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Understanding Patterns of Economic Growth: Searching for Hills among Plateaus, Mountains, and Plains

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The historical path of gross domestic product (GDP) per capita in the United States is, except for the interlude of the Great Depression, well characterized by reasonably stable exponential trend growth with modest cyclical deviations: graphically, it is a modestly sloping, slightly bumpy hill. However, almost nothing that is true of U.S. GDP per capita (or that of other countries of the Organisation for Economic Co-operation and Development) is true of the growth experience of developing countries. A single time trend does not adequately characterize the evolution of GDP per capita in most developing countries. Instability in growth rates over time for a single country is great, relative to both the average level of growth and the variance across countries. These shifts in growth rates lead to distinct patterns. While some countries have steady growth (hills and steep hills), others have rapid growth followed by stagnation (plateaus), rapid growth followed by decline (mountains) or even catastrophic falls (cliffs), continuous stagnation (plains), or steady decline (valleys). Volatility, however defined, is also much greater in developing than in industrial countries. These stylized facts about the instability and volatility of growth rates in developing countries imply that the exploding econometric growth literature that makes use of the panel nature of data is unlikely to be informative. In contrast, research into what initiates (or halts) episodes of growth has high potential.

The aspect of economic growth that makes it "hard to think about anything else" (Lucas 1988) is the implication for human well-being of large and persistent differences in growth rates. The power of compound interest, over long periods, turns even small differences in growth into huge shifts in living standards and sustained large differences into seismic shifts. From 1870 to 1980 the United States grew 1.84 percent a year, Great Britain grew 1.24 percent, and Japan grew 2.64 percent (Maddison 1995). The cumulative effect of this 0.6 percentage point lag in British growth relative to U.S. growth resulted in Great Britain's decline from reigning as the world's economic superpower to having to play catch up. The cumulative effect of Japan's 0.8 percentage point edge over the United States

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was Japan's transformation from economic backwater to superpower. The huge growth spurts of some East Asian countries, sustained only over the past few decades, have changed the global economic map. However, because of this fixation on long-run (even, possibly, steady-state) differences in growth, recent theoretical and empirical growth research has underestimated the importance of *instability* and *volatility* in growth rates, especially in developing countries.

Which aspects of countries' growth are growth theories trying to explain? Does explaining Brazil's growth mean explaining its 4.2 percent growth from 1965 to 1980 or explaining its stagnation from 1980 to 1992?[1] Or does theory ignore this break and explain the 1960–92 average of 3.14 percent? Between 1960 and 1980 Côte d'Ivoire grew at 3.1 percent, something of an African growth miracle, while between 1980 and 1992 its gross domestic product (GDP) per capita fell 4.1 percent a year, a growth disaster. Ignoring this break, average growth was 0.22 percent. Nearby Senegal stagnated throughout the same period, with stable growth of 0.18 percent. In what relevant sense are these two growth experiences the same?

This article has linked halves. The first half provides a set of descriptive statistics characterizing the evolution of GDP per capita for a broad cross section of countries, emphasizing the instability in growth rates and the volatility of output. The second half discusses the implications of these facts for recent econometric research. The use of high-frequency panel data, particularly with fixed effects, to investigate long-run growth correlates is almost certainly pointless. Instead, the nature of growth instability suggests future research into the determinants of shifts in growth rates focused on episodes of growth or policy changes.

I. DATA AND METHODS

The output variable I use throughout is the chain-linked index of real GDP per capita measured in 1985 purchasing power parity dollars (P$) from the Penn World Tables Mark 5.6.[2] I use the data beginning in 1960 for the 111 countries with at least 25 years of data. Since the final year of data varies from 1985 to 1992, I refer to it as the "most recent" year. I calculate statistics describing three aspects of growth for each country: average levels, instability, and volatility. The procedures and statistics reported in each category are described in table 1.

I separate countries as developing or industrial (table 2). I define industrial countries primarily by membership in the Organisation for Economic Co-operation and Development (OECD), before any recent expansion, and developing coun-

1. Unless otherwise noted, all growth rates are gross domestic product (GDP) per capita per year.

2. It is most likely that none of the results about growth and its characteristics would differ much if I had used the World Bank's national accounts data on real per capita GDP in constant local currency prices. The Penn World Tables Mark 5.6 provide information about the level of per capita GDP in comparable terms, but since for nearly all developing countries there are few benchmark points, most of the time-series content of the Penn World Tables data actually comes from the World Bank data.

Table 1. *Description of the Calculated Statistics on Growth Rates*

Statistic	*Reported*
Basic statistics on output level and average growth	
Ordinary least squares growth rate: the estimated coefficient b from a trend line regression, $y_t = a + bt + e_t$	Growth 1960–most recent year, 1960–73, 1973–82, 1982–most recent year
Initial income	GDP per capita for the first year, 1960
Final income	GDP per capita for the final year, generally 1992
Average annual growth	(Y_T/Y_0) $(1/T)$ (average of annual growth rates)
Ratio of final income to maximum (minimum) income	$Y_T/\max(Y_t)$ and $Y_T/\min(Y_t)$
Statistics on instability in growth rates	
Growth differences based on the best single breakpoint in trend: if $y_t = a_I I_I (t \leq t^*) + b_I t^* I_I(t \leq t^*) + a_{II}{}^* I(t > t^*) + b_{II} t^* I(t > t^*) + \varepsilon_t$ where $I(.)$ is an indicator function and t^* is chosen to minimize the sum of squared errors over all t, such that $t^* - t_0 \geq 6$ and $T - t \geq 6$)	Year of breakpoint (t^*) Growth before the break (g_b) Growth after the break (g_a) Difference in growth rates ($g_b - g_a$)
Explanatory power of a single trend: $y = a + bt + e_t$	R^2 of the trend regression
Statistics on volatility in output	
Variability of deviations from a single trend: $e_t = y_t - a' - b'y_t$ is the deviation from a single estimated trend	Standard deviation of e_t
ln first difference: $\ln(y_t - y_{t-1})$	Coefficient of variation Standard deviation Mean
ln second differences: $\ln(y_t - y_{t-2})$	Median of the absolute value
Forecast errors: $fe_t\,(10,3) = y_t - y_t'$, the actual less the predicted value three years ago. The prediction is $y_t' = y_{t-3} + b'3$, where b' is estimated on data from the 10 years prior to the forecast date $(t-3, t-3-10)$	Absolute value of the mean Maximum of the absolute value

Note: Y is GDP per capita, y is lnY, and T is total number of years in the panel.

tries as the rest.[3] This definition does not correspond to a ranking by initial income (in 1960 Republica Bolivariana de Venezuela had higher GDP per capita than France, Iraq than Japan, Mexico than Greece), but I believe the OECD classification better captures the nature of industrial countries than does a classification based on GDP per capita.[4] Using this definition affects the results, as one of the notable features of the data is the very strong performance over this period by the members of the OECD that were poorer intially: Greece, Ireland, Italy, Japan and Portugal.

3. There are three exceptions. I include two Mediterranean islands, Malta and Cyprus, in the industrial category, even though they are not part of the OECD, and I exclude Turkey, even though it is.

4. This definition also differs from the World Bank's "high-income" category by consistently excluding oil producers (such as Kuwait and Saudi Arabia) and by not adding new entrants as they pass an income threshold (such as Singapore and Hong Kong).

Table 2. *Summary Statistics on Basic Growth Rates*

Statistic	*Least squares growth (percent)*	*Growth rates by period (percent)* 1960–73	1973–82	1982–recent	*GDP per capita (1995 purchasing power parity dollars)* Initial	Final	*Final/maximum*	*Final/minimum*
Developing countries								
Mean	1.64	2.68	1.74	0.10	1,385	2,639	0.82	2.04
Median	1.51	2.72	1.99	−0.13	1,103	1,869	0.88	1.61
Standard deviation	1.98	2.20	3.22	2.94	1,089	2,696	0.18	1.37
Industrial countries								
Mean	2.90	4.26	2.05	2.47	5,430	12,665	0.98	2.69
Median	2.86	3.97	1.79	2.10	5,553	13,118	1.00	2.42
Standard deviation	1.05	1.57	1.51	1.14	2,368	3,062	0.04	0.98

Source: Author's calculations based on Penn World Tables Mark 5.6. See table 1 for a description of procedures.

II. Results

Growth rates were substantially higher in the industrial countries than in the developing countries (table 2). The median growth rate in the industrial countries was 2.86 percent, almost twice the rate of the developing countries (1.51 percent). As many other authors have emphasized (Quah 1996), incomes between industrial and developing countries diverge absolutely; the correlation between initial income and growth rates is positive, 0.22, and the ratio of median incomes increased from 5:1 to more than 7:1 (P$13,118 compared with P$1,869).

