The Dynamics of **Economic Growth**

A Visual Handbook of Growth Rates, Regimes, Transitions and Volatility
The Effective States and Inclusive Development Research Centre (ESID)

The Effective States and Inclusive Development Research Centre (ESID) is a network of researchers and policy partners in Bangladesh, Ghana, India, Malawi, Rwanda, South Africa, Uganda, the UK, the USA and other countries. ESID researchers are working together to investigate what kinds of politics help to secure inclusive development and how these can be promoted. ESID is funded by the UK Department for International Development (DFID) and is led from the School of Environment and Development and the Brooks World Poverty Institute at the University of Manchester, UK.

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The Dynamics of Economic Growth: A Visual Handbook of Growth Rates, Regimes, Transitions and Volatility

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List of Symbols and Abbreviations

Abbreviations

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<tr>
<td>BP</td>
<td>Bai-Perron</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>PWT</td>
<td>Penn World Tables</td>
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<tr>
<td>GDPPC</td>
<td>Gross Domestic Product Per Capita</td>
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<tr>
<td>MA</td>
<td>Moving Average</td>
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<td>OLS</td>
<td>Ordinary Least Squares</td>
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<td>ppa</td>
<td>Percent per annum</td>
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<td>SD</td>
<td>Standard Deviation</td>
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Symbols

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<td>Ln</td>
<td>Natural Log</td>
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<tr>
<td>g</td>
<td>Average Annual Growth Rate</td>
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<td>R²</td>
<td>Co-Efficient of Determination</td>
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<tr>
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<td>Δg</td>
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## List of Country Codes

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Acknowledgements

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Abstract

Why there are such significant and persistent differences in living standards across countries is one of the most important and challenging areas of development policy. In spite of a voluminous literature on the causes of economic growth, we still have a long way to go in understanding why the growth experiences of countries differ so much, why growth changes so much (for good and ill) over time, and why only a handful of developing countries have seen their incomes converge to the levels observed in developed countries. To understand the causes of economic growth, we first need to understand what growth is. Much of the focus in the academic and policy literature on “growth” has been on steady-state or long-run average rates of growth of output per capita, or equivalently, comparing levels of income. But the focus on one single growth rate for a particular country misses the point that most countries observe dramatic changes in their growth of per capita income. We present visually the dynamics of the growth experiences of 125 countries. The graphs themselves (and embedded numeric information) highlight the key point that we would like to convey in this Handbook – that economic growth is dynamic and episodic and that many countries have gone through very different growth phases. We identify the timing and magnitude of “breaks” or “episodes” or “regime transitions” for all our 125 countries from the application of a standard statistical procedure. Viewing economic growth as transitions across growth phases would imply that we would need to move beyond current approaches to growth, and that new “third generation” theoretical models and empirical methods would need to be developed to understand what determines economic growth.
Part I

Economic Growth: Getting the Question Right
Is there some action a government of India could take that would lead the Indian economy to grow like Indonesia’s or Egypt’s? If so, what, exactly? If not, what is it about the “nature of India” that makes it so? The consequences for human welfare involved in questions like these are simply staggering: once one starts to think about them, it is hard to think about anything else.

ROBERT E. LUCAS 1988

Part I: Economic Growth: Getting the Question Right

Why are there such significant and persistent differences in living standards across countries? This is one of the most important and challenging areas of development policy. These differences arise primarily due to different rates of economic growth across countries. In spite of a voluminous literature on the causes of economic growth: it is still “hard to think about anything else”. We still have a long way to go in understanding why the growth experiences of countries differ so much, why growth changes so much (for good and ill) over time, and why only a handful of developing countries have seen their incomes converge to the levels observed in developed countries – and “what, exactly” could be done about it.

To understand the causes of economic growth, we first need to understand what growth is. Much of the focus in the academic and policy literature on “growth” has been on steady-state or long-run average rates of growth of output per capita, or equivalently, comparing levels of income (e.g. Barro, 1991, 1996, 1997; Acemoglu et al., 2001, 2002; Hall and Jones, 1999). But the focus on one single growth rate for a particular country misses the point that most countries observe dramatic changes in their growth of per capita income.

Lucas’s concern that slow growth might be the “nature of India” reflected the possibility India was trapped in the so-called “Hindu rate of growth”. But it wasn’t the “nature of India” to grow slowly. But, only a few years after he wrote, India came out of an incipient macroeconomic crisis in 1991. From 1991 to 2010, GDP per capita grew at a pace of 4.8 percent per annum (ppa) compared with the pace of 2.5 percent from 1970 to 1991. GDP in 2010 was USD 1.45 trillion higher than had the previous pace continued (calculation
based on 2005 international currency units of the Penn World Tables 7.1) and the cumulative output gain of the higher growth trajectory of 1991-2010 versus 1970-1991 was over USD 8 trillion. Staggering indeed!

Long-run growth averages within countries, therefore, mask distinct periods of success and failure (Easterly et al., 1993; Ben-David and Papell, 1998; Pritchett, 2000; Jones and Olken, 2008; Jerzmanowski, 2006; Kerekes 2012). While the growth process of all “developed” economies is well characterized by a single growth rate and a “business cycle” around that trend (at least until the recent crises) – this is not true for most countries in the world (Aguiar and Gopinath, 2007). Massive discrete changes in growth are common in developing countries. Most developing countries experience distinct growth episodes: growth accelerations and decelerations or collapses (Rodrik, 1999, 2003; Hausmann et al., 2006; Aizenman and Spiegel, 2010). For policymakers, and business people too, what matters is not the infinite horizon level, but what will happen to output growth in the medium term (five to ten years), when economic growth is unstable and highly unpredictable in most countries (Pritchett and Werker 2012).

This Handbook describes visually in graphs (and numbers) the dynamics of the growth experiences of 125 countries. We use the chained real Gross Domestic Product (GDP) per capita (“rgdpch”) from the Penn World Tables (PWT) version 7.1 for each country for the years available (with the earliest starting year being 1950, and the ending year for all countries being 2010). For each country, we provide a set of eight exactly comparable graphs; each captures some essential features of the dynamics of economic growth. The emphasis is on a visual presentation of the varied experiences of economic growth across the world and we avoid tables to give the reader (viewer) a feel of growth. The graphs themselves (and embedded numeric information) highlight the key point that we would like to convey in this Handbook – that economic growth is dynamic and episodic and that countries have gone through very different growth phases.

Our objective here is ‘to get the question right’ – what are the empirical phenomena to be explained by a theory and empirics explaining ‘economic growth’? By presenting graphs that summarize the evolution of output per capita in a variety of ways we show that the phenomenon of “growth” to be explained is much more than just a single “growth rate”. But we consciously do not propose any “answers” – we are scrupulously free of any assertions about the “causes” of any aspect of growth. Our goal is to describe adequately the “Left Hand Side” – the level and time evolution of GDP per capita. We deliberately do not present any “Right Hand Side” as correlates (much less assert these are “determinants”) of the dynamics of economic growth.

The rest of the Handbook is in three parts.

Part II presents visually the stylized facts of economic growth. For each of 125 countries we present four exactly comparable graphs that summarize different aspects of the growth experience and are a visual rendition of standard summary statistics (growth, growth by decade, volatility of growth, comparison with world average growth, etc.). Our value added is comparability, as we solve the prosaic, but surprisingly unaddressed, problem that, since nearly all graphs of GDP per capita adjust the vertical and horizontal scales to the data of the particular country, the visual “slope”

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1 There is a vast literature on the so-called ‘growth empirics’ which are studies on the causes of growth. A few examples: Edwards (1993) and Rodriguez and Rodrik (2001) on trade; Levine (1997) on finance; Barro and McCleary (2003) on religion; Hausmann et al. (2007) and Hidalgo et al. (2007) on product space; and Jones and Olken (2005) on political leadership.
The graphs is not comparable. In fact, the automatic adjustments of the scale of the vertical axis done by nearly all spreadsheets or statistical programs cause countries with 1 percent, 3 percent and 5 percent growth to look exactly alike.

In Part III, we provide more structure and examine “breaks” in growth. We do this by implementing a modified version of a statistical method (Bai-Perron) that is commonly used to identify breaks in the GDP per capita series. Using this method, we demarcate each country’s growth experience into distinct growth phases and present our results graphically. The graphs show that economic growth in many countries has apparently discrete and quantitatively massive transitions between periods of high growth, periods of negative growth, and periods of stagnation. Further, we establish when these periods started and ended, and what have been the magnitudes of GDP per capita change in each of these episodes. We also highlight the common features of the growth experiences of very disparate countries – features that a focus only on a single time-averaged growth rate, or even that allow growth to vary in units of decades (e.g. 70s vs 80s), miss.

Our view is that we are moving into a “third generation” of growth research. First generation growth theory was Solow-Swan and its variants (Solow, 1956; Barro et al., 1995; Barro and Sala-i-Martin, 1992, 1995, 1997; Jones, 1997; Mankiw et al., 1992; Sala-i-Martin, 1996a, 1996b). The “second generation” had a theoretical and empirical component. The “endogenous growth” models provided theoretical models with interesting comparative dynamics of steady state growth rates by endogenizing technical change (Romer, 1986, 1990, 1993; Lucas, 1988; Aghion and Howitt, 1992; 2009; Helpman, 2004). The “second generation” of empirics started with Barro (1991) type regressions and progressed from throwing every conceivable variable on the “Right Hand Side” (e.g. Sala-i-Martin’s 1997 ‘four million’ regressions) to using more sophisticated panel data methods and more careful and robust selection of the set of instrumental variables (Islam, 1995; Jones, 1995; Levine and Renelt, 1992). The “second generation” also included theoretical and empirical work on the levels of income (e.g. Hall and Jones, 1999) including the emphasis on the role of “institutions” in determining long-run levels/growth rates (e.g. Acemoglu et al., 2001, 2002, 2004; Acemoglu et al., 2003; North et al., 2009; Easterly and Levine, 1997; Rodrik et al., 2004).

But the principal variable of interest in theoretical and empirical “second generation” literature is the level of output or long-run or time-averaged growth rate of per capita output. As we conclude in Part IV, this visual Handbook shows that such a conceptualization of growth is not a complete description of the reality of economic growth in developing countries.2 Viewing economic growth as transitions across growth phases would imply that new “third generation” theoretical models and empirical methods would need to be developed to understand what determines economic growth. We hope that the next stage of research in economic growth will be to use a different set of Left Hand Side variables – including perhaps some we present in Part III of the Handbook.

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2 To be fair to our intellectual forbears in the “first generation” of theoretical work, Hicks in Capital and Growth (1965) pointed out the growth theory of the “comparative dynamics” of differences in steady state growth rates was the least relevant branch of economics to developing countries, as their growth dynamics were dominated by “catch up” growth and “structural transformation” that were clearly incompatible with “steady state” differences in dynamics in which, almost by definition, all key ratios of the economy had to be constant.
Part II

Section I: Everything You Always Wanted to Know About Growth
Part II: Section I: Everything You Always Wanted to Know About Growth

What are the stylized facts of economic growth? In this part, we present the summary features of economic growth using PWT 7.1 data on real GDP per capita for 125 countries, both developed and developing. Our sample contains all countries from PWT 7.1 which have data at least since 1970 and with a population in 2000 of over 700,000. These cut-offs exclude mostly the new countries formed after the breakdown of the Soviet empire (e.g. Tajikistan, Croatia), very small nation-states (mostly small oil-states, e.g. Bahrain, Brunei), small islands in the Caribbean (e.g. Bermuda) and Pacific (e.g. Tonga) and some countries, such as Kuwait and Saudi Arabia, for which PWT 7.1 GDP per capita data is only available from the mid-1980s.

In the following section, we present four graphs per country.

**Figure 1** presents the plot of natural log (Ln) GDP per capita (GDPPC) for the country. On the plot are shown the growth rates overall (all available data) plus overall the decadal and five-year growth rates (ten-year growth rates at the top of the line graph and five-year growth rates at the bottom of the graph). Unless otherwise specified, all reported “growth rates” are the coefficient from an OLS regression of ln(GDPPC) on a time trend over the specified period.3

The top left hand side of Figure 1 presents three summary statistics:

i) $g$ – the OLS growth rate over the available data.

ii) $R^2$ – the $R$-square of regressing ln(GDPPC) on a single time trend

iii) $\sigma_{\Delta Y}$ – the standard deviation of the annual log changes in GDPPC.

“The” growth rate ($g$) is the single number of “growth” and is conventionally used in single cross-section growth regressions (usually over some common period). The other two summary statistics provide a characterization of the temporal behaviour of the GDPPC series.

When growth is moderate and steady (e.g. Denmark $R^2=0.96$) or rapid (e.g. Thailand $R^2=0.98$) the $R^2$ is very high (well above 0.9). A lower $R^2$ suggests either very low growth (Senegal $R^2=0.1$, $g=0.1$) or that the time evolution of output is not well-summarized by a single trend line (Republic of Congo $R^2=0.6$ even with $g=1.6$).

3 There are of course many other ways of calculating a “growth rate” – one could take the annual growth rates (as log first difference) and average them, or one could calculate the total change endpoint to endpoint and compute the exponential growth rate that would have achieved that change, one could just take $N$-period ln differences and divide by $N$.

4 Of course the standard measure of “cyclical” volatility through a decomposition into “trend” and “deviation around a trend” presumes there is a stable “trend”, which, in our view, and as Aguiar and Gopinath (2007) emphasize, gets the cart before the horse by assuming that the “cycle” (which isn’t really a “cycle”) is not what determines the “trend”.
The standard deviation of the first differences of $\ln(GDPPC) - \sigma_{\Delta Y}$ is one measure of growth rate volatility. Developed economies tend to be quite stable by this measure (USA $\sigma_{\Delta Y} = 2.6$, Belgium $\sigma_{\Delta Y} = 2.3$), while developing economies have much higher volatility, almost always above 4, even in relatively stable middle income countries (Indonesia $\sigma_{\Delta Y} = 4.3$, Turkey $\sigma_{\Delta Y} = 5.4$) and reaching spectacular highs in unstable countries (Nigeria $\sigma_{\Delta Y} = 7.8$).

