6

The race between technological development and education

6.1. Does growth automatically reduce income inequality?

We are now in a position to set out more accurately the long-term results of the interaction of demand for and supply of productive services, in particular some main types of labour. In this chapter we will concentrate on the *long-term movements in income inequality in developed countries.* As already shown with the aid of observed facts in Chapter 2, the main trend in income distribution in developed countries has been toward less inequality. This has even led some commentators and politicians to suggest that with increasing average income inequality goes down *automatically.* Some economists also have expressed this feeling. Kuznets [38] is more cautious and rightly states (p. 212):

> 'A variety of factors can be discerned, some inducing movements in one direction, others pushing the process in the opposite direction. The resulting trends are a net balance of these conflicting effects of different factors and can properly be explained only if each factor is observed and its possibly changing effects gauged over the period covered.'

In this chapter the factors we propose to deal with are the main demand and supply factors we have so far introduced. On the demand side it is the production function and more particularly the exponent ρ_3 of the number of third-level educated persons. On the supply side it is the proportion x_3 of the labour force which actually has third-level education.

The role played by these two key factors in explaining income inequality will be set out in the following sections. In the choice made among the available demand and supply factors it is implied that the measure of inequality chosen is the ratio of income of university graduates from their labour to the economy's average income.

6.2. Long-term characteristics of demand for university graduates

For a study of long-term developments in income inequality it cannot be assumed that the production function has constant coefficients. In the Cobb–Douglas production function so far used the coefficient ρ_3 stands for the proportion of national product produced by university graduates. This proportion changes for two reasons – the increase in capital and in technological development. In our generalized Cobb–Douglas approach we will accept the statistical fact that the proportion of national income allocated to capital has changed in the long run as is brought out by the figures in Table 6.I, derived from Kuznets [38] pp. 168/9. For comparison a figure of 37 per cent for Colombia, 1966, may be quoted from Jaksch [32].

Table 6.I
Percentage share of capital in national income; various countries and periods.

GB	Share	F	Share	D	Share	USA	Share
1860–69	44	1853	36	1895	35	1899–1908	28
1954–60	24	1954–60	18	1954–60	25	1954–60	21

Note: Figures shown are averages of Kuznets' two alternatives.

Our further calculations will be concentrated on the United States and the Netherlands, since the additional and most relevant information needed is available for these two countries. For the United States a study by Ullman [74] enables us

to estimate, for the period 1900–1963, the proportion ρ_3 of national income allocated to the higher educated labour force. Her concept of higher education is wider than only university graduates but we assume that the latter have been a constant portion of the former. Using the following symbols:

η ratio of total income of higher educated to that of others;
ρ_0 portion of national income allocated to capital (Kuznets);
$\bar{\rho}_3$ portion of Ullman's higher educated in national income;
ρ_3 portion of those with more than 16 years of schooling;
y income per capita in the USA in 1960 \$;

we derive from Ullman's figures Table 6.II.

Table 6.II
Figures on income distribution; USA, 1900–1963.

Year	η	ρ_0	$\bar{\rho}_3$ $\left(= \frac{\eta(1-\rho_0)}{1+\eta}\right)$	ρ_3 $(= 0.27\,\bar{\rho}_3)$	Y[a]
1900	0.193	0.28	0.116	0.031	1480
1910	0.280	0.28	0.158	0.043	1720
1920	0.285	0.29	0.158	0.043	2500
1930	0.313	0.30	0.166	0.045	2510
1940	0.411	0.27	0.213	0.057	2500
1948	0.312	0.24	0.181	0.049	3520[b]
1955	0.430	0.21	0.236	0.064	.
1958	0.580	0.21	0.289	0.078	3710[c]
1963	0.610	0.19	0.298	0.081	.

[a] Estimated from Trends in developing countries, World Bank, 1973, Table 2.7, assuming price level in 1960 to be 80 per cent of that in 1970.
[b] 1950.
[c] 1960.

The coefficient 0.27, used to estimate ρ_3 from $\bar{\rho}_3$, has been based on the value of ρ_3 for 1959, derived from American Census data [78] (for males 25 to 64 years old in the experienced labour force).

From Table 6.II we see that the portion of national income allocated to higher-educated manpower has shown a rising trend throughout the period. In order to extrapolate values of

ρ_3 until 1990, a regression on income Y per capita in 1960 \$ was estimated with the result,

$$\rho'_3 = 0.046 + \underset{(5)}{18}Y \cdot 10^{-6} \qquad (R = 0.83), \qquad (6.1)$$

where R is the correlation coefficient and (5) is the standard deviation of the regression coefficient 18.

