What Makes Growth Sustained?

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We identify structural breaks in economic growth in 140 countries and use these to define "growth spells:" periods of high growth preceded by an upbreak and ending either with a downbreak or with the end of the sample. Growth spells tend to be shorter in African and Latin American countries than elsewhere. We find that the duration of growth spells is most robustly related to income distribution, export orientation, and democratization within the spell. In contrast, the quality of institutions at the beginning of a growth spell does not seem to help predict the length of spells.

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I. Introduction

Perhaps the most important issue confronting policymakers in low-income and emerging market countries is how to embark on a process of *sustained* economic growth. An industry centered around cross-country growth regressions aimed to uncover the secret behind, say, the miracle episodes of Asian growth versus the equally spectacular failures in sub-Saharan Africa and Latin America. While many of the conclusions from the cross-country regressions held intuitive appeal—including the importance of openness to trade, macroeconomic stability, etc.—they turned out not to be robust, and thus were unable to give much real guidance on which policy levers were critical to igniting and sustaining growth in low-income countries. The quality of broad institutions may have been a missing element in this approach (Acemoglu, Johnson and Robinson, 2001, 2005; Rodrik, Subramanian and Trebbi, 2004). A more fundamental problem, however, may have been trying to explain average growth rates when growth in developing countries exhibits a remarkable lack of persistence: asking why country A had -2 percent growth over 1960-90 while country B had +3 percent is probably the wrong question if -2 is the average of -5, +5, and -9 over three decades, and vice-versa for country B. If developing countries' growth performance look more like mountains, cliffs, and plains, than the steady or steep hills observed in the industrial world, then looking for an explanation of *average* cross-country growth differences is unlikely to uncover much that is of policy use (Pritchett, 2000).

The literature has since shifted its focus from cross-country regressions to exploiting the information in *turning points* in countries' growth performance. If an economy has been falling off a cliff for a number of years and then turns itself around and starts climbing a mountain, it makes sense to ask what is going on around the time of the transition, and during the growth episode, to uncover any commonalities in the experience that can plausibly be exploited in other contexts. Likewise, if a country has been growing well for a number of years, but suddenly changes course for the worse, it would be very useful to know what the path out of growth looks like so that other countries can take a different fork in the road. Papers by Rodrik (1999), Hausmann, Pritchett and Rodrik (2004), and Jones and Olken (2005)—all of which drew inspiration from the ideas in Easterly and others (1993) and especially Pritchett (2000)—represent initial attempts to uncover the informational content of growth transitions.[2] While these papers suggest that growth transitions remain largely a mystery (in the sense that "usual suspects" in terms of correlates explain only a small fraction of what is going on during a transition), to some extent they confirm some of the elements that were thought to be important from the cross-country approach (e.g., the importance of openness). At the same time, they add additional elements such as currency depreciations and

[2] Related papers include Ben-David and Papell (1998), Aguiar and Gopinath (2004), and Jerzmanowki (2005).

political regime changes that seem to be correlated with growth accelerations,[3] and cast doubt on the importance of investment in growth upbreaks.[4]

Of course, examining the determinants of accelerations does not speak to the issue of what makes some growth spells more durable than others.[5] Jones and Olken (2005) stress the asymmetry between accelerations and collapses of growth: what works to get growth going is not the opposite of what seems correlated with a downbreak. For instance, growth accelerations seem to be driven largely by productivity rather than investment increases, perhaps in response to the opening of the economy to international trade. In contrasts, a collapse of investment seems to play a bigger role in decelerations, as do increases in conflict and macroeconomic instability. This analysis suggests that the correlates of upbreaks differ from those of downbreaks. While the authors downplay causality here, a tentative policy implication is that countries may need to do different things to get growth going from what is needed to keep it from stalling.

The present paper focuses squarely on this second question, namely, on what keeps growth going. Since closing the per capita income gap with rich countries will take extended periods of fast growth in the developing world, the question of how to make growth sustained appears to be of even greater policy relevance than how to get a growth episode underway. Furthermore, surges in growth are in fact relatively common in the developing world, even in regions that have done very badly over the past 3-4 decades, notably sub-Saharan Africa. What really sets sub-Saharan Africa and some other developing regions apart, as we will show, is the fact that its growth spells have tended to end much sooner than growth spells in East Asia or many industrial countries. The question of how to forestall the end of growth spells is thus of first order relevance, particularly to the developing countries (including many African countries) which are currently enjoying growth spells.

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[3] Johnson, Ostry, and Subramanian (2006) emphasize the role of manufactured exports and a competitive exchange rate in longer episodes of sustained growth.

[4] This is obviously a critical issue as far as "big push" views of economic development are concerned. Massive scaling up of aid flows to finance capital deepening in poor countries has recently been proposed by Sachs and others. Long before, the "poverty trap" development literature relied heavily on investment mechanisms to generate sustained growth in poor countries (see Rosenstein-Rodan, 1943; Nurkse, 1953; Gerschenkron, 1965; and Murphy and others, 1989). Jones and Olken's finding that investment is not a strong correlate of growth upbreaks would appear to cast doubt on big push or poverty trap theories.

[5] Hausmann, Pritchett and Rodrik (2004) stress that external shocks—such as to the terms of trade— are correlated with shorter lived upbreaks and downbreaks in growth but not strongly correlated with sustained growth episodes.

We approach the topic somewhat differently than the literature before us. Focusing on the before and after of a deceleration episode potentially misses a great deal of information, since it does not tell us what a country (or its environment) was "doing right" prior to its deceleration. Studies that focus on deceleration events are not well placed to draw lessons from the fact that some decelerations are preceded by much longer periods of high growth than others. We attempt to capture this information by moving the object of inquiry to duration per se: that is, by studying the determines the length of growth spells. We do so by applying duration analysis techniques that are common in medical or microeconomic applications (for example, studies that examine the length of unemployment spells).

The object of our analysis is the "growth spell": the time period between a growth acceleration and a deceleration. To identify accelerations and decelerations, we combine statistical and economic criteria. Relying exclusively on economic criteria (as in Hausmann, Pritchett, and Rodrik, 2004) may not be the best approach if volatility in the underlying growth series differs substantially across countries, as is indeed the case. But relying on statistical significance exclusively may not be enough, because some breaks that can be easily identified in the data may be too small to be of much interest economically.

Our statistical approach extends the work of Bai and Perron (1998, 2003), using sample-specific critical values, and modifying the Bai-Perron algorithm for sequential testing of structural breaks in a way that turns out to substantially increase the tests' power to find multiple breaks. The details of our approach are described in a companion paper (Antoshin and others, 2006). Having identified structural breaks at various significance levels, we define growth spells as a period between an upbreak leading to per capita growth of at least g percent (we mostly work with $g = 2$) and either a downbreak resulting in growth less than g or the end of the sample (censored, or incomplete, growth spells). We then use explore the potential determinants of growth duration by estimating a proportional hazards model with time-varying covariates which relates the probability that a growth spell will end to a variety of economic and political variables. In doing so, we usually distinguish between "initial conditions" in place at the time of an acceleration, and changes that took place during a growth spell.

Our main finding confirm some of the previous results in this literature, in particular, external shocks and macroeconomic volatility are negatively associated with the length of growth spells. We also have some more surprising findings. Trade liberalization, seems to help not only in getting growth going, as emphasized by previous authors, but also in sustaining it—particularly when combined with competitive exchange rates and current account surpluses. Most strikingly, we find that the duration of growth spells is strongly related to income distribution: more equal societies tend to grow longer. The quality of political institutions at the beginning of a growth spell does not seem to matter, but societies that democratize while the spell is ongoing have a greater chance of prolonging it. On the whole, these results share some of the flavor of recent work on the political economy of growth and development, which we briefly allude to in section III and in our conclusions.

