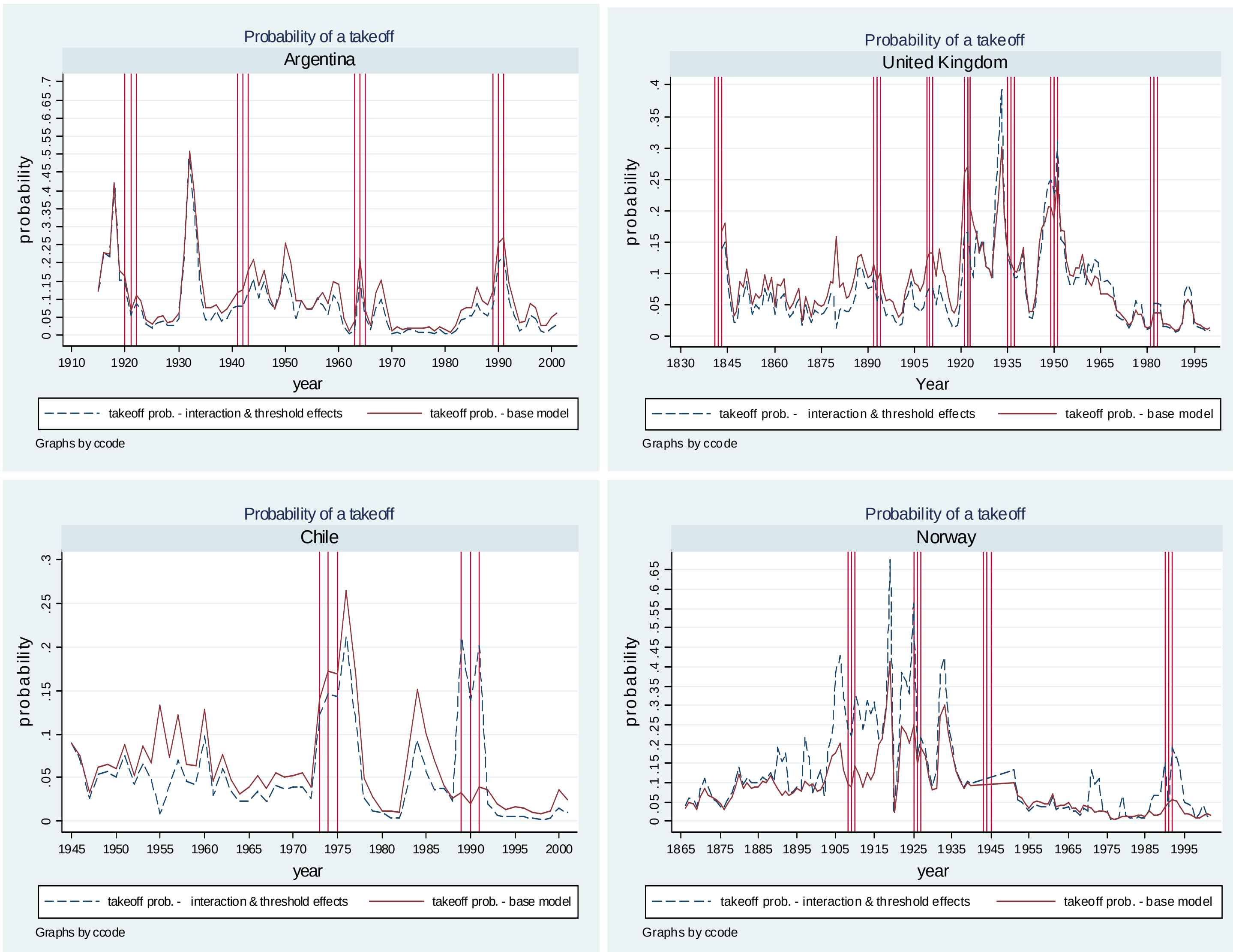


Figure 4: Odds ratio. Likelihood of a takeoff

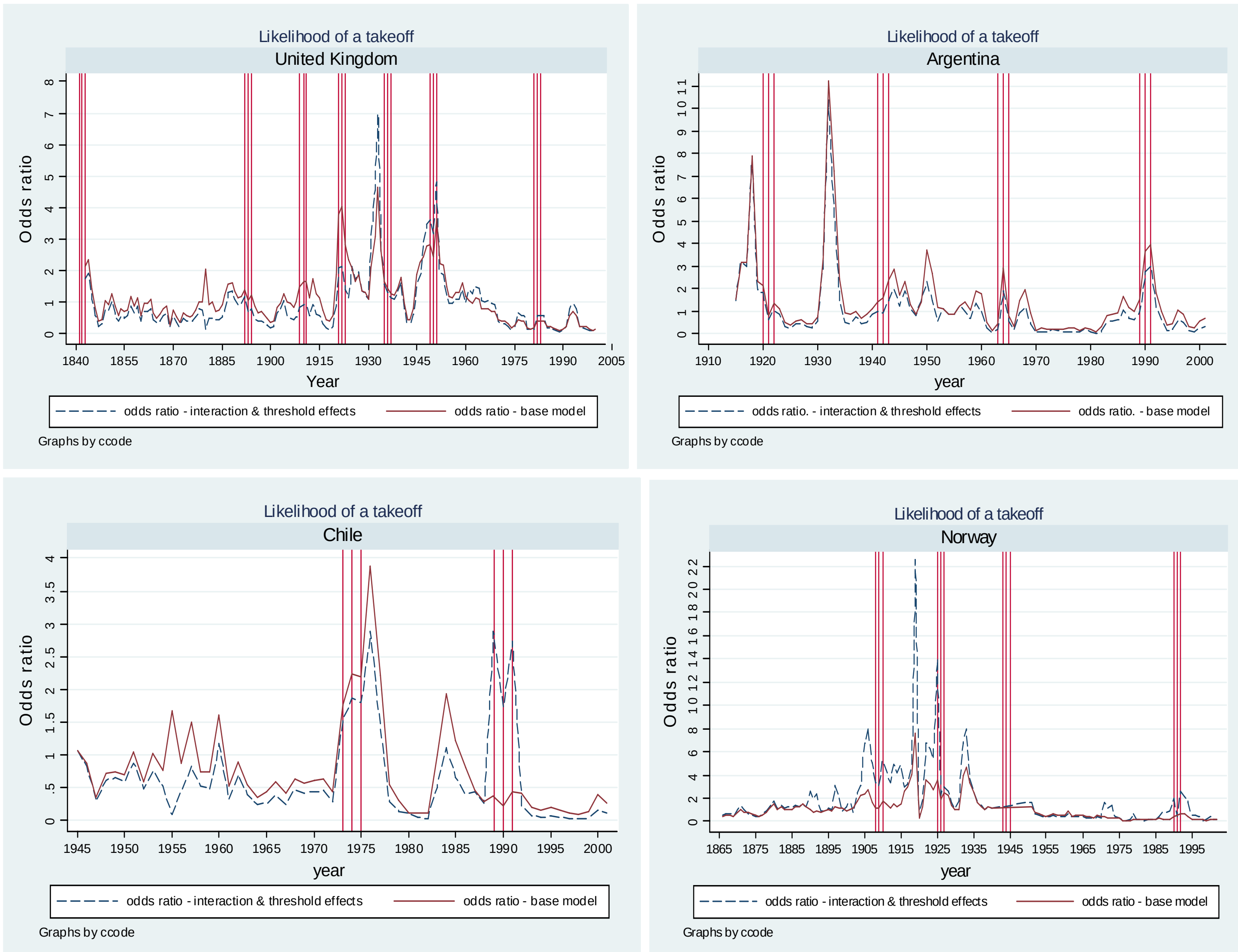


Table 2: Rapid growth episodes: Historical Definition

Country	year	growth before[1]	growth after[2]	Country	year	growth before	growth after
The Americas							
US	1877	0.0070	0.0402	Uruguay	1881	-0.0130	0.0385
	1896	0.0040	0.0380		1905**	0.0200	0.0488
	1922	0.0115	0.0249		1923	0.0243	0.0423
	1938	0.0329	0.1178		1943	-0.0054	0.0469
	1961	0.0111	0.0396		1973*	0.0060	0.0388
					1988**	0.0039	0.0258
Canada	1877	-0.0007	0.0446				
	1896	0.0016	0.0567	**Europe West**			
	1921	-0.0263	0.0576	UK	1842**	-0.0006	0.0348
	1937	-0.0006	0.0894		1893	0.0080	0.0241
	1949	-0.0034	0.0252		1910	0.0038	0.0256
	1962	0.0124	0.0365		1922	-0.0296	0.0238
	1996	0.0038	0.0279		1936	0.0150	0.0413
					1950	-0.0146	0.0228
Mexico	1936*[3]	0.0016	0.0229		1982	0.0124	0.0359
Colombia	1923	0.0006	0.0315	Ireland	1946	-0.0007	0.0308
	1933**[4]	0.0159	0.0325		1958	0.0135	0.0401
	1943	0.0055	0.0259		1994	0.0431	0.0840
