Economic Development and Income Distribution: A Cross-National Analysis

By KENNETH J. BRANCO *and* JOHN B. WILLIAMSON*

ABSTRACT. The relationship between level of *economic development* and *income distribution* is analyzed using both a relative measure of income distribution and, for the first time, an absolute measure of income distribution which corrects for *purchasing power* differences between *nations.* Cross-sectional regression analysis findings indicate support for non-linear relationships both in the total sample of *68 nations,* and also in sub-samples of *54 developing nations* and *14 industrial democracies.* Our findings suggest that the poorest 40 percent of the population lose income both relatively and absolutely in the early stages of economic development. Thereafter there are gains in income although with diminishing marginal returns at the highest levels of development.

I

Introduction

THE RELATIONSHIP BETWEEN level of economic development and income distribution has received much attention from economists and comparative political sociologists. This has been part of a larger effort to assess the impact of economic development on reducing inequality and poverty. Even though there have been numerous studies on the topic, several issues remain unresolved.

First, there has been no systematic attempt to separate the effects of higher levels of economic productivity in the developing countries from its effects in the industrialized countries. Models have been proposed for samples of developing countries alone, or for combined samples of developing and industrialized countries, but separate models for the developing and industrial nations have not emerged.

Second, a controversy remains over the U-hypothesis, which states that in the early stages of economic development, the poorest segment of the society loses income and does not share in the benefits of economic development until higher levels of productivity are reached. Support for the U-hypothesis using relative measures of income distribution have wide acceptance. However, the more important issue of the possibility of absolute declines in income to the poorest groups in the early stages of economic development remains controversial. The

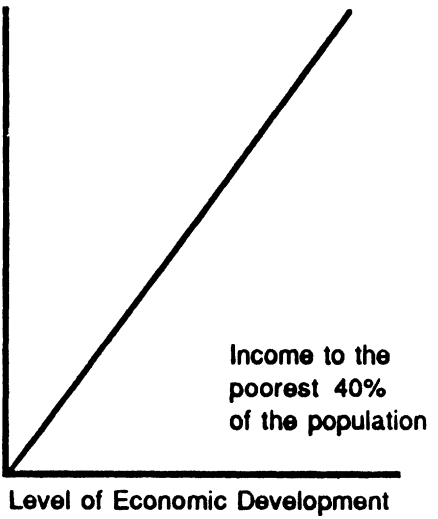
* [Kenneth J. Branco, Ph.D., is associate professor of sociology at Stonehill College, North Easton, MA 02356; John B. Williamson, Ph.D., is professor and chairperson of the department of sociology, Boston College, Chestnut Hill, MA 02167.]

American Journal of Economics and Sociology, Vol. 47, No. 3 (July, 1988).

issue has been further complicated by the fact that measures of absolute per capita income to the poorest groups have been based on exchange rate comparisons. These measures do not adjust for purchasing power differences between nations and therefore are inadequate for cross-national comparison. The present study is the first to use a measure of absolute per capita income to the poorest groups which adjusts for changes in purchasing power.

Our purpose here is to examine the relationship between economic development and the incomes of the poorest 40% of the population. Our goal is the development of statistical models which best represent the relationship between level of economic development and measures of income to the poorest 40%

FIGURE 1: LINEAR MODEL



for (1) the total sample; (2) the developing nations, and (3) the democratic industrial nations.

The discussion of choice of models is not only a statistical issue of goodness of fit. As we shall see, opinions about the proper specification of the statistical relationship are based on varying views of the consequences of economic development. This paper traces the empirical literature on the topic, points to some of the reasons for differences of opinion, specifies the equations which fit each theoretical position, and offers some choices based on careful comparisons.

II

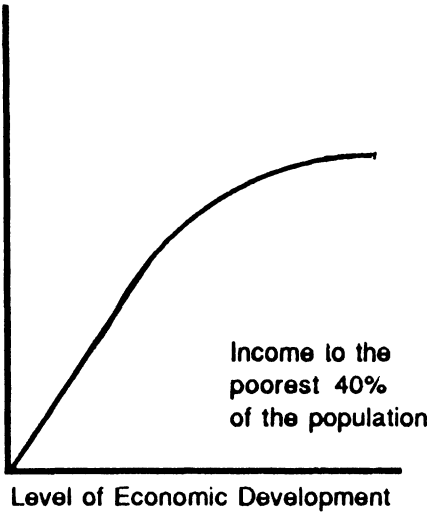
Theoretical Background

The Linear Model

Some writers have argued that low income groups benefit both relatively and absolutely through increased productivity. Their idea is that increasing the surplus allows more income to "trickle down" to low income groups. Aigner and Heins (1967) summarized this point of view in their statement that:

> . . . economic development per se may be a harbinger of social justice . . . and that is a rather comforting thought. That is not to suggest that social and economic policies designed to redistribute resources are useless, but, instead, that time and wealth accumulation are on the side of equality.[1]

FIGURE 2: LOGARITHMIC MODEL



The basic idea here is that higher levels of economic development bring higher levels of income to all groups, including the poorest segment of the population. This position is therefore represented by a positive linear relationship.[2] See Figure 1.

