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Explaining Miracles

Growth Regressions Meet the Gang of Four

William Easterly

Large positive residuals, such as those associated with the high performance of the Four Tigers, have historically been transitory. The stratospheric trajectory of the Four should be heading back toward earth soon.



Summary findings

Easterly examines a range of cross-sectional variation in performance and policies for evidence on what distinguishes successes from failures.

At about 6 percent, the growth rates of the Four Tigers — Hong Kong, the Republic of Korea, Singapore, and Taiwan (China) — are among the largest outliers in any study of growth. This is not surprising, says Easterly. The Four Tigers are Tigers *because* their growth rate was high. The Four generally have large positive residuals in growth regressions, but Easterly argues that this is not surprising for observations that were known in advance to be at the top of the sample.

But growth regressions and, more generally, quantitative measures of “policies” are not very successful at picking out the Gang of Four as “most likely to succeed.” Most observers before the “miracle” were pessimistic about East Asia.

The Four are not nearly as superlative in policies and other country characteristics as they are in per capita growth rates.

Large positive residuals such as those associated with the Four’s high performance have historically been transitory. The stratospheric trajectory of the Four should be heading back toward earth soon, says Easterly.

What may be unusual about the Four’s success is that they were all in one region. At least casually, the Asian successes look a lot like growth radiating from poles, with Japan followed by the Gang of Four, followed by China, Thailand, Malaysia, and Indonesia.

The great success of the Gang of Four does not imply a blanket endorsement of all 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.

It is disturbing how large and transitory the unexplained element is in economic success. Perhaps the best way to think about good policies is that they make success *likely* sooner or later.

When all is said and done, the story of the East Asian successes is consistent with the prosaic fundamentals: investment, education, financial depth, and low budget deficits. In these areas, the Four were above average.

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Explaining miracles: growth regressions meet the Gang of Four

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I. 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 LDC's: Hong Kong, Korea, Singapore, and Taiwan (China) -- known by such encomiums as the Gang of Four, the Four Dragons, the Four Tigers, the Asian Miracles, and the Newly Industrialized Countries (NIC's). 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 LDC's, the development problem would be solved. The metaphors for the Four recognize that replication is not 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's 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 (for example, 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 rate was 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. The 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 the 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.

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.

II. 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 (China)). 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 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 (China) and Korea. Primary education is exceptional in Singapore, but only slightly above average in the other three. Government consumption is adversely high in Taiwan (China) (whose many public enterprises are notorious for overstaffing and inefficiency -- see Liu (1993)). Initial income is low in Korea and Taiwan (China), 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 (China) 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 non-successes as Guyana, Jamaica, and Uruguay.

All of the Four Tigers have large positive residuals of two or three 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 would 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 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 (China), and much less so the miracle of Korea.

Interpreting Korea's high residual literally is an interesting thought experiment. According to Table 2, Korea had only about a one 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 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-section 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-squared that one can attain with permanent country characteristics in cross-section 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 pre-determined specification we examine is the core regression of Levine-Renelt (1992), which was found to be reasonably robust.⁹ Table 3 shows how the Four (actually the Three, since Taiwan (China) is omitted from the sample) rank according to the right-hand side variables of this regression. The 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 4 confirms again that 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 (China). 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 (China) 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 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 (China). The improvement in social indicators -- specifically the under-5 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's not that hard to find characteristics that four countries have in common, like a "Confucian work ethic" or high population density. Such ex-post "explanations" are of dubious value. The advantage of pre-determined 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/Africa/Latin America (see for example Kuznets (1966), pp. 360-61; Meier (1964), p. 6; Hagen (1968), p. 23; Higgins (1959), p. 10; Enke (1963), p. 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.

III. Is the Dragons' success transitory?

A recent paper (Easterly, Kremer, Pritchett, and Summers (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 .2 to .3, implying that only 20 to 30 percent of cross-country differences in growth rates persist from one decade to the next. The graph shown here, reproduced from EKPS, shows least-squares per worker growth (from Summers-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.

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 .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-squared in pure cross section 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-squared is about 0.6 with cross-section 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 fifty simulations show 4 or more countries in the top decile across successive periods.

While not the most likely outcome, it is not all that unusual to find 4 consistently positive outliers even with relatively small permanent differences in cross-country performance.

