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On the Evolution of the World Income Distribution

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How rich are the richest countries in the world relative to the poorest? Are poor countries catching up to the rich countries or falling further behind? How might the world income distribution look in the future? These questions have been the subject of much empirical and theoretical work over the last decade, beginning with Abramovitz (1986) and Baumol (1986), continuing with Barro (1991) and Mankiw, Romer and Weil (1992), and including most recently work by Quah (1993a, 1996). This paper provides one perspective on this literature by placing it explicitly in the context of what it has to say about the shape of the world income distribution. We begin in the first section by documenting several empirical facts concerning the distribution of GDP per worker across the countries of the world and how this distribution has changed since 1960.[1]

The main part of the paper attempts to characterize the future of the world income distribution using three different techniques. First, we use a standard growth model to project the current dynamics of the income distribution forward, assuming the policies in place in each country during the 1980s continue. One can interpret this exercise as forecasting the near-term income distribution. The results indicate that the near-term income distribution looks broadly like the current distribution. However, there are some notable exceptions, primarily at the top of the income distribution, where a number of countries are predicted to continue to converge toward and even overtake the United States as the richest country in the world.

Second, we exploit insights from the large literature on cross-country growth

[1] For a related review of the facts, see Parente and Prescott (1993) and Jones (forthcoming).

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regressions following Barro (1991) and Mankiw, Romer and Weil (1992). An important finding of this literature is that one can interpret the variation in growth rates around the world as reflecting how far countries are from their "steady state" positions. Korea and Japan have grown rapidly because their steady state positions in the income distribution are much higher than their current positions. Venezuela has grown slowly because the reverse is true. We use this insight to provide a second way of predicting where countries are headed based on current policies.

Finally, we step back and consider how the steady states toward which countries are headed are themselves changing. The evidence from the last 30 years suggests that growth miracles are occurring more frequently than growth disasters and that the relative frequency of miracles has increased. Projecting these dynamics forward indicates that the long-run world income distribution involves a substantial improvement in the incomes of many countries. For example in 1960, 60 percent of countries had incomes less than 20 percent of incomes in the richest country. In the long run, the empirical results indicate that the fraction of "poor" countries will fall from 60 percent to only 27 percent.

Facts

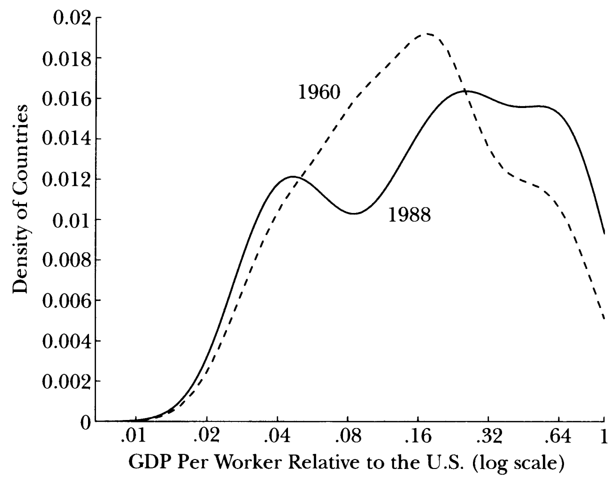
Before examining several facts about the world income distribution, it is worth pausing for a moment to consider which definition of income to use. GDP per capita seems like a natural definition if one is interested in an important determinant of average welfare. However, in many developing countries, nonmarket production is quite important, leading GDP per capita to understate true income in these countries. A coarse correction for this problem is to focus on GDP per worker. Both the numerator and the denominator then correspond to the market sector. To the extent that wages are equalized at the margin between the market and nonmarket sectors, this is a natural measure of income, and it is the one employed in most of this paper.

The world distribution of GDP per worker has changed substantially during the post–World War II period. Figure 1 plots the density of GDP per worker relative to the United States in 1960 and 1988 for 121 countries.[2] Roughly speaking, the more countries there are at a particular level of income, the higher the density will be at that point in the figure. The 121-country sample, which includes all countries for which Summers and Heston (1991) report real GDP per worker in both years, will make up the "world" for the purposes of this paper. The most notable omissions are several Eastern European economies and several economies in the Middle East for which data are not reported in 1960.

A number of features in this figure deserve comment. First, the distribution is

[2] The data are from the Penn World Tables Mark 5.6 update of Summers and Heston (1991) and therefore are in principle corrected for differences in purchasing power across economies. The density estimates are computed using a Gaussian kernel with a bandwidth chosen as $.9AN^{-1/5}$ where A is the standard deviation of the data and N is the number of observations.

Figure 1
World Income Distribution, 1960 and 1988



wide. In 1988, for example, the ratio of the income in the richest country (the United States) to the poorest country (Myanmar) was 35. Second, the 1960 distribution is single-peaked and looks roughly normal, although the tails are too thick. In contrast, the distribution in 1988 exhibits "twin-peaks," to use the appellation coined by Quah (1993a). This change reflects a shift in the mass of the distribution away from the middle and toward the ends. In particular, the "hump" in the 1960 distribution between about 5 and 30 percent of U.S. income has shifted upward into the 20 to 65 percent range. Finally, the world income distribution is wider in 1988 than it was in 1960, both at the top and at the bottom.

