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.

ESID partners include the Institute for Economic Growth, India, BRAC Development Institute, Bangladesh, University of Malawi, Centre for Democratic Development, Ghana, University of Cape Town, South Africa and the Centre for International Development at the Kennedy School of Government, Harvard University, USA, as well as research associates in Rwanda, the UK and elsewhere.

ESID research will investigate the political drivers of inclusive development, particularly how state capacity and elite commitment can emerge and be sustained and how to support these processes. There will be a central focus on the role of power relations and dominant ideas in shaping developmental forms of state capacity and elite commitment.

The centre has a strong focus on capacity strengthening, building partnerships and networks and exchanging knowledge and experience.
The Dynamics of Economic Growth: A Visual Handbook of Growth Rates, Regimes, Transitions and Volatility

Sabyasachi Kar¹
Lant Pritchett²
Selim Raihan³
Kunal Sen⁴

¹ Institute of Economic Growth, Delhi, India
² Harvard Kennedy School and CID, USA
³ Department of Economics, University of Dhaka, and South Asian Network on Economic Modeling (SANEM), Bangladesh
⁴ IDPM and BWPJ, University of Manchester, UK and Joint Research Director, ESID
# Table of Contents

List of Symbols and Abbreviations .................................................. vi
List of Country Codes ...................................................................... vii
Acknowledgements ......................................................................... ix
Abstract .......................................................................................... x

**Part I: Economic Growth: Getting the Question Right** ............................................. 1

**Part II:** ......................................................................................... 5
   **Section I:** Everything You Always Wanted to Know About Growth ............ 6
   **Section II:** Country Graphs (Figures 1-4) ............................................. 14

**Part III:** ....................................................................................... 139
   **Section I:** Viewing Economic Growth as Transitions in Growth Regimes ... 140
   **Section II:** Country Graphs (Figures 5-8) ............................................. 149

**Part IV: Conclusions** ..................................................................... 275

References ....................................................................................... 277

Appendix 1: Methods to Identify Growth Breaks ................................................. 280
## List of Symbols and Abbreviations

### Abbreviations

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

### Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln</td>
<td>Natural Log</td>
</tr>
<tr>
<td>g</td>
<td>Average Annual Growth Rate</td>
</tr>
<tr>
<td>$R^2$</td>
<td>Co-Efficient of Determination</td>
</tr>
<tr>
<td>SD</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>$\Delta g$</td>
<td>Change in Growth Rate</td>
</tr>
</tbody>
</table>
## List of Country Codes