II. STRUCTURAL BREAKS AND "GROWTH SPELLS"

A. Identifying Structural Breaks in Economic Growth

We apply a derivative of a procedure proposed by Bai-Perron (1998, 2003) for testing for multiple structural breaks in time series when both the total number and the potential location of those breaks is unknown. In what follows, we describe the basic approach informally; details are provided in a companion paper.[6]

At the outset, one must take a decision on the minimum "interstitiary period:" the minimum number of years, h, that we require between breaks. Imposing a long interstitiary period means that we could be missing true breaks that are less than h periods away from each other, or from the beginning or end of the sample period. However, allowing a short interstitiary period implies that some structural break tests may have to be undertaken on data subsamples containing as few as $2h$+1 observations (see below). In these circumstances, the size of the test may no longer be reliable, and the power to reject the null hypothesis of no structural break on the subsample may be low. We chose a relatively low interstitiary period, setting h either equal to 8 or to 5, because we want to give the procedure a chance to decide whether to interpret large output swings in developing countries as structural breaks or simply as volatility in the growth process. Given a given sample size T, the interstitiary period h will determine the maximum number of breaks, m for each country: m = int(T/h)-1. For example, if T = 50 and h = 8, then m = int(6.25)-1 = 5.[7]

We next employ an algorithm which sequentially tests for the presence of up to m breaks in the GDP growth series. The first step is to test for the null hypothesis of zero structural breaks against the alternative of 1 *or more* structural breaks (up to the pre-set maximum m). This means examining m F-test statistics associated with testing 0 breaks against 1 break, 0 breaks against 2 breaks, and so on. The location of potential breaks is decided by minimizing the sum of squared residuals between the actual data and the average growth rate before and after the break. Critical values are generated through Monte Carlo simulations, using bootstrapped residuals that take into account the properties of the actual time series (that is, sample size and variance). The null of no breaks is rejected if *any* of these m test statistic exceeds the critical value associated with a particular significance level.

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[6] See Antoshin et al (2006). The two innovations are: first, modifying the Bai-Perron algorithm for sequential testing of structural breaks, as described below; second, using sample-specific critical values that take into account heteroskedasticity and small sample size. In the companion paper, we show that these extensions improve both power and size.

[7] In Bai and Perron's terminology, the ratio h/T is referred to as the "trimming factor". Since T = 35-55 observations, our choices of h imply trimming factors between 10 and 20 percent.

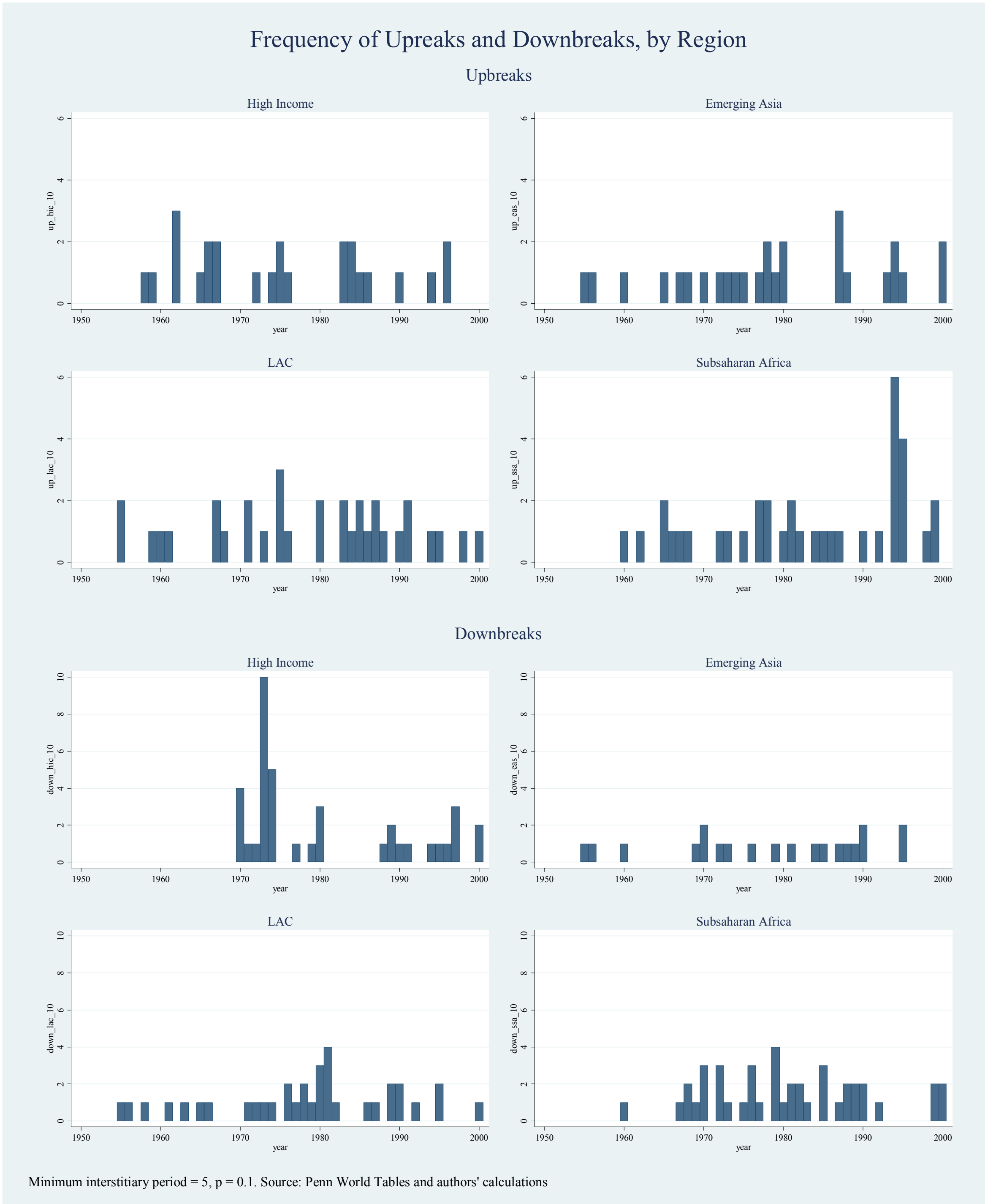
In the event that the null hypothesis of no structural breaks is rejected, we next examine the null hypothesis of exactly one break, the location of which is again optimally chosen. This is tested by applying the same test as before—i.e. testing the null hypothesis of 0 breaks against 1 or more breaks—on the *subsamples* to the right and left of the hypothesized break (up to the maximum number of breaks that the subsample length will allow given the interstitiary period). If *any* of the tests on the subsamples rejects, we move to testing the null of exactly two breaks, by testing for zero against 1 or more breaks on the three subsamples on the right, left and in between the optimally chosen two breaks, and so on. The procedure ends when the hypothesis of l structural breaks can no longer be rejected against the alternative of more than l breaks.

Table 1 and Figure 1 summarize the results from applying these tests to income per capita growth series in 140 countries for which internationally comparable output data are available since at least the 1970s. Our data source is version 6.2 of the *Penn World Tables*, extended from 2004 to 2006 using the IMF's World Economic Outlook database. Table 1 shows the number of "upbreaks" and "downbreaks", at the 10 percent significance level and minimum interstitiary periods of 5 and 8 years, respectively, by region and decade (see the appendix for the full set of break years). We also ran the algorithm using higher p-values to give us a chance to detect more breaks in countries in which the year-to-year volatility of output is high (albeit at the expense of more "false positives"). This increases the total number of breaks identified, but does not substantially affect the distributions of upbreaks and downbreaks across regions and time periods.

Table 1. Growth Breaks by Decade and Region
(p = 0.10)

		minimum segment = 5					minimum segment = 8				
Region	No. of countries	Total	50-60s	70s	80s	90s	Total	50-60s	70s	80s	90s
Total *upbreaks*	140	139	34	30	33	42	76	17	13	20	26
Industrial countries 1/	37	26	10	5	6	5	10	5	0	2	3
Emerging Asia	22	28	6	9	6	7	20	5	6	4	5
Latin America and Caribbean	28	33	8	7	11	7	18	2	4	8	4
Africa and Middle East	53	52	10	9	10	23	28	5	3	6	14
Total *downbreaks*	140	151	19	58	42	32	95	8	44	32	11
Industrial countries	37	39	0	23	6	10	19	0	13	1	5
Emerging Asia	22	20	4	6	6	4	15	0	6	6	3
Latin America and Caribbean	28	35	7	10	12	6	25	2	11	11	1
Africa and Middle East	53	57	8	19	18	12	36	6	14	14	2

1/ Includes Japan, Korea, Singpore, Hong Kong SAR and Taiwan Province of China.



At the ten percent significance level and $h = 5$, our algorithm identifies a total of 290 breaks—139 “upbreaks” and 151 “downbreaks”, that is, a little more than one upbreak and one downbreak per country on average. This is dramatically higher than the total number of breaks that the standard Bai-Perron algorithm identifies using the same data, p-value and interstitiary period (namely, 74, using asymptotic critical values). Upbreaks tend to be most common in the 1950s and 60s, driven by Europe and Latin America, and in the 1990s, driven by Africa (Figure 1 and Table 1). Downbreaks are particularly concentrated in the 1970s. For the high income countries, the first half of the 1970s stands out; for Latin America, the period between 1978 and 1983; for Africa, the 1970s and the first half of the 1980s.

