Recent Year-to-Year Trends in the Global Distribution of Income

Dr.Donghyun Park
Room No. S3 - B1A -12
Nanyang Business School
Nanyang Technological University
Singapore 639798

Abstract

We examine year-to-year trends in the global distribution of income over the period 1960-1992 as a simple means of checking the validity of the convergence hypothesis. Our data set consists of 133 countries and territories and is derived from the Penn World Tables. Our two main findings are that while the global distribution of income has not become more equal during 1960-1992 as a whole, it has been on a secular decline during 1976-1992. Thus, although the overall data fail to lend support to the convergence hypothesis, more recent data do so.

I. Introduction

In this paper, we analyze the trends in the global income distribution over the period 1960-1992 in this paper. Casual observation alone suggests the presence of vast differences in the standards of living across countries. In particular, a large gap exists between developed and developing countries. At the same time, growth performances have varied a great deal across the developing world. While some developing countries, particularly in East Asia, have experienced spectacular growth rates far surpassing those of most developed countries, others, most notably in Sub-Saharan Africa, appear to have stagnated or even regressed in some cases. In light of such diverse performances, it is unclear whether or not developing countries as a whole have been catching up with developed countries.

The central task of this paper is to look at the empirical evidence on international convergence in the period 1960 - 1992. For this purpose, we make use of the data in Penn World Tables (PWT), which provide a systematic attempt to render the incomes of different countries comparable. In constructing an index of income inequality among nations, we make the following two assumptions - there is perfect income equality among the citizens of each country in our sample and all the countries in our sample constitute a single world economy. The construction and application of this index will be our primary contribution to the literature on convergence. As such, our hoped-for contribution is largely methodological in nature. It is important to note that what is new here are not the indices themselves, for which we use the conventional Gini coefficient, but rather our derivation of a single measure of global income distribution, which we then use for our ultimate goal of analyzing trends in the inequality of income across countries during the period under study.

II. Growth Theory and Convergence

By international convergence, we mean a tendency for the living standards of the countries of the world to converge over time. Or, equivalently, it refers to the poor countries catching up economically with rich ones over time. In order for convergence to occur, the poor countries must experience higher rates of growth than richer ones. In the final analysis, the concept of convergence is a prediction about the pattern of economic growth across countries over time. Therefore, the logical point of departure for a theoretical review of convergence is a review of the neoclassical approach to growth theory. The two main strands of the neoclassical approach are the Solow model and the endogenous growth models.

(i) Solow Model

Solow (1956) derives the most basic neoclassical model of economic growth by combining the neoclassical production function with the assumption that a constant proportion of output is saved for the purpose of increasing the stock of capital. Solow's initial framework could not explain rising per capita incomes, a key stylized fact of modern economic growth. To overcome this problem, Solow (1957) explicitly introduced a variable which represents the state of technology in the economy, namely total factor productivity, as an additional element of the production function. Growing per capita incomes could now be attributed to two factors - growth in the capital-labor ratio and technological progress, or the celebrated Solow residual. Solow emphasized the second factor relative to the first, but assumed it to be exogenous.

In an empirically oriented 1992 paper, Mankiw, Romer and Weil (henceforth MRW) extend the basic Solow model to include human capital. Their work represents a general trend toward recognizing the potentially significant role of human capital accumulation in the growth process. A major assumption MRW make is that the level

of technology is identical for all countries. The MRW model differs from the basic Solow model mainly in predicting a higher proportion of output being allocated to capital, both physical and human. As in the basic Solow model, the MRW model predicts that per capita income growth is unsustainable in the absence of technological progress.

Building on earlier work by Ramsey (1928), Cass (1965) and Koopmans (1965) endogenized the consumption-saving decision as the outcome of intertemporal optimization by a representative individual. In doing so, they rectified a serious shortcoming of the basic Solow framework - the exogeneity of savings. Their main contribution to growth theory was to incorporate into the analysis the fact that savings behavior of rational individuals was guided by the rate of return to savings.

We now examine the implications of the Solow model for international economic convergence. As we have seen, according to the basic Solow model, exogenous technological progress is the primary determinant of economic growth. Unfortunately, the model's assumption of exogenous technological progress means that we can explain any pattern of growth rates across countries simply by assuming a corresponding pattern of technological progress rates across countries. Thus, although the model does not contradict convergence, neither does it predict it.

