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11 Explaining Miracles: Growth Regressions Meet the Gang of Four

William Easterly

11.1 Introduction

Like everyone else, economists find success irresistible. The spectacular success of the East Asian economies has attracted a huge literature to explain the success and to examine the prospects for imitation by others. The leading actors in this development drama are the four most successful of the East Asian less developed countries (LDCs): Hong Kong, Korea, Singapore, and Taiwan—known by such encomiums as the Gang of Four, the Four Dragons, the Four Tigers, the Asian miracles, and the newly industrialized countries (NICs). The Four have been used to support each development school's favorite prescriptions, ranging from free market outward orientation to aggressive trade intervention.[1]

It is obvious why the story of the Four is so tantalizing: if only their success could be understood and replicated in other LDCs, the development problem would be solved. The metaphors for the Four recognize that replication is not

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1. The case for market-friendly and outward-oriented policies is made by Balassa (1991), Krueger (1985, 1990), Thomas and Wang (1993), Chenery (1988), World Bank (1993b), and numerous others. The case for intervention ("getting prices wrong") is made in varying degrees by Amsden (1989, 1991) and Wade (1989, 1990). Somewhere in the middle are Kihwan and Leipziger (1992), Pack and Page (1993), Pack and Westphal (1986), Page and Petri (1993), Stiglitz (1992), and World Bank (1993a). Other authors stress education (Birdsall and Sabot 1993), stable real exchange rates (Kim 1985; Balassa 1978), political stability (Hofheinz and Calder 1982; Haggard 1989, 1990), low inequality (Krueger 1990; Haggard 1989), macroeconomic stability (Collins 1990; Nam 1988), foreign investment (Romer 1993; Parry 1988), and Confucian culture (Kahn 1979; MacFarquhar 1980).

so easy. "Miracles" are unique (the Red Sea was parted *once*); "tigers" are an endangered species. As Lucas (1993) says, "simply advising a society to 'follow the Korean model' is a little like advising an aspiring basketball player to 'follow the Michael Jordan model.'"

Nevertheless, economists find it much more appealing to study what the successes did right than what failures did wrong: from 1969 to the present there have been 717 articles on Singapore in economics journals.[2] On the Central African Republic, a country of similar population size but opposite performance, the number of articles over this period was: 1. It is not really clear why large positive outliers should contain more information than large negative outliers.

The alternative to case studies is to examine the entire range of cross-sectional variation of performance and policies for evidence on what distinguishes successes from failures. This approach was already well established in the development literature (e.g., the large literature on exports and economic growth of Balassa 1978, Feder 1983, and others), but has taken on truly mammoth proportions with the advent of the "new growth literature" inspired by Romer (1986). Numerous empirical studies have examined the relationships between policies and growth predicted by "new" growth models as well as by extended "old" growth models. The studies show strong associations between country characteristics and growth (e.g., Barro 1991), although these relationships are very sensitive to the choice of right-hand-side control variables (Levine and Renelt 1992).

A natural exercise is to examine to what extent this large empirical literature can explain the success of the Four.[3] The Four's per capita growth rates of around 6 percent will be among the largest outliers in any study of growth. This is not surprising: the Four Tigers are Tigers *because* their growth rates were high.[4] This sample selection problem bedevils the analysis of the Gang of Four: we cannot say *how* special are the Four because they were selected because they *are* special. This paper will examine the place of the Four in growth regressions keeping in mind this selection problem. The Four generally have large positive residuals in growth regressions, but this paper will argue that this is not surprising for observations that were known in advance to be at the top of the sample. Growth regressions and, more generally, quantitative measures of "policies" are not very successful at picking out the Four as most likely to succeed.

2. These numbers are taken from the number of references generated by a search request for the country's name in EconLit, the CD-ROM index of articles in economics journals, issued by the *Journal of Economic Literature*.

3. I have benefited from the similar exercise of Barro and Lee (1993) in identifying the best and the worst in economic growth.

4. The others that are ranked as high as the Four are Malta and Japan in the Barro exercise and Botswana and Yemen in the Levine-Renelt data. Japan is not in the Gang of Four because it has a separate, reverential status; Botswana, Malta, and Yemen are presumably less celebrated because they are tiny, not in a coherent region, and/or subject to peculiar circumstances.

Table 11.1 A Report Card for the Gang of Four, 1960–85 (110 observations)

Indicator	Hong Kong	Korea	Singapore	Taiwan
Per capita growth (1960–85) higher than:	99	98	100	95
Fitted value of per capita growth from Barro regression higher than:	94	75	99	86
Growth residual from Barro regression higher than:	97	98	99	94
Magnitude of growth residual	2.66	2.91	3.02	2.06
Primary enrollment (1960) higher than:	56	58	91	63
Secondary school enrollment (1960) higher than:	65	71	76	72
Share of government consumption in GDP (1960–85) lower than:	100	61	91	18
Deviation of investment deflator from United States (1960) lower than:	48	16	39	49
Revolutions and coups (1960–85) lower than:	100	19	100	64
Assassinations per capita (1960–85) lower than:	100	36	100	38
Initial per capita income (1960) lower than:	29	73	28	71

Source: Barro (1991).

Note: Table gives percentile rankings of Gang of Four for variables in growth regression, where 100 is the most favorable for growth.

The second, related issue to be examined is to what extent omitted, country-specific fixed factors explain the success of the Dragons. This is the same as asking how permanent is the success of the Asian miracles. Cross-country evidence will show that large positive residuals like those associated with the Dragons have historically been transitory. The natural conclusion is that the miraculous growth rates of the Dragons are unlikely to continue.

11.2 The Gang of Four in Growth Regressions

We examine in this section how the Gang of Four enter into growth regressions. We take two well-known empirical studies as a point of departure: Barro (1991) and Levine and Renelt (1992) (the latter unfortunately omits Taiwan). For each regression, we will examine how much the right-hand-side variables are successful in predicting the high growth of the Gang of Four. Equivalently, we will ask whether the Four were as highly ranked in their policies and other country characteristics as they were in their growth rates.

Table 11.1 shows the ranking of the Four in the right-hand-side variables from the Barro (1991) regression. Some of the policy rankings are considerably less than superlative. All of the Four are in the worst half on a measure of price distortion: the deviation of the investment goods price in dollars from the U.S. price. Hong Kong and Singapore have highly stable political systems, but not so Taiwan and Korea. Primary education is exceptional in Singapore, but only slightly above average in the other three. Government consumption is ad-

versely high in Taiwan (whose many public enterprises are notorious for overstaffing and inefficiency—see Liu 1993). Initial income is low in Korea and Taiwan, so that they benefited from the tendency of poor nations to grow faster (Barro and Sala-i-Martin 1992), but Hong Kong and Singapore were relatively rich. Altogether, the predicted value of growth from the right-hand-side variables is among the highest in the sample for Singapore and Hong Kong; Taiwan is less clearly picked out as exceptional, while Korea just barely makes the top quartile. To put it more graphically, there were 27 countries that were predicted to do better than Korea, including such notable nonsuccesses as Guyana, Jamaica, and Uruguay.

All of the Four Tigers have large positive residuals of 2 or 3 percentage points of growth.[5] The positive residuals are unsurprising: observations at the upper end of the sample are likely to have positive residuals. To illustrate this, suppose that growth had been completely random around a constant term. If we had regressed a large sample of such randomly determined growth rates on a constant term, then by definition the four largest growth rates would have the four largest residuals in such a regression. If we have a model with some predictive power, then the countries with the largest growth rates are likely to have above-average values *both* of the predicted value of growth and of the random error term.[6]

Another way of illustrating how poorly predicted is the growth of the Four in this regression is to calculate the probability that a given country will achieve a "miracle," where a miracle is defined as growth greater than 5 percent per capita. There were seven such miracles in the Barro data: Japan, Malta, Gabon, and the Gang of Four. The probability of reaching such a growth rate is calculated as the probability of a sufficiently large realization of the error term such that the fitted value of growth plus the error term is greater than 5 percent.[7] A country with favorable characteristics will need only a small realization of the error term to reach "miraculous" growth rates, while a country with highly unfavorable characteristics would need an improbably high realization to attain a miracle. Again, we see in table 11.2 that the Barro regression is good at picking out the success of Japan and Singapore, less so the success of Hong Kong and Taiwan, and much less so the miracle of Korea.

5. The regression is (t-statistics in parentheses): **Growth 60–85** = .023 (3.3) −.0000055 (−4.8) **Initial income 1960** + .027 (4.87) **Primary enrollment 1960** + .032 (2.80) **Secondary enrollment 1960** −.0035 (−1.67) **Assassinations per capita 60–85** −.0247 (−4.05) **Revolutions and coups 60–85** −.0688 (−2.66) **Government consumption 60–85** −.0063 (−1.26) **Investment price deviation 1960.** 110 observations, R^2 = .502, standard error = .014. The regression differs slightly from that reported in Barro (1991) because the sample is larger.

6. The lower the predictive power (the lower the R^2) of the growth regression, the larger is the expected magnitude and rank of the residual for the countries that have the largest growth rates in the sample. The expected value of the residuals of the countries with the largest growth rates is always positive for any R^2 less than one.

7. The t-distribution is used for the probability distribution of the residual divided by the standard error of the regression.

Table 11.2 **Probability of Country Attaining a Miracle**

Country	Probability (%)
Most probable	
Japan	**59.98**
Singapore	**34.62**
Malta	**30.95**
Cyprus	29.73
Greece	27.31
Guyana	24.45
Portugal	23.81
Hong Kong	**23.49**
Finland	22.86
Belgium	20.41
France	20.24
Mauritius	18.78
Jamaica	18.57
Malaysia	17.07
Paraguary	16.90
Taiwan	**16.84**
Ireland	15.60
Iceland	15.29
Brazil	14.30
Barbados	12.61
Sri Lanka	11.95
Gabon	**11.82**
Spain	11.27
Austria	11.06
Netherlands	10.35
Germany	9.51
Uruguay	8.98
Korea	**8.80**
Least probable	
Sudan	0.01
Ethiopia	0.00
Angola	0.00
Chad	0.00

Source: Barro (1991).

Note: A "miracle" is defined as greater than 5 percent per capita growth, 1960–85. Actual "miracles" are shown in boldface.