The period since the 1980s has been very bad for most developing countries (with the important exception of the world's two largest countries, China and India). The gap in growth rates between industrial and developing countries grew substantially in 1982–92.[5] Median growth rates for the industrial and developing groups were 4.0 and 2.7 percent in the 1960s. Then in the period after the oil shock (1973–82), growth rates were slightly lower for industrial countries, 1.8 percent compared with 2.0 percent for developing countries. But since 1982 median growth rates have been 2.1 percent for industrial countries and *negative* (–0.1 percent) for developing countries.

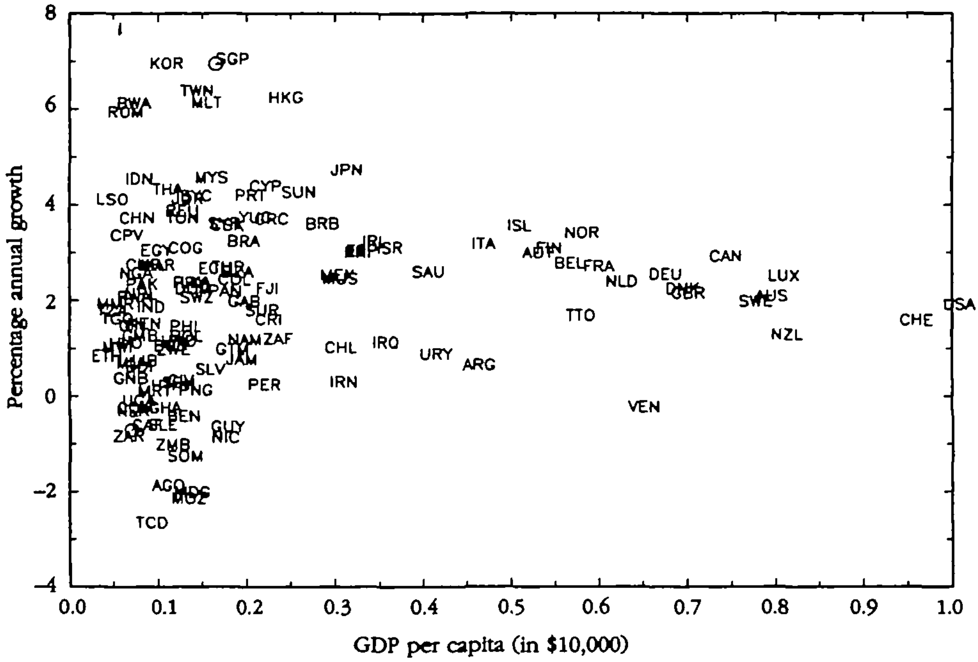
The variance in growth rates across countries is also much larger among developing countries. The standard deviation of growth rates is around 1 percent for industrial countries and nearly twice as large, around 2 percent, for developing countries. Figure 1 shows the scatter plot of initial income against subsequent growth rates. Whereas the positive correlation between growth and initial income is barely visible, the much larger variance in growth rates among countries that began the period below P$3,000 is striking.[6] The wider range of growth experience among developing countries is also seen in comparing the extremes. The industrial countries' growth rates fall into a narrow range as the fifth fastest, Greece, grew at 3.6 percent, while the fifth slowest, Australia, grew at 2.0 percent: a difference of only 1.6 percentage points. In contrast, the fifth fastest developing country, Botswana, grew at 6.0 percent, while the fifth slowest, Somalia, shrank at 1.4 percent: a difference of more than 7 percentage points (table 3).[7] Growth differentials of this magnitude produce rapid shifts in relative incomes: the Republic of Korea has gone from having less per capita income than Angola to having 10 times more in just 30 years.

5. This diversion has continued since 1992. The growth of population-weighted average gross national product per capita for the decade 1985–95 was –1.4 percent for low-income countries (excluding China and India), –1.3 percent for lower-middle-income countries, 0.2 percent for upper-middle-income countries, and 1.9 percent for high-income countries (World Bank 1997: table 1).

6. The slow and decelerating growth among many of the poorest countries (particularly in Africa), combined with the continued higher-than-world-average growth rates and absolute convergence in levels among the poorer but still well-off European countries, contributes to an emerging "twin peaks" in the distribution of world income (Quah 1996).

7. Of course, the absolute magnitude of the growth differential between the fifth fastest and fifth slowest developing country is also larger because there are more developing than industrial countries (differences in these order statistics tend to grow with sample size). But this does not explain all of the gap.

Figure 1. *Growth Rates and Initial Per Capita Income*



Note: See appendix for country names.
Source: Author's calculations.

Growth Instability

Although average growth is of interest, the evolution of most countries' GDP per capita is not well captured by a single trend growth rate. Rather, countries show large shifts in growth rates, often identifiable in episodes (table 4).[8] The first noticeable aspect of these shifts is the enormous deceleration of growth. On average, a country's growth has decelerated 2 percentage points. For the industrial countries this deceleration is largely the result of two phenomena: the global deceleration following the oil shocks and the deceleration of the European coun-

8. Graphs of each country's growth, including growth statistics, are available from the author. Ben-David and Papell (1997) introduce the analysis of growth shifts with country-specific breaks. The only difference between my approach and theirs is that Ben-David and Papell report summary statistics of changes in growth only for the changes that are statistically significant. This confounds two issues: the magnitude of the shift in growth and the power of the test for the shift. The issue of statistical power is especially problematic given the differing volatilities of the series. We are less able to detect a shift in a more volatile growth series. Given two shifts in growth rates of equal magnitude, but in countries with different underlying volatilities, one shift might be statistically significant and the other not. I take the view that growth rates are simply a convenient summary statistic of the GDP per capita time series. Just as one does not report country growth rates only for those countries in which the rates are statistically different from zero, so I report the before-and-after growth rates as a way of summarizing the GDP per capita time series. Whether those shifts are statistically significant is a different question and should not be the basis for sample selection.

Table 3. *Five Highest and Lowest Growth Rates of GDP Per Capita Since 1960*
(percent)

	Developing countries		Industrial countries	
Rank	*Country*	*Growth rate*	*Country*	*Growth rate*
Five highest growth rates	Singapore	6.95	Malta	6.03
	Korea, Rep. of	6.85	Japan	4.63
	Taiwan (China)	6.29	Cyprus	4.29
	Hong Kong	6.15	Portugal	4.10
	Botswana	6.03	Greece	3.61
Five lowest growth rates	Somalia	–1.36	Australia	1.99
	Angola	–1.97	Sweden	1.88
	Madagascar	–2.12	United States	1.81
	Mozambique	–2.25	Switzerland	1.49
	Chad	–2.75	New Zealand	1.19

Source: Author's calculations based on Penn World Tables Mark 5.6.

tries from their rapid post–World War II catch-up of the 1950s and 1960s. For the developing countries deceleration arises from a larger variety of events, discussed below.

Second, differences in growth rates within a country over time are large. Among the developing countries the absolute value of the shift in growth rates averages 3.4 percentage points, which is much larger than either the cross-sectional variance of 2.0 percent or the median growth rate of 1.5 percent. Growth rates in 55 of the 111 countries either decelerated or accelerated more than 3 percentage points within the period. Figure 2 shows these shifts with a 2 percentage point band around the 45 degree line (along which growth was equal in both periods), identifying countries whose growth decelerated (those located above the band) or accelerated (those located below the band) by more than 2 percentage points.

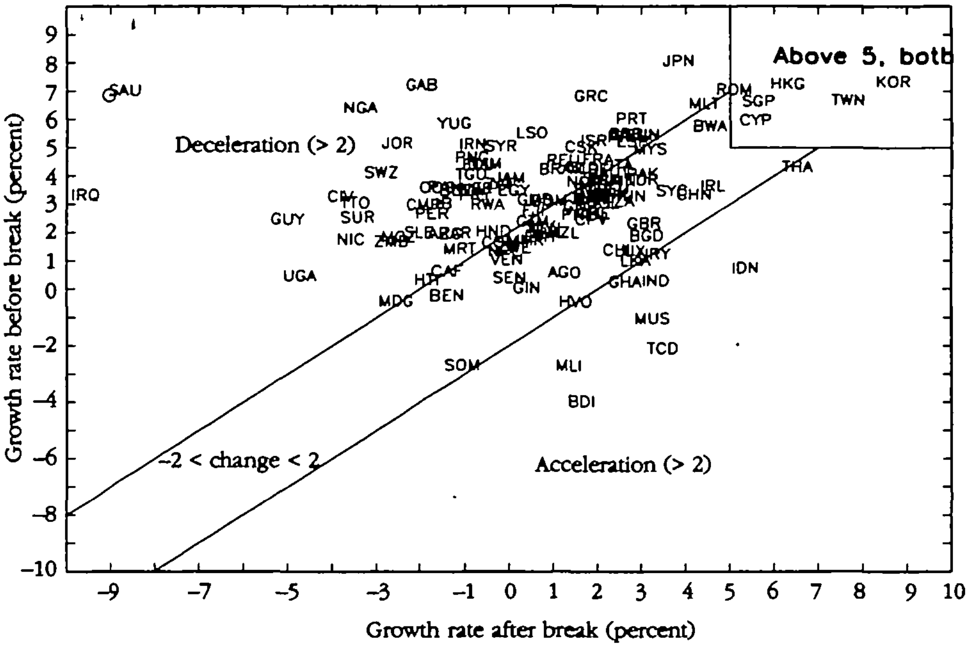
Third, the evolution of GDP per capita in the developing countries is not well characterized by a single exponential trend. The R^2 of fitting a single time trend

