Population and Sample Selection Effects in Measuring International Income Inequality*

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INTRODUCTION

A long tradition of theoretical work in the economics literature on economic growth predicts the convergence of poorer with richer economies, as a result of capital movements from areas of relatively high capital utilization to those where capital intensity is relatively lower. The work of neoclassical economists such as Samuelson (1948) and Solow (1956, 1957) was complemented by the work of heterodox theorists like Gerschenkron (1962), who emphasized the importance of technology transfer in contrast and complement to that of capital movement. Whatever the mechanisms, the new countries of the south were expected to grow rapidly in the decades following formal political independence.

Empirically, however, this growth did not materialize, and a sociological critique emerged that capital transfers, far from promoting convergence in income between rich and poor countries, might actual promote and perpetuate divergence. Building on the theoretical work of Frank (1969), Emmanuel (1972), and Amin (1974), Chase-Dunn (1975) demonstrated empirically that international economic dependence—the flipside of capital movement—actually retarded

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ABSTRACT

The issue of world income inequality has been debated widely in the literature. At issue is whether inequality has, on the whole, been increasing or decreasing over time. I reexamine results from Firebaugh's (1999) seminal article on demographic effects on inequality, in which he found a 30-year "plateau" of world income inequality when countries are weighted based on their populations. In contrast, I show that the increasing integration of market economies over the past decades has been reflected in dramatically increasing international inequality. "Inequality" as currently measured, however, may bear little resemblance to a naive understanding of the term. I conclude with some preliminary figures from an alternate characterization of convergence and divergence, based on world-systems categories.

economic growth. The ensuing empirical debate on foreign capital dependence continues to this day, with recent contributions from Kentor (1998), Dixon and Boswell (1996a, 1996b), and Firebaugh (1992, 1996). Only a hiatus in the production of new data seems to have slowed down the controversy.

Although rarely citing the sociology literature on dependence, economists have now largely abandoned the concept of convergence driven by exogenous capital flows. The "New Growth Theory" of Romer (1994) and Lucas (1988), essentially an elaboration on Gerschenkron, postulates that convergence between low and high income countries will only occur where sufficient human capital exists in the poorer countries to take advantage of the technological advances made in the richer countries. Empirical studies of "conditional convergence"—convergence conditional on levels of educational attainment—have generally supported this view. Barro (1991), Barro and Lee (1993) and Barro and Sala-I-Martin (1995) find that educational levels are significantly related to growth rates, and that once education is controlled statistically, low income countries do grow faster than high income countries. When no controls are made, however, Barro and his colleagues find no evidence of convergence, but instead find a measurable (but statistically non-significant) divergence between high and low income countries over the past few decades.

Meanwhile, within sociology a new debate has opened up on the measurement of international income inequality, sparked by Firebaugh's (1999) critique and elaboration on Korzeniewicz and Moran (1997). In a wide-ranging article on trends in world income inequality and their sources, Korzeniewicz and Moran (1997) found that increasing between-country inequality was the main source of an overall increase in inequality over the period 1965-1992. Their approach is based on the use of World Bank GNP per capita figures evaluated in U.S. Dollars at official exchange rates. In reaction, Firebaugh (1999) claimed that between-country inequality had actually been stable over the period 1965–1992, arguing that the earlier observed increase in inequality was the result of an inappropriate choice of data series. Using Penn World Table GDP data evaluated at purchasing power parity, Firebaugh described a "plateau" of inequality, and attempted to demonstrate that this plateau was not sensitive to the results for any particular country.

Korzeniewicz and Moran (2000) presented a comment on Firebaugh's (1999) article, which was published along with a reply by Firebaugh (2000). As they emphasized in their respective comments, the key scientific issue separating Firebaugh from Korzeniewicz and Moran is one of operationalization, although they also differ normatively. Both camps find that reported levels of inequality and changes in levels of inequality over time are highly sensitive to the specific

measures of inequality chosen to be studied. Both agree with the other camp's empirical results, once the choice of operationalization has been determined. Both camps argue that the measures chosen should represent theoretically grounded operationalizations of the authors' idiosyncratic understandings of the (ambiguous) term "inequality." What both camps fail to see, however, is that the data does not in fact differentiate between their views. Instead, I suggest in this paper that much of the controversy surrounding international income inequality stems from a failure to understand the theoretical implications of chosen operationalizations of the concept of inequality.

