II.B.2. WHAT IS THE RELATION BETWEEN INEQUALITY AND ECONOMIC GROWTH?

We begin with an overview of income distribution theory and of reasons given for the growth of inequality in the industrial countries. Then we review in more detail the ways in which economic growth and inequality might influence one another. We conclude with a summary and assessment.

II.B.2.a. Overview

1. What determines the distribution of income?

The two major theoretical approaches to the study of income distribution are those of political economics/structuralist analysis and neo-classical economics.[1] In the following notes we focus on the neo-classical approach, broadly defined, although political economic considerations enter at many points.

The neo-classical approach takes endowments as given and assumes that factors earn their marginal products in competitive markets. Utility maximizing agents behave in ways that equate various marginal costs and benefits, and in so doing determine wages, prices, rents and factor income shares. A model of the personal distribution of income would need to include a demographic element that specifies a distribution of factors among individuals, households, or other units of interest. It might also include a public sector that can intervene in markets. A complete model would also need to show household responses to changes in wages, prices, taxes and transfers, with particular attention to the allocation of time between labor and leisure.

If the model is to depict changes in the distribution of income over the long run it needs to be embedded within a general equilibrium framework that shows savings, investment and endogenous growth. It would need to include a human capital production function, and show the

[1] Pan (1996) lists additional theoretical approaches and elements that have been used in the study of the distribution of income, including individual choice theory, human capital theory, stochastic theory, educational inequality theory, life-cycle theory, public income distribution theory, distributive justice theory and inheritance theory.

relation of technology and human capital. If the long run of interest is multigenerational, parent utility functions that include some measure of descendants' well-being would be required.

Recent models of income distribution have included external effects, such as that provided by the "average level of human capital" on the ability of any individual to acquire additional human capital. Other recent models have included endogenous policy elements. These allow rational, utility-maximizing political actors to seek to modify market outcomes by referenda, influence or other means.

Analytic models of income distribution have provided insights but a general theory has yet to be realized. More modest research programs use empirical models and statistical analysis to identify variables that appear to be significantly correlated with measures of income distribution. A third approach involves the use of large scale simulation models that attempt to mimic complex economic systems and give numerical results concerning the distribution of income.

2. Why has inequality been increasing in the mature industrial economies?

We saw in Section B.1 that the distribution of earnings or income in most industrial countries has become more unequal in recent years. Explanations for this include:

a) demographic changes, including changes in age distribution, family size, martial status, migration and immigration, and assortive mating

b) greater returns to higher education and skills, including technological skills, "symbolic analyst" skills, and interactive skills

c) globalization, free trade, and increased international competition

d) economic restructuring, de-industrialization, and down-sizing

e) declining union membership and strength

f) governmental policies, including erosion of the minimum wage, social service cuts, and tax cuts favoring high income brackets

g) growth of winner-take-all markets for many goods and services

Clearly each of these might contribute, in different ways and to different degrees, to the growth of inequality. Analysis is complicated by the fact that many of these proposed causes may themselves be causally related.

Changes in age distribution, family size and other demographic variables do not appear to have contributed greatly to inequality (Danziger and Gottschalk, 1995). However, assortive mating may have contributed somewhat to the large income gains realized by upper-middle income households (Pryor, 1996).

Tax and spending policies appear not to have been a major cause of inequality in the industrial countries (Gottschalk and Smeeding, 1996). One study estimated that 85% of the increase in inequality since the late 70's was due to changes in pre-tax wages and salaries, while 15% was due to the Reagan/Bush tax cuts for the wealthy and social service cuts for the poor.[2]

Economic changes associated with increased trade have probably served to worsen the distribution of income, but the magnitude is uncertain. (Danziger and Gottschalk, 1995).

Many analysts believe that the increased demand for, and greater returns to, technological skills and education is perhaps the most clearly significant contributor to growing inequality in the United States. (Murphy and Welch 1993; Bound and Johnson 1992; Berman et al. 1993.)

In a survey of possible causes of the growth in inequality experienced by industrial countries other than the United States, Smeeding and Gottschalk (1996) were unable to find many clear common patterns. They suggested that public sector policies, including centralized wage setting, may have moderated the impact of a growing demand for skilled labor in some of these countries.

The Federal Reserve Bank of New York (1994) surveyed eighteen noted academics and other analysts for their estimate the share of the growth in economic inequality in the United States that might be attributed to different factors. The results were:

[2] I have not been able to identify the source for this report, but am continuing to try to do so.

technological change that rewards higher education:	50%
decline of union membership:	10%
growth of global trade:	10-20%
erosion of the minimum wage:	9%

A review by Danziger and Gottschalk (1995) concluded that for the United States,

> "The literature identifies no single cause for the increased earnings inequality of the past two decades. Many factors moved the economy in the same direction: a shrinking percentage of the workforce belonging to unions; a shift of jobs away from manufacturing; increased global competition and the consequent expansion of the import and export sectors. The introduction and widespread use of computers and other technological innovations also increased demand for skilled personnel who could run the more sophisticated equipment. Simultaneously, demand for less-skilled workers declined, as they were displaced by automation or had to compete with new imports." (p 149)

Finally, no less a figure than Felix Rohatyn of Lazard Freres (1996) has stated that:

> "The big beneficiaries of our economic expansion have been the owners of financial assets and a new class of highly compensated technicians working for companies where profit-sharing and stock ownership was widely spread. What is occurring is a huge transfer of wealth from lower-skilled middle-class American workers to the owners of capital assets and to the new technological aristocracy."

Below we consider the ways in which economic growth and inequality influence one another. We look first at ways in which economic growth might affect the distribution of income, and second at ways in which the distribution of income might affect growth. This partition is analytically unsatisfying because any compelling account of growth and inequality would focus on the results of their reciprocal influence. But most studies have focused on one or the other causal direction. I include comments on several studies that have attempted to model reciprocal influence.

II.b.2.b. How Does Economic Growth Affect the Distribution of Income?

1. The Kuznets Curve

Kuznets (1955) proposed an intuitive model based on rural-to-urban migration that appeared to be consistent with historical patterns of economic growth and inequality in Europe,

and which he believed might apply to modern developing nations as well. [3] Kuznets suggested that in the early periods of rural-to-urban migration new immigrants could be expected to occupy a wider range of income levels than they did in their less stratified rural home regions, and that this would tend to worsen the aggregate distribution of income. However, after a certain portion of the rural population had moved to the cities income inequality would begin to decline. This would happen because as the rural population shrinks it begins to represent an extreme population on one tail of the total income distribution. At that point a move to the city reduces the income inequality of the entire population.

Kuznets' migration-based explanation did not hold up under further study and was replaced by more sophisticated models of development, including dual-economy and labor surplus theories. The existence of the Kuznets curve itself appeared to be confirmed by numerous studies, but these relied heavily on cross-sectional data, rather than time-series data, and were thus open to question. In any event the experience of growth and development from the 1960's on did not conform to the predictions of the Kuznets curve, and today it is regarded as a possible scenario of development, not a likely one.

2. The Deininger-Squire (DS) Data Set

A recent study by Deininger and Squire (1996a), using a high-quality set of tightly comparable time-series statistics, found that for 39 of 48 countries (81%), no significant relation between the level of income and the level of inequality could be found. In four cases (India, USA, UK and Costa Rica), they found a statistically significant U-shaped relation between income and inequality, and in three cases (Mexico, Philippines and Trinidad) they found a statistically significant inverted-U [4].

[3] Kuznets supported his account with only a very few empirical data—scattered income distribution estimates for the United States, Germany and England in the late 19th and early 20th century, and single year distribution estimates for India (1949-1950), Ceylon (1950) and Puerto Rico (1948).