On the other hand, if we assume identical rates of technological progress across countries as MRW do, the Solow model does give us concrete predictions about economic convergence across countries. Those predictions depend critically on whether or not there is international capital mobility. If capital is immobile, each country converges to Solow's steady state, which grows at the uniform rate of technological progress - thus, there is no tendency for the per capita incomes of different countries to converge. The assumption of immobile capital, combined with

uniform technological progress, imply that over time all countries will grow at the same rate. In stark contrast, if we assume capital to be internationally mobile, the Solow model predicts that poor countries will catch up with rich ones over time. The basic insight is that rich countries have high capital-labor ratios relative to poor countries. Diminishing marginal productivity of capital means that the rate of return to capital will be higher in poor countries. Consequently, capital will flow from rich countries to poor countries, pushing the world economy toward convergence.

(ii) Endogenous Growth Model

Romer (1986) and Lucas (1988) pioneered a line of theoretical research which attempts to explain economic growth as an endogenous, rational process subject to the influence of policymakers. As such, this school of thought downplays the notion that exogenous technological progress is the primary engine of steady-state economic growth. The two most basic models of endogenous growth are the simple AK model and the extended AK model which allows for human capital.

The AK model, elaborated in Rebelo (1991), assumes constant returns to scale to capital. In this model, optimization by the representative individual determines the consumption and capital accumulation paths. The main implication is that capital accumulation alone determines the growth rate and since capital is not subject to diminishing marginal productivity, an increase in the rate of capital accumulation permanently raises the growth rate. Any policies which affect the decision to accumulate physical capital will permanently affect the growth rate. Economic growth is endogenous and does not require technological progress to be sustainable.

Barro and Sala-i-Martin (1994) expand the basic AK model by incorporating human capital. They assume constant returns to both types of capital, human and physical. The representative individual would always want to maintain a human capital-to-

physical capital ratio to be equal to the ratio between the scale parameters because at this ratio, neither form of capital is subject to diminishing marginal productivity and sustained economic growth does not require exogenous technological progress. Any policy which increases the rate of accumulation of either type of capital will permanently increase the rate of economic growth.

The simple AK model does not predict convergence. In the absence of policies which affect the rate of capital accumulation, countries with different income levels do not experience different rates of growth. As for the human capital-augmented AK model, its predictions about convergence in the case where all countries have the same level of technology and there is capital mobility differs significantly from the predictions of the Solow model. More precisely, poor countries will not always catch up with rich countries but only to the extent that they are relatively well-endowed with human capital. Thus, what is critical for international convergence is the level of human capital in developing countries.

III. Empirical Literature

Now we turn to the question of whether the Solow model's prediction of economic convergence is supported by empirical evidence. Romer (1989), Barro (1991), Barro and Sala-i-Martin (1992) and Parente and Prescott (1993), among others, have recently addressed this question. They all find no empirical evidence for convergence. That is, on average, the actual pattern of economic growth across countries does not indicate that poor countries have been catching up with rich countries.

Perhaps the most obvious way to test for convergence is to plot rates of economic growth against initial levels of per capita income and check for any discernible pattern. Romer (1989) and Barro (1991) do this but do not find any systematic pattern. More formally, Sala-i-Martin (1990a, 1990b) estimate an equation based on the economy

moving along its optimal path towards its steady-state per capita growth rate and find that the initial level of income is statistically insignificant as a determinant of the rate of economic growth.

An alternative way to empirically investigate convergence is to observe the evidence on international capital flows. In particular, the Solow model predicts capital to flow from rich countries to poor countries since the latter is relatively poorly endowed with capital and capital is subject to diminishing marginal productivity. Lucas (1990) finds that empirical evidence fails to support rich country-to-poor country capital flows of the magnitude predicted by the Solow model. Furthermore, Feldstein and Horioka (1980) point out that countries with high savings rates tend to have high rather than low investment rates as the diminishing marginal productivity assumption of the Solow model would imply.

Finally, Barro and Sala-i-Martin (1991) examine convergence with two sets of more disaggregated data - the U.S. states and 73 European regions. They find qualified evidence which lends support to convergence among the U.S. states. This finding may be consistent with the arguments raised by Blanchard and Katz (1992), which stresses the key role of labor mobility in promoting regional convergence within a country or an economic unit. Barro and Sala-i-Martin find evidence for convergence among the European regions to be much weaker than their evidence for U.S. states.