Interpreting Korea's high residual literally is an interesting thought experiment. According to table 11.2, Korea had only about a 1 in 11 chance of attaining the miraculous growth rates that it in fact attained. There would then be nothing special about Korea—it would just be the economy that got lucky out of a larger set of countries with good but not great economic policies. These odds of a miracle still reflect relatively favorable conditions for growth in Korea; by contrast, Chad—with adverse characteristics for growth, to put it

Table 11.3 Another Report Card for the Gang of Four

Indicator	Hong Kong	Korea	Singapore
Per capita growth (1960–89) (World Bank) higher than:	97	98	99
Fitted value from Levine-Renelt regression higher than:	84	87	99
Residual from Levine-Renelt regression higher than:	98	99	92
Magnitude of growth residual	3.13	3.23	1.69
Investment/GDP (1960–89) higher than:	92	80	100
Population growth (1960–89) lower than:	59	65	69
Initial income (1960) lower than:	30	63	36
Secondary enrollment (1960) higher than:	64	70	75

Source: Levine and Renelt (1992).

Note: Table gives percentile rankings of Gang of Four for variables in growth regressions, where 100 is the most favorable for growth.

mildly—had only a 1 in 100,000 chance of attaining "miraculous" growth. The "luck" view would accord with some of the new theoretical views of growth that stress multiple equilibria: countries with very similar characteristics could have widely divergent outcomes.[8]

We could also read the failure of the growth regression to pick out the Gang of Four as yet another indictment of cross-sectional growth regressions. As in the old growth models, the residual is a measure of our ignorance. We might hope that other plausible specifications would drastically reduce the large error term. There are, however, two reasons why this is unlikely. One is that, as we will see in the next section, the feasible R^2 that one can attain with permanent country characteristics in cross-sectional regressions is bounded by the high time-series instability of growth rates. The other, as we will see now, is that other specifications do not appreciably improve our ability to explain cross-country variation in general or the Gang of Four in particular.

The other predetermined specification we examine is the core regression of Levine-Renelt (1992), which was found to be reasonably robust.[9] Table 11.3 shows how the Four (actually the Three, since Taiwan is omitted from the sample) rank according to the right-hand-side variables of this regression. The

8. Among the many examples of models with multiple equilibria: Krugman (1991), Becker, Murphy, and Tamura (1990), and Kremer (1993). The development literature has long described mechanisms for virtuous and vicious circles. Birdsall and Sabot (1993) use the virtuous circle metaphor to describe self-reinforcing processes of rising education, fertility decline, and rapid growth in East Asia.

9. The regression, which is reproduced exactly as in the original source except for scale factors, is (*t*-statistics in parentheses): **Per capita growth 60–89** = −.0083 (−0.98) −0.385 (−1.72) **Population growth 60–89** + .174 (6.53) **Investment/GDP 60–89** + .032 (2.46) **Secondary Enrollment 1960** − .0035 (−2.52) **GDP per capita 1960.** 102 observations, R^2 = .463, standard error = .0139.

Table 11.4 A Final Report Card for the Gang of Four

Indicator	Hong Kong	Korea	Singapore	Taiwan
War casualties per capita (1960–88; EKPS 1993) lower than:	100	100	100	100
Government education spending/GDP higher than:	16	75	41	45
Ratio of consolidated public sector investment/GDP (Easterly and Rebelo 1993) higher than:	3	23	52	72
Ratio of income earned by top 20 percent to income earned by bottom 20 percent (Clarke 1993) lower than:	51	77	65	87
Ratio of trade to GDP (1960–88; Summers and Heston 1985 international prices) higher than:	98	43	99	n.a.
Ratio of M2 to GDP (1970; King and Levine 1993) higher than:	n.a.	64	93	n.a.
Average black market premium (1960–89; Fischer 1993) lower than:	100	49	77	99
Central government deficit (Easterly and Rebelo 1993) lower than:	n.a.	77	97	n.a.
Inflation (percentage change in the consumer price index, 1970–88) lower than:	74	42	95	n.a.
Terms of trade gain weighted as percent of GDP (EKPS 1993) higher than:	13	39	5	n.a.
Other performance indicators:				
Ratio of private investment to GDP (1960–88; Easterly and Rebelo 1993) higher than:	98	92	91	58
Percentage rate of decline in under-five mortality rates (1965–85; Sen 1993) higher than:	95	81	93	97
Consumption growth per capita (1960–88; World Bank) higher than:	98	92	90	n.a.

Note: Table gives percentile rankings of Gang of Four for variables in growth regressions, where 100 is the most favorable for growth.

most significant difference from the Barro regression is the addition of investment, where Singapore and Hong Kong outrank most of the world and Korea is also well above average.[10] With investment added, the residual for Singapore is much lower than in the Barro regression. This is reminiscent of the results of Young (1992) that total factor productivity growth (i.e., growth controlling for capital and labor growth) is close to zero in Singapore. Like the Barro regression, the Levine-Renelt regression is fairly successful at picking out Singapore as most likely to succeed, and less so at picking out Hong Kong and Korea. Sixteen countries are predicted to do better than Hong Kong, including Jamaica (again) and Suriname.

To conclude this section, the ranking of the Four Dragons for other variables common in growth regressions are considered. Table 11.4 confirms again that

10. As Levine and Renelt (1992) note, investment is likely to be endogenous and so is less an explanation of high growth than a corollary of it.

the Four generally had policies and other characteristics more favorable for growth than the average, but are by no means as extreme outliers in policies as they are in growth. The Four have completely avoided wars over 1960–89, but here they are tied with the three-quarters of the sample that was also at peace. Government spending on education is low in Hong Kong and unexceptional in the other three. Public investment is very different among the Four: very low in Hong Kong, below average in Korea, and above average in Taiwan. As frequently pointed out, inequality is low in the Four and openness is high. The financial system is exceptionally deep in Singapore and less so in Korea. The black market premium is absent in Taiwan and Hong Kong, but nontrivial in Korea and Singapore. Macroeconomic stability is exceptional in Singapore—low government deficits, low inflation—but not in Hong Kong or Korea.[11] Interestingly, the terms of trade changes in Hong Kong and Singapore have been among the most unfavorable in the world.

The last part of table 11.4 shows other performance indicators. Private investment (either a result or a cause of growth) is exceptionally high in all of the Four *except* Taiwan. The improvement in social indicators—specifically the under-five mortality rate—is among the largest in the sample, with the curious exception of Korea. Consumption growth per capita is not as impressive as overall per capita growth in Korea and Singapore, reflecting again the effect of high rates of capital accumulation. The Four's superiority of performance is not completely robust to other performance indicators.

While the Four Dragons do not seem to be striking outliers according to the right-hand-side variables considered here, there are no doubt other characteristics where they would be found to be exceptional; such characteristics could thus "explain" their high growth. The problem with such explanations is that they are too easy to find. It is not that hard to find characteristics that four countries have in common, such as a "Confucian work ethic" or high population density. Such ex post "explanations" are of dubious value. The advantage of predetermined specifications (like the Barro 1991 and Levine-Renelt 1992) is that they were not chosen specifically to explain the Four Dragons.

Of course, the most obvious trait the Four have in common are that they are in the same region: East Asia. The more recent success of other East Asian economies like China, Thailand, Malaysia, and Indonesia have added to the case for East Asian exceptionalism. However, the selection bias problem may be infecting even our regional definitions. Development textbooks written before the onset of the "East Asia Miracle" used a regional breakdown of Asia/

11. However, macroeconomic instability may be poorly measured by average inflation and average government deficits. Analysis of time series of macroeconomic indicators may uncover other dimensions of the quality of macromanagement (like the response to shocks), and the Four may look more exemplary in such an analysis. Bruno (1993) discusses how, in many non–East Asian middle-income developing economies, "the deep crisis of the 1970s (and even more in the 1980s), and the delayed adjustment to the external shocks, had and must still keep having a very marked effect on long-run growth" (40).

Africa/Latin America (see, e.g., Kuznets 1966, 360–61; Meier 1964, 6; Hagen 1968, 23; Higgins 1959, 10; Enke 1963, 48). The "East Asia" regional definition apparently came into use among development economists after the divergence in growth rates became evident.

Even if East Asia is a coherent geographic region, there are other coherent regional breakdowns that could have been used. The choice of which to use is partly endogenous. For example, East and West Africa could be distinguished, but usually are not because they are not dramatically different in performance. Drawing the boundaries of East Asia is also tricky: Is Myanmar (Burma) included? Is Malaysia? Does economic performance influence where we draw the boundary?

Even if exaggerated by endogenous regional definition, it still seems unlikely that the concentration of success in (East?) Asia occurred by chance. It is surprising that the literature does not make more of this concentration (other than to speculate about cultural or other fixed regional traits supposedly favorable for growth). The alternative explanation to a fixed Asia effect is that success is contagious across borders. DeLong and Summers (1991) tested formally for spatial correlation of residuals in a growth regression, but failed to find any correlation based on physical proximity. However, Chua (1993) presents evidence that spillovers exist from countries' right-hand-side variables (particularly investment) to their neighbors' growth performance.

Contagion seems like a more likely explanation than a fixed Asia effect, for the simple reason that Asia's success is relatively recent. As the next section shows, cross-country evidence suggests that episodes of success are short-lived, and so fixed effects like "cultural predisposition to growth" do not fit the evidence for either regions or countries.

11.3 Is the Dragons' Success Transitory?

A recent paper (Easterly et al. 1993, henceforth EKPS) found that success as measured by rapid growth is surprisingly transitory. The correlation of growth rates across successive decades or even longer periods is only about 0.2 to 0.3, implying that only 20 to 30 percent of cross-country differences in growth rates persist from one decade to the next. Figure 11.1 reproduced from EKPS, shows least squares per worker growth (from Summers and Heston 1991) in 1974–88 against growth in 1960–73. The dotted lines show the medians in each period. Many countries are in the off-diagonal quadrants: successes one period are disappointments the next, and vice versa. The boxes indicate the top and bottom deciles in each period. Only four countries are in the top decile in both periods: Botswana and three of the Gang of Four. The fourth gang member—Hong Kong—just misses out on the top decile in the first period. The Four are notable as consistent performers (with tiny Botswana) in the postwar data.

