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This article employs a common general formula for inequality indexes to answer several basic questions about intercountry income inequality in recent decades: Has inequality across nations increased or declined (and why have earlier studies yielded mixed results)? Have different rates of population growth played a significant role in the trend? Have large nations dominated the trend? Are the results robust over different inequality measures and different income series? Two findings stand out. First, different rates of population growth in rich and poor nations played the predominant role in determining change in the distribution of per capita income across nations. Second, the centuries-old trend of rising inequality leveled off from 1960 to 1989. The dependency theory thesis of a polarizing world system receives no support.

The Industrial Revolution produced a stunning increase in the income disparity between nations. At the beginning of the 19th century, average incomes in the richest nations were perhaps four times greater than those in the poorest nations. At the end of the 20th century, average incomes in the richest nations are *30 times* larger—annual incomes of about $18,000 versus $600 (Summers, Heston, Aten, and Nuxoll 1994).

Is the income disparity between nations still increasing? The answer to that question is critical. Because of the great disparity in average income from nation to nation, it is intercountry inequality—not inequality within nations—that is the major component of total income inequality in the world today. A recent sociological study (Korzeniewicz and Moran 1997, table 2) estimates that inequality across countries accounts for *over 90%* of current world income inequality as measured by the Gini index. Other studies give lower estimates, but all agree with Berry, Bourguignon, and Morrisson (1983*b*, p. 217) that "it is clear that the level of world inequality

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is . . . primarily due to differences in average incomes across countries rather than to intra-country inequality."

Although I begin with the question of whether intercountry inequality is still rising, the analysis does not end there. My aim is to provide the foundation for a general sociological literature on intercountry income inequality by *getting the facts right* about its key dimensions: Whether increasing or declining, is the trend in intercountry inequality due to differential economic growth across nations or to differential population growth across nations? Which countries contribute most to change in intercountry inequality? Are results robust over different inequality measures and income series? Although sociological studies of these important issues are rare,[2] there is no good reason for sociologists to continue to shy away from studying intercountry inequality. Careful income estimates are available for over 100 nations, which constitutes a near-universe of the world's population (Summers et al. 1994), and convenient methods have been developed for analyzing income inequality for aggregates (Firebaugh 1998). The time is ripe for systematic sociological research on intercountry inequality.

CONVERGENCE THEORY

Convergence Theory in Economics

The convergence issue—the issue of whether national economies tend to converge or diverge over time—has been a central concern in economics over the past decade. Many economists are keenly interested in the convergence issue because recent debates over the nature of economic growth turn on it. The traditional view, based on neoclassical growth theory (Solow 1956), is that national economies will tend to converge because of the principle of diminishing returns to capital and labor. As rich industrial nations begin to experience diminishing returns, poorer nations (who are farther from the point of diminishing returns) will tend to catch up as they industrialize. DeLong (1988, p. 1138) puts it this way in the *American Economic Review:* "Economists have always expected the 'convergence'

[2] Despite the overriding importance of intercountry inequality to global inequality, sociologists have focused instead on *within*-country income inequality (Cutright 1967; Weede and Tiefenbach 1981; Bollen and Jackman 1985; Hoover 1989; Nielsen and Alderson 1997). There are three apparent reasons for this focus. First, intranational inequality is more amenable to state policy. There are no international organizations with the muscle to force significant income transfers from rich to poor nations. Second, intranational inequality can be studied with cross-sectional data, whereas the study of intercountry inequality requires longitudinal data. Third, the psychic costs of inequality likely are greater for inequality within nations, since feelings of relative deprivation presumably derive more directly from local comparisons.

of national productivity levels. The theoretical logic behind this belief is powerful. The per capita income edge of the West is based on its application of the storehouse of industrial and administrative technology of the Industrial Revolution. . . . The benefits of tapping this storehouse are great, so nations will strain every nerve to assimilate modern technology and their incomes will converge to those of industrial nations."

The new "endogenous growth theory" (Romer 1986; Lucas 1988) challenges the convergence thesis by arguing that in today's world the principle of diminishing returns can be overcome by specialized inputs made possible by research. The new theory has had a powerful impact in economics. By questioning neoclassical growth theory, endogenous growth theory has reopened the debate about convergence and prompted a new generation of growth studies in economics. Economic research on national convergence is booming. In the words of Robert Solow, one of the founders of neoclassical growth theory, there is a "wildfire revival of interest in growth theory . . . [that] shows no signs of petering out" (1994, p. 45).

One popular test for convergence is to regress economic growth rate on initial economic level for some sample of nations. A negative slope indicates convergence (poorer nations tend to grow faster) and a positive slope indicates divergence. Though many cross-national studies find evidence of *conditional* convergence—that is, the initial economic level has a negative slope when control variables are added (Barro 1991; Barro and Sala-i-Martin 1992; Mankiw, Romer, and Weil 1992)—the recent consensus in economics is that the world as a whole has exhibited no tendency toward *unconditional* convergence in recent decades (Quah 1996; Jones 1997), where "unconditional" refers to the absence of control variables.

The Polarization Thesis

Although sociologists have no formal theory of intercountry income inequality to rival convergence theory in economics, prior sociological studies of intercountry inequality have used world system and dependency perspectives to predict increasing cross-nation polarization and thus rising intercountry inequality (see Korzeniewicz and Moran [1997] for an overview). World system theory begins with the premise that there are identifiable strata in the world economic system. The polarization thesis adds the argument that there are powerful forces driving these strata apart. Although polarization theorists sometimes identify intermediate strata (e.g., the "semiperiphery"), the perspective tends to be dualistic, placing greatest emphasis on the mechanisms by which nations at the top become richer at the expense of nations at the bottom.[3]

[3] As Korzeniewicz and Moran (1997) note, the intellectual roots of current polarization theory can be found in Marxist theories of imperialism (Lenin 1939), in the Prebisch-

Even though world system theorists usually tell a divergence story, there is nothing inherent in a world system perspective that would rule out convergence stories. Dependency theory, by contrast, is incompatible with convergence stories; removing the polarization thesis from dependency theory would hollow out the theory. Dependency theory is a theory of world stratification—of why some nations are so rich and others are so poor. The dependency theory thesis—that the development of core nations and the underdevelopment of peripheral nations are complementary processes—is inherently a polarization thesis. Core nations enrich themselves *at the expense of poor nations* because core nations differentially benefit from core-periphery economic exchange. Thus in dependency theory the principle of differential benefits from exchange (Mandel 1975; Bunker 1984)—not the principle of diminishing returns—is the mainspring for trends in intercountry inequality. The principle of differential benefits from exchange implies a "growing gap between core and periphery" in the world economy as a whole (Chase-Dunn 1975, p. 720). "A picture of unequal development emerges in which the core becomes progressively more developed while peripheral development is hindered as a result of its relationship to the core" (Peacock, Hoover, and Killian 1988, p. 839). In effect, then, dependency theory argues that Marx's principle of uneven development applies to the world economy as a whole rather than to groups within individual industrial nations (Chase-Dunn 1975).

Because polarization is fundamental to the dependency argument, the trend in intercountry income inequality in recent decades provides a critical test of the relevance of dependency theory to the current era. If rich nations benefit more from international exchange, *and if this exchange is the primary source of national income differences* (as dependency theory insists), then so long as rich and poor nations continue to engage economically we can expect national incomes to continue to diverge. If intercountry income inequality is not increasing, then adverse dependence effects either do not exist or are overshadowed by other forces. Either way, dependence effects do not pack the punch assumed in dependency theory.

If intercountry income inequality *is* increasing, it is important to determine if the increase is due to the faster population growth of poorer nations in recent decades. Income is measured as income per capita. If income per capita has grown more slowly in poorer nations in recent decades, that slower growth might be due to the swelling of the young

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Singer theory of deteriorating terms of trade for primary products (Prebisch 1950; Singer 1950), and in the world system (Wallerstein 1974, 1979) and dependency (Frank 1966; Cardoso 1977) formulations of the 1960s and 1970s. Although these theories offer different reasons for expecting disparity between the strata, according to Korzeniewicz and Moran (1997, p. 1004) they "all would agree that world income inequality becomes more pronounced over time."

(nonworking) population in poor nations quite apart from any effects of international economic exchange. In analyses of trends in intercountry income inequality, then, it is important to distinguish *population-induced polarization* from *dependency-induced polarization*—a theme I return to below.