Firebaugh's own avowed aim was "to provide the foundation for a general sociological literature on intercountry income inequality" (p. 1598). Accepting this ambition at face value, I will organize my own contributions in this article around Firebaugh's agenda. Firebaugh broke new ground on several fronts: through methodological advances in the handling of exchange rates, through his ANOVA metaphor for studying cross-country inequality, and, most importantly, through his specification of a demographic theory of world income convergence. In formulating my ideas, I will examine each of these advances in detail. While the first two areas are mainly of interest to specialists in the field, the third is of general importance for all social scientists and policy-makers working in the global arena, and will receive special attention.

1. NATIONAL CONTRIBUTIONS TO INTERNATIONAL INEQUALITY

Several measures of cross-national income inequality coexist in the literature. Firebaugh incorporates four of them in his article: "V^2," "Theil," "VarLog," and "Gini." A "key finding" (p. 1608) of Firebaugh's article is that all four of these indices can be represented in general terms by a single computational formula: each index, Firebaugh argues, can be expressed as the sum over all countries of each individual country's world population share times a function of its income ratio (the ratio of its income per capita to the average world income per capita):

$$I = \text{SUM}_j\,[p_j\,f(r_j)]$$

where

I = inequality index
j = country label
p_j = country j's proportion of world population
r_j = country j's proportion of world income
f = some functional form used to measure inequality
(p. 1608, eq. 2)

The function f is particular to the inequality measure used:

$V^2 : f(r_j) = (r_j - 1)^2$
$Theil : f(r_j) = r_j \log(r_j)$
$VarLog : f(r_j) = Var[\log(r_j)]$
$Gini : f(r_j) = r_j(q_j - Q_j)$, where q_j is the proportion of units poorer than j and
Q_j is the proportion of units richer than j
(p. 1608, eq. 3)

Formulating inequality in this way, Firebaugh traces each country's "contribution" to world income inequality simply by multiplying its own population share by a function of its income ratio. If this were correct, it surely would represent a "key finding," as Firebaugh claims.

The reality, however, is more complicated. Leave aside the fact that the Gini coefficient obviously cannot be computed from r_j alone as Firebaugh implicitly claims. Consider the simplest and mathematically most elegant measure of income inequality: the variance of the logs of national income per capita (VarLog). This measure has the advantage of being invariant under conditions of balanced economic growth: when all countries' income per capita grow by the same percentage, the variance of the logs of income per capita does not change. (The simple variance of income per capita would rise with economic growth.) Computing the unweighted variance of the logs is straightforward—one simply logs the national income per capita figures, and then takes the variance of the logged figures. Firebaugh has done this for 120 countries for the years 1960–1989 in his table 2. (p. 1606)

Is each country's "contribution" to unweighted income inequality in this case just its squared deviation from the mean, as Firebaugh would imply? One could make this argument, but it is not unambiguously correct. Each country contributes not just to the final variance score (which in this case is just the total squared deviation from the mean logged income per capita), but to the mean itself as well. When a country is taken out of the analysis, the new resulting VarLog measure does not perfectly correspond to the old measure minus the "contribution" of the excluded country, since by taking the country out of the analysis, the mean (around which the variance is calculated) changes as well.

Why didn't Firebaugh notice this? In his notation for equations 2 and 3, he creates the notation "r_j" to stand for the ratio of a country's income to the mean world income. The subscript "j," referring to the country, is here misleading, since r_j is not just a descriptor of a particular country, but also of the world as a whole, through the denominator of the expression. However, using r_j to stand for the ratio in subsequent analyses tends to lead the reader to think that each country's income ratio depends only on that country's data. If this were true, and a country's income ratio did not depend on the national incomes of every other country in the study (through their effect on the mean), Firebaugh's decomposition would be correct, and a major result, as Firebaugh claims. As it stands, world income inequality cannot be decomposed as Firebaugh suggests.

This in itself would not create a major problem for the paper—although it would invalidate the analyses of country contributions to inequality presented on pp. 1617–1619 (which I have, in any case, been unable to replicate). The real problem comes when population weights are introduced. Firebaugh's equation 2 implies that population weights can be applied to the already-computed income ratios. While this is possible computationally, it is a highly idiosyncratic way to conduct weighted analyses. Typically, in weighted analyses, weights are applied to each case according to some weighting variable (in this case, population). Each case is then essentially entered into the analyses as many times as its weighting indicates—i.e., if country A has ten times the population of country B, country A is entered ten times for every entry of country B. This would mean that the population weights would be used first to compute a weighted mean world income level, which would be used in calculating the national income ratios. Only then would the income ratios, based on the weighted mean income, be entered into the analysis. If Firebaugh's equations 2 and 3, as they stand, were used to calculate "weighted" inequality measures, the results would be truly odd—in the case of VarLog, weighted squared deviances from the unweighted mean of the logged income ratios.