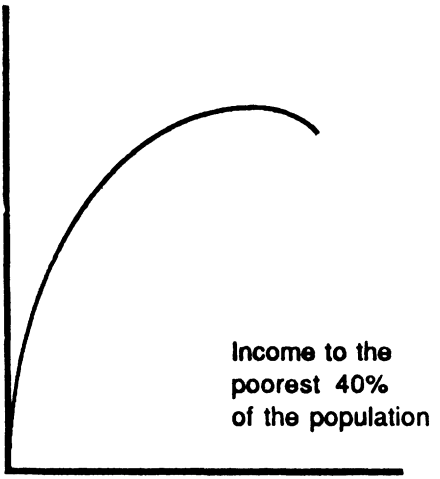
The Logarithmic Model

Other writers have argued that the relationship is not linear. One non-linear theory is that income to the poorest groups increases steadily from the lowest to the high levels of economic productivity, but that at the very highest levels of productivity, there are no further increases in the shares to the low income groups. In criticizing the linear model Goldthorpe (1969) argued that:

> . . . there are no grounds at all for regarding the regularity (*i.e.*, the poorer a society, the greater the 'skew' in distribution of income and wealth, as manifesting the operation of some process inherent in industrialization—of some general economic law—which will necessarily persist in the future and ensure a continuing egalitarian trend. Rather the possibility must be left quite open that where such a trend exists, it may at some point be checked—and at a point at which considerable economic inequality remains. . . . In fact, in my assessment, the relevant data suggest that such a check may already be occurring in some of the more advanced industrial societies of the West. . . .[3]

Jackman (1974, 1975) followed Goldthorpe's (1969) suggestion and argued that a curvilinear relationship exists between economic development and income distribution. His position was that in the initial stages of industrial development

FIGURE 3: QUADRATIC MODEL



there will be a more equal distribution of the surplus. After that initial improvement in equality, however, continued economic expansion will not produce continuing improvements in equality. As demonstrated by Jackman (1974, 1975) this relationship is represented by a logarithmic transformation of the measure of productivity.[4] See Figure 2.

The Quadratic Model

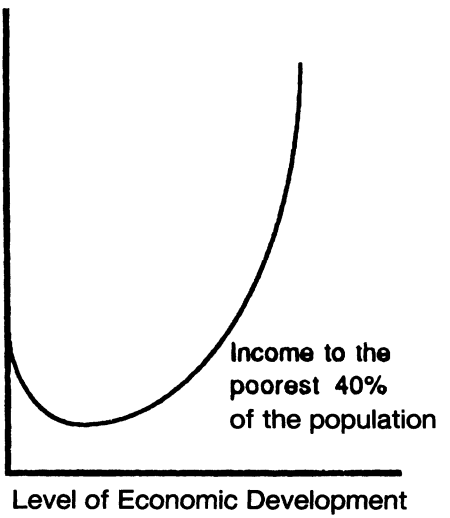
A variation on the preceding theme is that there is increased income distributed to the poorest groups as one moves from the lowest to the high levels of economic development, but that at the highest levels of development not only are there no further gains by the poorest segment of society, but there are actual losses to the lowest income groups (Lampman, 1962; Mrydal, 1963; Budd, 1970). This relationship is represented by a quadratic equation in which the sign of

the first coefficient is positive and the sign of the second coefficient is negative. See Figure 3.

The Log Quadratic Model

Another non-linear theory is that low-income groups receive a higher share in those countries with the very lowest levels of productivity. However, in the countries where productivity is somewhat higher, the low income groups receive a smaller share and do not benefit until productivity reaches still higher levels. Most writers credit Kuznets (1955, 1963) with the first suggestion of this U-shaped relationship, especially as it applies to lower income groups. Several researchers have found support for the U-hypothesis by first stratifying their

FIGURE 4: LOG QUADRATIC MODEL



sample by level of development and then testing for the relationship between development and income distribution within each strata (Oshima, 1962; Cutright, 1967a; Paukert, 1973). More recently researchers have found support for the U-hypothesis by utilizing a log quadratic formulation as a way to take non-linearities into account. Using this equation they have found the first coefficient to be negative and significant and the second coefficient to be positive and significant (Ahluwalia, 1974, 1976a, 1976b; Chenery and Syrquin, 1975; Weede, 1980; Bollen and Jackman, 1985). These findings suggest that there are decreases in the income share of the poorest 40% in the early stages of development and that the benefits of economic development do not reach this segment of the population until higher levels of development are attained.

There is substantial agreement on the U-hypothesis when some measure of relative income distribution, such as the Gini coefficient or the percentage of income received by the poorest 40% is utilized as the dependent variable. However, there is considerably less accord among researchers on a choice of models when some measure of absolute income to the poorest 40% is utilized.

This issue emerged when Adelman and Morris (1973) extended the argument for the U-hypothesis with their contention that the losses to the poor in the early stages of development were not only relative losses but were in fact absolute losses. They write:

> . . . When economic growth begins in a subsistence agrarian economy through the expansion of a narrow modern sector, inequality in the distribution of income typically increases greatly. . . . The position of the poorest 60 percent typically worsens, both relatively and absolutely. . . . Even when growth changes from the sharply dualistic form to one that is more broadly based, . . . the poorest 40% typically continues to lose both absolutely and relatively.[5]

Ahluwalia (1976a, 1976b) refuted the Adelman and Morris (1973) hypothesis that countries endure not only increasing relative inequality but also prolonged absolute losses for the lower income groups as a result of growing modern and of decline in traditional economic structures. Ahluwalia (1976b) argued that:

> . . . Against this bleak view of the development process, there is another explanation of the observed increase in relative inequality which is somewhat less pessimistic. On this view, increasing relative inequality is not due to absolute impoverishment but to unequal benefits from growth. Thus if economic expansion occurs in sectors and segments in which the initial benefits accrue to the upper income groups, and if these groups have relatively weak income linkages with the poorer income groups, we would expect income shares of the poorer groups to decline without any decline in their absolute incomes. . . .[6]

Ahluwalia (1976a, 1976b) tested the hypothesis of absolute income loss by using the estimated income shares of the lower income groups to calculate the per capita absolute income of these groups at different levels of per capita Gross National Product (GNP). The per capita absolute income of the 40th percentile was calculated as (Si/Sn)Y where Si is the percent of income received by the poorest 40%, Sn is 40% of a country's population, and Y is per capita GNP. When Ahluwalia (1976b) uses this measure of absolute per capita income to the poorest 40% he finds that while the first coefficient is negative it is not significant. He therefore rejects the U-shaped curve as describing the relationship between economic development and per capita income for the poorest 40%. When utilizing a measure of absolute per capita income to the poorest 40%, Ahluwalia (1976b) concludes that the relationship is linear.