Table 4. *Statistics on Instability of Growth Rates*

	Summary from "best break" analysis				
Statistic	*Year*	*Percentage point shift*	*Growth before break (percent)*	*Growth after break (percent)*	*R^2 of trend*
Developing countries					
Mean	1977	–2.58	2.62	0.05	0.58
Median	1978	–2.21	2.86	–0.04	0.67
Standard deviation	4	3.53	2.23	2.99	0.32
Industrial countries					
Mean	1975	–1.91	4.07	2.17	0.94
Median	1974	–1.93	3.83	1.84	0.95
Standard deviation	4	1.46	1.53	1.04	0.03

Source: Author's calculations based on Penn World Tables Mark 5.6. See table 1 for a description of procedures.

Figure 2. *Growth Rates Before and After Break Point*



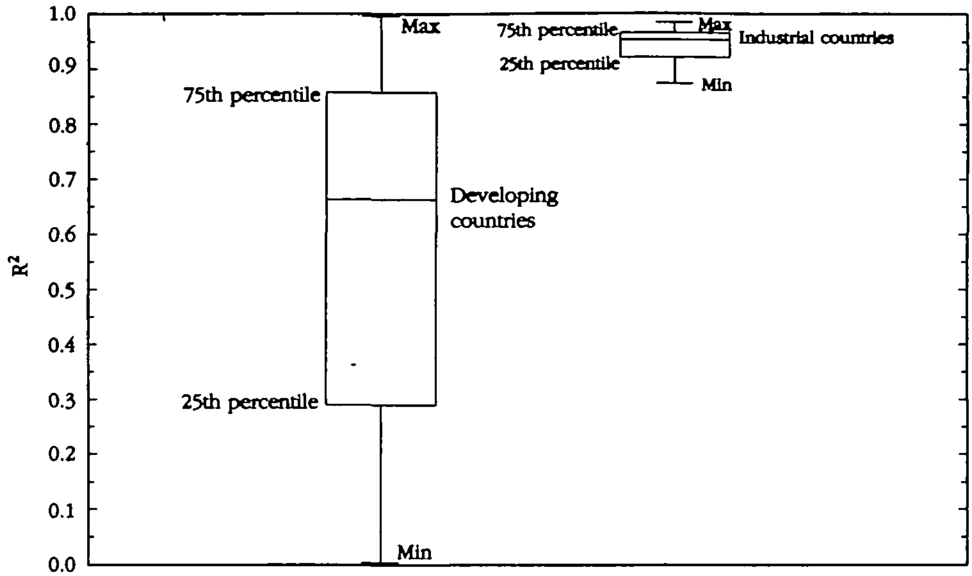
Note: See appendix for country names.
Source: Author's calculations.

shows how much of the time-series behavior is just the trend (last column of table 4). This statistic perhaps best captures the striking differences in the behavior of output growth in the industrial and developing countries (figure 3). In the industrial-country sample the median R^2 is 0.95, and the standard deviation is only 0.03. Thus for nearly every industrial country the total variance of the time series is almost completely summarized in a single number: the average growth rate. In contrast, for the developing-country sample the median R^2 is only 0.67, with a standard deviation of 0.32. So the R^2 values are distributed over the entire [0,1] range. In 40 percent of the developing countries the trend R^2 is less than 0.5, implying that shifts and fluctuations are the dominant features of the time-series evolution of GDP per capita.

Patterns of Growth

The interpretation of the trend R^2 is complicated, involving the magnitude of the trend, shifts in the trend, and deviations from the trend. These complications lead to an analysis of the patterns of growth not across countries but over time for the same country. Individual graphs and statistics on the levels of and shifts in growth rates reveal six distinct patterns of growth, based on the speed of growth before and after the statistically chosen structural break (table 5). Figure 4 shows two typical countries for each pattern to visually illustrate the topographical metaphor.

Figure 3. *Boxplot of the R^2 of a Single Trend*



Source: Author's calculations.

- *Steep hills.* These 11 countries had growth rates higher than 3 percent in both periods (figure 4a). This set includes only the high-performing East Asian countries, a few European periphery economies (Cyprus, Ireland, Malta), and Botswana. In these countries the trend is everything.
- *Hills.* These 27 countries had growth rates higher than 1.5 percent in each period (figure 4b).[9] Like the United States, most of the OECD countries are hills. A few relatively steady growers in the developing world (Costa Rica, Pakistan) also are in this category. For these countries the large and relatively stable trend means the trend R^2 is also high.
- *Plateaus.* These 16 countries had growth rates higher than 1.5 percent before their structural break, but afterward growth fell to less than 1.5 percent, although it remained positive (figure 4c). These countries are a mixed bag. The classic case is Brazil, with growth of 4 percent until 1980 and 0.66 percent afterward. Other countries are less true plateaus than borderline hills, like Sweden, with growth of 3.4 percent before the break and 1.4 percent afterward.
- *Mountains.* These 33 countries had growth rates higher than 1.5 percent before their trend break, but negative rates afterward (figure 4d). This category includes most of the oil-exporting countries (Algeria, Gabon,

9. Actually, the exact number is 1.48 percent (rounded up to 1.5 in the text only because 1.48 sounds silly). In any case the cutoff points are somewhat arbitrary and are rigged according to the outcomes that corresponded to my intuitive feel, particularly to retain the United States as a hill not a plateau.

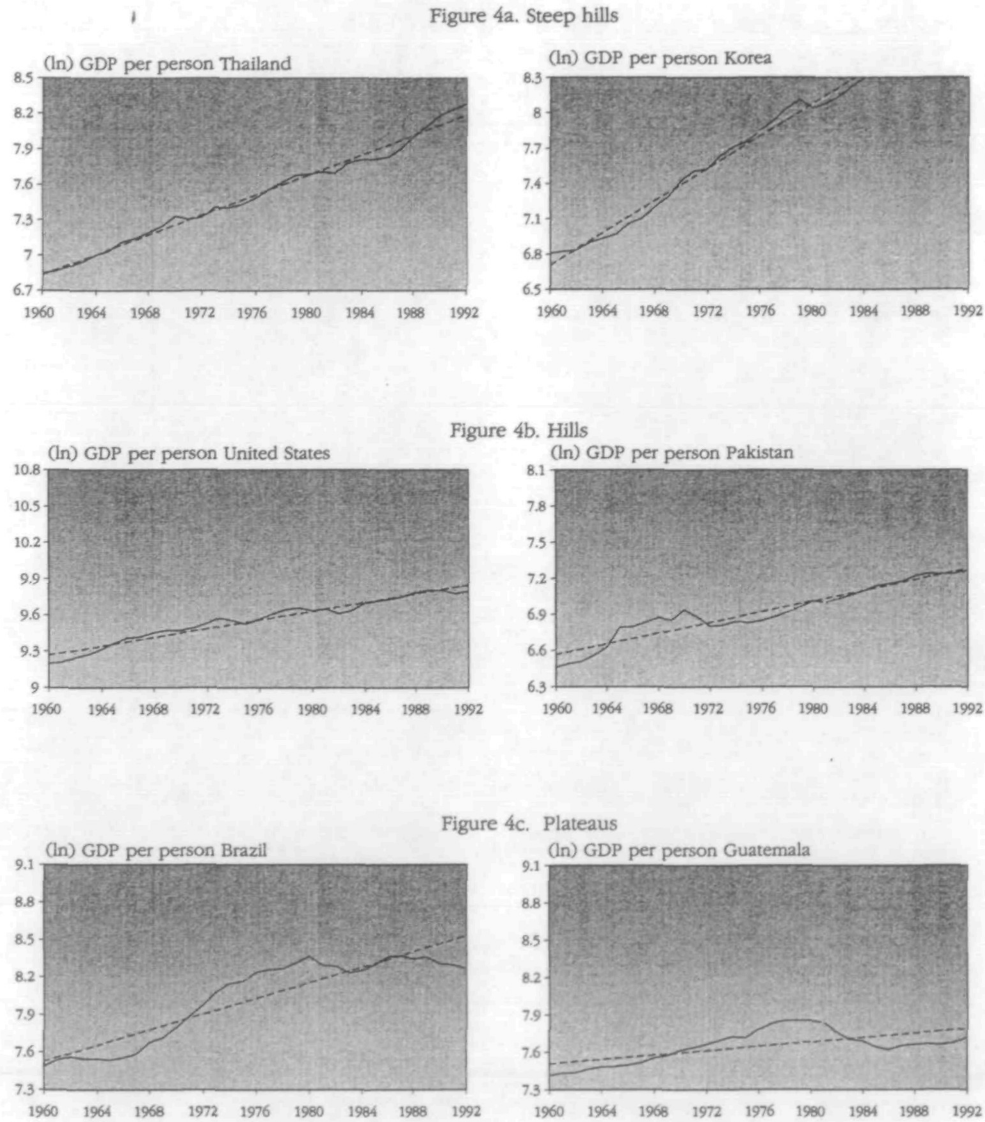
Table 5. *Classification of Countries by Levels of and Changes in Growth Rates*