Setting the minimum period between breaks to $h = 8$ substantially reduces the total number of breaks. At the 0.1 percent significance level we find 171 breaks: 76 upbreaks and 95 downbreaks (the standard Bai-Perron approach identifies only 64 breaks in total). The fact that setting $h = 8$ leads to 40 percent fewer breaks shows that the interstitiary period matters, but it does not tell us which approach is better. With $h = 5$, we may be picking up some breaks in long-term growth that we might be missing when we require breaks to be at least 8 periods apart. However, we may also be picking up abrupt output movements at shorter frequencies that reflect volatility, business cycles, or short-lived commodity price booms or busts. These are more likely to be filtered out by setting $h = 8$. In the remainder of the paper, we hence work with both sets of breaks to see whether the results are similar in both.

B. From Structural Breaks to Growth Spells

The period following a growth upbreak can be thought of as a "growth spell": a time period of higher growth than before, ending either with a downbreak or with the end of the sample. However, it is sometimes the case (after periods of very high growth) that high growth continues, albeit at a lower level. In this case, one would not want to say that a growth spell has ended. Conversely, it is sometime the case that an upbreak follows a period of sharply negative growth, leading to a period in which growth is still negative (or positive but very small). In this case, one would not want to say that a growth spell is under way.

In short, if the objective is to understand the determinants of economically *desirable* growth spells, the statistical criteria discussed in the previous section need to be supplemented by an economic criterion. We hence define growth spells as periods of time

- *beginning* with a statistical upbreak followed by a period of *at least g* percent average growth; and
- *ending* either with a statistical downbreak followed by a period of *less* than g percent average growth ("*complete*" growth spells) or with the end of the sample ("*incomplete*" growth spells).

Since growth in our definition means per capita income growth, growth of as low as 2 percent might be considered a reasonable threshold. We used $g = 2$, $g = 2.5$ and $g = 3$, with similar results, and focus on the $g = 2$ case below.[8]

[8] In the definition above, growth spells are required to begin with a *within-sample* upbreak. But there are many country cases in which there are no upbreaks in the first 20 years or so

(continued)

We now characterize the growth spells that result from applying these criteria to the structural breaks summarized in Table 1, using g = 2, from several angles.

Duration of Spells

Comparing the *frequency* of growth spells across regions is not very meaningful: few growth spells could mean few increases in trend growth, but could also reflect the preponderance of uninterrupted periods of high growth, or simply our inability to detect growth spells in the presence of high volatility of year-to-year growth. In contrast, comparing the *duration* of growth spells across regions is meaningful, since the concept of duration conditions on the presence of a growth spell. High volatility of output does not bias down the duration of growth spells: if anything, it biases it up, since in the presence of high volatility downbreaks are less likely to be detected. Hence, if we should find that growth spells in high volatility regions such as Latin America of Africa tend to be shorter than in other regions, then this is a strong finding, suggesting the Latin American and African growth spells do in fact end relatively early, for reasons that are worth exploring.

Table 2 presents the number of growth spells by region together with some rudimentary information about the distribution of the length of these spells. Focusing on the h = 5 case, there have been a total (both complete and incomplete) of 103 spells at the 10 percent level and 160 at the 25 percent level. For the h = 8 case, the number of spells is 62 and 91, respectively. A little under half of the spells identified at each level correspond to Latin America and Africa, about in line with the fraction of Latin American and African countries in the sample. Hence, in spite of the potential bias against finding growth spells in these countries as a result of their high year-to-year volatility, Latin America and Africa do not, on average, appear very unusual with respect to their ability to *get growth going*.

Instead, the real problem in these regions seems to be their inability to *sustain* growth, on average, over long periods. Irrespective of which minimum interstitiary period and p-level we choose, the mean length of growth spells is always much shorter—by up to a half—for Latin America and Africa compared to the industrial countries and emerging Asia. For h = 8, 80-100 percent of growth spells in high income countries and emerging Asia lasted 10 years or more, but only about two thirds of Latin American and African spells do so. For h = 5, 70-80 percent of spells in the high income and emerging Asian countries lasted at least 10 years, but only 30-50 percent of spells in Latin America or Africa last that long.

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because growth started out high. This growth period could reasonably be regarded as a growth spell initiated by an upbreak outside the sample period. We are working to extend the output series backwards, or use information about economic history, to roughly “time” the beginnings of these early growth spells.

Table 2. Frequency and Duration of Growth Spells 1/

Region	No. of countries	p = 0.10 No. of spells	p = 0.10 Mean duration	p = 0.10 % spells lasting at least 10 years	p = 0.10 % spells lasting at least 16 years	p = 0.25 No. of spells	p = 0.25 Mean duration	p = 0.25 % spells lasting at least 10 years	p = 0.25 % spells lasting at least 16 years
minimum length of spell: 5 years									
Complete spells, upbreak within sample period									
Industrial Countries 2/	37	9	12.8	67	22	21	10.3	48	14
Emerging Asia	22	7	18.9	71	57	16	13.6	56	38
Latin America	18	11	9.9	27	18	14	10.5	43	21
Sub-Saharan Africa	43	11	5.7	0	0	27	6.7	7	7
Other developing 3/	20	10	8.9	20	10	12	10.3	33	17
Incomplete spells, upbreak within sample period									
Industrial Countries 2/	37	11	28.8	91	82	20	23.5	95	60
Emerging Asia	22	13	21.6	77	54	12	18.1	58	33
Latin America	18	3	22.7	100	67	4	18.3	75	50
Sub-Saharan Africa	43	20	14.2	70	20	23	10.7	57	17
Other developing 3/	20	8	19.0	63	50	11	21.4	73	64
Total									
Industrial Countries 2/	37	20	21.6	80	55	41	16.7	71	37
Emerging Asia	22	20	20.7	75	55	28	15.5	57	36
Latin America	18	14	12.6	43	29	18	12.2	50	28
Sub-Saharan Africa	43	31	11.2	45	13	50	8.6	30	12
Other developing 3/	20	18	13.4	39	28	23	15.6	52	39
minimum length of spell: 8 years									
Complete spells, upbreak within sample period									
Industrial Countries 2/	37	2	13.0	100	0	7	16.1	71	29
Emerging Asia	22	3	20.3	67	67	7	13.6	43	29
Latin America	18	4	12.5	50	25	7	12.9	43	29
Sub-Saharan Africa	43	3	8.3	0	0	6	8.0	0	0
Other developing 3/	20	7	10.4	29	14	7	12.4	43	29
Incomplete spells, upbreak within sample period									
Industrial Countries 2/	37	8	27.8	100	75	12	24.2	100	67
Emerging Asia	22	13	26.1	100	62	13	22.8	100	62
Latin America	18	2	19.0	100	50	5	16.6	100	60
Sub-Saharan Africa	43	15	14.6	80	27	19	14.5	84	26
Other developing 3/	20	5	17.2	100	60	8	18.3	100	63
Total									
Industrial Countries 2/	37	10	24.8	100	60	19	21.2	89	53
Emerging Asia	22	16	25.0	94	63	20	19.6	80	50
Latin America	18	6	14.7	67	33	12	14.4	67	42
Sub-Saharan Africa	43	18	13.6	67	22	25	13.0	64	20
Other developing 3/	20	12	13.2	58	33	15	15.5	73	47

1/ Growth cutoff set to g = 2 percent (per capita).

2/ Includes Japan, Korea, Singpore, Hong Kong SAR and Taiwan Province of China.

3/ Middle East, North Africa, Cyprus, Turkey, and Caribbean countries.

The table also shows an interesting asymmetry between complete and incomplete growth spells for Africa and Latin America. Latin America had a fair number of (albeit short) growth spells in the past, but it has few ongoing growth spells (3-5, depending on the parameters chosen). In contrast, in Africa a fair number of countries (between 15 and 23, depending on parameters) are currently enjoying an ongoing growth spell. Most of these were initiated in the mid to late 1990s, which is why they are still short on average.

Growth Before, During and After Growth Spells

In addition to the incidence and duration of growth spells, overall growth performance will of course depend on growth levels both during and between spells. Table 3 examines whether there are systematic differences across regions in this regard, and also looks at growth immediately before and after growth spells, to see whether there is any suggestion that growth spells begin or end with economic crises.

In general, there are no big differences in growth levels *during* spells across regions (the main exception is Latin America, where growth spells that began in our sample period have tended to be somewhat less vigorous than in other countries). In contrast, there are big differences with respect to growth after spells ended. In the advanced countries and Asia, growth spells have on average ended with (relatively) “soft landings”—growth rates between -1 and 3 percent—while African spells have tended to end with deep collapses, with average growth rates between -3 and -6 percent. The remaining developing countries occupied an intermediate position, with growth rates between -3 and 1 percent.