	1967	0.0156	0.0390				
				Netherlands	1845**	-0.0029	0.0136
Venezuela	1907*	-0.0031	0.0369		1860	-0.0013	0.0187
	1922**	0.0393	0.1633		1879	0.0056	0.0259
	1932	0.0349	0.0775		1896	-0.0077	0.0114
	1942**	0.0135	0.1384		1921	0.0163	0.0382
					1944	-0.0841	0.1357
Peru	1922*	0.0222	0.0473		1984	0.0034	0.0236
	1931**	0.0088	0.0483				
	1948	0.0186	0.0378	Belgium	1918	-0.0421	0.0674
	1959	0.0133	0.0448		1943	-0.0364	0.0488
					1959	0.0220	0.0423
Brazil	1905	0.0025	0.0162				

Table 2: Rapid growth episodes: Historical Definition

Country	year	growth before[1]	growth after[2]	Country	year	growth before	growth after
	1916	0.0027	0.0406	France	1853*	0.0076	0.0262
	1931	0.0061	0.0379		1887	0.0046	0.0225
	1945	0.0153	0.0312		1906	0.0018	0.0239
	1955	0.0250	0.0442		1918	-0.0348	0.0801
	1967*	0.0088	0.0715		1932	-0.0006	0.0222
					1944	-0.0927	0.1291
Chile	1922	-0.0145	0.0337				
	1974*	0.0002	0.0403	Switzerland	1883	-0.0004	0.0325
	1990**	0.0437	0.0663		1892	0.0133	0.0275