We argue here that a problem with Ahluwalia's (1976b) measure of absolute income is that it is based on per capita GNP. Since per capita GNP is based on exchange rates it does not adjust for differences in purchasing power across nations. In this paper we utilize a measure of per capita income to the poorest

40% which makes that adjustment and reach quite different conclusions. See Figure 4.

III

Methods

WE HAVE REVIEWED these various models in order to demonstrate several issues of disagreement about the form of the relationship between economic development and income distribution. In this section we discuss methods used in this study to address those issues.

The first issue involves differences between relative and absolute measures of income distribution. As we have seen, some researchers argue that in the very early stages of economic development there is an increase in relative inequality, but that as development proceeds there is a reversal and further development brings increasing relative equality. This is typically referred to as the U-hypothesis. We have also seen that Adelman and Morris (1973) extended that hypothesis to include absolute as well as relative income losses to the poorest 40%. We shall address this issue in our analysis by utilizing both a measure of relative income to the poorest 40% and an improved absolute measure of per capita income to the poorest 40%.

A second issue which has been given less attention is the choice of different models for samples of developing versus samples of industrial nations. We shall compare all four models in each sample and demonstrate that the log quadratic U-shaped model emerges when either a sample of developing countries is utilized or when a mixed sample of developing and industrial countries is utilized. In either case researchers who choose this sampling strategy and then find support for the log quadratic relationship are placing much emphasis on the differences between countries which are very low in economic development and countries which are fairly low in economic development.

Other researchers argue that there is an increase in relative equality with economic development but that in the most advanced countries this relationship moderates. Thus they place their emphasis on the differences between countries which are high in economic development and countries which are very high in economic development. As we have seen this is a logarithmic model.

Our data enable us to test these conflicting perspectives as they apply to both relative and absolute income received by the poorest 40%. We shall argue below that the U-hypothesis of relative and absolute declines in income to the poorest 40% is not incompatible with the model of moderating improvements in income to the poorest 40% at the very highest levels of development. Both models capture a portion of the reality, and are not mutually exclusive findings. The U-

hypothesis, or log quadratic model applies to the sample of 54 developing countries. It will also apply to a combined sample of 68 developing and industrial countries. However this finding in the combined sample is largely the result of the fact that in combined samples there are many more developing countries and models fitted to that data reflect that fact. The logarithmic model, one of declining increases in income to the poor at the very highest levels of economic development can be demonstrated in a sample restricted to 14 industrial democracies.

In addressing the issues outlined above we test four different equations.

1. A linear model: $Y = A + B_1X$
2. A quadratic model: $Y = A + B_1X - B_2X^2$
3. A logarithmic transformation model: $Y = A + B_1 \ln X$
4. A quadratic model with logarithmic transformation: $Y = A - B_1 \ln X + B_2 \ln X^2$

Where Y equals the dependent variable, either percent of income received by the poorest 40%, or real per capita income received by the poorest 40% of the population, X equals energy consumption per capita, ln X equals the logarithm of energy consumption per capita, B_1 equals the first unstandardized regression coefficient, and B_2 equals the second unstandardized regression coefficient which is included in the quadratic models.

It should be noticed that in the quadratic model the sign of the first coefficient is positive and the sign of the second coefficient is negative, whereas in the log quadratic model the reverse is the case. This is not necessarily always the case in comparing these two models but rather reflects the relationship between level of development and income distribution. By spreading out scores at the lower end of the development scale and pulling in scores at the higher end of the development scale the logarithmic transformation detects the negative relationship at the low end of the scale.

In order to evaluate the models described above, we utilize cross-sectional regression analysis. Our sample consists of 54 developing and 14 industrial democratic nations on which data are available for both dependent variables, percent of income to the poorest 40%, and real per capita income of the poorest 40% of the population. The nation-State is treated as the unit of analysis and the data are measured at the aggregate level. Before presenting the analysis we shall describe the dependent variables. One of these variables, percent of income to the poorest 40%, is a relative measure with a long history of usage in cross-

national research on income distribution. It requires little further explanation. The second measure, one of absolute per capita income received by the poorest 40%, is a variation on a measure used in income distribution research at the World Bank. It was developed specifically for this research. We shall argue that it represents an improvement over measures of absolute income to the poorest 40% used in previous research.

IV

The Dependent Variables

SOCIAL EQUALITY HAS BEEN MEASURED in a variety of ways. One method which has received considerable attention is the measurement of income distribution. We find that some previous work has utilized questionable measures of income distribution. Jackman's (1975) use of the Schutz coefficient which measures degree of intersectoral income equality between eight economic sectors is one example. Degree of inequality between workers in agriculture, mining, manufacturing, construction, power, transportation, communication, commerce, and services is clearly not representative of the class differences which are typically thought of when income distribution is discussed.