There are also interesting differences in growth before the onset of growth spells, particularly for spells that are currently incomplete. Asian and high income countries tend to start their spells from per capita growth rates that are positive or very slightly negative. In contrast, growth spells in the remaining developing country regions tend to begin with crises. In these regions, average interstitiary rates prior to the last round of growth spells were between -1.3 and -5 percent, with even lower rates immediately prior to the onset of growth spells.

Table 3. Average Growth Before, During and After Growth Spells 1/

	p = 0.10					p = 0.25				
	Average growth			3 years …		Average growth			3 years …	
Region	before	during	after	before start	after end	before	during	after	before start	after end
				minimum length of spell: 5 years						
				Complete spells						
High Income	0.5	7.9	-0.6	0.1	-1.0	0.9	5.7	0.1	0.7	-0.4
Emerging Asia	-1.4	7.2	-0.7	-1.7	-1.0	-1.2	5.0	-0.3	-2.0	-0.7
Latin America	0.6	4.7	-0.1	0.0	-0.1	0.5	4.4	-0.4	0.0	-0.7
Sub-Saharan Africa	-0.9	9.5	-3.2	-3.1	-3.7	-1.7	7.4	-2.7	-3.0	-3.1
Other developing 2/	-1.4	6.2	-2.5	-1.3	-2.7	-1.0	5.7	-2.2	-0.9	-2.5
				Incomplete spells						
High Income	-0.9	5.4	…	-2.0	…	-0.9	4.1	…	-1.8	…
Emerging Asia	-0.7	4.9	…	-0.9	…	0.2	5.4	…	0.5	…
Latin America	-2.0	3.2	…	-3.9	…	-2.4	3.0	…	-3.3	…
Sub-Saharan Africa	-4.9	7.3	…	-7.5	…	-3.5	6.2	…	-5.3	…
Other developing 2/	-1.8	6.4	…	-5.1	…	-2.3	5.7	…	-3.1	…
				minimum length of spell: 8 years						
				Complete spells						
High Income	3.3	6.0	1.2	2.6	3.4	3.0	5.0	0.5	2.8	1.6
Emerging Asia	-0.9	8.7	1.4	2.0	1.9	0.3	6.4	1.2	1.4	2.4
Latin America	1.2	5.3	0.7	0.9	-0.8	1.4	4.7	-0.6	1.3	-0.1
Sub-Saharan Africa	-2.7	9.9	-3.9	-10.6	-6.5	-0.6	7.7	-2.6	-5.9	-3.5
Other developing 2/	-1.4	4.9	-0.9	-0.7	-1.9	-1.4	4.3	-1.3	-0.7	-3.1
				Incomplete spells						
High Income	1.3	5.9	…	1.1	…	0.2	5.0	…	-0.6	…
Emerging Asia	-0.2	4.9	…	0.1	…	0.1	4.5	…	-0.2	…
Latin America	-1.3	3.4	…	-3.0	…	-0.7	3.6	…	-1.3	…
Sub-Saharan Africa	-4.4	5.6	…	-7.2	…	-3.2	5.2	…	-6.5	…
Other developing 2/	-2.7	4.9	…	-4.3	…	-2.1	4.4	…	-3.6	…

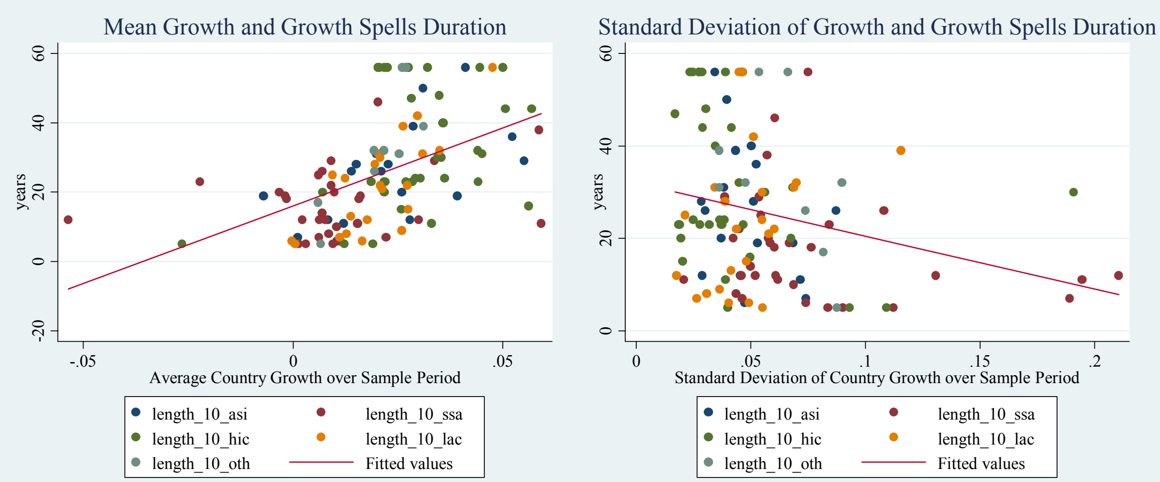
1/ Growth cutoff set to $g = 2$ percent (per capita).
2/ Includes Japan, Korea, Singpore, Hong Kong SAR and Taiwan Province of China.
3/ Middle East, North Africa, Cyprus, Turkey, and Caribbean countries.

Duration, Mean Growth, and Growth Volatility

One clearly expects a high correlation between overall growth performance and the duration of growth spells, but just how tight is it? How much do we loose, by concentrating on growth duration rather than growth performance as the immediate object of study? We would also expect a (negative) correlation between growth volatility and duration, since short duration in effect captures high *medium term* growth volatility. But to the extent that the former reflects year to year volatility as well as structural breaks in growth rates, the correlation might not be that high.

Figure 8 confirms that there is indeed a strong positive relationship between the duration of growth spells (using p = 0.10 and *h* = 5) and average long term growth. The cross-country correlation between the maximum length of a spell and total mean growth is about 0.5, and highly significant. Hence, understanding the duration of growth spells goes a long way toward understanding disparities in cross-country growth performance since the 1950s, though it is by no means the full story. The lower half of the figure shows that duration is also correlated (negatively) with real volatility. Though statistically significant, the correlation is much less tight (-0.25). Hence, studying the reasons why growth spells are longer in some countries than in others is not the same as studying the causes of cross country differences in real volatility.

Figure 8. Duration of Growth Spells and Mean and Standard Deviation of Growth



h = 5, minimum growth = 2, p = 0.1. Source: Penn World Tables and authors' calculations

III. Analyzing the Duration of Growth Spells

A. Empirical Strategy

We would like to relate the expected duration of growth spells—or equivalently, the probability that a spell will continue beyond a specific length—to the economic and political conditions prevailing at the beginning of the growth spells, and to policies undertaken during the growth spell. In doing so, we face two main challenges.

The first concerns model selection. The approach of this paper is atheoretical, in the sense that we do not base our modeling priors on a particular theory of why growth is more sustained in some cases than in others. Instead, our priors are influenced by a variety of ideas that come out of the existing literature: in particular, the notion that growth spells may end because growth processes are disrupted as a result of shocks (including terms of trade shocks, capital flow reversals, and major disruptions such as wars); the Olsonian notion that growth spells may collapse even without any such shocks either a result of distributional conflict or because of weaknesses in domestic institutions; and the notion that there might be an interaction between the two, as institutions may matter for the way in which societies can "handle" shocks (Rodrik, 1999). However, while these notions give us a little bit of structure that helps us think about model selection, they also point to a very wide range of potential determinants of growth duration, and to possible interactions between those determinants.

So far, this does not sound very different from the standard model selection problem in empirical growth analysis, which has received significant attention in recent years (for example, Fernandez et al, 2001; Sala i Martin et al, 2004; Hoover and Perez, 2004 and Hendry and Krolzig, 2004). It is greatly complicated in our case, however, due to data constraints that preclude the application of a general-to-specific modeling approach. The problem is that in order to analyze growth spells that began as far back as the 1950s for 119 countries, we require data for many countries over very long time periods. Some data series are available for many countries and many periods, many data series are available for some countries and many periods, and many data series are available for many countries and a few periods; but *not* many data series are available for many countries and many periods. Furthermore, the sample of growth spells that we start out with is small—no more than about 75 observations, even if we push the notion statistical significance to its limit ($p = 0.5$). As a result, running any growth spells regression that includes the main "usual suspects"—to say nothing of a broader regression that includes a number of more doubtful variables—will shrink our degrees of freedom to absurd sizes. The overlap in data availability between the main series we are interested in is simply too low.

