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A REVIEW ARTICLE ON JAN TINBERGEN'S

INCOME DISTRIBUTION: ANALYSIS AND POLICIES

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ABSTRACT

The importance of the topic, the significance of the contribution, and the prominence of the author justify a detailed critique of Jan Tinbergen's Income Distribution. In Part I, the book's primary findings and their bases will be recounted. Enough detail is provided to enable the reader to perceive clearly both the theoretical framework employed by Tinbergen and the data and analysis which he employs to test his theory. This rather detailed presentation serves as the basis for a number of questions regarding the merits of the overall approach--in particular, the empirical methodology--and the reliability of the findings. Those questions are posed in Part II. In the final part (III), an overall appraisal of the work is offered. An appendix adding a number of technical notes in the form of a readers' guide is available from the author on request. It is designed to be of assistance to any reader who seeks to appraise in detail the nature of Tinbergen's approach and findings.

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I.

The importance of Professor Tinbergen's book stems from the perspective that he brings to bear on both positive and normative questions of income inequality, and not from any new data which he has collected or analyzed. As he points out (page 1), his contribution rests largely on the analysis of data collected and published by others. It is by reorganizing and reanalyzing this data--in some sense, "shoe-horning" it into a form consistent with his theoretical framework--that he is able to 1) demonstrate persistent declines in income inequalities within developed Western democracies over time, 2) explain this decline by means of a narrowing of the wage rate differentials among classes of labor distinguished by education (ability) due to the shifting of demands and supply functions for the various classes over time, and 3) suggest how further decreases in inequality can be achieved by policies designed to secure additional favorable shifts in supplies and demands.

In his framework, it is "technology" that drives the level of demand for labor of various skill or education levels. With increases in the complexity and sophistication of technology, the demand curve for highly educated (high ability) labor will shift to the right faster than the demand for less educated (less able) labor. If there is no change in the relative education (ability) composition of the labor force (and if the cross-elasticities between education-specific labor-market segments are low), the equilibrium wage rate for highly educated labor will increase relative to that for less educated labor, and the degree of inequality between the two will increase. Hence, "the reduction of inequality is possible only if the expansion of education overtakes the expansion required by technological development" (page 9).

In Chapter 1, Tinbergen introduces his "demand and supply school" approach to the determination of income inequality by describing and critiquing two other approaches to explaining income inequality--the "human capital school" and the "educational planning school". The former approach he finds lacking because of its concentration on supply-side characteristics in explaining labor incomes, to the neglect of demand phenomena. The latter approach is criticized on opposite grounds. His own approach emphasizes both sides of the labor market. Like the two approaches criticized, his approach also relies on the estimation of structural models. Here, he also justifies his decision to exclude the contribution of inequality of capital incomes to total income inequality from his analysis.[2] In following this approach, Tinbergen reveals a judgment which pervades the study--that income inequality is attributable more to "exploitation by human capital...than exploitation by capital in the old sense" (page 6). Offering a preview, he suggests that his findings on the prospects for reducing income inequality are more optimistic than those given by the educational planning school (their estimated elasticities of substitution between labor of various skill levels are too high) and those who emphasize the tendency of capitalism to perpetuate class structure, but less optimistic than is implied by the English branch of the Cambridge controversy.

Following this introduction, Tinbergen surveys the long-term trends in income inequality among households or persons in Western countries in Chapter 2. In this survey three income concepts are used (primary income, income after taxes, and income after taxes and after allocation of public expenditure benefits), and two definitions of the

recipient unit (individual income recipients and income consumers). While most of the data is presented in decile form, Tinbergen also uses a number of indicators of inequality, including the ratio of income of the upper fifth percentile to the median, the Gini coefficient, and the maximum equalization percentage. Among the countries, the time span over which primary income inequality is measured ranges from 120 years (Netherlands) to 14 years (Denmark) for the decile comparisons, and from 85 years (Netherlands) to 13 years (Sweden) for the comparisons employing the single-valued indicators of inequality. For most of the countries, the final year of observation is in the 1950s, for some countries in the early 1960s, and for a few the late 1940s. On the basis of these primary income figures, Tinbergen concludes that there has been a clear equalitarian trend in all of the countries--indeed that the average percentage reduction in the inequality indicators is equal to from 0.6 to 1.0 times the number of years over which observations have been made. By extrapolating this annual percentage change relationship into the future, he concludes that "a reduction to one-half of existing inequality would take 50 to 85 years" (page 18).

Tinbergen's data on changes in inequality in after-tax income and postfisc income among countries is limited to four and three countries, respectively. Again, the last observation is typically in the 1950s or before. These data confirm the trend in inequality observed in the primary income data, and suggest an even faster rate of equalization. By scanning the three or four countries for which data is available, the author concludes that reductions in post-tax income inequality indicators have been about one-half of one percentage point per year over the 13 to 21 years

of observation. Projecting this relationship <u>linearly</u>, he concludes

that the indicators of inequality could be reduced by one-half—say,

the Gini coefficient from 0.30 to 0.15—in about a quarter of a century,

one generation. Using a similar projection procedure, Tinbergen

concludes that reduction in the inequality of postfisc income "to one-

half of its present value would take 14 years" (page 27). Finally, because

the ratio of the size of high to low-income living units has expanded over

time in Western Europe, the author finds that measures of <u>per capita</u> income

inequality have fallen even faster than the measures of inequality among

families or households.

Chapter 3 forms the first of four chapters in which income dis-

tribution is analyzed from the supply-demand perspective advocated by

Tinbergen. In this chapter, both of these market aspects are

handled in single-equation, reduced-form regression models, in which

one or another measure of income inequality serves as the dependent

variable and labor-supply and demand variables are treated as exogenous.