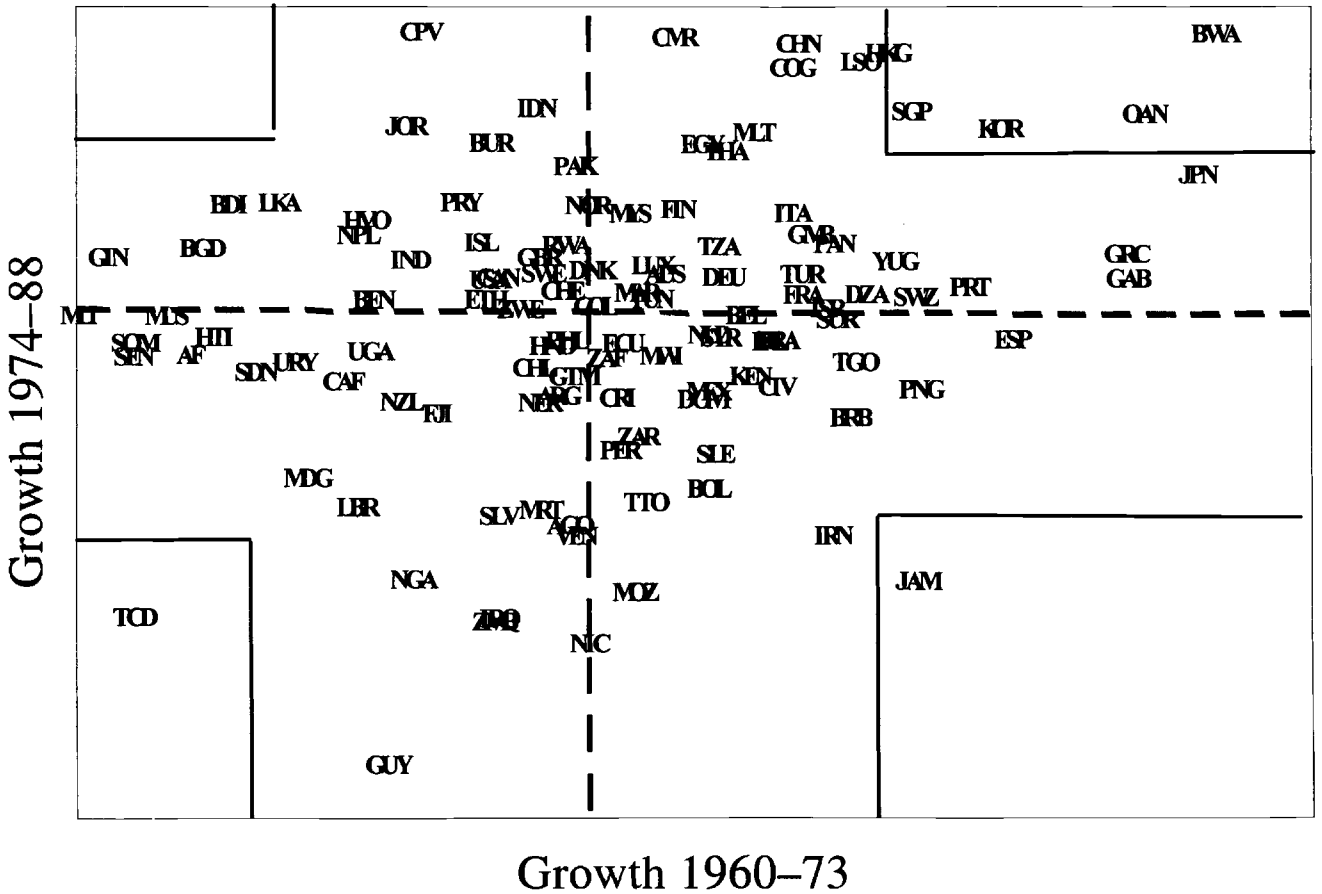

Fig. 11.1 Per capita growth rates, 1960–73 and 1974–88
Note: Three-letter World Bank country codes are used (also used in Summers and Heston 1991).

How unusual is it that four countries would appear in the top decile in two successive periods? EKPS show that the correlation coefficient of growth rates across periods can be interpreted as the ratio of the permanent cross-sectional variance in growth rates to the sum of the cross-sectional variance and the time-series variance in growth rates. A correlation coefficient of growth rates across periods of 0.33 implies that a third of the total variance of growth rates is explained by permanent cross-country differences as opposed to period-to-period variation. EKPS show that this also implies a limit to the R^2 in pure cross-sectional regressions that will be realized with permanent country characteristics on the right-hand side—persistence of 0.33 implies that the upper limit on the R^2 is about 0.6 with cross-sectional regressions covering 30 years. We perform an illustrative Monte Carlo simulation of the variance structure implied by a cross-period correlation of 1/3.[12] Twelve out of 50 simulations show four or more countries in the top decile across successive periods. While not the most likely outcome, it is not all that unusual to find four consistently positive outliers even with relatively small permanent differences in cross-country performance.

Like everyone else, the four NICs cannot count on success lasting very long. The pattern of low persistence of growth rates suggests that their growth is likely to fall in the 1990s.[13]

11.3.1 Before the Miracle: Historical Antecedents for the Four Dragons

While the success of the Four Dragons now seems to have been written in the stars, the Four's promise was not so apparent beforehand. Failure to recognize the low persistence of growth performance often leads to overestimation of the prospects of countries that have been doing well, and the underestimation of countries doing badly.

As table 11.5 shows, the performance of Korea and Taiwan—and of other Asian miracles—was not so stellar before the miracle. None of the later success stories had exceptional growth over the first part of the century (historical growth estimates—which of course should be taken with a grain of salt—are from Maddison 1989).

It is therefore not surprising that most observers before the miracle were pessimistic about East Asia. Enke (1963) presents a table of factors favorable

12. Specifically, we generate a random variable that is the sum of a $N(0,1)$—the cross-country variance—and a $N(0,2)$—the time-series variance. The realization of the cross-country process stays the same between successive periods, while there is a new realization of the $N(0,2)$ each period. The correlation coefficient between the two periods will be 1/3. The simulation was for 120 observations for 100 time periods. We then calculated the number of repeated successes (the same observation twice in the upper decile) for 50 independent pairs of time periods.

13. Other authors also urge caution about the NICs prospects. World Bank (1993a) notes coming infrastructural bottlenecks and the need for financial sector reforms. Krueger (1990) and Balassa and Williamson (1990) argue that continued rapid growth will require greater trade liberalization. Lehmann (1992) suggests that competition from the next tier of NICs will slow down the original Four. Hong (1993) argues that unless tax reforms are instituted in Korea to reduce incentives for speculation and improve distribution, growth will be slowed by internal conflicts and waste of resources.

Table 11.5 **Before the Miracle: Historical Statistics on Asian Economies, 1900–50**

Country	Per Capita Growth
Dragons	
South Korea	0.10
Taiwan	0.40
Other Asian miracles	
China	−0.30
Indonesia	−0.10
Japan	1.00
Thailand	0.10

Table 11.6 **Ranking of Regions in 1963 According to Factors Favorable or Unfavorable for Development**

Rank	*Per Capita Income*	*Population Pressure*	*Economic Culture*
Most favorable	Latin America	sub-Sahara Africa	Latin America
	Middle East	Latin America	Middle East
	sub-Sahara Africa	Middle East	sub-Sahara Africa
Least favorable	Southeast Asia	Southeast Asia	Southeast Asia

or unfavorable for development, reproduced here as table 11.6. He ranks four developing regions: Latin America, sub-Sahara Africa (*sic*), Middle East, and Southeast Asia. By the latter, he means all of Asia east of the Middle East and south of Siberia.

Southeast Asia was at the bottom of the list in all three of his categories. It was the poorest region, which was thought to be unfavorable for growth because of the low savings rates (!) of poor countries; it had the highest population pressure; it had the culture most unfavorable for development. The latter is particularly interesting given all that has subsequently been written about the "Confucian ethic" (Kahn 1979; MacFarquhar 1980). Such an ethic was not evident before 1960. An economist in 1952 commented sadly that "the age-long influence of the West . . . failed with only few exceptions to instill its economic activity and enterprise into the minds and habits of these peoples. The Western apparatus of . . . production remained an . . . indigestible element in Southeast Asia . . . the economic energy for a vigorous resurgence [was] lacking."[14]

Nor were the prospects of individual countries clear ex ante. The first World Bank mission to Korea in the early 1960s described the development program as ludicrously optimistic: "There can be no doubt that this development program [GDP growth of 7.1 percent of 1962–66] far exceeds the potential of

14. Quoted in Hoselitz (1952, 215).

the Korean economy. . . . It is inconceivable that exports will rise as much as projected." (In the event, Korean growth was 7.3 percent over that period.) Prominent academic economists also did not detect East Asia's promise. Chenery and Strout forecast in the early 1960s that growth in India and Pakistan over 1962–76 would exceed that of Korea. Rosenstein-Rodan at the same time predicted that Sri Lanka would have a higher per capita income than Taiwan or Korea by 1976. Hong Kong and Singapore, according to the same predictions, would be left in the dust by Argentina and Colombia. Myrdal worried that Singapore "has its own potentially explosive problems [of rapid population growth], which threatens a mounting unemployment burden."[15]

By contrast, the World Bank's economic report in 1957 was optimistic about the Philippines, which had "achieved a position in the Far East second only to Japan. . . . The prospects . . . for sustained long-term growth are good." An even more promising case was Burma, which in 1958 was said by the Bank to have "made remarkable economic progress. . . . Burma's long-run potential compares favorably with those of other countries in South East Asia."[16] (In the event, Burma [Myanmar] and the Philippines have been among the few poor performers in East Asia.)

Asia's prospects looked poor compared to those of Africa, where the World Bank's chief economist in 1967 predicted "the economic future before the end of the century can be bright." He listed seven African countries that "clearly have the potential to reach or surpass a 7 percent rate of growth." All of those he listed had negative per capita growth over 1970–88.[17]

The postwar doubts about Asia's prospects echoed earlier doubts about the most famous Asian success story, Japan. In the nineteenth century, the first Western visitors to Japan held out little hope for the country's future: "Wealthy we do not think it will ever become: the advantages conferred by Nature . . . and the love of indolence and pleasure of the people themselves forbid it. . . . In this part of the world principles, established and recognized in the West, appear to lose whatever virtue and vitality they originally possessed and to tend fatally towards weediness and corruption."[18]

11.3.2 Persistence of the Tigers' Residuals

We have seen that the Four Tigers have large positive residuals in growth regressions, and that their performance has been consistent since 1960. A way of probing deeper into both of these facts is to examine the residuals of the Tigers in pooled cross-section, decade regressions, where each country will have up to three decade-average observations (for the 1960s, 1970s, and 1980s). Regressions will again be run using roughly the Barro (1991) and Lev-

15. The last three predictions are taken from Hicks (1990).

16. The World Bank quotes, including the preceding one on Korea, are taken from World Bank (1993b, 14–15).

17. Kamarck (1967), quoted in EKPS.

18. A quote via Lipton and Sachs (1992, 250).

ine and Renelt (1992) specifications. We will examine the robustness of the results to alternative specifications of the dependent variable: Summers-Heston versus World Bank growth rates, and per capita versus per worker GDP growth rates.