This leads us to the following approach. All that can be done with the available data is to sequentially test the relevance of particular regressors of interest, while including some minimal controls. However, this may be acceptable if the ordering of sequential tests, and the controls that are included, are chosen in a reasonable way. In the empirical section below, we begin by running regression of duration on various proxies for external shocks, controlling only for per capita income levels. This is acceptable if external shocks are not correlated with other (e.g., institutional and policy) determinants of growth spells. Finding that some of these shocks matter, we then control for them while sequentially testing first for the relevance of some institutional variables and income distribution, and then for a variety of health and education related variables, variables related to trade and competitiveness, and macroeconomic policy. At the end, we summarize our results by showing the results of a few parsimonious regression that control for all or most of the variables that were found to matter during the sequential testing process.

The second challenge relates to the distinction between initial conditions at the beginning of the spell and changes in determinants of duration as the spell proceeds, and to how potential reverse causality can be addressed in that context. In many cases, we will be studying potential determinants of spell length—say, an institutional index, or an educational indicator, or an economic indicator such as inflation—which changes over the course of the spell. This indicator needs to be regarded as endogenous in the sense its level may depend on whether the country is in a growth spell or not. At the same time, however, it might be amenable to policy actions while a spell is ongoing. Hence, it would be desirable to understand not only how initial conditions affect duration, but also how ongoing changes in particularly variables influence the probability that a spell will end.

We seek to address this by distinguishing, for most variables, between the initial level of the variable at the beginning of the spell, and changes since the beginning of the spell. Reverse causality is addressed by estimating the effect of these time-varying variables on the hazard that a spell will end in the next period *conditional on its current length* (i.e. conditional on being in an ongoing spell). As explained in more detail below, this is achieved through a survival model with time-varying covariates, that can be viewed as roughly analogous to a panel estimation in which the right hand side variables are predetermined (though not strictly exogenous). While this will not eliminate all sources of endogeneity (for example, endogeneity through expectation that the end of a spell is imminent), it should prevent bias through standard feedback from the end of a spell to potential determinants (for example, from a growth collapse to higher inflation, rather than the reverse).

B. Regression Methodology[9]

Let t denote “analysis time” (here: time since growth accelerated) and T duration, a random variable (here: the length of a growth spell). $t = 1$ denotes the first year in a growth spell, $t < 1$ years prior to the beginning of the spell. $X(t)$ is a vector of time-varying variables that we suspect have an influence on the probability that a growth spell might end (also a random variable); x_t the realization of $X(t)$ at time t; and z a vector of non-time varying variables that may also have an impact on length of a growth spell. z could contain realizations of $X(t)$ before the beginning of a growth spell (i.e. x_t , $t < 1$) and also variables that have no time dimension at all, e.g. geographical variables. We want to estimate the effect of $X(t)$ and z of interest on T.

Duration is usually modeled by writing down and parametrizing the *hazard rate*—the conditional probability that the spell will end in the next period—and estimate the relevant parameters using maximum likelihood. In the presence of both time-varying and time invariant covariates, the hazard rate can be defined as (assuming continuous time for the time being):

(1)
$$\lambda(t, X(t), z) = \lim_{h \to 0} \frac{P(t \le T < t+h \mid T \ge t, X(t+h), z)}{h} = \frac{f(t \mid x_t, z)}{1 - F(t \mid x_t, z)}$$

[9] For details, see Woolridge (2002), Chapter 20.

where $F(t \mid x_t, z)$ and $f(t \mid x_t, z)$ are the c.d.f. and density function of *T*, respectively, conditioning on *z* and the realization of *X* at time *t*. The most popular approach to estimating (1) is to assume a "proportional hazard model"—in effect, an assumption that the time dependence of λ, called the "baseline hazard", is multiplicatively separable from its dependence on $\{X(t), z\}$—and to parametrize it by assuming that the relationship between λ and $\{X(t), z\}$ is log linear, and that the "baseline hazard" takes a particular functional form:

(2) $$\lambda(t) = g(X(t), z)\lambda_0(t) = \exp(\beta[X(t), z])\lambda_0(t)$$

where $\lambda_0(t)$ is assumed to obey a specific distribution whose parameters can be estimated along with the coefficient vector β.

One potential problem in estimating (2) arises from the feedback of duration to the covariates *X*, i.e. the fact that *X* might depend on whether or not a spell has ended or is still ongoing. This is analogous to the problem of endogeneity in growth or income level regressions, when there might be potential feedbacks from growth to the determinants of growth. As a benchmark, it is possible to define a "strict exogeneity condition" analogous to the condition in time series econometrics requiring that *X* be independent realizations of the left hand side variables in all leads and lags, namely:

(SE) $$P[X(t, t+h) \mid T \geq t+h, X(t)] = P[X(t, t+h) \mid X(t)]$$

Intuitively, this says that knowing that the growth spell will continue until at least time $t+h$ does not help us predict the realization of *X* between *t* and $t+h$. In the growth duration context, this strict exogeneity variable is manifestly *not* satisfied for most variables in *X*: knowing that a growth spell has ended most likely has information content, for example, for predicting future health indicators. Whether or not a growth spell has ended also has an impact on virtually all other macroeconomic variables, and possibly on institutional variables as well.

The question is hence whether (2) can be estimated in circumstances when the strict exogeneity condition (SE) is violated. As shown by Woolridge (2002), the answer is Yes if we can assume that the hazard at time *t* conditional on the covariates at time *t* depends only on the realizations of those covariates, i.e. when it does neither depend on future realizations of the covariates, or on unobserved covariates. Under this assumption, it is possible to construct a partial log likelihood function for each observation which represents the density that a growth spell will end in a particular time interval conditional on the realization of the covariates and a dummy indicating whether the observation is censored or not. The coefficient vector in (2) can then be estimated using maximum likelihood, and the maximum likelihood variance matrices and test statistics are asymptotically valid.

Intuitively, we are making three assumptions when we take this route (that is, when we estimate the hazard rate using essentially the same approach as in a hazard model without time varying covariates, i.e. when all covariates z are fixed at the beginning of each spell). First, we rule out contemporaneous feedback from the end of a growth spell to the time varying covariates within the current time period. In other words, we must *either* assume that the realization of covariates at t-1 contains all relevant information to predict whether a growth spell will end at t, *or* that if realizations at t matter, they will not change within the time period as a result of the end of a growth spell in that period (for example, health indicators may deteriorate in a low growth environment, but this will not be felt in the first period in which a downbreak occurs).[10] Second, we must assume that duration is conditionally independent of censoring. This is automatically satisfied in our sample, since we have fixed censoring (all growth observations end in 2003). Third, and most critically, we must not omit relevant variables from the regression. Given the data availability constrains discussed at the end of the last section, this is potentially the most serious problem.

In practice, we ran the duration regressions using Stata's `streg` command, assuming that $\lambda_0(t)$ follows a Weibull distribution that allows for either positive or negative duration dependence.[11] We mostly found negative duration dependence (in other words, the probability of "failure" is high at the beginning and declines over time) , reflecting the fact that there are many short spells and less intermediate and even less long spells. The main results are robust to other distributional assumptions.

[10] In duration analysis text treatment such as Wooldridge, Chapter 20.4.2, the first assumption is made, via the assumption that the time varying covariates are constant in each time period.

[11] A spell ID variable was created, as well as dummy variables for the beginning and ends of spells. To take account of the fact that a downbreak, by construction, cannot happen until 5 years into a spell at the earliest (a consequence of our interstitiary period), we created a dummy variable defining the notional start of the spell as the true start year plus four years. The data was set in survival time format using the Stata `stset` command using these variables (`stset year, id(spell_id) fail(stop) origin(startplus4))`

C. Results

As discussed above, we proceeded sequentially, examining first the role of external shocks, then of institutions and variables related to social conflict (income distribution and ethnic heterogeneity), and then a variety of other, policy related indicators, using some of the previous variables as controls. This sequence is motivated by the idea that external shocks, institutions and social heterogeneity are causally "deeper" than policies in the sense that they affect the economy both directly and through their effects on policies. Hence, omitting policies in a model that accounts for shocks, institution and inequality/heterogeneity merely changes the interpretation of the results (as direct and indirect effects of shocks/institutions/heterogeneity are combined), but does not misspecify the model. In contrast, omitting shocks/institutions/heterogeneity from a model with policy variables may result in a misspecification, to the extent that these are correlated with the "deeper" factors that are ignored in the model.

External Shocks

We focus on the two most basic external shocks: changes in the terms of trade, measured either to include only goods or goods and services; and changes in US interest rates, to reflect international interest shocks. We include first and second lags of terms of trade shocks (measured as year-to-year percentage changes) to give the model some flexibility with regard to the timing of the effect of the terms of trade, and first lags for US interest changes. As an alternative, we ran the same regression using a 0-1 dummy variable for large hikes in the U.S. federal funds rate instead of continuous changes in U.S. market rates (see Becker and Mauro, 2006). Table 4 shows the results from running these model on our basic four data samples: for growth spells based on breaks identified at the p = 0.1 and 0.25 level; and for interstitiary periods of 5 and 8, respectively.