CROSS-NATIONAL EVIDENCE

Cross-national studies of convergence appear at first glance to present a mishmash of conflicting results. In this section I show that consistent findings do emerge when the studies are sorted carefully. I will also show that sociologists should not be too hasty to use the findings from economics to reach conclusions about trends in world income inequality because economists and sociologists are asking different questions.

It is useful first to place the convergence studies in historical perspective. At the outset of the Industrial Revolution average income in the richest nations was perhaps four times the average income in the poorest nations (Maddison 1995, chap. 2). Average income in the richest nations and poorest nations now differs by a factor of about 30. Over the long haul, then—from the late 18th century through much of the 20th—national incomes diverged. No one disputes that.

The more vexing question is what has happened since about 1960. Some studies conclude that there has been little or no change in intercountry inequality in recent decades (Berry et al. 1983*a;* Peacock et al. 1988; Schultz 1998) whereas other studies conclude that national incomes have continued to diverge (Jackman 1982; Sheehey 1996; Jones 1997; Korzeniewicz and Moran 1997).

There are three keys to making sense of these findings. The first key is weighting. Studies that do not weight generally find divergence, whereas studies that weight generally find very little change in intercountry inequality over recent decades. The second key is whether or not the national income data have been adjusted for "purchasing power parity" (PPP—elaborated in a subsequent section). The use of unadjusted data results in spurious divergence (Schultz 1998). The third key is China. Weighted studies that exclude China are suspect.

Studies of Unweighted Convergence

Table 1 summarizes key convergence studies from economics, sociology, and political science. In each of these studies the dependent variable is per capita income. Note that the income measure of choice is based on purchasing power parity; among recent studies only Korzeniewicz and Moran (1997) rely exclusively on income estimates that are based on the foreign exchange method.

TABLE 1

SUMMARY OF MAJOR STUDIES OF NATIONAL INCOME CONVERGENCE*

Study	Data and Method	Conclusion
Unweighted by population:		
Jackman (1982, table 1, fig. 1)	Income growth rate,† 1960–78 (N = 98); regression of rate on initial level	Divergence with inverted-U pattern
Abramovitz (1986)	1870–1979 income;‡ coefficient of variation; 16 industrial nations (from Maddison 1982)	Long-run convergence among rich nations
Baumol (1986)	Same historical data as Abramovitz (1986), but uses regression	Long-run convergence among rich nations
Barro and Sala-i-Martin (1992, table 3, fig. 4)	Income growth rate,‡ 1960–85 (N = 98); regression of rate on initial level	Divergence
Sheehey (1996, table 2)	Income growth rate,‡ 1960–88 (N = 107 non-OPEC nations)	Divergence with inverted-U pattern
Jones (1997, tables 2, 3)	1960 and 1990 income (N = 74);‡ SD of logged income	Divergence for world but rich nations converge
Weighted by population:		
Berry et al. (1983*a*)	1950–77 income (N = 124);‡ Gini, Theil, mean log deviation, Atkinson	No overall trend
Peacock, Hoover, and Killian (1988, figs. 1, 2)	1950–80 income (N = 53);‡ Theil	No overall trend, with convergence within world system strata and divergence between strata
Ram (1989):		
Table 1	1960–80 income (N = 115; excludes China);‡ Theil§	Divergence
Table 2	1960–80 inequality trend (N = 21; regression of overall Theil on mean world income, 1960–80); excludes China in the Theil§	Inverted-U pattern
Korzeniewicz and Moran (1997)	1965–90 income (N = 121);† Gini, Theil	Divergence, especially in 1980s
Schultz (1998)	1960–89 income (N = 120);‖ Gini, variance of logged income, Theil	No trend for purchasing power parity income; divergence for foreign exchange (FX) rate income

* Because the object of this study is change in intercountry inequality, the table is restricted to studies of *unconditional* convergence, a term that refers to the absence of control variables. In regression analysis, unconditional covergence is examined by regressing growth rate of income per capita on initial level of income per capita. Conditional convergence is examined by adding control variables.

† Income estimates are based on foreign exchange rates.

‡ Income estimates are based on purchasing power parity (PPP).

§ The significance of excluding China in weighted analyses is addressed in the text. I do not note the unweighted analyses (top panel) that omit China because the omission of China hardly matters in those studies.

‖ Income estimates are based both on foreign exchange rates and on purchasing power parity.

The top panel of table 1 summarizes studies that do not weight nations by size and the bottom panel summarizes studies that do. I begin with the studies in the top panel. One of the earliest reliable studies of cross-national convergence is Jackman's (1982) study of the relative income growth rates of 98 nations from 1960 to 1978. Jackman found an inverted-U pattern for the relationship between income growth rate and initial income—a pattern that was subsequently replicated in studies using different income measures and longer time periods (e.g., Summers and Heston 1991, table 4; Sheehey 1996). Despite this faster growth in the middle of the distribution, there is *overall* divergence because growth rates tend to be higher for the richest nations than for the poorest nations. Subsequent research has replicated the divergence finding as well (Barro and Sala-i-Martin 1992, table 3 and fig. 4; Sheehey 1996, table 2; Jones 1997, tables 2 and 3).

In short, when each national economy is given the same weight—the sort of convergence that interests economists because it bears on endogenous growth theory—there is an inverted-U pattern in which nations in the upper middle of the distribution tend to exhibit the fastest rates of income growth and those at the lower end of the distribution tend to exhibit the slowest rates of growth. The upshot is that national economies are diverging for the world as a whole even though there are convergence "clubs" (e.g., there is evidence of income convergence among Western European nations; see Abramovitz 1986; Baumol 1986; Jones 1997).

Studies of Weighted Convergence

Although it is *weighted* national convergence that bears most directly on sociologists' interest in world inequality (see below), evidence on weighted national convergence is relatively scarce. In sharp contrast to the large and growing literature on unweighted convergence, the empirical literature on weighted convergence across nations consists of just a handful of studies.

The early study by Berry et al. (1983*a*) remains one of the best of these studies. Based on a large sample of nations containing most of the world's population, Berry et al. conclude, first, that economic growth in China was the most potent force equalizing world incomes from 1950 to 1977 and, second, that there was no clearcut trend in intercountry income inequality from 1950 to 1977.

Remove China, then, and the data will show weighted divergence—precisely what Ram (1989) found for 1960–80 with China removed. Include China and the data will show no overall trend in intercountry income inequality in recent decades—precisely what Peacock et al. (1988) and Schultz (1998) found, replicating the main conclusion of Berry et al. (1983*a*). So the studies are quite consistent: Weighted by population, the

data show no underlying trend in intercountry income inequality over recent decades; remove China, and the data show rising inequality.[4]

Only one key finding remains to be explained: Korzeniewicz and Moran's (1997) anomalous finding of rising intercountry inequality despite their inclusion of China. Schultz (1998) provides the key to the puzzle. Schultz presents two sets of findings, one for income data based on purchasing power parity (PPP) and one for income data based on foreign exchange (FX) rates (the type of income data used by Korzeniewicz and Moran). Intercountry income inequality rises for the FX income series but not for the PPP income series.

The important lesson to be learned from Schultz's (1998) two sets of findings is that researchers should not rely on official exchange rates when studying trends in relative national incomes. Though early studies in economics used FX estimates because PPP estimates were unavailable, PPP-based income is now the industry standard (in addition to the studies listed in table 1 above, see Barro 1991; Mankiw et al. 1992; Levine and Renelt 1992; Quah 1996). The rationale for the switch to PPP income measures will be elaborated later.

To summarize: When each national economy is given the same weight, the data indicate national divergence. Yet weighted studies find stability (the weighted studies that find divergence do so because they exclude China or use dubious income data).[5] So the issue turns on weighting: Do we want to give nations or individuals equal weight?

[4] Careful readers who compare this literature summary table with a similar table in Korzeniewicz and Moran (1997, table 1) might be puzzled by several inconsistencies. The most important inconsistency involves the findings of the Peacock et al. (1988) and Ram (1989) studies. Contrary to the Korzeniewicz-Moran table, Peacock et al. (1988, figs. 1 and 2) found no overall trend, and Ram (1989, table 1) found divergence.