For all countries the horizontal and vertical axes are the same, so that the "eyeball slope" (vertical gain per horizontal movement) represents the same gain in $\ln(GDPPC)$ per unit time across all graphs. While the levels of GDPPC are not comparable across country graphs, each vertical axis has 2.1 log units (the absolute values of the y-axis are set for each country by placing the lowest value of the vertical axis .1 ln units below the minimum value of $\ln(GDPPC)$ for each country). The levels of GDP per capita in USD for each country at its minimum, maximum and median are indicated on the right axis. This common scaling does mean some countries have lots of “white space” and some countries (e.g. Taiwan, the Republic of Korea) have their graph disappear out the top. The advantage is that, unlike every other graph of economic growth you have ever seen, what looks steeper in one country than another really does represent a faster growth rate. It is not an artefact of compressing the horizontal (to years available) or vertical (to minimize white space or display all data) scales.

Table 1 presents a tabular overview of Figure 1 by classifying each of the 125 countries by (i) growth rate (above or below zero), (ii) volatility ($\sigma_{\Delta Y}$ above or below 3.0) and (iii) goodness of fit of a single time trend (weak fit, $R^2 < 0.5$, moderate fit, $0.9 > R^2 > 0.5$ and strong fit, $R^2 > 0.9$).

All 38 countries with weak fit ($R^2 < 0.5$) have high volatility ($\sigma_{\Delta Y} > 3.0$). As can be seen even in the simplest graph, and in more detail in the others, most of these countries exhibit very sharp and massive growth breaks and multiple growth regimes, often with strongly positive growth followed by negative growth. For instance, Ethiopia had moderate positive growth in the 1950s and 1960s, negative growth in the 1970s and 1980s, but has had rapid growth ($g = 5.4$) recently and hence has overall $g = 0.5$, $R^2 = 0.29$, and $\sigma_{\Delta Y} = 6.1$). While most of the 38 "weak fit" countries are Sub-Saharan African, there are countries from other regions as well, such as Albania and Poland from Eastern Europe, Iran and Jordan from the Middle East, and Papua New Guinea from the South Pacific and Bangladesh in South Asia. For countries where fit is weak, either (a) it makes little sense to think of representing the time evolution of output as a single growth rate for each country or (b) the single stable trend growth rate is very near zero (positive or negative).

The 10 of the 38 with weak fit, high volatility, and negative growth ($g < 0$) include conflict affected and “failing states” – Nicaragua, Afghanistan, Haiti and Iraq – but also non-conflict weak performers – Zambia, Nigeria, Togo.

In the 40 countries with moderate fit ($0 < R^2 < 0.9$) growth transitions and episodes are also pronounced and volatility is high (only 2 have $\sigma_{\Delta Y} < 3.0$ –

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5 Setting the vertical axes so that all countries – from the USA to Ethiopia – are on the same absolute scale causes nearly all countries to look like the same flat line, with little gain.

6 The vertical scale of 2.1 units means that countries with more than an 8.2 fold ($\exp(2.1))$ increase in GDPPC go out the top of the graph before reaching 2010. On the other hand, expanding the vertical scale for every country, so that the Republic of Korea and Singapore’s data would fit, caused most countries’ variations to nearly disappear.
Guatemala and South Africa, both at $\sigma_{\Delta Y} = 2.6$). The regional background of countries in this category is more mixed. We have countries from every region, including Asia and Europe. Greece, a (borderline) advanced economy, is here too. Many of these countries have moderate overall growth rates, but massive differences over time. Peru, for instance, had $g = 4.8$ in 2000-2010 but $g = -2.4$ in the 1980s. This is a range of decade growth rates of 7.2 ppa (compared with a standard deviation of decade growth rates across countries of only around 2 ppa).

Interestingly, three of the ‘miracle growth’ countries identified by the Commission for Growth and Development (2008) – Brazil, Japan and Oman – are in this category, which demonstrates just how much growth rates change over time. Brazil had $g = 5.5$ in the 1970s but $g = -0.1$ in the 1980s, Japan had among the most ‘miraculous’ growth rates of all time in the 1960s, $g = 8.8$, but tepid growth ($g = 0.6$) in the 1990s.

In this “moderate fit” category with $g < 0$ are states with sufficient economic decline to create a moderate fit around a negative trend, e.g. Liberia $g = -4.1$, Somalia $g = -1.8$, Niger $g = -1.4$, Madagascar $g = -1.1$.

The 14 countries with strong fit ($R$-square $> 0.9$) and low volatility ($\sigma_{\Delta Y} < 3.0$) include 12 developed countries, Colombia and, perhaps surprisingly, Pakistan. Note that stable growth at moderate rates is a “typical” pattern for rich industrial countries, but extremely rare among developing countries.

The 31 countries with strong fit, positive growth and high volatility are a mixed bag. The rapid catch up countries of the OECD (Spain, Finland, Ireland, Portugal) are here. So are the high performing East Asian countries (China, Indonesia, the Republic of Korea, Malaysia, Thailand, Taiwan, and Vietnam). But there are also countries from other regions – India, Sri Lanka and Nepal from South Asia, Botswana and Lesotho from Sub-Saharan Africa, Egypt, Morocco and Tunisia from the Middle East and North Africa, and Dominican Republic and Mexico from Latin America and the Caribbean.

Of course to have strong fit around a negative trend ($g < 0$) a country has to be a consistent basket case of growth. The Central African Republic has had negative growth in each of the last four decades.
### Table 1: Summary of Growth Experiences across the World

<table>
<thead>
<tr>
<th>$\sigma_{\Delta y} &gt; 3$</th>
<th>g &gt; 0</th>
<th>$\sigma_{\Delta y} &lt; 3$</th>
<th>g &lt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0 &lt; R^2 &lt; 0.5$</td>
<td>AGO, ALB, BDI, BGD, BOL, CIV, CMR, ETH, GAB, GHA, GUJ, IRN, JOR, KEN, LBN, MNG, MWI, NAM, PNG, POL, RWA, SEN, SLE, TCD, UGA, VEN, ZWE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0.5 \leq R^2 &lt; 0.9$</td>
<td>ARG, BEN, BFA, BGR, BRA, CHE, CHL, COG, CUB, DZA, ECU, FJI, GRC, HND, HUN, JAM, JPN, KHM, MLI, MOZ, MRT, MUS, OMN, PER, PHL, PRY, ROM, SDN, SLV, SWZ, SYR, TTO, TZA, URY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0.9 \leq R^2 &lt; 1$</td>
<td>AUT, BWA, CHN, CRI, CYP, DOM, EGY, ESP, FIN, HKG, IDN, IND, IRL, ISR, KOR, LAO, LKA, LSO, MAR, MEX, MYS, NPL, NZL, PAN, PRI, PRT, SGP, THA, TUN, TUR, TWN, VNM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2 presents a different view of growth by showing the level of each country's ln(GDPPC) relative to all other countries at its first year of data and in 2010 (with data starting in 1960 or 1970).

The diagonal lines demarcate different growth benchmarks. Since the axes are equal, zero growth is a 45 degree line (adjusting for aspect ratio) and countries below this line finished 2010 poorer than they started. The 2% line is (roughly) the average economic growth rate across all countries, so countries above grew faster than average and below slower than average. Countries above the 4% line grew (roughly) one cross-national standard deviation (about 2 ppa) above the average (also about 2 ppa).

Figure 2 also shows numerically the level (not natural log) of GDP per capita at the beginning and end of the available data and the ratio of the two. It also provides information on the relative rank (from the bottom) of the country's per capita income.
The USA provides a nice benchmark, as it was near the top in 1960 (103 of 104) and stayed near the top (102 of 104 in 2010) but growing at almost exactly the average pace ($g=2.1$ in Figure 1) and hence increasing GDPPC by a factor of 2.7. Countries with a ratio higher than 2.7 converged on the leader; those with ratios less than 2.7 did not. There is little evidence of unconditional relative income convergence for most developing countries (Pritchett, 1997) but some countries with massive gains. The Republic of Korea (USD1656) and The Philippines (USD1459) started out with similar levels of per capita income in 1960. The Republic of Korea’s GDPPC in 2010 was 16.1 times higher, USD26,609 – by 2010 it had converged on developed country levels. GDPPC in The Philippines only went up by a factor of 2.2 – which is real progress – but fell relative to the leaders. Most developing countries were like the Philippines in not exhibiting income convergence, but some converging – and some of the rapid convergers had very big populations (e.g. China, India, Indonesia).

Figure 3 plots the first differences of ln GDPPC (which is roughly the annual percent growth rate of GDPPC) and the five-year moving average (MA) of the first differences. As in Figure 2, we benchmark the world average growth rate of 2% with a horizontal solid line, and the growth rates of 0% and 4% (about a cross-national standard deviation above and below) with two broken horizontal lines.

This figure captures the volatility in the GDPPC growth series over time. The number of times the five-year MA of a particular country crosses both the two broken horizontal lines gives us an indication of how volatile the growth rate of GDPPC for that country is. For stable countries, most of the annual observations and nearly all the smoothed five year moving averages are inside these lines – they mostly experience in each year a “typical” growth rate. But for many countries, even the smoothed five-year MA of first differences crosses both the 0% and 4% horizontal lines multiple times. For instance, Jordan has a low growth rate ($g = 0.9$) and high volatility ($\sigma_{\Delta Y} = 9.8$), so the MA crosses the 0% and 4% lines 11 times.

Figure 4 compares the distribution of all eight-year (overlapping) growth rates of the particular country with the distribution of all eight-year growth rates for the rest of the world (of course we could have done this for any other number of years). That is, we calculate all possible overlapping growth rates of duration eight-years (e.g. 1960-67, 1961-68, 1962-69, etc) for each country in the world.

We allocated these growth rates into six discrete bins (shown as the groups of bars on Figure 4): (i) growth less than -2.0% (growth collapse); (ii) growth between -2.0% and zero (negative growth); (iii) growth rate between zero and +2.0% (stagnation); (iv) growth between +2.0% and +4.0% (moderate growth); (v) growth between +4.0% and +6.0% (strong growth); and (vi) growth above +6.0% (rapid growth). Since the world average growth rate is 2.0% per annum, and the standard deviation (SD) of the world average growth rate is 2.0, these bins correspond roughly to an empirical “normal” distribution of growth rates.

Figure 4 shows that the same average growth rate can result from very different distributions of growth rates over time. Developed economies, like the UK, had $g = 2.4$ and nearly all of its eight-year growth rates were between 0% and 4%. But between 1970 and 2010 Cambodia has almost exactly the same average growth rate ($g = 2.3$), but did so by spending

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7 These two being linked of course by the formula: Ratio $= \frac{Y_{t+N}Y_t}{N+1}$, though this will not be exact, as $g$ is an OLS estimate, not calculated endpoint to endpoint.
substantial time in collapse ($g < -2$) and substantial time in rapid growth ($g > 6$).

Some countries were reasonably consistent growth “stars” and spent most time with $g > 4$ (e.g. Singapore, the Republic of Korea). Other countries were consistently poor performers (e.g. Central African Republic, Senegal).

As an example of how the four figures look like for a particular country, we present Figures 1-4 for Uganda below. Figure 1 shows that decadal growth rates varied from -4 % in the 1970s to +4.4% in the 1990s, in the context of a low average rate of growth of 0.4% per annum. Figure 2 shows that Uganda’s relative rank in GDPPC has changed very little in the period 1960-2010 (fifteenth from the bottom in 1960 and sixteenth from the bottom in 2010) and that Uganda’s average growth rate in 1960-2010 was below the world average rate of growth of 2% per annum. Figure 3 indicates that GDP per capita growth in Uganda has been volatile, with the MA of GDPPC growth crossing both the 0% and 4% horizontal lines. Finally, Figure 4 shows that Uganda has spent more time than the average country in “growth collapse” and “negative growth”, but also spent more time than the average country in “moderate growth”. Uganda, then, illustrates very well our point that economic growth can change quite remarkably in a relatively short period of time in a single country, and that focusing on the average rate of growth masks this very significant transition in growth phases.
The Dynamics of Economic Growth

Uganda

Figure 1: Overall, ten, and five year growth rates: Uganda

Figure 2: Initial and Final level of GDP: Uganda

Figure 3: (In) First Differences and five year MA: Uganda

Figure 4: Distribution of all 8 year growth rates: Uganda vs. world
For many countries the following seemingly paradoxical fact is that knowing what country the growth rate comes from increases the variance of your guess of the growth rate. That is, suppose you were drawing a country eight-year period growth rate from the world distribution of growth rates, you would know that the standard deviation is about 2 and the likelihood of being in either “collapse” or “rapid growth” is about 5%. But if we tell you that you are just choosing from the eight-year growth experiences of a country like Ghana, Nigeria, Jordan, Cambodia, Mozambique and Malawi, then your uncertainty about what you will find increases. These countries show more variation in the distribution of their growth episodes than the variation in growth rates across all countries in the world. These countries have spent more time in both rapid growth and growth collapse than the “typical” country.
Section II: Country Graphs

Afghanistan

Figure 1: Overall, ten, and five year growth rates: Afghanistan

Figure 2: Initial and Final level of GDPPC: Afghanistan

Figure 3: (In) First Differences and five year MA: Afghanistan

Figure 4: Distribution of all 8 year growth rates Afghanistan vs. world
Albania

Figure 1: Overall, ten, and five year growth rates: Albania

Figure 2: Initial and Final level of GDPPC: Albania

Figure 3: (ln) First Differences and five year MA: Albania

Figure 4: Distribution of all 8 year growth rates
Albania vs. world

Albania

The Dynamics of Economic Growth
The Dynamics of Economic Growth

Algeria

Figure 3: (In) First Differences and five year MA: Algeria

Figure 4: Distribution of all 8 year growth rates
Algeria vs. world

Figure 1: Overall, ten, and five year growth rates: Algeria

Figure 2: Initial and Final level of GDPPC: Algeria

Min. 9.28 1.0
Max. 8.9 2.8
1980 0.4
1985 0.1
1990 2.4

Ln(GDPCC)

Year

1955 7.8
1960 8.1
1965 8.3
1970 8.6
1975 8.9
1980 9.1
1985 9.3
1990 9.6
2000 9.9
2010 10.1

20422

4.6 1.4 4.5 1.8 -1.0 -2.3 1.8 3.9 0.9

Year

Min.

Med.

Max.