Other studies have used the Gini coefficient as an overall measure of income distribution or the percentage of income going to different percentages of the population. These measures are more representative of the kind of class distribution that stratification theorists are concerned with and thus were an advance over the Schutz coefficient. However, these relative measures suffer from problems of comparison across nations. Ahluwalia (1974) states that ". . . the limitations of a purely relative approach are self-evident: changes in relative equality tell us little about changes in income levels of the poor unless we also know what has happened to total income."[7] An example of this problem is shown in a comparison of the percent of a nation's income which is received by the poorest 40% of the population. In the United States, Italy, Panama, Fiji and Malawi the poorest 40% of the population received 15% of income in 1970. While we doubt that anyone would seriously argue that all of these groups receive comparable incomes the fact remains that with this as a dependent variable any statistical analysis will treat them as equivalent.

Simply stated, these relative measures do not answer the question: "15% of what?" We contend that it is better to have 15% of a dollar than 50% of a dime and believe that international comparisons of income distribution need to take this reality into account. Realizing that relative measures cannot do that, researchers at the World Bank developed a measure of absolute per capita income based on a country's GNP.

While this measure represented an improvement over the relative measures, since they were based on GNP they did not address the issue of purchasing power differences between nations. Is it better to receive a dollar in the United States or a dime in Malawi? If the dime will buy food for a day in Malawi while the dollar in the United States serves only as partial payment of a single meal, we contend that the dime in Malawi is the higher income. That fact should also be taken account of in measures of income to the poorest 40%.

Until recently these issues were unresolvable since comparisons of real gross domestic income were based on foreign exchange rates rather than purchasing power. Kravis (1978) summarizes the problem of exchange rate comparison:

> It is widely appreciated that the exchange-rate conversions of the Gross Domestic Products (GDPs) of different countries to a common currency such as the United States dollar do not yield a reliable basis for international comparisons. Detailed studies measuring the purchasing power parities (PPPs) of different countries show clearly that the purchasing power over GDP of the currencies of low-income countries is systematically greater than their exchange rates as compared to the purchasing power/exchange rate relationship for high income countries. Correspondingly, the real per capita GDP of low-income countries relative to that of high-income countries is greater than as indicated by comparisons based on exchange rate conversions of GDP's to a common currency.[8]

Recently, Summers and Heston (1984) have developed a structural relationship between purchasing power parities and exchange rates based on a larger data set than was previously available and which also takes into account exchange rate variability over time. Using this relationship they have developed a set of international comparisons of Real Gross Domestic Income per capita in 124 countries for each year between 1950 and 1980.

Real Per Capita Income of the Poorest 40%

In this study we shall utilize the Summers and Heston (1984) measure of Real Gross Domestic Income per capita in order to create an absolute measure of Real Per Capita Income of the poorest 40% of the population. This measure was constructed by multiplying the percentage of total disposable household income received by the poorest 40% in 1970 (World Bank, 1979; Jain, 1975; Ahluwalia, 1975; Chenery *et al.*, 1974; Paukert, 1973) by Real Gross Domestic Income per capita in 1970 (Summers and Heston, 1984), then dividing that product by .40. The measure is, therefore, identical to the measure of absolute per capita income of the poorest 40% which was developed and used in previous research at the World Bank (Ahluwalia, 1976a, 1976b; Chenery and Syrquin, 1975), with the important exception that it is based on Real Gross Domestic Income Per Capita, rather than on per capita GNP.

Conceptually the formula for the dependent variable, absolute per capita income received by the poorest 40% of the population is:

$$D = I/.4P \times RP$$

Where:

I = percent income received by the poorest 40% of a nation's population in 1970.
.4P = 40% of the 1970 population of a nation.
R = Real Gross Domestic Income per capita of a nation in 1970.
D = Dependent Variable: Absolute per capita income received by the poorest 40% of a nation's population in 1970.

Since P is cancelled out in the conceptual formula presented above the computational formula becomes:

$$I/.4 \times R = D$$

This gives us a dependent variable which better allows for cross-national comparison. Above we indicated that in the United States, Italy, Panama, Fiji, and Malawi the poorest 40% of the population received 15% of the income, and thus are treated as equivalent in any statistical analysis which uses percent of income as a dependent variable. The situation changes dramatically when our measure of the real per capita income received by the poorest 40% of the population is used. The corresponding figures are 2519 in the United States, 1425 in Italy, 685 in Panama, 540 in Fiji, and 96 in Malawi. We present the values of the dependent variable for the industrial democracies in Appendix 1, and for the developing countries in Appendix 2. We believe that these figures more accurately portray the situation of the poorest 40% in these different countries than do percentages of income received. They also provide a measure which we can use to test the different models of the relationship between level of economic development and income to the poorest 40%.

Percent of Income Received by the Poorest 40%

We have also retained a relative measure of income distribution, the percent of income received by the poorest 40% of the population in 1970. (Source: World Bank, 1979; Jain, 1975; Ahluwalia, 1975; Chenery *et al.,* 1974; Paukert, 1975).

V

The Independent Variable

LEVEL OF ECONOMIC DEVELOPMENT is measured as energy consumption per capita (in kilograms of coal equivalents) in 1970. (Source: Taylor and Jodice, 1983). This measure is preferred over GNP per capita both because of its theoretical relevance to industrial development and its clearer measurement across nations.

Let us now turn to an analysis of the different forms of the relationship between level of economic development and income received by the poorest 40%.

VI

Findings: Total Sample

TABLE 1 PRESENTS FINDINGS of the comparison between the linear, quadratic, logarithmic, and log quadratic models for the total sample. We shall first examine

Table 1: Unstandardized regression coefficients and percentage of variance explained by each of the four models: Total sample.