Like everyone else, the Four NIC's 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 90s.¹³

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 5 shows, performance of Korea and Taiwan (China) -- 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 or unfavorable for development, reproduced here as table 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), MacFarquar (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 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 60's 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 (China) 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 19th 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

Persistence of the Tigers' residuals

We have seen that the Four Tigers have large positive residuals in growth regressions, and that their performance is 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 60s, 70s and 80s). Regressions will again be run using roughly the Barro (1991) and Levine-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 60s and 70s, 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-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 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 2 out of the 3 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 toward the mean, where the mean by construction is zero). With a cross-decade correlation of only 0.1, 90% or 99% of the residual will tend to disappear in the following period.²¹ The graph 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 rather than per capita growth rates. Part of the success was simply due to faster labor force than population growth (especially notable in Singapore). The second is that the residuals in the sample in general are highly unstable and transitory -- 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, etc. 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

IV. Conclusions and suggestions for further research

Nothing in this paper should be taken as denigrating the success of Hong Kong, Korea, Singapore, and Taiwan (China). However 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' 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, 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 towards 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 (1992). 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 (China) 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 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 that 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.

Appendix: Pooled versions of Barro and Levine-Renelt (1992) regressions

(1) Levine-Renelt with World Bank per capita growth rates

LS // Dependent Variable is GYP
Number of observations: 306

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
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-squared	0.365726	Mean of dependent var	0.020583	
Adjusted R-squared	0.352998	S.D. of dependent var	0.025716	
S.E. of regression	0.020685	Sum of squared resid	0.127934	
Log likelihood	756.1182	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-Heston (1991), initial year of decade

(2) Levine-Renelt with World Bank per worker growth rates

LS // Dependent Variable is LGPW Number of observations: 296

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=====
      VARIABLE          COEFFICIENT      STD. ERROR      T-STAT.      2-TAIL SIG.
=====
          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
=====
R-squared                0.373179      Mean of dependent var      0.017675
Adjusted R-squared       0.360166      S.D. of dependent var      0.025384
S.E. of regression       0.020305      Sum of squared resid       0.119148
Log likelihood           737.0214      F-statistic                 28.67614
Durbin-Watson stat      1.914646      Prob(F-statistic)          0.000000
=====

```

- LGPD 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-Heston (1991), initial year of decade)

(3) Pooled "Barro" regression using per worker growth rates

LS // Dependent Variable is SLPW
 Number of observations: 303

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
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-squared	0.363949	Mean of dependent var		0.017640
Adjusted R-squared	0.348856	S.D. of dependent var		0.030669
S.E. of regression	0.024748	Sum of squared resid		0.180679
Log likelihood	694.9134	F-statistic		24.11416
		Prob(F-statistic)		0.000000

Variable definitions:

SLPW	Summers-Heston (1991) least-squares growth per worker, decade average
LGDPPC	Log of initial per capita income, beginning of decade (Summers-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-Heston (1991))
BLCK	Black market premium, average over decade (Levine-Renelt (1992), World Bank)
DUM60	Dummy variable for decade of 1960s
DUM70	Dummy variable for decade of 1970s

(4) Pooled "Barro" regression using per capita growth rates