0.3

0.73

8.6

1980 4105 73/103
2010 8263 53/103
Ratio 1.5

5 6 7 8 9 10 11

11

Level of GDPCC, 2010

Level of GDPCC, 1960

0 5 6 7 8 9 10 11

0

0.08

-0.08

-0.05

0.05

0.1

-0.02

0.02

0.04

0.06

0.08

0.1


Years

First Differences in GDPCC

Fraction of growth rates in category

Growth categories

0 1 2 3 4 5 6

0.01

0.1

0.2

0.3

0.4

0.5

0.6

0.7
Angola

Figure 1: Overall, ten, and five year growth rates: Angola

Figure 2: Initial and final level of GDP per capita: Angola

Figure 3: (In) First differences and five year MA: Angola

Figure 4: Distribution of all 8 year growth rates: Angola vs. world
The Dynamics of Economic Growth

Argentina

Figure 1: Overall, ten, and five year growth rates: Argentina

Figure 2: Initial and final level of GDP per capita: Argentina

Figure 3: (ln) First differences and five year MA: Argentina

Figure 4: Distribution of all 8 year growth rates: Argentina vs. world
The Dynamics of Economic Growth

Australia

**Figure 1:** Overall, ten, and five year growth rates: Australia

**Figure 2:** Initial and final level of GDP; Australia

**Figure 3:** First differences and five-year MA: Australia

**Figure 4:** Distribution of all 8-year growth rates: Australia vs. world

The Dynamics of Economic Growth

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Austria

**Figure 1:** Overall, ten, and five year growth rates: Austria

*Graph showing the growth rates over different time periods.*

**Figure 2:** Initial and final level of GDPPC: Austria

*Graph showing the level of GDPPC over time.*

**Figure 3:** (In) First differences and five year MA: Austria

*Graph showing the first differences and five year moving average.*

**Figure 4:** Distribution of all 8 year growth rates

*Austria vs. world

*Graph showing the distribution of growth rates in different categories.*
Figure 1: Overall, ten, and five year growth rates: Bangladesh

Figure 2: Initial and final level of GDP per capita: Bangladesh

Figure 3: (In) First differences and five year MA: Bangladesh

Figure 4: Distribution of all 8 year growth rates: Bangladesh vs. world

Bangladesh
The Dynamics of Economic Growth

Botswana

Figure 1: Overall, ten, and five year growth rates: Botswana

Figure 2: Initial and final level of GDPPC: Botswana

Figure 3: (ln) First differences and five year MA: Botswana

Figure 4: Distribution of all 8 year growth rates
Botswana vs. world
The Dynamics of Economic Growth

Brazil

Figure 1: Overall, ten, and five year growth rates: Brazil

Figure 2: Initial and Final level of GDPPC: Brazil

Figure 3: (In) First Differences and five year MA: Brazil

Figure 4: Distribution of all 8 year growth rates
Brazil vs. world

fraction of growth rates in category

growth categories
Bulgaria

Figure 1: Overall, ten, and five year growth rates: Bulgaria

Figure 2: Initial and Final level of GDPPC: Bulgaria

Figure 3: (In) First Differences and five year MA: Bulgaria

Figure 4: Distribution of all 8 year growth rates: Bulgaria vs. world
Burundi

Figure 1: Overall, ten, and five year growth rates: Burundi

Figure 2: Initial and Final level of GDPPC: Burundi

Figure 3: (In) First Differences and five year MA: Burundi

Figure 4: Distribution of all 8 year growth rates
Burundi vs. world
The Dynamics of Economic Growth

Cambodia

Figure 1: Overall, ten, and five year growth rates: Cambodia

Figure 2: Initial and final level of GDP/C: Cambodia

Figure 3: (ln) First Differences and five year MA: Cambodia

Figure 4: Distribution of all 8 year growth rates Cambodia vs. world
Cameroon

Figure 1: Overall, ten, and five year growth rates: Cameroon

Figure 2: Initial and Final level of GDP(C): Cameroon

Figure 3: (ln) First differences and five year MA: Cameroon

Figure 4: Distribution of all 8 year growth rates
Cameroon vs. world

The Dynamics of Economic Growth
Canada

Figure 1: Overall, ten, and five year growth rates: Canada

Figure 2: Initial and Final level of GDPPC: Canada

Figure 3: (in) First Differences and five year MA: Canada

Figure 4: Distribution of all 8 year growth rates Canada vs. world
The Dynamics of Economic Growth

Chad

Figure 1: Overall, ten, and five year growth rates: Chad

Figure 2: Initial and Final level of GDPPC: Chad

Figure 3: (In) First Differences and five year MA: Chad

Figure 4: Distribution of all B year growth rates Chad vs. world
Chile
China

Figure 1: Overall, ten, and five year growth rates: China Version 1

Figure 2: Initial and final level of GDPPC: China Version 1

Figure 3: (ln) First Differences and five year MA: China Version 1

Figure 4: Distribution of all 8 year growth rates
China Version 1 vs. world
The Dynamics of Economic Growth

Figure 1: Overall, ten, and five year growth rates: Colombia

Figure 2: Initial and Final level of GDPPC: Colombia

Figure 3: (ln) First Differences and five year MA: Colombia

Figure 4: Distribution of all 8 year growth rates: Colombia vs. world
Figure 1: Overall, ten, and five year growth rates: Congo, Dem. Rep.

Figure 2: Initial and final level of GPPC: Congo, Dem. Rep.

Figure 3: (in) First Differences and five year MA: Congo, Dem. Rep.

Figure 4: Distribution of all 8 year growth rates
Congo, Dem. Rep. vs. world
The Dynamics of Economic Growth

Costa Rica

Figure 1: Overall, ten, and five year growth rates: Costa Rica

Figure 2: Initial and final level of GDPPC: Costa Rica

Figure 3: (In) First Differences and five year MA: Costa Rica

Figure 4: Distribution of all 8 year growth rates
Costa Rica vs. world

Average growth 1.6
The Dynamics of Economic Growth

Cuba

Figure 1: Overall, ten, and five year growth rates: Cuba

Figure 2: Initial and final level of GDPPC: Cuba

Figure 3: First differences and five year MA: Cuba

Figure 4: Distribution of all 8 year growth rates
Cuba vs. world
The Dynamics of Economic Growth

Denmark

Figure 1: Overall, ten, and five year growth rates: Denmark

Figure 2: Initial and Final level of GDPPC: Denmark

Figure 3: (m) First Differences and five year MA: Denmark

Figure 4: Distribution of all 8 year growth rates Denmark vs. world
Dominican Republic

Figure 1: Overall, ten, and five year growth rates: Dominican Republic

Figure 2: Initial and final level of GPPPC: Dominican Republic

Figure 3: (ln) First Differences and five year MA: Dominican Republic

Figure 4: Distribution of all 8 year growth rates: Dominican Republic vs. world

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The Dynamics of Economic Growth

Egypt, Arab Rep.

Figure 1: Overall, ten, and five year growth rates: Egypt

Figure 2: Initial and Final level of GDP: Egypt

Figure 3: (in) First Differences and five year MA: Egypt

Figure 4: Distribution of all 8 year growth rates: Egypt vs. world

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The Dynamics of Economic Growth

El Salvador

Figure 1: Overall, ten, and five year growth rates: El Salvador

Figure 2: Initial and Final level of GDP per Capita: El Salvador

Figure 3: (In) First Differences and five year MA: El Salvador

Figure 4: Distribution of all 8 year growth rates El Salvador vs. World
Ethiopia

Figure 1: Overall, ten, and five year growth rates: Ethiopia

Figure 2: Initial and Final level of GDPPC: Ethiopia

Figure 3: (In) First Differences and five year MA: Ethiopia

Figure 4: Distribution of all 8 year growth rates Ethiopia vs. world
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Figure 1: Overall, ten, and five year growth rates: Fiji

Figure 2: Initial and Final level of GDPPC: Fiji

Figure 3: (ln) First Differences and five year MA: Fiji

Figure 4: Distribution of all 8 year growth rates
FIJI vs. world
Finland

Figure 1: Overall, ten, and five year growth rates: Finland

Figure 2: Initial and Final level of GDPPC: Finland

Figure 3: (ln) First Differences and five year MA: Finland

Figure 4: Distribution of all 8 year growth rates

Finland vs. world
The Dynamics of Economic Growth

France

Figure 1: Overall, ten, and five year growth rates: France

Figure 2: Initial and Final level of GDP vs. France

Figure 3: (ln) First Differences and five year MA: France

Figure 4: Distribution of all 8 year growth rates France vs. world
The Dynamics of Economic Growth

Figure 1: Overall, ten, and five year growth rates: Gabon

Figure 2: Initial and Final level of GDP per capita (GDP): Gabon

Gabon

Figure 3: (In) First Differences and five year MA: Gabon

Figure 4: Distribution of all 8 year growth rates: Gabon vs. world
The Dynamics of Economic Growth

Gambia, The

Figure 1: Overall, ten, and five year growth rates: Gambia, The

Figure 2: Initial and Final level of GDPPC: Gambia, The

Figure 3: (In) First Differences and five year MA: Gambia, The

Figure 4: Distribution of all 8 year growth rates Gambia, The vs. world
The Dynamics of Economic Growth

Ghana

Figure 1: Overall, ten, and five year growth rates: Ghana

Figure 2: Initial and Final level of GDPPC: Ghana

Figure 3: (ln) First Differences and five year MA: Ghana

Figure 4: Distribution of all 8 year growth rates
Ghana vs. world
Greece

Figure 1: Overall, ten, and five year growth rates: Greece

Figure 2: Initial and Final level of GDPPC: Greece

Figure 3: (In) First Differences and five year MA: Greece

Figure 4: Distribution of all 8 year growth rates Greece vs. world
The Dynamics of Economic Growth

Guatemala

Figure 1: Overall, ten, and five year growth rates: Guatemala

Figure 2: Initial and final level of GDP: Guatemala

Figure 3: In) First Differences and Five-year MA; Guatemala

Figure 4: Distribution of all 8 year growth rates; Guatemala vs. world

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Guinea

Figure 1: Overall, ten, and five year growth rates: Guinea

Figure 2: Initial and Final level of GDPPC; Guinea

Figure 3: (In) First Differences and five year MA: Guinea

Figure 4: Distribution of all 8 year growth rates
Guinea vs. world
The Dynamics of Economic Growth

Guinea-Bissau

Figure 1: Overall, ten, and five year growth rates: Guinea-Bissau

Figure 2: Initial and Final level of GDPPC: Guinea-Bissau

Figure 3: (In) First Differences and five year MA: Guinea-Bissau

Figure 4: Distribution of all 8 year growth rates
Guinea-Bissau vs. world
Honduras

Figure 1: Overall, ten, and five year growth rates: Honduras

Figure 2: Initial and Final level of GDPPC: Honduras

Figure 3: (ln) First Differences and five year MA: Honduras

Figure 4: Distribution of all 8 year growth rates Honduras vs. world
The Dynamics of Economic Growth

Hungary

Figure 1: Overall, ten, and five year growth rates: Hungary

Figure 2: Initial and final level of GDP: Hungary

Figure 3: (In) First differences and five year MA: Hungary

Figure 4: Distribution of all 8 year growth rates: Hungary vs. world
Indonesia

Figure 1: Overall, ten, and five year growth rates: Indonesia

Figure 2: Initial and Final level of GDP/PC: Indonesia

Figure 3: (in) First Differences and five year MA: Indonesia

Figure 4: Distribution of all 8 year growth rates
Indonesia vs. world
Iran, Islamic Rep.

Figure 1: Overall, ten, and five year growth rates: Iran

Figure 2: Initial and Final level of GDP per Capita: Iran

Figure 3: (m) First Differences and five year MA: Iran

Figure 4: Distribution of all 8 year growth rates Iran vs. world
Iraq
Ireland

Figure 1: Overall, ten, and five year growth rates: Ireland

Figure 2: Initial and Final level of GDPPC: Ireland

Figure 3: (ln) First Differences and five year MA: Ireland

Figure 4: Distribution of all 8 year growth rates
Ireland vs. world
The Dynamics of Economic Growth

Israel

Figure 1: Overall, ten, and five year growth rates: Israel

Figure 2: Initial and Final level of GDP: Israel

Figure 3: (in) First Differences and five year MA: Israel

Figure 4: Distribution of all 8 year growth rates
Israel vs. world
Italy

Figure 1: Overall, ten, and five year growth rates: Italy

Figure 2: Initial and Final level of GDPPC: Italy

Figure 3: (In) First Differences and five year MA: Italy

Figure 4: Distribution of all 8 year growth rates
Italy vs. world
Jamaica

Figure 1: Overall, ten, and five year growth rates: Jamaica

Figure 2: Initial and Final level of GDPPC: Jamaica

Figure 3: (In) First Differences and five year MA: Jamaica

Figure 4: Distribution of all 8 year growth rates
Jamaica vs. world
Kenya

Figure 1: Overall, ten, and five year growth rates: Kenya

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$R^2 = 0.49$

$GDP = 4.4$

Figure 2: Initial and Final level of GDPPC: Kenya

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Figure 3: (In) First Differences and five year MA: Kenya

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Figure 4: Distribution of all 8 year growth rates

Kenya vs. world

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Average growth 0.2
Figure 1: Overall, ten, and five year growth rates: Korea, Republic of

Figure 2: Initial and final level of GDPPC: Korea, Republic of

Figure 3: (in) First Differences and five year MA: Korea, Republic of

Figure 4: Distribution of all 8 year growth rates. Korea, Republic of vs. world
The Dynamics of Economic Growth

Figure 1: Overall, ten, and five year growth rates: Lebanon

Figure 2: Initial and final level of GDP per capita: Lebanon

Figure 3: (In) First differences and five year MA: Lebanon

Figure 4: Distribution of all 8 year growth rates: Lebanon vs. world

Lebanon
Lesotho

Figure 1: Overall, ten, and five year growth rates: Lesotho

Figure 2: Initial and Final level of GDPPC: Lesotho

Figure 3: (m) First Differences and five year MA: Lesotho

Figure 4: Distribution of all 8 year growth rates
Lesotho vs. world
Liberia

Figure 1: Overall, ten, and five year growth rates: Liberia

Figure 2: Initial and Final level of GDPPC; Liberia

Figure 3: (In) First Differences and Five year MA: Liberia

Figure 4: Distribution of all 8 year growth rates: Liberia vs. world
Malawi

Figure 1: Overall, ten, and five year growth rates: Malawi

Figure 2: Initial and final level of GDP per capita: Malawi

Figure 3: (In) First differences and five year MA: Malawi

Figure 4: Distribution of all 8 year growth rates: Malawi vs. world
Malaysia

Figure 1: Overall, ten, and five year growth rates: Malaysia

```
q: 4.5
R²: 0.98
arg: 4.7
```

```
Min: 11956
Max: 15347
Med: 4219
```