Luckily, Firebaugh does not actually apply equations 2 and 3 in computing his own weighted results in table 2 of his article (p. 1606). Using Firebaugh's data, I have confirmed computationally that in fact he uses conventional weighted analysis to arrive at the figures in his Table 2, not the methods detailed in his text. His (seeming) application of equations 2 and 3, however, in investigating the contributions to world inequality of individual countries have led him to ignore some important aspects of the data. I have not been able to replicate his results on the contributions of individual countries.

2. DATA PROBLEMS AND THE EFFECT OF CHINA ON WORLD INEQUALITY

In the study that kicked off the current debate, Korzeniewicz and Moran (1997) used GNP per capita figures reported by the World Bank. These figures are based on U.N. System of National Accounts (SNA) data generated and published by individual countries and compiled by the World Bank, which converts the local currency figures reported by all countries into U.S. Dollars. The SNA figures are on aggregate value-added estimates on the production side, computed bottom-up from surveyed prices and reported quantities of goods produced. The resulting aggregate figures are converted into U.S. Dollars at official exchange rates.

Firebaugh's work is based on data from the Penn World Table, Mark 5.6a (Summers et al 1994), henceforth PWT. The Penn World Table (PWT) is a set of purchasing power parity (PPP) based estimates of income per capita figures for over 140 nations, built around the benchmarks established by the United Nations' International Comparisons Program. (See Summers and Heston 1991 for a summary of the PWT methodology; see Ahmad 1994 for a description of the UN ICP.) In contrast to the SNA method, PWT real gross domestic product is estimated in a top-down fashion, beginning from final consumption and working towards implied output. They take as their base the final SNA consumption figures, but do not depend on a host of other SNA intermediate assumptions. Output figures in the PWT are ultimately computed at international, rather than domestic, prices.

The PWT methodology is only well-suited to environments in which prices are determined in an open market through the interaction of consumer's individual demand functions. Given its consumption-side approach, at the heart of the PWT methodology is the assumption that final consumer prices reflect in some meaningful way the producer prices of inputs to production processes. In the absence of free consumer markets, or worse in the presence of government manipulated producer markets, this methodology breaks down. In general, the PWT methodology is not well-suited to estimating GDP per capita in planned economies, and Summers et al recognize this by the inclusion in the table of a precautionary planned economy dummy variable. For example, Good and Ma (1999) show that the Penn World Table significantly overstates gross domestic product (GDP) per capita growth rates for eastern Europe and the Soviet Union in the post-war period.

In his country-by-country sensitivity analyses (p. 1617–1619), Firebaugh seems to find relatively small contributions by specific countries to changes in world income inequality (the lack of units in Table 5 makes the results difficult to interpret more specifically). This would lead one to conclude that his major results do not depend heavily on the contribution of any one observation. However, as I argued above, his methodology for isolating individual country effects is fatally flawed. On account of its huge population, any change in the position of China in the scale of world incomes does in fact have a huge impact on weighted between-country inequality. This point is especially relevant given China's high rate of economic growth in the 1970s and 1980s, as reported in the PWT.

Taking a much more straightforward approach than Firebaugh's, I find that when China (the world population leader) is simply excluded from the study of weighted income inequality, the percent change from 1960–1989 in the VarLog

measure jumps from +5% to +24%. In other words, with China in the analysis (N=120), world income inequality is found to have increased 5% in the period, while without China in the analysis (N=119), inequality is found to have increased 24%. Is the China effect real, or a methodological artifact arising from the application of the PWT methodology in an inappropriate environment? The online appendix to the PWT documentation includes the warning that "estimates for China and the large size of their difference from the exchange rate suggest the great uncertainty attached to these numbers." (Summers et al 1994, Appendix) In a section that runs over 3400 words (in an unpaginated computer file), Summers et al detail the problems with and uncertainties surrounding the Chinese figures. Given the problems of applying the PWT methodology in planned economies, this China effect is suspicious.

China is only one of five east-bloc non-market economies included in the 120 country subset of the Penn World Table for which income and population data are available for 1960–1989 (the others are the USSR, Romania, Yugoslavia, and Czechoslovakia). Until better data is available for all of these countries, it would seem premature to come to definitive conclusions about *world* income inequality. At the present time, prudence suggests that our analyses be restricted to changes in international income inequality among market economies only.