The regressions are reported in the appendix. The "Barro" versions regress decade-average growth rates on time dummies for the 1960s and 1970s, per capita income at the beginning of the decade, primary and secondary enrollment ratios at the beginning of each decade, the average share of government consumption in GDP (decade average), and the decade-average black market premium (which is a substitute for Barro's price distortion variable, since the latter is not available separately for decades). The "Barro" regression uses Summers and Heston (1991) GDP data for two alternative definitions of the dependent variable: least squares per capita growth and least squares per worker growth.[19] The "Levine-Renelt" regression has as right-hand-side variables the investment rate over the decade, secondary enrollment at the beginning of decade, population growth (or labor force growth when per worker growth is the dependent variable), initial per capita income in the decade, and decade dummies. The dependent variable is decade-long least squares growth for either GDP per capita or GDP per worker, using World Bank GDP data.

Table 11.7 shows the resulting residuals for the four alternative specifications. The residuals stay consistently high and positive in the Levine-Renelt regression with per capita growth rates, but somewhat less so in the Barro regression with per capita growth rates. The residuals are more unstable when per worker instead of per capita growth rates are used: Singapore has residuals close to zero for two out of the three decades in both Barro and Levine-Renelt per worker regressions. The other three Tigers also have erratic residuals in the Barro per worker regression.[20]

What is the tendency of residuals to persist for the entire sample? EKPS showed that the low persistence of growth rates is *not* explained by variations in policies or other country characteristics. It follows that the persistence of residuals in pooled growth regressions will be low. In the Barro regression with per worker growth rates, for example, the cross-decade correlation of the residuals is only 0.1 and is statistically insignificant. An equivalent way of stating this low persistence is that residuals for all countries will tend to move back toward zero (i.e., there is regression to the mean, where the mean by construction is zero). With a cross-decade correlation of only 0.1, $1 - 0.1$, or

19. The original Barro (1991) regression used the previous version of Summers and Heston (1988). We use the newer one because it goes up to 1988 instead of 1985.

20. Barro and Lee (1993) also show unstable residuals for the Four Tigers in separate regressions for 1965–75 and 1975–85, even using per capita growth rates (based on Summers and Heston 1988—version 4). The particularly low residuals for Singapore in our results are again suggestive confirmation for Young's (1992) conclusion that productivity growth in Singapore was zero. Kim and Lau (1993) fail to reject the hypothesis of zero total factor productivity growth for *all* of the NICs except Taiwan.

Table 11.7 Growth Residuals of Gang of Four in Pooled Growth Regressions

Country	1960s	1970s	1980s
Levine and Renelt (1992) Regression with World Bank per Capita Growth Rates			
Hong Kong	2.57	3.98	4.07
Korea	2.02	3.97	3.75
Singapore	2.83	2.24	2.06
Levine and Renelt (1992) Regression with World Bank per Worker Growth Rates			
Hong Kong	1.90	3.35	3.72
Korea	1.86	3.48	4.71
Singapore	2.80	0.19	0.45
Barro (1991) Regression Using Summers-Heston Mark V per Capita Growth Rates			
Hong Kong	3.03	2.70	4.44
Korea	2.17	2.87	3.62
Singapore	0.28	2.06	3.45
Taiwan	1.93	2.33	2.78
Barro (1991) Regression Using Summers-Heston Mark V per Worker Growth Rates			
Hong Kong	2.11	1.35	4.28
Korea	1.28	2.19	2.85
Singapore	−0.43	−0.29	3.85
Taiwan	2.46	1.20	1.68

90 percent of the residual will tend to disappear in the following period.[21] Figure 11.2 shows this as the tendency for the change in the residual from the first to the second decade to be inversely related to the residual in the first decade. We see in the graph that the Four Tigers fit snugly into the overall pattern: the evanescence of the unexplained component of success.[22]

The behavior of the Tigers' residuals (and those of the rest of the sample) implies two important conclusions. One is that the residuals are reduced, and more of the Tigers' success explained, with per worker than with per capita growth rates. Part of the success was simply due to the labor force growing faster than the population (especially notable in Singapore). The second is that the residuals in the sample in general are highly unstable and transitory—

21. If the variance of the residuals is unchanged each period (which appears to be roughly the case), then the expected value of the correlation coefficient across decades is the same as that of the β coefficient from regressing the residual on the lagged residual. The regression of the change in the residual on the level of the lagged residual will yield a coefficient of $\beta - 1$.

22. If we use per capita instead of per worker growth rates, then the Four Dragons would be at the upper boundary of the downward sloping blob of points in the figure. Using the Levine-Renelt residuals does not change the graph or the conclusions. The graph shows the change in decade residuals plotted against the lagged decade residual for each country, so that for any given country there would be two points: the residual's change from the 1970s to the 1980s against the residual in the 1970s, and the residual's change from the 1960s to the 1970s against the residual in the 1960s.

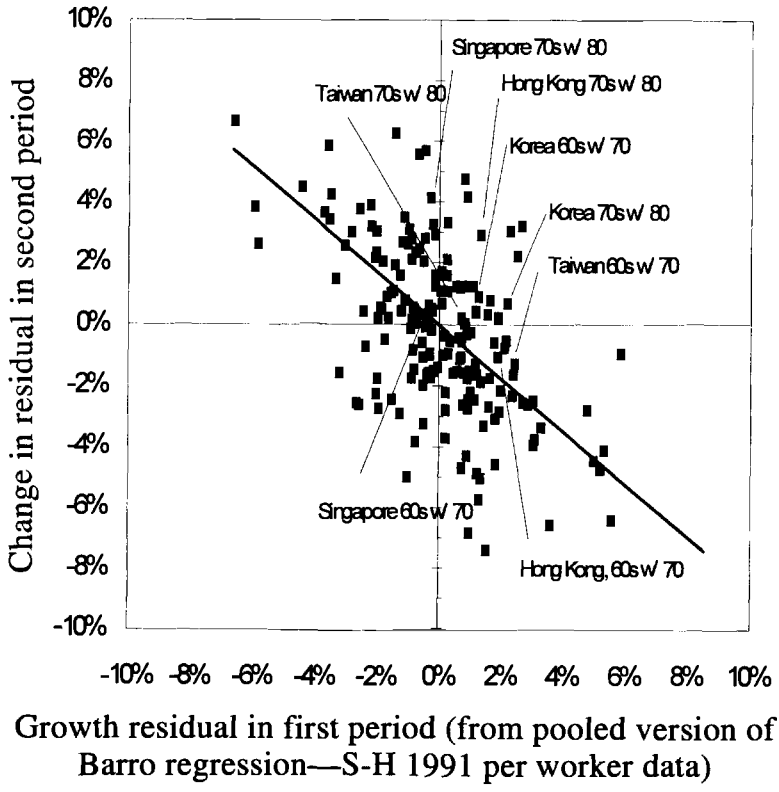

Fig. 11.2 Change in growth residual in second period against residual *in* first period

country fixed effects do not seem to be an important part of the explanation of the part of growth unexplained by investment, education, price distortions, and so forth. The low persistence of the residuals would rule out those unobservable factors that are relatively fixed over time—like culture, institutions, quality of government—as a large part of the explanation of growth differences.[23]

11.4 Conclusions and Suggestions for Further Research

Nothing in this paper should be taken as denigrating the success of Hong Kong, Korea, Singapore, and Taiwan. How ever it was achieved, the rapid growth of these Four is one of the most remarkable success stories in economic history.

But what should we make of the fact that a significant part of the Dragons'

23. Others have also pointed out that a "Confucian ethic" that has been around for millenia is not a terribly convincing explanation for an economic surge beginning after 1960. Cf. Stiglitz (1992).

success is unexplained? This paper argues: not much. The Four were selected *because* they were highly successful. If there is any random variation in our models at all, then we should not be surprised that the strongest positive outliers in growth have a positive growth residual. The quest to explain the success of the Four is bound to be at least partly futile. The literature has often been unable to resist the temptation to read too much into East Asia's success. The great success of the Gang of Four does not imply a blanket endorsement of all of their policies—they may have made mistakes that were more than offset by other good policies and, probably at least in part, by good luck. As in the story of the man turning 100 who attributes his longevity to generous consumption of whiskey, not all of the Dragons' habits are fit for imitation.

What are the implications for the Dragons of the low persistence of growth rates? It is true that the Four were more consistent good performers than almost anyone else in the sample. It is also true that one would expect some small number of countries to be consistent good performers even with only a modest tendency toward persistence of growth differences. The cross-country evidence suggests that the stratospheric trajectory of the Four should be heading back toward earth soon.

What *may* be unusual about the Four's success is that they were all in one region. The spatial association of success with East Asia (even if the category "East Asia" is partly endogenous) would imply that more attention should be paid to economic geography, as argued by Krugman (1991). The Asian successes look at least casually a lot like growth radiating from poles, with Japan followed by the Gang of Four, followed by China, Thailand, Malaysia, and Indonesia. Wang and Mody (1993) have shown how there are spillovers from Taiwan and Hong Kong to coastal provinces in China. Chua (1993) shows that countries benefit from their neighbors' good policies. It may be that the "something extra" in East Asia is partly the mutually beneficial set of spillovers from high investment and other favorable country characteristics. But this is in itself not sufficient to explain concentration of success—what is also needed is that neighbors influence each other to adopt high investment rates or other "good" characteristics (or that growth itself spills across borders). While past attempts at identifying spatial correlation based on physical proximity have had no success (DeLong and Summers 1991), it may be that more complicated interactions between countries remain to be studied.