[5] Table 1 above summarizes key studies of *un*conditional convergence. Scattered throughout the social sciences are dozens of cross-national regression studies of economic growth that include initial income as a regressor and thus provide evidence (often unwittingly) on *conditional* convergence. Because these studies most often are focusing on an issue other than convergence, the sign of the coefficient for initial income often escapes notice. Typically that sign is negative, which provides support for conditional convergence (see, e.g., Firebaugh 1983; Barro 1991; Barro and Sala-i-Martin 1992; Mankiw et al. 1992; Levine and Renelt 1992; Sheehey 1996, table 3; for contrary evidence, see Quah [1996]). This negative *partial* effect does not imply that intercountry inequality is declining, since it is *un*conditional convergence that bears on trends in intercountry inequality. Finally, to complete the picture, Levy and Chowdhury (1994) estimate that aggregate income (*total* income, not per capita income) converged cross-nationally at the rate of about 0.6% annually from 1960 to 1985. The convergence of aggregate income does not tell us very much about intercountry inequality, however, because the growth of aggregate incomes has been largely a function of nations' population growth in recent decades. When population

Weighted versus Unweighted Convergence

Sociologists and economists are interested in intercountry convergence for different reasons. The stimulus for many economists is theoretical, to test theories of macroeconomic growth. Very often for economists, then, each nation represents one unit (one economy) and, in typical analyses, economic trends in Luxembourg count just as much as economic trends in China, even though China has nearly 3,000 times more people. By contrast, sociologists generally study intercountry income inequality because of what it can reveal about income inequality for the world as a whole (Korzeniewicz and Moran 1997), so sociologists are interested in whether there is intercountry convergence in the case where *individuals, not nations,* are given equal weight. Thus most sociologists are interested in *weighted* convergence.

To appreciate the point that it is weighted national incomes that determine the level of world income inequality, suppose we had income data for every individual in the world. Then we could calculate total world inequality using some summary measure such as the Theil index. It is important to note that we could partition this measure of total inequality into a "within-nation" and a "between-nation" component (Allison 1978): World inequality = between-nation inequality + within-nation inequality. As noted earlier, students of world inequality agree that between-nation inequality is by far the larger component.

The partitioning of world inequality into between- and within-nation inequality is analogous to the familiar ANOVA partitioning of variance as total variance = between-group variance + within-group variance:

$$\Sigma_j\Sigma_i\,(X_{ij} - \mu)^2/N = \Sigma_j n_j(\mu_j - \mu)^2/N + \Sigma_j\Sigma_i(X_{ij} - \mu_j)^2/N, \qquad (1)$$

where j indexes group, i indexes individual, and μ denotes mean. Observe that the between-group component, $\Sigma_j n_j\,(\mu_j - \mu)^2/N$, is *weighted by group size* (n_j), so group effects in ANOVA are effects based on the *equal weighting of individuals.* The partitioning of total *inequality* is governed by the same principle: the between-nation component in the inequality identity (total = between + within) is a *population-weighted* component. In studying intercountry inequality, then, sociologists should weight nations by their population size because—as Korzeniewicz and Moran (1997) note—the objective is to gain leverage on total world inequality.

Weighting is likely to matter a lot in the case of intercountry inequality because nations vary so much in population size. Large nations such as

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grows significantly faster in poorer nations than in richer ones—as in recent decades—aggregate incomes converge.

TABLE 2

THE 1960–89 TRENDS IN INTERCOUNTRY INCOME INEQUALITY: WEIGHTED VERSUS UNWEIGHTED RESULTS

YEAR	AVERAGE WORLD INCOME*		INEQUALITY (VARLOG)	
	Weighted	Unweighted	Weighted	Unweighted
1960	2,277	2,294	.91	.74
1965	2,660	2,729	1.04	.84
1970	3,118	3,266	1.08	.90
1975	3,426	3,761	1.11	.96
1980	3,835	4,303	1.07	1.02
1985	4,059	4,421	.96	1.08
1989	4,367	4,826	.96	1.18
1960–89 change (%)	+92	+110	+5	+59

SOURCE.—Summers et al. (1994).

NOTE.—Real gross domestic product per capita is given in constant U.S. dollars (variable RGDPCH in the Penn income series, ver. 5.6); $N = 120$ nations containing 92%–93% of the world population.

* Average per capita income for the 120 nations, in constant U.S. dollars. "Weighted average" indicates that the national means are weighted by population size.

China and India affect the weighted measure but have little effect on the unweighted measure, and the reverse is true for small, rich nations such as Luxembourg and Norway.

To verify the importance of weighting, table 2 presents the weighted and unweighted trends in intercountry inequality from 1960 to 1989 (I use 1989 as the endpoint because the dissolution of the Soviet Union interrupts the income series at that point). I use variance of logged income (VarLog) because it is the inequality measure most often used in economic studies. Table 2 reports the results for five-year intervals.

The difference between the weighted and unweighted results is striking. The unweighted results confirm economists' findings of divergence. But when nations are weighted by size, intercountry inequality increases monotonically until 1975 and declines thereafter; as a result, there is little net change in inequality from 1960 to 1989.

A CONVENIENT METHOD FOR STUDYING INTERCOUNTRY INEQUALITY

In this section I explain the common general formula for inequality indexes that I will use in the analysis of intercountry inequality. The common formula is a powerful tool for studying intercountry inequality because it provides a convenient way to compare the contributions of China,

of India, of the United States, and so on, to trends in intercountry inequality *as measured by each of the standard inequality indexes.*

My method is based on the insight that inequality measures are weighted functions of $X/\bar{X}$ (the ratio of X to the mean of X) calibrated to zero when the ratio is 1.0 for all units. Even though this insight is implicit in prior econometric work (see formulas in Atkinson [1970], Cowell [1977], and Shorrocks [1980]), neither economists nor sociologists have fully appreciated the leverage it provides in analyzing inequality trends. This paper illustrates one way to exploit the insight.

It is instructive to begin with the fundamentals. By definition a quantity X is equally distributed over the N units in a population when $X_i = \bar{X}$ for all $i = 1, 2, \ldots, N$. Assuming X—a nonnegative quantity—exists in the population (so it is not zero), the equivalent *ratio definition of equality* is $r_i = 1.0$ for all $i = 1, 2, \ldots, N$, where $r_i = X_i/\bar{X}$. I hereafter refer to r_i as the "income ratio," since in this study X is income.

Inequality is the absence of equality. Thus inequality occurs when r_i does not equal 1.0 for all i. The greater the average departure of the r_i from 1.0, the greater the inequality.

Inequality indexes are based on this notion of "average departure of the r_i from 1.0." Briefly put, inequality indexes reflect the average disproportionality of the units' shares of X. Unless a unit's income ratio is exactly 1.0, it has a disproportionate share of income—either a disproportionately large share ($r_i > 1$) or a disproportionately small share ($r_i < 1$). So the deviation of r_i from 1.0 reflects disproportionality for a given unit. Because average *deviation* from 1.0 is always zero (positive and negative deviations offset), one must first transform the deviations to some function of *distance* from 1.0 (e.g., one might square the deviations) before taking the average. Inequality indexes measure "disproportionality" or "unequal share" as a function of distance of income ratios (r_i) from 1.0. As we will see, inequality indexes differ because they employ different functions of distance.

Regardless of the distance function used to measure it, disproportionality is zero when all the income ratios are 1.0 (equality). For that reason an inequality index—whatever its distance function—is zero in the case of equality. Hence inequality indexes can be described concisely as *functions of income ratios that are calibrated to zero for equality.*

It is important to note that inequality indexes are *population-weighted* functions of income ratios that are calibrated to zero for equality. In the case of individuals, the units are the same size so they are weighted equally. In the more general case, however, the units differ in size so they are not weighted equally. To underscore the switch to the general case of different-size units, I replace the i subscripts with j subscripts, consistent with the convention that j indexes "group."

A general expression for inequality indexes (I) is

$$I = \Sigma_j p_j f(r_j), \tag{2}$$

where $r_j = X_j/\overline{X}$, the income ratio for the jth unit; $p_j = n_j/N$, the population share of the jth unit; f = the functional form used to measure disproportionality; and, $\Sigma_j f(r_j) = 0$ when $r_j = 1$ for all j (see app. A).

Equation (2) is a key finding. Observe that the population shares (the p_j) and the income ratios (the r_j) do not depend on the inequality index used. It follows from equation (2) that *inequality indexes differ only because they employ different functions of the income ratios.* Those functions are as follows for four popular indexes (V^2, Theil, VarLog, and Gini, respectively):

$$\begin{aligned} v_j &= f(r_j) = (r_j - 1)^2, \\ t_j &= f(r_j) = r_j \log(r_j), \\ l_j &= f(r_j) = \{\log(r_j) - E[\log(r_j)]\}^2, \\ g_j &= f(r_j) = r_j(q_j - Q_j), \end{aligned} \tag{3}$$

where E is expected value, log is the natural logarithm, q_j is proportion of total population in units poorer than unit j, and Q_j is proportion of total population in units richer than unit j (so $p_j + q_j + Q_j = 1$).