3. INEQUALITY AMONG MARKET ECONOMIES

In addition to data concerns, there are strong theoretical arguments for excluding the five east-bloc countries based on the nature of their economic systems. The non-market economies made concerted attempts to exclude themselves from the western world-economy, insulating themselves from the very world-systemic forces that increased world income inequality in the period under study. Although Wallerstein (1979:100) explicitly considers the east bloc to have been integrated into the modern world-economy, other scholars (notably Szymanski 1983) have argued that the socialist countries formed a distinct, competing world-system. If this is the case, it makes theoretical sense to exclude them from measures of inequality that are designed to measure the inequality-inducing effects of the modern world-system.

If, as Emmanuel (1972) and others have argued, the exploitation of the periphery of the world-economy is accomplished through unequal exchange, it stands to reason that higher levels of international trade could be associated with higher levels of exploitation. Chase-Dunn, Kawano, and Brewer (2000) have observed that global trade has increased dramatically since 1945, accelerating especially after 1960. It would be interesting to observe whether or not this increase in global trade has been paralleled by an increase in inequality among

Table 1 – PWT World Income Inequality (VarLog)

| Year | All Cases (N=120) | | Market Economies (N=115) | |
	Weighted	Unweighted	Weighted	Unweighted
1960	0.91	0.74	0.98	0.75
1965	1.04	0.84	1.1	0.85
1970	1.08	0.9	1.17	0.91
1975	1.11	0.96	1.2	0.98
1980	1.07	1.02	1.2	1.04
1985	0.96	1.08	1.13	1.11
1989	0.96	1.18	1.13	1.21
1960–89 change (%)	5%	59%	15%	61%

Source: Summers et al 1994.
Note: Countries listed in Firebaugh 1999, note 8, p. 1612.

Table 2 – PWT World Income Inequality (VarLog)

| Year | Market Economies (N=59) | |
	Weighted	Unweighted
1950	1.04	0.73
1955	1.06	0.75
1960	1.04	0.78
1965	1.16	0.81
1970	1.24	0.85
1975	1.28	0.85
1980	1.31	0.9
1985	1.24	0.98
1989	1.22	1.06
1960–89 change (%)	17%	45%

Source: Summers et al 1994.
Note: Countries listed in Appendix 1.

market economies, i.e., those economies exposed to the extraction of surplus value through the channel of unequal exchange.

When I replicate Firebaugh's analyses with the five east-bloc counties in the sample excluded, I arrive at very different results from those reported in Firebaugh's Table 2 (p. 1606). My weighted and unweighted results for world income inequality, using the VarLog measure, appear in Table 1. In the first two columns, I replicate Firebaugh's (N=120) results, while in the last two columns, I report the results for market economies only, with the five east-bloc economies are excluded (N=115).

The differences between my and Firebaugh's results are not so striking as when China alone is excluded, but the reported increase in world income inequality is still three times that reported by Firebaugh (+15% versus +5%). The pattern is similar to that reported by Firebaugh, however, with inequality increasing sharply between 1960 and 1965, then leveling out or dropping after 1965. The discontinuity in both series between 1960 and 1965 is somewhat disturbing. Are the results for 1960 aberrantly low? Or are those for 1965 aberrantly high? If the former, we should exclude 1960, begin our analyses in 1965, and report relatively stable levels of inequality, whether or not planned economies are included in the analyses. If the latter, we should begin our analyses in 1960, and report dramatically increasing inequality over the period. If we had data reaching back to, say, 1950, it would be easy to tell whether 1960 or 1965, or neither, stuck out of trend as an aberrant point.

Unfortunately for this solution, many of the countries in these analyses did not exist in 1950, and we may never have an internationally-comparable set of GDP per capita estimates for the colonial administrative areas corresponding to the independent countries studied here. The Penn World Table does, however, contain data for the entire period 1950–1989 for n=59 countries, and results for these are reported in Table 2. Note that none of these 59 countries had planned economies. The results seem to confirm the admissibility of the figures for 1960; that year appears to have been the end point of a period of stable inequality that extended back at least as far as 1950. Between 1960 and 1965 there does appear to have been a jump in inequality, but a real jump, not a spurious jump arising from random error.

Another way to approach this problem would to examine a corresponding income per capita time series derived from foreign currency exchange rates rather than purchasing power parity. The World Bank's (1999) World Development Indicators include such a series for gross national product (GNP) per capita beginning in 1960. If analyses based on the foreign exchange (FX) series also contain a discontinuity between 1960 and 1965, it would cast further doubt on the reliability of the 1960 estimate. If, on the other hand, the results derived from the FX series show a smooth trend from 1960 forward, it would suggest that perhaps it is the 1965 figure that is out of line. Results based on World Bank data

Table 3 – World Bank World Income Inequality (VarLog)

Year	All Cases (N=91)		Market Economies (N=89)	
	Weighted	Unweighted	Weighted	Unweighted
1960	3.91	2.12	2.71	2.09
1965	4.27	2.27	2.88	2.23
1970	4.15	2.38	3.03	2.34
1975	4.06	2.45	3.1	2.42
1980	3.82	2.59	3.14	2.57
1985	3.32	2.7	3.18	2.7
1989	3.12	2.84	3.24	2.85
1960–89 change (%)	–20%	34%	20%	36%

Source: World Bank 1999.
Note: Countries listed in Appendix 1.

for all available countries (n=91) and for market economies only (n=89; China and Hungary excluded) are presented in Table 3.