Another geographic twist is to notice that Singapore and Hong Kong are really more like cities than countries. Cities are more subject than countries to forces like sectoral shifts from agriculture to industry and externalities from migration and urbanization (which would plausibly have strong effects on cities' per capita growth as well as their population growth rates).[24] One might

24. See Rauch (1993) and Glaeser et al. (1992) for suggestive evidence of strong externalities within cities. Ciccone and Hall (1993) argue that density in itself has a strong productivity effect across U.S. states.

think accordingly that cities have a higher variance of per capita growth rates than do countries, and would be thus more likely to have large positive outliers (as well as negative ones). Mean per capita growth rates of all cities may also be higher than those of rural areas. It follows that the natural comparators to the success of Hong Kong and Singapore would be other cities' economic growth, not growth rates of countries.[25] Other city "miracles" could be hidden in the data by aggregation within countries. For example, the Anaheim, California, metropolitan area (1970 population: 1.4 million) had per capita growth of 5.9 percent in the 1950s (when U.S. growth was only 1.2 percent). But Anaheim did not thereby enter the lore of economic miracles (Anaheim's success probably had more to do with the opening of Disneyland in 1955 than with "good policies" by the city fathers).[26] Data on per capita income growth of developing country metropolises are unfortunately hard to come by.

Finally, when all is said and done, the story of the East Asian successes is consistent with the old prosaic fundamentals—investment, education, financial depth, low budget deficits. The Four were above average in these areas, and regressions do show quantitatively and statistically significant effects of policies on growth. This cross-country evidence has at least as much to say as the case studies that attempt to decipher the meaning of the Four's large growth residuals.

Perhaps the best way to think about good policies is that they make success *likely* sooner or later. Policymakers should be convinced by looking at cross-country evidence that it is a lot better to make miracles feasible through good policy than to make them impossible by bad policy. But the policymakers' lot is not an easy one: it is disturbing how large and transitory is the unexplained element in economic success.

25. I am indebted to Lant Pritchett for making this point.

26. Anaheim's per capita growth is from Greenwood (1981, 74), which gives the nominal growth in median family income (which of course is not exactly "per capita"—if family size was lower in 1960 than 1950, then per capita growth would be higher). I deflate it by U.S. CPI inflation for the 1950s (which may overstate Anaheim's real growth since inflation was probably higher in a booming area).

Appendix
Pooled Versions of Barro (1991) and Levine and Renelt (1992) Regressions

Table 11A.1 **Levine-Renelt with World Bank per Capita Growth Rates: Least Squares (Dependent Variable = GYP; 306 Observations)**

Variable	Coefficient	Standard Error	*t*-Statistic	Two-Tail Significance
C	0.0123264	0.0165139	0.7464239	0.4560
DUM60	0.0295255	0.0032858	8.9858686	0.0000
DUM70	0.0191983	0.0030524	6.2896584	0.0000
INV	0.1492889	0.0188816	7.9065956	0.0000
SEC	0.0253555	0.0094359	2.6871204	0.0076
GPO	−0.3279395	0.1634988	−2.0057602	0.0458
LRGDP	−0.0052455	0.0023868	−2.1977155	0.0287
R^2	0.365726			
Adjusted R^2	0.352998			
S.E. of regression	0.020685			
Log likelihood	756.1182			
Mean of dependent variable	0.020583			
S.D. of dependent variable	0.025716			
Sum of squared residual	0.127934			
F-statistic	28.73422			
Prob (*F*-statistic)	0.000000			

Variables (decades are 1960–69, 1970–79, and 1980–89):

GYP	Per capita growth, compound rate by decade (World Bank National Accounts)
DUM60	Dummy variable for decade of 1960s = 1, otherwise = 0
DUM70	Dummy variable for decade of 1970s = 1, otherwise = 0
INV	Investment/GDP, average for decade (World Bank National Accounts)
SEC	Secondary school enrollment ratio, beginning of decade (Barro 1991)
GPO	Growth of population, by decade (World Bank Social Indicators)
LRGDP	Log of income (Summers and Heston 1991), initial year of decade

Table 11A.2 **Levine-Renelt with World Bank per Worker Growth Rates: Least Squares (Dependent Variable = LGPW; 296 Observations)**

Variable	Coefficient	Standard Error	*t*-Statistic	Two-Tail Significance
C	0.0246784	0.0154730	1.5949396	0.1118
DUM60	0.0299728	0.0032674	9.1733685	0.0000
DUM70	0.0154288	0.0029886	5.1624633	0.0000
INV	0.1542238	0.0188695	8.1731867	0.0000
SEC	0.0220750	0.0086438	2.5538607	0.0112
GRLF	−0.4920195	0.1309579	−3.7570816	0.0002
LRGDP	−0.0066414	0.0023710	−2.8010763	0.0054

(continued)

Table 11A.2 (continued)

Variable	Coefficient	Standard Error	*t*-Statistic	Two-Tail Significance
R^2	0.373179			
Adjusted R^2	0.360166			
S.E. of regression	0.020305			
Log likelihood	737.0214			
Durbin-Watson	1.914646			
Mean of dependent variable	0.017675			
S.D. of dependent variable	0.025384			
Sum of squared residual	0.119148			
F-statistic	28.67614			
Prob (*F*-statistic)	0.000000			

Variables:

LGPW	Least squares growth rate by decade, GDP per worker (World Bank National Accounts)
DUM60	Dummy variable for decade of 1960s = 1, otherwise = 0
DUM70	Dummy variable for decade of 1970s = 1, otherwise = 0
INV	Investment/GDP, average for decade (World Bank National Accounts)
SEC	Secondary school enrollment ratio, beginning of decade (Barro 1991)
GRLF	Least-squares growth rate of labor force by decade (World Bank Social Indicators)
LRGDP	Log of income (Summers and Heston 1991), initial year of decade

Table 11A.3 **Pooled "Barro" Regression Using per Worker Growth Rates: Least Squares (Dependent Variable = SLPW; 303 Observations)**

Variable	Coefficient	Standard Error	*t*-Statistic	Two-Tail Significance
C	0.1364398	0.0209900	6.5002292	0.0000
LGDPPC	−0.0188251	0.0030151	−6.2436568	0.0000
PRIM	0.0001987	6.996E-05	2.8403036	0.0048
SEC	0.0003837	9.947E-05	3.8574606	0.0001
SGOV	−0.0741720	0.0219419	−3.3803750	0.0008
BLCK	−0.0297244	0.0044487	−6.6816356	0.0000
DUM60	0.0271613	0.0039898	6.8076529	0.0000
DUM70	0.0198466	0.0035927	5.5241248	0.0000
R^2	0.363949			
Adjusted R^2	0.348856			
S.E. of regression	0.024748			
Log likelihood	694.9134			
Mean of dependent variable	0.017640			
S.D. of dependent variable	0.030669			
Sum of squared residual	0.180679			
F-statistic	24.11416			
Prob (*F*-statistic)	0.000000			

Table 11A.3 (continued)

Variables:

SLPW	Summers and Heston (1991) least squares growth per worker, decade average
LGDPPC	Log of initial per capita income, beginning of decade (Summers and Heston 1991)
PRIM	Primary enrollment, beginning of decade (World Bank)
SEC	Secondary enrollment, beginning of decade (World Bank)
SGOV	Share of government consumption in GDP (Summers and Heston 1991)
BLCK	Black market premium, average over decade (Levine and Renelt 1992; World Bank)
DUM60	Dummy variable for decade of 1960s = 1, otherwise = 0
DUM70	Dummy variable for decade of 1970s = 1, otherwise = 0

Table 11A.4 **Pooled "Barro" Regression Using per Capita Growth Rates: Least Squares (Dependent Variable = LSPC; 283 Observations)**

Variable	Coefficient	Standard Error	*t*-Statistic	Two-Tail Significance
C	0.1015168	0.0197857	5.1308283	0.0000
LGDPPC	−0.0155429	0.0028198	−5.5119951	0.0000
PRIM	0.0002455	6.469E-05	3.7955829	0.0002
SEC	0.0004337	9.322E-05	4.6527473	0.0000
SGOV	−0.0488336	0.0204781	−2.3846737	0.0178
BLCK	−0.0388459	0.0048094	−8.0771068	0.0000
DUM60	0.0278901	0.0037380	7.4611895	0.0000
DUM70	0.0232782	0.0033872	6.8724279	0.0000
R^2	0.435391			
Adjusted R^2	0.421019			
S.E. of regression	0.022256			
Log likelihood	679.3560			
Mean of dependent variable	0.018928			
S.D. of dependent variable	0.029249			
Sum of squared residual	0.136213			
F-statistic	30.29465			
Prob (*F*-statistic)	0.000000			

Variables:

LSPC	Per capita growth rate, least squares by decade (Summers and Heston 1991)
LGDPPC	Log of initial per capita income, beginning of decade (Summers and Heston 1991)
PRIM	Primary enrollment, beginning of decade (World Bank)
SEC	Secondary enrollment, beginning of decade (World Bank)
SGOV	Share of government consumption in GDP (Summers and Heston 1991)
BLCK	Black market premium, average over decade (Levine and Renelt 1992; World Bank)
DUM60	Dummy variable for decade of 1960s = 1, otherwise = 0
DUM70	Dummy variable for decade of 1970s = 1, otherwise = 0

References

Amsden, Alice. 1989. *Asia's next giant.* New York: Oxford University Press.

———. 1991. Diffusion of development: The late-industrializing model and greater East Asia. *American Economic Review* 81 (2): 282–86.

Balassa, Bela. 1978. Exports and economic growth: Further evidence. *Journal of Development Economics* 5 (June): 181–89.

———. 1991. *Economic policies in the Pacific area developing countries.* London: Macmillan.

Balassa, Bela, and John Williamson. 1990. *Adjusting to success: Balance of payments policy in the East Asian NICs.* Washington, D.C.: Institute for International Economics.

Barro, Robert J. 1991. Economic growth in a cross section of countries. *Quarterly Journal of Economics* 106: 407–43.

Barro, Robert J., and Jong-wha Lee. 1993. Losers and winners in economic growth. In *Proceedings of the World Bank Annual Conference on Development Economics, 1993. World Bank Economic Review,* Supplement: 267–315.

Barro, Robert J., and Xavier Sala-i-Martin. 1992. Convergence. *Journal of Political Economy* 100: 223–51.

Becker, Gary, Kevin Murphy, and Robert Tamura. 1990. Human capital, fertility, and economic growth. *Journal of Political Economy* 98: S12–S37.

Birdsall, Nancy, and Richard Sabot. 1993. Virtuous circles: Human capital, growth and equity in East Asia. Paper prepared for the World Bank's project on Strategies for Rapid Growth: Public Policy and the Asian Miracle. Washington, D.C.: World Bank.

Bruno, Michael. 1993. Inflation and Growth in an Integrated Approach. NBER Working Paper no. 4422. Cambridge, Mass.: National Bureau of Economic Research.