[4] Two other cases--Brazil and Hungary--showed a statistically significant inverted-U but had other data problems that reduced confidence.

Tests using the new data set also revealed little relation between rates of economic growth and changes in the level of inequality. During 88 "periods of growth," inequality decreased during 45 of them and increased during 43. During seven "periods of decline," inequality decreased during two and increased during five.[5] In a companion study Deininger and Squire (1996b) did find that in developing countries a more equal distribution of land was associated with more rapid subsequent economic growth. However, this relationship did not hold for the industrial countries.

Boxes IIB-18 and **IIB-19** show how levels and rates of growth of per capita GDP and inequality for 18 industrial countries vary with one another. IIB-18 shows no significant relation between the level of inequality and the rate of per capita GDP growth during the period 1985-1994 ($p = .06$; $R^2 = .18$; without Hong Kong, $p = .48$). Figure 1 in IIB-19 shows no significant correlation between the level of per capita GDP in 1980 and subsequent changes in inequality ($p=.78$; $R^2 = .01$). Figure 2 in IIB-19 shows that in the period since 1965 there do not appear to be significant correlations between periods of either high or low per capita GDP growth and positive or negative changes in the Gini coefficient ($p = .11$, $R^2 = .15$).

3. Neo-classical Theory

Below we review two neo-classical models of income distribution, with attention to what they suggest concerning the relation between economic growth and inequality.

Von Weizsäcker (1993) presents a model in which disposable earnings depend upon a person's level of human capital, the wage rate, and the costs of further education and training. People can increase their capital stock by investing some of their current capital in education, and by spending income on education services. People seek to maximize the discounted sum of total disposable income over time. This model generates the standard neo-classical human capital

[5] Ravallion and Chen (1996) used the DS data set for additional studies of growth and distribution and reached similar conclusions.

BOX IIB-18. Regression of Per Capita GNP Growth Rates Against Level of Inequality

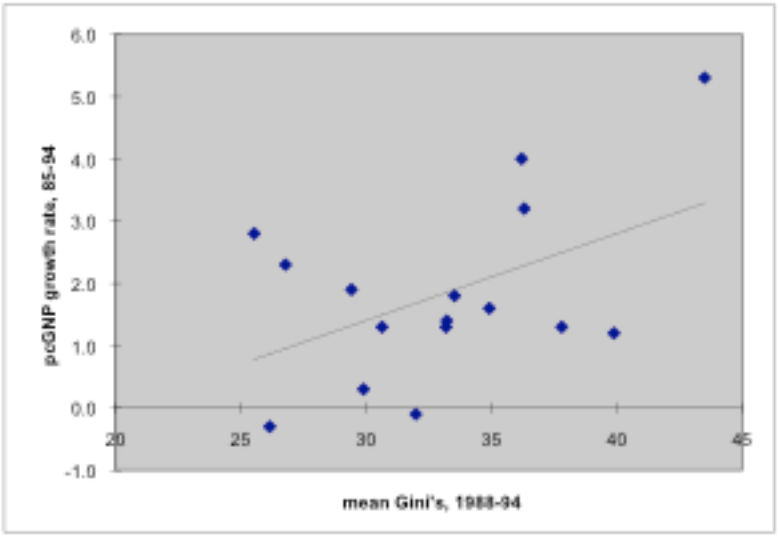
[Gini coefficients are from Deininger and Squire, 1996a. Per capita GNP growth rates are from the World Development Report, 1996, Table 1]

Table 1

Country	average of Gini's, 1988-1994	average annual per capita GNP growth rate, 1985-1994
Spain	25.5	2.8
Finland	26.2	-0.3
Belgium	26.8	2.3
Netherlands	29.4	1.9
Canada	29.9	0.3
UK	30.6	1.3
Sweden	32.0	-0.1
Denmark	33.2	1.3
Norway	33.2	1.4
Italy	33.5	1.8
France	34.9	1.6
Portugal	36.2	4.0
Japan	36.3	3.2
USA	37.8	1.3
Australia	39.9	1.2
Hong Kong	43.5	5.3
means	33.1	1.8

Taiwan	30.2
Germany	32.2

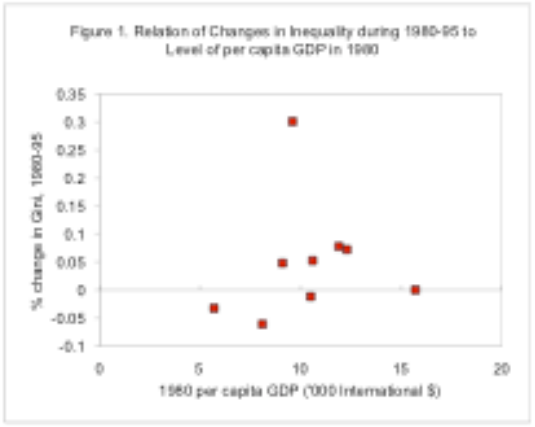
Figure 1 Comparison of Gini's and per capita GNP growth rates



BOX IIB-19. Comparisons of Inequality Growth Rates and Level and Growth Rates of per capita GDP

		USA	UK	Sweden	Italy	Taiwan	Canada	Japan	Australia	France	Germany	Spain	Netherlands
% change													
in Gini,													
1965-80	= "A"	0.016	0.025	-0.029		-0.135	-0.007	-0.040	0.238	-0.259	0.105	-0.163	
1980-93	= "B"	0.078	0.301	0.000	-0.061	0.101	-0.119	0.048	0.052			-0.033	0.072

		% change in Gini	pc GDP grth rate/yr	pc GDP 1980 (K)
Sweden	B	0	1.3	15.7
Canada	B	-1.2	1.4	10.5
Austria	B	5.2	1.6	10.6
USA	B	7.8	1.7	11.9
Netherlands	B	0.072	1.7	12.3
USA	A	0.016	1.8	
Sweden	A	-0.029	2	
UK	A	0.025	2	
Italy	B	-0.061	2.1	8.1
Australia	A	0.238	2.2	
UK	B	0.301	2.3	9.6
Spain	B	-0.033	2.7	5.7
Germany	A	0.105	3	
Canada	A	-0.007	3.3	
Japan	B	0.048	3.4	9.1
France	A	-0.259	3.7	
Spain	A	-0.163	4.1	
Japan	A	-0.040	5.1	



p-value = .78; R^2 = .01

p-value = .11; R^2 = .15

sources:
Gini coefficient rates of change were calculated using the Deininger and Squire 1996 (a) data set.
Per Capita GDP growth rates are from the 1996 Human Development Report.
1980 Per Capita GDP values are from the 1996 World Development Report; values are 1980 international dollars.

scenario: investment in human capital is greatest early in life and continues thereafter at a declining rate. Much of the variability in incomes depends upon two key parameters. One measures the amount of productive human capital a person realizes from a unit investment in education. The other measures the amount by which incomes increase as a result of the acquisition of a unit of new human capital. The initial values of these two parameters are distributed randomly among persons. Key equations of the model are shown in **IIB-20**.

Von Weizsäcker's model predicts that an increase in the wage rate leads to a rise in the overall inequality of earnings; that improvement in the opportunities for increasing the human capital stock by way of practical job experiences (learning-by-doing) causes additional inequalities; and that falling birth rates will increase the overall inequality of earnings. Von Weizsäcker summarizes by noting that:

> "The model… predicts a basic policy conflict between the level of per capita earnings and the level of earning inequality; according to which, the social aims of higher per capita earnings and lower earnings inequality, are not generally compatible with each other." (pp 199-200)

The results noted appear in large part to be due to a general feature of the model, whereby initial (random) advantages that individuals possess at an early age are strengthened by their, and others', optimizing behavior. For example, persons from families that invest heavily in education (initially a random factor) find it relatively less costly to invest in more education in later years than do others.