IV. Data and Methodology

Our data set is the Penn World Tables (henceforth PWT), version 5.6. For a comprehensive explanation of this data set, please refer to Summers and Heston (1991). As is well known, PWT's great advantage is that all the economic variables are expressed in a common set of prices and in a common currency. PWT's estimates of national income are based on purchasing power parity and hence are much more

accurate than estimates based on nominal exchange rates. The development of this database has allowed for more meaningful comparisons of variables across countries and has, in fact, served as a catalyst in empirical research on analysis of the international pattern of economic growth.

The full universe of our sample consists of 133 countries and territories. The sole criterion for our sample selection was the availability of PWT data. The most populous countries to be excluded due to lack of data are Vietnam, North Korea, Afganistan and Cuba. Our sample, however, still covers well over 97% of the global population. Our variables of interest are the population (POP in PWT) and per capita income (RGDPC in PWT) of each country and territory. We examine the data annually for the period 1960-1992. Data limitations prevent us from pursuing our analysis beyond 1992.

We do not make use of income distribution within individual countries, which are only available on a limited basis in, for example, the World Development Report. The reason is that in this paper, global income inequality refers to the inequality among the nations of the world rather than the individuals of the world. The key assumption we make in this connection is that all the individuals of a country earn the same level of income. Although there are rich Ethiopians and poor Americans, an American will be rich on average and the Bangladeshi will be poor on average. The question we investigate is whether, on average, the gap between the Bangladeshi and the American has been narrowing or not over the last three decades. Or, equivalently, whether or not Bangladesh has been catching up with the U.S..

Before we proceed, let us briefly examine trends in the global population, global income and global per capita income implied by our data set. Global population and global income is obtained by summing up the populations and national incomes in our data set while per capita income is derived by dividing global income by population.

	Population (in millions)	Total Income (in billions of US$)	Per Capita Income (in US$)
1960	2956	6634	2244
1968	3440	9798	2848
1976	4014	14023	3494
1984	4607	18050	3918
1992	5285	22633	4283

Table 1: Trends in Global Population, Income and Per Capita Income

V. Empirical Evidence

We now report the principal trends in international income inequality for the period 1960-1992 implied by our data set.

i) Percentile Shares of Global Income

We divide the global population - or more precisely, the total population of the countries and territories in our sample - into fifths and tenths. Our first step is to rank all political entities by their per capita income. Thus, in 1960, Ethiopia is one end and the U.S. at the other. For the case of fifths or twenty percentiles, we first divide the global population by five. For example, if there are four billion people in the world, each fifth would consist of 800 million. In constructing the poorest fifth, we would include all Ethiopians as well as the populations of the next poorest countries until 800 million people living in the poorest countries are included. Conversely, the richest fifth would consist of all Americans as well as the populations of the next richest countries until 800 million people living in the richest countries are included. We repeat the exercise for the middle three fifths. Countries at the cut-off points will have a part of their population included in one fifth and another included in another fifth. We apply the same methodology in dividing the global population by tenths or ten percentiles in terms of per capita national income.

	q1	q2	q3	q4	q5

1960	4.74	5.75	8.80	20.7	60.0
1961	3.98	5.29	8.25	21.7	60.8
1962	3.65	5.26	8.14	21.7	61.2
1963	3.74	5.28	8.28	21.5	61.2
1964	3.90	5.25	8.08	21.5	61.3
1965	4.16	4.98	7.65	21.4	61.8
1966	4.39	4.77	7.15	21.7	62.0
1967	4.04	4.67	7.18	21.8	62.3
1968	3.65	4.49	7.09	22.1	62.6
1969	3.96	4.64	6.97	21.8	62.7
1970	4.24	4.86	7.04	22.0	61.9
1971	4.22	4.83	6.84	22.5	61.6
1972	4.12	4.67	6.47	22.6	62.1
1973	4.07	4.53	6.27	22.9	62.2
1974	4.03	4.43	6.42	23.8	61.3
1975	4.19	4.69	6.56	24.3	60.3
1976	3.65	4.45	6.51	24.5	60.9
1977	3.96	4.57	6.67	24.5	60.3
1978	4.09	4.66	6.66	24.2	60.4
1979	4.06	4.67	6.63	23.9	60.7
1980	4.21	5.09	6.78	23.8	60.1
1981	4.32	5.05	6.94	23.6	60.1
1982	4.45	5.10	7.06	23.5	59.9
1983	4.56	5.38	7.01	23.0	60.0
1984	4.45	5.66	6.95	22.6	60.4
1985	4.46	5.95	7.17	22.1	60.4
1986	4.38	5.75	6.86	21.3	61.7
1987	4.47	5.94	6.99	21.7	61.0
1988	4.53	6.09	7.00	21.1	61.3
1989	4.56	6.12	7.04	20.7	61.6
1990	4.63	6.08	7.09	20.4	61.8
1991	4.62	6.26	7.32	20.3	61.5
1992	4.58	6.56	7.56	19.8	61.4

Table 2: Shares of Global Income by Twenty Percentiles (unit: %)

In Table 2, q1 refers to the percentage share of global income accruing to the poorest fifth of the global population, as defined earlier, while q5 indicates the percentage share of the richest fifth.