<table>
<thead>
<tr>
<th>Country</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>AFG</td>
</tr>
<tr>
<td>Albania</td>
<td>ALB</td>
</tr>
<tr>
<td>Algeria</td>
<td>DZA</td>
</tr>
<tr>
<td>Angola</td>
<td>AGO</td>
</tr>
<tr>
<td>Argentina</td>
<td>ARG</td>
</tr>
<tr>
<td>Australia</td>
<td>AUS</td>
</tr>
<tr>
<td>Austria</td>
<td>AUT</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>BGD</td>
</tr>
<tr>
<td>Belgium</td>
<td>BEL</td>
</tr>
<tr>
<td>Benin</td>
<td>BEN</td>
</tr>
<tr>
<td>Bolivia</td>
<td>BOL</td>
</tr>
<tr>
<td>Botswana</td>
<td>BWA</td>
</tr>
<tr>
<td>Brazil</td>
<td>BRA</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>BGR</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>BFA</td>
</tr>
<tr>
<td>Burundi</td>
<td>BDI</td>
</tr>
<tr>
<td>Cambodia</td>
<td>KHM</td>
</tr>
<tr>
<td>Cameroon</td>
<td>CMR</td>
</tr>
<tr>
<td>Canada</td>
<td>CAN</td>
</tr>
<tr>
<td>Central African Republic</td>
<td>CAF</td>
</tr>
<tr>
<td>Chad</td>
<td>TCD</td>
</tr>
<tr>
<td>Chile</td>
<td>CHL</td>
</tr>
<tr>
<td>China</td>
<td>CHN</td>
</tr>
<tr>
<td>Colombia</td>
<td>COL</td>
</tr>
<tr>
<td>Congo, Rep.</td>
<td>COG</td>
</tr>
<tr>
<td>Congo, Dem Rep.</td>
<td>ZAR</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>CRI</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>CIV</td>
</tr>
<tr>
<td>Cuba</td>
<td>CUB</td>
</tr>
<tr>
<td>Cyprus</td>
<td>CYP</td>
</tr>
<tr>
<td>Denmark</td>
<td>DNK</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>DOM</td>
</tr>
<tr>
<td>Ecuador</td>
<td>ECU</td>
</tr>
<tr>
<td>Egypt, Arab Rep.</td>
<td>EGY</td>
</tr>
<tr>
<td>El Salvador</td>
<td>SLV</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>ETH</td>
</tr>
<tr>
<td>Fiji</td>
<td>FJI</td>
</tr>
<tr>
<td>Finland</td>
<td>FIN</td>
</tr>
<tr>
<td>France</td>
<td>FRA</td>
</tr>
<tr>
<td>Gabon</td>
<td>GAB</td>
</tr>
<tr>
<td>Gambia, The</td>
<td>GMB</td>
</tr>
<tr>
<td>Germany</td>
<td>DEU</td>
</tr>
<tr>
<td>Ghana</td>
<td>GHA</td>
</tr>
<tr>
<td>Greece</td>
<td>GRC</td>
</tr>
<tr>
<td>Guatemala</td>
<td>GTM</td>
</tr>
<tr>
<td>Guinea</td>
<td>GIN</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>GNB</td>
</tr>
<tr>
<td>Guyana</td>
<td>GUY</td>
</tr>
<tr>
<td>Haiti</td>
<td>HTI</td>
</tr>
<tr>
<td>Honduras</td>
<td>HND</td>
</tr>
<tr>
<td>Hong Kong SAR, China</td>
<td>HKG</td>
</tr>
<tr>
<td>Hungary</td>
<td>HUN</td>
</tr>
<tr>
<td>India</td>
<td>IND</td>
</tr>
<tr>
<td>Indonesia</td>
<td>IDN</td>
</tr>
<tr>
<td>Iran, Islamic Rep.</td>
<td>IRN</td>
</tr>
<tr>
<td>Iraq</td>
<td>IRQ</td>
</tr>
<tr>
<td>Ireland</td>
<td>IRL</td>
</tr>
<tr>
<td>Israel</td>
<td>ISR</td>
</tr>
<tr>
<td>Italy</td>
<td>ITA</td>
</tr>
<tr>
<td>Jamaica</td>
<td>JAM</td>
</tr>
<tr>
<td>Country</td>
<td>Code</td>
</tr>
<tr>
<td>------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Japan</td>
<td>JPN</td>
</tr>
<tr>
<td>Jordan</td>
<td>JOR</td>
</tr>
<tr>
<td>Kenya</td>
<td>KEN</td>
</tr>
<tr>
<td>Korea, Rep.</td>
<td>KOR</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>LAO</td>
</tr>
<tr>
<td>Lebanon</td>
<td>LBN</td>
</tr>
<tr>
<td>Lesotho</td>
<td>LSO</td>
</tr>
<tr>
<td>Liberia</td>
<td>LBR</td>
</tr>
<tr>
<td>Madagascar</td>
<td>MDG</td>
</tr>
<tr>
<td>Malawi</td>
<td>MWI</td>
</tr>
<tr>
<td>Malaysia</td>
<td>MYS</td>
</tr>
<tr>
<td>Mali</td>
<td>MLI</td>
</tr>
<tr>
<td>Mauritania</td>
<td>MRT</td>
</tr>
<tr>
<td>Mauritius</td>
<td>MUS</td>
</tr>
<tr>
<td>Mexico</td>
<td>MEX</td>
</tr>
<tr>
<td>Mongolia</td>
<td>MNG</td>
</tr>
<tr>
<td>Morocco</td>
<td>MAR</td>
</tr>
<tr>
<td>Mozambique</td>
<td>MOZ</td>
</tr>
<tr>
<td>Namibia</td>
<td>NAM</td>
</tr>
<tr>
<td>Nepal</td>
<td>NPL</td>
</tr>
<tr>
<td>Netherlands</td>
<td>NLD</td>
</tr>
<tr>
<td>New Zealand</td>
<td>NZL</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>NIC</td>
</tr>
<tr>
<td>Niger</td>
<td>NER</td>
</tr>
<tr>
<td>Nigeria</td>
<td>NGA</td>
</tr>
<tr>
<td>Norway</td>
<td>NOR</td>
</tr>
<tr>
<td>Oman</td>
<td>OMN</td>
</tr>
<tr>
<td>Pakistan</td>
<td>PAK</td>
</tr>
<tr>
<td>Panama</td>
<td>PAN</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>PNG</td>
</tr>
<tr>
<td>Paraguay</td>
<td>PRY</td>
</tr>
<tr>
<td>Peru</td>
<td>PER</td>
</tr>
<tr>
<td>Philippines</td>
<td>PHL</td>
</tr>
<tr>
<td>Poland</td>
<td>POL</td>
</tr>
<tr>
<td>Portugal</td>
<td>PRT</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>PRI</td>
</tr>
<tr>
<td>Romania</td>
<td>ROM</td>
</tr>
<tr>
<td>Rwanda</td>
<td>RWA</td>
</tr>
<tr>
<td>Senegal</td>
<td>SEN</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>SLE</td>
</tr>
<tr>
<td>Singapore</td>
<td>SGP</td>
</tr>
<tr>
<td>Somalia</td>
<td>SOM</td>
</tr>
<tr>
<td>South Africa</td>
<td>ZAF</td>
</tr>
<tr>
<td>Spain</td>
<td>ESP</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>LKA</td>
</tr>
<tr>
<td>Sudan</td>
<td>SDN</td>
</tr>
<tr>
<td>Swaziland</td>
<td>SWZ</td>
</tr>
<tr>
<td>Sweden</td>
<td>SWE</td>
</tr>
<tr>
<td>Switzerland</td>
<td>CHE</td>
</tr>
<tr>
<td>Syrian Arab Republic</td>
<td>SYR</td>
</tr>
<tr>
<td>Taiwan</td>
<td>TWN</td>
</tr>
<tr>
<td>Tanzania</td>
<td>TZA</td>
</tr>
<tr>
<td>Thailand</td>
<td>THA</td>
</tr>
<tr>
<td>Togo</td>
<td>TGO</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>TTO</td>
</tr>
<tr>
<td>Tunisia</td>
<td>TUN</td>
</tr>
<tr>
<td>Turkey</td>
<td>TUR</td>
</tr>
<tr>
<td>Uganda</td>
<td>UGA</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>GBR</td>
</tr>
<tr>
<td>United States</td>
<td>USA</td>
</tr>
<tr>
<td>Uruguay</td>
<td>URY</td>
</tr>
<tr>
<td>Venezuela, RB</td>
<td>VEN</td>
</tr>
<tr>
<td>Vietnam</td>
<td>VNM</td>
</tr>
<tr>
<td>Zambia</td>
<td>ZMB</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>ZWE</td>
</tr>
</tbody>
</table>
Acknowledgements

This handbook would have not been possible without the able research assistance of Jagadish Sahu, Sitakanta Panda, Debajit Jha (all at Institute of Economic Growth, India), Mir Tanzim Nur Angkur (SANEM), and Aroni Barkat (SANEM and Department of Economics, University of Dhaka). We are grateful to all these individuals for their help. The genesis of the handbook occurred during a meeting in SANEM in November 2012, and we would like to thank Sk. Ashibur Rahman, P.S. to the Executive Director, SANEM, who made sure that the logistics of the meeting were taken care of smoothly. We would also like to thank Aarti Krishnan at the University of Manchester for her editorial support and Julia Brunt, Programme Manager of ESID, also at the University of Manchester, for ably guiding the production process from start to finish. Finally, we would like to thank Monika Kerekes for providing the STATA algorithm to run the Bai-Perron test.
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 the 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
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.

Nobel Laureate Robert E. Lucas 1988, P. 5

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. Lucas’s writings were confirmed only a few years later – as 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.
The Dynamics of Economic Growth

(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. A staggering gain of USD 8 trillion!

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.1 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

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.
and horizontal scales to the data of the particular country, the visual “slope” of 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 interested 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.