Years
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7.2 7.4 7.6 7.8 8.0 8.2 8.4 8.6 8.8 9.0 9.2
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Figure 2: Initial and Final level of GDP per capita: Malaysia

```
1980: 1434 43/103
2010: 11956 73/103
Ratio: 8.3
```

Figure 3: (in) First Differences and five year MA: Malaysia

Figure 4: Distribution of all 8 year growth rates: Malaysia vs. world
The Dynamics of Economic Growth

Mali

Figure 1: Overall, ten, and five year growth rates: Mali

Figure 2: Initial and final level of GDPPC; Mali

Figure 3: (In) First Differences and five year MA; Mali

Figure 4: Distribution of all 8 year growth rates, Mali vs. world
The Dynamics of Economic Growth

Mauritania

Figure 1: Overall, ten, and five year growth rates: Mauritania

Figure 2: Initial and Final level of GDP per Capita: Mauritania

Figure 3: (ln) First Differences and five year MA: Mauritania

Figure 4: Distribution of all 8 year growth rates
Mauritania vs. world
The Dynamics of Economic Growth

Mauritius

Figure 1: Overall, ten, and five year growth rates: Mauritius

Figure 2: Initial and Final level of GDPPC: Mauritius

Figure 3: (m) First Differences and five year MA: Mauritius

Figure 4: Distribution of all 8 year growth rates
Mauritius vs. world
The Dynamics of Economic Growth

Mexico

Figure 1: Overall, ten, and five year growth rates: Mexico

Figure 2: Initial and Final level of GDPPC: Mexico

Figure 3: (ln) First Differences and five year MA: Mexico

Figure 4: Distribution of all 8 year growth rates
Mexico vs. world
The Dynamics of Economic Growth

Mongolia

Figure 1: Overall, ten, and five year growth rates: Mongolia

Figure 2: Initial and final level of GDPPC: Mongolia

Figure 3: (In) First Differences and five year MA: Mongolia

Figure 4: Distribution of all 8 year growth rates: Mongolia vs. world
Morocco

Figure 1: Overall, ten, and five year growth rates: Morocco

Figure 2: Initial and final level of GDPPC: Morocco

Figure 3: (ln) First differences and five year MA: Morocco

Figure 4: Distribution of all 8 year growth rates
Morocco vs. World
Nepal

Figure 1: Overall, ten, and five year growth rates: Nepal

Figure 2: Initial and Final level of GDP/PC: Nepal

Figure 3: (m) First Differences and five year MA: Nepal

Figure 4: Distribution of all 8 year growth rates
Nepal vs. world
The Dynamics of Economic Growth

Netherlands

Figure 1: Overall, ten, and five-year growth rates: Netherlands

Figure 2: Initial and final level of GDPPC: Netherlands

Figure 3: (In) First differences and five-year MA: Netherlands

Figure 4: Distribution of all 8-year growth rates: Netherlands vs. world
The Dynamics of Economic Growth

New Zealand

Figure 1: Overall, ten, and five year growth rates: New Zealand

Figure 2: Initial and Final level of GDP per Capita: New Zealand

Figure 3: (In) First Differences and five year MA: New Zealand

Figure 4: Distribution of all 8 year growth rates
New Zealand vs. World

Average growth 1.4
The Dynamics of Economic Growth

Nicaragua

Figure 1: Overall, ten, and five year growth rates: Nicaragua

Figure 2: Initial and final level of GDPPC; Nicaragua

Figure 3: (In) First Differences and five year MA; Nicaragua

Figure 4: Distribution of all 8 year growth rates. Nicaragua vs. world
The Dynamics of Economic Growth

Niger

Figure 1: Overall, ten, and five year growth rates: Niger

Figure 2: Initial and Final level of GDP: Niger

Figure 3: (in) First Differences and five year MA: Niger

Figure 4: Distribution of all 8 year growth rates
Niger vs. world

Average growth -1.7
The Dynamics of Economic Growth

Nigeria

Figure 1: Overall, ten, and five year growth rates: Nigeria

Figure 2: Initial and Final level of GDPPC: Nigeria

Figure 3: (ln) First Differences and five year MA: Nigeria

Figure 4: Distribution of all 8 year growth rates Nigeria vs. world
The Dynamics of Economic Growth

Figure 1: Overall, ten, and five year growth rates: Oman

Figure 2: Initial and Final level of GDPPC: Oman

Figure 3: (ln) First Differences and five year MA: Oman

Figure 4: Distribution of all 8 year growth rates Oman vs. world
Pakistan

Figure 1: Overall, ten, and five year growth rates: Pakistan

Figure 2: Initial and final level of GDPPC: Pakistan

Figure 3: (in) First Differenced and five year MA: Pakistan

Figure 4: Distribution of all 8 year growth rates: Pakistan vs. world

The Dynamics of Economic Growth
The Dynamics of Economic Growth

Panama

Figure 1: Overall, ten, and five year growth rates: Panama

Figure 2: Initial and Final level of GDP per capita: Panama

Figure 3: (In) First differences and five year MA: Panama

Figure 4: Distribution of all 8 year growth rates: Panama vs. world
Papua New Guinea

Figure 1: Overall, ten, and five year growth rates: Papua New Guinea

Figure 2: Initial and final level of GDPPC: Papua New Guinea

Figure 3: (ln) First differences and five year MA: Papua New Guinea

Figure 4: Distribution of all 8 year growth rates, Papua New Guinea vs. world
Peru

Figure 1: Overall, ten, and five year growth rates: Peru

Figure 2: Initial and Final level of GDPPC: Peru

Figure 3: (in) First Differences and five year MA: Peru

Figure 4: Distribution of all 8 year growth rates Peru vs. world

The Dynamics of Economic Growth
Poland

Figure 1: Overall, ten, and five year growth rates: Poland

Figure 2: Initial and final level of GDPPC; Poland

Figure 3: (In) First differences and five year MA; Poland

Figure 4: Distribution of all 8 year growth rates

Poland vs. world

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Average growth: 2.0
Portugal
Puerto Rico

Figure 1: Overall, ten, and five year growth rates: Puerto Rico

Figure 2: Initial and Final level of G3PPC: Puerto Rico

Figure 3: (in) First Differences and five year MA: Puerto Rico

Figure 4: Distribution of all 8 year growth rates
Puerto Rico vs. world
Romania

Figure 1: Overall, ten, and five year growth rates: Romania

Figure 2: Initial and Final level of GDPPC: Romania

Figure 3: (in) First Differences and five year MA: Romania

Figure 4: Distribution of all 8 year growth rates Romania vs. world
Rwanda

Figure 1: Overall, ten, and five year growth rates: Rwanda

Figure 2: Initial and Final level of GDPPC: Rwanda

Figure 3: (In) First Differences and five year MA: Rwanda

Figure 4: Distribution of all 8 year growth rates: Rwanda vs. world
The Dynamics of Economic Growth

Senegal

Figure 1: Overall, ten, and five year growth rates: Senegal

Figure 2: Initial and final level of GDP per capita: Senegal

Figure 3: First differences and five year MA: Senegal

Figure 4: Distribution of all 8 year growth rates

Senegal vs. world
Sierra Leone

Figure 1: Overall, ten, and five year growth rates: Sierra Leone

Figure 2: Initial and final level of GDPPC: Sierra Leone

Figure 3: (In) First Differences and five year MA: Sierra Leone

Figure 4: Distribution of all 8 year growth rates: Sierra Leone vs. world
Somalia

Figure 1: Overall, ten, and five year growth rates: Somalia

Figure 2: Initial and final level of GDP: Somalia

Figure 3: (In) First differences and five year MA: Somalia

Figure 4: Distribution of all 8 year growth rates
Somalia vs. world

Average growth: -1.8
South Africa

Figure 1: Overall, ten, and five year growth rates: South Africa

Figure 2: Initial and final level of GDPPC: South Africa

Figure 3: (In) First Differences and five year MA: South Africa

Figure 4: Distribution of all 8 year growth rates
South Africa vs. World
The Dynamics of Economic Growth

Spain

Figure 1: Overall, ten, and five year growth rates: Spain

Figure 2: Initial and Final level of GDPPC: Spain

Figure 3: (in) First Differences and five year MA: Spain

Figure 4: Distribution of all 8 year growth rates: Spain vs. world
Sri Lanka

Figure 1: Overall, ten, and five year growth rates: Sri Lanka

Figure 2: Initial and Final level of GDPPC; Sri Lanka

Figure 3: (In) First Differences and five year MA; Sri Lanka

Figure 4: Distribution of all 8 year growth rates - Sri Lanka vs. world

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Sudan

Figure 1: Overall, ten, and five year growth rates: Sudan

Figure 2: Initial and Final level of GDP per capita: Sudan

Figure 3: First differences and five year MA: Sudan

Figure 4: Distribution of all 8 year growth rates: Sudan vs. world

1.4
0.61
5.6

1.4
0.61
5.6

1.14
33/125
2010
22/88
29/125
Ratio 2.1

-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0

1.4

Average growth 1.4
The Dynamics of Economic Growth

Sweden

Figure 1: Overall, ten, and five year growth rates: Sweden

Figure 2: Initial and final level of GDP: Sweden

Figure 3: First differences and five year MA: Sweden

Figure 4: Distribution of all 8 year growth rates

Sweden vs. world
The Dynamics of Economic Growth

Switzerland

Figure 1: Overall, ten, and five year growth rates: Switzerland

Figure 2: Initial and Final level of GDPPC: Switzerland

Figure 3: (In) First Differences and five year MA: Switzerland

Figure 4: Distribution of all 8 year growth rates
Switzerland vs. world
Figure 1: Overall, ten, and five year growth rates: Syria

Figure 2: Initial and Final level of GDP/PC: Syria

Figure 3: (ln) First Differences and five year MA: Syria

Figure 4: Distribution of all 8 year growth rates Syria vs. world
Taiwan

Figure 1: Overall, ten, and five year growth rates: Taiwan

Figure 2: Initial and Final level of GDP: Taiwan

Figure 3: (ln) First Differences and five year MA: Taiwan

Figure 4: Distribution of all 8 year growth rates
Taiwan vs. world
Figure 1: Overall, ten, and five year growth rates: Thailand

Figure 2: Initial and Final level of GDPPC: Thailand

Figure 3: (in) First Differences and five year MA: Thailand

Figure 4: Distribution of all 8 year growth rates
Thailand vs. world

The Dynamics of Economic Growth
The Dynamics of Economic Growth

Figure 1: Overall, ten, and five year growth rates: Togo

Figure 2: Initial and Final level of GDP per capita: Togo

Figure 3: (ln) First differences and five year MA: Togo

Figure 4: Distribution of all eight year growth rates: Togo vs. world
Trinidad and Tobago

Figure 1: Overall, ten, and five year growth rates: Trinidad & Tobago

Figure 2: Initial and Final level of GDPPC: Trinidad & Tobago

Figure 3: (n) First Differences and five year MA: Trinidad & Tobago

Figure 4: Distribution of all 8 year growth rates Trinidad & Tobago vs. world
Tunisia

Figure 1: Overall, ten, and five year growth rates: Tunisia

Figure 2: Initial and final level of GDPPC: Tunisia

Figure 3: (In) First Differences and five year MA: Tunisia

Figure 4: Distribution of all 8 year growth rates

Tunisia vs. world
Turkey

Figure 1: Overall, ten, and five year growth rates: Turkey

Figure 2: Initial and Final level of GDPPC: Turkey

Figure 3: (ln) First Differences and five year MA: Turkey

Figure 4: Distribution of all 8 year growth rates
Turkey vs. world
Uganda
The Dynamics of Economic Growth

United States

Figure 1: Overall, ten, and five year growth rates: United States

Figure 2: Initial and final level of GDP per capita: United States

Figure 3: First differences and five year MA: United States

Figure 4: Distribution of all 8 year growth rates: United States vs. world

AVERAGE GROWTH 2.1


Venezuela, RB

![Figure 1: Overall, ten, and five year growth rates: Venezuela](image)

![Figure 2: Initial and Final level of GDPPC: Venezuela](image)

![Figure 3: (ln) First Differences and five year MA: Venezuela](image)

![Figure 4: Distribution of all 8 year growth rates Venezuela vs. world](image)
Vietnam

Figure 1: Overall, ten, and five year growth rates: Vietnam

Figure 2: Initial and Final level of GDPPC: Vietnam

Figure 3: (In) First Differences and five year MA: Vietnam

Figure 4: Distribution of all 8 year growth rates
Vietnam vs. world
Zimbabwe

Figure 1: Overall, ten, and five year growth rates: Zimbabwe

Figure 2: Initial and Final level of GDPPC; Zimbabwe

Figure 3: (ln) First Differences and five year MA: Zimbabwe

Figure 4: Distribution of all 8 year growth rates, Zimbabwe vs. world
Part III

Section I: Viewing Economic Growth as Transitions in Growth Regimes
Part III: Section I: Viewing Economic Growth as Transitions in Growth Regimes

We have seen in Part II that the average or long-run rate of economic growth is a poor approximation of country growth experiences, and that countries make frequent transitions between periods of high growth, periods of negative growth and periods of stagnation. To understand economic growth, we need to understand why most countries switch from one growth regime to another. This is not straightforward. How do we know when growth is accelerating when, in most low-income countries, income movements are highly volatile, so a movement up or down may be transitory, and not signal a shift in the growth rate? How do we identify a growth break, which is an episode involving a significant change in growth rates implying a transition from one growth regime to another?