Argentina	1921	0.0125	0.026		1918	-0.0197	0.0486
	1942	0.0131	0.0323		1943	0.0003	0.0650
	1964	0.0077	0.0328				
	1990	-0.0177	0.0400	Spain	1870	-0.0116	0.0365
					1896	-0.0013	0.0251
Europe West					1920	0.0057	0.0230
Portugal	1880	-0.0033	0.0236		1950	-0.0016	0.0454
	1894	-0.0039	0.0271		1960	0.0288	0.0812
	1918**	-0.0093	0.0381		1984**	0.0105	0.0405
	1942	0.0072	0.0273		1996	0.0150	0.0388
	1959	0.0352	0.0597				
	1984	0.0198	0.0524	Finland	1868	0.0030	0.0231
					1892	0.0097	0.0386
Germany	1923**	0.0038	0.0524		1918**	-0.0471	0.0712
	1932	-0.0032	0.0700		1931*	0.0260	0.0541
	1951	-0.0097	0.0711		1948**	0.0205	0.0381
					1958	0.0301	0.0478
Austria	1922**	0.0033	0.0406		1967	0.0352	0.0561
	1934	-0.0408	0.0657		1993	-0.0026	0.0416
	1950	-0.0034	0.0664				
				Sweden	1842	-0.0047	0.0143
Italy	1881	-0.0011	0.0157		1853	-0.0004	0.0264
	1902**	0.0259	0.0432		1867	0.0017	0.0450
	1911	0.0387	0.0540		1891	0.0120	0.0246

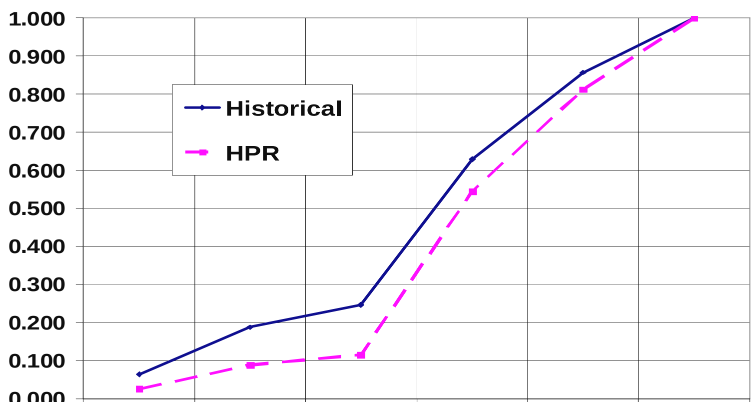
Table 2: Rapid growth episodes: Historical Definition