As is standard in survival analysis, the table shows *exponentiated* regression coefficients. These can be interpreted as "hazard ratios": as the factor by which the hazard rate increases when the covariate increases by one unit. For example, a hazard ratio of 1.1 means that a unit change in the regressor increases the risk of a growth downbreak in the next period by 10 percent. A hazard ratio of 1 means there is no effect, and a hazard ratio of less than one denotes a "protective effect". The p-values shown below the hazard ratios (expressed in scientific notation; for example, 4.3E-02 means 0.043) refer to the test that the hazard ratio equals 1. Here and in the remainder of the paper, we use the convention that hazard ratios that are significantly different from 1 at the 5 percent level or less are denoted in bold; hazard ratios significant at the 10 percent but not 5 percent level in bold and italics.

Table 4. Duration Regressions: External Shocks 1/
(hazard ratios and *p* values shown)

Model	Variable	5 year minimum spell: $p_{BR} = 0.1$	5 year minimum spell: $p_{BR} = 0.25$	8 year minimum spell: $p_{BR} = 0.1$	8 year minimum spell: $p_{BR} = 0.25$
1	Terms of trade growth 2/	**0.98**	**0.98**	***0.97***	1.00
		4.3E-02	**3.3E-02**	***7.5E-02***	9.9E-01
	US Interest Rate Change 3/	0.92	0.90	0.89	0.90
		3.4E-01	9.6E-02	4.1E-01	3.3E-01
	First Lag	**1.29**	**1.26**	**1.51**	**1.43**
		1.2E-02	**1.9E-03**	**9.8E-03**	**4.1E-03**
	Spells/failures	88/45	139/84	55/18	82/32
2	Terms of trade growth 2/	**0.98**	**0.98**	**0.96**	0.99
		4.2E-02	**4.9E-02**	**2.1E-02**	5.9E-01
	US Interest Rate Shock 4/	1.84	1.57	**3.29**	***2.39***
		1.8E-01	1.7E-01	**4.5E-02**	***6.1E-02***
	Spells/failures	69/38	112/75	35/15	56/29

1/ Survival time regressions based on spells using growth cutoff $g = 2$ percent. All regressions control for initial income per capita.
2/ Expressed in percentage points; increase means terms of trade improvement.
3/ Change in the average annual 3 month treasury bill rate, in percentage points.
4/ Federal Funds rate hike of at least 150 basis points in the previous year.

As expected—given Rodrik (1999) and related work—external shocks seem to increase the risk that growth spells will end. For the terms of trade, a hazard ratio of 0.97-0.98 means that a one percent improvement in the terms of trade will reduce the probability of a growth downbreak by 2-3 percent (though the effect is not precisely estimated, and does not show up in one of our four samples). We also find a very large and significant effect of U.S. interest rate changes on duration: depending on the sample, a one percentage point (100 basis point) increase in U.S. rates is estimated to increase the probability that a growth spell will end in the next year by 25-50 percent. Using the Becker-Mauro dummy for large hikes in the U.S. Federal Funds rate leads to broadly consistent results, though the estimates are much less precise.

Democratic Institutions and Inequality

Controlling for terms of trade shocks and US interest shocks, we next examine the effect on duration of some institutional indicators and two measures of heterogeneity: economic, proxied by the Gini coefficient, and a measure of ethnic heterogeneity. The question is whether more democratic or more homogenous societies can "keep growth spells going" for a longer time (Table 5).

Table 5. Duration Regressions: Political Institutions and Inequality 1/
(hazard ratios and *p* values shown)

Model	Variable	5 year minimum spell		8 year minimum spell	
		$p_{BR} = 0.1$	$p_{BR} = 0.25$	$p_{BR} = 0.1$	$p_{BR} = 0.25$
1	Executive constraints (Polity IV database)				
	Initial level	0.87	0.92	0.73	**0.73**
		2.6E-01	3.0E-01	1.2E-01	**2.5E-02**
	Change within spell	0.98	0.94	0.87	0.85
		8.6E-01	4.7E-01	3.6E-01	1.8E-01
	Spells/failures	49/24	84/49	35/13	50/25
2	Democracy (Polity IV database)				
	Initial level	0.98	**0.96**	1.02	1.01
		2.1E-01	**4.0E-05**	5.7E-01	6.9E-01
	Change within spell	**0.99**	**0.98**	***0.99***	**0.98**
		9.9E-02	**1.6E-03**	***7.2E-02***	**4.0E-02**
	Spells/failures	66/34	107/66	41/16	63/29
3	Inequality (Gini Coefficient)				
	Initial level	**1.13**	**1.05**	***1.14***	1.04
		3.9E-03	**2.3E-02**	***5.3E-02***	2.0E-01
	Change within spell	1.05	0.99	0.93	0.95
		3.7E-01	8.7E-01	3.3E-01	2.8E-01
	Spells/failures	30/13	62/36	21/6	31/14
4	Inequality (Gini Coefficient)	**1.12**	**1.04**	**1.10**	***1.05***
		8.5E-05	**2.4E-02**	**1.8E-02**	***7.1E-02***
	Spells/failures	44/20	81/51	29/10	42/21
5	Ethnic heterogeneity (Easterly)	1.00	1.00	1.00	1.00
		8.5E-01	7.9E-01	5.2E-01	7.8E-01
	Spells/failures	78/40	127/76	49/17	78/32

1/ Survival time regressions based on spells defined using growth cutoff of $g = 2$ percent. Regressions control for terms of trade shocks, US interest changes, and initial income.

Table 5 carries two main messages. First, the association between duration of growth spells and measures of political institutions such as executive constraints—famous from the work of Acemoglu, Johnson and Robinson (2000) and other studies on growth and institutions—is surprisingly weak. The same applies to the "polity" index, which measures political participation. While the coefficients of these regressors usually have the expected signs, they are rarely statistically significant. The main exception, shown in the second regression model summarized in Table 5, is democratization *within spell*. While the initial level of democratization appears to be irrelevant for duration in most samples—reflecting the fact that both initially democratic societies (e.g. in high income countries) and non-democratic societies (e.g. in emerging Asia) have experienced long growth spells, the results seem to suggest that societies that are able to democratize over the course of a growth spell are more likely to keep growth going. Note, however, that the effect is economically small: a one point increase in the democracy index—measured on a scale from 1 to 10, where 1 is least democratic—leads to a reduction in the hazard rate by 1-2 percent.

The second message of Table 5 is that there is a large and statistically significant association between income inequality and duration. A one percentage point higher Gini, according to the table, lowers the hazard that growth will end in any given year by 4 to 14 percent. Since the cross-sectional standard deviation of the Gini in our sample in 2000, for example, was over 10 percentage points, this is an enormous effect. Note that, unlike democratization, all the action comes from cross-sectional differences in initial levels of the Gini; "within spell" changes in the Gini are estimated very imprecisely (which is perhaps not surprising, given the high persistence of the Gini over time) and do not have statistically significant effects.[12] Model 4 shows that the effect is largely preserved if one simply includes the contemporaneous Gini into the model, rather than distinguishing between Ginis at time zero and changes in the Gini. This is important because controlling for the contemporaneous Gini only allows us to work with a large sample, that includes a number of extra spells for which initial Ginis were not available.

Finally, a measure of ethnic heterogeneity—available as a cross-sectional variable only—seemed to have no statistically significant effect on the hazard rate.

Education and Health

Controlling for the effect of terms of trade shocks, US interest rates changes, and the contemporaneous Gini coefficient, we next show the effects of a variety of education and health indicators in the model (Table 6).

Table 6 shows that although the coefficients have the "right sign," there are no significant associations between education measures and the duration of growth spells. The possible exception is within-spell improvements in primary education, particularly when one does not control for the Gini coefficient (not shown), which has the effect of increasing the regression samples by about 25 percent.

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[12] Year-to-year Gini proxies were obtained by linearly interpolating the Gini's contained in the comprehensive WIDER 2a database of worldwide income inequality (June 2005). The mismeasurement resulting from this linear interpolation may be another reason why no within-spell changes in the Gini appear to have not effect.