Several such "price equations" based on data published by others are

analyzed. Each of these will be described briefly.

The first price equation analyzed by Tinbergen is based on cross-

sectional national data in which the dependent variable is the ratio

of earnings at the 95th percentile to median earnings. The supply vari-

ables tested include cohort-specific primary and secondary school enroll-

ment percentages, the Gini coefficient of inequality in schooling, and the

higher education enrollment per 1000 aged 20-29. Demand variables

include the percentage of the labor force in manufacturing (or, conversely,

in agriculture), GNP, and GNP growth per capita. Numerous regression

equations are estimated on from nine to twelve observations in which from one
to three of the supply and demand variables (always at least one supply
variable) are entered as independent variables. The correlation coeffi-
cients (R) range from 0.54 to 0.82 and, as the author notes, "most of the
regression coefficients found are highly unstable" (page 31), although
the coefficient on education is always negative. Using these regressions,
Tinbergen estimates the amount of additional education required
to reduce the measure of income inequality by one-half (say, from 300
percent to 150 percent). Assuming that 6 percent of those receiving
lower education will obtain higher education, he estimates a required
increase of 11 to 33 points in the cohort-specific lower education en-
rollment percentage (which already stands at about 75 in Western countries)
and an increase of 0.7 to 2.0 points in the cohort-specific higher-educa-
tion enrollment percentage. In general, he finds these figures to be
"within reach" (page 33).

Tinbergen's second analysis is based on time-series re-
gressions for two countries, the Netherlands and Norway, covering 40 and
75 years, respectively. Again, single-valued indicators of income in-
equality are employed as dependent variables and education (supply) and
industrialization (demand) variables similar to those employed in the
cross-sectional analysis are entered as independent variables. From the
Netherlands regression, Tinbergen concludes that a halving of
the income inequality indicator will require an increase in secondary ed-
ucation of from 75 percent of the relevant age cohort to 90 percent and
a doubling in the percent of the relevant cohort enrolled in higher ed-
ucation. For Norway, a doubling of the higher education variable is also
required.

In the third set of price equation analyses, Tinbergen returns
to single-equation cross-sectional regressions---of states in the
United States, provinces in Canada, and municipalities and provinces
in the Netherlands. A variety of single-valued inequality indicators
are employed--the variance of the natural log of income in $1000, the Gini
coefficient, and the ratio of income at the ninth decile to median income.
The supply variables are again some measures of schooling, while demand is
measured by either average income or an index reflecting the deviation
between education required and actual education average over various sec-
tors. For some of the analyses, a measure of the inequality in education
is also used.

For each body of cross-sectional data, numerous regressions were
run, in which the explanatory variables were entered singly or in
various combinations with each other. Over the several analyses, re-
gression coefficients are again unstable--out of 46 regressions shown,
both the demand and supply variables have the expected sign less than
twice as often as its opposite, and the variable measuring inequality of
schooling has an expected positive sign less than three times as often as
a negative sign. Notwithstanding this instability, Tinbergen selects
a "best case" from each of the analyses on the basis of the size of the
correlation coefficient (R) and a priori expectations. Even among
these best cases, the demand and supply coefficients are not stable.
For "best case" analyses not employing his demand index, Tinbergen
finds that a two-year increase in average years of schooling will lead
to change in income inequality ranging from about -7 percent to about
+4 percent. For the regression referred to as the "best result" from
the set of regressions using his demand index, income inequality would

require that the proportion of the population with higher education
would have to be more than doubled.[3]

Following this work with reduced-form price equations,
Tinbergen analyzes the supply and demand sides of the market separately.
Chapter 4 is concerned with supply factors. To facilitate the search
for fundamental supply factors and to enable the explicit analysis of
both the optimal and equitable income distribution, Tinbergen
eschews the direct measurement of labor-supply functions and concentrates
on specifying the utility function which underlies them. His preferred
function for an individual is:

$$w_i = 1_n \; [x_i - c_0 s_i - 1/2 \; c_2 \; (s_i - v_i)^2] \qquad\qquad (1)$$

In this function, an individual's economic welfare (w_i) is seen to be
positively related to his income (x_i), and negatively related to the
required education level of his job (s_i)--viewed as creating an incon-
venience or "tension"--and the difference between his actual schooling
and that required by his job $(s_i - v_i)$; again viewed as an inconvenience
or tension. In this framework, individuals can choose among jobs of
various required education levels and wage rates (that is, s_i and x_i
are variables), but actual education (v_i) is taken as a parameter and,
hence, is fixed. Similarly, the individual cannot affect the existing
wage and salary structure. The coefficients $(c_0$ and $c_2)$ are assumed to
be equal for all individuals and require estimation.

In estimating c_0 and c_2, Tinbergen classifies the 1962
Dutch labor force into cells indexed by schooling required (s_i) and
schooling attained (v_i) and then--assuming welfare (w) to be equal

across cells--measures the effect of changes in required education be-
tween jobs and changes in the gap between required and actual education
between cells, on income differentials. This regression yields implicit
estimates of c_0 and c_2. Using education at the top quartile of the
actual education distribution within a job category as the required ed-
ucation variable, the estimation was found to be statistically "unsatis-
factory." Adding an arbitrary 3 or 4 value index of "the ability to make
independent decisions" (page 64) based on the nature of the chosen occu-
pation to aid in distinguishing among individuals with the same actual
education and treating this variable as a parameter, statistically sig-
nificant regressions based on six observations are found yielding c_0 =
.075 and c_2 = .018 (when expressed in dollars). The utility function with
these coefficients is accepted as the basis for further analysis.