Fischer and Serra (1996) develop a model in which the average level of human capital in an economy has external effects that have important implications for both growth and inequality (see **IIB-21**). Output is produced by unskilled labor and human capital. Agents live for a single period and derive utility from consumption and from expenditures on their children's' education. The accumulation of human capital depends on education expenditures, on the informal influence of parents (a function of parents' education) and on "social interaction with friends and

BOX IIB-20. The von Weizsäcker Model (1993)

Equations of the model:

(1) $$Q_n = b_0 \left(s_n K_n\right)^{b_1} D_n^{b_2}$$

(2) $$K_{n+1} = K_n + Q_n + c(1-s_n)K_n - \delta K_n$$

(3) $$A_n = RK_n(1-s_n) - PD_n$$

(4) $$V = \sum_{n=0}^{N} A_n (1+r)^{-n}$$

(5) $$K_0 = a_0 + a_1 S$$

(6) $$b_0 = b_0\left[LA(G,HO,CU); DF(HO,CU); QPC; CR; SQ\right]$$

where:

n = working age/earning period
Q_n = human capital produced by education other than formal schooling or learning-by-doing in period n
K_n = human capital stock at period n
s_n = fraction of human capital stock diverted for investment in period n
D_n = educational goods and services purchased in period n
A_n = disposable earnings in period n
R = wage rate for services from a unit of human capital for 1 period
P = price per unit of D
V = value of disposable earnings discounted from the time of entry into the labor market
S = time spent in full-time schooling
b_1 = elasticity of human capital production with respect to the factor s_nK_n
b_2 = elasticity of human capital production with respect to the factor D_n
b_0 = ability of an individual to increase their productive capacities during their working life
c = rate of learning-by-doing
δ = rate of depreciation of human capital
a_0 = stock of human capital at the beginning of the planning horizon
a_1 = human capital production efficiency during the full-time schooling phase
r = interest rate
LA = learning ability of individuals
DF = Lydall's D-Factor: motivation, energy, ambition, etc.
QPC = personality and character traits
CR = class-rank variables (e.g., school achievement)
SQ = schooling quality
G = physical endowments
HO = family background
CU = cultural influences

BOX IIB-21. The Fischer and Serra Model (1996)

Equations of the model

1a) $$X_{1t} = L_{1t}^{\alpha} H_{1t}^{1-\alpha}$$

1b) $$X_{2t} = L_{2t}^{\beta} H_{2t}^{1-\beta}$$

2) $$H_t = H_{1t} + H_{2t} + G_t$$

3) $$u_t^z = c_{1t}^{z\tau} c_{2t}^{z\nu} \left(g_t^z + g^*\right)^{(1-\tau-\nu)}$$

4) $$y_t^z = w_t^z + h_t^z$$

5) $$h_{t+1}^z = (\bar{h}_t)^{1-\delta} (\rho h_t^z + g_t^z)^{\delta}$$

Where

X_i = amount of final good i
L_i = labor to produce final good i
H_i = human capital to produce final good i
H = total stock of human capital
G = aggregate allocation of human capital for education of the next generation by agents living in the present
u^z = utility of agent z
c_i^z = consumption of final good i by agent z
g^z = amount of human capital an agent spends on a descendant;
g^* = utility gained by doing things for a descendant that do not require expenditure of human capital
y^z = income of an agent z
w^t = wages of an agent z
h^z = amount of human capital owned by agent z
α, β = elasticity of output with respect to labor and human capital, respectively
τ, ν = elasticity of utility with respect to consumption of goods 1 and 2, respectively
ρ = human capital depreciation factor
δ = elasticity of next generation's human capital with respect to parents' level of human capital and parents' expenditures of human capital on descendant (i.e., "strength of the externality")
h = average level of human capital in the society

schoolmates." The last represents an externality measured by the average level of human capital in society.

Their model shows two opposing tendencies. As the average stock of human capital increases so does the relative price of unskilled labor, which tends to reduce economic inequality. At the same time wealthier agents spend a higher proportion of their income on education, which tends to raise inequality. The values of the parameters of the model determine which tendency prevails. The authors do not attempt to estimate these values, some of which are quite abstract, but in an exercise a set of empirically plausible parameter values causes inequality to decline.

4. Growth, Inequality, and Technology

Technological innovation is essential for continued economic growth. What bearing might technological innovation have on income distribution?

a. Technology and Factor Shares

Karni and Zilcha (1994) note that technological change can affect income inequality "through its effects on factor prices directly (through productivity) and indirectly (through its influence on the accumulation of factors of production)." They prepare a model to test the distributional implications of three types of technological change: Harrod-neutral [labor-saving], Solow neutral [capital-saving], and Hicks-neutral [factor share neutral]. They find that Hicks-neutral technological change has no effect on the distribution of incomes, and that

> "The impacts of Harrod-neutral and Solow-neutral technologies depend on the elasticity of substitution in production. Harrod-neutral changes increase (decrease) the level of income inequality if the elasticity of substitution in production between capital and labor is larger (smaller) than one. Solow-neutral changes decrease (increase) the level of income inequality if the elasticity of substitution is larger (smaller) than one." (p 280)

What does this mean? In most growth studies technological change is assumed to be Harrod-neutral, i.e., pure labor saving. The justification for this is that the return to labor (wages) has grown continually over the course of the technologically-driven industrial epoch, whereas the return to capital (interest) has been far more constant. Growth studies also commonly employ iso-elastic production functions such as the Cobb-Douglas. This is consistent with the observation

that despite the increasing return to labor, the shares of output going to capital and labor have remained roughly constant; that is, capital has been substituted for labor at the same rate that wages have increased.

It is not clear that this analysis adds much to our understanding of technology and the distribution of income. The determination of whether a particular technological innovation, a network of innovations, or for that matter the technological trajectory of a particular epoch, is labor saving, capital saving or factor neutral is not something that can be readily assessed prior to the operation of that technology in the real world. Rather, we observe certain patterns of behavior regarding capital and labor, and declare *post hoc* the nature of the technology [6].

b. Greater Returns to Skilled Labor

Studies of the causes of the growth of income inequality in the United States have shown that returns to skilled labor have been increasing with respect to those for less skilled labor over the past 20 years. Berman, Bound and Griliches (1993) found that during the 1980's more than two-thirds of the increase in the demand for skilled labor was attributable to the introduction of labor-saving technological innovations in the production process. Less than one-third could be attributed to other causes, such as the decline of less skill-intensive industries due to growing international trade.