As a check for five observations in developed countries around 1960 ρ_3 was also regressed on Y; the data are shown in Table 6.III.

Table 6.III
Estimated portion ρ_3 allocated to university-educated manpower in some developed countries around 1960 and income per capita Y in 1960 \$, for year concerned.

Country	Year	ρ_3	Y	Sources for ρ_3
NL	1962	0.064	1430	Nota Inkomensverdeling [48]
CDN	1961	0.065	2100	Census of Canada, Bull. 4.1-1
S	1974[a]	0.079	3200	Husén [31]
USA	1959	0.078	2690	Census of Population, earnings
USA	1968	0.130	3490	Census sample, corrected

[a] Husén's figures refer to 35-year-olds in 1964. They have been taken to represent total working force composition for 1974, since 45 years of age is close to the average age of the labour force.

The cross-section regression equation appears to be

$$\rho'_3 = 0.016 + \underset{(8.2)}{26}Y \cdot 10^{-6} \qquad (R = 0.86). \qquad (6.2)$$

With the aid of these two regression equations extrapolated values for ρ_3 were obtained, based on alternative values for Y. For 1970–1980 an annual growth rate of 3 per cent and for 1980–1990 two alternatives of 3 and 2 per cent per annum were used. These growth rates are lower than the rate for 1960–1970, which was 3.2 per cent, in order to take into account the probable and necessary deceleration of growth in view of environmental factors, including the increased scarcity of energy and food expected for the world at large [72].

Table 6.IV
Values of ρ_3; USA, 1950–1990.

Year	Eq. (6.1)	Eq. (6.2)
1950	0.090	0.080
1960	0.096	0.088
1970	0.114	0.115
1980	0.138	0.149
1990 high	0.169	0.194
1990 low	0.158	0.178

A similar extrapolation, forward to 1990 and backward to 1900, has been made for the Netherlands. National income per capita at constant prices of 1970 are available from the National Accounts for 1972 over the period 1900–1970 (Netherlands Central Bureau of Statistics). For 1980, income per capita has been estimated at 150 per cent of 1970; this corresponds with 4.1 per cent growth per annum, as opposed to 3.9 per cent between 1960 and 1970 and is accounted for by the sudden fall in birth rates. For 1990 a high estimate has been based on the same rate of growth and a low one based on a 2 per cent annual increase, for the reasons given with regard to the USA. Transformation of the incomes per capita on a 1960 $ basis and the two alternative calculations of ρ_3 are shown in Table 6.V.

Table 6.V
Income per capita, 1970 = 100 and in 1960 $, and calculations of ρ_3 with the aid of formulae (6.1) and (6.2); the Netherlands, 1900–1990.

Year	Income per capita		ρ_3	
	1970 = 100	In 1960 $	Eq. (6.1)	Eq. (6.2)
1900	30	585	0.057	0.032
1930	46	900	0.062	0.039
1960	67	1310	0.070	0.050
1970	100	1940	0.081	0.066
1980	150	2910	0.098	0.092
1990 high	225	4400	0.125	0.130
1990 low	183	3505	0.109	0.107

6.3. Long-term characteristics of supply of university graduates

For both countries figures are available over the period 1900–1990 giving an estimate of the percentage of manpower with university education. For the United States, Ullman's estimates [74] cover a wider category, as already observed, but from 1940 onwards census figures are available which have been extrapolated until 1990 [61]. For the Netherlands, J. Passenier [50] has presented a series for the whole period 1900–1990. Since the overwhelming part of manpower expected to live in 1990 has already been born, there is no demographic reason to work with two alternatives for 1990 on the supply side; but two educational forecasts are given for the USA. The figures for both countries are given in Table 6.VI.

Table 6.VI
Percentage of labour force with higher or university education x_3; USA and the Netherlands, 1900–1990.

	1900	1910	1920	1930	1940	1948	1960	1970	1980	1990
USA higher	7.2	10.7	13.9	13.4	18.0	16.6	31.4[a]			
USA university (low)	1.8	2.7	3.6	3.4	4.6	6.0[b]	7.7	11.0	14.5	18.1
USA university (high)									15.0	20.5
NL university	0.54	–	–	0.61	–	0.88[c]	1.32	1.82	3.33	5.00

[a] Interpolated between 1958 and 1963.
[b] 1950.
[c] 1947.

The main tendency brought out by the figures is the steep increase since 1900, not only in historical figures, but also in expected figures for the last two decades. Even so figures have occasionally fallen. Then, although the figures for the United States must be higher than those of the Netherlands, they are not likely to be so very much higher, as the table shows. Some difference in definition probably remains. In fact, for males between 25 and 64 in 1959 the percentage of the experienced labour force with university education is given as 5.1 (5 or more years of college). For our purpose only the relative rise is important, however, and the inter-country difference should not be taken too literally.