Country	year	growth before[1]	growth after[2]	Country	year	growth before	growth after
	1933*	-0.0007	0.0303		1923**	0.0118	0.0395
	1945	-0.0695	0.0965		1932	0.0219	0.0479
					1958	0.0249	0.0446
Denmark	1842	0.0048	0.0214		1996	0.0015	0.0284
	1921	-0.0035	0.0255				
	1941	-0.0151	0.0447	Norway	1909	0.0175	0.0317
	1958	0.0219	0.0421		1926	0.0155	0.0293
					1944	-0.0234	0.0661
Europe East					1991	0.0163	0.0375
Poland	1992	-0.0286	0.0558				
				Asia & Oceania			
Hungary	1948	-0.0517	0.0446	Japan	1888	0.0176	0.0304
	1956	0.0329	0.0495		1914	0.0058	0.0433
	1996**	-0.0203	0.0455		1934	0.0122	0.0545
					1951	0.0118	0.0629
Czechoslovakia	1934	-0.0238	0.0587		1960	0.0678	0.0839
	1953	0.0287	0.0543				
				Thailand	1961*	0.0274	0.0502
Yugoslavia	1932*	-0.0021	0.0335		1986	0.0355	0.0885
	1943	0.0388	0.0591				
	1957	0.0360	0.0563	Malaysia	1972*	0.0353	0.0564
					1987	0.0187	0.0689
Greece	1931*	0.0090	0.0319				
	1963	0.0475	0.0680	Singapore	1966*	0.0350	0.1118
Bulgaria	1945	-0.0422	0.0924	Indonesia	1967	-0.0147	0.0766
	1956	0.0357	0.0707		1988	0.0212	0.0606
Romania	1960	0.0369	0.0597	Australia	1918	-0.0145	0.0277
					1931	-0.0298	0.0451
USSR	1942	0.0303	0.1128				
				New Zealand	1899	0.0128	0.0316
Albania	1996*	-0.0105	0.0577		1932	-0.0197	0.0668

Table 3.1: Summary of growth acceleration episodes
HPR method and Historical method compared

	HPR Method		*Historical Method*	
	Overlapping episodes (% of the total to date)	Episodes # to date	Overlapping episodes (% of the total to date)	Episodes, # to date
before 1914	84.61	13	28.95	38
before 1945	75.41	61	47.42	97
before 1970	74.73	91	51.52	132
before 2003	75	112	54.55	154

Table 3.2: 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

[1] Average 8-year growth rate before the initiation of a takeoff
[2] Average 8-year growth rate after the initiation of a the takeoff
[3] *growth episode occurred within 5 years after a negative enduring regime change
[4] **growth episode occurred within 5 years after a positive enduring regime change
[5] Ratio of the number of episodes to date divided by the total number of episodes identified by the given method

Table 3.3: Summary of rapid growth episodes by region and time period, % of the total number of episodes

	Asia	Europe West	Europe East	Latin America	Western Offshoots[6]	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 #	12	78	16	32	16		154

Table 3.4: Average growth for countries in the top 50th income percentile [7]

Average Growth(%)	Year_t
0.7153	1840
1.5362	1860
1.2886	1880
1.2285	1899
1.2278	1920
1.3332	1940
1.4887	1960
2.0296	1980
2.0163	1996

[6] United States, Canada, Australia and New Zealand

[7] The measure of average growth listed in the table should be interpreted as follows: The average growth rate of the richest 50 percent of countries in the sample prior to 1840 is 0.7153%. This growth rate becomes a benchmark growth rate - poorer countries must grow at least at the rate of 0.7153% to be able to catch up with richest countries in the sample. This measure is updated in 1841, when the benchmark growth rate for all countries becomes the average growth rate of the richest 50 percent prior to 1860 and so on. The measure is constructed by analogy with the principle used in the HPR analysis.