What cannot be seen in the figure is the general growth in GDP per worker throughout the world. Though this paper is almost entirely about relative incomes, it is important to remember that in absolute terms, income growth is a prevalent feature around the world. For example, U.S. GDP per worker grew at an average annual rate of 1.4 percent from 1960 to 1988. In other words, if in Figure 1 we plotted actual instead of relative incomes, the 1988 distribution would be shifted noticeably to the right. Nevertheless, not all countries experienced positive growth. GDP per worker actually declined from 1960 to 1988 in 11 percent of the countries.

Throughout this paper, we will consider incomes relative to U.S. income; that is, we will focus on the GDP per worker of the countries of the world divided by U.S. GDP per worker. The choice of the denominator is an important one, and U.S. income is chosen for several reasons. First, the United States had the highest GDP per worker in both 1960 and 1988, so the units of relative income are readily interpreted. Second, U.S. growth has been relatively steady over this 30-year period. Finally, it is natural to think of the U.S. economy as lying close to the technological frontier. Therefore, U.S. growth is probably a reasonable proxy for the growth rate of the technological frontier. These considerations indicate that the U.S. economy is "well-behaved" and that normalizing by U.S. income will not distort our view of the income distribution.

One drawback of Figure 1 is that individual countries cannot be identified. Figure 2 helps to address this concern by plotting GDP per worker relative to the United States in 1960 and in 1988 on a natural log scale.[3] Changes in the world distribution of income are then illustrated by departures from the 45-degree line. Countries with GDP per worker greater than about 15 percent of U.S. income in 1960 typically experienced increases in relative income. These countries correspond to the shift in the mass of the income distribution toward the top in Figure 1. On the other hand, many countries with relative incomes of less than 10 or 15 percent in 1960 experienced a decrease in relative income over this period. They grew more slowly than did the United States and more slowly than did most of the countries above the 15 percent mark. These are the countries that make up the peak at the lower end of the income distribution. One way of interpreting these general movements is that there has been some convergence or "catch-up" at the top of the income distribution and some divergence at the bottom.

Figure 2 also allows us to identify the growth miracles and growth disasters of this 28-year period. Hong Kong (HKG), Singapore (SGP), Japan (JPN), Korea (KOR) and Taiwan (OAN) all stand out as growth miracles, having increased their relative incomes substantially. For example, Hong Kong, Singapore and Japan grew from about 20 percent of U.S. GDP per worker in 1960 to around 60 percent in 1988. Korea rose from 11 percent to 38 percent. Several less well known growth miracles are also noteworthy. Relative income in Botswana (BWA) increased from 5 percent to 20 percent, in Romania (ROM) from 3 percent to 12 percent, and in Lesotho (LSO) from 2 percent to 6 percent.

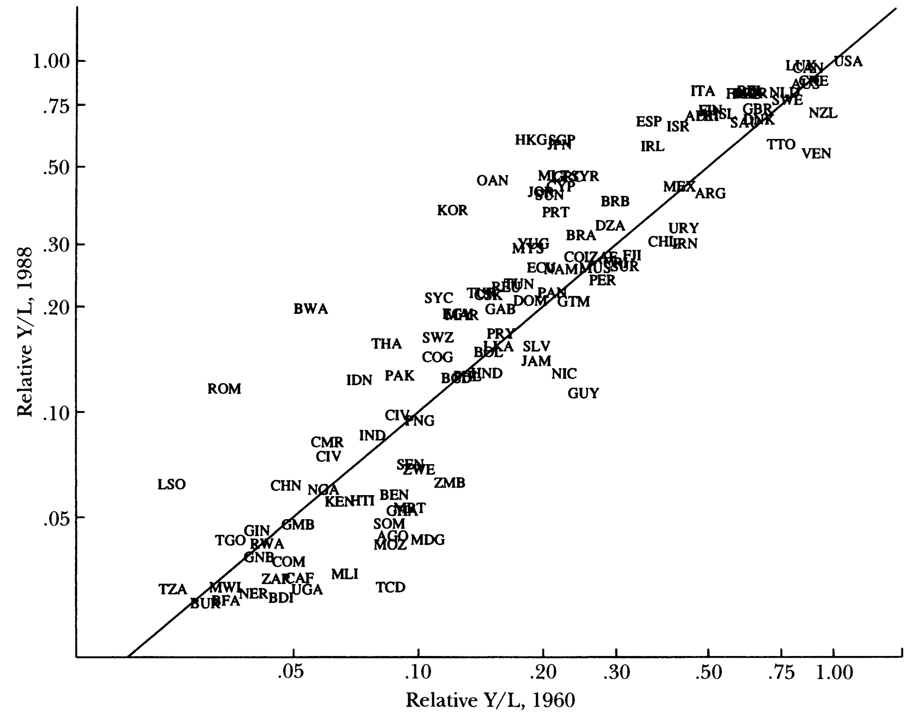
A large number of the growth disasters—countries that experienced large declines in relative incomes—are located in sub-Saharan Africa. Chad (TCD), for example, fell from a relative income of 8 percent to 3 percent. However, growth disasters outside Africa are also impressive. For example, Venezuela (VEN) was the third richest economy in the world in 1960 with an income equal to 84 percent of U.S. income. By 1988, relative income had fallen to only 55 percent.