```

LS // Dependent Variable is LSPC      Number of observations: 283
=====
      VARIABLE      COEFFICIENT      STD. ERROR      T-STAT.      2-TAIL SIG.
=====
          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-squared              0.435391      Mean of dependent var      0.018928
Adjusted R-squared     0.421019      S.D. of dependent var      0.029249
S.E. of regression     0.022256      Sum of squared resid       0.136213
Log likelihood          679.3560      F-statistic                 30.29465
                               Prob(F-statistic)          0.000000
=====

```

LSPC Per capita growth rate, least squares by decade (Summers-Heston 1991)
LGDPPC Log of initial per capita income, beginning of decade (Summers-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-Heston (1991))
BLCK Black market premium, average over decade (Levine-Renelt (1992), World Bank)
DUM60 Dummy variable for decade of 1960s
DUM70 Dummy variable for decade of 1970s

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Table 1: A report card for the Gang of Four

percentile rankings of Gang of Four for variables in growth regressions, where 100 is the most favorable for growth

Barro (1991) growth regression, 1960-85 (110 observations):

	Hong Kong	Korea	Singa- pore	Taiwan (China)
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, 60-85, lower than:	100%	61%	91%	18%
Deviation of investment deflator from US, 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%

Table 2: Probability of a country attaining a miracle (from Barro regression)

Miracle defined as > 5 percent per capita growth, 1960-85 (actual miracles are shown as shaded)

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%
Paraguay	16.90%
Taiwan (China)	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%

Table 3: Another report card for the Gang of Four
percentile rankings of Gang of Four for variables in growth regressions, where 100 is the most favorable for growth

Levine-Renelt (1992) regression:

	Hong Kong	Korea	Singa- pore
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%
<i>(Magnitude of growth residual</i>	<i>3.13%</i>	<i>3.23%</i>	<i>1.69%</i>
Investment/GDP 60-89 higher than:	92%	80%	100%
Population growth 60-89 lower than:	59%	65%	69%
Initial income, 1960, lower than:	30%	63%	36%
Secondary enrollment, 1960, higher than:	64%	70%	75%

Table 4: A final report card for the Gang of Four

percentile rankings of Gang of Four for variables in growth regressions, where 100 is the most favorable for growth

Other common variables in growth regressions:

	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-Rebelo 1993) higher than:	3%	23%	52%	72%
Ratio of income earned by top 20 percent to income earned by bottom 20 percent (Clarke 1992) lower than:	51%	77%	65%	87%