Table 3.5 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	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 Expenditure 3 year average	3586	0.1850	0.1302	0.0127	0.9920
log GDP 4 year average	4870	8.2610	0.8152	6.5232	10.2604
Infant mortality 4 year average	4098	0.0765	0.0641	0.0027	0.3145
Polity 5 year average	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

Table 4: Results (continued on the next page)

	Base Model (1-3)			*Base Model With Interaction Terms* (4-6)		
Variables	Coefficients [1]	Marginal Effects [2]	Marginal effects 1sd[8] [3]	Marginal effects 1sd [4]	Marginal effects 1sd [5]	Marginal effects 1sd [6]
Positive regime change$_{t-1}$	0.1574	1.6261	2.3834	5.8531 †	6.2039 †	7.2273*
	0.1752					
Negative regime change$_{t-1}$	0.4295*	4.4375*	6.6504*	7.1988 †	7.6120	6.9713 †
	0.1928					
Polity$_{t-1,\ \text{5-year average}}$	0.0250**	0.0054**	1.4330**	1.9970**	2.1146 †	2.3082**
	0.0091					
Control Variables						
Crisis$_{t-1}$	0.1926*	1.9893*	2.3209*	2.8648*	3.0620	1.7484
	0.0913					
Trade openness$_{t-1}$	1.3776*	0.1423*	8.6521*	9.2400*	9.6986*	9.5665 †
	0.7017					
Trade openness$_{t-2}$	-0.2421	-0.0250	-0.9082	-0.9595	-1.0213	-0.2703
	0.8317					
Trade openness$_{t-3,\ \text{3-year average}}$	-0.8811	-0.0910	-2.6217	-2.7020	-2.8877	-3.0122
	0.6673					
Investment$_{t-1}$	-5.7614**	-0.5952**	-2.9718**	-2.9394**	-3.1434**	-3.2584**
	1.9132					
Investment$_{t-2}$	1.9432	0.2008	1.5792	1.4575	1.5447	1.6127
	2.0406					
Investment$_{t-3,\ \text{3-year average}}$	-0.4907	-0.0507	-0.3406	-0.2853	-0.3032	0.3976
	1.4753					
Government Expenditure$_{t-3,\ \text{3-year average}}$	-1.5170**	-0.1567**	-1.5609**	-1.6145**	-1.7208**	-1.7194*
	0.5740					
log GDP$_{t-1}$	-3.1432***	-0.3247***	-5.0084***	-4.9241***	-5.3131***	-5.0741***
	0.6673					
log GDP$_{t-2,\ \text{4-year average}}$	2.6963***	0.2786***	61.3875***	61.7271***	62.6743***	46.8658**
	0.6327					

	Base Model (1-3)			*Base Model With Interaction Terms* (4-6)		
Variables	Coefficients	Marginal Effects	Marginal effects 1sd[8]	Marginal effects 1sd	Marginal effects 1sd	Marginal effects 1sd
	[1]	[2]	[3]	[4]	[5]	[6]
Infant mortality$_{t-1, \text{ 4-year average}}$	-3.7839*	-0.3909*	-1.9093*	-1.9020*	-2.0286**	-1.6856
	1.8996					
Time control variables						
log GDP$_{\bar{t},t-1}$	-0.5915	-0.0611	-2.5773	-2.7074	-2.8935	-2.9132
	0.5051					
Trade Openness$_{\bar{t},t-1}$	-1.3399*	-0.1384*	-1.8952*	-1.7931*	-1.9119**	-0.5965
	0.5524					
Government Expenditure$_{\bar{t},t-1}$	0.5285	0.0546	0.3953	0.4755	0.5047	0.6470
	2.2736					
Investment$_{\bar{t},t-1}$	-1.2916	-0.1334	-0.5957	-0.5008	-0.5325	-1.4603
	2.9739					
Polity$_{\bar{t},t-1}$	0.0520†	0.0054†	1.4330†	1.2927	1.3704	1.0632
	0.0294					
Infant mortality$_{\bar{t},t-1}$	-9.6356**	-0.9955**	-3.4214**	-3.4465**	-3.6915**	-3.9411**
	3.5810					
Rate of return (US, UK)$_{t-1}$						0.2569
US, UK growth rate$_{t-1}$						0.7559*
Interaction Terms						
Crisis*Pos. reg. change$_{t-1}$				-3.4847 †	-3.3773	-3.7486 †
Crisis*Neg. reg. change$_{t-1}$				0.0401	1.0551	0.5590
Crisis*Polity 5-year av.$_{t-1}$					1.5185**	
Constant	9.6603**					
	3.5911					
Observations	2760			2760	2760	2351