The facts about the world income distribution so far have concerned the behavior of incomes in terms of countries. While this is a common way to view the data, it can be misleading: for example, if we drew national borders differently—for example, so that each of the 50 U.S. states were a separate country—the shape of the densities in Figure 1 would look different. An alternative approach is to weight each country by its population. The unit of observation is then a person instead of a country.[4] The most important fact to note in this regard is that roughly 40 percent of the world's population lives in China (23 percent in 1988) and India (17 percent in 1988). The experience of these two countries largely determines

[3] A complete guide to the country codes used in this figure can be found on the World Wide Web at http://www.stanford.edu/~chadj/growth.html.

[4] Of course, this exercise says nothing about changes in the income distribution *within* a particular country.

Figure 2
Relative Y/L, 1960 vs. 1988
(log scale)

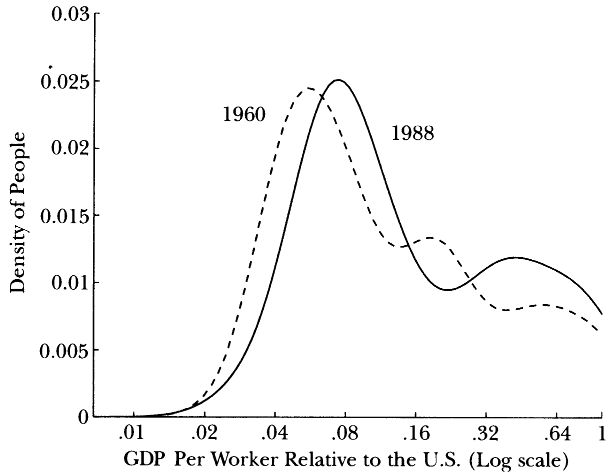


what happens to the "typical" poor person in the world. In contrast, less than 10 percent of the world's population lives in the 39 countries that make up sub-Saharan Africa.

Figure 3 plots the density of GDP per worker relative to the United States, weighted by population. In comparing this figure to Figure 1, one sees the overwhelming importance of India and China. While the distribution of countries has exhibited some divergence at the bottom, the same is not true for the distribution weighted by population. Both China and India have grown faster than the United States in the last three decades, leading to some catch-up at the bottom of the income distribution weighted by population. The catch-up in the top part of the income distribution also remains evident in Figure 3.

The cumulative distribution of GDP per worker by population—that is, the area under the density—provides additional information that is helpful in interpreting Figure 3. In terms of the cumulative distribution, 50 percent of the world's population lives in countries in which GDP per worker is about 10 percent of that in the United States. To be more exact, the income of the country containing the median person has improved from 8.1 percent of U.S. income in 1960 to 11.8 percent in 1988. Improvements for people higher up in the distribution have

Figure 3
Density of GDP Per Worker Weighted by Population



been even more substantial. The 75th percentile of the population lived in a country with 22.5 percent of U.S. income in 1960, but 40.3 percent in 1988. The 90th percentile of the population lived in a country with 59.2 percent of U.S. income in 1960, and 79 percent in 1988.

The Assumption of Similar Long-Term Growth Rates

The remainder of this paper considers various techniques for making statements about the future shape of the world income distribution. First, however, there is an important issue to consider. The world income distribution will only settle down to a stable, nondegenerate distribution if all countries eventually grow at the same rate. Why? Well, suppose one thinks growth in Japan will permanently be higher than growth in the United States. In that case, the ratio of Japanese to U.S. income will diverge to infinity. If this is the way the world works, one might be more interested in the long-run distribution of growth rates than in incomes. However, I will argue here that in the long run, all countries are likely to share the same rate of growth.

This assertion may seem counterintuitive. After all, growth rates of output per worker over long periods of time do differ substantially, and there may be an initial inclination to believe that the endogenous growth literature has provided ample evidence against this hypothesis. Nevertheless, there are both conceptual and empirical reasons to think that most countries are likely to share the same rate of growth in the long run. The conceptual reason is most persuasive and has been presented in several recent papers (Eaton and Kortum, 1994; Parente and Prescott, 1994; Barro and Sala-i-Martin, 1995; Bernard and Jones, 1996). Following the recent endogenous growth literature, let us assume that the engine of growth is technological progress: output per worker grows in the long run because of the creation of ideas. Ideas diffuse across countries, perhaps not instantaneously, but eventually. Belgium does not grow only or even largely because of the ideas created by Belgians, but rather a substantial amount of growth in Belgian output per worker is due to ideas invented elsewhere in the world. In this framework, the fact that countries of the world eventually share ideas means that their incomes cannot get infinitely far apart. All countries eventually grow at the average rate of growth of world knowledge, as shown in each of the papers cited above.

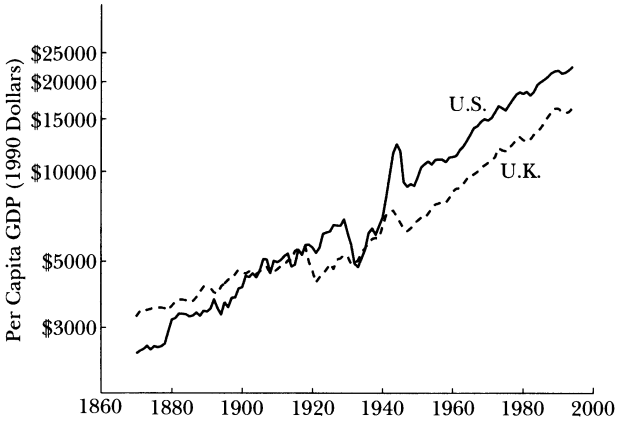
Which brings us to the empirical reason. What do we make of the large empirical variation in growth rates? Japan, for example, grew at an average rate of 5.1 percent per year between 1960 and 1988 while the United States grew only at 1.4 percent. Or consider an even longer horizon using the GDP per capita data reported by Maddison (1995). Over the century and a quarter spanning 1870 to 1994, the United States grew at an average rate of 1.8 percent per year while the United Kingdom grew only at 1.3 percent.