Chenery, Hollis. 1988. Industrialization and growth: Alternative views of East Asia. In *Achieving industrialization in East Asia,* ed. Helen Hughes. New York: Cambridge University Press.

Chua, Hak. 1993. Regional spillovers and economic growth. Center Discussion Paper no. 700. Economic Growth Center, Yale University.

Ciccone, A., and R. E. Hall. 1993. Productivity and the density of economic activity. NBER Working Paper no. 4313. Cambridge, Mass.: National Bureau of Economic Research.

Clarke, George. 1993. New evidence on inequality and economic growth. World Bank Working Paper WPS 1064. Washington, D.C.: World Bank.

Collins, Susan. 1990. Lessons from Korean economic growth. *American Economic Review* 80 (2): 104–7.

De Long, J. B., and L. H. Summers. 1991. Equipment, investment, relative prices, and economic growth. *Quarterly Journal of Economics* 106: 445–502.

Easterly, William, Michael Kremer, Lant Pritchett, and Lawrence Summers. 1993. Good policy or good luck? Country growth performance and temporary shocks. *Journal of Monetary Economics* 32: 459–83.

Easterly, William, and Sergio Rebelo. 1993. Fiscal policy and economic growth: an empirical investigation. *Journal of Monetary Economics* 32: 417–58.

Enke, Stephen. 1963. *Economics for development.* London: Dennis Dobson.

Feder, Gershon. 1983. On exports and economic growth. *Journal of Development Economics* 12 (February/April): 59–73.

Fischer, Stanley. 1993. Macroeconomic factors in growth. *Journal of Monetary Economics* 32: 485–512.

Glaeser, E. L., H. D. Kallal, J. A. Scheinkman, and A. Shleifer. 1992. Growth in cities. *Journal of Political Economy* 100 (6): 1126–52.

Greenwood, Michael J. 1981. *Migration and economic growth in the United States: National, regional, and metropolitan perspectives.* New York: Academic.

Hagen, Everett. 1968. *The economics of development.* Homewood, Ill.: Irwin.

Haggard, Stephen. 1989. The East Asian NICs in comparative perspective. *Annals of the American Academy of Political Science Society* 505: 129–41.

———. 1990. *Pathways from the periphery: The politics of growth in the newly industrializing countries.* Ithaca, N.Y.: Cornell University Press.

Hicks, George. 1990. Explaining the success of the Four Little Dragons: A survey. In *Essays in honor of Professor Sinichi Ichimura,* ed. Seiji Naya and Akira Takayama. Singapore: Institute of Southeast Asian Studies.

Higgins, Benjamin. 1959. *Economic development: Principles, problems and policies.* New York: Norton.

Hofheinz, Roy, and Kent Calder. 1982. *The East Asia edge.* New York: Basic.

Hong, Wontack. 1993. Export-oriented growth and equity in Korea. In *Trade and Protectionism,* ed. Anne O. Krueger and Takatoshi Ito. Chicago: University of Chicago Press.

Hoselitz, Bert, ed. 1952. *The progress of underdeveloped areas.* Chicago: University of Chicago Press.

Kahn, Herman. 1979. *World economic development: 1979 and beyond.* Boulder, Colo.: Westview.

Kamarck, Andrew M. 1967. *The economics of African development.* New York: Praeger.

Kihwan, Kim, and Danny Leipziger. 1992. Korea: The case of effective government-led development. Washington, D.C.: World Bank. Mimeograph.

Kim, Jong-Il, and Lawrence Lau. 1993. The sources of economic growth of the East Asian newly industrialized countries. Washington, D.C.: International Monetary Fund.

Kim, Kwang Suk. 1985. Lessons from South Korea's experience with industrialization. In *Export-oriented development strategies,* ed. Vittorio Corbo, Anne Krueger, and Fernando Ossa. Boulder, Colo.: Westview.

King, Robert, and Ross Levine. 1993. Finance, entrepreneurship, and growth. *Journal of Monetary Economics* 32: 513–42.

Kremer, Michael. 1993. The O-ring theory of economic development. *Quarterly Journal of Economics* 108: 551–76.

Krueger, Anne. 1985. The experience and lessons of Asia's super exporters. In *Export-oriented development strategies,* ed. Vittorio Corbo, Anne Krueger, and Fernando Ossa. Boulder, Colo.: Westview Press.

———. 1990. Asian trade and growth lessons. *American Economic Review* 80: 108–12.

Krugman, Paul. 1991. *Geography and trade.* Cambridge: MIT Press.

Kuznets, Simon. 1966. *Modern economic growth: Rate, structure, and spread.* New Haven, Conn.: Yale University Press.

Lehmann, Jean-Pierre. 1992. *In support of Asian development.* Study commissioned by the Department for International Development Cooperation, Ministry for Foreign Affairs, Sweden.

Levine, Ross, and David Renelt. 1992. A sensitivity analysis of cross-country growth regressions. *American Economic Review* 82: 942–63.

Lipton, David, and Jeffrey Sachs. 1992. Prospects for Russia's economic reforms. *Brookings Papers on Economic Activity,* no. 2: 213–83.

Liu, Phillip. 1993. The rough road to privatization. *Free China Review,* July, 36–41.

Lucas, Robert E. 1993. Making a miracle. *Econometrica* 61: 251–72.

MacFarquhar, Roderick. 1980. The Post-Confucian challenge. *The Economist,* February 9, 67–72.

Maddison, Angus. 1989. *The world economy in the twentieth century.* Development Centre Studies. Paris: OECD.

Meier, G. M. 1964. *Leading issues in development economics.* New York: Oxford University Press.

Nam, Sang-Woo. 1988. Alternative growth and adjustment strategies of newly industrializing countries in Southeast Asia. In *Beyond adjustment: The Asian experiment,* ed. Paul Streeten. Washington, D.C.: International Monetary Fund.

Pack, Howard, and John M. Page. 1993. Accumulation, exports and growth in the high performing Asian economies. Washington, D.C.: World Bank. Mimeograph.

Pack, H., and L. E. Westphal. 1986. Industrial strategy and technological change: Theory vs. reality. *Journal of Development Economics* 22: 87–126.

Page, John M., and Peter A. Petri. 1993. Productivity change and strategic growth policy in the Asian miracle. Washington, D.C.: World Bank. Mimeograph.

Parry, Thomas. 1988. The role of foreign capital in East Asian industrialization, growth and development. In *Achieving industrialization in East Asia,* ed. Helen Hughes. New York: Cambridge University Press.

Rauch, James. 1993. Productivity gains from geographic concentration of human capital: Evidence from the cities. *Journal of Urban Economics,* forthcoming.

Romer, Paul. 1986. Increasing returns and long-run growth. *Journal of Political Economy* 94: 1002–37.

———. 1993. Ideas and objects in economic development. *Journal of Monetary Economics* 32: 543–74.

Sen, Amartya. 1993. Economic regress: Concepts and features. Paper presented at annual World Bank Conference on Development Economics. Washington, D.C.: World Bank. Processed.

Stiglitz, Joseph E. 1992. Some lessons from the Asia miracle. Department of Economics, Stanford University. Mimeograph.

Summers, Robert, and Alan Heston. 1988. A new set of international comparisons of real product and price levels: Estimates for 130 countries. *Review of Income and Wealth* 34: 1–25.

———. 1991. The Penn World Table (Mark 5): An expanded set of international comparisons, 1950–1988. *Quarterly Journal of Economics* 106: 327–68.

Thomas, Vinod, and Yan Wang. 1993. Government policies and productivity growth: Is East Asia an exemption? Washington, D.C.: World Bank. Mimeograph.

Wade, Robert. 1989. What can economies learn from East Asian success? *Annals of the American Academy of Political Science* 505: 68–79.

———. 1990. *Governing the market: Economic theory and the role of government in East Asian industrialization.* Princeton, N.J.: Princeton University Press.

Wang, Fang-Yi, and Ashoka Mody. 1993. Industrial growth in Coastal China: Economic reforms . . . and what else? Washington, D.C.: World Bank. Mimeograph.

World Bank. 1993a. *The East Asian miracle.* New York: Oxford University Press.

———. 1993b. *Sustaining rapid development in East Asia and the Pacific.* Washington, D.C.: World Bank.

Young, Alwyn. 1992. A tale of two cities: Productivity growth in Hong Kong and Singapore. *NBER Macroeconomics Annual 1992.* Cambridge, Mass.: National Bureau of Economic Research.

Comment

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Easterly has done a good job in drawing our attention to the remarkable Asian growth experiences in the large-scale, cross-country growth regressions. He handles data well and his presentation is clear, and we learn a lot from his paper. Although I will differ in my interpretation of the findings, Easterly's regressions provide us a good overview of East Asian experiences in the modern literature on growth. His regressions highlight how exceptional the Asian growth experiences have been compared to the world standard. Can they be explained by economic conditions and economic logic—maybe a fast catch up with a low starting point—or by random elements? This is the challenge presented to us by Easterly's findings.

My comments are directed both to the interpretation of Easterly's findings and to the promising literature of growth convergence in general.

How Do We Take Solow's Residual?

In the original growth accounting literature, Solow's residuals were an em barrassment, in that they represented portions of growth that the model could not explain. Models became sophisticated to account for technological changes embodied in capital or in labor, but still some residuals were present, which was taken to be a failure of modeling.

In the more recent interpretation of total factor productivity (TFP), what used to be Solow's residuals became something wonderful, in that they represent a country's "miracle," possibly due to increasing returns. When Alwyn Young concluded that Singapore overinvested in capital and switched technologies too quickly, one of his supporting pieces of evidence was a low TFP.

Now we have Easterly who tells us that it is all but natural for miracle countries to have large positive residuals in growth regressions. He argues that "observations at one extreme of the sample are the most likely to have large residuals." Winners should all have the lucky components.

I still think that residuals are residuals. Large residuals show a failure of the assumptions (such as constant returns) that underlie the regression. This may be "suggestive" of an alternative (such as increasing returns), but does not positively identify the reason.[1]

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The author is indebted to Anne O. Krueger and David Weil for their helpful comments on an earlier version of these comments.

1. If the unit of man-hours for "labor input" produces large residuals, then an econometrician may want to improve the labor input variable by including "education," "years of experience," etc., to take into account the quality of labor. Large residuals should not stop one from thinking of alternatives.

What Is Convergence?

It is quite popular these days to run time-series and/or cross-country regressions attempting to prove that low-income countries grow faster than high-income countries. This is called a growth regression, or a regression to prove convergence.