	PERCENT INCOME TO THE POOREST 40%			
	LINEAR	QUADRATIC	LOGARITHMIC	LOG QUADRATIC
N=68				
ENPC	0.0006**	0.001*		
$(ENPC)^2$		-0.0000007		
LnENPC			0.42	-8.01**
$(LnENPC)^2$				0.67**
R^2	.11	.12	.03	.23

	REAL PER CAPITA INCOME TO THE POOREST 40%			
	LINEAR	QUADRATIC	LOGARITHMIC	LOG QUADRATIC
N=68				
ENPC	0.30**	0.57**		
$(ENPC)^2$		-0.00003**		
(LnENPC)			421.90**	-1129.61**
$(LnEPC)^2$				123.20**
R^2	.80	.89	.69	.87
Cook's D	2.97			
United States				
WITH UNITED STATES EXCLUDED:				
N=67				
ENPC	0.36**	0.57**		
$(ENPC)^2$		-0.00003**		
LnENPC			412.29**	-1192.46**
$(LnENPC)^2$				128.77**
R^2	.83	.88	.67	.86
Cook's D	3.55	4.51		
Canada				
WITH UNITED STATES AND CANADA EXCLUDED:				
N=66				
ENPC	0.10**	0.47**		
$(ENPC)^2$		-0.00001		
LnENPC			402.94**	-1254.93**
$(LnENPC)^2$				134.35**
R^2	.87	.88	.65	.85

ENPC: Energy consumption Per Capita.
LnENPC: Natural Logarithm of Energy consumption Per Capita.
R^2: percentage of variance explained.
**: $p<.01$ *: $p<.05$

results with percent of income received by the poorest 40% of the population dependent. The choice of models here is quite clear. The quadratic equation can be eliminated since the second coefficient (B_2) is insignificant. The logarithmic model can also be eliminated since its coefficient (B_1) is not significant.

That leaves us with a choice between the linear model and the log quadratic model. The former explains only 11% of the variance while the latter explains 23% of the variance. Thus we conclude that in the total sample a log quadratic model best describes the relationship between level of economic development and our relative measure, percent of income received by the poorest 40%. This finding is consistent with previous research findings of support for the U-hypothesis with a relative measure of income distribution as the dependent variable (Ahluwalia, 1976a, 1976b; Chenery and Syrquin, 1975; Weede, 1980; Bollen and Jackman, 1985).

TABLE 2: Unstandardized regression coefficients and percentage of variance explained by each of the four models: Developing Nations.

	PERCENT OF INCOME TO THE POOREST 40%			
	LINEAR	QUADRATIC	LOGARITHMIC	LOG QUADRATIC
N=54				
ENPC	-0.0006	0.0002		
$(ENPC)^2$		-0.0000003		
LnENPC			-0.69	-7.35*
$(LnENPC)^2$				0.59
R^2	.01	.01	.04	.12
Cook's D	.39	1.27	.08	.37
South Africa				
WITHOUT SOUTH AFRICA				
N=53				
ENPC	0.0001	-0.0002		
$(ENPC)^2$		0.000001		
LnENPC			-0.55	-9.75**
$(LnENPC)^2$				0.83**
R^2	.01	.02	.03	.16
	REAL PER CAPITA INCOME TO THE POOREST 40%			
	LINEAR	QUADRATIC	LOGARITHMIC	LOG QUADRATIC
N=54				
ENPC	0.36**	0.84**		
(ENPC)2		-0.0002**		
LnENPC			192.05**	-486.38**
$(LnENPC)^2$				60.55**
R^2	.52	.64	.49	.59
Cook's D	3.25	4.07	0.17	1.02
South Africa				
WITHOUT SOUTH AFRICA				
N=53				
ENPC	0.48**	0.64**		
$(ENPC)^2$		-0.00008		
LnENPC			206.11**	-721.18**
$(LnENPC)^2$				82.23**
R^2	.69	.70	.52	.69

ENPC: Energy consumption Per Capita
LnENPC: Natural Logarith of Energy Consumption Per Capita
R^2: percentage of variance explained.
**: $p<.01$ *: $p<.05$

The analysis with the absolute measure of income to the poorest 40% is more complex. If we look at results in the total sample (N = 68) without any analysis of influential cases we have a difficult choice of models. All coefficients are

significant. Proportion of variance explained is also high for all. If our analysis ended here then the only model that we could say is clearly inferior is the logarithmic transformation, since the R^2 is .69 for that model. Since the Cook's D of 2.97 is high for the U.S. in the linear model, we then performed the model comparisons after excluding the U.S.

We found that if we exclude the United States from the analysis (N = 67), the overall picture does not change much. The percentage of variance explained

Table 3: Unstandardized regression coefficients, and percentage of variance explained by the linear and the log quadratic models, with the very poorest nations excluded: Developing Nations.

REAL PER CAPITA INCOME TO THE POOREST 40%

WITHOUT SOUTH AFRICA

	LINEAR	LOG QUADRATIC
N=53		
ENPC	0.48**	
LnENPC		-721.18**
$(LnENPC)^2$		82.23**
R^2	.69	.69
		4.4 turning point

WITHOUT SOUTH AFRICA AND THE POOREST 8 COUNTRIES[11]
Niger, Chad, Benin, Malawi, Burma, Tanzania, Madagascar, Uganda.

	LINEAR	LOG QUADRATIC
N=45		
ENPC	0.48**	
LnENPC		-1329.88**
$(LnENPC)^2$		132.35**
R^2	.66	.68
		5.0 turning point

WITHOUT SOUTH AFRICA AND THE POOREST 13 COUNTRIES[12]
Niger, Chad, Benin, Malawi, Burma, Tanzania, Madagascar, Uganda, Indonesia, Sudan, Senegal, Sierra-Leone, Sri-Lanka

	LINEAR	LOG QUADRATIC
N=39		
ENPC	0.48**	
LnENPC		-1569.92
$(LnENPC)^2$		150.59**
R^2	.63	.65

ENPC: Energy consumption Per Capita
LnENPC: Natural Logarithm of Energy Consumption Per Capita
R^2: percentage of variance explained.
**: p<.01 *: p<.05

by the linear model increases slightly, but the Cook's D for Canada is high for both the linear and the quadratic formula, 3.55 and 4.51 respectively.