[8]Calculated at the sample means of continuous variables. *Marginal effects 1sd* indicate a change in the probability of rapid growth episode initiation when the variable increases by 1 standard deviation from the mean. For dummy variables marginal effects are calculated for a variable change from 0 to 1.

In Tables 4, 5 and 6: $\dagger p < 0.1, *p < 0.05, **p < 0.01, ***p < 0.001$; standard errors in italics

Table 5: Threshold Effects

Variables	Marginal Effects 1 std. dev. change from the mean, % [1]	Marginal Effects 1 std. dev. change from the mean, % [2]	Marginal Effects 1 std. dev. change from the mean, % [3]	Coefficients [4]
Crisis (t-1)	2.2212*	4.0017*	2.3611*	0.2053*
Positive regime change$_{t-1}$		4.8003	2.0053	0.1325
Pos. reg. change$_{t-1}$ (log gdp $\leq$ 8.6479)	-1.0870			
Pos. reg. change$_{t-1}$ (log gdp $>$ 8.6480)	15.9597**			
Negative reg change$_{t-1}$	6.6885*	11.7406*	6.5214*	0.4358*
Polity$_{t-1,\text{ 5-year average}}$	1.8780**		1.7790**	0.0239**
Polity$_{t-1,\text{ 5-year average}}$ (Polity $\leq$ 9)		0.8518		
Polity$_{t-1,\text{ 5-year average}}$ (Polity $>$ 9)		0.0876***		
Volume of Trade$_{t-1}$	8.4601*	12.5615 †		
Volume of Trade$_{t-1}$ (VOT $\leq$ 0.634269)			3.9243*	1.5922*
VOT $_{t-1}$ (VOT $>$ 0.634269, $\leq$ 0.794905)			5.4240**	2.3122**
VOT $_{t-1}$ (VOT $>$ 0.794905)			10.9985†	1.3921 †
Volume of Trade$_{t-2}$	-1.1262	-1.5470	-0.9009	-0.2526
VOT$_{t-3,\text{ 3-year average}}$	-2.5866	-4.3838	-2.5615	-0.9147
Investment$_{t-1}$	-3.0098**	-5.4181**	-2.8644**	-5.8828**
Investment$_{t-2}$	1.5058	2.4665	1.8336	2.3083
Investment$_{t-3,\text{ 3-year average}}$	-0.3173	-0.4427	-0.3699**	-0.5604
Government Expenditure$_{t-3,\text{ 3-year average}}$	-1.5970**	-2.7705**	-1.4737*	-1.5003*
log GDP$_{t-1}$	-4.9496***	-9.6804***	-4.7304***	-3.1734***
log GDP$_{t-2,\text{ 4-year average}}$	60.7004***	70.3858***	61.9930***	2.6979***
Infant mortality$_{t-1,\text{ 4-year average}}$	-1.7850**	-2.0604	-1.7966 †	-3.7274 †
log GDP$_{t,t-1}$	-2.9080	-2.9512	-2.0065	-0.4537
VOT$_{t,t-1}$	-1.8932*	-3.1841*	-2.0366 **	-1.5582**
Government Expenditure$_{t,t-1}$	0.4280	0.3273	0.1735	0.2467
Investment$_{t,t-1}$	-0.7232	-1.0651	-0.9150	-2.1502
Polity$_{t,t-1}$	1.4052**	2.6540	1.3979 †	0.0529 †
Infant mortality$_{t,t-1}$	-3.5515**	-5.8499	-3.2469 **	-9.6224**
Observations	2760	2760	2760	

Tests for the optimal sample split along a particular threshold

Table 6-a Sample split variable: Polity 5-year average

Threshold variable: Polity 5-year average

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

Table 6-b Sample split variable: Volume of Trade

Threshold variable: Volume of Trade

	Estimated Threshold (VOT/GDP)	Percentile	Bootstrap p-value
1st Threshold	0.7949	87	0.047*
2nd Threshold	0.6343	78	0.066 †
3rd Threshold	0.282828	30	0.170