Suppose that technological change is Harrod neutral, that is, technological progress is labor augmenting. It is well known (from the literature in the 1960s) that Harrod-neutral technological change produces a steady state where Y/L and K/L increase at the same rate, while Y/LH and K/LH stay constant (where Y denotes income, L natural units of labor, K capital, and H human capital). However, if initial conditions are not at the steady state, then the economy moves toward a steady state (given that a stability condition such as the Inada condition is met).

If capital is below its steady state level at the start (i.e., right after the revolution or war, or the first year of observation for an econometrician), then one might expect that the growth rate is higher when the country is underdeveloped, catching up to the world standard. For example, Japan grew at an average annual rate exceeding 10 percent from 1955 to 1973, while its average annual growth rate dropped below 5 percent after 1974. This can be interpreted as the result that Japan did "catch up."

Let me illustrate this point by some figures. Figure 11C.1, panel (a) is a standard growth figure showing the relationship between k ($=K/HL$) and y ($=Y/HL$), linearized at the steady state, (k^*, y^*). Various countries (or different years of the same country) are shown as dots on this line, with growth velocities corresponding to the lengths of arrows. Assume the same Harrod-neutral production function with the same steady saving rate (and thus the same steady state levels) and the precise measurement of K, L, H, and Y. The theory predicts that a state with low y is associated with a long arrow, a high growth rate (dy/y), and a state with high y is associated with a short arrow, a low growth rate (dy/y). This is shown in figure 11C.1, panel (b).

Now the same line is shown in figure 11C.2, where the vertical and horizontal axes have been switched.

If the theory is right and all assumptions are true, we will find countries on the solid line in figure 11C.1 (b), or figure 11C.2. Of course, there are shocks to the production function, and thus to the growth rates. Then we will have scatter dots around the line. Vertical deviations from the solid line are "residuals" in the growth regressions.

Now Easterly's argument, or the theory of lucky growth, is that, after ranking countries by "actual" growth (dy/y), we find that the top-growth countries are countries with large residuals (vertical deviations from the line). As shown in figure 11C.2, the states with the highest growth rates (circled dots) have large positive "residuals"; in fact, two of them have the largest residuals in the sample.

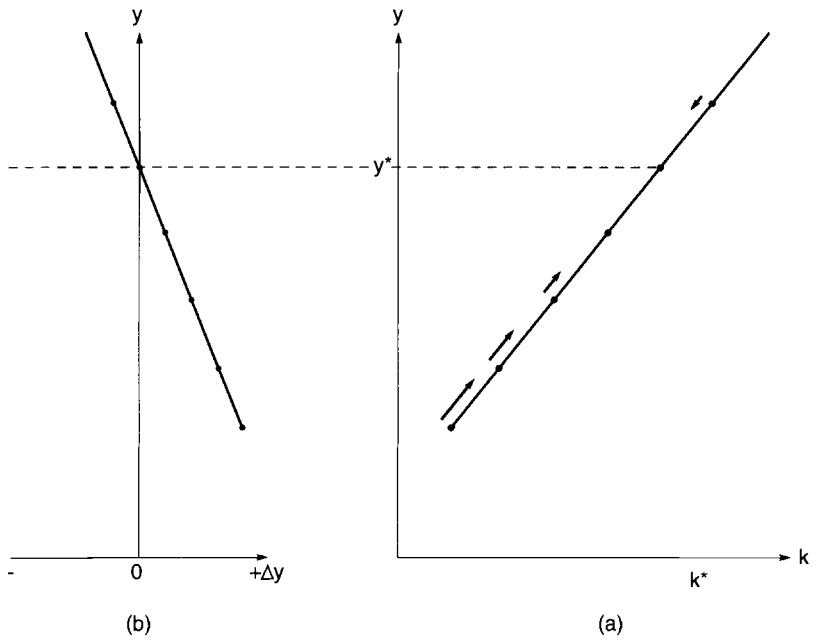

Fig. 11C.1 Relations between capital, income, and growth
Note: Δy = per capita growth rate; k^* = steady state capital per capita; y^* = steady state income per capita; k = capital per capita; y = income per capita.

But notice three factors, all now clear from figure 11C.2, that contribute to the "lucky growth theory." First, the order in growth rates would be exactly the order of residuals, if the solid line were flat. In general, the flatter the slope is, the more correlated are the rankings of growth rates and residuals, given the vertical scatters of dots (given y) around the line. Second, if dots are widely scattered given y, then the ranking correlation is more likely to hold. In other words, a high correlation of rankings is equivalent to low R^2, of course. Third, even in 1950s and 1960s, the Four Tigers were not among the least developed countries (LDCs), the left-most countries on the horizontal axis in figure 11C.2.

In sum, the theory of lucky growth, as argued by Easterly, is a confession of a (apparent) low correlation between y and dy/y, and low R^2. I do not consider it a "natural" outcome of regression analysis.

In the following, I will elaborate on these observations and present an alternative way of thinking about the growth experiences represented in Easterly's findings. In the next section, I will give a reason why the slope coefficient may have a downward bias. In the following section, I will argue that growth experience may be a "nonlinear" process, citing the traditional development literature.

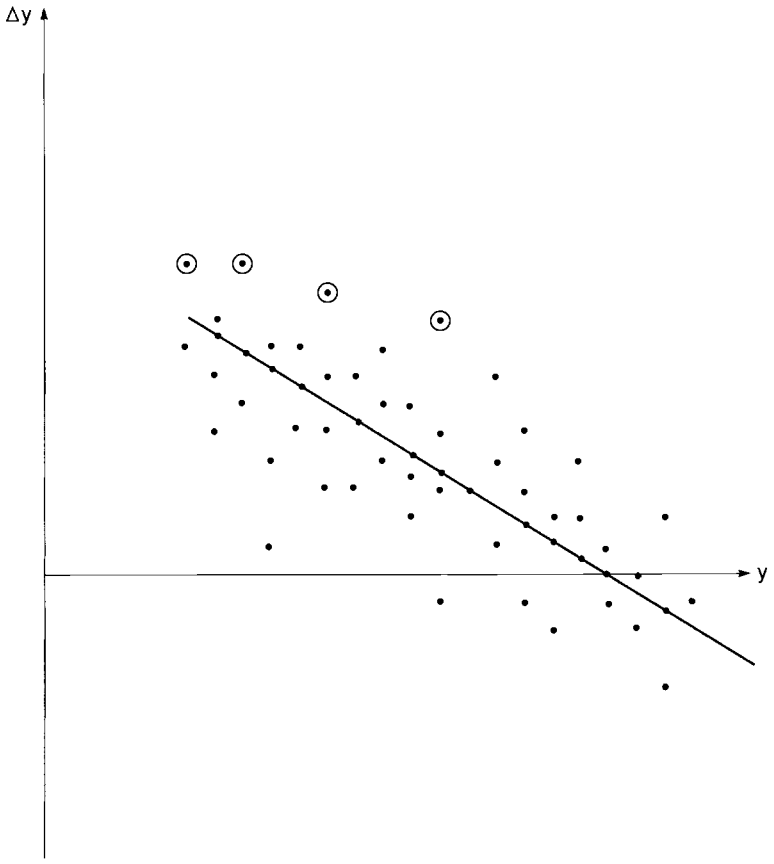

Fig. 11C.2 Growth versus level of income
Note: Each dot represents a hypothetical country's level of income and growth rate. Circled dots represent the Four Tigers

Permanent Growth Theory

The catch-up story of the preceding section is more likely to hold as a long-run relationship, while business cycles and other transitory disturbances affect both growth rates and the level of income in the short run. In other words, the true relationship between the level of income y and the growth rate g ($= dy/y$) is in their permanent components, y^P, and g^P:

$$y^P = b * g^P,$$

while what is observed is a combination of a permanent component and a transitory component:

$$y = y^P + e_y,$$

$$g = g^P + e_g,$$

where e_y and e_g are "transitory" components and are assumed to be uncorrelated. Then a regression of g on y, such as

$$g = a + b^*y + e,$$

would produce a case of "errors in variables." The estimated coefficient of b would be biased downward. This is a straightforward application of the permanent income hypothesis of Milton Friedman.

Since the estimated b is biased downward, there would be apparently less correlation between y and g, leading to a case of "lucky growth" as explained in the preceding section.

One might rebut the above reason for caution, however. The income level used on the right-hand side of the regression is usually an average of several years, so that the "transitory" component of y is smoothed out. Moreover, the business cycle in one country (e_y) is relatively small compared to the cross-country differences in y^P.

Growth versus Development

We were taught in the 1960s that growth theory and development theory are to be distinguished. Growth theory is applicable to advanced countries where quantitative changes are the issue, while development theory is intended to describe or to explain the qualitative change from an underdeveloped state to an industrialized state. Development theory describes the change from an agrarian society to a modern economy through industrial revolution. Components of exports and imports change as industrialization proceeds. Fertility and mortality rates change dramatically. Savings rates also increase as growth rates accelerate. Education level will rise as less youth are needed in the production of subsistence food. In fact, there is some crucial point in the progress from a low-growth equilibrium (poverty cycle) to a speed-up in the growth rate. Concepts such as modern economic growth (MEG) proposed and studied by Kuznets and "big push" and "take off" by Rostow suggest a nonlinear relationship between y and g, where a crucial jump in g plays an important role in catching up. I will take these observations of the old development theory seriously.