In Part III, we present four more graphs per country. Figure 5 is a simple plot of log GDPPC, and also contains the three summary statistics of growth for each country – $g$, $R^2$ and $\sigma_{\Delta Y}$ – that we discussed in Part II. Figure 6 presents our growth breaks – where we modify the Bai-Perron (1998) method using our economic filters. We also report the growth rates pre- and post-break, and the change in the growth rate ($\Delta g$) from one growth episode to the next. Figure 7 gives the breaks as identified by the Bai-Perron (henceforth, BP) method to compare with the breaks that we have identified. In most cases, the breaks that we have identified are the same as when we apply the Bai-Perron method without modification. However, in several instances (as in the case of Zimbabwe, for example), we obtain more breaks by our method than if we applied the BP method without modification. In some cases (for example, South Africa), the years identified by the BP break differ from ours – this occurs when we drop the potential break identified by BP, as it does not meet the criteria of a break by our filters; and where the iterative procedure followed by BP leads to a different growth break year. In Figure 8, we report magnitudes of growth in each growth episode using the second of the methods in computing growth magnitudes discussed previously.

Figure 5 replicates Figure 1 (since the figures come either singly or in panels, with four graphs per panel, this makes sure the raw ln(GDPPC) data and graph is present in both panels).

Figure 7 displays the results of one procedure for identifying structural breaks in growth (we describe Figure 7 first, since understanding Figure 6 depends on understanding Figure 7).

The widely used BP methodology (1998, 2003a, 2003b, 2006) estimates the dates of structural breaks in time series. BP is a two-step method. The first step estimates the years to place a given number of breaks that would most increase a test-statistic, while the second step sequentially tests how many of these breaks are statistically significant.

In the first step, it is assumed that the growth rate is a stationary dependent variable that equals a regime-specific mean growth rate plus an error term. To implement a BP procedure the user has to specify the
minimum length of any growth regime (e.g. so the breaks cannot be in sequential years and must be, say, five years apart) and the maximum number of potential candidate breaks. The first step of the BP procedure recursively minimizes the sum of squared residuals, both with respect to the break dates and with respect to the regime-specific mean growth rates, subject to the user provided constraint on the minimum length of a growth regime, up to the maximum number of breaks specified.8

We implement BP using a “growth regime” minimum of eight-years. One can use shorter or longer periods, but shorter periods (e.g. three or five years) risk conflation with “business cycle fluctuations” or truly “short run” shocks (e.g. droughts). Longer periods (e.g. 10 or 12 years) for a given length of data reduce the number of potential breaks.

We specify a maximum number of candidate breaks for each country, depending on the length of the series. A country with:

i) Forty years of data (only since 1970), a maximum of two breaks
ii) More than 40 years and up to 55 years (data since 1955), a maximum of three breaks
iii) More than 55 years (before 1955), a maximum of four breaks

The second step of the BP procedure decides which of the candidate breaks are statistically significant. BP suggests a sequential testing procedure that starts at zero breaks and then proceeds until one fails to reject the null hypothesis of n breaks against n+1 breaks. The test statistic supFₙ, is the supremum of all the F-statistics testing the equality of means across regimes over all admissible k-partitions. The value of the test statistic is compared with simulated critical values, which depend on the number of breaks and a trimming parameter (which in turn depends on the minimum size of the regime).9

The BP procedure identifies both accelerations and decelerations. For instance, the Republic of Korea accelerated in 1962 from a growth of 1.4 ppa to 6.0 ppa, an acceleration of 4.6 ppa. Growth in Nicaragua is estimated to have decelerated in 1977 from 3 to -1.2, a deceleration of 4.2 ppa. Some countries are estimated to have had multiple BP breaks in their growth. For instance, Jamaica is estimated to have experienced a massive deceleration in 1972, from 4.3 ppa before to -3.5 ppa after, a deceleration of 7.8 ppa. But this lasted only until 1980, when growth accelerated from -3.5 ppa to the modest, but positive, pace of 0.7 ppa, an acceleration of 4.2 ppa.

Figure 6 displays the results of transitions in growth that combine the first stage of the BP procedure to identify the “candidate” breaks with a filter for “genuine” breaks that depends on the magnitudes and directions of the changes in growth, not a purely statistical procedure.

In a separate paper we describe and justify our method versus a “pure” BP approach (Kar et al., 2013) and here we just show the graphs of the output. Our filter takes the break years that BP identifies as the best candidates (with four, three, or two candidate years, depending on the length of

8 The Bai-Perron test is robust in that the error term may have different variances across growth regimes and exhibit autocorrelation.

9 In some cases, it is difficult to reject the null of zero against one break, but easy to reject the null of zero against a higher number of breaks. In these cases the testing procedure breaks down. In order to take care of this, Bai and Perron (2006) recommend an adjustment to the procedure that uses an alternative procedure in the first step when the null hypothesis of zero breaks is tested. Here, instead of testing zero against one break point, the hypothesis tests the null of m = 0 against the alternative of 1 ≤ m ≤ M, where M is chosen exogenously. After this altered first step, the rest of the test proceeds exactly as before.
We then apply the following filter to rule out changes in growth that are “too small” to be “genuine” breaks in growth (and might just be due to random fluctuations in the data).

i) In case of the first candidate break, since it is not known whether it follows an acceleration or deceleration, any change of more than 2 ppa (up or down) we count as a growth break.

After that, the threshold depends on the previous history:

ii) If a candidate acceleration follows a previous deceleration or a candidate deceleration follows a previous acceleration, then to qualify as a genuine growth break the absolute magnitude of the growth difference has to be 3 ppa.

iii) If, however, a candidate acceleration follows a previous acceleration or a candidate deceleration follows a previous deceleration, then a change of only 1 ppa (in absolute value) qualifies as a genuine break.

Using this method, which is “BP to identify candidate break years plus a magnitude filter”\(^\text{10}\), we find a total of 318 structural breaks from the group of 125 countries.

These are provided in Table 2, with the country, year, date of the structural break, growth before the break and growth after the break and the years each growth episode lasts.

The method, the outcome, and the differences with a pure statistically approach like BP are best illustrated with a few examples.

The BP procedure finds only one growth break as statistically significant for Brazil, in 1980, separating growth before 1950-1980 of 4.8 ppa from growth from 1980 to 2010 of 0.7 ppa. The first step of the BP procedure identifies four candidate break years: 1967, 1980, 1992 and 2002. In 1967 growth accelerated from 3.7 in 1950–1967 to 6.3 ppa from 1967 to 1980. Since this is the first and above the 2 ppa threshold, we include it as a break. In 1980 growth decelerates from 6.3 ppa to -1.1 ppa from 1980 to 1992, a deceleration of 7.4 ppa, and easily passes the “deceleration following acceleration” threshold of 3 ppa. In 1992 growth accelerates from -1.1 ppa to 1.4 ppa, a change of 2.5 ppa. However, as this is an acceleration following a deceleration it would have to be above 3 ppa and hence we do not include 1992 as a “genuine” growth break. In 2002 growth accelerated again, this time to 2.5 ppa, and since this was an acceleration following a previous candidate acceleration it only had to pass the 1 ppa threshold.


The BP procedure finds only one statistically significant growth break for Ghana, from growth of 0.1 from 1955 to 1983 to growth of 2.6 from 1983 to 2010. Our “BP plus magnitude filter” method classifies all four of the BP candidate break years as breaks and hence has five growth regimes in

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\(^{10}\) See Appendix 1 for further discussion of the different methods to identify growth breaks.
Ghana: slow growth 1955-1966; a burst of growth from 1955 to 1966 (g = 3.7); a growth disaster from 1974 to 1983 (g = -4.5); slow growth from 1983 to 2002 (g = 1.9); and strong growth from 2002 to 2010 (g = 4.2).

Our method clearly creates a richer description of the dynamics, but at the risk of identifying periods that were not “true” growth regime switches. There is nothing special about our proposed filter (other than using the “focal point” thresholds of 1, 2, 3), but there is nothing special for purposes of describing growth regimes in a fetishism of “statistical significance” either.

What do the breaks identified by our methodology tell us about the nature of growth transitions? Do we observe any “stylized facts” about transitions based on these results? More specifically, how much do these transitions change the average growth rates of an economy? Table 2 answers some of these questions by classifying all transitions in terms of a four-by-four matrix that captures the relationship between average growth rates before and after a transition. The vertical axis represents growth rates corresponding to the regime before the break, while the horizontal axis represents growth rates corresponding to the regime after the break.

Consistent with our approach in Part II, we divide the distribution of average growth rates in both the axes into four bins centred on the world average growth rate of 2% (but combining the lower and upper bins). Thus, the four bins are: (i) $g < 0$%; (ii) $0% \leq g < 2$%; (iii) $2% \leq g < 4$%; and (iv) $g > 4$%, where $g$ is the average growth rate of a regime, either before or after a break.

The individual cells of the matrix report all transitions that belong to the corresponding bins in the vertical and horizontal axis, in terms of the country names and the year of transition. Further, for the first column (i.e., for $g < 0$), entries in light coloured shades (pink) represent transitions to growth rates between 0% and -2%, while entries with dark coloured shades (red) represent transitions to growth rates less than -2%. Thus entries with darker shades in this column represent transitions into bigger crisis compared with those with lighter ones. Similarly for the fourth column (i.e., for $g > 4$), entries in light coloured shades (light blue) represent transitions to average growth rates between 4% and 6%, while those with dark colours (dark blue) represent transitions to growth rates higher than 6%. Thus dark coloured entries represent transitions to stronger miracle growth.

Table 2 shows that there are multiple growth transitions corresponding to all 16 cells of the matrix. Moreover, apart from the diagonals that have a lesser possibility of transition by definition (particularly for column two and three that cover a small range of growth rates), all other cells have a large and comparable number of entries. This tells us that the growth transitions resemble a Markov process with comparable probabilities for all types of transitions. Thus, the stylized fact is that when it comes to transitions, anything is possible!
### Table 2: Regime Transitions for each Bai-Perron+Filter Break

<table>
<thead>
<tr>
<th>Growth After Break</th>
<th>g&lt;0</th>
<th>0≤g&lt;2</th>
<th>2≤g≤4</th>
<th>g&gt;4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Growth Before Break</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2≤g≤4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g&gt;4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth After Break</td>
<td>g&lt;0</td>
<td>0≤g&lt;2</td>
<td>2≤g≤4</td>
<td>g&gt;4</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----</td>
<td>-------</td>
<td>-------</td>
<td>-----</td>
</tr>
</tbody>
</table>
One limitation of a matrix-based approach is that it is sensitive to the choice of the bins. Alternatively, one can estimate the transition probability functions that are based on an infinite number of bins, each with a range tending to zero. In other words, we estimate a continuous version of the matrix in Table 2. The transition probability function corresponding to our transitions is diagrammatically represented in Figures 9 and 10. Figure 9 is a surface plot, with the Y-axis representing growth before the break and the X-axis representing growth after the break. The Z-axis represents the probability of a transition. Figure 10 is a contour plot representing the same transition probability function, with the iso-probability lines representing all transitions that have a similar probability.

Figures 9 and 10 confirm the conclusions of Table 2, for the specific ranges of the bin that were chosen for that table. Thus, starting from any of those four ranges of growth rates on the Y-axis (growth before a break), the surface plot and the contour plot show that there are significant probabilities of a transition to any of the other three ranges on the X-axis (growth after a break). Significantly, Figures 9 and 10 reveal something more about the transitions. They indicate that, irrespective of the growth rates before the transitions, there is a strong tendency to move towards the world average growth rate of about 2% after the transition. This is evident from the shape of the transition probability function, with the highest probability points being bunched parallel to the Y-axis and perpendicular to the X-axis corresponding to the 2% growth rate. This supports the evidence that there is a tendency towards mean-reversion in growth dynamics.

First, the cumulative magnitude is a combination of the magnitude of the shift in growth rates per annum and the number of years the episode lasts. So a growth acceleration from 2 ppa to 6 ppa that lasts only eight years produces less cumulative impact than an acceleration from 2 ppa to 4 ppa that lasts 28 years. If we conceptualize the growth process as a probabilistic shift across growth regimes, then cumulative growth performance is obviously the product of duration in each regime times the growth rate while in that regime. As we have seen, the rich industrial countries did not get rich by having very rapid growth rates; rather it was the result of staying consistently in regimes of moderate (or slow) growth.

Second, establishing the cumulative impact of a growth regime transition has to involve some counter-factual of what growth would have been without the growth regime transition that was observed. This is, of course, impossible to know with any certainty. There are three obvious possibilities. One is that the country would have stayed at its existing rate of growth. But this ignores one of the most widely replicated and consistent facts about growth – that there is “regression to the mean” over time and little inter-temporal correlation of growth rates (e.g. Easterly et al., 1993), so predicting that a country will remain at its current growth rate is generally a bad prediction. A second is to assume full regression to the mean and that a country’s growth rate would have been the world average growth rate over the post-regime transition. This, however, ignores completely the country’s previous growth experience and also any tendencies to “convergence”.

The graphs here rely on a method described more fully in a separate paper (Pritchett et al., 2013) and calculate “simple predicted” growth by running a separate prediction regression for each growth transition and predicting a country’s growth on the basis of its previous growth and its level of GDPPC (convergence). Then the total impact of a growth regime transition
is the difference between the actual growth after the transition and the predicted growth in the post-transition period times the duration of the transition. Again, this is best illustrated with an example (and a graph), for which we will use Uganda.


In 1969 growth decelerated from 3.0 to -3.6 ppa and this lower rate of growth lasted until 1980 (11 years). The regression prediction of the growth rate from 1969 to 1980 of a country that was growing at a rate of 3.0 from 1961 to 1969 and at Uganda’s level of GDPPC in 1969 of USD824 is 2.3 ppa. So the cumulative loss from the growth regime transition in 1969 is \((-3.6 - 2.3) \times 11 = -65.7\) – that is, Uganda’s GDPPC in 1980 was 66% lower than it would have been had it grown at the predicted rate versus the actual rate.

In 1980 there was an acceleration that was the end of the collapse from 1969 to 1980 and then in 1988 there was another acceleration. The acceleration of 1988 took growth from -0.5 to 3.5 and the predicted growth from 1988 to 2010 of a country growing at -0.5 ppa from 1980 to 1988 and at Uganda’s level of GDPPC in 1988 was 1.4 ppa. So the total gain from the 1988 growth acceleration was \((3.5-1.4) \times 22 = 46\) – Uganda’s output was 46% higher due to the 1988 growth acceleration than the counter-factual of 1.4 ppa growth.