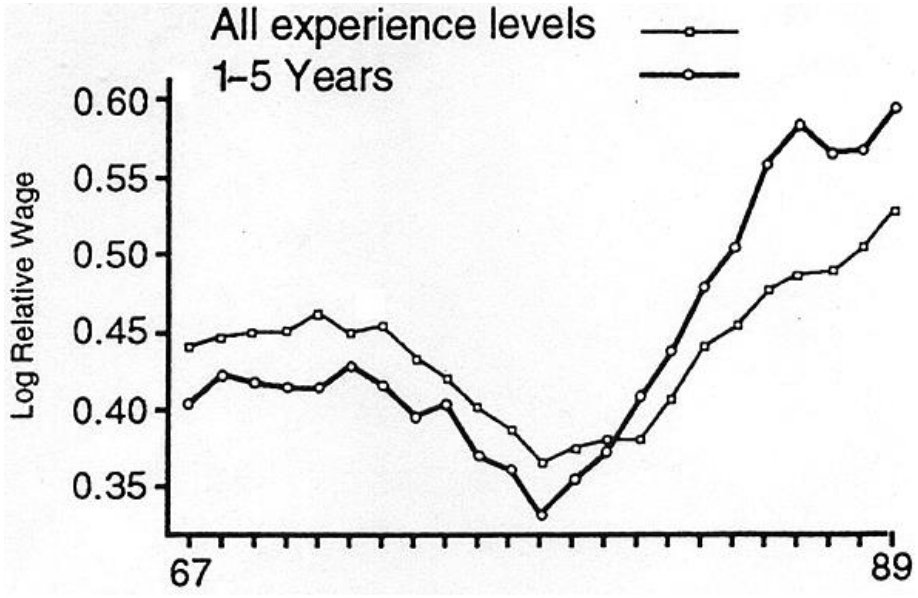
Box IIB-22 shows that the premium for college education declined until 1978, at which point it began a steep rise. The widening gap between returns to college and high school education is even greater for young people.

Box IIB-23 shows that within even the traditional blue and white collar sectors the premium for higher education is growing, while persons with no education beyond high-school have experienced an absolute decline in earnings.

[6] Bessant and Cole (1985) argue that technologies whose initial impacts are labor-saving might turn out to be capital saving over the long run. Zuboff (1988) argues that many technologies can be either labor or capital saving, depending upon institutional commitment.

BOX IIB.22 Trends in Relative Wages: 1967-1989
[Reprinted from Murphy and Welch, 1993]

College / High School Wage Premium



BOX IIB-23. Median Annual Earnings of Male High School and College Graduates

[Levy and Murnane, 1992; all values 1988 US $]

Figure 1. Median annual earnings of 25-34 year old male High School Graduates

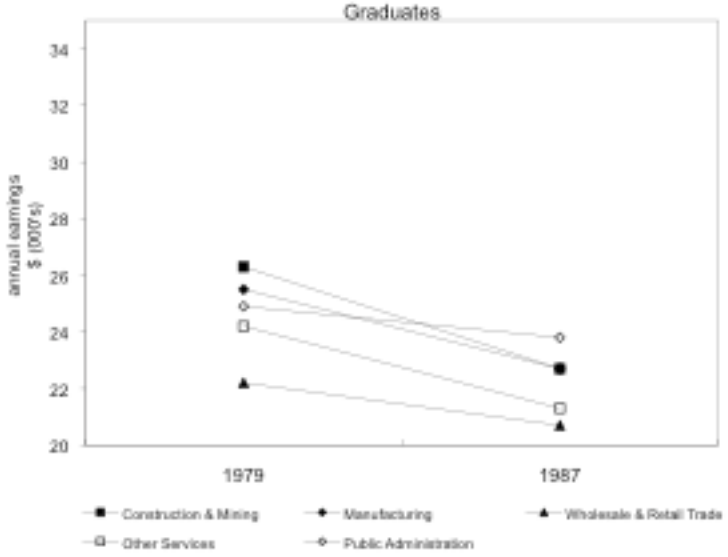
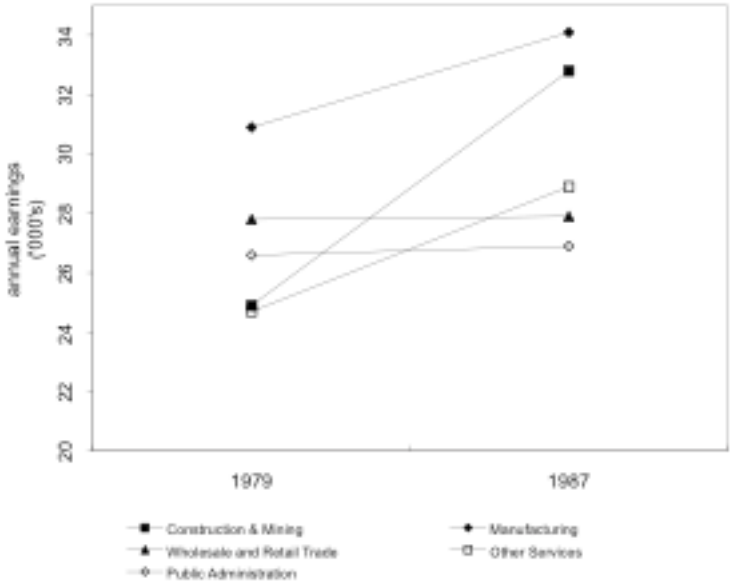


Figure 2. Median annual earnings of 25-34 year old male College Graduates



Box IIB-24 gives some indication of the extent to which educational differences might contribute to income inequality. The charts show that in the United States the median professional earns three times as much as the median high school graduate, but represents a very small segment of the population.

Is a continually growing demand for increasingly skilled labor a necessary feature of continued economic growth in mature industrial economies? Many commentators believe this is so. The rationale seems to be that if economic growth depends on continued technological innovation, and if the contribution of innovation is that it allows "the manipulation of matter and energy over increasingly finer scales of space and time,"[7] then greater skills will be needed to use such technology in the manner needed to exploit its ability to contribute to continued output growth.

Krugman (1994) differs, noting that from the 1920's to the 1970's much technological change was embodied in process technologies, such as assembly lines, that increased the productivity of unskilled labor many-fold. In the future, he says, highly sophisticated information technologies may be able to more readily replace accountants, doctors, and pharmacists in much the same way that skilled wheelwrights were replaced by unskilled auto assembly-line workers. Yet many currently low-paid jobs, such as gardeners or home healthcare workers, might be less easily replaceable.

The arguments on both sides of this question are speculative, not analytic. As of now there is no strong theory of technological innovation that can be used to support either position. But the question of whether future technological change is necessarily increasingly skill-intensive is immensely important.

What about the supply side? If an increased demand for skilled labor elicits an increase in supply, the new premium for skilled labor vanishes. On the other hand, if the demand for

[7] See Section II.A.3.a of these notes.

BOX IIB-24. Income and Number of Households, by Educational Attainment of Householder
[source: Census Bureau, Statistical Abstract of the US, 1995]

Figure 1. Household income, by educational attainment of householder, 1993

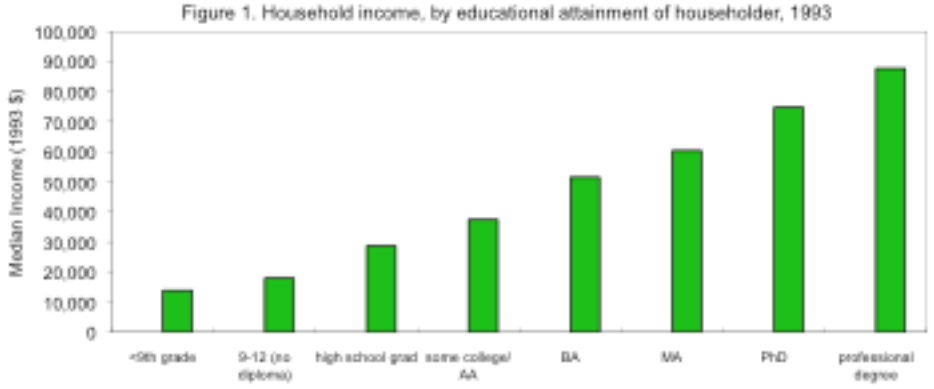
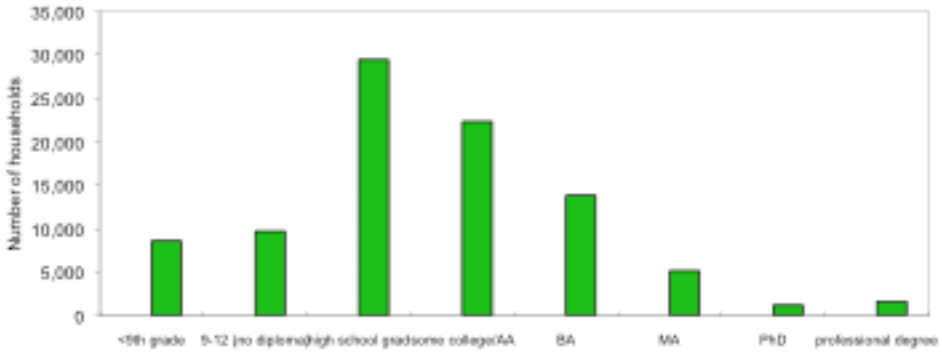


Figure 2. Number of households, by educational attainment of householder, 1993



skilled labor accelerates, supply would have to accelerate as well simply to prevent the existing gap from widening.