In short, the Gini index, the Theil index, the squared coefficient of variation (V^2), the variance of the logarithm, and other popular inequality indexes can be reduced to a simple common expression (eq. [2]). The expression of inequality indexes in this common form provides parallel calculations so results for the various indexes can be readily compared.

TREND IN INTERCOUNTRY INCOME INEQUALITY

The Korzeniewicz-Moran (1997) study provides a convenient point of departure for studying the trend in intercountry income inequality. As noted earlier, Korzeniewicz and Moran conclude that intercountry income inequality is rising. Because that conclusion fits nicely with a large body of sociological literature on world polarization, the study is likely to attract a good deal of attention among sociologists. Moreover, the finding seems plausible, given the growth spurt in world income in recent decades (Easterlin 1998): careful estimates (Summers et al. 1994) indicate that the world's per capita income, stated in constant U.S. dollars, almost doubled from 1960 to 1989 (from $2,277 in 1960 to $4,367 in 1989), and an increase of this magnitude certainly has enormous potential for destabilizing the distribution of income across nations. Have Korzeniewicz and

Moran uncovered an important trend that other weighted studies have missed?

The answer is no. The Korzeniewicz-Moran findings are based on the FX rate method, which is an unreliable method for comparing national incomes (e.g., Summers and Heston 1991; Horioka 1994). It is well documented that the use of official exchange rates exaggerates intercountry inequality (Ram 1979) and produces spurious divergence in intercountry inequality (Summers and Heston 1991, table 4; Schultz 1998). When industry-standard income data are substituted for the data used by Korzeniewicz and Moran, the rise in intercountry inequality disappears. What Korzeniewicz and Martin have demonstrated is not world polarization but the "dangers of using market exchange rates when making international comparisons" (Horioka 1994, p. 298).

To demonstrate these points, it is necessary first to summarize central issues regarding the comparison of income across nations.

Income Data

International comparisons of economic activity traditionally were obtained by using the FX rate to convert each country's national account data to a common currency, usually the U.S. dollar. But FX rates are highly flawed calibrators of currencies for two reasons. First, many goods and services are not traded on the international market, so exchange rates are based on a restricted bundle of goods and services (Grosh and Nafziger 1986, p. 351). Because this failure to capture economic activity is especially acute for nonmonetized exchange in nonindustrial nations, FX measures of national income tend to miss significant economic activity in poorer nations. Second, FX markets are not totally "free" but are routinely distorted by government policy and speculative capital movement. As a result, exchange rates fail to reflect accurately the actual purchasing power parities (PPPs) of currencies.

To alleviate the deficiencies of FX-based income measures, several economists at the University of Pennsylvania spearheaded an ambitious effort to estimate national incomes using PPP to calibrate local currencies. Cross-nation parity for goods and services was determined through detailed studies of national price structures. As a result of those efforts, there is now an income series—the Penn series (Summers, Kravis, and Heston 1980; Kravis, Heston, and Summers 1982; Summers and Heston 1991; Summers et al. 1994)—that does not rely on FX rate. Even critics of the PPP measure concede that it represents a big improvement over the old FX measure (Dowrick and Quiggin 1997).

To appreciate the severity of the problem with using foreign exchange

rates to compare national incomes, consider the FX income estimates for China and Japan. The remarkable economic growth of China since 1978 (Nee 1991, fig. 1; Chow 1994; Mastel 1997) is reflected in the PPP income series, where China's income ratio jumps roughly 40% between 1975 and 1989. Incredibly, though, the FX-based World Bank income series used by Korzeniewicz and Moran fails to capture that growth; instead it indicates that China's growth rate lagged so far behind the rest of the world that the FX income ratio for China declined by a whopping one-third from 1970 to 1989 (from .139 to .090).

The FX estimates for Japan are just as misleading. Though Japan experienced brisk economic growth through the 1970s and 1980s (Tachi 1993; Argy and Stein 1997), per capita income in Japan at the end of the 1980s still fell well short of incomes in the richest nations in the West (Horioka 1994). Yet FX-based income estimates place Japan's 1989 per capita income *above* per capita incomes in many rich Western nations (12% higher than Sweden and 16% higher than the United States; see World Bank 1993).

How do FX income estimates become so distorted? The Japanese case is illustrative. The use of foreign exchange rates to compare incomes leads one to conclude that Japanese per capita income as a percentage of U.S. per capita income rose from 67% in 1985 to 121% in 1988 (Horioka 1994, table 1). Obviously an increase of this magnitude in just three years would have been nothing short of miraculous. In fact this stupendous increase is "nothing more than a statistical illusion" (Horioka 1994, p. 297) caused by the too-rapid appreciation of the yen from 238 yen to the dollar in 1985 to 128 yen to the dollar in 1988. As Horioka (1994, table 1) demonstrates, more realistic measurement indicates that the Japan/U.S. income ratio rose only marginally over those three years, from 0.74 in 1985 to 0.76 in 1988.

In addition to the evidence that official exchange rates yield implausible income estimates for specific nations such as Japan and China, there are critical theoretical reasons for using PPP-based estimates when comparing incomes across nations (Summers and Heston 1980, 1991; Grosh and Nafziger 1986). Though Korzeniewicz and Moran (1997, p. 1011) state that the FX rate method "provides a better relational indicator of *command over income*" (emphasis in original), to the extent that exchange rates bear on command over income, they do so *in the world marketplace*—a largely hypothetical concept in the workaday world of the vast majority of the world's population. For the vast majority of the world's population, foreign-exchange-rate income is largely moot, since most of what is produced is not traded internationally. People face local prices, not international prices. This is not to deny that foreign-exchange-rate price can

TABLE 3

RESULTS FOR PPP-BASED VERSUS FX-BASED INCOME ESTIMATES

	PPP		FX			
			Theil		Gini	
YEAR	Theil	Gini	Nominal	Adjusted	Nominal	Adjusted
1965	.552	.560	.816	.762	.661	.643
1970	.548	.558	.826	.771	.666	.647
1975	.540	.555	.847	.775	.674	.650
1980	.531	.550	.878	.782	.681	.650
1985	.512	.539	.963	.835	.706	.663
1989	.526	.543	1.079	.900	.733	.683
1965–89 change (%)	−4.7	−3.0	+32.2	+18.1	+10.9	+6.2

SOURCE.—Summers et al. (1994) for the PPP income data and World Bank (1993) for the FX income data.

NOTE.—There are 120 nations in the PPP data set and 112 nations in the FX data set. The data sets contain both capitalist and socialist nations and all populous nations and cover over 90% of the world's population. Theil and Gini results are reported to allow comparison with results offered by Korzeniewicz and Moran (1997). Results for V^2 and VarLog lead to the same conclusions. Under FX, "nominal" uses exchange-rate income estimates as given and "adjusted" uses more realistic estimates of income trends in China and Japan (see text).

affect local price, but it is to say that an ox does not become half-an-ox when a nation decides to devalue its currency by half relative to the U.S. dollar.[6]

Trends for FX versus PPP Income Estimates

Table 3 reports the 1965–89 trend in intercountry inequality based on both PPP and FX income. I try to replicate the Korzeniewicz and Moran (1997) study as closely as possible. First, I rely on the same source for FX

[6] Foreign-exchange-rate income pertains to the level of goods and services that an individual in a given nation could purchase *in international trade*. Purchasing power parity measures, by contrast, are designed to measure level of experienced income. By "level of experienced income" I refer to the level of goods and services that an individual in a given nation can purchase, faced with the price structure of that nation. Consider farmers, who constitute a substantial fraction of the population in most poor nations. Suppose a farmer has an ox. Because the ox has value—e.g., it can be used to pull a plow—it can be sold locally. The price that it would command is its local price. The ox also has a foreign-exchange-rate price, i.e., the price it could command *if* it were sold internationally. The local price is the relevant price to the farmer. As Summers and Heston (1991, p. 360) put it, "After all, residents of a country face their own prices, not international prices." The worth of an ox to a farmer is not halved when a nation decides to devalue its currency by half relative to the U.S. dollar.

income estimates—the World Bank (1993)—and I use the same population data. Second, I use 1965 as the starting point.[7] Third, I use the inequality indexes they used, the Theil and the Gini (results for V^2 and VarLog are similar). Finally, to ensure that results do not vary because of sampling differences, both "samples" here represent a near-universe of the world's people.[8]

The results vividly demonstrate the difference in the two income series. According to the PPP-based income estimates, intercountry inequality declined modestly from 1965 to 1989. Yet according to the FX-based estimates, intercountry income inequality shot up 32.2% based on the Theil and 10.9% based on the Gini. Korzeniewicz and Moran (1997, table 3) report similar results (increases of 38.2% based on the Theil and 12.5% based on the Gini). These results reinforce the warning of, among others, Summers and Heston (1991, p. 355) that "it really makes a difference if exchange rates are used rather than PPPs" so "the practice of using exchange rates as quick, easily obtained estimates of PPPs is invalidated" (p. 335).