### Table 3: Growth Magnitudes for Uganda

<table>
<thead>
<tr>
<th>Country</th>
<th>Start year</th>
<th>Level of income at start</th>
<th>Growth before episode</th>
<th>Growth during episode</th>
<th>Simple predicted growth during episode</th>
<th>Episode duration</th>
<th>Cumulative magnitude of growth regime transition gain/loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uganda</td>
<td>1961</td>
<td>636</td>
<td>-0.7%</td>
<td>3.0%</td>
<td>1.7%</td>
<td>8</td>
<td>10.4%</td>
</tr>
<tr>
<td>Uganda</td>
<td>1969</td>
<td>824</td>
<td>3.0%</td>
<td>-3.6%</td>
<td>2.3%</td>
<td>11</td>
<td>-65.7%</td>
</tr>
<tr>
<td>Uganda</td>
<td>1980</td>
<td>536</td>
<td>-3.6%</td>
<td>-0.5%</td>
<td>-1.4%</td>
<td>8</td>
<td>6.8%</td>
</tr>
<tr>
<td>Uganda</td>
<td>1988</td>
<td>529</td>
<td>-0.5%</td>
<td>3.5%</td>
<td>1.4%</td>
<td>22</td>
<td>46.0%</td>
</tr>
</tbody>
</table>

11 There is some discrepancy between these growth rates and the numbers in Figure 6 because the growth rates in Figure 6 are the result of the output of the BP procedure, whereas the numbers in the table (and used in Figure 8) are OLS estimated growth rates.

12 The equation, with coefficients estimated from all countries except Uganda, is: \(g^{\text{Predicted}}_{1969-1980} = 0.0065 + 0.191 \times g_{1980-1988} + 0.001 \times \ln(\text{GDPPC}_{1988})\) Hence plugging in the values of \(g_{1961-1969} = 0.30\) and \(\ln(824) = 6.71\), produces \(g^{\text{Predicted}}_{1969-1980} = 0.23\).

13 The equation for this episode is (the prediction equation is estimated for each episode):

\[g^{\text{Predicted}}_{1988-2010} = 0.0065 + 0.91 \times g_{1980-1988} + 0.001 \times \ln(\text{GDPPC}_{1988})\] And plugging in of \(g_{1980-1988} = -0.05\) and \(\ln(529) = 6.27\), produces \(g^{\text{Predicted}}_{1988-2010} = 0.14\).
The Dynamics of Economic Growth

Uganda

Figure 5: Single trend for Uganda

Figure 6: Breaks filtered from four possible B-P breaks: Uganda

Figure 7: Bai-Perron identified Break(s) for Uganda

Figure 8: Cumulative change in LGDPCC from start to end of episode compared to regression prediction over episode period: Uganda
Section II: Country Graphs

Afghanistan

Figure 5: Single trend for Afghanistan

Figure 6: Breaks filtered from two possible B−P breaks: Afghanistan

Figure 7: Bai–Perron identified Break(s) for Afghanistan

Figure 8: Cumulative change in Ln(GDPPC) from start to end of episode compared to regression prediction over episode period: Afghanistan
Albania

Figure 5: Single trend for Albania

Figure 6: Breaks filtered from two possible B-P breaks: Albania

Figure 7: Bai-Perron identified Break(s) for Albania

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Albania
The Dynamics of Economic Growth

Algeria

Figure 5: Single trend for Algeria

Figure 6: Breaks filtered from three possible R−P breaks: Algeria

Figure 7: Bai−Perron Identified Break(s) for Algeria

Figure 8: Cumulative change in log(GDP) from start to end of episode compared to regression prediction over episode period: Algeria
The Dynamics of Economic Growth

Angola

Figure 5: Single trend for Angola

Figure 6: Breaks filtered from two possible B-P breaks: Angola

Figure 7: Bai-Perron Identified Break(s) for Angola

Figure 8: Cumulative change in LogDPPC from start to end of episode compared to regression prediction over episode period: Angola
Figure 5: Single trend for Argentina

Figure 6: Breaks filtered from four possible B-P breaks: Argentina

Figure 7: Bai-Perron Identified Break(s) for Argentina

Figure 8: Cumulative change in LGDPFPC from start to end of episode compared to regression prediction over episode period: Argentina

Argentina
Australia

Figure 5: Single trend for Australia

Figure 6: Breaks filtered from four possible B–P breaks: Australia

Figure 7: Bai–Perron Identified Break(s) for Australia

Figure 8: Cumulative change in LGDPCC from start to end of episode compared to regression prediction over episode period: Australia
The Dynamics of Economic Growth

Benin

Figure 5: Single trend for Benin

Figure 6: Breaks filtered from three possible B−P breaks: Benin

Figure 7: Bai−Perron Identified Break(s) for Benin

Figure 8: Cumulative change in LGDP from start to end of episode compared to regression prediction over episode period: Benin
Botswana

Figure 5: Single trend for Botswana

Figure 6: Breaks filtered from three possible B-P breaks: Botswana

Figure 7: Bai-Perron Identified Break(s) for Botswana

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Botswana
Brazil
Bulgaria

Figure 5: Single trend for Bulgaria

Figure 6: Breaks filtered from two possible B-P breaks: Bulgaria

Figure 7: Bai-Perron Identified Break(s) for Bulgaria

Figure 8: Cumulative change in LGDPCC from start to end of episode compared to regression prediction over episode period: Bulgaria
Figure 5: Single trend for Burkina Faso

Figure 6: Breaks filtered from three possible B-P breaks: Burkina Faso

Figure 7: Bai-Perron Identified Break(s) for Burkina Faso

Figure 8: Cumulative change in log(GDP) from start to end of episode compared to regression prediction over episode period: Burkina Faso
Cambodia

Figure 5: Single trend for Cambodia

Figure 6: Breaks filtered from two possible B−P breaks: Cambodia

Figure 7: Bai–Perron Identified Break(s) for Cambodia

Figure 8: Cumulative change in LGDFP from start to end of episode compared to regression prediction over episode period: Cambodia
Cameroon

Figure 5: Single trend for Cameroon

Figure 6: Breaks filtered from three possible B-P breaks: Cameroon

Figure 7: Bai–Perron Identified Break(s) for Cameroon

Figure 8: Cumulative change in LSDDPC from start to end of episode compared to regression prediction over episode period: Cameroon
The Dynamics of Economic Growth

Central African Republic

Figure 5: Single trend for Central African Republic

Figure 6: Breaks filtered from three possible B-P breaks: Central African Rep

Figure 7: Bai–Perron identified Break(s) for Central African Republic

Figure 8: Cumulative change in LSQPPC from start to end of episode compared to regression prediction over episode period: Central African Rep.

Total: -0.30 Total: -0.44
Years: 10 Years: 14
Chad

**Figure 5:** Single trend for Chad

\[ g_t: 0.6 \]
\[ \beta_t: 0.19 \]
\[ \sigma: 8.4 \]

**Figure 6:** Breaks filtered from three possible B-P breaks: Chad

\[ g_t = 1.0 \]
\[ \sigma_t = 4.2 \]
\[ \beta_t = 5.2 \]

\[ g_t = 1.5 \]
\[ \sigma_t = 5.7 \]

\[ g_t = 6.8 \]
\[ \sigma_t = 5.3 \]

**Figure 7:** Bai-Perron identified Break(s) for Chad

\[ g_t: 0.0 \]
\[ \sigma: 6.6 \]

**Figure 8:** Cumulative change in ln(GDP) from start to end of episode compared to regression prediction over episode period: Chad

- Years: 20
  - Total: 0.40
- Years: 10
  - Total: 0.25
- Years: 9
  - Total: 0.45
The Dynamics of Economic Growth

Chile

Figure 5: Single trend for Chile

ln(GDPPC) vs. Years

Figure 6: Breaks filtered from four possible B-P breaks: Chile

ln(GDPPC) vs. Years

Figure 7: Bai-Perron identified Break(s) for Chile

ln(GDPPC) vs. Years

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Chile

Cumulative Change in ln(GDPPC) vs. Years

Total: 0.39
Years: 8
Total: -0.03
Years: -13

Years: 10
Years: 11
Total: 0.11
Total: 0.53
The Dynamics of Economic Growth

Colombia

Figure 5: Single trend for Colombia

Figure 6: Breaks filtered from four possible B–P breaks: Colombia

Figure 7: Bai–Perron identified Break(s) for Colombia

Figure 8: Cumulative change in LGDP from start to end of episode compared to regression prediction over episode period: Colombia
Congo, Dem Rep

Figure 5: Single trend for Congo, Dem. Rep.

Figure 6: Breaks filtered from four possible B-P breaks: Congo, Dem. Rep.

Figure 7: Bai-Perron Identified Break(s) for Congo, Dem. Rep.

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Congo, Dem. Rep.
The Dynamics of Economic Growth

Costa Rica

Figure 5: Single trend for Costa Rica

Figure 6: Breaks filtered from four possible B–P breaks: Costa Rica

Figure 7: Bai–Perron Identified Break(s) for Costa Rica

Figure 8: Cumulative change in LQDPPC from start to end of episode compared to regression prediction over episode period: Costa Rica

Total: -0.20
Years: 12
Total: -0.10
Years: 19

Total: -0.10
Years: 21
Total: 0.25
Years: 19
The Dynamics of Economic Growth

Cuba

Figure 5: Single trend for Cuba

Figure 6: Breaks filtered from two possible B-P breaks: Cuba

Figure 7: Bai-Perron Identified Break(s) for Cuba

Figure 8: Cumulative change in LQOFPC from start to end of episode
compared to regression prediction over episode period: Cuba
The Dynamics of Economic Growth

Cyprus

Figure 5: Single trend for Cyprus

Figure 6: Breaks filtered from four possible B-P breaks: Cyprus

Figure 7: Bai-Perron identified Break(s) for Cyprus

Figure 8: Cumulative change in LGDPCC from start to end of episode compared to regression prediction over episode period: Cyprus
The Dynamics of Economic Growth

Dominican Republic

Figure 5: Single trend for Dominican Republic

Figure 6: Breaks filtered from four possible B-P breaks: Dominican Republic

Figure 7: Bai–Perron identified break(s) for Dominican Republic

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Dominican Republic

180
The Dynamics of Economic Growth

Ecuador

Figure 5: Single trend for Ecuador

Figure 6: Breaks filtered from four possible B−P breaks: Ecuador

Figure 7: Bai−Perron Identified Break(s) for Ecuador

Figure 8: Cumulative change in ln(GDP/CPP) from start to end of episode compared to regression prediction over episode period: Ecuador

The Dynamics of Economic Growth
El Salvador

Figure 5: Single trend for El Salvador

Figure 6: Breaks filtered from four possible B-P breaks: El Salvador

Figure 7: Bai-Perron identified Break(s) for El Salvador

Figure 8: Cumulative change in LGDP/PC from start to end of episode compared to regression prediction over episode period: El Salvador
Ethiopia

Figure 5: Single trend for Ethiopia

Figure 6: Breaks filtered from four possible B-P breaks: Ethiopia

Figure 7: Bai-Perron identified Break(s) for Ethiopia

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Ethiopia
The Dynamics of Economic Growth

Figure 5: Single trend for Finland

Figure 6: Breaks filtered from four possible B-P breaks: Finland

Figure 7: Bai-Perron Identified Break(s) for Finland

Figure 8: Cumulative change in ln(GDP per capita) compared to regression prediction over episode period: Finland
The Dynamics of Economic Growth

France

Figure 5: Single trend for France

Figure 6: Breaks filtered from four possible R-P breaks: France

Figure 7: Bai-Perron Identified Break(s) for France

Figure 8: Cumulative change in ln(GDP)PC from start to end of episode compared to regression prediction over episode period: France
The Dynamics of Economic Growth

Gambia, The

Figure 5: Single trend for Gambia, The

Figure 6: Breaks filtered from three possible B-P breaks: Gambia, The

Figure 7: Bai-Perron Identified Break(s) for Gambia, The

Figure 8: Cumulative change in LGDPFC from start to end of episode compared to regression prediction over episode period: Gambia, The
Germany

Figure 5: Single trend for Germany

Figure 6: Breaks filtered from two possible B-P breaks: Germany

Figure 7: Bai-Perron identified break(s) for Germany

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Germany
Ghana

Figure 5: Single trend for Ghana

Figure 6: Breaks filtered from three possible B-P breaks: Ghana

Figure 7: Bai-Perron Identified Break(s) for Ghana

Figure 8: Cumulative change in log(GDP per capita) compared to regression prediction over episode period: Ghana
The Dynamics of Economic Growth

Greece

Figure 5: Single trend for Greece

Figure 6: Breaks filtered from four possible B–P breaks: Greece

Figure 7: Bai–Perron Identified Break(s) for Greece

Figure 8: Cumulative change in LGDP from start to end of episode compared to regression prediction over episode period: Greece
Guinea

Figure 5: Single trend for Guinea

Figure 6: Breaks filtered from three possible B-P breaks: Guinea

Figure 7: Bai-Perron Identified Break(s) for Guinea

Figure 8: Cumulative change in LSDPPC from start to end of episode compared to regression prediction over episode period: Guinea
The Dynamics of Economic Growth

Guinea-Bissau

Figure 5: Single trend for Guinea-Bissau

- g: -0.2
- ε: 0.05
- σ: 5.5

Figure 6: Breaks filtered from three possible B-P breaks: Guinea-Bissau

- g1: 4.7
- g2: -2.4
- g3: 1.7
- g4: -2.3

Figure 7: Bai-Perron identified Break(s) for Guinea-Bissau

Figure 8: Cumulative change in ln(GDP) from start to end of episode compared to regression prediction over episode period: Guinea-Bissau

- Total: -0.42
- Years: 11

- Total: -0.50
- Years: 13

- Total: 0.26
- Years: 16
Figure 5: Single trend for Haiti

Figure 6: Breaks filtered from three possible B-P breaks: Haiti

Figure 7: Bai-Perron identified Break(s) for Haiti

Figure 8: Cumulative change in LGDPFC from start to end of episode compared to regression prediction over episode period: Haiti
The Dynamics of Economic Growth

Honduras

Figure 5: Single trend for Honduras

Figure 6: Breaks filtered from four possible B-P breaks: Honduras

Figure 7: Bai-Perron Identified Break(s) for Honduras

Figure 8: Cumulative change in LGDPCC from start to end of episode compared to regression prediction over episode period: Honduras
The Dynamics of Economic Growth

Hong Kong SAR, China

Figure 5: Single trend for Hong Kong

Figure 6: Breaks filtered from three possible B-P breaks: Hong Kong

Figure 7: Bai-Perron Identified Break(s) for Hong Kong

Figure 8: Cumulative change in LQGFC from start to end of episode compared to regression prediction over episode period: Hong Kong
Hungary