In fact, such differences—even over 125 years—are not inconsistent with the hypothesis that all countries share a common long-run growth rate. The resolution of this apparent inconsistency is transition dynamics. To the extent that countries are changing position within the world income distribution, their average growth rate can be faster or slower than the growth rate of world knowledge over any finite period. This point is illustrated clearly by a closer look at the U.S. and U.K. evidence for the last century.

Figure 4 plots the log of GDP per capita in the United States and United Kingdom from 1870 to 1994 using the data from Maddison (1995). As mentioned above, average growth in the United States has been a half a percentage point higher than in the United Kingdom over this 125-year period. However, as the figure shows, nearly all of this difference is accounted for by the pre-1950 experience. Between 1870 and 1950, the U.S. economy grew at 1.7 percent while growth in the United Kingdom was a comparatively sluggish 0.9 percent. This growth performance occurred as the United States overtook the United Kingdom as the world's richest country around the turn of the century. Since 1950, however, average growth rates have been almost identical, with the United States growing at 1.95 percent and the United Kingdom growing at 1.98 percent. Forecasters who in 1950 expected the large growth differentials of the preceding 70 years to continue were clearly mistaken.

Similarly, the fact that Japan has grown faster than the United States since 1950 says very little about whether or not these two economies will grow at the same rate in the long run. Rather, in a world where Japan and the United States have a common long-run growth rate, the experience of the last half-century is evidence that Japan is moving "up" in the income distribution.

Figure 4
Income in the United States and United Kingdom
(log scale)



The Future of the Global Income Distribution

Under the assumption that all countries grow at the same average rate in the long run, there are a number of ways to make statements about the eventual shape of the income distribution. The remainder of this paper employs three such techniques. First, we examine the predictions generated from a standard, well-known growth model due to Solow (1956). Second, we use a prediction based on transition dynamics. And finally, we employ a statistical technique that looks at the frequency of growth miracles and growth disasters.

Projecting from Current Investment Levels

The Solow (1956) growth model predicts that the level of output per worker in an economy in the long run is a function of the rate of investment in capital, the growth rate of the labor force, and the level of technology.[5] Statements about the future of the income distribution can be made if we can make statements about the future of investment rates, population growth rates, and (relative) technology levels. Notice that nothing really hinges on our following Solow in assuming exogenously given and constant investment rates and population growth rates. Provided these variables "settle down" in steady state to some constant value (which is nearly a definition of the steady state), what we really need empirically is to be

[5] Mathematically, $y(t) = (s/(n + g + \delta))^{\alpha/1-\alpha}A(t)$, where s is the investment rate, n is the population growth rate, δ is the constant rate at which capital depreciates, α is capital's share in production, and $A(t)$ is the level of labor-augmenting technology, which is assumed to grow at the constant, exogenous rate g.

able to predict *where* these variables are going to settle. The Solow model then tells us how to map these values into steady state incomes.

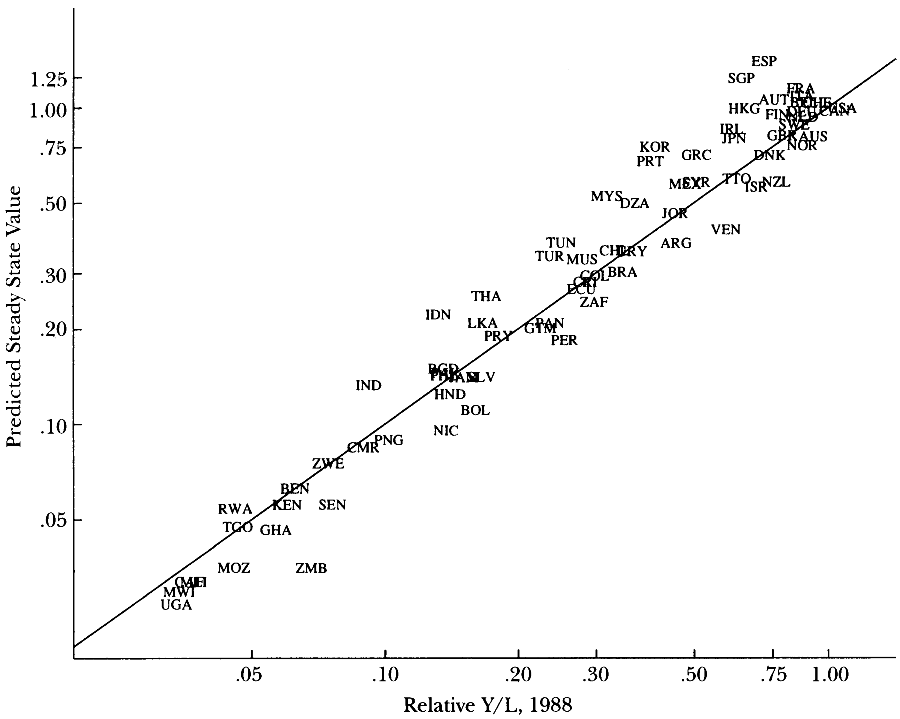
Jones (1997) follows this line of reasoning in a more general model that incorporates human capital as well as physical capital. A simple way of predicting where investment rates and population growth rates will settle is to assume that the rates that prevailed in the 1980s will persist. Of course, this simple method ignores the fact that investment rates, for example, may be affected by the transition dynamics of the economy. Moreover, what this exercise cannot predict are underlying changes in policy, which are presumably very important in the actual evolution of the income distribution. Still, this is a useful benchmark to consider. Later sections will address these other concerns.