We now examine the data on the basis of tenths or ten percentiles of populations rather than fifths or twenty percentiles.

	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10

1960	2.21	2.53	2.57	3.18	3.43	5.36	8.91	11.8	21.2	38.8
1961	1.91	2.08	2.29	3.01	3.30	4.94	9.34	12.3	21.9	38.9
1962	1.77	1.88	2.20	3.06	3.26	4.88	9.35	12.4	22.2	39.0
1963	1.82	1.93	2.19	3.09	3.37	4.91	9.17	12.3	22.2	38.9
1964	1.87	2.04	2.19	3.06	3.33	4.75	9.02	12.4	22.5	38.8
1965	1.97	2.19	2.24	2.74	2.97	4.67	8.73	12.6	22.7	39.2
1966	2.02	2.37	2.37	2.41	2.61	4.53	8.84	12.8	22.6	39.4
1967	1.88	2.16	2.18	2.49	2.68	4.50	8.75	13.1	23.2	39.1
1968	1.73	1.92	2.01	2.49	2.67	4.42	8.69	13.5	23.5	39.1
1969	1.88	2.08	2.13	2.51	2.64	4.33	8.55	13.2	23.9	38.7
1970	1.97	2.27	2.28	2.58	2.68	4.37	8.40	13.6	24.1	37.8
1971	1.97	2.25	2.28	2.55	2.70	4.13	8.73	13.8	23.9	37.7
1972	1.91	2.20	2.25	2.43	2.53	3.93	8.79	13.9	24.1	38.0
1973	1.88	2.19	2.20	2.33	2.40	3.87	8.80	14.1	24.3	38.0
1974	1.87	2.16	2.18	2.25	2.52	3.91	9.24	14.5	24.0	37.3
1975	1.92	2.27	2.29	2.40	2.61	3.95	9.26	15.0	23.7	36.5
1976	1.57	2.08	2.13	2.32	2.57	3.95	9.34	15.1	23.8	37.1
1977	1.86	2.11	2.19	2.37	2.59	4.07	9.34	15.1	23.5	36.9
1978	1.86	2.23	2.27	2.39	2.62	4.04	9.06	15.1	23.1	37.3
1979	1.84	2.22	2.33	2.34	2.63	3.99	9.06	14.9	23.5	37.3
1980	1.88	2.33	2.52	2.56	2.72	4.06	8.90	14.9	23.5	36.6
1981	1.93	2.39	2.51	2.53	2.70	4.24	8.67	14.9	23.4	36.8
1982	1.96	2.49	2.54	2.56	2.79	4.28	8.74	14.8	23.8	36.1
1983	1.96	2.59	2.67	2.70	2.81	4.20	8.46	14.6	23.8	36.3
1984	1.88	2.57	2.76	2.90	2.90	4.05	8.36	14.2	23.5	36.9
1985	1.84	2.63	2.80	3.16	3.16	4.02	8.23	13.8	23.4	37.0
1986	1.76	2.62	2.77	2.97	2.98	3.87	7.88	13.4	22.8	38.9
1987	1.73	2.74	2.87	3.07	3.07	3.92	7.91	13.7	23.6	37.3
1988	1.68	2.85	2.95	3.14	3.14	3.86	7.56	13.5	23.8	37.5
1989	1.68	2.88	2.97	3.15	3.16	3.89	7.35	13.3	23.9	37.8
1990	1.69	2.94	2.99	3.09	3.10	4.00	7.38	13.0	23.6	38.2
1991	1.68	2.94	3.02	3.24	3.24	4.07	7.34	12.9	23.3	38.2
1992	1.63	2.96	3.08	3.49	3.49	4.07	7.31	12.5	23.0	38.4

Table 3: Shares of Global Income by Ten Percentiles (unit: %)

ii) Gini Coefficient

Gini coefficient is the most well-known and widely used measure of inequality. It is based on the Lorenz curve, which plots the cumulative share of total income against the cumulative share of total population and is shown for the 20% case in Figure 1 below. If there were perfect inequality, the Lorenz curve would be a 45-degree line since 20% of the population would have 20% of total income and so on. More

generally, the smaller is the area between the 45-degree line and the actual income distribution, the smaller is the degree of inequality. The Gini coefficient is a convenient one-number summary of inequality in the sense of the Lorenz curve and it satisfies the three most desirable properties of an index of income distribution - scale independence, population size and the Pigou-Dalton condition.