To supplement this test, Tinbergen performs the same sort
of analysis ("experiment") on cell data constructed arbitrarily from
aggregate occupational and average education marginals and assumed required
education levels from the state of Illinois. A regression test (of
income differences between cells regressed on education differences and
required actual education gap differences) again based on six observa-
tions yields implicit coefficient values of c_0 = .146 and c_2 = .035--
about twice the Dutch values. Some additional, provisional estimates of
c_0 and c_2 for six other relatively high income American states are also
shown--the estimates of c_0 ranging from .09 to .28 and for c_2 from -.06
to + .16, suggesting substantial and unexplained instability.

Chapter 5, the complement of Chapter 4, concentrates on the demand
side of the labor market. Again, the analysis focuses on specifying the

underlying determinant of labor demand—a macroeconomic production
function with heterogeneous labor—rather than the market relationships
themselves. Maintaining the distinction between schooling available and
schooling required developed in Chapter 4, Tinbergen adopts the following
"generalized" Cobb-Douglas function:

$$y = C(\phi_{11} + \pi_{21} \phi_{21})^{\rho_1} (\phi_{22} + \pi_{32} \phi_{32})^{\rho_2} \phi_{33}^{\rho_3} \tag{2}$$

in which y is income per worker employed, C is the contribution to product
by capital, ϕ_{ij} is the proportion of the labor force in an education re-
quired (i) = education available (j) cell, π_{ij} is the ratio of the pro-
ductivity of workers with education j in a job requiring education i = j + 1
to their productivity in a job requiring education i = j, and ρ_j is the
proportion of y contributed by labor possessing education level j. From
undescribed independent estimations or assumptions—casual or otherwise—
the values of y, C, π_{ij}, and ρ_j are stipulated for the Netherlands in 1962
and inserted into the function, which then becomes[4]

$$9.1 = 15 \left[\phi_{11} + (1 + 2.3\phi_{21}) \phi_{21}\right]^{.648} \tag{3}$$

$$\left[\phi_{22} + (1 + 5\phi_{32}\right]^{.088} \phi_{33}^{.064}.$$

Given this specification, the elasticity of substitution of labor of dif-
ferent amounts of education <u>within an occupation with a specified required</u>
<u>level of education</u> was algebraically estimated to be −6.3 in moving from
a worker with actual education 1 to one with actual education 2 within an
occupation requiring education 2, and −1.9 in moving from a worker with
actual education 2 to a worker with actual education 3 within an occupa-
tion requiring education 3.[5]

To test the reliability of the unit elasticity of substitution required by

his production function, Tinbergen presents his estimates of the

elasticity of substitution between higher-educated and all other labor

from two other data sources, one cross-national and the other cross-state.[6]

His cross-national estimates of the demand elasticity of substitution range

from -0.6 to -1.2, while those from cross-state data range from -0.4 to -2.1.

He concludes from these tests that the "semi-empirical" production function

developed in this chapter "gives a realistic picture for the substi-

tution elasticity between third-level educated and all other manpower"

(page 96).

Having set out both demand and supply characteristics of labor

services, Tinbergen proceeds to wed these two sides of the market in

Chapters 6 and 7. In Chapter 6, his purpose is to explain the secular de-

crease in income inequality (described in Chapter 2) by considering supply

and demand factors as set forth in his model. For this analysis, income

inequality is measured by the ratio of the labor income of college grad-

uates to average labor income. The relevant demand factor is the propor-

tion of national income allocated to those who are college graduates

(ρ_3), and the relevant supply factor is the percentage of the labor force

with college degrees (x_3). Hence, given the Cobb-Douglas production func-

tion, the inequality measure is defined to be equal to ρ_3/x_3. As a first

step, Tinbergen measures ρ_3 for both the United States and the

Netherlands and projects it to 1990. For both countries, ρ_3 was measured

by manipulation of published data and projection to 1990 was based upon

simple time-series (7 observations) and cross-sectional (4 observations) re-

gressions of ρ_3 on income per capita and <u>assumed</u> growth rates of income

$$\frac{Y_c N_c}{Y_c N_c + Y_N N_N} \Bigg/ \frac{N_c}{N = N_c + N_N} = \frac{Y_c}{Y_c \left(\frac{N_c}{N}\right) + Y_N \left(\frac{N_N}{N}\right)}$$

But econ theory tells us that N_c, N_N, Y_c, and Y_N are behaviorially related

per capita. Projected values of x_3 to 1990 were taken from other published

work. Because the growth in ρ_3 is projected to be higher than that for

x_3, Tinbergen forecasts (within the framework of his production

function) consistently decreasing inequality over time. He suggests that

inequality in the United States will fall by between 7 and 18 percent

between 1970 and 1990;[7] the predicted reduction in the Netherlands is

from 35 to 48 percent. The race between technology and education will be

won by the latter.

Chapter 7 is the culmination of work in Chapters 4 through 6. A "complete

model" of income distribution is built for the Netherlands for 1962, and

used to (1) simulate the effects on income inequality of altering education

levels, tax rates, and technology and (2) estimate the "optimal" distribu-

tion of income. By combining his "semi-empirical" Cobb-Douglas produc-

tion function with five education possessed/education required labor cate-

gories (from Chapter 5), assumed marginal tax rates, and the distribu-

tion of actual education levels over the population, Tinbergen

sets forth four versions of his "analytical model" with the number of

unknowns and equations ranging from 11 to 15. Employing alternative

versions of the model, numerical estimates are simulated of the effect

on the model's endogenous variables--including relative income ratios--

from hypothetical variations in educational distributions, tax rates,

and technology. From these simulations, a number of relationships are

perceived, none of which are particularly surprising given the structure

of the model: (1) income inequality among education possessed/education

required groups is decreased as the proportion of the labor force with

higher education is increased (for example, not surprisingly, a 33 percent

increase in the proportion of the labor force with level 2 and level 3

education will reduce the ratio of level 3 to level 1 incomes by about

33 percent); (2) because taxes do not effect primary incomes, "redistri-

bution by direct taxes does constitute a means to reduce inequality"

(page 117); and (3) "generally, technological development will tend to

widen income differences" (page 117).