To see if the misleading FX income estimates for China and Japan matter much, I estimated a second, adjusted set of FX-based trends in intercountry income inequality (table 3, cols. 4, 6). These results are based on the same FX income data as before, except that I use better income

[7] Again, I use 1989 as the endpoint because the dissolution of the Soviet Union interrupts the income series at that point. I did not attempt to extend the series past 1989 by using a weighted average of the republics' income estimates to reaggregate the Soviet Union because reliable income estimates are difficult to obtain for some of the former Soviet republics.

[8] There are 120 nations in the PPP data set and 112 nations in the FX data set. The data sets contain both capitalist and socialist nations and all populous nations. Both data sets cover over 90% of the world's people. The 120 nations are Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde Island, Central African Republic, Chad, Comoros, Congo, Egypt, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Ivory Coast, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Reunion, Rwanda, Senegal, Seychelles, Somalia, South Africa, Swaziland, Togo, Tunisia, Uganda, Zaire, Zambia, Zimbabwe, Barbados, Canada, Costa Rica, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Puerto Rico, Trinidad and Tobago, United States, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela, Bangladesh, China, Hong Kong, India, Indonesia, Iran, Israel, Japan, Jordan, South Korea (Republic of Korea), Mongolia, Myanmar, Pakistan, Philippines, Saudi Arabia, Singapore, Sri Lanka, Syria, Taiwan, Austria, Belgium, Cyprus, Czechoslovakia, Denmark, Finland, France, West Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Romania, Spain, Sweden, Switzerland, Turkey, United Kingdom, Soviet Union, Yugoslavia, Australia, Fiji, New Zealand, Papua New Guinea, and Tonga.

TABLE 4

TRENDS BASED ON FOUR INEQUALITY INDEXES

Year	Average World Income*	V^2	VarLog	Theil	Gini
1960	2,277	1.36	.91	.517	.540
1965	2,660	1.42	1.04	.552	.560
1970	3,118	1.36	1.08	.548	.558
1975	3,426	1.30	1.11	.540	.555
1980	3,835	1.29	1.07	.531	.550
1985	4,059	1.28	.96	.512	.539
1989	4,367	1.34	.96	.526	.543

SOURCE.—Summers et al. (1994).
NOTE.—N = 120 nations. V^2 is the coefficient of variation, squared.
* Mean per capita income for the 120 nations in constant U.S. dollars.

ratio estimates for China and Japan. Using more defensible income ratios (based on PPP) for *just those two nations* reduces the observed increase in the Theil and the Gini by over 40%.

In short, Korzeniewicz and Moran found divergence because they used a dubious income measure. Lest there be any doubt that the FX data yield a specious increase in intercountry inequality, it should be noted that a recent technical analysis of the PPP data used here (Dowrick and Quiggen 1997) concludes that the PPP data are, if anything, biased *in favor of polarization.* If so, then my failure to replicate the Korzeniewicz-Moran polarization result using PPP income cannot be dismissed on the ground that the use of PPP income as the yardstick stacks the deck against the polarization thesis.

If the FX income estimates tell the wrong story about recent trends in intercountry inequality, what is the right story? I now use PPP income estimates to answer that question.

Trends in Four Inequality Indexes

Table 4 reports 1960–89 trends in intercountry inequality based on PPP income for 120 nations. For all four inequality indexes, intercountry income inequality was about the same in 1989 as it was in 1960: it fell slightly according to V^2 and rose slightly according to the other three indexes. If we start at 1965 instead of 1960, all four indexes declined somewhat. Nevertheless, the big story here is not change, but lack of it. The distribution of income across nations remained remarkably stable over a period of substantial income growth in the world.

In terms of the pattern of change in inequality, three of the four indexes—V^2, Theil, and Gini—give parallel results: Inequality peaked in the mid-1960s, declined monotonically from 1965 to 1985, and increased somewhat from 1985 to 1989. The variance of the logs, by contrast, indicates that inequality peaked in 1975. These patterns appear to be robust, since Schultz (1998, table 1) reports similar patterns for VarLog, Theil, and Gini based on an earlier version of the Penn income series (he does not report results for V^2).

The variance of the logs gives different results because it is the most sensitive of the four indexes to change at the lower end of the income distribution. By logging income, VarLog compresses higher incomes more than lower incomes; so a $100 increase has a greater effect among poor nations than it does among rich nations. The Theil index and VarLog both use logged values for income, but the Theil index mutes the effect of logging by weighting $\log(r_j)$ by r_j. Of the four indexes, then, VarLog is the most influenced by income change at the lower end of the income distribution. It is interesting that, when we weight the inequality index to place more emphasis on income trends for the poorer nations (as in VarLog and the Atkinson index given below), we find that intercountry income inequality has declined since 1975.

ACCOUNTING FOR THE STABILITY IN INTERCOUNTRY INCOME INEQUALITY

Why did intercountry inequality remain stable in the face of the near-doubling of the world average income? The common expression for inequality indexes (eq. [2]) is a good place to begin in addressing this question. By expressing inequality indexes in their common form as functions of income ratios and population shares, it is then straightforward to (*i*) decompose the change in each index in a standardized way to determine the contributions of changing income ratios (economic convergence or divergence) versus changing population shares for the nations; and (*ii*) quantify the contribution of *each nation* to the overall change in inequality.

Changing Income Ratios versus Changing Population Shares

By decomposing the trend in the inequality indexes we solve the mystery of why unweighted studies find economic divergence whereas weighted studies find no increase in intercountry inequality. Unweighted convergence studies capture the effect of changing income ratios but miss the effect of changing population shares. Weighted studies capture both. The decomposition reveals that the income ratios are in fact diverging, ex-

plaining why economists typically find divergence in their unweighted studies; yet change in population shares across countries offsets that divergence, so *weighted* intercountry income inequality does not increase.

Appendix B, table B1 reports the decomposition results. All four indexes confirm that differential economic growth boosted intercountry inequality whereas differential population growth reduced intercountry inequality. In other words the inequality-enhancing effect of diverging income ratios was blunted by the slower population growth of the richer nations.

So we have an answer to the stability question: intercountry income inequality was stable because the divergence in the income ratios (indicating faster per capita income growth, on average, in richer nations than in poorer ones) was offset by the slower population growth of richer nations. To conceptualize this phenomenon, consider national populations distributed along an X-axis of income ratios. The percentage of the world's population living in nations at the upper tail of the distribution (such as the United States) was smaller in 1989 than in 1960, and this narrowing of the upper tail offset the inequality-enhancing effect of the stretching of the X-axis as income ratios diverged (see fig. 1).

What If Population Growth Rate Had Not Varied across Nations?

Suppose population growth rate had been the same for all nations from 1960 to 1989. Under that circumstance, what would the trend in intercountry inequality have been? The answer appears to be simple: constant population growth rates across nations imply constant population shares, so $\Delta p_j = 0$ and the second and third terms in the decomposition $(\sum_j \Delta\, p_j f[r_{j1}] + \sum_j \Delta p_j \Delta f\,[r_j]$, the "changing population shares" and "joint

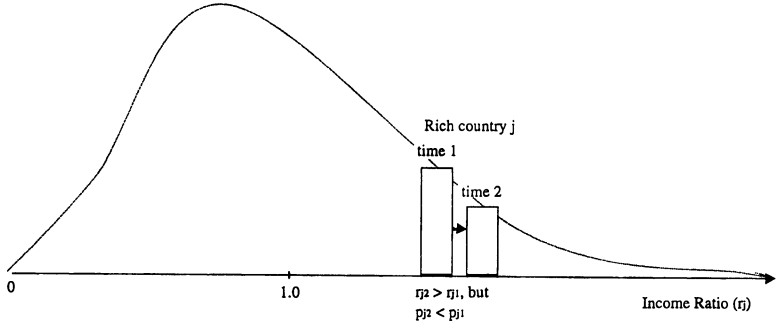

FIG. 1.—How divergence of income ratios ("stretching" of the X-axis) is offset by population shares for rich nations.

effect" components in table B1) go to zero. Because only the "changing income ratios" component remains, and that component is positive in table B1, the decomposition results suggest at first glance that intercountry income inequality would have increased if population growth rate had not varied across nations.