---

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 0.1 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 $\sigma_{\Delta Y} < 3.0$ –
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 $g = 4.8$ 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></th>
<th>( g &gt; 0 )</th>
<th>( \sigma_{\Delta y} &gt; 3.0 )</th>
<th>( g &lt; 0 )</th>
<th>( \sigma_{\Delta y} &lt; 3.0 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 0 &lt; R^2 &lt; 0.5 )</td>
<td>AFO, ALB, BDI, BGD, BOL, CIV, CMR, ETH, GAB, GHA, GUY, IRN, JOR, KEN, LBN, MNG, MWI, NAM, PNG, POL, RWI, SEN, SLE, TCD, UGA, VEN, ZWE</td>
<td></td>
<td>AFG, GIN, GMB, GNB, HTI, IRQ, NGA, NIC, TGO, ZMB</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>GTM, ZAF</td>
<td>LBR, MDG, NER, SOM, ZAR</td>
<td></td>
</tr>
<tr>
<td>( 0.9 \leq R^2 &lt; 1 )</td>
<td>AUS, 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>AUT, BEL, CAN, COL, DNK, FRA, GBR, DEU, ITA, NLD, NOR, PAK, SWE, USA</td>
<td>CAF</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.\(^7\) 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

\[^7\] These two being linked of course by the formula: Ratio \(\frac{y_{t+N}/y_t}{(1+g)^N}\), 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 GDPPC: 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 GDP: CPC: Afghanistan

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

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

Average growth = -1.7
Albania

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

Figure 2: Initial and Final level of GDPPC: Albania

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

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

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>1.7</td>
</tr>
<tr>
<td>1960</td>
<td>-4.3</td>
</tr>
<tr>
<td>1965</td>
<td>-0.5</td>
</tr>
<tr>
<td>1970</td>
<td>0.6</td>
</tr>
<tr>
<td>1975</td>
<td>2.3</td>
</tr>
<tr>
<td>1980</td>
<td>5.3</td>
</tr>
<tr>
<td>1985</td>
<td>10.7</td>
</tr>
<tr>
<td>1990</td>
<td>15.0</td>
</tr>
<tr>
<td>1995</td>
<td>19.8</td>
</tr>
<tr>
<td>2000</td>
<td>25.6</td>
</tr>
<tr>
<td>2005</td>
<td>31.4</td>
</tr>
<tr>
<td>2010</td>
<td>37.2</td>
</tr>
</tbody>
</table>

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

- Level of GDP per capita, 1970: 5164
- Level of GDP per capita, 2010: 15363

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

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

- Growth rates categories: -2.0 to -0.5, 0.0 to 2.0, 2.0 to 4.0, 4.0 to 6.0, 6.0 and above
- Average growth rate: 1.3

Legend:
- All Countries
- Angola
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: First differences and five year MA: Argentina

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

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

Figure 2: Initial and final level of GDPPC: Australia

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

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

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

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

Figure 3: (in) First differences and five year MA: Belgium

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

Benin

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

Figure 2: Initial and Final level of GDPPC: Benin

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

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

Average growth 1.0
The Dynamics of Economic Growth

Bolivia

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

Figure 2: Initial and final level of GDP: Bolivia

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

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

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

Figure 2: Initial and final level of GDPPC: Botswana

Figure 3: (in) 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
The Dynamics of Economic Growth

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
The Dynamics of Economic Growth

Burkina Faso

Figure 1: Overall, ten, and five year growth rates: Burkina Faso

Figure 2: Initial and Final level of GDPPC: Burkina Faso

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

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

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

Average growth 0.3
Cambodia

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

Figure 2: Initial and Final level of GDPPC: 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 GDPPC: Cameroon

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

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

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

Figure 2: Initial and final level of GDP per capita: Central African Republic

Figure 3: In First Differences and five year MA: Central African Republic

Figure 4: Distribution of all 8 year growth rates: Central African Republic 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 8 year growth rates
Chad vs. world
Figure 1: Overall, ten, and five year growth rates: Chile

Figure 2: Initial and final level of GDP/PC: Chile

Figure 3: (in) First differences and five year MA: Chile

Figure 4: Distribution of all 8 year growth rates: Chile vs. world
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(GDP) First Differences and five year MA: China Version 1

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

Figure 2: Initial and final level of GDPPC: Colombia

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

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

Congo, Rep.

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

Figure 2: Initial and final level of GDPPC; Congo, Republic of

Figure 3: \( \ln(GDPPC) \) for Congo, Republic of

Figure 4: Distribution of all 8 year growth rates. Congo, Republic of vs. world
Congo, Dem Rep.

Figure 1: Overall, ten, and five year growth rates: Congo, Dem. Rep.

Figure 2: Initial and final level of GDP per capita: 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
Costa Rica

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

Figure 2: Initial and final level of GDP per Capita: 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
Côte d'Ivoire

Figure 1: Overall, ten, and five year growth rates: Côte d'Ivoire

Figure 2: Initial and final level of GDP/PC: Côte d'Ivoire

Figure 3: (in) First Differences and five year MA: Côte d'Ivoire

Figure 4: Distribution of all 8 year growth rates
Côte d'Ivoire vs. world
Cuba

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

- g1: 1.5
- R²: 0.55
- σ₁₆: 5.5

Years
GDP/CAP
2.9 3.0 6.8 -0.3 -6.7 3.0 4.3 4.7

Figure 2: Initial and final level of GDP/CAP: Cuba

- Level of GDP/CAP, 2010
- Level of GDP/CAP, 1970

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

First Differences in GDP/CAP

Years
-0.08 -0.02 0.02 0.04 0.06 0.08

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

- Fraction of growth rates in category
- Growth categories

- 1.5
- All Countries
- Cuba

Average growth: 1.5
The Dynamics of Economic Growth

Cyprus

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

Figure 2: Initial and final level of GDPPC: Cyprus

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

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

Average growth 3.5
The Dynamics of Economic Growth

Denmark

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

Figure 2: Initial and Final level of GDP: Denmark

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

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

Dominican Republic

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

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

Average growth 2.5
Ecuador

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

Figure 2: Initial and Final level of GDPPC: Ecuador

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

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

Average growth 1.7
Egypt, Arab Rep.