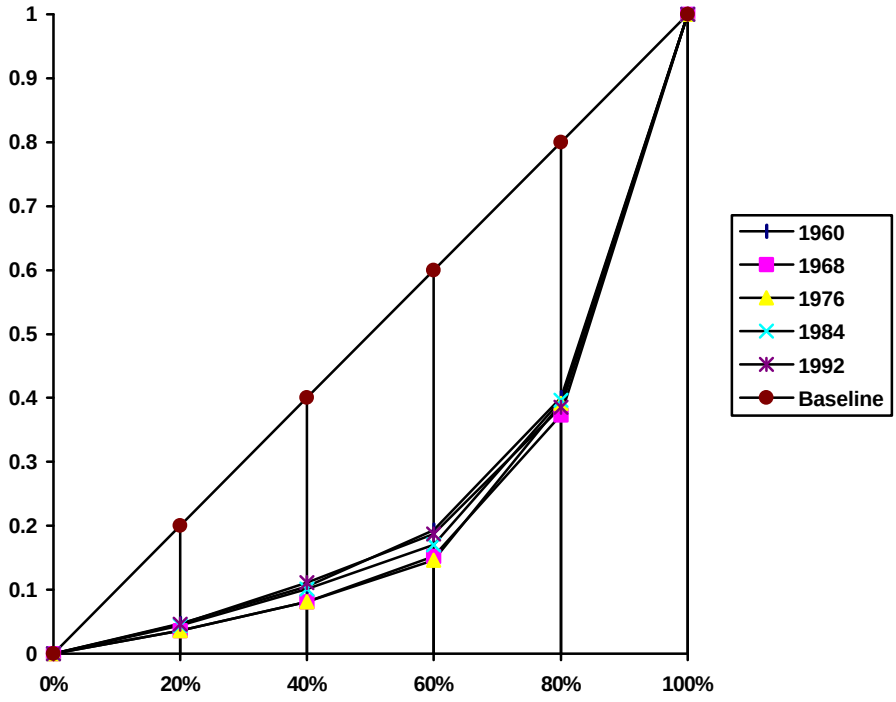

Figure 1: Lorenz Curve for q = 20%, selected years

The formula for the Gini coefficient is:

$$G = 1 + \frac{1}{n} - \frac{2}{n^2 \bar{y}}(y_n + 2y_{n-1} + \ldots\ldots + ny_1) \text{ where } y_i = \text{income of } i \text{ th person}$$

$$\text{and } y_1 \le y_2 \le \ldots\ldots \le y_n$$

We derive the values of Gini coefficients for fifths and tenths of the world population by simply replacing incomes with shares of income, and the average income with the average share of income so that

$$G = 1 + \frac{1}{n} - \frac{2}{n^2 \bar{q}}(q_n + 2q_{n-1} + \ldots\ldots + nq_1) \text{ where } q_i = \text{income of } i \text{ th group}$$

$$\text{and } q_1 \le q_2 \le \ldots\ldots \le q_n$$

Making use of this, we obtain the values of the Gini coefficient for twenty percentiles and ten percentiles of the world population for each year in our sample period.

	q = 10%	q = 20%
1960	0.5255	0.5022
1961	0.5427	0.5201
1962	0.5415	0.5190
1963	0.5470	0.5246
1964	0.5462	0.5240
1965	0.5498	0.5269
1966	0.5519	0.5287
1967	0.5573	0.5347
1968	0.5652	0.5425
1969	0.5599	0.5381
1970	0.5508	0.5297
1971	0.5506	0.5298
1972	0.5566	0.5358
1973	0.5596	0.5387
1974	0.5562	0.5359
1975	0.5474	0.5270
1976	0.5594	0.5381
1977	0.5517	0.5306
1978	0.5507	0.5286
1979	0.5516	0.5303
1980	0.5431	0.5220
1981	0.5421	0.5205
1982	0.5374	0.5170
1983	0.5351	0.5144
1984	0.5362	0.5150
1985	0.5328	0.5116
1986	0.5444	0.5209
1987	0.5363	0.5147
1988	0.5360	0.5143
1989	0.5387	0.5146
1990	0.5370	0.5145
1991	0.5341	0.5113
1992	0.5310	0.5080

Table 4: Global Gini coefficients for 1960-1992

Regardless of whether we use twenty percentiles or ten percentiles, the Gini coefficient exhibits the same pattern - a secular rise during 1960 - 68, a period of volatility during

1968 - 1976 and a secular decline for 1976 - 92. For the entire period of our study, however, the Gini coefficient does not fall and in fact, rises slightly.