Upon reflection, though, it is not clear that the income ratios would have diverged if population had in fact grown at the same rate in rich and poor nations, since the divergence of the income ratios itself (app. B, table B1) could have been due to the faster population growth of the poorer nations. The key here is to remember that the income ratios are based on per capita income. Income per capita tends to grow more slowly in fast-growing populations because of the effect of rapid population growth on the ratio of dependents to workers. For this reason alone income ratios could diverge when (as here) poorer nations have faster rates of population growth.

In short, income ratios could diverge across nations simply because of the swelling of the young nonworking population in poor nations, quite apart from any endogenous growth or dependence effects. To distinguish population-induced polarization from other types of polarization, I removed the dependents from the denominator, that is, I examined the trend for income *per worker.* If the income ratios in table B1 are diverging only because of the faster growth of the dependent population in poorer nations, then the income ratios should no longer diverge when dependents are removed from the analysis—which is precisely what happens when dependents are removed from the denominator. If we decompose the income *per worker* trend in the Theil, for example, we find that the *income ratios* converged slightly (−.028) from 1960 to 1989; compare this result with the result for income *per capita,* where the income ratios *diverged* (+.136 for the Theil; see table B1). The other indexes give similar results. These findings support Sheehey's (1996) conclusion that the faster population growth of poorer nations accounts for the divergence in national income ratios found in the unweighted convergence studies in economics.

Hence *all the important dimensions of the 1960–89 trend in intercountry income inequality are related to differences in the population growth rates of richer and poorer nations.* First, the effect of changing population shares offsets the inequality-enhancing effect of changing income ratios. Second, the inequality-enhancing effect of changing income ratios is *itself* the apparent product of population processes: the income ratios did in fact diverge, yet this stretching of the X-axis represents spurious *economic* divergence in the sense that the stretching is rooted in population processes (faster growth of the nonworking population in poorer nations) rather than in economic processes. With regard to the recent trend in inter-

country income inequality, then, the headline story is the ascendant effect of national differences in population growth rates.

Offsetting Effects of Influential Nations

This study, up to this point, makes several contributions. First, it shows how research on intercountry income inequality (the dominant component of total world income inequality) can go astray either by confusing weighted and unweighted convergence or by using dubious income estimates based on foreign exchange rates. Second, the study describes a common formula for inequality indexes that demystifies the indexes and facilitates the study of inequality. Third, the study shows that the trend in *weighted* intercountry inequality was basically flat from 1960 to 1989 because divergence in the income ratios was offset by a decline in the population share of richer nations. Fourth, the study shows that the faster population growth of poorer nations also accounts for the divergence in national income ratios found (*a*) in studies of the *unweighted* inequality trend and (*b*) in the income ratios component of the weighted inequality trend. This section of the article adds to knowledge about the trend by identifying the nations that matter most for the weighted trend and by describing the effect those nations have on that trend.

Equation (2) tells us that a nation's contribution to inequality depends on the nation's income ratio and population share. It follows that a nation's contribution to *change* in intercountry inequality is determined by *change* in the nation's income ratio and population share. Intercountry inequality is reduced when a nation's income ratio moves toward 1.0 and increased when a nation's income ratio moves away from 1.0.

Based on changes in income ratios and population shares we expect Japan, India, the United States, and China to play major roles in the movement of intercountry inequality from 1960 to 1989. Japan's income ratio skyrocketed over this period, from 1.3 in 1960 to 3.1 in 1989. Because the ratio moved away from 1.0, Japan will boost intercountry inequality over the period. India will also boost inequality over this period because of faster-than-world-average population growth (India's share of the world population increased from roughly 14% to roughly 16%) and slower-than-world-average economic growth (which moved India's income ratio further below 1.0). India's faster-than-average population growth boosts inequality because India lies in the left-hand tail of the income distribution.

The income ratios for China and the United States, by contrast, moved *toward* 1.0—in China because of faster-than-world-average economic growth and in the United States because of slower-than-world-average growth. The income ratio for China changed from 0.25 to 0.31. Though

TABLE 5

LEADING CONTRIBUTORS TO CHANGE IN INTERCOUNTRY INCOME INEQUALITY, 1960–89

Nation	Δr_j	Δp_j	V^2	VarLog	Theil*	Gini*
Increased inequality the most:						
Japan	+1.84	−.008	.125	.053	.068	.043
Soviet Union	+.72	−.016	.058	.050	.043	.036
India	−.06	+.019	. . .†	.040	.026	.057
Italy	+.80	−.006	.029	. . .	. . .	. . .
Reduced inequality the most:						
United States	−.21	−.012	−.189	−.054	−.071	−.040
China	+.06	−.003	−.018	−.087	−.055	−.082
Indonesia	+.14	+.003	. . .	. . .	−.015	−.014
United Kingdom	+.03	−.007	−.016	−.016	. . .	. . .

SOURCE.—Summers et al. (1994).
NOTE.—N = 120 nations.
* Centered using $r_j - 1$ (see app. C).
† Not in top three for this inequality index.

this increase might appear to be relatively modest, it is likely to have a major impact on global inequality because of the sheer size of China's population. In the United States, economic growth and population growth over the period both lagged behind world averages. The result is a declining income ratio and a declining population share for the United States, thus reducing intercountry inequality.

Results.—The insight that inequality indexes can be expressed as functions of income ratios and population shares (eq. [2]) provides the necessary analytic leverage for quantifying the contributions of each nation to change in intercountry inequality (see app. C for technical details). In table 5 I report the results for change in intercountry inequality, 1960–89, for each of the four indexes. To save space I report the most influential countries only (the nations that most increased, and those that most reduced, 1960–89 intercountry inequality).

The four indexes tell the same story though they differ somewhat on the details. Based on the Gini index, India boosted inequality the most, followed by Japan and the Soviet Union, and China reduced inequality the most, followed by the United States and Indonesia. The Theil index identifies the same six nations but ranks them somewhat differently. Based on VarLog, Japan and the Soviet Union boosted inequality the most, and China and the United States reduced inequality the most. Two nations—Japan and the United States—are identified by V^2 as dominating the trend, with Japan boosting intercountry inequality and the United States reducing it.

So we now have another answer to the question of why intercountry

inequality remained so stable during a period of substantial income growth: the effects of the big nations offset. The inequality-enhancing effect of brisk economic growth in Japan and sluggish growth in India was blunted by the inequality-reducing effect of rapid economic growth in China and slower-than-world-average growth in the United States over this period.

OVERWEIGHTING POORER NATIONS

As this article makes plain, inequality indexes are averages (average disproportionalities). Because an inequality index is an average, the trend in an inequality index might miss offsetting changes in an income distribution. That point is pertinent here because some studies of intercountry inequality (e.g., Peacock et al. 1988) note an offsetting pattern of convergence and divergence. If there is convergence at some regions of the income distribution and divergence at other regions, then one's conclusion about overall inequality might be sensitive to the weight given to the different regions of the income distribution.

In this section I show what happens to the 1960–89 trend when poorer nations are given more weight in calculating inequality. The decision to give more weight to poorer nations follows from the welfare principle that income increases at lower ends of the income distribution produce greater welfare benefits than do income increases at the upper end of the income distribution. Atkinson (1970) demonstrates that the following index is consistent with the welfare principle:

$$A = 1 - (\Sigma_j p_j r_j^{1-\epsilon})^{1/(1-\epsilon)}, \qquad \epsilon > 0, \tag{4}$$

where (as before) p_j is the population share and r_j is the income ratio.

The Atkinson index (A) does not refer to a single index of inequality but rather to a family of measures that depend on the parameter ϵ. The parameter ϵ determines the relative sensitivity of A to transfers at different points in the income distribution: the larger the ϵ, the greater the weight given the lower end of the income distribution.