The most interesting analysis in this chapter is the combining of the

"analytical model" on the production side with the utility function derived

in Chapter 4 to form a "policy model" for determining the optimal income

distribution. By maximizing a social welfare function (derived by assign-

ing each individual the same individual ability function and an equal

weight, implying equality of welfare for all) subject to the production

function and labor- and product-balance equations, optimal values for the

size of each of the five manpower groups and the primary incomes and taxes

of each group are obtained. When the simulation restricts the distribu-

tion of educational levels to their initial level, little change in the

inequality of primary incomes is recorded and almost the entire burden

of equalization is placed on the tax-transfer system. Average positive

tax rates of 50 percent and average negative tax rates of 40 percent are

recorded (which taxes and transfers are lump sum in nature), and the ratio

of level 3 to level 2 posttax income falls from about 3 to about 1.2.

The version of the model which leaves education levels free to vary records

slightly less posttax equalization, enormous changes in primary incomes

(the primary income of university-trained workers falls by 60 percent), a

more than doubling in the number of workers with level 3 income, and a

small distributive burden placed on the tax-transfer system. Presumably,

reality lies somewhere between the two.

The final three chapters of the volume--Chapters 8 through 10--deal with normative and policy questions. The conclusion of these chapters can be summarized readily.

In Chapter 8, Tinbergen discusses the concept of equity and justice and presents his approach to this issue. It consists of combining the "scientific" proposition that only measurable inequalities be counted in evaluating economic status with an ethical postulate that all individuals be considered equivalent in the sense of having utility functions with the same arguments, "the same mathematical shape and the same coefficients" (page 129). In this sense, he urges that equity be defined as "equal welfare for all individuals" (page 130), which "does not imply equality of income" (page 131). In this chapter, he also discusses the feasibility of achieving equity or optimality in the income distribution given present institutions (he is optimistic regarding the supply side of the labor market, but less optimistic regarding both the demand side and tax-transfer policy), mentions some of the weaknesses of his effort at utility measurement, and urges "a vast programme of further research" to refine utility measurement by correcting the neglected factors in his model.

Chapter 9 deals with both direct and indirect policy interventions designed to change the income distribution. Tinbergen views this discussion as a bridge between the "framework constructed in the preceding chapters" (page 138) and the world of practical policies designed to equalize incomes. After surveying the policies presently used to affect the income distribution--trade unions, social legislation, tax policy, in-kind transfers, minimum wages, and negotiated settlements on distributive shares involving governments and employee and employer organization in Western Europe--he discusses the impact of the recent

inflation on real income inequality. He concludes that this "inflation
has become a real social problem" (page 144) which works to the dis-
advantage of "the masses" (page 145). Because he attributes the current
inflation to "social groups simultaneously claim[ing] a larger piece of
the pie of national product" (page 145), his first policy recommendation
is that government should seek to secure agreement on "an objective
yardstick for the future distribution" (for example, "agreement on the
increase in the portion of national product allocated to the lowest
income groups") to serve as "the framework of socioeconomic planning"
(page 146). In addition, he advocates the design of education (supply)
and research and development (demand) policies to achieve distributional
objectives, a search for improved measurement of innate human capabilities
on which taxes can be based (so as to avoid disincentive effects), and a
further rise in death duties linked to the receiver's wealth.

Finally, Chapter 10 presents a summary of the volume, again em-
phasizing Tinbergen's view that the process of income distribution is best
characterized as a race between the demand and supply of educated labor,
"with education as the inequality depressing agent and technological de-
velopment as the inequality boosting agent" (page 155).

II.

Tinbergen's volume is, in his words, "a succession of studies"
(page 152) drawing from fifteen of his articles published between 1972
and 1975. Although all the studies fit into a common framework, a
critique that does justice to the volume cannot appraise only the framework;

it must inquire into the validity of the approach and results of each of
the components. This part of the review, then, provides such a detailed
critique. A broader appraisal is left to Part III. The procedure followed
in this critique is to proceed seriatim through the volume, raising ques-
tions regarding concepts, techniques, and interpretation; each question
indicates an aspect of the work which would seem to require additional
buttressing prior to acceptance.[8]

1. The supply-demand theoretical framework and the "semi-macro-
economic model" presented in the volume isolate factors (primarily
education and technology) designed to explain the _earnings_ distribution--
income flows from capital, land, and the tax-transfer system are not
included. These factors are then employed in explaining variations in
income inequality both over time and across jurisdictions (Chapter 3).
Given the enormous changes in tax-transfer systems and in the size and
distribution of capital income over time and the variation in these insti-
tutions among jurisdictions--on the surface, changes and variation at least
as large as in labor markets,[9] should not the decision to omit these
former variables from the explanation be defended and/or the interpretation
of empirical results reflect their exclusion? Moreover, is it not likely
that variation in both education and the transfer system reflects the varia-
tions over both time and nations in the relative size of the public sector
or "the welfare state"?