5. International trade

The expansion of international trade has been an important factor encouraging strong economic growth in many countries. What bearing does the expansion of trade have on the distribution of income? [8]

Economic theory predicts that in the industrial countries greater international trade should tend to increase the wage rate of high-skilled workers, and lower the wages of low-skilled workers. In developing countries greater trade will hurt high-skilled workers and benefit low skilled workers (Bergstrand et al. 1994; Fischer and Serra 1996). Empirical studies appear to confirm these predictions for the industrial countries, but the results for developing countries are ambiguous.

Estimates of the share of the growth of inequality in the United States that has been caused by the expansion of trade varies from less than 10% (Danziger and Gottschalk 1995) to 30% (Haveman 1994).

Over a period of decades factor prices among trading countries should become more equal and the expansion of international trade should slow. As this happens the contribution of trade to the growth of inequality should decline. Pryor (1996) estimates that the theoretical maximum share of exports in United States GDP is about 20%. If the export share continued to grow at the rate it has over the past 15 years, about 1.4% annually, the maximum level of 20% would be reached in about 75 years. Thus the contribution of international trade to growing economic inequality may be significant in particular industrial countries for greater or shorter periods, but by the middle of this century it will probably not be large.

[8] An important study by William Cline, *Trade and Income Distribution*, was published after completion of this section of the dissertation on which this exercise is based. His conclusions are not inconsistent with the notes that follow. I discuss Cline's TIDES model in Section II.D.4.c.

6. The Bessant-Cole Model

Bessant and Cole (1985) use a multi-sectoral global model to investigate the relation of technological innovation, economic growth, trade and income distribution. They emphasize particularly the role of information technologies. They begin with an exhaustive survey of the state of technological development in 24 3-digit economic sectors (textiles, aerospace, agriculture, construction, chemicals, etc.) to assess the impacts that those new technologies are likely to have in the coming years on jobs, skills, costs and other factors. They find that the direct impacts of projected technological developments would in large part be labor-saving. Next they draw on a variety of methods to assess possible second and third order effects of these labor-saving technological innovations. Their analysis suggests that "the more significant impact of information technology could come from a system-wide reorganizing of production… (resulting in) a more intensive use of existing capital and installation of production systems with greatly improved capital productivity." This restructuring might involve, for example, "greater reliability, reduced down time, and an increase in the number of shifts." They use these studies to determine initial values and parameters for their global model.

Their model divides the world into high, middle and low income countries, and within each of these into wealthy and poor households. A first run of the model includes only the immediate, better understood labor-saving impacts of new technology. GDP in the high income countries increases minimally, and in the middle and low income countries by 1% and 2%, respectively. In the high income countries the income of poor households declines by 5% but those of rich households increase by 9%. In the low and middle income countries, however, the distribution of income improves.

Bessant and Cole next run the model with the possible capital-saving effects included. GDP in the high, middle and low income countries increases by 14%, 9% and 4%. All have done better than in the first run, but now the between-country distribution worsens rather than improves. The income distribution in the middle and low income countries improves much as it

did in the first run. In the high income countries the incomes of the rich and the poor households increase by 22% and 6%. Thus both are notably better off than before, but the relative distribution of income has worsened.

7. Winner-take-All Markets

We noted earlier that a major portion of the increase in earnings inequality in the United States was due to increases at the upper end of the income range, and that the higher the range, the higher the rate of income growth (see Box IIB-13, Figures 5 and 6). Frank and Cook (1995) propose that much of this increase is due to the growth of *winner-take-all* markets. These are different from typical markets in that compensation is determined by relative performance, not absolute performance. Such markets arise when there are very large markets for the product of top performers, or when firms are willing to pay top performers very high salaries.

The significance of winner-take-all markets clearly increases with economic growth. Many products in these markets are consumed in larger proportions as household incomes increase. Further, the simple expansion of markets, domestically and internationally, magnifies the potential returns to top position.

Frank and Cook maintain that firms pay top performers far more than their apparent marginal product. This is because part of the payment is an insurance premium. When the stakes are very high, and small differences in ability can translate into huge differences in outcomes, firms are willing to pay this premium. The key observation for our purposes is that the reason that "the stakes are very high" is precisely because economic growth, and globalization, have created new, larger markets for the products of firms.

8. Stochastic Processes

A case can be made that as an economy grows inequality can be expected to increase, simply as a result of the mechanical process known as the *law of proportionate effect.* Suppose that a variable changes over time, and that the change in the variable is a random proportion of the variables' previous value. An economy with a positive growth rate, within which individual

incomes obey the law of proportionate effect, will generate a log-normal distribution of the sort that characterizes most income distributions. The justification for stochastic models is that they may be able to capture the manifold, cascading indeterminancies that pervade any process as complex as an economy better than conventional deterministic models. However they are devoid of economic content and economists have not found them to be especially useful (von Weizsäcker, 1993).

II.B.2.c. How Does The Distribution of Income Affect Economic Growth?

While Kuznets was concerned with the impact of economic growth on inequality, others focused on the ways in which inequality might affect the rate of growth. The Lewis two-sector model (1954) was among the first to address this topic; in fact it addressed both directions of the growth/inequality relationship. It noted first that the accumulation of capital by entrepreneurs was a necessary condition of economic growth. Further, since the labor supply curve of "surplus" rural workers was perfectly elastic, wages would not rise as urban output increased. The Lewis model thus forecast a positive feedback loop between growth and inequality for the early period of development. This unfortunate situation would begin to change after the rural labor force was reduced in numbers to such a level that wages there would begin to rise and force urban entrepreneurs to raise wages as well. The experience of the past two decades has not offered strong support for the Lewis model as a general description of the development process. (Gillis et al.1992).

An analogous set of questions has been posed concerning the mature industrial countries. Throughout the post-WWII decades advocates and opponents of redistributive policies have claimed that their programs would encourage economic growth and that those of their adversaries would discourage it. Many Marxian and Keynesian economists argued that since wealthier persons have a lower marginal propensity to consume, and that under certain conditions they might withhold savings from productive investment, high economic inequality could lead to a

shortage of aggregate demand and cause economic growth to slow, perhaps catastrophically. Neo-classical economists argued that redistributive policies were inefficient and for that reason would be a drag on economic growth.

In this section we survey recent research on the ways in which inequality might affect economic growth, particularly in mature industrial countries.