Table 6. Duration Regressors: Education and Health 1/
(hazard ratios and p values shown)

		5 year minimum spell		8 year minimum spell	
Model	Variable	$p_{BR} = 0.1$	$p_{BR} = 0.25$	$p_{BR} = 0.1$	$p_{BR} = 0.25$
1	Primary Education (Barro-Lee; years)				
	Initial level	0.90	0.74	0.36	***0.45***
		7.6E-01	1.5E-01	1.9E-01	***5.6E-02***
	Change within spell	0.57	0.78	***0.09***	**0.21**
		3.7E-01	5.1E-01	***9.1E-02***	**2.1E-02**
	Spells/failures	31/15	56/31	18/6	26/12
2	Secondary Education (Barro-Lee; years)				
	Initial level	0.46	0.53	0.04	**0.03**
		4.0E-01	1.8E-01	1.0E-01	**3.3E-02**
	Change within spell	2.13	1.07	0.30	**0.03**
		1.5E-01	8.7E-01	5.0E-01	**2.9E-02**
	Spells/failures	31/15	56/31	18/6	26/12
3	Infant mortality (deaths per 100 births)				
	Initial level	1.10	**1.09**	**1.64**	**1.39**
		4.3E-01	**6.2E-02**	**4.0E-02**	**1.6E-03**
	Change within spell	**1.51**	**1.36**	1.16	***1.37***
		4.5E-02	**1.7E-02**	5.6E-01	***5.4E-02***
	Spells/failures	37/16	68/41	23/7	31/13
4	Adult mortality (males; deaths per 100)				
	Initial level	0.99	**1.04**	1.08	1.06
		8.2E-01	**2.5E-02**	3.1E-01	1.4E-01
	Change within spell	1.02	1.02	1.11	1.02
		6.4E-01	6.4E-01	3.3E-01	7.0E-01
	Spells/failures	36/15	65/39	21/5	29/11

1/ Based on spells defined using growth cutoff of $g = 2$ percent. Regressions control for terms of trade shocks, US interest changes, income inequality, and initial income.

The results for health are a bit stronger: in particular, there seems to be a positive association between child mortality and the hazard that a growth spells will end (even controlling for income inequality and initial income). However, the coefficients are very imprecisely estimated, and the point estimates are not robust across subsamples, with implausibly large effects for the (very small) $h = 8$ samples. When the Gini coefficient is dropped as a control, the sample sizes almost double, and the estimated hazard rates in the $h = 5$ and $h = 8$ samples become much closer aligned, in the range of 1.08 to 1.15. Hence, an increase in infant mortality by one death per 100 is estimated to increase the hazard that a growth spell will end by about 10 percent per year.

Trade, Competitiveness, and the Current Account

Trade and openness have traditionally been linked to growth performance. More recently, a set of papers by Aizenman, Pinto, and Radziwill (2004), Rajan and Subramanian (2005), Johnson, Ostry and Subramanian (2006), and Prasad, Rajan, and Subramanian (2006) has focused specifically on the role of domestic financing, current account surpluses, exports, and competitiveness on long term growth. One idea in this literature is that development strategies led by manufacturing exports might be successful even when other factors—including the quality of broad institutions—are initially inhospitable (as was the case in Asia). Manufactured exports may help create a middle class which acts as a constituency for reforming or improving broad institutions, which in turn propels growth. Domestic savings could be an important channel for sustaining accelerations because they reduce reliance on foreign capital which can in turn cause bouts—often extended bouts—of exchange rate overvaluation, undercutting prospects for exports.

Table 7 shows associations between duration and both traditional variables (trade liberalization and openness) and the variables stressed by the most recent literature. Because of small sample sizes, we drop the Gini as a control but we retain the remaining controls. We will return later to the issue of robustness in the presence of other regressors.

The results are as follows. First, we find a significant and very large effect of *trade liberalization*—regardless of whether this occurred before or within a spell. Roughly speaking (and bearing in mind that we are controlling only for external shocks and initial income at this point) countries that have liberalized trade appear to enjoy an 80 percent reduction in the hazard that a growth spell will end. This effect does not fully carry over to *openness*, however (regardless of whether adjusted or unadjusted measures of openness are used). Although openness appears to have a protective effect, it is small and statistically significant only in one of our four samples (namely, for $h = 8$ and $p = 0.1$). Similarly, overvaluation appears to affect duration adversely at least on the samples that exclude high frequency breaks, i.e. imposing $h = 8$. On these samples, each percentage point of overvaluation increases the hazard that a growth spell will end next period by 1-2 percent.

Consistent with the ideas of Johnson, Ostry and Subramanian (2006), we find a robust effect of *export structure* on duration. Although the initial export structure does not appear to matter, countries that manage to increase their share of manufacturing exports after growth has taken off enjoy a higher chance that growth will continue. A one percentage point increase in the share of manufacturing exports in total exports reduces the chance that a growth spell will end next year for 2-4 percent.

Table 7. Duration Regressors: Trade, Competitiveness, and the Current Account 1/
(hazard ratios and *p* values shown)

Model	Variable	5 year minimum spell		8 year minimum spell	
		$p_{BR} = 0.1$	$p_{BR} = 0.25$	$p_{BR} = 0.1$	$p_{BR} = 0.25$
1	Trade Liberalization (Wacziarg-Welch Dummy Variable)				
	Initial level	**0.26**	**0.21**	**0.31**	**0.17**
		5.9E-03	**1.1E-05**	**1.1E-01**	**1.5E-03**
	Change within spell	**0.21**	**0.32**	**0.12**	**0.26**
		3.1E-04	**5.7E-04**	**5.7E-03**	**4.9E-03**
	Spells/failures	60/33	102/66	36/15	57/29
2	Openness (PWT, adjusted for structural characteristics)				
	Initial level	0.99	1.00	**0.98**	0.99
		3.2E-01	3.6E-01	**4.5E-02**	1.8E-01
	Change within spell	0.99	0.99	**0.97**	0.99
		1.4E-01	1.5E-01	**2.5E-02**	1.2E-01
	Spells/failures	74/34	118/64	49/15	73/25
3	Overvaluation (residual of cross-sectional regressions of price levels on PPP GDP per capita				
	Initial level	1.00	1.00	1.01	**1.01**
		8.0E-01	3.4E-01	4.5E-01	**8.9E-02**
	Change within spell	1.00	1.00	**1.01**	**1.02**
		7.9E-01	4.4E-01	**2.0E-02**	**5.3E-03**
	Spells/failures	81/40	128/76	49/18	78/33
4	Manufacturing exports/Total exports (percent, WDI)				
	Initial level	0.99	0.99	1.00	0.99
		2.5E-01	1.5E-01	9.3E-01	2.9E-01
	Change within spell	***0.98***	**0.98**	**0.96**	**0.98**
		6.8E-02	**3.9E-02**	**2.0E-02**	**2.9E-02**
	Spells/failures	41/23	71/42	28/13	44/20
5	Current Account Balance (percent of GDP, WDI and IFS)				
	Initial level	0.95	0.93	0.84	0.88
		5.1E-01	2.1E-01	2.2E-01	2.8E-01
	Change within spell	0.95	**0.90**	**0.76**	**0.84**
		4.6E-01	**1.8E-02**	**6.5E-03**	**2.9E-02**
	Spells/failures	28/11	54/25	23/6	32/7
6	Domestic Savings (percent of GDP, WDI)				
	Initial level	0.98	0.98	0.97	1.00
		4.7E-01	1.5E-01	4.4E-01	9.3E-01
	Change within spell	0.99	0.99	***0.92***	1.00
		6.4E-01	3.6E-01	***7.9E-02***	9.9E-01
	Spells/failures	54/26	94/51	32/11	52/19

1/ Based on spells defined using growth cutoff of $g = 2$ percent. Regressions control for terms of trade shocks, US interest changes, and initial income.

Finally, running a *current account surplus* seems to increase the chance that growth will be sustained. As in the case of export structure, what seems to matter here is not so much whether a country enters into a growth spell in surplus, but whether it manages to raise its surplus (or lower its current account deficit) in the course of a growth spell. Every percentage point of GDP increase in the current account balance lowers the risk that the spell will end next year by 10-20 percent. We also find that the hazard ratios associated with *domestic savings* are consistently below 1, though the are not statistically significant.

Although these findings appear to be broadly consistent with each other—supporting the notion that export-orientation is good for long-term growth—they are obviously amenable to many interpretations. For example, current account surpluses could be associated with longer growth spells because they indicate a dynamic export sector; because they imply greater reliance on domestic than foreign financing, because they make the economy less crisis-prone, or because they tend to strengthen constituencies that are likely to support economic reforms in other areas. Table 5 suggests that export orientation and competitiveness are perhaps more important than openness and integration *per se*; but our results are not crisp enough to discriminate between these channels.