6.4. Impact of the race between technology and education on income inequality

With the aid of the figures given or derived in the two preceding sections we can now estimate the income ratio of university graduates to the average income recipient. With our generalized Cobb–Douglas production function this ratio equals ρ_3/x_3 and these figures are shown in Table 6.VII.

Table 6.VII
Ratio ρ_3/x_3 of income with university training to average income recipients; USA and the Netherlands, with alternatives, 1900–1990.

	Eq. for ρ_3	1900	1930	1950	1960	1970	1980	1990 (low)	1990 (high)
USA	(6.1)	4.05	2.67	1.50	1.25	1.04	0.92–0.95	0.77–0.87	0.83–0.94
USA	(6.2)	3.15	2.38	1.33	1.14	1.04	0.99–1.02	0.87–0.99	0.95–1.07
NL	(6.1)	10.5	10.1		5.3	4.5	2.9	2.2	2.5
NL	(6.2)	5.8	6.4		3.8	3.6	2.8	2.1	2.6

In this table again the absolute figures for both countries are not to be taken seriously, since the ρ_3 have been based, for formula (6.1) on the absolute level for 1959 only, which may have been exceptional, and for formula (6.2) on the values for five countries. In fact, in 1972, family income with a university-trained head was still 150 per cent of average family income; or, alternatively, in 1959 earnings of a university-trained member of the labour force were 190 per cent of the mean earnings. What is significant is the movement over time. For the low 1990 USA figures and for the Netherlands, the *trend is falling consistently.* Only the high figures for 1990, based on a continuation of past growth in income per capita, are an exception: in that case the race between technological development and education *will be lost by education.* Generally, however, in the past 70 years that race has been *won by education* and Ullman's figures show this without the roundabout way of our table, set up for forecasting purposes. If we take the average between high and low figures for 1990, they tell us that between 1970 and 1990 our inequality index (ratio between income from university training and average income) pre-

sumably will fall by another 18 per cent according to formula (6.1) and by 7 per cent according to formula (6.2) after having fallen, between 1900 and 1970, by 74 and 67 per cent, respectively. For the Netherlands a further reduction by 48 and 35 per cent, respectively, is forecast, after a reduction from 1900 to 1970 by 57 and 38 per cent, respectively. The divergencies between the alternatives illustrate the uncertainties involved. Even so, it stands to reason that more possibilities for a further reduction exist in the Netherlands than in the United States. Finally the reader must be reminded of the fact that this chapter deals with *primary incomes*. Incomes after redistribution show a much less unequal picture, as illustrated in Chapter 2. This aspect will be taken up again in the subsequent chapters.

6.5. Irrelevance of concepts of surplus or shortage of university graduates

With the strong increase in the number of university-trained workers extensive discussions have developed about the question whether or not '*too many*' *university-trained* individuals have been delivered by the educational system and whether, consequently, educational policies should not be changed so as to prevent these larger numbers of university graduates from entering the labour market. Calculations have been presented concerning 'the' demand for various types of university graduates, often in an attempt to show that the market is 'flooded' with many types of graduates for whom employment 'never' will be found. Similarly, at the other end of the labour market unskilled labour is said to be in serious shortage and foreign workers have to be attracted, since the national labour force is no longer prepared to do the dirty or otherwise hard work.

Such statements tend to create considerable misunderstanding about the nature of the problems concerned. In the short run the situation may be represented more or less correctly by the expressions and statements quoted. For the long-run

development they are *irrelevant* and the operation of the price mechanism is neglected. The school of education planners, mentioned in Section 1.2 and in Chapter 5, has rightly understood that demand for practically all types of manpower is not rigid but depends on the price to be paid. Similarly the human capital school has correctly based its analysis of supply on the incomes to be expected.

From the figures shown in this chapter we see that the percentage of manpower with higher education has risen fourfold between 1900 and 1960 in the United States and trebled between 1900 and 1965 in the Netherlands. On occasions when the demand for unskilled labour has risen considerably, as for instance in the Punjab in India as a consequence of the 'green revolution', its wages have trebled within a few years. If unskilled jobs paid better than they pay at present in Europe, quite a few foreign workers could be replaced by nationals again. This is not to say that such a substitution is desirable before unemployment in the home countries of the foreign workers has been eliminated. The point is, however, that there is *no pre-ordained wage ratio* between skilled and unskilled workers or any other type of labour, and that too often public discussion on income and education policies tend to overlook this.