If we exclude both the United States and Canada from the analysis (N = 66), then we can eliminate the quadratic from consideration since the second coefficient (B_2) is now insignificant. The logarithmic transformation continues to explain the least amount of variance and so is still eliminated. The choice of models is limited to a linear model which suggests that with economic development there is uninterrupted improvement in the absolute per capita income

received by the poorest 40% of the population; and a quadratic after logarithmic transformation which suggests that in the countries which are lowest in economic development the bottom 40% of the population receives a higher absolute per capita income than in the countries which are somewhat higher in economic development, but that in all higher levels of economic development the bottom 40% receives increasingly higher absolute shares.

Our decision is to leave in the United States and Canada and to use the quadratic after logarithmic transformation. This model is not influenced by extreme cases and explains as much variance as the linear equation. Our decision here follows the recommendation of Bollen and Jackman (1985) to avoid the removal of cases if other remedies are possible. They write: ". . . the idea that case

Table 4: Unstandardized regression coefficients and percentage of variance explained by each of the four models: Industrial Democracies.

	PERCENT INCOME TO THE POOREST 40%			
	LINEAR	QUADRATIC	LOGARITHMIC	LOG QUADRATIC
N=14				
ENPC	-0.00009	0.002		
$(ENPC)^2$		-0.000001		
LnENPC			-0.14	50.09
$(LnENPC)^2$				-2.92
R^2	.01	.10	.01	.05
	REAL PER CAPITA INCOME TO THE POOREST 40%			
	LINEAR	QUADRATIC	LOGARITHMIC	LOG QUADRATIC
N=14				
ENPC	0.11*	0.50*		
$(ENPC)^2$		-0.00003		
LnENPC			719.95*	8591.06
$(LnENPC)^2$				-458.97
R^2	.32	.48	.40	.44

ENPC: Energy consumption Per Capita.
LnENPC: Natural Logarithm of Energy consumption Per Capita.
R^2: percentage of variance explained.
*: $p<.05$

removal is the only remedy for apparently influential cases is quite misleading. In fact, case removal is the most severe remedy—sometimes, as in the present example, less severe action such as a change in functional form is optimal."[9]

The example under consideration in the Bollen and Jackman (1985) analysis is the relationship between energy per capita and income distribution. They conclude, as we do, that the quadratic after logarithmic transformation is the best choice.

VII

Findings: Developing Nations

FINDINGS ON DIFFERENT MODELS for developing nations are presented in Table 2. In analyzing the developing nations we find that South Africa is an influential

outlier, with high Cook's Ds throughout. Here we argue that the elimination of South Africa from the sample is warranted. The apartheid system of South Africa prevents the poorest 40% of the population from benefiting from increased productivity in ways which are not typical of the rest of the sample. Since the logic of statistical model analysis is to search for typical patterns and South Africa's inclusion alters the pattern in ways which are not typical of the whole, we believe that the exclusion of this nation is the most appropriate solution. When South Africa is eliminated from the sample we find that the percentage of variance explained by each model increases. We present results with (N = 54) and without (N = 53) South Africa in Table 2.

As in the analysis of the total sample when percent of income received by the poorest 40% of the population is the dependent variable the choice of models is straightforward. Only the log quadratic model has significant coefficients, and that model explains the greatest variance. Thus the U-hypothesis of relative income losses to the poorest 40% is confirmed in the sample of developing countries, as it was in the total sample.

When we turn our attention to the measure of absolute per capita income received by the poorest 40% we find that we can eliminate the quadratic model since the second coefficient (B_2) is not significant when South Africa is removed. We can also eliminate the logarithmic model since it is inferior to the other models in terms of percentage of variance explained. We are left once again with a choice between the linear model and the quadratic after logarithmic transformation of energy per capita. Both explain an equal percentage of variance. We can therefore not eliminate the U-hypothesis from consideration with a measure of absolute income to the poorest 40%. This finding challenges the finding of Ahluwalia, (1976a, 1976b) and Chenery and Syrquin (1975) that when a measure of absolute income received by the poorest 40% is dependent, the first coefficient is nonsignificant. We find, as indicated in Table 2, that with the sample of developing countries, that the first coefficient is both negative and significant.

We were concerned, however, that the significant negative effect was caused by only a few countries. Since we did not wish to challenge the Ahluwalia (1976a, 1976b) finding that absolute income to the poorest 40% does not increase between the very lowest and the lower levels of development without sufficient cause we performed further analysis.

Our strategy was to (1) calculate the turning point for the log quadratic equation; (2) eliminate those countries below that turning point from the analysis; (3) compare the regression results of the linear versus the log quadratic equation in the sample without countries below the turning point. The results are presented in Table 3.

First we calculated a turning point for the log quadratic equation for all developing countries, excluding only South Africa from the analysis. That turning point was calculated as 4.4.[10] We then eliminated those eight countries that were below that point from the analysis and performed the regressions again.

As can be seen in Table 3 both coefficients in the log quadratic equation are still significant. The effect of this exercise was essentially to shift the turning point to the right and not to eliminate the early negative relationship. The turning point for this equation when the poorest eight countries are eliminated is a log of energy per capita of 5.0.