To appreciate the effect of the reweighting, consider two nations of equal population, one rich and one poor, with income per capita differing by a factor of 10 for the two nations. Suppose we want to increase the per capita income of the poor nation P by \$1 at the expense of the rich nation R. By varying ϵ we specify how much we are willing to reduce income per capita in R in order to add \$1 to the per capita income of P: From equation (4) it follows that we are willing to sacrifice up to 10^{ϵ} income per capita in R in order to add \$1 to the per capita income of P (Cowell 1977, p. 45). For example, $\epsilon = 0$ implies a willingness to take \$1 from R to enrich P by \$1; in other words, we are "inequality averse," so

TABLE 6

TRENDS BASED ON ATKINSON MEASURES

YEAR	RELATIVE WEIGHTING OF LOWER END OF DISTRIBUTION				
	$\epsilon = 0.1$	$\epsilon = 0.6$	$\epsilon = 1.1$	$\epsilon = 1.5$	$\epsilon = 2.5$
1960	.051	.274	.430	.512	.618
1965	.055	.296	.466	.552	.658
1970	.054	.299	.472	.560	.666
1975	.054	.299	.476	.566	.673
1980	.053	.292	.465	.554	.662
1985	.051	.277	.439	.524	.635
1989	.052	.282	.444	.528	.639
1960–89 change (%)	+2.0	+2.9	+3.3	+3.1	+3.4

SOURCE.—Summers et al. (1994).

NOTE.—$N = 120$ nations. The larger the ϵ, the greater the weight given the lower end of the income distribution. Larger values of ϵ reflect greater aversion to inequality (see text).

we believe that total welfare is increased when income is transferred from a richer to a poorer unit. Values of $\epsilon > 0$ imply a willingness to accept a net income loss in order to reduce inequality: $\epsilon = 0.5$ implies a willingness to reduce R's income by \$3.16 to increase P's by \$1 (a net income loss of \$2.16); $\epsilon = 1.0$ implies a willingness to accept a loss of \$9 (\$10 from R, \$1 to P); $\epsilon = 2.0$ implies the willingness to accept a loss of \$99 to transfer \$1 to P; and so on.

I report results for ϵ for 0.1, 0.6, 1.1, 1.5, and 2.5 (table 6). Schwartz and Winship (1979, p. 31) cite studies suggesting that ϵ should be between 0.5 and 0.75, but I report a broader range to demonstrate the robustness of the results for intercountry income inequality. It should be noted that $\epsilon = 2.5$ is an extreme reweighting in favor of the lower end of the distribution, since $\epsilon = 2.5$ implies the willingness to accept a net income loss of \$315 to enrich the poorer nation by \$1 in the example above where the two nations differ by a factor of 10.

Reweighting in favor of poorer nations does not affect our conclusions. All five values of ϵ repeat the story of little change in intercountry income inequality from 1960 to 1989. Inequality in 1989 is slightly higher than it was in 1960 but lower than it was in 1965. For the five ϵ-values, intercountry inequality peaked in 1975 (except $\epsilon = .1$, where 1965 is the peak), declined from 1975 to 1985, then increased somewhat from 1985 to 1989. This pattern of increase from 1960 to 1975 and decline thereafter (except 1985–89) most closely resembles the pattern exhibited by VarLog. This similarity is not surprising because, of the four popular indexes, VarLog gives the most weight to poorer nations.

DISCUSSION AND IMPLICATIONS

This study employs a powerful tool—a common general formula for inequality indexes—to get the basic facts right about intercountry inequality over the 1960s, 1970s, and 1980s. This effort to get the facts right yields two big stories. One big story—not found in the usual world system or endogenous growth theory accounts of intercountry inequality—is the overriding importance of differential rates of population growth on intercountry inequality. A second big story is that the centuries-old trend of increasing intercountry income inequality has stalled at least since 1960.

The Centrality of Population Change

Population grew more rapidly in poor nations than in rich nations from 1960 to 1989. Intuition suggests that this difference is likely to affect change in the distribution of per capita income across nations because, after all, change in *per capita* income is a function of changing income *and* changing population.

The findings confirm intuition in this instance. Differences in nations' rates of population growth played a central role both in producing divergence in income ratios across nations and in muting the effect of that divergence. First, with regard to the muting effect of population growth, the slower population growth rate of the rich nations reduced weighted intercountry inequality by narrowing the right-hand tail of the income distribution. This narrowing of the right-hand tail offset the inequality-enhancing effect of divergence in the income ratios. The net result was the plateau in weighted intercountry income inequality over the 1960s, 1970s, and 1980s.

Second, the divergence of the income ratios was *itself* the result of population processes. Classical economists such as Malthus ([1798] 1960), John Stuart Mill ([1848] 1923), Ricardo ([1817] 1962), and Smith (1776) viewed economic growth as a "race between increases in the population and capital stock" (Dorfman 1991, p. 577). If economic growth is a race between increases in population and capital stock, then at this point in history poor nations—with their more rapid rates of population growth—are inherently disadvantaged. It is well documented, for example, that the rapid population growth in poor nations has resulted in a high ratio of dependents, and by definition dependents add directly to the denominator but not the numerator of income per capita.[9]

[9] Malthus's famous prediction is that population growth will outrun economic growth, so the rapid population growth of poor nations should produce *negative* growth rates for per capita income. The argument here is less extreme—I assume only that nations with fast-growing population tend to experience *slower* growth rates for per capita income (slower growth rates can be positive, of course). If population growth is faster

The *per worker* results support this line of reasoning. The income ratios diverge when income per capita is used but not when income per worker is used. This finding is consistent with Sheehey's (1996) claim that the effect of population growth through age structure accounts for the income divergence economists usually find in their unweighted studies (see Crenshaw, Ameen, and Christenson [1997] for further supporting evidence). In other words, per capita income ratios *are* diverging, but the divergence is *population induced.* Upon close inspection, then, neither the unweighted studies of economists nor the weighted studies of sociologists support theories of continuing economic divergence in today's world. The weighted studies do not because they find no net divergence. The unweighted studies do not because the divergence they find apparently arises from the age-structure effect of the more rapid population growth of poorer nations rather than from either dependence effects or endogenous growth effects.

The Intercountry Income Inequality Plateau of 1960–89

It is well documented that, since about the mid-1970s, income inequality *within* the United States has risen after a long period of decline (Fischer et al. 1996; Nielsen and Alderson 1997).[10] This phenomenon has been dubbed "the great U-turn" (Harrison and Bluestone 1988). Less appreciated is the pause in the long-run trend of rising intercountry inequality. This pause spans at least the 1960s, 1970s, and 1980s.

The discovery of a "great plateau" in the historical trend has important implications for our understanding of trends in world income inequality. One implication is that if income inequality across individuals has been increasing sharply for the world as a whole, as Korzeniewicz and Moran (1997) conclude, then the increase must be due to increases *within* nations. To cause the sort of increase in total world inequality that Korzeniewicz and Moran describe, the within-nation increase would need to be of colossal proportions because most of the total world income inequality is between, not within, nations.

A second implication of the plateau is that intercountry income inequal-

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in poorer nations (as it is) *and* if rapid population growth slows per capita income growth (as it apparently does), then differential population growth contributes to the divergence of national income ratios.

[10] "Intercountry income inequality" in this section refers to weighted data. The great plateau observation nonetheless also applies to the unweighted data: again, the divergence in income ratios observed in the unweighted data is "spurious" (in the sense that the divergence appears not to be based on economic processes) so, when income *per worker* is used to remove the age structure effect, the unweighted data also plateau.

ity does not inevitably rise (or fall) with rising world income. Intercountry inequality was about the same in 1989 as it was 30 years earlier, and an important challenge for future studies is to determine why intercountry inequality remained so stable in a period when the world's average income shot up so rapidly. During a period of such great potential for destabilizing the distribution of income across nations, why did the variance neither increase nor decline? This study provides one part of the answer: offsetting trends in the most populous nations. The inequality-enhancing effects of rapid economic growth in Japan and sluggish economic growth in India were blunted by the inequality-reducing effects of rapid economic growth in China and slower-than-world-average population and economic growth in the United States over this period.

Finally, the discovery of the great plateau in weighted intercountry income inequality adds to the clamor for new sociological theories of national development (Gereffi 1989; Firebaugh 1992; Firebaugh and Beck 1994). Stable variance in the distribution of logged income across nations in a period of active core-periphery exchange calls into question fundamental assumptions sociologists have made about the impact of international exchange on national development. If the benefits of core-periphery movement of goods and capital in fact accrue primarily to rich nations and if this differential benefit is in fact the principal cause of intercountry income divergence (as dependency theory appears to claim), then it is hard to explain why the long-standing trend toward intercountry divergence was interrupted during an era of active core-periphery exchange.

APPENDIX A

A Common Formula for Inequality Indexes

Probably the most popular measures of inequality are the Gini index (G), Theil's index (T), the coefficient of variation (V), and (in economics especially) the variance of the logarithms (VarLog). In this section I express these indexes as functions of r_i. These expressions verify that the indexes are all functions of the average distance of the r_i from 1.0 and that they differ only because they employ different functions of "average distance."