2. The main conclusions of Chapter 2 involve estimates of the number
of years required to halve the inequality of primary income (50-85 years),
after-tax income (25 years), and postfisc income (14 years) in developed
Western economies. These estimates are based on _linear_ extrapolations of

past trends in percent and percentage point changes in increased inequality.

Is this exercise legitimate and do its results have credibility given

(a) There is no reason to believe that the underlying demographic,
policy, and taste changes which contributed to past trends are
likely to continue into the future?

(b) Recent trends in the uncoupling of living arrangements (among
the young and the aged, especially) and the rapidly increasing
labor-force participation of married women suggest
increased inequality in the distribution of household earned
income?

(c) Western developed economies appear to have nearly exhausted
the ability of the tax-transfer system to achieve further
reductions of income inequality, without intolerable adverse
side effects on investment, economic growth and work incentives?

(d) Energy and environmental considerations imply significant
alterations in both the rate and sectoral composition of
future economic growth, many of which appear to be regressive.

(e) The net rate of return on higher education has been eroded by
narrowed net income differentials due in large part to the
high implicit tax rates imposed by tax-transfer policy?

(f) The first decrements in income inequality (from, say a Gini
coefficient of 0.5 to one of 0.35) can be achieved with less
effort than later decrements (from, say, 0.35 to 0.2 or even
0.25)?

3.   Chapter 3 focuses on cross-sectional and time-series "price-

equations"—reduced-form regressions of income inequality on supply

and demand factors—from which estimates of the increment to education

required to halve inequality derived. Can the reader be expected to

have confidence in the cross-sectional and time-series estimates (Section

3.2 to 3.5) set forth by Tinbergen, given (a) the enormous instability

of coefficients; (b) the small number of observations on which the regressions

are based (9-17, 50, 7 and 11 in the cross-sectional analysis, and an un-

reported number but probably less than 6 for the time-series analysis);

(c) the absence of any reported significance tests for the estimated

regression coefficients; (d) the extrapolation of results far beyond

the limits of the data; (e) the small number (1 to 4) and coarse nature

of independent variables, the choice of which is defended in only the

most general terms; (f) the relatively modest amount of variation explained,

even for such grouped data (ranging from 2 to 88 percent, with a median of

57 percent); (g) the arbitrary basis for the choice of equation on which

to base the estimates of required education (typically, the highest cor-

relation coefficient and conformance to a priori expectations); (h) the

absence of any tests for nonlinear relationships in order to establish

a basis for linear extrapolations; (i) the absence of any evidence on the

correlation between supply (education) and demand (technology) variables,

to justify estimates based on extrapolations of the supply variable alone;

and (j) the nature of the primary inequality measure, which records the

extent of and changes in income differences among only the highest 50

percent of the observations?[10]

4. On the basis of the extrapolations, Tinbergen concludes

that the increases in education required to halve income inequality (hold-

ing technology and other demand factors constant) "do not seem to be out

of reach" (page 50). Would most observers agree that a shift of 22 percent

of the labor force out of level 1 education (0 to 7 years) into level 2 and

3 (a 50 percent reduction in the existing number of workers with level 1

education) or a doubling in the percentage of the population with university

education is within reach, given the actual and projected reduction in wage

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differentials and the return to incremental education? Is it reasonable

to cite such an estimate, when it is based on the assumption that tech-

nology will remain constant--that one of the two participants in the

education-technology race is standing still?

5. Chapter 4, which specifies and measures utility functions, is

a heroic chapter, leaving a number of conceptual and methodological ques-

tions unanswered. On what conceptual basis can the arguments in the

utility function be limited to the three chosen (income and two "tension"

arguments)? Are there not a multitude of other economically relevant

variables and parameters which are likely to have at least as large an

impact on individual/household welfare as the two "tension" arguments?

Drawing only from recent empirical economics literature, the following

appear to be candidates: the skin color and other characteristics of

one's coworkers; the level of environmental quality and other physical

characteristics of one's neighborhood; the physical difficulty, danger, or

unpleasantness of one's job (relative to, say, one's age, health staus and

physical strength), the size and composition of one's family and their

health status, one's physical appearance and skin color relative to the

norm, or the effectiveness (market power) of the trade union of which one

is a member. Of what normative significance are the estimated coefficients

in a welfare function which excludes these and other similar variables

and parameters?

6. Turning to methodological issues in estimating the coefficients in

the utility function we may ask: (a) In what sense can it be claimed that "wel-

fare" is "measured" (page 62) when the estimated coefficients of the utility

function are a simple transformation of the payoff in money income from an

arbitrarily defined index of the deviation of workers' actual education
from an arbitrary measure of the education required for the job,[11] based on
a simple regression and assuming that the welfare of all individuals is
equal? Stated alternatively, to what extent can estimates of the addi-
tional income required to accept jobs with education requirements differ-
ent from one's actual education constitute a measurement of economic
welfare? (b) Presuming a satisfactory answer to (a), what confidence can
the reader be expected to have in the results of an empirical "test" based
on an undefended assumption regarding the educational requirements of
occupations (the <u>actual</u> education level of the upper quartile of the
workers in the occupation), the undefended insertion of an arbitrary element
(the ability to make decisions) required to secure a statistically sig-
nificant regression coefficient, the treatment of the element as a para-
meter (innate trait) rather than as a variable (even though the <u>assumed</u>
value of the element was based only upon the nature of the occupation
which workers were presumed to have <u>chosen</u>), and a two-variable regression
run on six observations?