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

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

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

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

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 GDPPC: 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

El Salvador
The Dynamics of Economic Growth

Ethiopia

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

Figure 2: Initial and final level of GDPPC: Ethiopia

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

Figure 4: Distribution of all 8 year growth rates
Ethiopia 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
France

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

Figure 2: Initial and final level of GDPPC: France

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

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

52
The Dynamics of Economic Growth

Gabon

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

Figure 2: Initial and Final level of GDPPC: Gabon

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

Figure 4: Distribution of all 8 year growth rates

Gabon vs. world
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
Germany

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

Figure 2: Initial and final level of GDP_PC; Germany

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

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

The Dynamics of Economic Growth
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
Guinea

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

Figure 2: Initial and final level of GDPPC: Guinea

Figure 3: (ln) 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 GDPPPC: Guinea-Bissau

Figure 3: (ln) First differences and five year MA: Guinea-Bissau

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

Average growth: -0.2
Guyana

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

Figure 2: Initial and final level of GDPPC: Guyana

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

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

The Dynamics of Economic Growth
Haiti

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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth Rate</td>
<td>1.4</td>
<td>3.1</td>
<td>-2.5</td>
<td>0.2</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Figure 2: Initial and Final level of GPPPC: Haiti

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

Figure 4: Distribution of all 8 year growth rates

Haiti vs. world

Average growth -0.2
Honduras

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

Figure 2: Initial and final level of GDPPC: Honduras

Figure 3: (in) 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 GDPPC: Hungary

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

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

<table>
<thead>
<tr>
<th>g</th>
<th>2.0</th>
<th>-2.0</th>
<th>0.0</th>
<th>0.0</th>
<th>2.0</th>
<th>4.0</th>
<th>6.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Countries</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Hungary</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Average growth 1.5
The Dynamics of Economic Growth

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

Figure 2: Initial and final level of GDPPC: India

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

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

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

Figure 2: Initial and final level of GDPPC: Indonesia

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

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

The Dynamics of Economic Growth
Iran, Islamic Rep.

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

Figure 2: Initial and final level of GDPPC: Iran

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

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

Average growth 1.2
Iraq

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

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

Figure 3: First differences and five year MA: Iraq

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

Dynamics of Economic Growth
The Dynamics of Economic Growth

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
The Dynamics of Economic Growth

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
The Dynamics of Economic Growth

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
The Dynamics of Economic Growth

Jordan

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

Figure 2: Initial and final level of GDPPC: Jordan

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

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

Figure 2: Initial and Final level of GDP: Kenya

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

Figure 4: Distribution of all 8 year growth rates

Kenya vs. world
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: (ln) 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

Lao PDR

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

Figure 2: Initial and final level of GPPPC: Laos

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

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

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

Figure 2: Initial and final level of GDPPC: Lebanon

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

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

Lebanon
The Dynamics of Economic Growth

Lesotho

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

Figure 2: Initial and Final level of GDP: Lesotho

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

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

Madagascar

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

Figure 2: Initial and final level of GDPPC: Madagascar

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

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

Malawi

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

Figure 2: Initial and final level of GDPPC: Malawi

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

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

Average growth 0.6
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: (ln) First Differences and five year MA: Mali

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

Average growth 1.5
The Dynamics of Economic Growth

Mauritania

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

Figure 2: Initial and final level of GDP: Mauritania

Figure 3: First Differences and five year MA: Mauritania

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

Average growth 1.4
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
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 GDP per capita; Mongolia

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

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

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
Mozambique

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

Figure 2: Initial and Final level of GDPPC: Mozambique

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

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

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

Figure 2: Initial and Final level of GDPPerC: Namibia

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

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

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

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

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

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

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
New Zealand

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

Figure 2: Initial and final level of GDPPC: 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

The Dynamics of Economic Growth
The Dynamics of Economic Growth

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

Figure 2: Initial and Final level of GDPPC: Niger

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

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

Niger
Pakistan

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

Figure 2: Initial and final level of GDPPC: Pakistan

Figure 3: (in) First Differences 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 GDPPC: Panama

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

Figure 4: Distribution of all 8 year growth rates
Panama vs. world
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: (In) 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
Philippines

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

Figure 2: Initial and Final level of GDPPC: Philippines

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

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

Portugal

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

Figure 2: Initial and final level of GDPPC; Portugal

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

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

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

Figure 2: Initial and Final level of GDPPC: Romania

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

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

The Dynamics of Economic Growth
The Dynamics of Economic Growth

Rwanda

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

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

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

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

Average growth 0.2
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
The Dynamics of Economic Growth

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

- $\text{Grow} = -0.8$
- $\text{Grow} = 0.3$
- $\text{Grow} = -4.9$
- $\text{Grow} = 0.1$

- $q_1 = -1.8$
- $q_1 = 0.6$
- $q_2 = 7.5$

Figure 2: Initial and Final level of GDPPC: Somalia

- Rank 17/125
- Ratio 0.6

Figure 3: First Differences and five year MA: Somalia

Figure 4: Distribution of all 8 year growth rates

Somalia vs. world

- $\text{Age} = 2.0$
- $\text{Age} = 0.0$
- $\text{Age} = 2.0$
- $\text{Age} = 4.0$
- $\text{Age} = 6.0$

Average growth $-1.8$
The Dynamics of Economic Growth

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
Sri Lanka

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

\[
\begin{align*}
\text{GDP growth} & = 1.0, 3.2, 2.8, 4.1, 4.4 \\
\text{R}^2 & = 0.98 \\
\alpha & = 4.4 \\
\end{align*}
\]

Years: 1955-2010

Min. 563

Figure 2: Initial and final level of GDP per capita; Sri Lanka

\[
\begin{align*}
\text{Growth} & = 6.7 \\
\text{Rank} & = 13/103 \\
\end{align*}
\]

Figure 3: First differences and five year MA: Sri Lanka

\[
\begin{align*}
\text{First differences in GDP} & = 0.08 \\
\end{align*}
\]

Years: 1955-2010

Figure 4: Distribution of all 8 year growth rates, Sri Lanka vs. World

\[
\begin{align*}
\text{Average growth} & = 3.4 \\
\end{align*}
\]
Sudan

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

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

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

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

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

Figure 2: Initial and Final level of GDPPC: Swaziland

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

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

Average growth 1.6
The Dynamics of Economic Growth

Sweden

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

Figure 2: Initial and final level of GDPPC: Sweden

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

Figure 4: Distribution of all 8 year growth rates

Sweden vs. world
The Dynamics of Economic Growth

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

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

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

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

122
**Syrian Arab Republic**

**The Dynamics of Economic Growth**

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

**Figure 2:** Initial and Final level of GDP per capita: Syria

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

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

---

123
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
The Dynamics of Economic Growth