I use V, which is the standard deviation divided by the mean, to illustrate how these expressions are derived:

$$\begin{aligned} V &= \sigma/\mu, \\ \rightarrow V^2 &= \sigma^2/\mu^2 \\ &= (1/N)\textstyle\sum_i (X_i - \mu)^2/\mu^2 \qquad (i = 1, 2, \ldots, N) \\ &= (1/N)\textstyle\sum_i (r_i - 1)^2, \end{aligned} \tag{A1}$$

where Σ denotes summation and μ is the mean of X. From equation (A1) it is obvious that V^2 is the average of the squared deviation of the income ratios (the r_i) from 1.0.

By similar algebraic manipulation it is possible also to express the other inequality indexes as functions of the r_i. The functions are

$$T = (1/N)\Sigma_i(X_i/\mu)\log(X_i/\mu) = (1/N)\Sigma_i r_i \log(r_i), \quad \text{(A2)}$$

where log is the natural logarithm, and

$$G = (2/N^2)\Sigma_i r_i[i - (N + 1)/2], \quad \text{(A3)}$$

where the units are ranked in ascending order on X so i is the unit's *rank* on X (see Firebaugh [1998] for the deviation of [A3]). The bracketed part, $i - (N + 1)/2$, is the difference between the unit's rank and the average rank, $(N + 1)/2$.

$$\text{VarLog} = (1/N)\Sigma_i\{\log(r_i) - E[\log(r_i)]\}^2, \quad \text{(A4)}$$

where log is the natural logarithm and $E[\log(r_i)]$ is the expected value (mean) of the logged income ratio. Thus the variance of the logarithms is also a function of r_i.

Expressing the indexes as functions of r_i reveals that they have the common form $I = [\Sigma_i f(r_i)]/N$, that is, inequality indexes are means of $f(r_i)$. This insight will prove useful in decomposing the trend in intercountry income inequality.

Grouping cases with the same values on X yields this convenient common expression for inequality indexes, where $p_j = n_j/N$, the population share of the jth group:

$$I = \Sigma_j p_j f(r_j), \quad \text{(A5)}$$

subject to the constraint $\Sigma_j f(r_j) = 0$ when $r_j = 1$ for all j.

Because inequality indexes can be expressed as $\Sigma_j p_j f(r_j)$, and because p_j and r_j do not depend on the index used, it follows that inequality indexes differ only because they employ different functions of r_j, as follows:

$$\begin{aligned} v_j &= f(r_j) = (r_j - 1)^2, \\ t_j &= f(r_j) = r_j \log(r_j) \\ l_j &= f(r_j) = \{\log(r_j) - E[\log(r_j)]\}^2, \\ g_j &= f(r_j) = r_j(q_j - Q_j). \end{aligned}$$

The expressions for v_j (squared coefficient of variation), t_j (Theil), and l_j (VarLog) follow directly from equations (A1), (A2), and (A4), respectively; g_j follows from the Gini formula for grouped data given by Blau (1977), where q_j is proportion of total population in units poorer than unit j and Q_j is proportion of total population in units richer than unit j (so $p_j + q_j + Q_j = 1$).

APPENDIX B

Decomposition Results

To decompose change in inequality as shown in table B1, I adapt a standard three-component formula for decomposing weighted means (Kitagawa 1955; Firebaugh 1997, pp. 27–28). The adaptation yields

$$\Delta I = \sum_j p_{j1}\Delta f(r_j) + \sum_j \Delta p_j f(r_{j1}) + \sum_j \Delta p_j \Delta f(r_j), \quad \text{(B1)}$$

where ΔI denotes change in an inequality index, r_j is the income ratio for the jth unit, p_j is j's population share, Δp_j is $p_{j2} - p_{j1}$ (the change in j's population share from time 1 to time 2), and $\Delta f(r_j)$ is $f(r_{j2}) - f(r_{j1})$, the change in j's income ratio as a function of v_j, t_j, l_j, or g_j (see eq. [3] above and see Firebaugh [1998]).

In plain English, change in an index of income inequality is the sum of three factors.

1. *Differential economic growth.*—$\sum_j p_{j1}\Delta f(r_j)$, the contribution of changing income ratios while holding population shares constant;
2. *Differential population growth.*—$\sum_j \Delta p_j f(r_{j1})$, the contribution of changing population shares while holding income ratios constant; and
3. *Joint effect.*—$\sum_j \Delta p_j \Delta f(r_j)$, the joint contribution of changing income ratios and changing population shares.

The effect of population growth on change in inequality depends on where the population growth occurs along the income axis. When nations at the tails of the income distribution grow faster than those in the middle of the distribution, differential population growth boosts inequality; when

TABLE B1

DECOMPOSITION OF 1960–89 CHANGE IN INTERCOUNTRY INCOME INEQUALITY

	INDEX			
COMPONENT	V^2	VarLog	Theil*	Gini*
Changing income ratios	.252	.189	.136	.0946
Changing population shares	−.205	−.103	−.074	−.0732
Joint effect	−.071	−.034	−.030	−.0190
1960–89 change	−.025	.052	.031	.0024

SOURCE.—Summers et al. (1994).

NOTE.—N = 120 nations.

* These indexes were centered using $r_i - 1$ (see app. C). Centered Theil increases by .031 (from 1.0345 in 1960 to 1.0654 in 1989).

populations grow faster in middle-income nations, population growth reduces inequality. The decomposition method used here reflects that fact. When population is growing faster for nations at the tails of the income distribution, the positive Δp_j's are concentrated in the tails (where $f(r_{j1})$ is larger) and the negative Δp_j's are concentrated in the middle (where $f[r_{j1}]$ is smaller), so $\sum_j \Delta p_j f(r_{j1}) > 0$ (recall that $f[r_{j1}]$ is always positive). When population is growing faster for middle-income nations, the negative Δp_j's are concentrated in the tails, so $\sum_j \Delta p_j f(r_{j1}) < 0$.

However, the method is ill-suited for determining the effect of changing population share for a *specific nation.* Because $f(r_{j1})$ is positive, $\Delta p_j f(r_{j1})$ is positive when Δp_j is positive and negative when Δp_j is negative. For a specific middle-income nation, this result is backward: inequality is *reduced* by faster than average population growth ($\Delta p_j > 0$) in a middle-income nation and *enhanced* by slower than average population growth ($\Delta p_j < 0$). (I am indebted to David Lam for prompting me to clarify these points.)

APPENDIX C

Ranking Nations' Contributions to Inequality and to Change in Inequality

Because inequality is measured as the sum of $p_j f(r_j)$, an individual unit contributes $p_j f(r_j)$ to an inequality measure. Hence the contribution of units to inequality can be ranked based on $p_j f(r_j)$—or so it would appear.

This ranking method works in a straightforward manner for V^2 and for VarLog but not for the Theil and Gini indexes. (Do not confuse the objective here—determining a unit's contributions to inequality and change in inequality—with the discussion in the final paragraph of app. B, where the issue is how to *decompose* a unit's contribution to change in inequality. Decomposing a unit's contribution to change in inequality is not straightforward for any of the measures, as app. B explains.) Consider intercountry income inequality. The ranking method works for V^2 and VarLog because $p_j v_j$ and $p_j l_j$ are positive values that are larger for nations at either end of the income distribution than for nations in the middle, a fact in line with the concept of inequality. In the case of Theil and Gini, by contrast, the use of $p_j t_j$ and $p_j g_j$ does not work in a straightforward manner to rank nations because it violates the basic principle that (size constant) nations at either extreme contribute more to inequality than do nations in the middle. That principle is violated for nations on the left side of the income distribution: $p_j t_j$ and $p_j g_j$ are *negative* for poor nations, and the poorer the nation, the more negative the value.

My solution is to "center" t_j and g_j by substituting $r_j - 1$ for r_j as follows:

$$t_j^* = f(r_j) = (r_j - 1)\log(r_j),$$
$$g_j^* = f(r_j) = (r_j - 1)(q_j - Q_j).$$

It can be shown that $\sum_j p_j g_j^* = \sum_j p_j g_j$, that is, the centering procedure does not change the value for Gini. Thus the Gini itself can be calculated with or without centering. In the case of Theil, $\sum p_j t_j^* = \sum p_j t_j - \sum p_j \log(r_j)$, that is, centering adds a constant to the value for Theil. Thus the centered Theil should be used only to *rank* the contribution of individual units to inequality and to change in inequality; it should not be used to estimate the overall level of inequality.

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