			Developing countries				
Class	*Total number of countries*	*Industrial countries*	*East Asia*	*South Asia*	*Middle East and and North Africa*	*Latin America and the Caribbean*	*Sub-Saharan Africa*
Steep hills (g_b > 3 percent, g_a > 3 percent)	11	Cyprus, Ireland, Japan, Malta	Hong Kong, Korea (Rep. of), Malaysia, Singapore, Taiwan (China), Thailand				Botswana
Hills (g_b > 1.5 percent, g_a > 1.5 percent)	27	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Portugal, Spain, Switzerland, United States	China, Myanmar, Philippines	Bangladesh, Pakistan	Israel, Tunisia, Turkey	Barbados, Colombia, Costa Rica, Mexico	Tanzania
Plateaus (g_b > 1.5 percent, 0 < g_a < 1.5 percent)	16	Iceland, Netherlands, New Zealand, Sweden			Morocco	Brazil, Dominican Republic, El Salvador, Guatemala	Ethiopia, The Gambia, Guinea-Bissau, Kenya, Lesotho, Malawi, Swaziland

Mountains (g_b >1.5 percent, g_a < 0 percent)	33	United Kingdom	Namibia, Papua New Guinea		Algeria, Egypt, Iran, Iraq, Jordan, Saudi Arabia, Syrian Arab Republic	Argentina, Bolivia, Ecuador, Guyana, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Peru, Suriname, Trinidad and Tobago	Cameroon, Congo, Côte d'Ivoire, Gabon, Liberia, Mozambique, Niger, Nigeria, Sierra Leone, South Africa, Togo, Zaire, Zambia
Plains (g_b < 1.5 percent, g_a < 1.5 percent)	17			Nepal		Haiti, Republica Bolivariana de Venezuela	Angola, Burundi, Benin, Central African Republic, Guinea, Burkina Faso, Madagascar, Mali, Mauritania, Rwanda, Senegal, Somalia, Uganda, Zimbabwe
Accelerators (g_b < 1.5 percent, g_a >1.5 percent)	7		Indonesia	India, Sri Lanka		Chile, Uruguay	Ghana, Mauritius
Number of countries	111	23	12	5	11	24	36

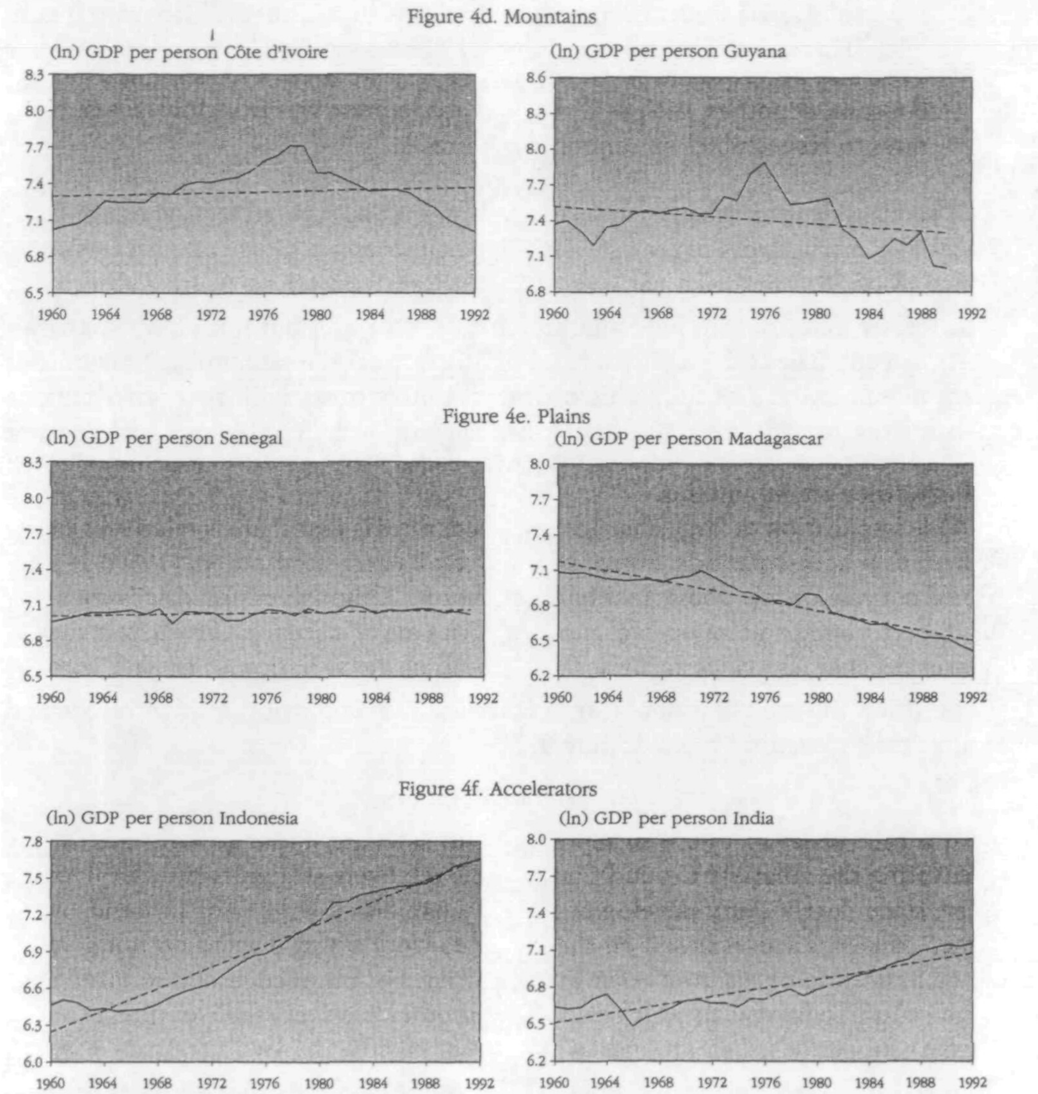
Note: g_b (g_a) is growth measured before (after) the structural break, using procedures described in table 1.
Source: Author's calculations.

Figure 4. *GDP Per Capita, by Pattern of Growth, 1960–92*



Nigeria, Saudi Arabia), a number of commodity exporters that experienced positive commodity price shocks followed by negative shocks (Côte d' Ivoire, Guyana, Jamaica, Zambia), and Latin American countries affected by the debt crisis (Argentina, Bolivia, Paraguay). The mountains include some countries with *cliffs*, very sharp drops, usually resulting from war or civil unrest (Liberia, Mozambique, Nicaragua). Because of a sharp break in their growth, the mountain countries show a low trend R^2 (for example, Côte d'Ivoire, 0.013; Argentina, 0.204; Nicaragua, 0.190).

Figure 4. *(continued)*



Note: Dotted line is the trend.
Source: Author's calculations.

- *Plains.* These 17 countries had growth rates less than 1.5 percent both before and after their structural break (figure 4e). Nearly all of these countries (14 of the 17) are in Sub-Saharan Africa. Senegal is a classic plain, with continuous stagnation and a fairly steady growth rate around zero (0.18 percent). Hence GDP per capita is reasonably characterized by a single trend, but nevertheless has a low R^2 (0.213). Included among the plains countries are those with consistently negative growth rates, such as Mozambique, which could be characterized as *valleys*.

- *Accelerators* or "*Denver*."[10] These seven countries did not have growth rates above 1.5 percent before their structural break, but did afterward (figure 4f). This class includes a number of clear successes, like Indonesia after 1966 and Mauritius after 1970, as well as less clear-cut successes, like India. For some countries, such as Ghana, the acceleration was from low or negative rates to respectable, but unimpressive, rates.