1. Channels of Influence

A number of studies suggest that economic inequality has a negative impact on economic growth. Several channels of influence, not mutually exclusive, have been suggested. These include the possibilities that inequality 1) creates imperfect markets for human capital; 2) motivates redistributive policies that hurt growth; and 3) creates political instability that reduces investor confidence. We look at representative models that seek to characterize these influences below.

a) Imperfect Markets for Human Capital

Loury (1981) proposed a two period overlapping generations model in which family income in the first period is divided between consumption and education of youth. The central equations are shown in **IIB-25**. "Natural economic ability" is distributed randomly among persons, and is not known to parents until their children are mature. The utility of parents depends on their own level of consumption and on the utility experienced by their children when they in turn become parents in the second half of their lives. Income shows diminishing returns to education and training. Because of this, Loury notes,

> "[P]arents [of different families] making different income-constrained investment decisions face divergent expected marginal returns to training in terms of their offsprings' earnings. If the parent investing less, facing the higher expected marginal return, could induce the parent investing more to transfer to his son a small amount of the other's training resource, then the offspring of both families could on average (through another inter-family income transfer in the opposite direction) have greater incomes in the next

BOX IIB-25. The Loury Model (1981)

Equations of the model

(1) $U_1 = c_1^{\gamma} V^{1-\gamma}$

(2) $x_1 = (\alpha_1 \varepsilon_1)^{\delta}$

(3) $\varepsilon_1 = x_0 - c_0$

Where

U_1 = family utility
c_1 = family consumption
c_0 = parents' consumption
V = descendants' utility
x_1 = earnings of the head of the family
x_0 = earnings of the parents
α_1 = family (head's) ability (randomly endowed)
ε_1 = family (head's) training
γ = elasticity of Utility with respect to consumption
δ = strength of the contribution of abilities and training to earnings

Note: "family" is the current generation; "parents" is the immediate past generation; "descendants" means the children of the family.

period." (p 844)

Loury notes that many low-income parents are unable to borrow money to support the education of their children, and his model incorporates this feature. He finds that initial income inequality leads to an inefficient distribution of training resources and thus a slower rate of economic growth. In a quantitative example he shows that public education could account for a 35% reduction in the dispersion of incomes and a 3.4% increase in the rate of economic growth.[9] Loury comments that while the impact of public education on incomes appears to be significant, the impact on the growth rate is small.

In another study, Galor and Zeira (1993) suggest that when markets for human capital are imperfect low-income persons are not able to take advantage of the technological shocks that may be significant events in the structural evolution of an economy. This prevents the economy from growing as rapidly as it would otherwise.

b) Endogenous Policy

Alesina and Rodrick (1991) develop a model including "endogenous policy," in which output is a function of capital, labor, technology and "the flow of government expenditures on productive investment." Both expenditures and transfers are financed by a tax on capital. Individuals differ along a continuum regarding their relative endowments of labor and capital, and seek to maximize the net present value of consumption. The tax rate is determined by majority vote. Using the median voter theorem, which states that the outcome of a referendum will be that which maximizes the utility of the median voter, the authors find that:

> " …[D]emocracies with an uneven distribution of wealth should exhibit lower growth than democracies with more equally distributed resources. This is because a large working class with little capital would vote for high taxes on capital; the positive effect on the level of workers' real incomes would be traded off against the adverse growth consequences." (p 29)

The authors ran regression analyses and found that a 10% increase in the share of wealth held by the upper 20% of households in democracies is associated with a subsequent reduction in

[9] That is, economic growth would increase from, e.g., 2% to 2.068%, not from 2% to 5.4%.

the rate of economic growth of perhaps one third of a percentage point. However, Deininger and Squire (1996a) suggest that this relation may disappear when calculated using their new, high-quality data set.

Persson and Tabellini (1991) combine elements of both human capital and endogenous policy modeling. They propose a two-period overlapping generations model in which growth is a function of the accumulation of knowledge capital, a randomly distributed complement of basic skills, and an externality that is proportional to the average endowment of knowledge capital. Accumulation of knowledge capital is determined by an exogenous rate of return and a redistributive policy variable determined by the median voter theorem. Redistribution transfers knowledge capital from those with more to those with less, but also reduces investment and thus the basis for subsequent growth.

Persson and Tabellini find that the more equal the distribution of basic skills, the greater the rate of economic growth. They also find that a lower rate of political participation by the poor, or a higher rate by the rich, increases the growth rate. In a regression analysis they confirm these results empirically. For a large sample of countries they find that a one standard deviation decrease in inequality increases economic growth by just under half a percentage point. However, Deininger and Squire (1996a) question the reliability of their inequality statistics.

c) Inequality, Political Instability and Growth

Beńabou (1996) uses a repeated-game theoretic model to illustrate a possible relation between inequality, social instability, and economic growth. In the model each of two agents face a choice of either moderating their claims to economic output ("cooperate") or seeking vigorously to try to earn the greatest incomes they can ("defect"). If both agents cooperate they each earn the market solution. If one cooperates and the other defects, the cooperator suffers. If they both defect they both suffer, but not quite as much as a cooperating agent suffers when the other does not. Beńabou interprets (DD) as the outcome based on the raw exercise of political power.

This structure of payoffs defines a Prisoner's Dilemma game. We know that the outcome (CC) is not a Nash equilibrium for a single period PD game. But if the game is indefinitely repeated, (CC) can be the best strategy for both parties if the discounted stream of income earned by cooperating is greater than that earned from defecting. Whether this is so or not depends on the parameters of the model.

Beńabou sets up payoff functions and uses these to conclude that there is a maximum sustainable growth rate constrained by conflict over the distribution of income. This constraint exists because the better-off would have an incentive to transfer some of their capital to the less well-off rather than suffer the greater losses that social conflict would cause.

Alesina and Perotti (1993) test whether political instability caused by inequality might reduce investment, which in turn would reduce economic growth. They regress investment against an index of instability, and instability against economic inequality, for a cross-section of 70 countries over the period 1960-1985. Their measure of inequality is the share of total income of the third and fourth quintiles of the population in or around 1960. Their stability index is:

$$SPI = 1.86\ ASSASS + 1.28DEATH + 7.5SCOUP + 7.09UCOUP + 5.04DICT$$

in which ASSASS is the number of politically-motivated assassinations, DEATH is the number of persons killed in domestic mass violence, SCOUP is the number of successful coups d'état, UCOUP is the number of *un*successful coups d'état, and DICT is a dummy.

The authors find that for both tests the correlations are positive and significant. However, if we run the regression separately for the 18 industrial countries in the sample we find no significant correlation, simply because variability in the index of instability is very small.

d) other channels of influence

If the marginal propensity to save increases with income, then growing inequality could have a dampening effect on economic growth. This idea was used historically by Marx, later by

Keynes and much later by Greider (1997) to argue that higher incomes should be at least more heavily taxed. National accounts suggest that higher income households do save proportionately more than lower income households. However, some economists suggest that this value may be a statistical artifact. Higher incomes vary on an annual basis much more than do moderate and low incomes; thus, an identical percent of income saved over the lifecycle may show as a lower percent for high income households than for lower income households in any given year.