7. Chapter 5 has two objectives: specification of a "semi-empirical"
macro-production function with heterogeneous labor and defense of the form
of the production function employed ("generalized" Cobb-Douglas). As noted
in part I of this paper, given Tinbergen's production function and eleven
numbers (3ρ's, 5ϕ's, 2π's and C), the production structure of the economy
is specified and output is determined. While most production function
studies estimate the coefficients of the production function (the ρ's, the
π's, and C, in this case) by statistically fitting the function to cross-
sectional data, Tinbergen does not. Should not a special effort be made

to defend the reliability of the specified function—especially given its

central position in subsequent policy simulations—when C is "taken"

(page 83), the π's are "assumed" (page 86), and the ρ's are simply described

as "estimated" (page 83)?

8. The conformity of the function with the results of other research

also raises questions. Tinbergen's function imposes unit elasticity

of substitution constraints among the three labor classes (defined by

education levels). Yet, independent studies of the elasticity of

substitution among labor inputs distinguished by education indicate

far higher coefficients. Bowles (1970) found elasticities of sub-

stitution between three levels of education similar to those specified

by Tinbergen to be 12 (between levels 1 and 2) and 200 (levels 2 and 3).

Dougherty (1972), using eight educational categories, found pairwise elasticities

ranging from 5 to ∞ with all of the estimates being above unity at the one

percent level (and with the estimate of the elasticity between higher and

lower educated being in excess of 5). Psacharopoulos and Hinchliffe (1972)

found elasticities between the three Bowles-Tinbergen education classifi-

cations to be about 5 and 2 (using data on both developed and developing

countries) and the elasticity between higher and secondary graduates for

developed countries to be close to infinity (even after adjusting this

estimate by controlling for variations in physical capital, the elasticity

estimate was 20). Finally, Dresch (1975) estimated the elasticity between

those with and without a university degree in the United States to be 3.8.

Of the available estimates, only those of Fallon and Layard (1975) in-

dicate elasticities consistent with the requirements of the Cobb-Douglas

function.[12] When these results are combined with the a priori expectation

of high substitution possibilities between categories of the same factor

and the small recent change in educated wage diffentials (in spite of a

significant increase in the ratio of educated to uneducated labor),[13]

should not the very form of the production function employed lead to

skepticism regarding the policy conclusions derived from it (more on this

in point 10)?

9. To be sure, Tinbergen is aware of the inconsistency of

the functional form he has chosen with a portion of the contrary evidence

cited in point 8, and does seek to empirically demonstrate the reasonable-

ness of the Cobb-Douglas function. He does this by estimating the elas-

ticity of substitution between university-educated labor and all other

labor by means of a single-equation regression in which the educational

composition of the labor force is explained by relative earnings and a

demand factor (the proportion of the labor force employed in the trans-

portation, utilities, and professional services sector) is used as a

shift variable. His estimated elasticities, using both Dougherty and

Bowles data, are not significantly different from unity. Again, is the

reader expected to be convinced that the Cobb-Douglas function is "realis-

tic" (page 96), and "statistically verified" (page 15) given that (a) the

choice of the demand factor is not defended and seems on the face of it

to be rather arbitrary, (b) the statistical significance of the estimated

coefficients is not shown in three of the five regressions run, (c) the

tests on the Bowles data cover both developed and developing countries

(Psacharopoulos and Hinchliffe, using a test similar to Tinbergen's, found

significant differences in substitution possibilities between developed

and developing countries, with the elasticities for the former set being

substantially <u>larger</u> than for the latter),[14] and (d) the substantial volume
of evidence (cited in point 8) indicating the inappropriateness of the
Cobb-Douglas function?

10. In Chapter 6, projections of the demand and supply of educated
labor are used to predict future wage differentials. Again questions of
the credibility of the results are troublesome. In this analysis, the
crucial elements are the projections of ρ_3 and x_3, and the Cobb-Douglas
function again (which defines the ratio of ρ_3 and x_3 as the ratio of the
income of workers with university education to the average income recip-
ient). Is the projection of ρ_3 to be accepted, given that (a) the pro-
jected growth of ρ_3 is <u>linearly</u> extrapolated from a simple time-series
regression of <u>estimated</u> ρ_3 on real income per capita based on nine observa-
tions for the United States covering sixty-three years (implying that future
technological change will have the same implications for the demand for
university-educated labor that the changes in the past 60 years have had);[15]
(b) the estimated value of ρ_3 for years before 1960 (on which the regression
is based) is likely to be biased upwards because its reliance on the un-
defended <u>assumption</u> that the ratio of those in the labor force with a
college degree to those with some higher education has been <u>constant</u> from
1900 to 1963, and equal to the 1959 ratio for prime-age <u>males</u> in the
U.S. <u>experienced</u> labor force (0.27); and (c) the projected growth
of real income per capita (though not unreasonable) is arbitrary and not
defended? Similarly, is the strong downward trend in the projected rela-
tive wage (ρ_3/x_3) from 1960 to 1990 to be accepted, given that (a) it rests
on the unit elasticity of substitution requirement of the Cobb-Douglas
production function (which implies a high responsiveness of the relative

inconsistent with Fn. 16 where you claim only a 26½ (19-34%) reduction ⟹ a decline from 1.60 to 1.176

wage to changes in the supply of higher educated labor); (b) it suggests

equality between the wage of university graduates and average income ✓ _amazing._

recipients by 1980; (c) it assumes that the future supply of educated labor

is unaffected by the projected reduction in relative wages; and (d) it shows _'c_

substantial divergence from the result of other estimates based on less

restrictive labor-demand models, fitted production functions, and a supply

model which is sensitive to demographic and relative wage changes?[16]

11. The questions raised in points 5 to 10 pertain directly to the

simulation estimates of the impact of changes in the educational compo-

sition of the labor force on relative wage differentials (income inequality)

in Chapter 7. In general these questions suggest that the estimated reduc- _that wasn't clear_

tion in inequality from increased higher education is substantially over-

stated. An additional question arises in the simulation of changes in

taxes. Is it reasonable to estimate the effects of doubling average effec-

tive tax rates on college educated workers (implying a more than two-fold

increase in marginal effective tax rates) without permitting any labor

supply or human investment (education) disincentive effects?