The multiple equilibria case in growth theory can be depicted in figure 11C.3, where the production function does not satisfy a condition for uniqueness of equilibrium. In figure 11C.3, two economies, one high-saving and one low-saving, are depicted: k^* is the high-income equilibrium in the low-saving economy; k^{**} is the low-income equilibrium in the low-saving economy; k^c is a critical point for convergence, in the sense that any historical starting point below (above) k^c will eventually converge to k^* (k^{**}); k^h is the equilibrium for the high-saving economy. There are two locally stable equilibria, one with high income and one with low income, if the saving rate is relatively low. However, if the saving rate becomes higher, the low-income equilibrium disappears, and

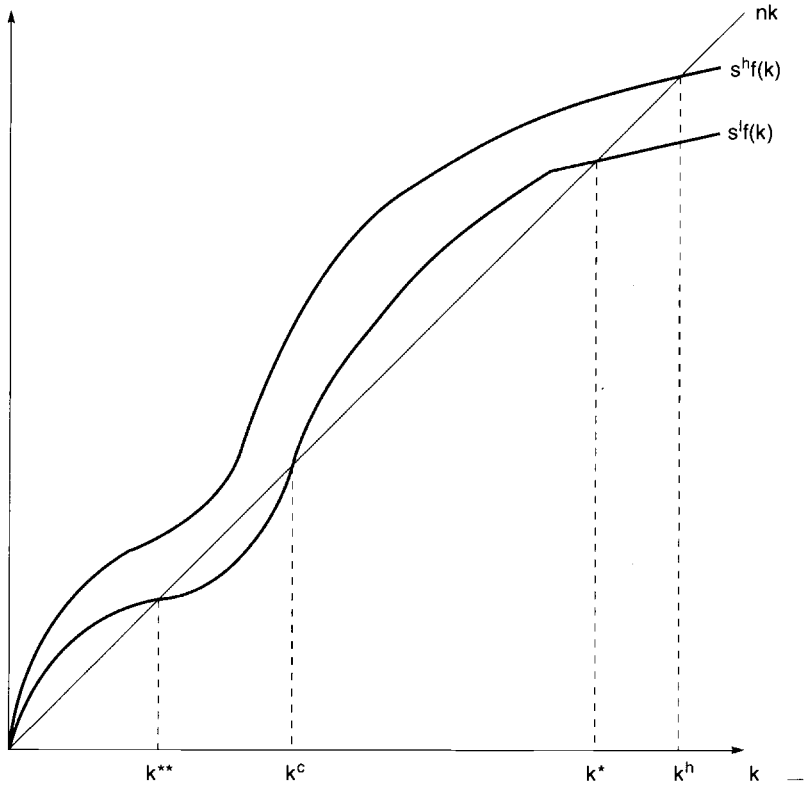

Fig. 11C.3 Multiple equilibria
Note: s^l = low saving rate case; s^h = high saving rate case; k^* = high equilibrium (steady state) with s^l; k^{**} = low equilibrium (steady state) with s^l; k^h = unique equilibrium with s^h.

the country will eventually converge to a high-income equilibrium. Suppose that some country, initially low income, succeeds in raising its saving rate, so that it leaves the low-income equilibrium state and "catches up" to the high-income state. Then we will observe three kinds of countries: high-income countries, low-income countries, and those in the process of catching up from a low equilibrium to a high equilibrium. Note that the small change in the saving rate can result in a large change in this framework.[2]

The economy breaks off from an old low equilibrium and moves to the re-

2. I am indebted to David Weil for the discussion in this section. Alternatively, I can illustrate the phenomenon of "a small change producing large results" with a uniform saving rate alone (without a high saving rate curve) in fig. 11C.3. Suppose that the capital-labor ratio (or income) level is subject to "disturbances" or "transitory shocks." Then some low-income countries may exit the boundary of the poverty cycle (the field of attraction to the low equilibrium) and start moving up to a high equilibrium.

gion of high equilibrium when some fortuitous shock arrives, such as political stability, an increase in domestic saving, or an increase in food production, and moves it out of the low-income equilibrium.

If some low-income countries "take off" from a low equilibrium, then they start to catch up with high-income countries by accelerating growth. Latecomers like Japan, Korea, Taiwan, Singapore, and Hong Kong move toward a high equilibrium, or toward joining an advanced nation club, such as the OECD. This is depicted in figure 11C.4. This observation is consistent with Easterly's claim that "rapid growth is surprisingly transitory."

Now suppose we run a growth regression (growth rate on the level of income) mixing countries near a high equilibrium, those near a low equilibrium, and those in the process of catching up. Although countries near an equilibrium will show convergence to that equilibrium, mixing countries near two different equilibria would make the point estimate biased toward zero and make the standard error of coefficient large. Countries in transition from a low equilibrium to a high equilibrium will have large residuals.

Summary

I first pointed out that Easterly's "theory of lucky growth" amounts to saying that the growth regressions have low R^2. Low R^2 values mean that the coeffi-

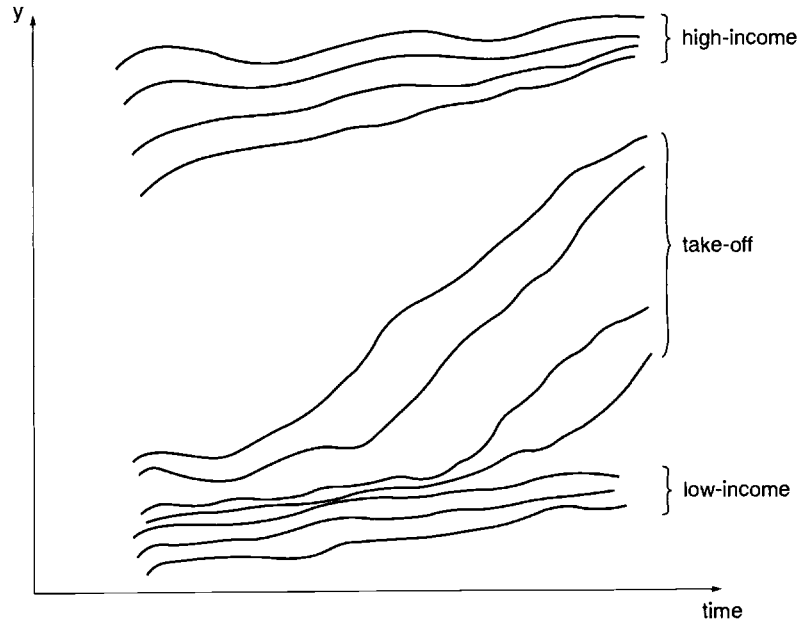

Fig. 11C.4 Model of nonlinear growth
Note: Figure shows conceptual paths of countries' income.

cient on the income level is close to zero, and the variance in growth rates is large.

I cited two different reasons why the coefficient on the income level may *apparently* be close to zero. Put differently, the coefficient is biased downward in the regression. First, downward bias will occur when there are measurement errors in income as well as in the growth rate. Second, if there are multiple equilibria and if there are some countries in transition from a low-income equilibrium to a high-income equilibrium, a regression with heterogeneous sample countries will result in the downward biased coefficient.

These comments are meant to be taken as constructive suggestions to improve the specification of growth regression in the future.

Comment T. N. Srinivasan

I enjoyed reading Easterly's paper, particularly his sarcasm about our profession's amazing ability to read confirmation of mutually contradictory explanations or hypotheses from the same data! He is right in saying that we tend to pay less attention to learning from development disasters (e.g., the Central African Republic) than from development miracles (e.g., Singapore). But, on the other hand, the former prime minister of Singapore, Lee Kuan Yew, is a far more interesting personality, with his economic philosophy and ideas on who should marry whom and how many children the couple should have, than the former emperor Bokassa of the Central African Republic ever was, with his penchant for an expensive coronation and gifts of diamonds to the French president, Giscard d'Estaing. No wonder that since 1969 there have been 717 articles in the economics journals on Singapore, compared to only one on the Central African Republic! Easterly is right that we should pay as much attention to the dogs that did not bark as to the tigers that roar.

Easterly asserts that because the Gang of Four were outliers (i.e., in the top 1 percent) of the *marginal distribution* of growth rates, they must also be outliers in the *distribution of residuals* from a regression explaining growth rates. Of course, if the regression has no explanatory power, this would be true. But, if it has significant power, it is possible that it explains very well the spectacular growth performance of the outliers so that their residuals are in no sense outliers and could even be zero. On the other hand, a country which is not an outlier in the marginal distribution of growth rates might still be an outlier in the distribution of residuals. That is, its growth rate might be too high (or too low for that matter) relative to that explained by the regression. However, one must also be very careful in using an appropriate statistical tool, such as tolerance (as contrasted with confidence) intervals, in detecting outliers in a distribution of residuals.

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Easterly is not quite correct in equating the performance of the explanatory variables in predicting the growth rates of the Gang of Four with the expectation that they must also be outliers in the *distribution* of each of the important explanatory variables. Since different explanatory variables could substitute for each other in explaining growth performance, a country need not be in the top 1 percent of the distribution of *any* of the explanatory variables for it to be in the top 1 percent of the distribution of *expected* growth rates from the regression or of the *marginal* distribution of *actual* growth rates.

Easterly sensibly raises the issue of persistence of growth performance over time. In analogy with biostatistics in which a common genetic component and an idiosyncratic component are attributed to siblings, one can write the observed growth rate g_{it} of country i in period t as the sum of a country-specific effect g_i, a time-specific effect g_t (possibly that of common external shocks, such as oil shocks affecting all countries), and a residual u_{it}. If g_i, g_t, and u_{it} are uncorrelated, then the variance σ^2 of g_{it} is the sum of the variances σ_1^2 of g_i, σ_2^2 of g_t, and σ_3^2 of u_{it}. Now, if the u_{it} are serially uncorrelated, then the correlation between g_{it} and g_{it-1} is easily seen to be the proportion $\sigma_1^2/(\sigma_1^2+ \sigma_2^2 + \sigma_3^2)$. This correlation, known as the intraclass correlation, measures the contribution of *persistence* in growth of countries over time. Thus, if the variance in g_t and u_{it} are small relative to that in g_i, then there will be strong persistence. Thus, in analogy with biostatistics, the *genetic* component explains most of the variation among the performance of the offspring of different families. I do not know whether Easterly is among those who attribute the stellar performance of the Gang of Four to their common "genetic" endowment, namely, their Confucian heritage. I am afraid, like the use of a "dummy" (or should I say "dumb") variable for the Gang of Four, Confucian heritage attribution is mere labeling (without even the saving grace of quantification in terms of the coefficient of a Gang of Four dummy!) without any policy or scientific significance.

Let me conclude by saying that Easterly is unduly harsh in holding the predictions of an earlier generation of economists to the piercing light of hindsight. After all, like all rational persons, they made their best predictions *given their models* (i.e., the economic theory then available) *and the information* available to them. Of course, if either the models were wrong in some respects or the information then available was incomplete and inaccurate, predictions would prove wrong as well. I am not entirely convinced that we now have a better theory of development, but we certainly have lots more data about the past, though not all of it is necessarily reliable. For example, if the early development economists had known that, contrary to the experience of the interwar period, world trade would grow at unprecedented rates, their enthusiasm for inward orientation and, hence, their confidence in the development prospects of economies with large internal markets and natural resources would have been muted. Put another way, one can and should criticize, as I am fond of doing, the present generation for ignoring the past, but not the past generation for ignoring the future!