As with the PPP results, our interpretation of the trend in international inequality as reported in Table 3 depends on whether we choose to include China in the analysis (Hungary has only a minor impact on the weighted figures). If, as I argue above, we concentrate on the results for market economies only, there appears to be a smooth increasing trend in inequality. This would suggest that it is the 1965 figures that are spurious in Table 1. On the other hand, those including the planned economies would reach the opposite conclusion. It should be noted, however, that FX-derived income figures are even more severely flawed for planned economies than are PPP figures. The exchange rates used by the World Bank are the official rates reported by the respective governments; in the case of planned economies, these rates are set by the government, with no regard to market conditions, since currency exchanges occur only with government permission.

Since both the restricted–N, 1950–1989 PPP results for market economies and the 1960–1989 FX results for market economies lend support to the thesis that the (relatively) low inequality score for 1960 is a valid observation, it seems safe to conclude that international inequality did, in fact, increase over the period. Moreover, the high consistency of the estimated growth in weighted inequality among market economies in each of the three tables above (15%, 17%, 21%; see Table 4) shows that these results are somewhat robust with respect to

Table 4 – Comparison of Inequality Growth Estimates

Series	Market Economies Only		All Available Cases	
	Weighted	Unweighted	Weighted	Unweighted
PPP (1960-89)	15%	61%	5%	59%
PPP (1950-89)	17%	45%	N/A	N/A
FX (1960-89)	20%	36%	–20%	34%

Note: N/A = Not Applicable
Source: Tables 1–3 above.

period, sampling, and method of analysis. This is in marked contrast to the wild swings found both in the unweighted analyses and in the analyses conducted with planned economies included in the sample. In sum, it seems safe to use population weights, as Firebaugh advocates, so long as planned economies, China in particular, are excluded. Whether it will be possible to include China in weighted analyses in the future, as its economy becomes more open, is unknown. Given the sheer size of China's population, it is imperative that we look for ways to properly handle the Chinese case. However, until such time as we can reliably include China in our analyses, a conservative estimate for the increase in inequality in the three decades after 1960 seems to be around 15–20%.

4. ASSESING FIREBAUGH'S CONTRIBUTIONS

As the foregoing arguments demonstrate, Firebaugh's article does in fact mark a critical juncture in the study of international inequality. First, Firebaugh makes a strong case for the use of purchasing power parity exchange rates in computing inequality. Although in the end the choice of exchange rate seems to have little effect on measured changes in inequality, the practical arguments in favor of purchasing power parity are strong. Scholars in the world-system tradition have tended to use market exchange rates in making international comparisons, since their objective has been to measure international purchasing power, not domestic purchasing power. The root problem with this approach is not its emphasis on international versus domestic prices, but the fact that true, free-market exchange rates exist for only a handful of countries for the periods under study. In any case, using purchasing power parity measures, unweighted world inequality has increased dramatically since 1960, an increase almost twice that found using "market" exchange rates. Firebaugh's advocacy of purchasing power parity represents an advance in the field that should be endorsed by world-system scholars and their critics alike.

Firebaugh's second major contribution, the promulgation of an "ANOVA" model for studying inequality, is prefigured in Korzeniewicz and Moran (1997) and mirrored in recent work by Alderson and Nielsen (1999). Firebaugh uses this model to make a strong argument for the use of population-weighted measures. Although changes in unweighted inequality may be easier to interpret, Firebaugh's model suggests that weighted inequality corresponds more closely to what sociologists mean by the concept. However, taking Firebaugh's principles one step further, I have argued that inequality be studied using only market economies. There are strong theoretical reasons to do so. Sociological theories of the creation and maintenance of international inequality are largely grounded in concepts like investment dependence (Alderson and Nielsen 1999) and economic differentiation (Gustafsson and Johansson 1999). By largely removing themselves from the world-economy, the planned economies insulated themselves from these effects. It is perhaps telling that the income levels of the formerly planned economies of the east bloc dropped precipitously upon integration with the world-economy. The strongest arguments for restricting analyses to market economies may, however, be simply pragmatic. Good data just isn't available for the planned economies, and, until it is, their income trends relative to the rest of the world must remain a mystery.