12. The issues mentioned in points 5 to 11 also have implications

for the estimates of the optimal income distribution. In particular,

would not the optimal income distribution be substantially less equal _give an example of how & why_

if the unit elasticity constraint of the production function were re-

laxed and/or if labor supply and human capital investment responses to

high marginal tax rates were introduced? Moreover, would not the change

in higher-educated labor required to achieve the (more unequal) optimum

be substantially greater if these same constraints and assumptions were

relaxed? Still further, is it appropriate to simulate the required

changes in taxes and education necessary to achieve the optimal income
distribution, assuming no change in the demand for labor (technology)?
Finally, what are the implications of simulating the optimal income
distribution from the special sort of utility function employed (see
point 5)--in particular, a utility function which results in a higher
after-tax income for a highly educated worker employed in a job re-
quiring a modest education than for the same worker employed in a job
requiring the education he possesses (page 123)?

13. A question regarding the neoclassical marginal productivity
approach that underlies Tinbergen's entire analysis--especially
his projections of future wage differentials, his simulations of the
effect of policy changes on income inequality, and his estimate of the
optimal income distribution--must also be put. Does not the acceptance
of the marginal product-wage equality assumption of these analyses
require an explicit defense in the face of evidence that such equalities
do not exist and that a perpetual "disequilibrium" may well characterize
Western capitalist economies (Thurow, 1968 and 1969)? And should not the
implications of some alternative models of labor-market behavior--models
emphasizing job competition rather than wage competition (Thurow) or dual
or segmented labor markets (Piore and Doeringer)--be explored? Indeed,
to the extent that Tinbergen's labor market involves distinct
(educational) "compartments" (page 29) with low supply--and demand--side
substitution possibilities among them, is it not akin to some of the dual
and radical labor market theories? And should not the extent and impli-
cations of this kinship--for both analysis and policy--be examined?[17]

14. A final set of questions pertain to the policy recommendations put forth by Tinbergen. Because these recommendations follow directly from his analyses, a number of economic issues pertinent to them have already been raised. In addition, the political viability of some of his suggestions seems open to question. Given that higher education is already highly subsidized and open to nearly all qualified indi iduals in the Western democracies, how can public policy significantly increase the level of higher education in the population without coercion or a significant reduction in its quality—especially in the face of projected falling rates of return on such investments? Doesn't the recommendation that a social contract be achieved among the various groups with divergent interests on an appropriate income distribution, or a procedure by which to contain inequality-boosting inflationary pressures need to be buttressed by some evidence that such contracts are feasible options? Is the potential for developing measures of innate human capabilities sufficiently great and is the possibility of political acceptance of such measures (if developed) as the basis for tax-transfer policy sufficiently high to warrant the substantial increase in "psychotechnical testing" which Tinbergen suggests? Are the allocative efficiency and economic growth consequences of explicitly redirecting research and investment policy toward increasing the demand for low-education relative to high-education workers sufficiently understood to warrant the implementation of policies along these lines? Many observers would have substantial reservations to the affirmative answers to such questions that Tinbergen's recommendations imply.

After all this, then, what is the overall appraisal of what
Tinbergen has offered us?

First, the positive things. Income Distribution is a funda-
mental and creative book. Its focus is the structure of the
economic process that generates differences in primary income among
people, and its analyses illuminate that process. As he has done so
often in the past, Tinbergen has cut away the underbrush in an enor-
mously dense area and has exposed a basic economic process at work—the
relative growth rates of the supply and demand for skilled manpower. And,
in so doing, he has brought out into the open a number of questions which,
for one reason or another, have often been neglected in discussions of
income distribution. For example, to the extent that capitalist exploita-
tion is the cause of income inequality, is it not the human capitalist
(educated and skilled manpower) and his control over access to this scarce
resource who is the main culprit? Or, should not the Western democratic
states seek to achieve agreement "by a considerable majority of the citi-
zens" (page 146) on some well-defined reduction in inequality as an ex-
plicit policy target, and then employ the available policy instruments
to achieve that objective? And, in designing policy, should not both
the structure and size of the education sector and the nature of research
and development (that is, technology-advancing) activities stand side-by-
side with the tax-transfer system, as primary instruments for achieving
income distribution goals? In assisting policy planners, should not the
scientific community turn its attention to measuring those aspects of
economic life in addition to income which convey welfare, to establishing

the linkages between education and technology from which income inequality springs, and to identifying those "permanent" human capabilities to serve as a base for a more effective tax-transfer system?

In addition to exposing this economic process and raising these fundamental questions, Tinbergen has set forth a full model of the income-distribution process, has specified the model with numbers designed to reflect the structure of the economy, and has employed the model to simulate the effect of incremental education and changes in the tax-transfer system and to estimate the optimal income distribution--no mean feat. Significantly, by emphasizing the linkages and rigidities between and within the production and distribution sectors, his model is an implicit refutation of the British side of the Cambridge controversy. While the model is elementary and the estimates preliminary, its existence illustrates the kinds of planning instruments and knowledge necessary if effective policy to equalize incomes is to be undertaken. And, as a by-product of its admittedly rudimentary form, it pinpoints a large number of areas on which further economic (income distribution) research is needed. The book is a gold mine of potential dissertation topics.