This classification scheme captures some interesting stylized facts about differences in growth across regions.[11] The OECD countries are nearly all hills or steep hills (18 of 23), and even the five exceptions are borderline. Nearly all of the plains are countries in Sub-Saharan Africa (14 of 17), but not all Sub-Saharan African countries are plains (only 14 of 36); a nearly equal number of countries are mountains (13 of 36). This even division contrasts with two other regions with slow overall growth: Latin America, with very few plains (2 of 24) but many mountains (12 of 24), and the Middle East and North Africa, where 7 of 11 countries are mountains.

One implication of large changes in growth rates is that there is relatively little correlation across periods. Since the study by Easterly and others (1993) is devoted entirely to this point, I will not belabor it. Although casual discussions of high-performing and low-performing countries make it seem as if relatively time-persistent characteristics account for the bulk of the variation in growth across countries, the cross-national (rank) correlation of countries' growth before and after their structural break is only 0.24.

Growth Volatility

If a time series can be well represented by a single stable growth rate, then measuring the volatility around that trend is relatively straightforward.[12] However, since nearly every developing country exhibits a large shift in trend over time, simple measures based on the residuals from a single trend do not give a good indication of the pure volatility of output. For instance, if one country has high volatility around a stable trend while another has very stable output in each of two subperiods, but around two different trends, the two countries would appear to have similar volatilities. This is the reason for using a variety of measures, including measures that allow for a shifting or rolling trend. The correla-

10. The only geographic metaphor I thought of was Denver, where the Great Plains meet the Rocky Mountains.

11. The classification also throws up a few anomalies, which reveal some limitations of the method. For instance, China is a consistent growth performer (a hill) because the data only allow one break, smoothing over the disasters of the Great Leap Forward. Similarly, the data break Tanzania's growth at 1980 and give two reasonably high-growth subperiods, smoothing over the disastrous years from 1978 to 1984. Great Britain is a mountain because the data break their otherwise very smooth series at the peak of a business cycle in 1987.

12. Although I use the simple trend and deviations throughout, I suspect that I would find similar results about differences in volatility and shifts in the drift parameter among countries if I were to treat the series as difference-stationary.

tions among the measures are high, but not high enough to suggest that there are not real differences as to the aspects of volatility the different statistics are capturing.

However measured, volatility is much higher in the developing countries. The median standard deviation of the deviation from trend is twice as high in the developing countries as in the industrial countries, 0.10 compared with 0.05 (table 6). The median forecast error is also nearly twice as large in the developing countries (0.095 compared with 0.054), and the typical maximum forecast error is also twice as large (0.28 compared with 0.14). The coefficient of variation of the (natural) log of first differences of GDP per capita is four times as high in the median developing country as in the median industrial country (4.3 compared with 1.04). Figure 5 shows the scatter plot of one measure of volatility (the standard deviation of the deviations from a single trend) against initial GDP per capita.

III. So, You Think You Want To Run a Growth Regression?

What are the implications of the instability and volatility of per capita GDP for empirical research into the determinants of economic growth? Recently, this research has expanded to regressions using higher-frequency data and country-specific growth effects, motivated by two arguments. First, there is a naive notion that one should use all the data so as not to throw away information. Second, the correlation between the included growth correlates and unobserved country-specific growth effects could generate misleading results. However, the commonly proposed cure of higher-frequency data and country-specific effects could easily worsen the disease. Given the instability and volatility of output, moving to shorter and shorter time periods and eliminating long-period variance are likely to entangle dynamics, specification, endogeneity, and statistical power, which will ultimately confuse, not clarify, issues of growth, especially in developing countries.

Preliminaries

A theory of economic growth relates the level of income at each point in time (and hence its growth rate) to another set of variables. Three dimensions of growth are traditionally distinguished based on the notion of the equilibrium level of income as a function of the underlying (X) variables, denoted $y^*(X)$, and the actual level of output, y.

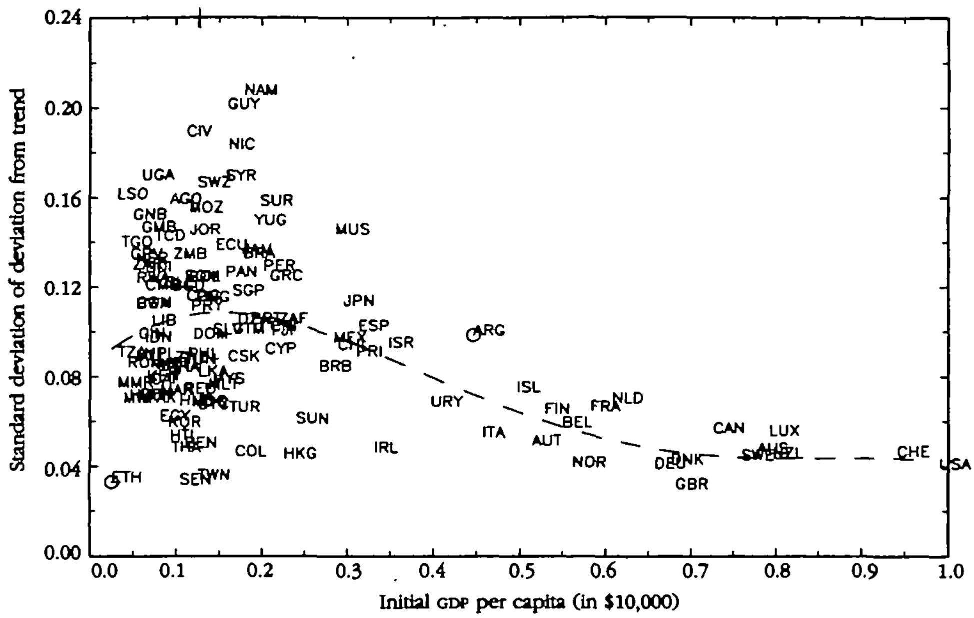
- The *steady state* refers to the growth rate of the steady-state level of output, $y^*(.)$.
- *Transitional dynamics* refer to movements of output as it adapts to changes in the steady-state level or steady-state growth rate of $y^*(.)$.
- The *business cycle* refers to the dynamics in actual output, y, without shifts in either the level or growth rate of $y^*(.)$.

Table 6. *Summary Statistics on the Volatility of Output*

Indicator	Standard deviation of deviation from single trend	First differences: Coefficient of variation	First differences: Standard deviation	First differences: Mean	Median absolute value of second differences (*100)	Forecast error (3,10): Mean	Forecast error (3,10): Maximum
Developing countries							
Mean	0.112	10.597	0.065	0.018	0.7	0.114	0.314
Median	0.100	4.314	0.059	0.014	0.5	0.095	0.283
Standard deviation	0.052	19.449	0.027	0.015	0.7	0.053	0.166
Industrial countries							
Mean	0.063	1.140	0.031	0.029	0.4	0.056	0.153
Median	0.054	1.040	0.027	0.028	0.3	0.054	0.135
Standard deviation	0.026	0.473	0.013	0.011	0.4	0.022	0.086

Source: Author's calculations, based on Penn World Tables Mark 5.6. See table 1 for a description of procedures.

Figure 5. *Volatility and Per Capita Income*



Note: See appendix for country names.
Source: Author's calculations.

Growth, $g_t(N)$, at time t over horizon N, has a steady-state, a transitional, and a cyclical component:

$$(1) \qquad g_t(N) = y_t - y_{t-n} = (y_t^* - y_{t-n}^*) + (y_t^T - y_{t-n}^T) + (y_t^C - y_{t-n}^C)$$

Obviously, the fraction of the variation of growth (over time and across countries) due to each of these three components varies with the horizon N.

The second element necessary to organize a discussion of the implication for growth research is to classify the myriad possible growth correlates according to three features: time-series persistence, exogeneity, and model rationale. Persistence ranges from country-specific, time-invariant variables, such as latitude (Hall and Jones 1999) and access to the sea (Gallup and Sachs 1999), to quantities that evolve very slowly, such as population size and human capital stock (Barro 1997) and trust (Knack and Keefer 1997), and to highly volatile series, such as black market premia, capital inflows, and terms of trade. Whereas stable, high-persistence variables are also usually exogenous, with little or no feedback from growth, the volatile variables can be either exogenous to a country's growth (terms of trade shocks) or highly endogenous (foreign investment).

Potential growth correlates can be further classified according to their *model rationale*, the postulated causal chain from the variable to growth. That is, every model tells a story in which one thing is affected by another, which then affects a third, which in turn affects output. Hence the model rationale includes (too often only implicitly) information relevant to the extent of exogeneity and the component of growth affected (steady-state, transitional, cyclical) and the expected time scale of the impact. This information can range from exogenous variables acting over decades to simultaneously determined variables affecting output over several months. Some types of model rationales include structural, shock, production function, policy, intermediate-outcome, and institutional (table 7).