Table 6-c Sample split variable: Positive Enduring Regime Change

Threshold variable: log GDP per capita

	Estimated Threshold (log GDP per capita)	Percentile	Bootstrap p-value
1st Threshold	8.6479	69	0.077 †
2nd Threshold	7.589482	23	0.1262

Table 6-d Sample split variable: Negative Enduring Regime Change

Threshold variable: log GDP per capita

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

Table 7: Probability forecast evaluation. Mean squared errors and skill scores

	All Sample	Growth years	Non-growth years
$MSE(p,x)_{\text{full model forecast}}$	0.0734	0.75930	0.00982
$MSE(\mu,x)_{\text{unconditional forecast}}$	0.0776	0.8376	0.00719
Skill Score (SS)	**0.0545**	**0.095**	**-0.3667**

Table 8 (a-c): Skill scores under different forecast rules and "success" definitions

Forecast rule:

When (Forecast Odds/Unconditional Odds)$_{i,t}$ > threshold (TH) – predict growth probability = 1;

When (FO/UO)$_{i,t}$ < TH – predict growth probability = 0

Definition of Success (a):

"hit" - forecast$_{i,t}$ = 1, realization$_{i,t}$ = 1

"miss" - forecast$_{i,t}$ =0, realization$_{i,t}$=1

"correct zero" - forecast$_{i,t}$ =0, realization$_{i,t}$ =0

"false alarm" - forecast$_{i,t}$ =1, realization$_{i,t}$ = 0

Table 8-a

Method	TH = 1	TH = 1.5	TH =2
KSS	***0.3872***	0.2992	0.2433
HSS	0.1947	***0.2083***	0.2055
ORSS	***0.6850*****	0.6549**	0.6322**

Note: in this and the subsequent tables, highlighted in bold italics are the best skill score results associated with each evaluation method;

* indicates statistical significance on 5% level; * indicates significance on 10% level.

Forecast Odds are based on the full model, which incorporates all interaction terms and optimal thresholds.

Relaxing the definition of success under the forecast rule:

Definition of Success (b):

"hit" - $\text{forecast}_{i,t}$ =1, $\text{realization}_{i,t}$ =1 or $\text{realization}_{i,t+1/i,t-1}$ =1 (growth happens within a year of the forecast)

"miss" - $\text{forecast}_{i,t}$=0, $\text{realization}_{i,t}$=1 or $\text{realization}_{i,t+1/i,t-1}$ =1

"correct zero" - $\text{forecast}_{i,t}$=0, $\text{realization}_{i,t}$ =0 and $\text{realization}_{i,t+1/i,t-1}$ =0 (nothing happens within a year of the forecast)

"false alarm" - $\text{forecast}_{i,t}$=1, $\text{realization}_{i,t}$ = 0 and $\text{realization}_{i,t+1/i,t-1}$ =0

Table 8-b

Method	TH = 1	TH = 1.5	TH =2
KSS	***0.3475***	0.2725	0.2252
HSS	0.2523	***0.2559***	0.2411
ORSS	***0.6453*****	0.6420**	0.6514**

Definition of Success (c):

"hit" - $\text{forecast}_{i,t}$ =1, $\text{realization}_{i,t}$ =1 or $\text{realization}_{i,t+2/i,t-2}$ =1 (growth happens within two years of the forecast)

"miss" - $\text{forecast}_{i,t}$ =0, $\text{realization}_{i,t}$ =1 or $\text{realization}_{i,t+2/i,t-2}$ =1

"correct zero"- $\text{forecast}_{i,t}$ =0, $\text{realization}_{i,t}$ =0 and $\text{realization}_{i,t+2/i,t-2}$ =0 (nothing happens within 2 years of the forecast)

"false alarm" - $\text{forecast}_{i,t}$ =1, $\text{realization}_{i,t}$ = 0 and $\text{realization}_{i,t+2/i,t-2}$ =0

Table 8-c

Method	TH = 1	TH = 1.5	TH =2
KSS	***0.3143***	0.2502	0.1931
HSS	0.2769	***0.2661***	0.2269
ORSS	0.6111**	***0.6256****	0.6186**