Figure 5 plots steady state relative incomes based on this forecasting exercise against relative incomes in 1988 for 74 countries.[6] Two features of Figure 5 stand out. First, broadly speaking, the 1988 distribution is quite similar to the distribution of steady states. Uganda (UGA) and Malawi (MWI) are not poor because of transition dynamics. Rather, they are poor because investment rates are low and technology levels are low. (Population growth rates are also high, but a little analysis illustrates that changes in population growth rates have relatively small effects in most neoclassical models.) Based on recent experience in the 1980s, there is no reason to expect these broad features driving the world income distribution to change in the near future.

Second, this similarity is less pronounced at the top of the income distribution, where countries continue to "catch up" to the United States, than it is at the bottom. One notable exception is India (IND), which is predicted to grow from a relative income of 9 percent in 1988 to 13 percent based on policies in place in the 1980s. Similarly, Malaysia (MYS), Korea, Hong Kong and Singapore are all predicted to continue to grow faster than the United States during a transition to higher relative incomes, as are a number of OECD economies like Spain (ESP), Italy (ITA) and France (FRA). In fact, according to this particular exercise, a number of countries such as Singapore, Spain, France and Italy are predicted to surpass the United States in GDP per worker. While the exact location of particular countries is somewhat sensitive to assumptions, this general feature that the United States is not expected to retain its lead in output per worker is robust. The explanation is simple. Ignoring differences in technology for the moment, differences in income are driven by differences in investment rates in physical and human capital. The United States is one of the leaders in human capital investment (though not by much), but its investment rate in physical capital is substantially lower than are investment rates in a number of other countries. A high U.S. technology level helps, but it is insufficient to compensate for the lower U.S. investment

[6] Specifically, the exercise assumes a common capital share of 1/3 across countries. Educational attainment is assumed to augment labor, and a common rate of return to schooling of 10 percent is used. Investment rates, schooling enrollment rates and population growth rates from the 1980s and the level of (labor-augmenting) total factor productivity from 1988 are used in the computation. See Jones (1997) for more details.

Figure 5
Steady State Incomes, Based on Current Policies



rate. It is largely these differences that are driving the differences in incomes at the top of the distribution.[7]

Transition Dynamics and Steady State Incomes

A second way of estimating the shape of the steady state income distribution exploits recent work in the cross-country growth literature. According to this work, one of the most persuasive explanations for why some countries have grown faster than others over long periods of time is transition dynamics. The further a country is below its steady state position in the income distribution, the faster the country should grow. I will refer to this as the *principle of transition dynamics.* This principle can be found in the Solow and Ramsey growth models, as well as in models that emphasize the importance of technology transfer and the diffusion of ideas.[8]

[7] Jones (1997) considers several scenarios to check the robustness of these findings, including models in which technology levels converge, a demographic transition leads to identical population growth rates around the world, human capital investment rates converge, and physical capital flows internationally to equalize returns.

[8] Only the simplest growth models in which the dynamics are driven by foregoing consumption to invest output in physical capital, human capital, or research generally obey the principle as written (for ex-

According to this principle, the growth rate of the economy is proportional to the gap between the country's current position in the income distribution and its steady state position. In an unfortunate choice of terminology, the factor of proportionality is sometimes called the "speed of convergence." This phrase uses the word convergence in the mathematical sense of a sequence of numbers converging to some value. It describes the rate at which a country closes the gap between its current and steady state positions in the income distribution. This use is unfortunate because it seems to suggest that this equation has something to do with different countries getting closer together in the income distribution, which is not the case (at least not directly). With this definition, the principle of transition dynamics can be stated as

$$\text{Growth rate of relative income} = \text{Speed of convergence} \times \text{Percentage gap to own steady state.}$$

For example, suppose a country has a GDP per worker relative to the United States of 0.4 and a steady state value equal to 0.5. This represents a 20 percent gap. If the speed of convergence is 5 percent per year, then the country can expect its relative income to grow at 1 percent per year. Its actual GDP per worker will then grow at 1 percent plus the underlying growth rate of world technological progress (assuming the United States has reached its steady state).[9]

This relation has been exploited by the cross-country growth literature to explain differences in growth rates. The numerous right-hand side variables included in such regressions, in addition to the initial GDP per worker variable, are an attempt to measure the gap between initial income and the steady state position of the country in the world income distribution. A key parameter estimated by these regressions is the speed of convergence. For example, a number of authors such as Mankiw, Romer and Weil (1992) and Barro and Sala-i-Martin (1992) have documented using econometric techniques the well-known "2 percent" speed of convergence. Other authors, however, have recently argued for faster rates of convergence.[10] The standard Solow model implies a speed of convergence of about 6 percent for conventional parameter values. Alternatively, in a model that incorporates the diffusion of technology across countries, the speed of convergence is related to the rate of diffusion.