The major contribution of Firebaugh's article, however, is the graphic demonstration that demographics matter. Even if Firebaugh may be premature in claiming to have discovered a "great plateau" (p. 1622) in world income inequality in the period 1960–1989, he is right to stress the importance of demographic effects on inequality. It is in this respect that his work is seminal.

5. DEMOGRAPHY AND INEQUALITY

Since national incomes are generally compared on a per capita basis, population is an important component of all international inequality measures. The impact of population issues is compounded when income data is weighted by population. I will discuss the population—GDP per capita nexus briefly below; it is too complicated to be treated fully here. I will, however, attempt to isolate some of the effects on measured inequality of changes in population acting through population weights in inequality measures.

Ceteris paribus, an increase (decrease) in population will yield a decrease (increase) in GDP per capita. There are at least two mechanisms through which a change in population would not be expected to yield a corresponding change in GDP. First, the change in total population may be associated with a change in the age structure of the population. For example, an increase in the birth rate will lead to a higher proportion of (non-working) children in the population.

Table 5 – PWT World Income Inequality (VarLog) – Population versus Income Effects (Weighted Results)

Year	All Cases (N=120)		Market Economies (N=115)	
	Constant (1960) Pop. Share	Constant (1960) Income Ratio	Constant (1960) Pop. Share	Constant (1960) Income Ratio
1960	0.91	0.91	0.98	0.98
1965	1.06	0.9	1.21	0.97
1970	1.12	0.88	1.21	0.95
1975	1.17	0.86	1.25	0.92
1980	1.15	0.83	1.28	0.9
1985	1.06	0.81	1.24	0.88
1989	1.08	0.8	1.27	0.86
1960–89 change (%)	19%	−12%	30%	−12%

Source: Summers et al 1994.
Note: Countries listed in Firebaugh 1999, note 8, p. 1612.

In this case, population may rise with no corresponding rise in GDP, yielding a decline in GDP per capita. Second, population growth may lower the marginal productivity of labor. Labor is only one of many inputs in economic production. If population grows more quickly than the supply of other inputs, the marginal value of an additional unit of labor will decline over time. As a result, GDP growth will not keep pace with population growth. Similarly, slowly growing or declining populations may be associated with GDP per capita growth due to the higher marginal productivity of labor under these conditions. Such effects are not easy to estimate; the estimation of the effects of population growth and the demand elasticity of labor on a wide cross-national basis would require a dedicated monograph.

There is however another, more tractable issue with how population issues affect inequality measures. Firebaugh was right to emphasize it, although his methodological errors (discussed in section 1 above) make nonsense of his results. At issue is the extent to which changes in weighted inequality over time have been the result of changes in the relative population weights of the various countries, as opposed to resulting from changes in GDP per capita.

A crude way to study the effects of changing population weights on measured international income inequality is simply to hold the weights constant,

while allowing the levels of GDP per capita to change. By my calculations, if population growth had been identical in all countries from 1960 through 1989, and countries' population shares thus remained constant at their 1960 levels over the entire period, weighted inequality would have increased 30% in the non-Communist world, instead of the 15% observed. (Table 5) In effect, differential population growth seems to have slowed the increase in inequality by half. This sounds like good news—population processes are working to reduce income inequality.

Another way to look at the same issue is to hold GDP per capita constant at 1960 levels, while allowing the population weights to change as observed. In this analysis, we would have seen a 12% drop in measured inequality among market economies simply through the action of changing weights over time: population growth in countries farther in the tails of the income distribution is not keeping up with population growth in the middle of the distribution. (Table 5) On both counts, then, population effects seem to be reducing inequality.

But is this a good thing? Unfortunately, these seemingly optimistic results are merely a chimera arising from the difficulty of interpreting weighted analyses. Using population-weighted measures, "inequality" is reduced whenever a child is born in a country that is near the weighted mean world income level. Since income distributions are skewed with a long right tail, even rather poor countries are closer to the mean than are moderately rich countries. As a result, increasing populations in poor countries reduce measured "inequality." This effect can lead to perverse policy prescriptions. For example, a policy promoting rapid population growth in relatively poor countries would tend to reduce "inequality" as measured by any of the conventional metrics. The use of weighted inequality measures may be scientifically appropriate in most cases, but in every case they should be clearly labeled "HANDLE WITH CARE."