K. Hayes (1994) suggested, but did not explore, the possibility that increased inequality is likely to cause workers to invest in human capital at diverging rates, and that "as the variance of skills of heterogeneous labor increases, workers may not 'mesh' as efficiently, reducing labor productivity." She also suggested that as incomes become more unequal, "workers may become more resentful of the status quo and less cooperative and effective in the workplace." Variables such as "mesh" and "resentfulness" are difficult to define in a way that allows empirical study. However, Hayes' suggestions are clearly relevant to our primary concern with growth and inequality in mature industrial countries.

e) additional quantitative estimates

Beńabou (1996) surveyed 26 studies and estimated that a 1 standard deviation increase in inequality lowers the annual growth rate of GDP per capita by .5 to .8 percentage points. Is this a lot or a little? The mean Gini for 108 countries in the Deininger and Squire data set is 39.9 with a standard deviation of 9.9. The Gini for the United States is 37.94. Beńabou's estimate suggests that an increase in inequality in the United States to about 47, which is roughly equal to that of Malaysia or the Philippines, might reduce per capita GDP growth from its recent level in the neighborhood of 2.3% to something closer to 1.5-1.8%. We saw in Box IIB-17 that the U.S. Gini could grow to that level somewhere between 50 to 75 years from now, assuming a 1% per capita GDP growth rate and no change in the quintile dispersion trends. In any event, Beńabou notes

that the relation he found between inequality and growth vanishes in some studies when dummies for Africa and Latin America are added, or when the stock of human capital is included.

K. Hayes et al. (1994) conducted one of the few studies that tested for mutual causality between economic and inequality growth rates. They compared changes in productivity and the Gini coefficients for the USA over the period 1948 through 1990. They found that mutual causality was positive and significant: "greater productivity growth tends to lead to lower inequality growth" and "greater income inequality growth tends to lead to lower productivity growth." They note that this virtuous circle runs counter to the widespread opinion that efforts to reduce inequality will necessarily lead to *reductions* in productivity.

Note that in Hayes' analysis greater productivity growth does not necessarily imply a *decrease* in inequality; rather, it implies a decrease in the rate at which inequality *increases.* Her results are consistent with the possibility of a secular increase in inequality that may be moderated, but not necessarily stopped, by higher rates of productivity. Also, the use of 1948 as the beginning of the period of analysis may blur the possibility that a structural break of some sort concerning growth and inequality occurred at some point during the mid 1970's (see Raj and Slottje, 1994).

2. Explaining the stability of income distributions

We've noted that the recent data set prepared by Deininger and Squire shows a greater stability of income distribution within countries than earlier data had suggested. If this new data is correct, the burden of analysis of the mutual interaction of economic inequality and growth changes from one of explaining patterns of reciprocal influence to one of explaining the stability of the former in the face of great variation in the latter.

Many analysts have suspected for some time that income distributions are very stable. Yotopoulos (1976) said,

> "The evidence suggests that dualism of the "haves" and "have nots" exists and persists over time. In our opinion, this is explained by the persistence of the market imperfections that originally give rise to dualism. These imperfections usually result

> from the efforts of individual groups to establish rent-maximizing positions… Once these are established, they tend to be reinforced by devoting the rents at least partly to attempts to further reduce effective competition." (p 238)

Li et al (1996) use the Deininger-Squire data and present a model in which wealthy persons have the power to protect their wealth and poor persons have little ability to accumulate wealth. The equations of the model are shown in **IIB-26**. Total output is determined by the human capital possessed by the wealthy and the poor, and by a term representing environmental endowments. The income of the wealthy depends upon their own human capital, the endowment, income from a distortion, or "tax," that they levy on the rest of society by virtue of their economic strength, the costs of accumulating human capital (education), and the costs of levying and enforcing the "tax." The incomes of the poor depend on their own human capital, the endowment, the severity of the "tax" levied by the rich, and the cost of their own education. The more democratic the society, the greater the costs to the wealthy of levying and enforcing the "tax." Both groups maximize the discounted value of income, subject to constraints on the accumulation of human capital, i.e., the cost of education and the "depreciation" of human capital caused by technological change. Imperfect capital markets are incorporated by assuming that the cost of education is proportionately more for the poor than for the wealthy.

Li et al. derive first order conditions for utility maximizing by the wealthy and the poor, and then use these results to find the Cournot-Nash equilibrium. They find that there is a single optimal equilibrium level of income inequality, human capital accumulation, "distortion" and output growth. The level of income inequality is constant over time, even as the economy grows. Changes in the structural variables (level of democracy, initial level of education, initial distribution of collateral assets, and financial market development) lead to new, stable levels of the outcome variables.

They test their results with empirical data via regression analysis and derive quantitative relationships for their key variables. They find that the joint effect of a 10% increase in financial market development and a 10% reduction in asset inequality results in a 7% reduction in

BOX IIB-26. The Li et al Model (1996)

Equations of the model

(1) $$Q(t) = Q(h(t), H(t), \theta(t))$$

(2) $$y(t) = m(h(t), \theta(t)) + \tau M(H(t), \theta(t)) - \alpha \varepsilon(t) - f(\tau, \rho)$$

(3) $$Y(t) = (1 - \tau) M(H(t), \theta) - C(\lambda) E(t)$$

(4) $$U^R = \int_0^\infty y(t) e^{-\rho t} dt$$

(5) $$U^P = \int_0^\infty Y(t) e^{-\rho t} dt$$

(6) $$\dot{H} = \mu E - \delta H$$

(7) $$\dot{h} = \mu \varepsilon - \delta h$$

Where

Q(t) =	total output
H(t), h(t) =	human capital of the poor and the rich
Y(t), y(t) =	total net income of the poor and the rich
θ(t) =	structural variables (e.g., natural resource endowments)
M(t), m(t) =	earned income of the poor and the rich
τ =	income distortion, or "tax," imposed by the rich on the incomes of the poor
α =	unit cost of education for the rich
E(t), ε(t) =	educational services purchased by the poor and the rich
p =	degree of democracy/civil liberties/political freedom/educational opportunity
f(.) =	cost to the rich of lobbying for τ and defending it
λ =	factors that influence the ease of access to the financial credit market
C(.) =	unit cost of education for the poor
U^P, U^R =	utility of the poor and the rich
ρ =	discount rate
μ =	increase in skills or knowledge per unit of educational services purchased
δ =	human capital depreciation rate

inequality. By contrast, the joint impact of a 10% increase in secondary education and in civil liberties yields less than a 2% reduction in inequality. They conclude that "the variables associated with the financial market imperfection argument have a much greater influence on inequality than those associated with the political economy argument" (p 26).

The categories and variables used in this model are very abstract so it is difficult to know how to usefully interpret the results. In any event, the impact of inequality—in this case, of human capital due to market imperfections—is moderate. A 14% decrease in the Gini coefficient of the United States takes it from .38 to .33, roughly the level of Sweden, Germany and Italy. The Li et al. results suggest this might be accomplished by a 10-20% reduction in the inequality of wealth. The current wealth Gini for the US is .65. A 15% reduction would bring it to .55. This could be accomplished via a one-time wealth tax of about 9% on the top quintile with the proceeds transferred to the bottom two quintiles. For a middle-class family with assets of about $250,000 this would come to about $22,500.

II.B.2.d. Simulation Models

Models of changes in income distribution that are simple enough to allow analytic solutions may be incapable of providing results specific enough to inform policy. A complementary approach to learning about economic growth and the distribution of income is to construct models that seek to describe economic behavior in far more particular detail, and achieve numerical, rather than analytic, solutions[10].

Robinson (1979) describes the structural components of such a model. The core would be a computable general equilibrium (CGE) model. These are multi-sector, aggregate input-output models capable of showing how wages, prices, and factor supplies are likely to change when one or more independent variables or parameter values change. The CGE would be expanded to include a social accounting matrix, or SAM, which links the core CGE with

[10] The Bessinger-Cole model noted in section B.6 above is a model of this type. I described it there because of its special focus on the question of technology and distribution.

demographic and other social variables. The SAM should allow factor incomes to be converted into household incomes, and larger income aggregates could be built up from these. Robinson also notes that the model must include the laws of motion of a dynamic economy, in order to move the short range adjustments produced by the CGE model over a long range trajectory. Thus a dynamic CGE model is a succession of short range CGE runs, with adjustments (say, for capital investment or technological change) after each run. Further, a comprehensive model of income distribution would also have to include assumptions about human capital formation, education, motivation, expectations, household formation and similar social processes that take place over periods of decades.