Four Problems with Growth Regressions in Higher Frequencies

With the classification of the three components of growth and the classification of potential growth correlates by their persistence, exogeneity, and model rationale, the elements are in place to argue that the use of shorter panels is as likely to hurt as to help studies of long-run growth. There are four problems with using higher-frequency data, particularly with techniques that remove country-specific effects: lower power, greater measurement error, endogeneity, and dynamic misspecification (which itself comes in three flavors).

LOWER POWER. The lack of identification of country-specific, time-invariant variables using fixed effects in panel data is merely the limiting case of the decline

Table 7. *Classification of Variables Included in Growth Regressions*

	Persistence		
Endogeneity	*Stable*	*Medium*	*Volatile*
Low	Structural: geographic (land-locked, distance from the equator), climatic (rainfall), resource endowment (minerals) Institutional: for example, ethnic diversity, political system, language, colonial experience, type of legal system		Shocks: terms of trade, spillovers from financial crises, weather
Medium		Policy: quantities over which some individual or entity has more or less direct control (such as tariff rates)	
High		Intermediate-outcome: for example, trade ratio, inflation, budget deficit, financial depth	Intermediate-outcome: for example, foreign direct investment, export growth, budget deficit, black market premium

Source: Author.

in statistical power as the "between" country variance in time-persistent right-side variables is swept out by the fixed effects. Table 8 compares the fraction of total variation in five-year panel data that is due to variation over time within countries as a measure of a variable's persistence. The fraction of variance in per capita GDP growth that is within country is 0.73, reflecting instability of growth as well as volatility of output. In contrast, for many growth correlates the within-country variance is very low, only 0.22 for investment rates, 0.07 for level of education, and 0.02 for population size. Other growth determinants also have strong persistence: Isham, Kaufman, and Pritchett (1997) show high persistence for measures of democracy and civil liberties, while Deininger and Squire (1996) report that in their panel data on inequality only 10 percent of the variation in inequality is within country.

The difference in persistence between growth and growth correlates implies that fixed effects will sweep out much of the variation in right-side variables, while increasing the proportion of variance due to the volatile components of growth. We can estimate how much lower the *t*-statistics would be from fixed effects relative to time-averaged cross sections using a Monte Carlo evaluation of a simple bivariate regression with 100 countries and six periods (table 8). For a variable with the same persistence as level of education, the use of five-year-horizon fixed-effects estimates would cut *t*-statistics to a third of their level in the cross section. This implies that in the cross section the *t*-statistic would have to be 6 or higher to avoid being made statistically insignificant simply by the lower power of fixed effects.

MEASUREMENT ERROR. A well-known problem of panel econometrics (pointed out early, and subsequently often, by Grilliches and others) holds that if the cross-

Table 8. *Differences in Persistence between Economic Growth and Typical Explanatory Variables in Growth Regressions and the Implications for Statistical Power*

Variable	*Number of countries*	*Number of observations*	*Ratio of within-country variance to total variance*	*Ratio of t-statistics from fixed effects versus cross-section regressions for a right-side variable with the ratio of within-country to total variance indicated (based on Monte Carlo simulation)*
Growth of GDP per capita	126	756	0.73	
Population growth	126	756	0.31	0.62
Investment rates	126	756	0.22	0.54
Level of education	84	504	0.07	0.32
ln of population site	126	756	0.02	0.18

Note: The predicted ratio comes from a Monte Carlo simulation of data for 100 countries over six periods with growth and the right-side variables having different time-series persistence. By varying the degree of persistence of right-side variables while holding the persistence of growth at 0.75, a tight predicted relationship with *t*-statistics is produced.

sectional variance is large relative to the time-series variance and if the measurement-error variance has a large time series relative to the cross-sectional variance, then the use of fixed effects exacerbates the degree of measurement error and hence increases the attenuation bias. This effect can be enormous, especially with high-persistence variables, in which the variance of the measurement error is constant for each repeated measurement. The use of fixed effects with variables that have persistence characteristics similar to those in table 8 could easily increase attenuation bias due to measurement error by a factor of 10, making even large effects disappear.

ENDOGENEITY BIAS. Short panels can exacerbate the endogeneity problem, as seen in a simple hypothetical model. Suppose there are long-run growth, $g_{\cdot}$, and business cycle effects in the determination of current output for each country i at time t:

$$g_{\cdot}^{i} = \beta \bar{x}^{i}. \tag{2}$$

In addition, suppose that there is a causal relationship from the country-specific average of x to long-run growth ($g_{\cdot}$):

$$y_t^i = y_{t-1}^i (1 + g_{\cdot}^i)(1 + g_{c_t}^i) \tag{3}$$

Finally, suppose that although the average level of x is the result of a policy choice, the cyclical component of x is a result of the business cycle component of growth:

$$(x_t^i - \bar{x}^i) = \delta g_{c_t}^i. \tag{4}$$

In this simple setup it is easy to see that if one is trying to identify the long-run impact on growth of policy changes in x, β, then moving from the time-averaged cross section to fixed effects on panels will be a disaster. Instead of identifying β, the fixed-effects estimator identifies the impact of growth on x, δ, which represents an entirely different phenomena. This problem has wide implications because many growth correlates (especially intermediate-outcome variables) are endogenous.

DYNAMIC MISSPECIFICATION. The fourth problem is dynamic misspecification created by arbitrarily changing the time span over which the regression is estimated. Dynamic misspecification raises two distinct problems. The first is the dynamic misspecification of the time scale over which the growth correlates have an effect. Arbitrarily parsing time series into shorter periods imposes the assumption that the dynamics are invariant across growth correlates.[13] Although including lagged income levels creates some ad hoc adjustment dynamics, this still assumes that the speed of adjustment is equal across the right-side variables. But, in fact, although some growth effects are contemporaneous, especially macroeco-

13. Arbitrary is not too strong a word: I have seen published growth regressions at 1-, 3-, 4-, 5-, 7-, and 10-year horizons, justified only on the grounds that data were available at those frequencies or the researcher wanted to divide the whole period into equal chunks.

nomic and cyclical factors, others could take several years, such as transitional dynamics due to changes in investment incentives, and still others could take decades, such as the impact of changes that affect the rate of technical progress. Some right-side variables may have output or growth effects at all horizons—cyclical, transitional, and steady-state—and there is no reason to believe that these effects are of similar magnitude, nor have the same sign, because some policy choices may lead to temporary booms but ultimately to busts.

The second problem is that emphasizing the higher-frequency components of the right-side variables assumes that transitory and permanent changes in a growth correlate have the same impact on growth rates at every frequency. This is false for most variables in dynamic-optimization macroeconomic models in which responses depend on expectations. The output response to changes in a growth correlate (tariffs, taxes, terms of trade, investment incentives) can be of a completely different order of magnitude, or even sign, depending on whether the change is perceived as permanent or temporary.

For any given growth correlate, x, there are six underlying sets of output-response coefficients: the steady-state ($*$), transitional (T), and cyclical (C) dynamics in output in response to either a permanent (P) or temporary (R) change in the growth correlate. These are sets of coefficients, as each has its own growth dynamics with possible lags from zero (contemporaneous) to k with the resulting long-run impact $\beta_{LR}^{m,n} = \sum_{n=0}^{k} \beta_{LR_{t-n}}^{m,n}$.

(5)
$$
\begin{aligned}
Y_t^{*} &= \sum_{n=0}^{k} \beta_{t-n}^{*P} X_{t-n}^{P} + \sum_{n=0}^{k} \beta_{t-n}^{*R} X_{t-n}^{R} \\
Y_t^{T} &= \sum_{n=0}^{k} \beta_{t-n}^{TP} X_{t-n}^{P} + \sum_{n=0}^{k} \beta_{t-n}^{TR} X_{t-n}^{R} \\
Y_t^{C} &= \sum_{n=0}^{k} \beta_{t-n}^{CP} X_{t-n}^{P} + \sum_{n=0}^{k} \beta_{t-n}^{CR} X_{t-n}^{R}
\end{aligned}
$$

A typical growth regression specification is:

(6)
$$g_t(n) = \Theta(n) f(x_{t_1}, \ldots x_{t-n}) + \lambda y_{t-n}$$

where f (.) is a function of the N annual observations on x (usually a simple average, beginning-of-period values, x_{t-n}, or end-of-period values, x_t) when in levels or usually just $x_t - x_{t-n}$ when in differences. The resulting coefficient, $\Theta(n)$, is a complex weighted average of the underlying βs. Since the weights vary with the variance components of y^*, y^T, and y^C and with the permanent and temporary components of x reflected in the data, $\Theta(n)$ depends strongly on the chosen horizon, N. Since the βs need not even have the same sign, $\hat{\Theta}(1)$, $\hat{\Theta}(5)$, and $\hat{\Theta}(30)$

are not estimates of the same parameter using data at different horizons; rather they are estimates of different underlying combinations of parameters.