On another front, however, it may be a mistake to concentrate on reducing or eliminating inequality as a policy goal. Leaving demography aside, decreasing inequality, however measured, may not actually be a good thing. For example, the rise of east Asia is now *increasing* world income inequality dramatically; as east Asian economies advance beyond the world (weighted or unweighted) mean income, inequality increases in lock-step. An equality-minded global public policy would be obliged to discourage such economic adventurism. This is absurd. In a similar vein, consider changes in the world since 1989. With the collapse of the Soviet Union, national income levels in Russia, Ukraine, Belarus, and the other former Soviet republics have declined precipitously. Since living standards in the Soviet Union in 1989 were well above the world mean, these precipitous declines have had the effect of *reducing* world income inequality. Few would argue that the plunging into poverty of a vast region, home to some three

Table 6 – Mean logged GDP per capita for three zones of the world-economy (PWT data; weighted results)

Year	Core (n=10)	Semiperiphery (n=15)	Periphery (n=36)
1960	9.02	7.9	6.63
1965	9.19	8.1	6.67
1970	9.32	8.3	6.77
1975	9.39	8.45	6.83
1980	9.51	8.54	6.95
1985	9.6	8.5	7.06
1989	9.7	8.55	7.17
1960-89 change (%)	7.50%	8.20%	8.10%

hundred million people, is a good thing…yet it has reduced "inequality," by bringing these countries closer to the world mean.

Difficulties of interpretation notwithstanding, demographic changes are driving much of the vertical mobility of countries in the world-economy. As Firebaugh argues, GDP per capita declines when populations grow quickly, not because the output per worker declines, but because fast-growing populations are young populations, with relatively fewer workers and relatively more dependents. Extending Firebaugh's reasoning, we should not expect economic models to do very well at predicting changes in GDP per capita. Models of per capita income should, where appropriate, incorporate demographic analyses, since population growth rates may completely obliterate the impact of GDP growth, as suggested by Table 5 (above). Although Firebaugh does not make the conclusion, his reasoning suggests that we should model demographic and economic change separately, only weaving the two threads at the final stage, when we analyze changes in GDP per capita as the synthesis of the two. It may turn out that the forces driving economic growth (change in GDP) are not the primary forces driving improvements in welfare (change in GDP per capita). It is likely that the latter have a strong demographic coloring (population age structure, labor force participation, population growth, etc.).

6. TOWARDS AN IMPROVED INEQUALITY MEASURE

An alternative operationalization of international income inequality would be to consider the gaps not between individual countries, but between levels in

Table 7 – Inter-level differences in mean logged GDP per capita (PWT data; weighted results)

	C-P difference (n=10)	C-S difference (n=15)	S-P difference (n=36)
1960	2.39	1.12	1.27
1965	2.52	1.09	1.43
1970	2.55	1.02	1.53
1975	2.56	0.94	1.62
1980	2.56	0.97	1.59
1985	2.54	1.1	1.44
1989	2.53	1.15	1.38
1960–89 change (%)	5.90%	2.70%	8.70%

Table 8 – Variance of logged GDP per capita for three zones of the world-economy (PWT data; weighted results)

Year	Core (n=10)	Semiperiphery (n=15)	Periphery (n=36)
1960	0.0399	0.123	0.0371
1965	0.0398	0.14	0.0576
1970	0.0331	0.126	0.0658
1975	0.0262	0.113	0.0604
1980	0.0249	0.129	0.085
1985	0.0242	0.117	0.0872
1989	0.0192	0.135	0.12
1960-89 change (%)	−52%	10%	223%

the world-system hierarchy. This approach shifts the unit of analysis from the country to the hypothesized components of the system. This has the benefit of comparing like with like, largely separating within-level mobility from inter-level convergence.

Using Arrighi and Drangel's (1986) categorization of the world-economy into "organic" core, semiperipheral, and peripheral zones, I have calculated the mean logged GDP per capita for each zone. The results are reported in Table 6. All three levels have grown at roughly the same rate over the 39 study years.

As a first attempt at constructing a new inequality measure, I have followed Arrighi and Drangel (pp. 49–53) in calculating the differences in means between each of the zones. (Table 7) Each of the gaps has increased over the four decades, albeit modestly. The gap that has widened the most dramatically has been the gap between the semiperipheral and peripheral means. The core has been leaving the semiperiphery behind in terms of average level of development only slowly, but the gap between the semiperiphery and the periphery has widened more dramatically. In addition to the secular trend, there is also a great wave in the core - semiperiphery gap. The semiperiphery rapidly advanced on the core in the 1960s and 1970s, but fell back substantially over the course of the 1980s.