In general, the authors in the cross-country growth literature have not examined the shape of the steady state world income distribution implied by their regressions. However, the principle of transition dynamics suggests a simple, intuitive way to calculate the distribution of steady states. Instead of using the principle to

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ample, Mankiw, Romer and Weil, 1992). More sophisticated models require more than one state variable and cannot typically be reduced to so simple a formulation, although a similar relation often holds, either as an approximation or when applied to a slightly different variable such as total factor productivity.

[9] Mathematically, the principle of transition dynamics is $d\log\tilde{y}(t)/dt = \lambda(\log\tilde{y}^* - \log\tilde{y}(t))$ where $\tilde{y}$ is relative income, $\tilde{y}^*$ denotes the steady state value of relative income, and λ is the "speed of convergence."

[10] For example, see the work employing panel data of Islam (1995) and Caselli, Esquivel and Lefort (1996).

estimate speeds of convergence in a regression, we can simply impose alternative values. Then, data on growth rates from 1960 to 1988 and initial incomes in 1960 can be used to back out the implied steady states.[11] To the extent that countries roughly obeyed a stable principle of transition dynamics over this 28-year period, we can calculate the targets toward which they were growing.

Figure 6 reports the results of this exercise for several cases, corresponding to speeds of convergence of 2 percent, 4 percent and 6 percent. In general, the steady state distributions are determined as follows. Countries that have grown faster than the United States has over the 28-year period are predicted to continue to increase relative to the United States; countries that have grown more slowly are predicted to continue to fall. The extent to which the changes continue is determined by the speed of convergence. If this speed is slow, as in the first panel of Figure 6, then steady states must be far away in order to explain a given growth differential, implying large additional changes in the income distribution. On the other hand, if the speed is fast, say at 6 percent as in the last panel, then small deviations from the steady state can generate large growth differences; as a result, the current distribution looks quite similar to the steady state distribution.

Looking more carefully at the first panel of the figure, the steady state relative incomes for a number of countries seem implausibly large with a 2 percent speed of convergence. A number of East Asian countries are predicted to have incomes of more than 150 percent of U.S. income. The explanation for this prediction is that these countries have grown very rapidly for 30 years; with a very low speed of convergence, the only way to obtain such rapid growth rates is if the countries are extremely far from their steady states. In contrast, the steady states computed with a 4 percent or a 6 percent rate of convergence seem more reasonable.[12]

The Very Long-Run Income Distribution

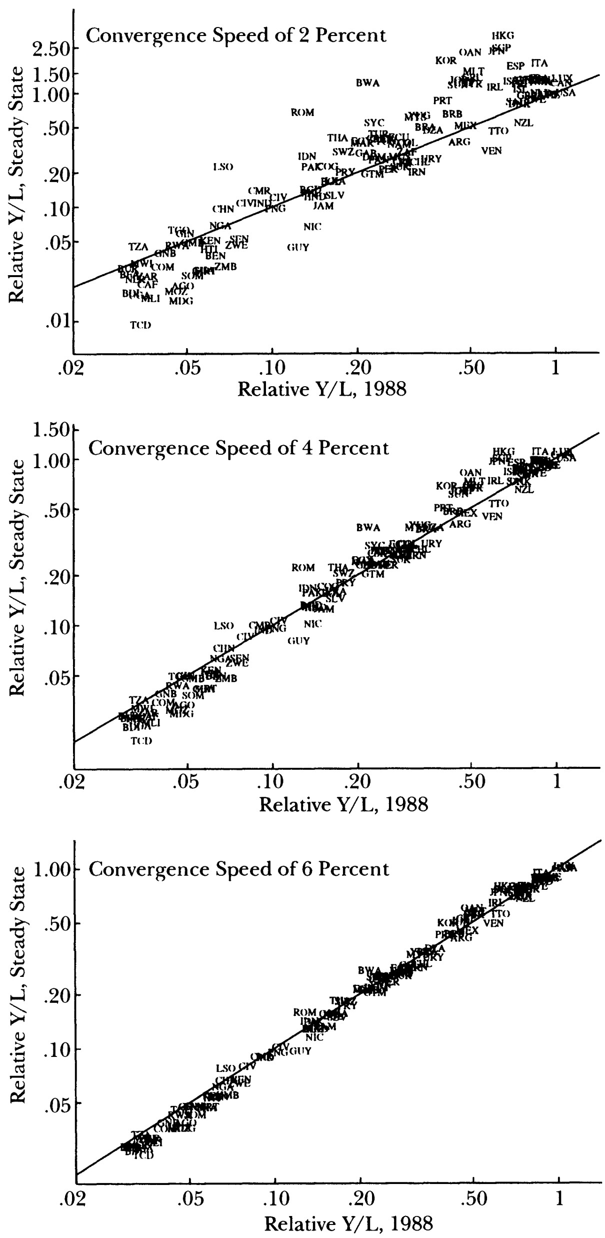
So far, we have considered the future of the income distribution under the assumption that the policies currently in place in each country continue, so that countries are growing toward constant targets. This has a number of advantages. For example, it allows us to infer the position within the income distribution toward which each country is headed. It also has the flavor of forecasting the near future.