Ratio of trade to GDP, 1960-88 (Summers-Heston 1985 international prices) higher than	98%	43%	99%	#N/A
Ratio of M2 to GDP, 1970 (King-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-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
<i>Other performance indicators:</i>				
Ratio of private investment to GDP, 1960-88 (Easterly-Rebelo (1993)) higher than:	98%	92%	91%	58%
Percentage rate of decline in under-5 mortality rates, 1965-85 (Sen 1993) higher than:	95%	81%	93%	97%
Consumption growth per capita, 1960-88 (World Bank)	98%	92%	90%	#N/A

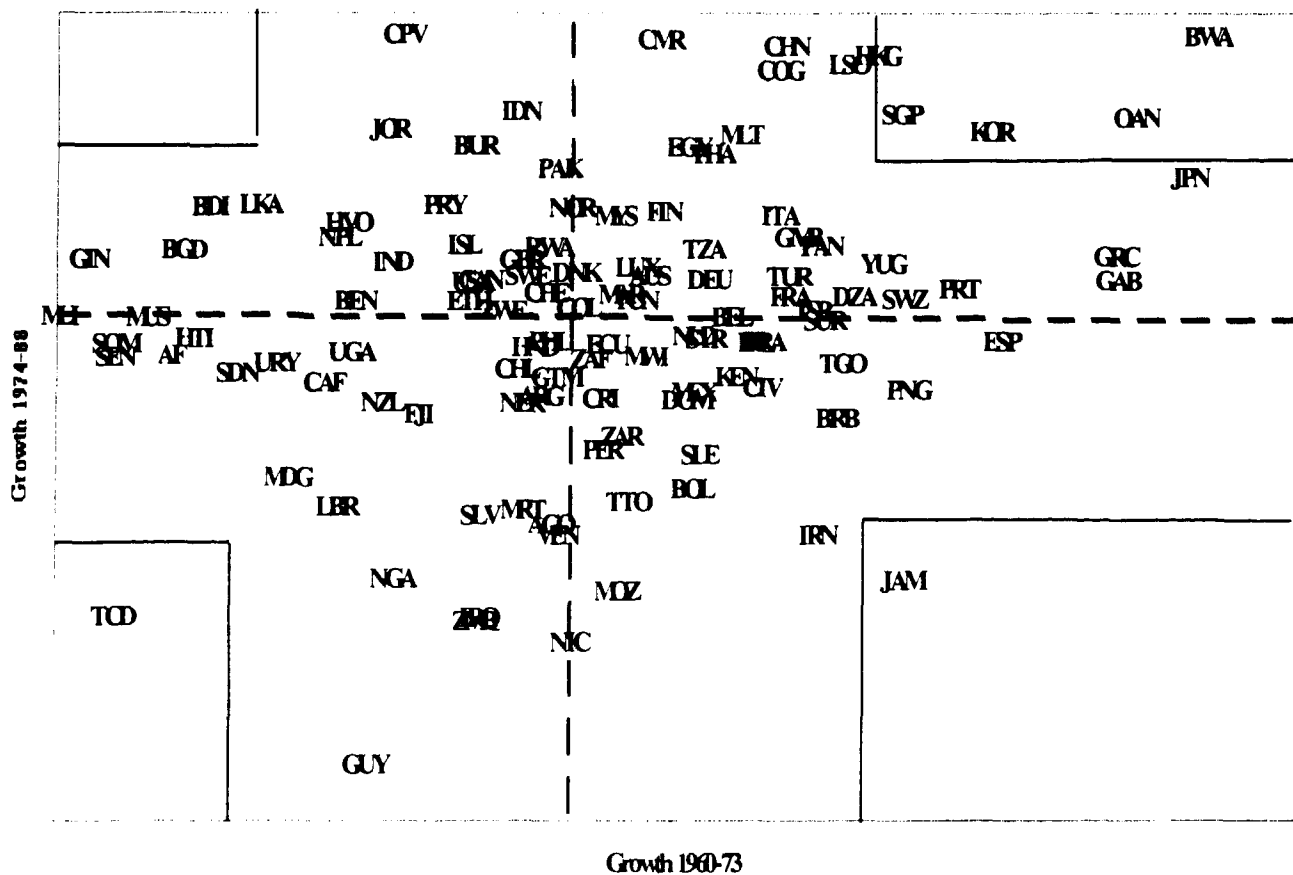
Table 5: Before the miracle: historical statistics on Asian economies	
<i>Per capita growth, 1900-50</i>	
<i>Dragons:</i>	
South Korea	0.10%
Taiwan (China)	0.40%
<i>Other Asian miracles:</i>	
China	-0.30%
Indonesia	-0.10%
Japan	1.00%
Thailand	0.10%

Table 6: Ranking of regions in 1963 according to factors favorable or unfavorable for development			
	<i>Per capita income</i>	<i>Population pressure</i>	<i>Economic culture</i>
<i>Most favorable</i>	Latin America	sub-Sahara Africa	Latin America
	Middle East	Latin America	Middle East
	sub-Sahara Africa	Middle East	sub-Sahara Africa
<i>Least favorable</i>	Southeast Asia	Southeast Asia	Southeast Asia

Table 7: Growth residuals of Gang of Four in pooled growth regressions, 60s 70s and 80s			
	60s	70s	80s
<i>Levine-Renelt (1992) regression with World Bank per capita growth rates</i>			
Hong Kong	2.57%	3.98%	4.07%
Korea	2.02%	3.97%	3.75%
Singapore	2.83%	2.24%	2.06%
<i>Levine-Renelt (1992) regression with World Bank per worker growth rates</i>			
Hong Kong	1.90%	3.35%	3.72%
Korea	1.86%	3.48%	4.71%
Singapore	2.80%	0.19%	0.45%
<i>Barro (1991) regression using S-H v. 5 growth per capita</i>			
Hong Kong	3.03%	2.70%	4.44%
Korea	2.17%	2.87%	3.62%
Singapore	0.28%	2.06%	3.45%
Taiwan (China)	1.93%	2.33%	2.78%
<i>Barro (1991) regression using S-H v. 5 per worker growth rates</i>			
Hong Kong	2.11%	1.35%	4.28%
Korea	1.28%	2.19%	2.85%
Singapore	-0.43%	-0.29%	3.85%
Taiwan (China)	2.46%	1.20%	1.68%

Figure 1

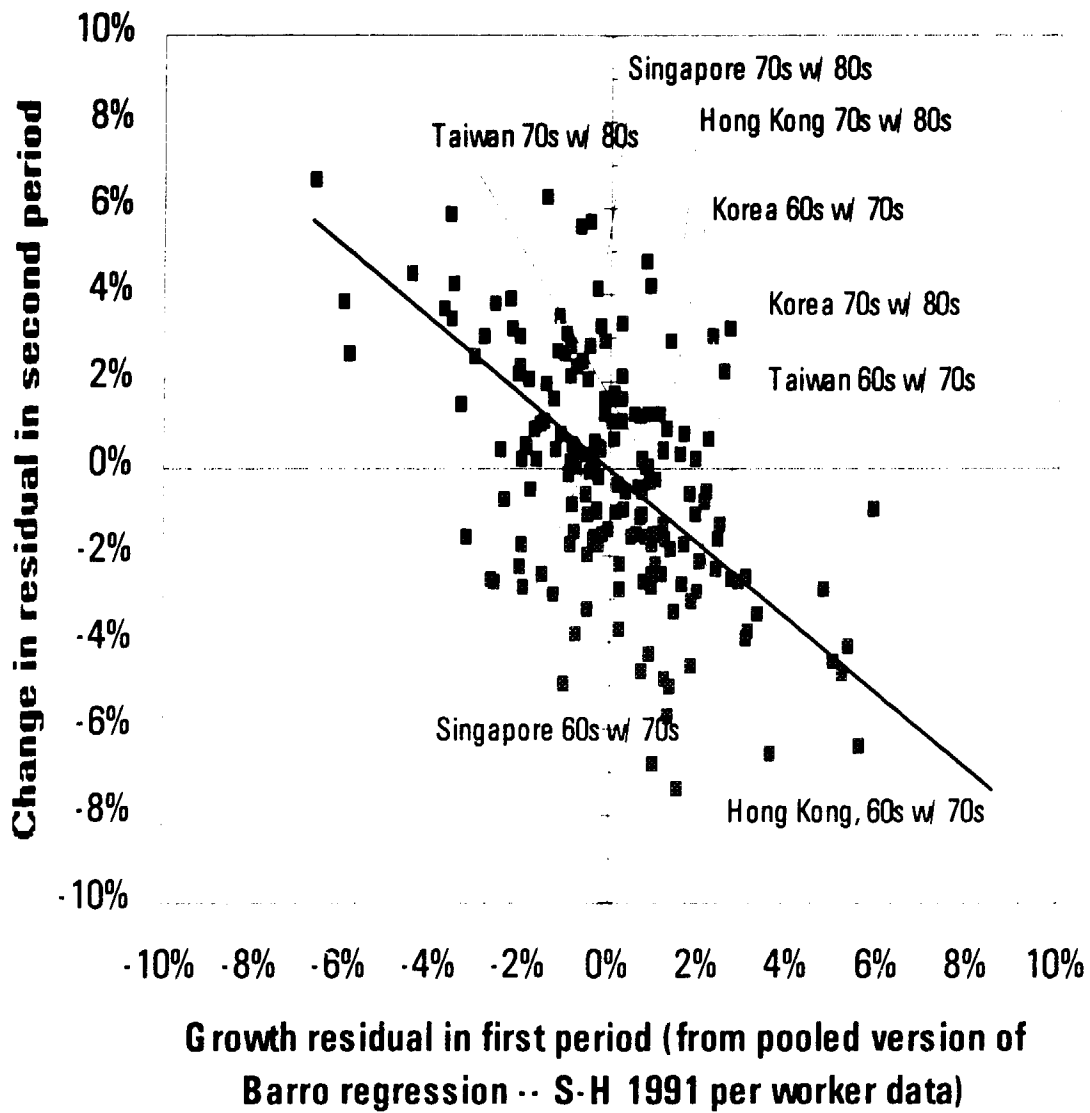
Per Capita Growth Rates, 1960-73 and 1974-88



Note: three letter World Bank country codes in parentheses (also used in Summers-Heston 1991).

Figure 2

Change in growth residual in second period against residual in first period



Footnotes

¹The 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 (1987)), 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 (1990)), and Confucian culture (Kahn (1979), MacFarquhar (1980)).

²These 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 by the Journal of Economic Literature.

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

⁴The 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.