Tanzania

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

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

Figure 3: First Differences and five year MA: Tanzania

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

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

Figure 3: First Differences and five year MA: Thailand

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

Trinidad and Tobago

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

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

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

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

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

Figure 2: Initial and Final level of GDP/PPP: Turkey

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

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

Average growth 2.3
United Kingdom

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

Figure 2: Initial and final level of GDPPC: United Kingdom

Figure 3: (in) First differences and five year MA: United Kingdom

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

Figure 3: (In) 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
The Dynamics of Economic Growth

Uruguay

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

Figure 2: Initial and final level of GDP: Uruguay

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

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

Average growth 1.3
Venezuela, RB

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

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

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

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

135
Vietnam

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

Figure 2: Initial and final level of GDP PPC: Vietnam

Figure 3: (In) First Differences and Five Year MA: Vietnam

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

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

Figure 2: Initial and final level of GDPPC: Zambia

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

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

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

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

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

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

The Dynamics of Economic Growth
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
The Dynamics of Economic Growth

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 \( 1 \leq m \leq M \), where \( M \) is chosen exogenously. After this altered first step, the rest of the test proceeds exactly as before.
the data series). 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”\textsuperscript{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

\textsuperscript{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 Before 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>
</table>
### Growth After Break

<table>
<thead>
<tr>
<th>$g&lt;0$</th>
<th>$0\leq g&lt;2$</th>
<th>$2\leq g\leq 4$</th>
<th>$g&gt;4$</th>
</tr>
</thead>
</table>
| 2$g\leq 4$ | 145
| 4$g>4$ | 145

- AUS: Australia
- BFA: Benin
- BDI: Burundi
- CIV: Côte d'Ivoire
- CMR: Cameroon
- CRI: Costa Rica
- CYP: Cyprus
- DZA: Algeria
- ETH: Ethiopia
- FIN: Finland
- FJI: Fiji
- GTM: Guatemala
- HTI: Haiti
- JAM: Jamaica
- MEX: Mexico
- MNG: Mongolia
- MRT: Mauritania
- NAM: Namibia
- NIC: Nicaragua
- PHL: Philippines
- PNG: Papua New Guinea
- PRI: Puerto Rico
- SDN: Sudan
- SWZ: Swaziland
- SYR: Syria
- UGA: Uganda
- VEN: Venezuela
- ZAF: South Africa
- ZMB: Zambia

- BEL: Belgium
- BRA: Brazil
- CHE: Switzerland
- DOM: Dominican Republic
- ECU: Ecuador
- EGY: Egypt
- ESP: Spain
- IDN: Indonesia
- IND: India
- JAP: Japan
- KHM: Cambodia
- KOR: South Korea
- LBN: Lebanon
- LSO: Lesotho
- MYS: Malaysia
- MUS: Mauritius
- NGA: Nigeria
- OMN: Oman
- OMN: Oman
- PAN: Panama
- PER: Peru
- PRT: Portugal
- PRI: Puerto Rico
- PHL: Philippines
- SWZ: Swaziland
- THA: Thailand
- TTO: Trinidad and Tobago
- TUN: Tunisia
- URY: Uruguay
- VNM: Vietnam

- AGO: Angola
- BWA: Botswana
- CHN: China
- CYP: Cyprus
- EGY: Egypt
- ESP: Spain
- IDN: Indonesia
- IND: India
- JAP: Japan
- KHM: Cambodia
- KOR: South Korea
- MAR: Morocco
- MUS: Mauritius
- NGA: Nigeria
- OMN: Oman
- PAN: Panama
- PER: Peru
- PRT: Portugal
- PRI: Puerto Rico
- PHL: Philippines
- SWZ: Swaziland
- THA: Thailand
- TTO: Trinidad and Tobago
- TUN: Tunisia
- URY: Uruguay

- AGO: Angola
- BWA: Botswana
- CHN: China
- CYP: Cyprus
- EGY: Egypt
- ESP: Spain
- IDN: Indonesia
- IND: India
- JAP: Japan
- KHM: Cambodia
- KOR: South Korea
- MAR: Morocco
- MUS: Mauritius
- NGA: Nigeria
- OMN: Oman
- PAN: Panama
- PER: Peru
- PRT: Portugal
- PRI: Puerto Rico
- PHL: Philippines
- SWZ: Swaziland
- THA: Thailand
- TTO: Trinidad and Tobago
- TUN: Tunisia
- URY: Uruguay

- AGO: Angola
- BWA: Botswana
- CHN: China
- CYP: Cyprus
- EGY: Egypt
- ESP: Spain
- IDN: Indonesia
- IND: India
- JAP: Japan
- KHM: Cambodia
- KOR: South Korea
- MAR: Morocco
- MUS: Mauritius
- NGA: Nigeria
- OMN: Oman
- PAN: Panama
- PER: Peru
- PRT: Portugal
- PRI: Puerto Rico
- PHL: Philippines
- SWZ: Swaziland
- THA: Thailand
- TTO: Trinidad and Tobago
- TUN: Tunisia
- URY: Uruguay

The Dynamics of Economic Growth
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 a 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: 

\[
g_{\text{predicted 1969-1980}} = 0.065 + 0.191 \times g_{1961-1969} + 0.001 \times \ln(GDPPC_{1969})
\]

Hence plugging in the values of \(g_{1961-1969} = 0.30\) and \(\ln(824) = 6.71\), produces \(g_{\text{predicted}} = 0.23\).