The same is true of $\Theta_{FE}(n)$ and $\Theta_{OLS}(n)$. Taking out the fixed effect enhances the relative signal of output that is cyclical and the relative signal of the right-side growth correlates that is temporary (versus permanent). By using the within-country variation to identify coefficients, this approach may completely miss, or change the sign of, important long-run impacts on growth.

Implications for Reading the Growth Literature

These four problems make it impossible to assert that the higher-frequency regressions have done a better job of estimating the structural relationship between growth and a candidate growth determinant. For any growth correlate the empirical findings using time-averaged cross sections and those using higher-frequency data with country-specific effects can differ in four possible ways. The correlation coefficient of x could not be robust, could fall in magnitude, could rise in magnitude or change sign, or could be unstable over time. None of these possibilities is of any particular interest in helping us understand long-term growth.

NOT ROBUST. A common finding is that many estimates are not robust to the inclusion of country effects, in the mechanistic sense that variables that are statistically significant in the cross section are not statistically significant in panels with country effects. For instance, although cross-sectional studies typically find that, conditional on initial income, the level of education (or the enrollment rate) is a significant determinant of subsequent growth (Mankiw, Romer, and Weil 1992 and Barro and Sala-i-Martin 1995), panel regressions typically find that the level of education is insignificant (Islam 1995).[14] In many cases the confidence interval of the fixed-effects estimate is large enough to include zero (and hence not be statistically significant), even though the point estimate is larger than the cross-section estimate. In this case all that is learned is that the new estimate is less precise. A failure to reject is completely uninformative unless accompanied by a serious analysis of statistical power (Andrews 1989).

LOWER IN MAGNITUDE. A second possibility is that in moving to estimates with country effects, the magnitude of the point estimate falls. But given the substantial measurement error in most of the growth correlates and the well-known exacerbation of attenuation bias by transformations that reduce signals more than noise, a smaller coefficient is completely uninteresting—without a serious remedy for the measurement error bias. A smaller and statistically insignificant growth correlation from panel estimation is twice as uninteresting.

HIGHER IN MAGNITUDE (OR CHANGE IN SIGN). If robustness and falling magnitude were the only two problems, the situation would not be completely hope-

14. The growth–human capital regressions that mix economic growth with education levels or enrollment rates have additional, extremely serious, empirical and theoretical problems (Pritchett 1996b).

less, as the direction of the changes from these two problems (larger standard errors and attenuation to zero) are well known. The results might still be interesting if the estimated magnitude of the partial correlation rose or if the sign of the partial correlation changed. However, once the problems of endogeneity and dynamic misspecification enter, anything can happen. The interpretation of the differences between the cross-sectional and fixed-effects estimates depends entirely on the underlying theories of the cyclical and adjustment dynamics of output—which typically are not developed within growth theories.

An example illustrating these two problems is a regression relating growth and budget deficits. If a country pursues a countercyclical fiscal policy, then periods of low cyclical growth would correspond to periods of high deficit. Using short-period data (and, given the large magnitude of output volatility relative to trend, "short" could be quite long), estimates could easily show that budget deficits have a large negative effect on growth when, in fact, the causality is exactly the reverse. An even more likely possibility is that moving to fixed effects increases the omitted variable bias from dynamic structural misspecification. There are many kinds of temporary shocks—war, political disruption, terms-of-trade movements, adverse weather—that affect output in a variety of ways. These shocks are more highly correlated with the time-series dimension of fiscal deficits than with cross-national, long-period averages. Time averaging reduces the correlation between growth and the unobserved (or not included) shock variables and the correlation between growth and fiscal deficits—hence reducing the omitted-variable bias. However, moving to higher frequencies and removing country effects worsen these sources of bias (Easterly and others 1993).

Changes in magnitude and sign can be the result of arbitrarily changing the time scale of regressions without considering the dynamics implicit in any given model rationale. For instance, several recent studies find that the negative correlation between inequality and economic growth in cross sections is not robust, and even reverses sign, when using five-year panels (Forbes 1997). But certainly the models that propose a model rationale running from inequality to median-voter preference to politically determined tax rates to investment to growth (Persson and Tabellini 1994) or a rationale running from inequality to political instability to investment to growth (Alesina and Perotti 1993) are not meant to be tested using a *contemporaneous* relationship between short-run deviations of growth from its long-run average and short-run deviations of inequality from its long-run average, while sweeping out permanent cross-national differences. Moreover, one can easily imagine models in which a short-run increase in growth causes a short-run increase in inequality, whereas a long-run increase in inequality causes a decrease in output or growth.[15] A finding that the short-run impact is

15. Just to prove that it is easy to imagine such a model, here is one (of many possibilities). A positive shock increases the returns to human capital, given the role of human capital in adapting to disquilibrium. Thus there is a temporary increase in growth and a temporary increase in inequality. At the same time persistent inequalities in income distribution lead to unequal educational opportunities across talent levels, thus lowering the long-run quality of human capital.

different than the long-run impact does not contradict or refute the robustness of the long-run growth correlation.

An important point that seems to have been overlooked is that a Hausman-Wu type specification test is an *omnibus* specification test. Many studies frame the test as one of the bias due to correlation with omitted country-specific variables. Hence they interpret a rejection as evidence that ordinary least squares is an inconsistent estimator of the parameter of interest. This reasoning is incorrect. Any misspecification that prevents Θ_{FE} and $\Theta_{OLS}(n)$ from converging to the same parameter vector Θ_0 can cause a rejection, including the endogeneity, misspecification, and measurement-error problems described above. A rejection of the null—$H_0 : \Theta_{OLS}(30) = \Theta_{OLS}(5)$, either informally or through a vigorous specification test—does not lead to the conclusion that ordinary least squares is an inferior estimate of the long-run impact of permanent changes in β^{*P}_{LR}. The rejection that may arise may be due not to the bias in $\Theta_{OLS}(30)$ as an estimate of β^{*P}_{LR} or to the problem of correlation with unobserved and omitted country-specific effects, but rather to dynamic misspecification or the exacerbation of endogeneity in $\Theta_{FE}(5)$ as an estimate of β^{*P}_{LR}.

With intermediate-outcome variables (such as the black market premium, inflation, or the ratio of trade to GDP or investment), which are themselves time-varying, the combined problems of endogeneity and dynamic misspecification may be overwhelming. Intermediate-outcome variables are not, strictly speaking, "policy" variables, since they are determined both by policy actions and by responses to those policies. For these cases, although simple time averaging might not be the optimal filter, it may be better than no filter at all, as the additional signal in higher-frequency data may not be a signal relevant to identifying the long-run impact, β^{*P}_{LR}.

UNSTABLE. The final empirical problem often found with the use of higher frequencies is that the regression parameters are not stable over time (with or without fixed effects). In regressions run on 10- or 5-year periods the statistical significance and even the signs of coefficients are not the same as those in regressions run on time-averaged data. Kelley and Schmidt (1994) regress GDP per capita growth on population growth decade by decade and find a mildly negative coefficient in the 1960s, a mildly positive coefficient in the 1970s, and a larger and negative coefficient in the 1980s. Similarly, Knack and Keefer's (1997) study on social characteristics and growth shows substantial parameter instability—the social variables have different signs in the regressions on growth after 1980 than in regressions on growth prior to 1980, even though one would suspect that the underlying social characteristics actually changed very slowly (the study has data for only one year). Similarly, one of the best-researched findings in the growth literature is the connection among financial depth, characteristics of the banking sector, and growth (Levine 1997 and Levine and Zervos 1998). However, even this relationship shifts in decade-by-decade data. Vavamkidis (1997) looks at the relationship between growth and trade over the long run, using data going back into the 1900s, and finds that the partial correlation of the two shifts over time.

Well, so what? So absolutely nothing. Parameter instability is not particularly informative because it is hard to reconcile with any of the coefficients that identify a "true" invariant structural parameter that links a variable with output (or growth) at all frequencies.[16] But, then, how does one interpret these parameter shifts? Does the underlying structural relationship produce the reduced-form shifting? Does this reflect shifts in temporary growth dynamics or in the steady-state components of growth? Do these shifts reveal true strategic opportunities: it was good to be open to trade in the 1960s, but not in the 1930s? It was good to be financially deep in the 1980s, but not in the 1970s? To make assertions about time-varying relationships between determinants and growth requires a growth theory that specifies not only what these relationships are but also how they shift over time. Without such a theory, it is impossible to say which time-varying parameter is relevant for the current or future periods. For instance, suppose one really believed that the association between population growth and per capita GDP growth changed from the 1960s to the 1970s to the 1980s. What could be inferred from the past about the expected relationship in the 1990s? Without a (verified) explanation of the causes of the parameter shifts, the answer is: nothing.