⁵The 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 50-85 - .0247 (-4.05) Revolutions and Coups 60-85 - .0688 (-2.66) Government Consumption 60-85 - .0063 (-1.26) Investment price deviation, 1960**. 110 observations, R2 = .502. Standard error = .014. The regression differs slightly from that reported in Barro (1991) because the sample is larger.

⁶The lower the predictive power (the lower the R-squared) 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-squared less than one.

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

⁸Among the many examples of models with multiple equilibria: Krugman (1991), Becker, Murphy, and Tamura (1991), 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.

⁹The 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-squared = .463, Standard error of regression = .0139.

⁰As Levine and Renelt (1992) note, investment is likely to be endogenous and so is less of an explanation of high growth than a corollary of it.

¹However, 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 macro management (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." (p.40)

¹²Specifically, we generate a random variable that is the sum of a Normal (0,1) -- the cross-country variance -- and a Normal (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 Normal (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.

¹³Other authors also urge caution on the NIC's 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 NIC's 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.

¹⁴Quoted in Hoselitz (1952), p. 215.

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

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

¹⁷Kamarck (1967) quoted in Easterly, Kremer, Pritchett, Summers (1993).

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

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

²⁰Barro 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-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 TFP growth for *all* of the NIC's except Taiwan.

²¹If 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 Beta 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 $\text{Beta} - 1$.

²²If 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 70s to the 80s against the residual in the 70s, and the residual's change from the 60s to the 70s against the residual in the 60s.

²³Others 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).

²⁴See Rauch (1992) and Glaeser, Kallal, Scheinkman, and Shleifer (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.

⁵I am indebted to Lant Pritchett for making this point.

⁶Anaheim's per capita growth is from Greenwood, p. 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 50s (which may overstate Anaheim's real growth since inflation was probably higher in a booming area).

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