However, much of the movement of countries within the income distribution presumably occurs as a result of policy changes within a country (broadly interpreted to include institutional changes). Japan, for example, had an income of roughly 20 percent of that in the United States from 1870 until World War II. After the substantial reforms following World War II, we see enormous increases in Jap-

[11] To be more precise, we first integrate the equation in footnote 9 and compute the average growth rate, as in Mankiw, Romer and Weil (1992). The resulting equation can be solved for $\tilde{y}^*$ as a function of the data.

[12] This result suggests one possible limitation of the exercise. The calculation assumes that the growth dynamics for 30 years are driven by a one-time increase in the gap between current income and steady state income. Instead, perhaps the steady states for these economies have shifted upward several times over the last 30 years. Some calculations reveal that this alternative does not help as much as one might suspect.

Figure 6
Steady States Implied by Transition Dynamics



anese relative income far beyond recovery back to the 20 percent level. On the other side, there is the famous example of Argentina, a relatively rich country during the early part of the twentieth century, but with income in 1988 of only 42 percent of that of the United States. Much of this decline is attributable to the

Table 1
Frequency of Growth Miracles and Growth Disasters

Interval	*Number of Countries*	*Fast Growth*	*Intermediate Growth*	*Slow Growth*
All Countries	(121)	40	45	15
$\tilde{y} \leq .05$	(18)	22	61	17
$.05 < \tilde{y} \leq .10$	(23)	22	35	43
$.10 < \tilde{y} \leq .20$	(31)	65	32	3
$.20 < \tilde{y} \leq .40$	(24)	42	50	8
$.40 < \tilde{y} \leq .80$	(21)	43	52	5
$\tilde{y} > .80$	(4)	0	75	25

Notes: Entries in the main part of the table reflect the percentage of countries in each interval exhibiting fast, intermediate and slow growth. Fast growth is defined to be one percentage point faster than U.S. growth (1.4 percent), and slow growth is defined to be one percentage point slower.

disastrous policy "reforms" of the Perón era (De Long, 1988, and the references there).

Predicting when and where such large changes in institutions and economic policies will occur is extremely difficult, if not impossible; certainly, it requires detailed knowledge of a particular economy. However, predicting the frequency with which such changes are likely to occur somewhere in the world during a decade is somewhat easier: we observe a large number of countries for several decades and can simply count the number of growth miracles and growth disasters.

One way of making this count is provided in the first row of Table 1. The 121 countries are classified according to how fast they grew from 1960 to 1988. The somewhat arbitrary cutoffs for fast and slow growth are defined as one percentage point faster and slower than U.S. growth. Because its growth rate is a reasonable proxy for the growth rate of the world's technological frontier, the United States is a natural benchmark for this exercise. The first row of the table clearly illustrates one of the key facts about the world income distribution: rapid growth has been significantly more common over the last 30 years than slow growth. For example, 40 percent of countries experienced fast growth over this period, while only 15 percent of countries experienced slow growth. This general result was also apparent in Figure 2. Looking back at this figure, one sees that there are more countries moving up in the distribution than moving down. There are more Italys than Venezuelas.

The second part of the table divides countries into six intervals, based on their GDP per worker in 1960. For example, the intervals correspond to countries with income less than 5 percent of U.S. income, less than 10 percent but more than 5 percent, and so on. The variable $\tilde{y}$ indicates a country's GDP per worker measured as a fraction of U.S. income. This part of the table documents that fast growth and slow growth occur at roughly the same frequency at the bottom of the income distribution; if anything, slow growth is more common. For countries with incomes

Table 2
World Income Distributions, Using Markov Transition Method

			Predicted		
Interval	*1960*	*1988*	*2010*	*2050*	*Long-Run*
$\tilde{y} \leq .05$	15	17	15	12	8
$.05 < \tilde{y} \leq .10$	19	13	13	11	8
$.10 < \tilde{y} \leq .20$	26	17	14	13	11
$.20 < \tilde{y} \leq .40$	20	22	23	23	24
$.40 < \tilde{y} \leq .80$	17	22	23	26	30
$\tilde{y} > .80$	3	9	12	15	19

Note. Entries in the table reflect the percentage of countries with relative incomes in each interval.

of more than 10 percent of U.S. GDP per worker, however, the frequency of rapid growth rises markedly. The clear implication is that once countries make it out of the lowest income categories, significant upward movements in the income distribution are much more common than large downward movements.

Motivated by this data on the frequency of fast and slow growth, we can provide a forecast of the very long-run income distribution. Table 2 follows the approach of Quah (1993a,b) based on Markov transition analysis. As in Table 1, we sort countries into intervals based on their 1960 levels of income relative to the world's leading economy, the United States during recent decades.[13] Then, using annual data from 1960 to 1988 for the 121-country sample, we calculate the probabilities that countries will move from one interval to another. Finally, using these sample probabilities, we compute an estimate of the long-run distribution of incomes.[14]

The sense in which this computation is different from the forecasts of the income distribution in previous sections of the paper is worth emphasizing. Previously, we computed the steady state toward which each economy seems to be headed and examined the distribution of the steady states based on current policy regimes. Here, the exercise recognizes that all countries may be subject to policy changes that shift their steady state positions. Therefore, the computation emphasizes a longer-term view of the income distribution. Moreover, instead of focusing on any particular country, we focus on the shape of the distribution as a whole. It turns out that in the long-run distributions computed using this approach, there is a positive probability of any country spending some time in any interval. This is because there is some probability that a country, no matter how rich or poor, will experience a large policy disaster or policy reform.