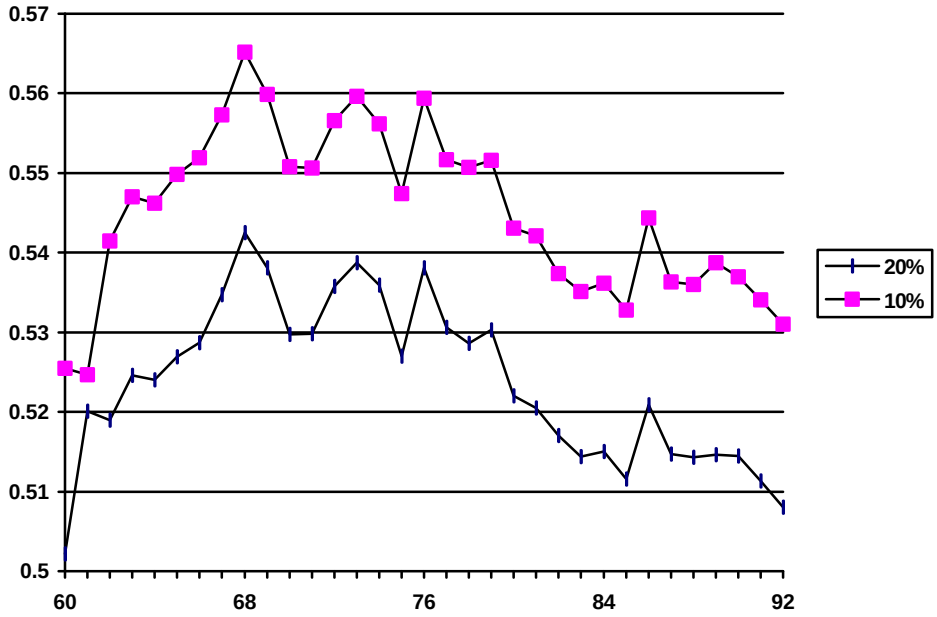

Figure 2: Trends in the Gini Coefficient, 1960 - 1992

VI. Concluding Remarks

Our examination of the convergence hypothesis yields two main findings. First, our evidence indicates that the global distribution of income did not become more equal during 1960-1992. Second, the same distribution does appear to have fallen continuously during the sub-period 1976 - 1992. Therefore, our evidence does supports the convergence hypothesis during the second half of our sample period although it fails to do so during the whole sample period. In addition, there appears to be a period of secular rise in global inequality during the sub-period 1960 - 1968 as well as a period of volatile movements in the Gini coefficient during the sub-period 1968 - 1976. It would thus be fairly accurate to say that the period under study consists of three distinct phases in terms of changes in the world distribution of income.

We may interpret the three phases as follows. In the early and mid-1960s, relatively only a few developing countries had embarked upon serious economic reforms and adjustments which allowed for significant growth, causing the gap between developing countries and developed countries to widen. The period between the late 1960s and mid-1970s marked an intermediate period during which a growing number of developing countries began to pursue sound policies and achieve solid growth but this effect was not strong enough to promote global convergence on a continuous basis. Finally, in the period between mid-1970s and early 1990s, many developing countries, particularly in East Asia but also in other parts of the world, took off in earnest and thereby gave convergence a systematic, sustained push despite the unfortunate presence of a large number of developing countries, particularly in sub-Saharan Africa, which continued to stagnate.

Given that world income inequality fell on a secular basis during 1976 - 1992, the most interesting issue for our purposes is whether this trend will persist. We expect even greater empirical support for the convergence hypothesis in the future. In this connection, the economic resurgence of China will have a most noticeable impact simply due to the sheer size of its population. The recent improvement in India's economic performance, while less dramatic than that of China, will further promote international convergence. An interesting and meaningful line of future research would be to examine trends in convergence for more recent years if and when the data become available. The rapid growth of populous Asian countries implies that the recent trend toward greater global equality will continue and persist not only for the remainder of this decade but well into the 21st century as well.

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