Second, the reservations. As Section II of this review suggests, and as Tinbergen acknowledges (pages 60, 65, 73, 134-135, and 158), the ambitious and pathbreaking nature of the work leaves all its elements--the conceptual model, the empirical estimates, and the policy recommendations--open to question. Tinbergen's confident presentation may serve to stimulate both debate and additional research-- which may well be his objective. However, given the uncertainties that surround all these elements, a more tentative stance--involving a

discussion of alternative labor market theories, the presentation of con-
fidence bands around empirical estimates and forecasts, the undertaking
of sensitivity analyses to indicate the effect of changes in critical
variables on outcomes (especially in the simulation and optimization
analyses) and recommendations, and recognition of the potential incon-
sistency of the proposals offered with political reality--would seem to
be called for.

One final comment: While Tinbergen describes his book as
"simple" (page 150), it is not. It is, in fact, a very dense book, with
numerous complex relationships and subtle assumptions lurking within each
paragraph and table. To the reader who only wishes to find out where
Tinbergen comes out and how, in a general way, he got there,
this is no problem. However, to the reader who seeks to trace the author's
steps more carefully, this characteristic represents a hindrance. Such a
reader is required to ferret out the crucial relationships and assumptions
and to gauge their effect on the results on his own, with little help from
the author. What is saved in lumber and paper is more than lost in
reader manhours.

These comments and reservations not withstanding, Tinbergen's
Income Distribution is a volume which must be thought through by every
serious student of the subject. His approach, estimates, and recommenda-
tions will influence the study of and policy toward income inequality
for a long time.

NOTES

[1] Jan Tinbergen, _Income Distribution: Analysis and Policies._ (Amsterdam: North-Holland Publishing Co, 1975).

[2] This contribution can be neglected, he claims, because it has been repeatedly analyzed by others and because "a considerable part of this income is taxed away" (page 6) in countries in the northwest of Europe.

[3] When the cross-sectional analysis not employing his demand index but yielding the highest positive coefficient on education is reworked by substituting the demand index for the original demand variable, it is estimated that income inequality could be halved by both halving the inequality in the distribution of education _and_ increasing the average number of years of schooling by 2.2 years.

[4] This "semi-empirical" production function was constructed with several constraints. These include: $\pi ij > 1$; the marginal product of a worker in $C_{i,j(=i+1)}$ will be less than or equal to the marginal product of a worker in $C_{i+1, j(i+1)}$; $\pi_{ij} = 1$ when $\phi_{ij} = o$; and $\Sigma p_j = 1-$ (the contribution of capital to the national product).

[5] In this model, it should be noted, the change in income from adding one more person to an occupation requiring a higher level of education than the job the person held previously (termed the "job substitution elasticity" by Tinbergen) is ∞ in the short run.

[6]Such a test seemed essential to Tinbergen, given the very high elasticities of substitution (from -8 to over -200) presented by a number of other researchers.

[7]It should be noted that Tinbergen's projected relative wage falls below unity for the United States by 1890 or 1990--an unexplained and improbable result.

[8]Obviously, "acceptance" depends on the extent to which an approach or results are "convincing" or "persuasive", which is ultimately a personal matter. A point that is unconvincing to one reader may well be patently obvious to all others.

[9]For example, in the United States, public social welfare expenditures rose from 4.3 percent of GNP to 8.8 percent between 1964 and 1972, accounting for the bulk of poverty reduction and reduced inequality during this period. As a result, the change in inequality in the distribution of total income over time was in the opposite direction from the change in inequality in the distribution of earned income. In the countries of western Europe, the share of transfers in total income is more than twice as large.

[10]Recent research by Roberti indicates that the relationship of economic growth to income inequality in the postwar period is overstated by relying on single-valued measures of overall inequality, and especially by single-valued measures of inequality that are concerned with only the top one-half of the distribution. Examining trends in inequality decile by decile in 6 developed Western economies, he finds that "the deciles which fall below the national mean income... appear to have a

higher risk of becoming more unequal than the deciles with income greater

than the mean income," and that "growth produces a reduction in the shares

of both the lowest and the highest deciles." Moreover, it should be noted

that his data measure total (i.e., after transfer) money income. Thurow

(1975) also presents evidence indicating a small relationship between

wage differentials and economic growth in postwar United States (page 58).

[11] Indeed, in the U.S. context it is not even clear that the

concept of the number of years required for a job is a meaningful one in

the large majority of job matches. See Thurow (1975) for a further dis-

cussion of this.

[12] And, as Dresch and Dougherty have noted, problems of collinearity

and the imposition of still other restrictions on the production function

leave these estimates open to serious question.

[13] See Thurow (1975), pages 58 and 62 ff.

[14] The result led them to conclude that "the possibilities of sub-

stitution between secondary- and higher-education graduates are much

greater in developed than in underdeveloped countries" (page 789), where

the elasticity was found to be in excess of 2.

[15] Or, alternatively, on a cross-sectional regression based on 4 obser-

vations.

[16] On the basis of such a model, Dresch projects that the ratio of

the wage of college graduates to noncollege graduates in the United

States will fall from 1.60 in 1970 to 1.39 (in 1989,) a decrease of about

13 percent compared to Tinbergen's projected reduction of from

19 to 34 percent.

[17]For example, the implications of an increase in education (or a reduction in its inequality) on education group wage differentials are rather different in Thurow's job competition model than in Tinbergen's (Thurow, 1975). It is apparently the dependence of the supply of skills on the demand for them through employer allocation of on-the-job training investments that causes the reversal of results. Should not the implications of this linkage for Tinbergen's results be considered?

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