Much of the early development of CGE models in the 1970's was motivated specifically by the desire to study issues concerning income distribution and growth (see Adelman and Robinson 1976; Dervis et al. 1982). Interest in distributive issues declined during the 1980's as economic growth in the developing countries faltered and attention turned to the pressing need of its revival by any means necessary.

The income distributions generated by the early CGE models tended to be remarkably stable over long periods of time, regardless of trends in economic growth or for that matter of policies. This came as a surprise to the developers of these models, who appear to have been expecting Kuznets curves.

Results from a typical CGE model are shown in **IIB-27**. This model (Moreland 1984) drew on functional forms and parameter values of an earlier model of the Philippines, and was intended to mimic a representative developing country. Over three decades per capita income increases by a factor of 2.5, i.e., at an average annual growth rate of 3%, but the Gini coefficient is essentially static. An aggressive set of redistributive policies has the effect of increasing the average annual growth rate to 4.7%, but barely nudges the Gini from .614 to .591.

BOX IIB-27. The BACHUE-International Model of Growth and Income Distribution
[source: Moreland, 1984]

The Bachue Model sought to model the impact of distributive policies on income distribution. The Table and Figures below show the impact of the following set of policies:

* Education Completion: + + 25%
* Migration propensity: + 50%
* Unemployment Benefits: + 25%
* Profit Taxes: + 25%
* Urban Unemployment - 25%

Table 1. Inequality Without and With Redistributive Policies

year	per capita income (no policies)	per capita income (with policies)		year	total Gini (no policies)	total Gini (with policies)
0	1.99	1.99		0	0.614	0.614
5	2.29	2.37		5	0.617	0.606
10	2.59	2.75		10	0.624	0.598
15	2.81	3.13		15	0.628	0.590
20	3.21	3.90		20	0.631	0.590
25	3.90	4.95		25	0.633	0.590
30	4.91	6.16		30	0.635	0.590

Average annual per capita income growth rate:
With no distributive policies: 3.6%
With distributive policies: 4.9%

Figure 1. Per Capita Incomes (Bachue Model)

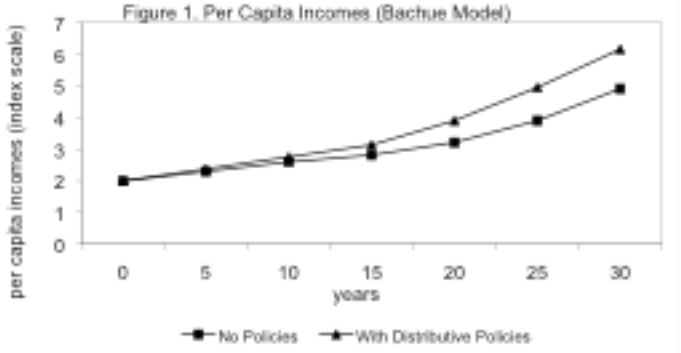
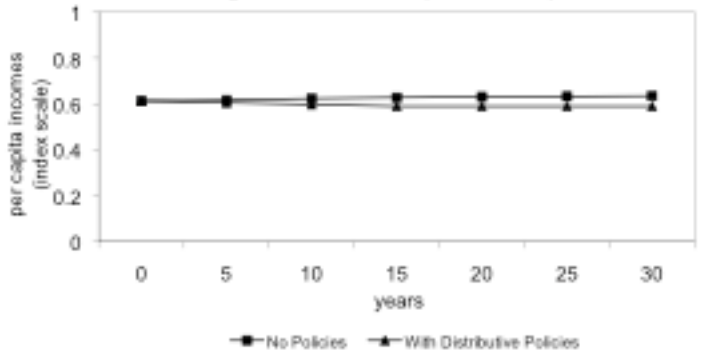


Figure 2. Gini Coefficient (Bachue Model)



Explanations for the stability of the income distributions focused on the use of particular functional forms regarding market closure, on the fact that income received by one sector "leaks" into other sectors over time, and on the omission of important sociological factors. (see Taylor and Lysy 1979 and Dervis 1982). It may or may not be coincidental that the results of the early GGE models now appear to be supported by the Deininger-Squire data set.

II.B.2.e. Review and Assessment

For most of the last 40 years the distribution of income within most countries has been largely stable. Over the past 20 years the inequality of incomes has increased, at varying rates, in most, although not all, mature industrial countries.

A major part of the increase in income inequality appears to have been due to technological change that rewards higher levels of education and skills. A question of critical importance is whether the continuing growth of economic output necessarily requires an increasingly technologically-skilled labor force. It is widely asserted, although not demonstrated, that this is so.

Other factors that have contributed to greater inequality include the growth of trade and deindustrialization, and to a lesser extent changes in demographics and public policies. The expansion of international trade is expected to worsen the distribution of incomes in high income countries and improve it in low income countries, but opinions differ as to whether the magnitudes of these changes will be large or small. In any event the impact should lessen over time as per capita incomes of the higher and lower income countries converge.

Although the aggregate growth of inequality has arguably been moderate, the growth of incomes realized by the very highest percentiles has been much greater. This is less likely to be a result of higher returns to skilled labor than it is of winner-take-all structures resulting from the growth of markets in general and globalization in particular, and from the use of some portion of

upper percentile incomes to influence political, social and cultural behaviors that protect and advance these income shares.

Neo-classical models suggest that there should be stable levels of economic growth, human capital accumulation, and earnings distribution. There is little evidence of any strictly economic mechanism that would necessarily cause higher levels of inequality to have a seriously retarding effect on the rate of economic growth, at least at levels that appear plausible over the next 75 years or so. Of course, even a moderate increase in inequality could elicit social and political responses that could affect growth. Models that include endogenous policy suggest that high income persons would accept some measure of redistributive effort, and low income persons would accept some decrease in the rate of economic growth, in order to achieve a stable equilibrium that is optimal for all. In none of the studies surveyed did it appear that the optimal rate of economic growth would be zero.

The solution values of these models depend upon the nature and distribution of initial endowments and on a host of parameters that reflect largely normative and social factors. These include such factors as the nature of parental utility functions, social externalities to education and skill, and whether the accumulation and use of human capital is subject to increasing, constant or decreasing returns. Because such factors are difficult to define and measure empirically, it is difficult to know whether the results generated by these models are important or not. When speculative but plausible values for these factors are applied to these models, the relation between economic growth and inequality is not shown to be strong.

Based on this review, what patterns of interaction between economic growth and income inequality should we incorporate into our scenarios of long run global development? In our reference scenario, Scenario 1, we showed no relationship between economic growth and income inequality in the high income countries. In the developing countries we showed inequality declining as per capita GDP increased, to the point where both per capita GDP and 80/20 ratios were equal to their respective values in the developed countries as of 1960. After that point the

80/20 ratios continued unchanged, as they did in the developed countries. In retrospect, and quite fortuitously, it appears that these reference case assumptions are as plausible as any others, and maybe more so.

But what advocated goals for distributional equity can we realistically propose, and what do we need to do to realize them? Our provisional ideal scenario calls for the realization of 80/20 ratios of 2.5, in all countries, by 2150. In the next two sections we review policies that have been proposed to reduce income inequality, and discuss public opinion about inequality and ways to reduce it. After that we evaluate our ideal scenario regarding income distributional goals.