Another interesting perspective to be gained from looking at the data by level is on the behavior of international income inequality within zones of the world-economy. Separating the data out by zone eliminates many of the skew effects that plague similar analyses conducted on all countries at once, while adding an important new dimension. The results of this analysis are striking. (Table 8) Convergence within the core was quite strong over the 39 year period,

with the VarLog measure for core countries declining by over 50%. Income inequality in the semiperiphery, by contrast, was relatively stable. Income inequality in the periphery, however, ballooned by over 200%. Interpreting and understanding these trends will require both better data and additional research.

7. CONCLUSIONS

Hopefully, the results reported above may help to put the methodological arguments of the convergence/divergence debate in perspective. Contra Firebaugh and Korzeniewicz and Moran, the choice of data series makes little difference, once the planned economies are excluded. Whether weighted by population, or unweighted, whether using purchasing power parity or "market" exchange rates, inequality among market economies was on the rise in the three decades after 1960. Political independence has not led to economic independence for most of the countries of the world, nor for most of the people of the world. Quite the opposite: the post-colonial world has been marked by even greater inequality in incomes than was the world in 1960. Rich countries have gotten richer, while poor countries have not. Moreover, rich countries have become more similar in their incomes, while poor countries have become more diverse. Keeping in mind the fact that there is a floor effect in operation at the poorer end of the world income distribution (incomes cannot go below zero), these results are all the more discouraging.

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APPENDIX 1

A. Countries Represented in Table 2 (n=59)

Argentina	El Salvador	Mauritius	South Africa
Australia	Finland	Mexico	Spain
Austria	France	Morocco	Sri Lanka
Belgium	Germany, West	Myanmar	Sweden
Bolivia	Greece	Netherlands	Switzerland
Brazil	Guatemala	New Zealand	Thailand
Canada	Guyana	Nicaragua	Trinidad and Tobago
Chile	Honduras	Nigeria	Turkey
Colombia	Iceland	Norway	U.K.
Costa Rica	India	Pakistan	U.S.A.
Cyprus	Ireland	Panama	Uganda
Denmark	Italy	Paraguay	Uruguay
Dominican Republic	Japan	Peru	Venezuela
Ecuador	Kenya	Philippines	Zaire
Egypt	Luxembourg	Portugal	

B. Countries Represented in Table 3 (n=91)

Algeria	Costa Rica	Jamaica	Panama
Argentina	Cote d'Ivoire	Japan	Papua New Guinea
Australia	Denmark	Kenya	Paraguay
Austria	Dominican Republic	Korea, Rep.	Philippines
Bahamas, The	Ecuador	Lesotho	Portugal
Bangladesh	Egypt, Arab Rep.	Luxembourg	Rwanda
Barbados	El Salvador	Madagascar	Seychelles
Belgium	Fiji	Malawi	Singapore
Belize	Finland	Malaysia	South Africa
Benin	France	Malta	Spain
Botswana	Gabon	Mauritania	Sri Lanka
Brazil	Ghana	Mauritius	Sudan
Burkina Faso	Greece	Mexico	Suriname
Burundi	Guatemala	Morocco	Swaziland
Cameroon	Guyana	Nepal	Sweden
Canada	Honduras	Netherlands	Switzerland
Central African	Hong Kong, China	New Zealand	Thailand
Republic	Hungary	Nicaragua	Togo
Chad	Iceland	Niger	Trinidad and Tobago
Chile	Indonesia	Nigeria	U.K.
China	Ireland	Norway	U.S.A.
Congo, Dem. Rep.	Israel	Oman	Uruguay
Congo, Rep.	Italy	Pakistan	Zambia

C. Countries Represented In Tables 6–8

Core (N=10)

- Austria
- Canada
- Denmark
- Germany, West
- New Zealand
- Norway
- Sweden
- Switzerland
- U.K.
- U.S.A.

Semiperiphery (N=15)

- Argentina
- Chile
- Costa Rica
- Greece
- Hong Kong
- Ireland
- Israel
- Jamaica
- Mexico
- Panama
- Portugal
- South Africa
- Spain
- Turkey
- Venezuela

Periphery (N=36)

- Angola
- Bangladesh
- Benin
- Bolivia
- Burkina Faso
- Burundi
- Cameroon
- Central Afr.R.
- Chad
- Egypt
- El Salvador
- Guinea
- Haiti
- Honduras
- India
- Indonesia
- Kenya
- Madagascar
- Malawi
- Mali
- Mauritania
- Mozambique
- Niger
- Nigeria
- Pakistan
- Papua N.Guinea
- Philippines
- Rwanda
- Senegal
- Somalia
- Sri Lanka
- Thailand
- Togo
- Uganda
- Zambia
- Zimbabwe

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