[13] I use the United States as the world's leading economy for the entire 1960–1988 period despite the fact that a number of oil-producing economies had higher GDP per worker in the late 1970s.

[14] Mathematically, the computation is easily illustrated. First, we estimate the transition probabilities of a Markov transition matrix using sample data. Multiplying this matrix by a vector that corresponds to the current distribution yields an estimate of the distribution during the next period. Doing this many times yields an estimate of the long-run distribution.

Table 2 shows the distribution of countries across the income intervals in 1960 and 1988 as well as estimates of the future distributions. The basic changes from 1960 to 1988 have already been documented. There has been some "convergence" toward U.S. income at the top of the income distribution, and this phenomenon is evident in the table. The long-run distribution, according to the Markov results, strongly suggests that this convergence will play a dominant role in the continuing evolution of the income distribution. For example, in 1960 only 3 percent of countries had more than 80 percent of U.S. income, and only 20 percent had more than 40 percent of U.S. income. In the long run, according to the results, 19 percent of countries will have relative incomes of more than 80 percent of the world's leading economy and 49 percent will have relative incomes of more than 40 percent. Similar changes are seen at the bottom of the distribution: in 1988, 17 percent of countries had less than 5 percent of U.S. income; in the long run, only 8 percent of countries are predicted to be in this category. This latter result is of interest in light of the finding reported in Table 1 that large upward and downward movements occur with roughly the same frequency at the bottom of the distribution. The long-run results here suggest that there is no development trap into which the poorest countries will be permanently condemned. The columns in the table labeled "2010" and "2050" provide some indication of how long it takes before this long-run distribution is reached.

The world income distribution has been evolving for centuries. Why doesn't the long-run distribution look roughly like the current distribution? This is a broad and important question. The fact that the data say that the long-run distribution is different from the current distribution indicates that something in the world continues to evolve: the frequency of growth miracles in the last 30 years must have been higher than in the past, and there must have been fewer growth disasters.

One possible explanation of this result is that society is gradually discovering the kind of institutions and policies that are conducive to successful economic performance, and these discoveries are gradually diffusing around the world. To take one example, Adam Smith's *An Inquiry into the Nature and Causes of the Wealth of Nations* was not published until 1776. The continued evolution of the world income distribution could reflect the slow diffusion of capitalism during the last 200 years. Consistent with this reasoning, the world's experiments with communism seem to be coming to an end only in the 1990s. Perhaps it is the diffusion of wealth-promoting institutions and infrastructure that accounts for the continued evolution of the world income distribution. Moreover, there is no reason to think that the institutions in place today are the best possible institutions. Institutions themselves are simply ideas, and it is quite likely that better ideas are out there waiting to be found. Over the broad course of history, better institutions have been discovered and implemented. The continuation of this process at the rates observed during the last 30 years would lead to large improvements in the world income distribution.

Using the Markov methods, we can conduct some other experiments that are informative. For example, we can calculate the likelihood of large movements within the income distribution. Consider first the frequency of growth miracles. The "Korean experience" is not all that unlikely. A country in the

10 percent bin will move to an income level in the 40 percent bin or higher with a 10 percent probability after 37 years. The same is true of the "Japanese experience:" a country in the 20 percent bin will move to the richest category with a 10 percent probability after 50 years. Given that there are a large number of countries in these initial categories, one would expect to see several growth miracles at any point in time.

One can also speculate on the frequency of large movements in the opposite direction. A famous historical example of such a move occurred in China. At least in terms of inventions and technologies, China was one of the most advanced countries in the world around the fourteenth century but today has a GDP per worker of something like 10 percent of that of the United States. What is the likelihood of a similar change today, based on the Markov results? Taking a country in the richest bin, only after more than 125 years is there a 10 percent probability that the country will fall to a relative income of less than 10 percent.

Conclusion

The post–World War II period has seen substantial changes in the distribution of GDP per worker around the world. A number of countries have exhibited large increases in income relative to the richest countries. A significant but smaller number of countries have seen incomes fall relative to the richest countries. The net result of these changes is a movement in the shape of the world income distribution from something that looks like a normal distribution in 1960 to a bimodal "twin-peaks" distribution in 1988.

One of the key facts that stands out from this analysis is that fast growth has been more common than slow growth in the last 30 years. That is, countries have shown a tendency to move up in the income distribution. If such dynamics continue, the world income distribution across countries is likely to be more compact in the future, as a result of the general movement up in the distribution by poor countries. In terms of the distributions plotted in Figure 1, one might expect the mass to continue to shift from the bottom part of the distribution toward the top. Viewed in terms of population instead of countries, the recent rapid growth in China and India reinforces this conclusion, as roughly 40 percent of the world's population lives in these two countries.

Of course, these changes are by no means automatic, and the fact that we have not already reached the long-run distribution indicates that the forces currently shaping the income distribution are a somewhat recent phenomenon. Understanding exactly what these forces are continues to be the subject of active research. Whatever, they are, however, the experience of the last 30 years provides some reason to be optimistic about the future of the world income distribution.

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