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

\[
g_{\text{predicted 1988-2010}} = 0.0065 + 0.91 \times g_{1980-1988} + 0.001 \times \ln(GDPPC_{1988})
\]

And plugging in of \(g_{1980-1988} = -0.05\) and \(\ln(529) = 6.27\), produces \(g_{\text{predicted}} = 0.14\).
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 LGDP/PC 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 LGDPCC 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 LGDPCC from start to end of episode compared to regression prediction over episode period: Albania
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 LOGPPC from start to end of episode compared to regression prediction over episode period: Angola
The Dynamics of Economic Growth

Argentina

Figure 5: Single trend for Argentina

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

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

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

Figure 5: Single trend for Austria

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

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

Figure 8: Cumulative change in \( \ln(\text{GDPPC}) \) from start to end of episode compared to regression prediction over episode period: Austria
Bangladesh

Figure 5: Single trend for Bangladesh

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

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

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

Bolivia

Figure 5: Single trend for Bolivia

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

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

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

Figure 5: Single trend for Brazil

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

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

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

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 LGDPCC from start to end of episode compared to regression prediction over episode period: Burkina Faso

The Dynamics of Economic Growth
The Dynamics of Economic Growth

Figure 5: Single trend for Burundi

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

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

Figure 8: Cumulative change in Log(GDP) from start to end of episode compared to regression prediction over episode period; Burundi
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 log(GDP) 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 Republic

Figure 7: Bai-Perron Identified Break(s) for Central African Republic

Figure 8: Cumulative change in LGDP/C from start to end of episode compared to regression prediction over episode period: Central African Republic
The Dynamics of Economic Growth

Chad

Figure 5: Single trend for Chad

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

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

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

Chile

Figure 5: Single trend for Chile

Figure 6: Breaks filtered from four possible Bai-Perron breaks: Chile

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

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

Congo, Rep.

Figure 5: Single trend for Congo, Republic of

Figure 6: Breacks filtered from three possible B–P breaks: Congo, Republic

Figure 7: Bai–Perron identified Break(s) for Congo, Republic of

Figure 8: Cumulative change in LGDPDC from start to end of episode compared to regression prediction over episode period: Congo, Republic.
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 LGDPDC from start to end of episode compared to regression prediction over episode period: Costa Rica
Côte d’Ivoire

Figure 5: Single trend for Côte d’Ivoire

\[ g_t = 0.2 \]
\[ R^2 = 0.07 \]
\[ \sigma = 4.7 \]

Figure 6: Breaks filtered from three possible B–P breaks: Côte d’Ivoire

\[ g_1 = 4.3 \]
\[ g_2 = 2.9 \]
\[ \delta_1 = 1.5 \]
\[ \delta_2 = 4.4 \]
\[ \delta_3 = 1.4 \]

Figure 7: Bai–Perron Identified Break(s) for Côte d’Ivoire

\[ g_t = 3.5 \]
\[ \delta_t = -0.8 \]
\[ \delta_t = -4.4 \]

Figure 8: Cumulative change in ln(GDP) from start to end of episode compared to regression prediction over episode period: Côte d’Ivoire

Total: -0.74
Years: 32
The Dynamics of Economic Growth

Figure 5: Single trend for Cuba

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

Figure 7: Bal–Perron Identified Break(s) for Cuba

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

Cuba
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 LGDPPC from start to end of episode compared to regression prediction over episode period: Cyprus
Denmark

Figure 5: Single trend for Denmark

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

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

Figure 8: Cumulative change in log(GDP/C) from start to end of episode compared to regression prediction over episode period: Denmark
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 LN(GDP/C) from start to end of episode compared to regression prediction over episode period: Dominican Republic
Ecuador

Figure 5: Single trend for Ecuador

\[
\begin{align*}
g_t &= 1.7 \\
g_e &= 0.85 \\
g_{\Delta} &= 4.0
\end{align*}
\]

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

\[
\begin{align*}
g_t &= 1.8 \\
g_e &= 6.9 \\
g_{\Delta} &= -2.2 \\
g_{\Delta\Delta} &= 1.7 \\
g_{\Delta\Delta\Delta} &= 2.7
\end{align*}
\]

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

\[
\begin{align*}
g_t &= 1.8 \\
g_e &= 5.1 \\
g_{\Delta} &= -6.1
\end{align*}
\]

Figure 8: Cumulative change in \( \ln(\text{GDPPC}) \) from start to end of episode compared to regression prediction over episode period: Ecuador

\[
\begin{align*}
\text{Cumulative Change in } \ln(\text{GDPPC}) & \text{ during episode} \\
\text{Years: 21} & \text{ Total: } -0.41 \\
\text{Years: 21} & \text{ Total: } 0.33 \\
\text{Years: 11} & \text{ Total: } 0.09
\end{align*}
\]
Egypt, Arab Rep

Figure 5: Single trend for Egypt

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

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

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

Finland

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 LGDPPC from start to end of episode compared to regression prediction over episode period: Finland
Figure 5: Single trend for France

Figure 6: Brecks filtered from four possible B-P breaks: France

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

Figure 8: Cumulative change in log(GDP) compared to regression prediction over episode period: France
Gambia, The

Figure 5: Single trend for Gambia, The

\[ g_t = 0.0 \]
\[ g_{\text{long}} = 0.00 \]
\[ \sigma_{\text{y}} = 4.9 \]

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

\[ g_t = 0.8 \]
\[ g_{\text{P}_1} = 2.1 \]
\[ g_{\text{P}_2} = -4.3 \]
\[ g_{\text{P}_3} = 3.3 \]

Figure 7: Bai–Perron identified Break(s) for Gambia, The

\[ g_t = 0.0 \]
No Breaks

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

Total: -0.21
Years: 13

Total: -0.28
Years: 16
The Dynamics of Economic Growth

**Germany**

Figure 5: Single trend for Germany

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

**Figure 7: Bai-Perron identified Breck(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 LOGPPC from start to end of episode 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 LGDPCC from start to end of episode compared to regression prediction over episode period: Greece

192
Figure 5: Single trend for Guinea

\[
g_1 = -0.1 \\
R^2 = 0.04 \\
\sigma_g = 0.3
\]

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

\[
g_1 = 0.9 \\
g_2 = -0.6 \\
g_3 = 1.6 \\
g_4 = 2.1 \\
g_5 = 2.7 \\
g_6 = -3.1
\]

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

\[
g = -0.1
\]

No Breaks

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

\[
\text{Total: } -0.39
\]

Years: 8
Figure 5: Single trend for Guinea-Bissau

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

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

Figure 8: Cumulative change in LGDP:PC from start to end of episode compared to regression prediction over episode period: Guinea-Bissau
Figure 5: Single trend for Guyana

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

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

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

Haiti

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 ln(GDP/PC) from start to end of episode compared to regression prediction over episode period: Haiti
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 LGDPPC 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 ln(GDP/P) from start to end of episode compared to regression prediction over episode period: Hong Kong
Hungary