It is also interesting to note that several variables related to competitiveness, openness, and the source of financing "work better" on the $h = 8$ than the $h = 5$ samples. In other words, variables related to openness, and the source of financing, may not explain why growth in many lower-income developing countries—particularly in Africa—has been so choppy, but they may help explain the *really* long growth spells that we have seen in East Asia and some countries of the industrial world.

Macroeconomic Stability

We now examine the relationship between duration and two traditional indicators macroeconomic volatility: inflation, and nominal exchange rate depreciation. We use the traditional log transformation for inflation and exchange rate depreciation, multiplied by 100 to make the hazard ratios easier to interpret (i.e., our inflation measure is $100*\ln(1+\pi)$, where π is the log difference of the price level). We could have used $\ln(\pi)$ instead, which some authors (Sarel, 1996; Ghosh and Phillips, 1998) have argued is more appropriate to study the effect of inflation on growth. However, this transformation would not have worked for exchange rate depreciation (negative depreciations, i.e. appreciations, being very common in our sample) and we wanted to use the same transformation for both inflation and depreciation to make the coefficients comparable, and the results for inflation turn out to be insensitive to the choice of transformation in this case.

The main result is that nominal instability—inflation or depreciation—appears to be a statistically and economically significant risk factor for growth spells. Depending on the sample, the results for inflation suggest that a one point increase in $100*\ln(1+\pi)$ leads to a 1-4 percent increase in the risk of a downbreak in growth. At low inflation rates, $100*\ln(1+\pi)$ is approximately linear, so that one percentage point in inflation is about the same as a one point rise in 100*ln(1+π). Suppose for example that inflation rises from 10 percent a year to about 50 percent. This is the same as a rise in 100*ln(1+π) by about 30 points, which implies a increase in the annual risk that a growth spell will end by up to 120 percent relative to the baseline risk. For a depreciation in the exchange rates, the effect is even higher, with a one point increase leading to an increase in risk by 2-6 percent.

Table 8. Duration Regressors: Macroeconomic Volatility
(hazard ratios and *p* values shown)

Model	Variable	5 year minimum spell		8 year minimum spell	
		p_{BR} = 0.1	p_{BR} = 0.25	p_{BR} = 0.1	p_{BR} = 0.25
1	Log (1+inflation)				
	Initial level	1.00	1.00	1.02	**1.04**
		6.8E-01	8.9E-01	5.5E-01	**5.0E-02**
	Change within spell	**1.01**	**1.01**	1.03	**1.04**
		1.9E-02	**9.1E-03**	4.1E-01	**6.2E-02**
	Spells/failures	82/43	133/79	51/18	81/33
2	Log(1+depreciation in the parallel exchange rate)				
	Initial level	***1.01***	***1.01***	**1.06**	**1.05**
		6.0E-02	***6.0E-02***	**2.3E-02**	**8.2E-04**
	Change within spell	**1.02**	**1.02**	**1.03**	**1.03**
		3.1E-02	**3.3E-04**	**4.5E-02**	**9.2E-03**
	Spells/failures	33/16	54/33	22/9	30/18
3	Log(1+moderate inflation) 2/				
	Initial level	**1.07**	**1.06**	1.08	**1.07**
		7.8E-03	**1.9E-03**	1.1E-01	**2.1E-02**
	Change within spell	***1.04***	**1.05**	1.03	***1.04***
		5.1E-02	**7.6E-04**	4.5E-01	***9.9E-02***
	Spells/failures	75/41	126/76	46/18	75/32

1/ Based on spells defined using growth cutoff of *g* = 2 percent. Regressions control for terms of trade shocks, US interest changes, and initial income.
2/ Observations with inflation in excess of 50 percent per annum replaced by missing values.

One important question is whether the strong results we obtain for inflation and exchange rate depreciation are driven by outliers, as has recently been argued in the context of conventional cross-country growth regressions (Easterly, 2005). To check this, we drop all observations from the sample in which either current or initial inflation/depreciation exceeded 50 percent per annum (this means dropping all observations in spells where inflation/depreciation at the beginning of a growth spell exceeded 50 percent, even if contemporaneous inflation/depreciation was lower). The results (model 3 in Table 8) show that this has no effect on our basic result; indeed, the hazard ratios are now even larger than before. Hence, the inflation result is not driven by hyperinflation, supporting the view that even moderate "inflation might be hazardous to your growth" (Ghosh and Phillips, 1998).

A Summary View

Having concluded our tour of the main covariates that can be usefully analyzed with our data, it is important to see whether the effects hold up if they are jointly included in the model. Specifically, there is a sense that several variables that happen to be positively associated with duration—income inequality, current account surpluses, competitive exchange rates, and macroeconomic stability, for example—may be reflecting the differences between the Asian experience and that of other developing countries. The question is whether these variables are merely proxying for Asia, or whether they have independent power to predict longer growth spells.

As discussed before, the extent to which we can examine the covariates of growth spells jointly is limited by data availability. However, it is possible to include at least some variables from each of the groups examined in a way that maintains a reasonable sample size. The results are shown in Table 9.

Table 9. Summary Regression
(hazard ratios and *p* values shown)

	5 year minimum spell		8 year minimum spell	
Variable	$p_{BR} = 0.1$	$p_{BR} = 0.25$	$p_{BR} = 0.1$	$p_{BR} = 0.25$
Log (1+inflation)	1.01	1.00	1.05	1.00
	1.4E-01	3.0E-01	2.7E-01	6.1E-01
Inequality (Gini Coefficient)	**1.16**	1.03	**1.14**	**1.10**
	3.7E-05	2.5E-01	**4.4E-02**	**3.3E-03**
Democratization (change within spell)	**0.98**	**0.98**	0.99	**0.97**
	1.1E-02	**2.4E-03**	4.6E-01	**5.0E-03**
Trade Liberalization	0.92	***0.40***	0.48	**0.18**
	9.0E-01	***5.6E-02***	4.5E-01	**1.3E-02**
Overvaluation	1.01	**1.01**	1.01	**1.02**
	5.9E-01	**1.2E-02**	4.6E-01	**3.8E-03**
Infant Mortality (per 100)	1.09	0.96	1.12	***1.18***
	5.1E-01	5.4E-01	6.5E-01	***7.7E-02***
Terms of Trade Change (percent)	0.97	0.98	0.97	1.01
	1.1E-01	1.9E-01	3.4E-01	2.8E-01
U.S. Interest Rate Change (points)	1.30	**1.34**	1.22	***1.31***
	1.2E-01	**1.2E-02**	4.3E-01	***7.2E-02***
Initial Income Per Capita (in thousands)	1.10	1.06	**1.63**	**1.27**
	6.5E-01	2.4E-01	**4.1E-02**	**3.2E-02**
Spells/failures	37/18	69/40	26/10	40/21

1/ Based on spells defined using growth cutoff of $g = 2$ percent.

As expected, the joint inclusion of many variables weakens some of the individual results, and two variables—terms of trade changes, and inflation—loose statistical significance (the same happens if exchange rate depreciations are included in the model instead of inflation).

Most other variables, however, retain their statistical and economic significance at least on some samples. The most robust predictors of duration are income distribution and democratization, followed by overvaluation and trade liberalization (other trade related variables such as the current account or the ratio of manufacturing to GDP cannot be examined in Table 9 because the sample would shrink too much). For these variables, the hazard ratio estimates are broadly unchanged from the associations examined before.

IV. Conclusion

This paper builds on the emerging literature on growth transitions by moving the object of inquiry to the duration of periods of sustained growth. Using an extension of Bai and Perron's (1998, 2003) approach to testing for multiple structural breaks, we identified a rich set of structural breaks in economic growth paths around the world, and used these to define "growth spells." We then used survival analysis to tentatively explore a large number of potential economic factors that might be influencing the length of growth spells.

The paper identified a handful of economic and political characteristics that appear to sustain growth: more equal income distribution, a tendency to democratize over time, liberal trade regimes, and competitive exchange rates. We also found that stable macroeconomic environments, with lower inflation rates and fewer instances of high depreciation, are conducive to longer growth spells. However, these associations lose significance in the presence of the previously named variables and external shocks, suggesting that macroeconomic instability may be a symptom of deeper characteristics with direct effects on growth, rather than an independent factor.

While we have not gone much beyond pointing out basic associations and regularities in the data, our findings seem consistent with several themes arising from recent work on the political economy of development and growth. These include the view that export orientation may help growth by helping constituencies in favor of building better institutions (Johnson, Ostry, and Subramanian, 2006; Rajan and Zingales, 2005); that more equitable and "cohesive" societies build better institutions which in turn produce higher growth (Easterly, Ritzen and Woolcock, 2005), or that more cohesive societies are better at managing external shocks (either directly or through better institutions, as argued by Rodrik, 1999). Exploring and differentiating these channels remains a task for future work.

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