Figure 5: Single trend for Hungary

Figure 6: Breaks filtered from two possible B-P breaks: Hungary

Figure 7: Bai-Perron identified break(s) for Hungary

Figure 8: Cumulative change in GDPPC from start to end of episode compared to regression prediction over episode period: Hungary
The Dynamics of Economic Growth

Figure 5: Single trend for India

Figure 6: Breaks filtered from four possible B-P breaks: India

Figure 7: Bai-Perron identified Break(s) for India

Figure 8: Cumulative change in LGDPFC from start to end of episode compared to regression prediction over episode period: India

India
Figure 5: Single trend for Israel

Figure 6: Breaks filtered from four possible B-P breaks: Israel

Figure 7: Bai–Perron identified break(s) for Israel

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Israel
Italy

Figure 5: Single trend for Italy

Figure 6: Breaks filtered from four possible B–P breaks: Italy

Figure 7: Bai–Perron identified Break(s) for Italy

Figure 8: Cumulative change in ln(GDP/PC) from start to end of episode compared to regression prediction over episode period: Italy
The Dynamics of Economic Growth

Jamaica

Figure 5: Single trend for Jamaica

Figure 6: Breaks filtered from four possible B−P breaks: Jamaica

Figure 7: Bai−Perron identified Break(s) for Jamaica

Figure 8: Cumulative change in LGDPCC from start to end of episode compared to regression prediction over episode period: Jamaica
The Dynamics of Economic Growth

Japan

Figure 5: Single trend for Japan

Figure 6: Breaks filtered from four possible B-P breaks: Japan

Figure 7: Bai-Perron Identified Break(s) for Japan

Figure 8: Cumulative change in LGDPFC compared to regression prediction over episode period: Japan
The Dynamics of Economic Growth

Figure 5: Single trend for Jordan

Figure 6: Breaks filtered from four possible B-P breaks: Jordan

Figure 7: Bai-Perron identified break(s) for Jordan

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Jordan
Kenya

Figure 5: Single trend for Kenya

\[ g_t = 0.2 \\
\text{Var} = 0.49 \\
\text{Max} = 4.4 \]

Years


L(GDPFC)

$\text{L}(\text{GDPFC})$


Figure 8: Cumulative change in \( \text{L}(\text{GDPFC}) \) during episode compared to regression prediction over episode period: Kenya

\[ \text{Total: } -0.44 \\
\text{Years: } 4.5 \]

Years


Figure 7: Bai-Perron identified break(s) for Kenya

\[ g_t = 0.2 \\
\text{No Breaks} \]

Years


L(GDPFC)

$\text{L}(\text{GDPFC})$


Figure 6: Breaks filtered from four possible B-P breaks: Kenya

\[ g_t = 1.2 \\
g_t = -1.4 \\
g_t = -2.6 \\
g_t = 2.6 \\
g_t = 2.6 \\
g_t = -1.8 \\
g_t = 2.2 \]

Years


L(GDPFC)

$\text{L}(\text{GDPFC})$
Korea, Rep.

Figure 5: Single trend for Korea, Republic of

Figure 6: Breaks filtered from four possible B-P breaks: Korea, Republic of

Figure 7: Bai-Perron identified Break(s) for Korea, Republic of

Figure 8: Cumulative change in LGDPCC from start to end of episode compared to regression prediction over episode period: Korea, Republic of
The Dynamics of Economic Growth

Figure 5: Single trend for Laos

Figure 6: Breaks filtered from two possible B–P breaks: Laos

Figure 7: Bai–Perron identified break(s) for Laos

Figure 8: Cumulative change in LGDPFPC from start to end of episode compared to regression prediction over episode period: Laos
Lebanon

Figure 5: Single trend for Lebanon

Figure 6: Breaks filtered from two possible B-P breaks: Lebanon

Figure 7: Bai-Perron identified Break(s) for Lebanon

Figure 8: Cumulative change in LGDPCC from start to end of episode compared to regression prediction over episode period: Lebanon
Lesotho

Figure 5: Single trend for Lesotho

\[ y_t = 2.3, \quad \delta_y = 0.93, \quad \delta_{\mu} = 7.1 \]

Figure 6: Breaks filtered from three possible B-P breaks: Lesotho

\[ g_1 = 2.9, \quad g_2 = 8.0, \quad g_3 = -3.2, \quad g_4 = 3.1 \]

Figure 7: Bai-Perron identified Break(s) for Lesotho

\[ g_1 = 5.2, \quad \delta_g = 0.2, \quad g_2 = 3.1, \quad \delta_g = 6.3 \]

Figure 8: Cumulative change in Ln(GDP) from start to end of episode compared to regression prediction over episode period: Lesotho

Total: 3.4
Years: 8
Years: 24
Total: 0.4
Total: 0.50
The Dynamics of Economic Growth

Madagascar

Figure 5: Single trend for Madagascar

\[ g_t = -1.1 \]
\[ \sigma_f = 0.84 \]
\[ \sigma_{df} = 4.1 \]

Years

Figure 6: Breaks filtered from three possible B–P breaks: Madagascar

\[ g_1 = 0.8 \]
\[ g_2 = -3.0 \]
\[ b_1 = 3.6 \]
\[ g_2 = 1.4 \]
\[ b_2 = 2.1 \]

Years

Figure 7: Bai–Perron identified Break(s) for Madagascar

\[ g_t = -1.1 \]
No Breaks

Years

Figure 8: Cumulative change in Ln(GDP) from start to end of episode compared to regression prediction over episode period: Madagascar

Total: -0.58

Years: 28

Total: -0.19

Years: 8
The Dynamics of Economic Growth

Malawi

Figure 5: Single trend for Malawi

Figure 6: Breaks filtered from four possible B-P breaks: Malawi

Figure 7: Bai-Perron identified break(s) for Malawi

Figure 8: Cumulative change in LogGDP from start to end of episode compared to regression prediction over episode period: Malawi
Malaysia

Figure 5: Single trend for Malaysia

Figure 6: Breaks filtered from three possible B-P breaks: Malaysia

Figure 7: Bai–Perron Identified Break(s) for Malaysia

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Malaysia
Mali

Figure 5: Single trend for Mali

Figure 6: Breaks filtered from three possible B-P breaks: Mali

Figure 7: Bai-Perron Identified Break(s) for Mali

Figure 8: Cumulative change in ln(GDP/C) from start to end of episode compared to regression prediction over episode period: Mali
Mauritius

Figure 5: Single trend for Mauritius

Figure 6: Breaks filtered from four possible B-P breaks: Mauritius

Figure 7: Bai-Perron identified Break(s) for Mauritius

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Mauritius
The Dynamics of Economic Growth

Mexico

Figure 5: Single trend for Mexico

Figure 6: Breaks filtered from four possible A–P breaks: Mexico

Figure 7: Bai–Perron Identified Break(s) for Mexico

Figure 8: Cumulative change in LGDPFC from start to end of episode compared to regression prediction over episode period: Mexico

Total: -0.3980
Years: 8
Years: 21
Mongolia

Figure 5: Single trend for Mongolia

Figure 6: Breaks filtered from two possible B-P breaks: Mongolia

Figure 7: Bai-Perron identified Break(s) for Mongolia

Figure 8: Cumulative change in LGDPC from start to end of episode compared to regression prediction over episode period: Mongolia
The Dynamics of Economic Growth

Morocco

Figure 5: Single trend for Morocco

Figure 6: Breaks filtered from four possible B-P breaks: Morocco

Figure 7: Bai-Perron identified Break(s) for Morocco

Figure 8: Cumulative change in L(IOPPC) from start to end of episode compared to regression prediction over episode period: Morocco
The Dynamics of Economic Growth

Mozambique

Figure 5: Single trend for Mozambique

Figure 6: Breaks filtered from three possible B–P breaks: Mozambique

Figure 7: Bai–Perron identified Break(s) for Mozambique

Figure 8: Cumulative change in LGDPCC from start to end of episode compared to regression prediction over episode period: Mozambique
New Zealand

Figure 5: Single trend for New Zealand

Figure 6: Breaks filtered from four possible B-P breaks: New Zealand

Figure 7: Bai-Perron identified Break(s) for New Zealand

Figure 8: Cumulative change in LGDP/c from start to end of episode compared to regression prediction over episode period: New Zealand
Nicaragua

Figure 5: Simple trend for Nicaragua

Figure 6: Breaks filtered from four possible B-P breaks: Nicaragua

Figure 7: Bai-Perron identified break(s) for Nicaragua

Figure 8: Cumulative change in LGDPFC from start to end of episode compared to regression prediction over episode period: Nicaragua
The Dynamics of Economic Growth

Niger

Figure 5: Single trend for Niger

Figure 6: Breaks filtered from three possible B-P breaks: Niger

Figure 7: Bai-Perron Identified Break(s) for Niger

Figure 8: Cumulative change in LGDPCC from start to end of episode compared to regression prediction over episode period: Niger
The Dynamics of Economic Growth

Nigeria

Figure 5: Single trend for Nigeria

Figure 6: Breaks filtered from four possible B-P breaks: Nigeria

Figure 7: Bai–Perron identified Break(s) for Nigeria

Figure 8: Cumulative change in LGDP_PC from start to end of episode compared to regression prediction over episode period: Nigeria
The Dynamics of Economic Growth

Norway

Figure 5: Single trend for Norway

Figure 6: Breaks filtered from four possible A-P breaks: Norway

Figure 7: Bai-Perron Identified Break(s) for Norway

Figure 8: Cumulative change in LGDPCC from start to end of episode compared to regression prediction over episode period: Norway
The Dynamics of Economic Growth

Oman

Figure 5: Single trend for Oman

Figure 6: Breaks filtered from two possible B-P breaks: Oman

Figure 7: Bai-Perron Identified Break(s) for Oman

Figure 8: Cumulative change in ln(GDP) from start to end of episode compared to regression prediction over episode period: Oman
Pakistan

Figure 5: Single trend for Pakistan

Figure 6: Breaks filtered from four possible B-P breaks: Pakistan

Figure 7: Bai-Perron Identified Break(s) for Pakistan

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Pakistan
Panama

Figure 5: Single trend for Panama

Figure 6: Breaks filtered from four possible B-P breaks: Panama

Figure 7: Bai-Perron identified Break(s) for Panama

Figure 8: Cumulative change in LQDPFC from start to end of episode compared to regression prediction over episode period: Panama
Papua New Guinea

Figure 5: Single trend for Papua New Guinea

Figure 6: Breaks filtered from three possible B-P breaks: Papua New Guinea

Figure 7: Bollerslev & Perron identified break(s) for Papua New Guinea

Figure 8: Cumulative change in LGDP from start to end of episode compared to regression prediction over episode period: Papua New Guinea
Paraguay

Figure 5: Single trend for Paraguay

Figure 6: Breaks filtered from four possible B-P breaks: Paraguay

Figure 7: Boll-Perron identified break(s) for Paraguay

Figure 8: Cumulative change in LQDPFC from start to end of episode compared to regression prediction over episode period: Paraguay
The Dynamics of Economic Growth

Peru

Figure 5: Single trend for Peru

Figure 6: Breaks filtered from four possible B-P breaks: Peru

Figure 7: Bai-Perron Identified Break(s) for Peru

Figure 8: Cumulative change in ln(GDP) from start to end of episode compared to regression prediction over episode period: Peru
The Dynamics of Economic Growth

Philippines

Figure 5: Single trend for Philippines

Figure 6: Breaks filtered from four possible B-P breaks: Philippines

Figure 7: Bai–Perron identified Break(s) for Philippines

Figure 8: Cumulative change in LGDPFC from start to end of episode compared to regression prediction over episode period: Philippines

Total: -0.24  Total: -0.14
Years: 18  Years: 8
Years: 25
Total: 0.04
Poland

Figure 5: Single trend for Poland

Figure 6: Breaks filtered from two possible B–P breaks; Poland

Figure 7: Bai–Perron identified Break(s) for Poland

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period; Poland
The Dynamics of Economic Growth

Portugal

Figure 5: Single trend for Portugal

Figure 6: Breaks filtered from four possible B–P breaks: Portugal

Figure 7: Bai–Perron Identified Break(s) for Portugal

Figure 8: Cumulative change in LGDP/PC from start to end of episode compared to regression prediction over episode period: Portugal
The Dynamics of Economic Growth

Puerto Rico

Figure 5: Single trend for Puerto Rico

Figure 6: Breaks filtered from four possible R-P breaks: Puerto Rico

Figure 7: Bai-Perron identified Break(s) for Puerto Rico

Figure 8: Cumulative change in LSGDPC from start to end of episode compared to regression prediction over episode period: Puerto Rico
Rwanda

Figure 5: Single trend for Rwanda

Figure 6: Breaks filtered from three possible B-P breaks: Rwanda

Figure 7: Bai-Perron identified Break(s) for Rwanda

Figure 8: Cumulative change in GDPPC from start to end of episode compared to regression prediction over episode period: Rwanda
The Dynamics of Economic Growth

**Figure 5:** Single trend for Senegal

- $g_t$: 0.1
- $R_t$: 0.02
- $s_{yr}$: 4.3

**Figure 6:** Breaks filtered from three possible B-P breaks: Senegal

- $g_t$: -1.5
- $g_t$: 1.4
- $g_t$: -2.9
- $g_t$: -2.5
- $g_t$: 1.7
- $g_t$: 2.9

**Figure 7:** Bai-Perron identified Break(s) for Senegal

- $g_t$: 0.1
- No Breaks

**Figure 8:** Cumulative change in GDPPC from start to end of episode compared to regression prediction over episode period: Senegal

- Cumulative Change in ln(GDPPC) during episode
- Years: 37
- Total: 0.05
Sierra Leone

Figure 5: Single trend for Sierra Leone

Figure 6: Breaks filtered from three possible B-P breaks: Sierra Leone

Figure 7: Bai-Perron identified break(s) for Sierra Leone

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Sierra Leone
The Dynamics of Economic Growth

Figure 5: Single trend for Singapore

Figure 6: Breaks filtered from three possible B-P breaks: Singapore

Figure 7: Bai-Perron identified Break(s) for Singapore

Figure 8: Cumulative change in LGDPFC from start to end of episode compared to regression prediction over episode period: Singapore
The Dynamics of Economic Growth