Figure 5: Single trend for Hungary

![Graph showing economic growth trends](image1)

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

![Graph showing economic growth trends with breaks](image2)

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

![Graph showing identified breaks in economic growth](image3)

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

![Graph showing cumulative changes in GDP](image4)
India

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 ln(GDP) from start to end of episode compared to regression prediction over episode period: India
Indonesia

Figure 5: Single trend for Indonesia

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

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

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

Ireland

Figure 5: Single trend for Ireland

Figure 6: Brecks filtered from four possible B-P breaks: Ireland

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

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

205
The Dynamics of Economic Growth

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 log(GDP) 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(GDPPC) from start to end of episode compared to regression prediction over episode period: Italy
The Dynamics of Economic Growth

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 LGDP from start to end of episode compared to regression prediction over episode period: Jamaica
The Dynamics of Economic Growth

Jordan

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
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 LQDPPC from start to end of episode compared to regression prediction over episode period: Korea, Republic of
Lao PDR

Figure 5: Single trend for Laos

$g_t = 3.5$
$q_t = 0.95$
$q_{gr} = 4.1$

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

$g_t = 1.4$
$q_t = 3.8$
$q_{gr} = 3.8$

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

$g_t = 3.1$
$q_{gr} = 4.5$

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

Cumulative Change in ln(GPPC) during episode

- Total: 0.66
- Years: 23

Cumulative Change in ln(GPPC) during episode

- Total: 0.31
- Years: 8
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 ln(GDP) during episode compared to regression prediction over episode period: Lebanon
Lesotho

Figure 5: Single trend for Lesotho

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

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

Figure 8: Cumulative change in LGDP(PCR) from start to end of episode compared to regression prediction over episode period: Lesotho
The Dynamics of Economic Growth

Liberia

Figure 5: Single trend for Liberia

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

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

Figure 8: Cumulative change in LGDPPC from start to end of episode compared to regression prediction over episode period: Liberia
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 GDP per capita from start to end of episode compared to regression prediction over episode period: Malawi
The Dynamics of Economic Growth

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

219
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 GDPPC from start to end of episode compared to regression prediction over episode period: Mali
Mauritania
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 log(GDP) from start to end of episode compared to regression prediction over episode period: Mauritius
Mexico

Figure 5: Single trend for Mexico

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

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

Figure 8: Cumulative change in LGDP(PC) from start to end of episode compared to regression prediction over episode period: Mexico
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 LGDPPC from start to end of episode compared to regression prediction over episode period: Mongolia
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 \( \ln(\text{GDP per capita}) \) from start to end of episode compared to regression prediction over episode period: Morocco
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 LGDPPC from start to end of episode compared to regression prediction over episode period: Mozambique
Namibia

Figure 5: Single trend for Namibia

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

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

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

Nepal

Figure 5: Single trend for Nepal

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

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

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

Years: 27
Total: 0.33
The Dynamics of Economic Growth

Figure 5: Single trend for Netherlands

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

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

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

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 logGDP from start to end of episode compared to regression prediction over episode period: New Zealand
Nicaragua

Figure 5: Single trend for Nicaragua

\[ g_t = 0.6 \]
\[ q_t = 0.18 \]
\[ \Delta g_t = 0.1 \]

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

\[ g_t: 3.8 \]
\[ 1967: q_t - 6.4 \]
\[ 1979: q_t = 6.4 \]
\[ 1987: q_t - 9.6 \]
\[ 1995: q_t = 1.6 \]

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

\[ g_t: 5.0 \]
\[ 1977: q_t - 1.2 \]
\[ \Delta g_t = 4.2 \]

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

Cumulative Change in \( \ln (\text{GDPPC}) \) during episode

- Total: -0.36
- Years: 12

Cumulative Change in \( \ln (\text{GDPPC}) \) during episode

- Total: -0.54
- Years: 8
- Years: 15

Cumulative Change in \( \ln (\text{GDPPC}) \) during episode

- Total: 0.23
- Years: 8
The Dynamics of Economic Growth

Niger

Figure 5: Single trend for Niger

\[ g = -1.7 \]
\[ R^2 = 0.86 \]
\[ \sigma_g = 6.3 \]

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

\[ g_1 = 1.8 \]
\[ g_2 = -0.3 \]
\[ \delta_1 = -2.1 \]
\[ g_2 = -5.4 \]

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

\[ g = -1.7 \]

No Breaks

Figure 8: Cumulative change in GDP per capita from start to end of episode compared to regression prediction over episode period: Niger

Total: -0.35
Total: -0.48
Total: -0.19

Years: 11
Years: 8
Years: 23
Norway

Figure 5: Single trend for Norway

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

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

Figure 8: Cumulative change in LGDP per cap from start to end of episode compared to regression prediction over episode period: Norway
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 LGDP 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 LGDPFC from start to end of episode compared to regression prediction over episode period: Pakistan
The Dynamics of Economic Growth

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: Bai-Perron identified break(s) for Papua New Guinea

Figure 8: Cumulative change in Ln(GDP) during episode compared to regression prediction over episode period: Papua New Guinea
The Dynamics of Economic Growth

Paraguay

Figure 5: Single trend for Paraguay

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

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

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

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 LOGPCC from start to end of episode compared to regression prediction over episode period: Philippines

Philippines
The Dynamics of Economic Growth

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 LGDP/GDP from start to end of episode compared to regression prediction over episode period: Poland

Total: -0.22
Years: 12

Years: 19
Total: 0.46
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 LGDPpC from start to end of episode compared to regression prediction over episode period: Portugal

The Dynamics of Economic Growth
The Dynamics of Economic Growth

Puerto Rico

Figure 5: Single trend for Puerto Rico

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

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

Figure 8: Cumulative change in log(GDP) from start to end of episode compared to regression prediction over episode period: Puerto Rico
Romania

Figure 5: Single trend for Romania

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

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

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

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 LGDPPC from start to end of episode compared to regression prediction over episode period: Rwanda
Senegal

**Figure 5:** Single trend for Senegal

- $g$: 0.1
- $q_t$: 0.02
- $s_{20}$: 4.3

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

- $g(t) = -1.5$
- $g(t) = -1.4$
- $g(t) = -1.1$
- $g(t) = -1.7$
- $g(t) = -2.9$
- $g(t) = -2.5$
- $g(t) = -2.6$