We then eliminated the 13 countries with a log energy per capita below the turning point of 5.0 and performed the regressions once more. It is only when we eliminate the poorest 13 countries, those with a log energy per capita below 5.0, that the negative coefficient in the log quadratic equation becomes nonsignificant. We have therefore decided that the log quadratic model is the best choice to represent the relationship between economic development and real per capita income to the poorest 40%. This decision is consistent with our earlier decision to use this model for the total sample. If there is a turning point in the total sample which includes these nations, and the turning point occurs in the total sample among the developing countries, then it stands to reason that the turning point continues in the restricted sample of developing nations.

VIII

Findings: Industrial Democracies

FINDINGS FOR THE 14 INDUSTRIAL DEMOCRATIC NATIONS are presented in Table 4. We are unable to reach a conclusion when using the relative measure of percent of income received by the poorest 40%. None of the coefficients are significant and the percentage of variance explained is negligible. This is essentially a result of the small sample size.

When we use the absolute measure of real per capita income received by the poorest 40% as the dependent variable we are able to reach a conclusion, even with the small sample. First, we can eliminate the quadratic equation since its second coefficient (B_2) is not significant. We can also eliminate the quadratic after logarithmic transformation since neither coefficient is significant. We are left with a choice between a linear model which explains 32% of the variance and a logarithmic model which explains 40% of the variance. It appears then that the logarithmic transformation provides the best fit based on the percentage of variance explained.

IX

Conclusions

WE HAVE PRESENTED and compared different models of the relationship between level of economic development and income received by the poorest 40% of the population. Four models were tested: (1) linear, (2) quadratic, (3) logarithmic, and (4) log quadratic. In comparing the models we used two dependent variables: (1) a relative measure of income distribution, percent of income received by the poorest 40% of the population, and (2) a measure of absolute per capita income received by the poorest 40% of the population. The measure of absolute per capita income was based on the Summers and Heston (1984) measure of real gross domestic income. It therefore corrects for purchasing power differences between nations. Previous measures of absolute per capita income received by the poorest 40% have not done that.

We conclude that the relationship between economic development and income distributed to the poorest 40% is best represented differently for different

Appendix 1: Real Per Capita Income (US$,1970) of the Poorest 40% of the Population, Industrial Democracies. n=14

Finland	1330.58	Japan	2212.87
Italy	1425.45	Germany-Fed-Rep	2249.52
France	1776.95	Denmark	2336.42
New-Zealand	1840.96	Canada	2395.26
United Kingdom	1992.06	United States	2519.02
Netherlands	2157.07	Australia	2789.88
Norway	2165.28	Sweden	2967.31

samples. For the total sample and for the developing nations the relationship is best represented by a quadratic after logarithmic transformation of energy production per capita. This is the model of choice when either the relative or the absolute measure of income received by the poorest 40% is used. This is strong support for the U-hypothesis. For the industrial democracies the small sample size prevents us from drawing any conclusions if we use the relative measure of income. However, when we use the absolute measure we can conclude that the relationship is best represented by a model using a logarithmic transformation of energy production per capita.

Taken together the findings of the analysis suggest the following conclusions: (1) the situation of the poorest 40% appears to be better in those countries which are very low in economic development than in those countries that are low in economic development (2) the situation of the poorest 40% is increasingly improved by economic development in those countries which are in middle and high levels of economic development (3) in those industrial nations at the very highest levels of economic development, the real per capita incomes of

the poorest 40% is not greater than the real per capita incomes of the poorest 40% in the those countries that are high in economic development. Further increases in productivity at the highest levels does not lead to increased income "trickling down" to the poorest 40%. We recommend the usage of models which reflect these relationships in future research on income received by the poorest 40% of the population.

Appendix 2: Real Per Capita Income (US$,1970) of the Poorest 40% of the Population, Developing Nations. n=54

Malawi	96.38	Thailand	261.03	S. Korea	469.82
Sierra-Leon	104.40	Bolivia	263.06	Costa Rica	480.30
Ecuador	124.02	Egypt	266.14	Gabon	510.85
Burma	132.00	Uganda	271.41	Mexico	516.29
Tanzania	132.98	Ivory Coast	272.42	Fiji	540.20
Honduras	166.08	El-Salvador	279.42	Iran	555.31
Indonesia	169.11	Peru	284.55	Panama	685.52
Benin	171.82	Tunisia	289.56	Chile	700.15
India	193.50	Pakistan	290.46	Hong-Kong	781.95
Senegal	200.50	Malaysia	329.13	Uruguay	940.04
Chad	209.41	Columbia	338.75	Venezuela	944.25
Madagascar	210.28	Dominican-Rep	345.03	Argentina	969.30
Brazil	214.38	Morrocco	346.55	Suriname	1056.48
Niger	218.25	Sri-Lanka	367.20	Barbados	1084.84
Philippines	232.35	South Africa	375.03	Cyprus	1106.91
Zambia	234.65	Jamaica	377.40	Greece	1162.32
Iraq	260.33	Turkey	401.28	Israel	1384.69
Sudan	260.63	Guyana	424.13	Spain	1437.79

Notes

1. Aigner and Heins, p. 180.
2. Each of the models described is diagrammed in Figures 1 to 4.
3. Goldthorpe, p. 456.
4. Jackman (1975) also tried a linear relationship and a quadratic. He rejected the linear since it explained the least variance and the quadratic on several grounds: "First, there are theoretical reasons for placing more emphasis on the logarithmic curve, . . . The intercept term is smaller for the logarithmic than the polynomial specification. Such a strong relationship at lower levels of economic development is exactly what we would expect in light of Goldthorpe's (1969) argument. Second, inspection of the scatterplots . . . suggests that the negative slope of the polynomial model at higher levels of economic development . . . may simply reflect an oversensitivity of this specification to the effects of the United States as an outlier. . . . Finally, the criterion of parsimony implies that the logarithmic specification is preferable to the polynomial because it is simpler (bivariate rather than multivariate) . . ." (p. 39).
5. Adelman and Morris, pp. 179–80.
6. Ahluwalia, 1976a, p. 331.
7. Ahluwalia, 1974, p. 11.
8. Kravis, *et al.*, pp. 215–16.
9. Bollen and Jackman, p. 532.