**Somalia**

**Figure 5: Single trend for Somalia**

\[ g = -1.8 \]
\[ R^2 = 0.86 \]
\[ a = 7.5 \]

**Years**


**Figure 6: Breaks filtered from two possible B–P breaks: Somalia**

\[ g_1 = 2.3 \]
\[ g_2 = 2.9 \]
\[ g_3 = -0.1 \]
\[ a_1 = 2.8 \]

**Years**


**Figure 7: Bai–Perron identified Break(s) for Somalia**

\[ g = -1.8 \]

No Breaks

**Years**


**Figure 8: Cumulative change in LGDP(c) from start to end of episode compared to regression prediction over episode period: Somalia**

- Total: -0.95
- Years: 32

**Cumulative Change in LGDP(c) during episode**

<table>
<thead>
<tr>
<th>Year</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>-0.8</td>
</tr>
<tr>
<td>1980</td>
<td>-0.2</td>
</tr>
<tr>
<td>1990</td>
<td>-0.3</td>
</tr>
<tr>
<td>2000</td>
<td>-0.57</td>
</tr>
</tbody>
</table>
South Africa

Figure 5: Single trend for South Africa

Figure 6: Breaks filtered from four possible B-P breaks: South Africa

Figure 7: Bai-Perron identified break(s) for South Africa

Figure 8: Cumulative change in log(GDP) from start to end of episode compared to regression prediction over episode period: South Africa
![Graph of Spain's economic growth with identified breaks and cumulative change in log(GDP per capita)](image-url)
The Dynamics of Economic Growth

Sri Lanka

Figure 5: Single trend for Sri Lanka

\[ g_t = 3.4 \]
\[ g_t = 0.98 \]
\[ 4.4 \]

Years

\(1950\)
\(1960\)
\(1970\)
\(1980\)
\(1990\)
\(2000\)
\(2010\)

Figure 6: Breaks filtered from four possible B–P breaks: Sri Lanka

\[ g_t = -0.4 \]
\[ g_t = 3.3 \]
\[ 3.8 \]
\[ 5.8 \]
\[ 2.4 \]
\[ 2.2 \]
\[ -3.5 \]
\[ 4.3 \]
\[ 2.0 \]

Years

\(1950\)
\(1960\)
\(1970\)
\(1980\)
\(1990\)
\(2000\)
\(2010\)

Figure 7: Bai–Perron identified break(s) for Sri Lanka

\[ g_t = -0.4 \]
\[ g_t = 3.9 \]
\[ 4.4 \]

Years

\(1950\)
\(1960\)
\(1970\)
\(1980\)
\(1990\)
\(2000\)
\(2010\)

Figure 8: Cumulative change in ln(GDP per capita) from start to end of episode compared to regression prediction over episode period: Sri Lanka

\(\text{Years: 14} \quad \text{Years: 8} \quad \text{Years: 29} \)
\(\text{Total: 0.23} \quad \text{Total: 0.23} \quad \text{Total: 0.52} \)
The Dynamics of Economic Growth

Sudan

Figure 5: Single trend for Sudan

Figure 6: Breaks filtered from two possible B-P breaks: Sudan

Figure 7: Bai-Perron Identified Break(s) for Sudan

Figure 8: Cumulative change in LGGDP from start to end of episode compared to regression prediction over episode period: Sudan
Swaziland

Figure 5: Single trend for Swaziland

Figure 6: Breaks filtered from two possible B-P breaks: Swaziland

Figure 7: Bai-Perron Identified Break(s) for Swaziland

Figure 8: Cumulative change in LGDPFC from start to end of episode compared to regression prediction over episode period: Swaziland
The Dynamics of Economic Growth

Sweden

Figure 5: Single trend for Sweden

Figure 6: Breaks filtered from four possible B-P breaks: Sweden

Figure 7: Bai-Perron Identified Break(s) for Sweden

Figure 8: Cumulative change in L(GDPPC) from start to end of episode compared to regression prediction over episode period: Sweden
The Dynamics of Economic Growth

Syrian Arab Republic

Figure 5: Single trend for Syria

Figure 6: Breaks filtered from three possible B-P breaks: Syria

Figure 7: Bai-Perron identified Break(s) for Syria

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Syria
Taiwan

Figure 5: Single trend for Taiwan

\[
\begin{align*}
\text{L}(\text{GDPPC}) & \quad 6.2 & 7.4 & 7.8 & 8.0 & 8.2 & 8.4 & 8.6 \\
\end{align*}
\]

\[
\begin{align*}
g_1 &= 5.9 \\
g_2 &= 0.99 \\
\sigma_g &= 3.0 \\
\end{align*}
\]

Figure 6: Breaks filtered from four possible B-P breaks: Taiwan

\[
\begin{align*}
\text{L}(\text{GDPPC}) & \quad 6.2 & 7.4 & 7.8 & 8.0 & 8.2 & 8.4 & 8.6 \\
\end{align*}
\]

\[
\begin{align*}
g_1 &= 4.5 & g_2 &= 6.2 & g_3 &= 3.6 & g_4 &= 5.8 & g_5 &= 7.4 & g_6 &= 3.9 \\
\delta g &= -3.4 & \delta g &= -3.6 & \delta g &= -3.4 & \delta g &= -3.6 \\
\end{align*}
\]

Figure 7: Bai-Perron identified Break(s) for Taiwan

\[
\begin{align*}
\text{L}(\text{GDPPC}) & \quad 6.2 & 7.4 & 7.8 & 8.0 & 8.2 & 8.4 & 8.6 \\
\end{align*}
\]

\[
\begin{align*}
g_1 &= 6.4 & g_2 &= 3.8 & \delta g &= -2.6 \\
\end{align*}
\]

Figure 8: Cumulative change in L(GDPPC) from start to end of episode compared to regression prediction over episode period: Taiwan

\[
\begin{align*}
\text{Cumulative Change in L(GDPPC) during episode} & \quad -0.3 & 0.3 & 0.7 & -0.1 & 0.2 \quad \text{Total: 1.40} \\
\text{Cumulative Change in L(GDPPC) during episode} & \quad -0.1 & -0.5 & -0.6 & -0.8 \quad \text{Total: 0.03} \\
\end{align*}
\]
Tanzania

Figure 5: Single trend for Tanzania

Figure 6: Breaks filtered from three possible B-P breaks: Tanzania

Figure 7: Bai-Perron identified Break(s) for Tanzania

Figure 8: Cumulative change in LGDPCC from start to end of episode compared to regression prediction over episode period: Tanzania
The Dynamics of Economic Growth

Thailand

Figure 5: Single trend for Thailand

Figure 6: Breaks filtered from four possible B-P breaks: Thailand

Figure 7: Bai-Perron Identified Break(s) for Thailand

Figure 8: Cumulative change in LQ(DPFC) from start to end of episode compared to regression prediction over episode period: Thailand
The Dynamics of Economic Growth

Figure 5: Single trend for Togo

Figure 6: Breaks filtered from three possible B-P breaks: Togo

Figure 7: Bai-Perron Identified Break(s) for Togo

Figure 8: Cumulative change in LSGDPPC from start to end of episode compared to regression prediction over episode period: Togo
Trinidad and Tobago

Figure 5: Single trend for Trinidad & Tobago

Figure 6: Breaks filtered from four possible B–P breaks; Trinidad & Tobago

Figure 7: Bai–Perron identified Break(s) for Trinidad & Tobago

Figure 8: Cumulative change in LGDPFC from start to end of episode compared to regression prediction over episode period; Trinidad & Tobago
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Tunisia

Figure 5: Single trend for Tunisia

Figure 6: Breaks filtered from three possible B-P breaks; Tunisia

Figure 7: Bai-Perron identified break(s) for Tunisia

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period; Tunisia

Years: 9  Years: 29
Total: 0.12 Total: 0.03
Turkey

Figure 5: Single trend for Turkey

Figure 6: Breaks filtered from four possible B-P breaks: Turkey

Figure 7: Bai-Perron Identified Break(s) for Turkey

Figure 8: Cumulative change in LGDPFC from start to end of episode compared to regression prediction over episode period: Turkey
United Kingdom

Figure 5: Single trend for United Kingdom

Figure 6: Breaks filtered from four possible B-P breaks: United Kingdom

Figure 7: Bai-Perron identified break(s) for United Kingdom

Figure 8: Cumulative change in ln(GDPPC) from start to end of episode compared to regression prediction over episode period: United Kingdom
Uruguay

Figure 5: Single trend for Uruguay

Figure 6: Breaks filtered from four possible R-P breaks: Uruguay

Figure 7: Bai-Perron identified Break(s) for Uruguay

Figure 8: Cumulative change in LGDPFC from start to end of episode compared to regression prediction over episode period: Uruguay
Figure 5: Single trend for Vietnam

Figure 6: Breaks filtered from two possible B-P breaks: Vietnam

Figure 7: Bai-Perron Identified Break(s) for Vietnam

Figure 8: Cumulative change in LGDPFPC from start to end of episode compared to regression prediction over episode period: Vietnam
Zambia

Figure 5: Single trend for Zambia

Figure 6: Breaks filtered from three possible B–P breaks: Zambia

Figure 7: Bai–Perron identified Break(s) for Zambia

Figure 8: Cumulative change in LnGDP per capita from start to end of episode compared to regression prediction over episode period: Zambia
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Zimbabwe

Figure 5: Single trend for Zimbabwe

Figure 6: Breaks filtered from four possible B-P breaks: Zimbabwe

Figure 7: Bai-Perron identified Break(s) for Zimbabwe

Figure 8: Cumulative change in log(GDPPC) from start to end of episode compared to regression prediction over episode period: Zimbabwe
Figure 9: Surface Plot of Transition Probability Function

Figure 10: Contour Plot of Transition Probability Function
Part IV

Conclusions
Part IV: Conclusions

All happy families are alike, every unhappy family is unhappy in its own way.

TOLSTOY, ANNA KARENINA

What would “growth theory” be a theory of? As we see graphically, in the “happy” families of the rich industrial countries the traditional decomposition of the evolution of output per capita into “trend” and “cycle” makes lots of sense. Their growth rates are moderate, volatility is low and growth transitions are within a small range (no busts, no huge booms). The distinction between a “growth theory” (and empirics) that explains “the” growth rate (in either “exogenous” or “endogenous” variants) and a theory (and empirics) that explains the “cyclical” variations around that trend (macroeconomics) again makes sense.

However, almost no developing countries’ growth experiences fit that pattern. Our primary goal for this “visual handbook” is to make it easy for people to look at the country growth experiences.

Part II summarizes each country’s growth experience in a series of exactly comparable graphs that illustrate the different dimensions of growth from the simplest overall trend (Figure 1) to relative long-run performance (Figure 2) to growth volatility (Figure 3) to distribution across “growth regimes” (Figure 4).

Part III also produces new comparable graphs focused on documenting the timing and magnitude of “breaks” or “episodes” or “regime transitions” from the application of the standard statistical procedure (Figure 6) to a classification of growth breaks based on the magnitude of growth shifts (Figure 7) to estimates of the cumulative magnitude of growth episodes (Figure 8).

Unlike most papers that propose and defend a particular causal model (or add a new variable to an existing model) or propose an explanation of some phenomenon, our goal is to illustrate that there is an interesting phenomenon to be explained. There is nothing about the dynamics of economic growth – the apparent shifts across growth regimes – that is well-explained by either “growth theory” or “business cycle macroeconomics” of the first or second generation varieties. But these dynamics are empirically important – indeed in some instances “staggering” in magnitude.
References


Penn World Tables, 7.1 version, Center for International Comparisons of Production, Income and Prices (CIC), University of Pennsylvania, available online: https://pwt.sas.upenn.edu/php_site/pwt71/pwt71_form.php


Appendix 1: Methods to Identify Growth Breaks

The methodology used to identify growth breaks in the literature can be classified as either one of two distinct approaches, namely, the “filter-based” approach and the “statistical break test-based” approach. The “filter” approach identifies growth changes as “breaks” on the basis of statistical tests plus the magnitude of the change in growth before and after a break against a subjectively defined threshold (e.g. Hausmann et al., 2005). The “statistical” approach uses estimation and testing procedures that identify growth breaks in terms of statistically significant changes in (average) growth rates (e.g. Jones and Olken, 2008; Berg et al., 2012; Kerekes, 2011).

All of the essential differences between “filter based” and “statistical” approaches come in the second stage of deciding which of the “candidate” break years identified by choosing years that maximize a test statistic (or, equivalently, minimizing the Sum of Squared Errors (SSE) under constraints) represents a “true” break.

The strongest criticism of the BP methodology is that it has low statistical power, leading to rejection of structural breaks even when they are “true” breaks. Moreover, since the statistical power of the test is dependent on the underlying volatility of the GDPPC series, the BP procedure may “reject” the null and identify as a “true” break a shift in growth rates with an acceleration from $g=1$ to $g=3.5$, $Δg=2.5$ in one country and “fail to reject” a break of the exact same magnitude in another country with higher volatility.

The literature has tried to deal with this problem in two ways. One set of papers (Jones and Olken, 2008; Kerekes, 2011) have accepted this shortcoming and stressed that although the set of breaks identified in their studies are a subset of the complete set of “true” breaks, the breaks that are identified are very large in magnitude and analysis of these breaks can throw light on growth transitions, even if others are excluded. Jones and Olken allow the minimum length of the growth regimes to vary depending on the length of the data available (which differs from country to country in the Penn World Tables). Kerekes (2011) fixes the shortest growth at eight years for all countries.

A second approach (Berg et al., 2012) makes methodological changes to the BP tests in order to increase the power of these tests. One important outcome of the methodological differences in these studies is that, as contributions using a common framework, they fail to identify a largely common set of breaks, even for the historical data (Kar et al., 2013). This clearly leads to serious concerns about the cohesiveness of the literature on growth breaks.

In Figure 6, for each country, we provide the year of the growth break if we...
only used BP to identify breaks in growth. Generally speaking, the timings of our breaks coincide with Berg et al. (2012). We find more breaks than Jones-Olken and Kerekes, both of which use a pure statistical approach. We also find more breaks with our “BP plus filter” approach as compared with using BP only, which, as we noted, with its low power, tends to accept the null hypothesis of no break more often than may be justified by the time-series data of GDPPC for several countries.