The Way Forward

Many agree that growth regressions as a tool for investigating long-run growth have passed the point of diminishing returns (see my requiem for growth regressions, Pritchett 1997). There is a group that sees a way forward in combining higher-frequency data with new econometric techniques for dynamic panels. These techniques are aimed primarily at solving another, more narrow econometric problem that arises in panels, that of the bias in dynamic regressions with a lagged endogenous variable. Although it is possible that these techniques might address some of the problems raised here (such as measurement error), so far most of the work has depended on more or less arbitrary restrictions on the time-series properties of the data for identification. Opinions still differ on whether using dynamic generalized methods of moments estimators identified from assumptions on dynamics is a fruitful approach for understanding countries' economic growth and its determinants. I have become more, rather than less, doubtful by the results produced.

But since it is hard to think about anything other than long-term growth, let me end on a positive note and offer some suggestions on ways to research the determinants of growth that might even contribute to policy. First, analysis of the episodes of growth acceleration or the onset of growth deceleration has prom-

16. Parameter stability is also an omnibus specification test so that a failure to reject is some evidence of a correct specification, but a rejection of parameter stability could arise from any number of specification problems.

ise.[17] For each of the plateau, mountain, and cliff countries there is usually an easily identifiable turning point after which growth is much slower. Moreover, for many of the steep hill and accelerator countries there is an identifiable takeoff date after which growth is much more rapid. One research strategy that seems promising is to examine the economic, political, institutional, and policy conditions that accompany these break points: why did growth suddenly change sharply at a certain time? Research also could identify which political conditions made the adoption of such reforms possible or made the adoption of policies that would avoid a decline in growth unlikely (Rodrik 1996).

Studies of rapid growth in Korea in the early 1960s (Haggard, Byung-Kook, and Moon 1990), Mauritius in 1970 (Romer 1993), Indonesia after 1966, China since 1978, or Chile since 1988 are extremely useful in establishing the conditions that initiate episodes of growth. Similarly, we can also ask why some countries hit periods of slow or negative growth and were unable to reverse the decline. This question is particularly interesting in a comparative context in which countries experienced similar shocks, but their growth responses differed widely: Korea's response to the debt shock of the early 1980s compared with Brazil's, Chile's response to the long-run collapse in the price of copper compared with Zambia's, Nigeria's response to the decline in oil prices in the 1980s compared with Indonesia's, or, more recently, Indonesia's response to the Asian crisis compared with Thailand's.

The second type of useful study is an analysis of discrete episodes in the evolution of potential growth determinants. For instance, Bruno and Easterly (1998) show that it is impossible to estimate the impact of inflation on growth from either long-period averages or panels. But when one analyzes episodes of inflation, one finds clear and robust, if surprising, results. Similarly, Krueger's (1978) study of discrete episodes of changes in exchange rate regimes and import liberalization in 10 countries, although "ancient," still has, in my opinion, more insights on the impact of policies on growth and ultimate persuasive power for policymaking than the hundreds of growth regressions with openness as a right-side variable.[18] If variable x is a powerful growth determinant, then large changes in x should be followed by large shifts in output and growth. Hence beginning from known episodes of policy change is a promising avenue.

The third approach that has great potential is cross-sectional analysis of changes in growth rates over time. This approach has great potential because it is almost unexplored. In fact, when I wrote the first draft of this article, I could claim that

17. A rich economic literature in a number of fields relies on episodic analysis, based on both statistical tests and case studies. The studies on the effects of devaluation by Kamin (1988) and Edwards (1989) rely on identification of discrete devaluation episodes; studies of the impact of debt crises, banking crises, and currency crises similarly rely on episodic analysis.

18. Pritchett (1996a) explains that the lack of internal coherence of the various indicators of openness makes the usual interpretation of the results dubious in any case.

there were no studies looking systematically at the determinants of changes in growth rates. However, Rodrik (2000) investigates the change in growth between the early and later periods of the data (using at one stage the data from this work). He shows that growth deceleration is determined by a combination of shocks to the economy and countries' ability to adjust to those shocks, which in turn is determined by social and political factors. Rodrik's article shows the promise of taking instability seriously and examining shifts in growth rates as well as levels.

IV. Conclusion

The exception should prove the rule, not be mistaken for it. Although stable growth rates are the exception outside of the OECD, those exceptions—the East Asian countries that sustained rapid growth rates for three decades (at least until 1997)—have captured the imagination. Both casual talk and an academic literature on growth have focused on why some GDP per capita hills are steeper that others. However, the rule of growth in developing countries is that anything can happen and often does. The instability of growth rates makes talk of *the* growth rate almost meaningless. Moreover, the enormous volatility of growth around its trend (however defined) means that even over periods as long as a decade, growth can be dominated by shocks and recovery.

This implies that the arbitrary parsing of the entire time series of output into different lengths is unlikely to lead to significant, policy-relevant insights into growth. Although we have learned some things from examining growth correlates with multivariate regressions of various types, there is little more to be learned by moving to panels. This approach leads to low power, greater measurement error bias, confusion about causality and endogenity, and dynamic misspecification of many stripes, all of which cloud the interpretation of regressions using higher frequencies. One can certainly question the usefulness of a technique that might cause the estimated partial correlation to rise, fall, shift, or lose statistical significance, when any of these would have no impact on inferences about the important question of interest: the impact of permanent policy shifts on long-run output or growth.

A more promising approach to understanding the determinants of growth in developing countries, particularly in a way that is relevant to policy, is more careful research into three questions:

- What are the conditions that initiate an acceleration of growth or the conditions that set off sustained decline?
- What happens to growth when policies—trade, macroeconomic, investment—or politics change dramatically in episodes of reform?
- Why have some countries absorbed and overcome shocks with little impact on growth, while others have been completely overwhelmed?

Appendix 1. Country Acronyms and Names

Code	Country name	Code	Country Name	Code	Country Name
AGO	Angola	GNB	Guinea-Bissau	NIC	Nicaragua
ARG	Argentina	GRC	Greece	NLD	Netherlands
AUS	Australia	GTM	Guatemala	NPL	Nepal
AUT	Austria	GUY	Guyana	NZL	New Zealand
BDI	Burundi	HKG	Hong Kong	PAK	Pakistan
BEL	Belgium	HND	Honduras	PAN	Panama
BEN	Benin	HTI	Haiti	PER	Peru
BGD	Bangladesh	HVO	Burkina Faso	PHL	Philippines
BOL	Bolivia	IDN	Indonesia	PNG	Papua New Guinea
BRA	Brazil	IND	India	PRT	Portugal
BRB	Barbados	IRL	Ireland	PRY	Paraguay
BWA	Botswana	IRN	Iran, Islamic Rep. of	RWA	Rwanda
CAF	Central African Republic	IRQ	Iraq	SAU	Saudi Arabia
CAN	Canada	ISL	Iceland	SEN	Senegal
CHE	Switzerland	ISR	Israel	SGP	Singapore
CHL	Chile	ITA	Italy	SLE	Sierra Leone
CHN	China	JAM	Jamaica	SLV	El Salvador
CIV	Côte d'Ivoire	JOR	Jordan	SOM	Somalia
CMR	Cameroon	JPN	Japan	SUR	Suriname
COG	Congo	KEN	Kenya	SWE	Sweden
COL	Colombia	KOR	Korea, Rep. of	SWZ	Swaziland
CRI	Costa Rica	LIB	Liberia	SYR	Syrian Arab Republic
CYP	Cyprus	LKA	Sri Lanka	TGO	Togo
DEU	Germany	LSO	Lesotho	THA	Thailand
DNK	Denmark	MAR	Morocco	TTO	Trinidad and Tobago
DOM	Dominican Republic	MDG	Madagascar	TUN	Tunisia
DZA	Algeria	MEX	Mexico	TUR	Turkey
ECU	Ecuador	MLI	Mali	TWN	Taiwan (China)
EGY	Egypt	MLT	Malta	TZA	Tanzania
ESP	Spain	MMR	Myanmar	UGA	Uganda
ETH	Ethiopia	MOZ	Mozambique	URY	Uruguay
FIN	Finland	MRT	Mauritania	USA	United States
FRA	France	MUS	Mauritius	VEN	Venezuela
GAB	Gabon	MWI	Malawi	ZAF	South Africa
GBR	United Kingdom	MYS	Malaysia	ZAR	Zaire
GHA	Ghana	NAM	Namibia	ZMB	Zambia
GIN	Guinea	NER	Niger	ZWE	Zimbabwe
GMB	Gambia, The	NGA	Nigeria		

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