10. Turning points were calculated using the formula

$$Dy/Dx = b + 2cX = 0$$

Thus in the first comparison:

Where: $b = -721.38$

$c = 82.23$

If: $b + 2cX = 0$

Then: the turning point is X

$$X = -b/2c$$

$$X = -721.18/2(82.23)$$

$$X = 4.4$$

11. Log Energy Per Capita less than 4.4.
12. Log Energy Per Capita less than 5.0.

Bibliography

Adelman, Irma and Cynthia T. Morris, 1973, *Economic Growth and Social Equity in Developing Countries.* (Stanford, CA: Stanford Univ. Press.)

Ahluwalia, Montek S., 1974, "Income inequality: some dimensions of the problem," pp. 3–37 in Hollis Chenery *et al., Redistribution with Growth.* (London: Oxford Univ. Press.) 1976a, "Inequality, poverty, and development." *Journal of Development Economics,* 3:307–342. 1976b, "Income distribution and development: some stylized facts." *American Economic Review,* 66:128–35.

Aigner, Dennis J. and A. J. Heins, 1967, "On the determinants of income inequality." *American Economic Review,* 57:175–184.

Allison, Paul D., 1978, "Measures of inequality." *American Sociological Review,* 43:865–80.

Atkinson, Anthony B., 1975, *The Economics of Inequality,* (Oxford: Oxford Univ. Press.) 1970, "On the measurement of inequality." *Journal of Economic Theory,* 2:244–63.

Bollen, Kenneth A. and Robert W. Jackman, 1985, "Regression diagnostics: an expository treatment of outliers and influential cases." *Sociological Methods and Research,* 13:510–42.

Budd, Edward, 1970, "Post-war changes in the size distribution of income in the United States." *American Economic Review,* 60:247–260.

Chenery, Hollis and Moises Syrquin, 1975, *Patterns of Development 1950–1970.* (London: Oxford Univ. Press.)

Cutwright, Philips, 1967a, "Inequality: a cross-national analysis." *American Sociological Review,* 32:562–78. 1967b, "Income redistribution: a cross-national analysis," *Social Forces,* 48:180–90.

Goldthorpe, John A., 1969, "Social stratification in industrial society," pp. 452–465 in Celia S. Heller (ed.), *Structured Social Inequality,* New York: Macmillan.

Hewitt, Christopher, 1977, "The effect of political democracy and social democracy on equality in industrial societies: a cross-national comparison," *American Sociological Review,* 42: 450–64.

Jackman, Robert W., 1974, "Political democracy and social equality: a comparative analysis," *American Sociological Review,* 39:29–45. 1975, *Politics and Social Equality: a comparative analysis* (New York: Wiley.) 1980b, "The impact of outliers on income inequality," *American Sociological Review,* 45:344–47.

Jain, Shail, 1975, *Size Distribution of Income: A Compilation of Data.* (Washington: The World Bank.)

Kravis, Irving B., Alan W. Heston, and Robert Summers, 1978, "Real GDP per capita for more than one hundred countries," *The Economic Journal,* 88:200–216.

Kuznets, Simon, 1963, "Quantitative aspects of the economic growth of nations, VIII: the distribution of income by size." *Economic Development and Cultural Change,* 11:1–80. 1955, "Economic growth and income inequality." *American Economic Review,* 45:1–28.

Lampman, Robert J., 1962, *The Share of Top Wealth-Holders in National Wealth.* (Princeton: Princeton Univ. Press.)

Myrdal, Gunnar, 1963, *Challenge to Affluence.* New York: Vintage Books.

Neter, John, William Wasserman, and Michael H. Kutner, 1983, *Applied Linear Regression Models.* (Homewood, IL: Irwin.)

Oshima, H., 1962, "The international comparison of size distribution of family incomes with special reference to Asia." *Review of Economics and Statistics.* Nov.

Paukert, Felix, 1973, "Income distribution at different levels of development: a survey of evidence." *International Labor Review,* 108:97–125.

Summers, Robert and Alan Heston, 1984, "Improved international comparisons of real product and its composition: 1950–1980." *Review of Income and Wealth,* 30:207–62.

Taylor, Charles L. and David A. Jodice, 1983, *The World Handbook of Political and Social Indicators III: 1948–1977.* (Ann Arbor: The Inter-University Consortium for Political and Social Research.)

Weede, Eric, 1980, "Beyond Mis-specification in the sociological analysis of income inequality." *American Sociological Review,* 45:497–501.

Hope for a Free Society

DURING THE DEPRESSION of the 1890s, Ernest B. Gaston, an Iowa journalist, led a group of midwesterners disaffected by the abuses of human rights in American industrialization to the eastern shore of Mobile Bay. There they established the utopian colony of Fairhope, Alabama, to put into practice the ethical democracy philosophy of Henry George.

The group practiced "cooperative individualism," whereby the land was publicly owned and, for its imputed rent, given into the secure possession of those who used it. All other property was privately owned and improvements in or on the land were exempted from taxation. The community was run on the basis of participatory democracy, with women playing an equal role with men. Three crusaders for the free society George envisioned, Nancy Lewis, Marie Howland and Marietta Johnson, were their leaders.