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

- $g$: 0.1
- No Breaks

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

- Cumulative Change in ln(GDP) during episode
  - Years: 37
  - Ttest: 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 Ln(GDP/PC) from start to end of episode compared to regression prediction over episode period: Sierra Leone
Somalia

Figure 5: Single trend for Somalia

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


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

\[ g_1 = 2.3 \]
\[ g_2 = -2.9 \]
\[ \delta g_1 = 5.1 \]
\[ \delta g_2 = 2.8 \]

1978

Figure 7: Bai-Peron Identified Break(s) for Somalia

\[ g = -1.8 \]

No Breaks

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

Total: -0.95

Years: 32
Spain

Figure 5: Single trend for Spain

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

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

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

Figure 5: Single trend for Sri Lanka

\[ g_t = 3.4 \]
\[ \hat{g} = 0.98 \]
\[ \hat{g}_y = 4.4 \]

Years

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

\[ g_t = -0.4 \]
\[ g_1 = 3.3 \]
\[ g_2 = 6.8 \]
\[ g_3 = 2.2 \]
\[ g_4 = 4.3 \]

Years

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

\[ g_t = -0.4 \]
\[ \hat{g} = 3.9 \]
\[ \hat{g}_y = 4.4 \]

1959

Years

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

Years: 14
Total: 0.23

Years: 8
Total: 0.25

Years: 29
Total: 0.52

Cumulative Change in LGDPPC during episode
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 LOGPCC from start to end of episode compared to regression prediction over episode period: Sudan
Figure 5: Single trend for Swaziland

<table>
<thead>
<tr>
<th>Year</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>1.5</td>
</tr>
<tr>
<td>1960</td>
<td>1.55</td>
</tr>
<tr>
<td>1970</td>
<td>1.6</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Break</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>10.2</td>
<td>0.1</td>
</tr>
<tr>
<td>1980</td>
<td>2.9</td>
<td>0.1</td>
</tr>
<tr>
<td>1989</td>
<td>7.3</td>
<td>2.8</td>
</tr>
</tbody>
</table>

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

No Breaks

Figure 8: Cumulative change in LGDP PC compared to regression prediction over episode period: Swaziland

Cumulative Change in LGDP PC

- Total: 0.63
- Years: 21

Cumulative Change in LGDP PC for Swaziland

- Years: 11
- Total: 0.18
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 LGDPPC from start to end of episode compared to regression prediction over episode period: Sweden
Switzerland

Figure 5: Single trend for Swaziland

\[ g = 1.5 \]
\[ n = 0.25 \]
\[ g_{n} = 9.1 \]

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

\[ g_1 = 10.2 \]
\[ g_2 = 2.9 \]
\[ g_3 = 0.1 \]
\[ a_g = -7.3 \]
\[ a_g = -2.8 \]

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

\[ g = 1.6 \]
No Breaks

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

Total: 0.63
Years: 21

Years: 11
Total: 0.18
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 Ln(GDPPC) from start to end of episode compared to regression prediction over episode period: Syria
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 LGDPPC from start to end of episode compared to regression prediction over episode period: Tanzania
The Dynamics of Economic Growth

**Figure 5:** Single trend for Thailand

- $g_t = 4.4$
- $s_t = 0.98$
- $g_t = 5.2$

Years: 1950-2010

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

- $g_t = -2.4$
- $g_t = 5.5$
- $g_t = 8.8$
- $g_t = 3.6$
- $g_t = 8.3$
- $g_t = 2.0$
- $g_t = 6.3$

Years: 1950-2010

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

- $g_t = -2.4$
- $g_t = 5.7$
- $g_t = 8.0$
- $g_t = 2.0$
- $g_t = -3.7$

Years: 1950-2010

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

- Total: -0.04
- Years: 15

- Total: 1.03
- Years: 8

Cumulative Change in ln(GDPPC) during episode

Years: 1950-2010
Togo

**Figure 5:** Single trend for Togo

$$g_t = -0.8$$  
$$R^2 = 0.36$$  
$$\sigma_g = 0.8$$

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

- $g_t = 6.1$  
- $g_t = 0.8$  
- $g_t = 4.0$  
- $g_t = 0.2$

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

**Figure 8:** Cumulative change in GDP per capita compared to regression prediction over episode period: Togo

- Total: $-0.31$, Total: $-0.37$, Total: $-0.50$
- Years: 10, Years: 14, Years: 17
The Dynamics of Economic Growth

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 LGDPCC from start to end of episode compared to regression prediction over episode period: Trinidad & Tobago
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 ln(GDP) during episode compared to regression prediction over episode period: Tunisia
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 ln(GDP) from start to end of episode compared to regression prediction over episode period: Turkey
The Dynamics of Economic Growth

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 LGDP in episode compared to regression prediction over episode period: Uganda
United States

Figure 5: Single trend for United States

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

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

Figure 8: Cumulative change in LQDPPC from start to end of episode compared to regression prediction over episode period: United States
Uruguay

Figure 5: Single trend for Uruguay

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

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

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

Venezuela, RB

Figure 5: Single trend for Venezuela

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

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

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

- q1: 2.9
- q2: -0.5
- δ_q: -3.4
- 1977
- 1977
- 1985
- 2002
The Dynamics of Economic Growth

Vietnam

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 ln(GDPPC) 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 LGDPPC from start to end of episode compared to regression prediction over episode period; Zambia
The Dynamics of Economic Growth

**Zimbabwe**

Figure 5: Single trend for Zimbabwe

\[ g_1 = 0.6 \]
\[ g_2 = 0.22 \]
\[ g_3 = 8.0 \]

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

1968
1983
1991
2002

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

\[ g_1 = 2.8 \]
\[ g_2 = -1.3 \]
\[ g_3 = -4.2 \]

1983

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

Total: 0.02
Total: 0.40
Total: 0.41

Years: 9
Years: 11
Years: 8

Cumulative Change in LN(GDP) during episode

Years: 15
Total: 0.14
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

A 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 GDP per capita 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 $g=3.5$, $\Delta g=2.5$ 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

---

14 Hausmann et al. only calculate up breaks using a filter-break approach, and so is not strictly comparable with other studies, including ours, all of which use a statistical approach or a combination of a statistical plus filter approach.
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.