Labour shares and the personal distribution of income in the OECD

Daniele Checchi [a] **and** **Cecilia García Peñalosa** [b]
University of Milan **CNRS and GREQAM**

June 2004

Abstract: The aim of this paper is to study the relationship between the factor and the personal distribution of income.

JEL classification numbers:

Key words: income inequality, labour share, trade unions.

[a] University of Milan, Department of Economics, via Conservatorio 7, 20124 Milan-Italy. Email:daniele.checchi@unimi.it

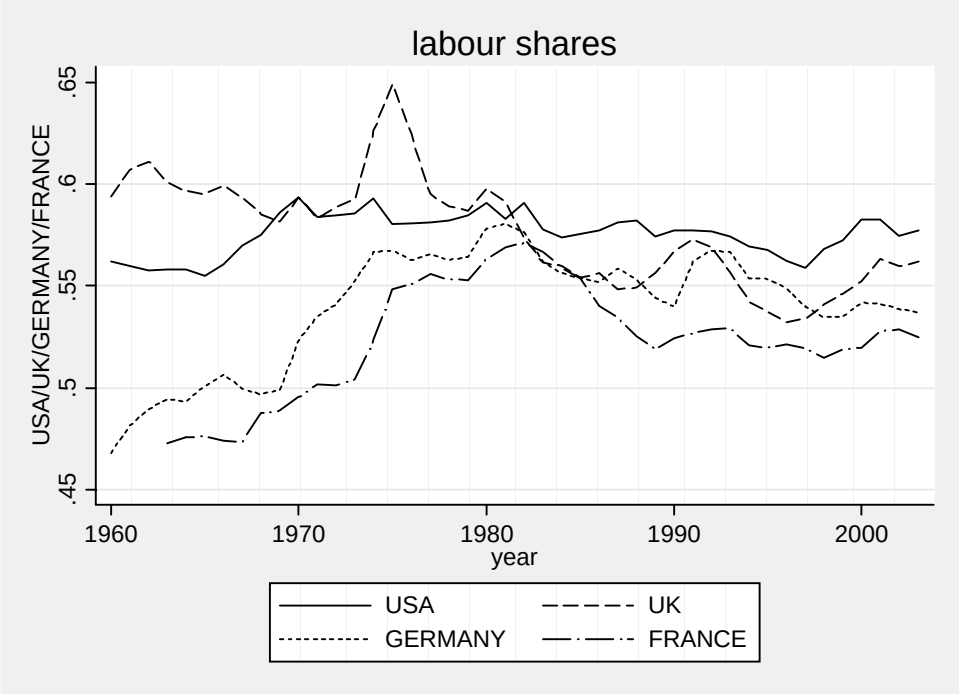
[b] GREQAM, Centre de la Vieille Charité, 2 rue de la Charité, 13002 Marseille, France. Email: penalosa@ehess.univ-mrs.fr

1. Introduction

Income inequality has been a major concern for economists over the past two hundred years. Starting with the work of David Ricardo (1821), economists have tried to understand how capital and labour are rewarded, and for a century and a half these rewards were seen as the cornerstone of theories of income distribution. A major shift in interest took place in the 1970s, when economist started to address the issue of what determines the distribution of income across individuals in a society, with the seminal work of Atkinson (1970, 1975), Champernowne (1973), Sen (1973), Stiglitz (1969) and Tinbergen (1975), among others. This paper argues that both distributions are related, and that the labour share remains a key element in order to understand differences in the distribution of personal incomes across countries.

Contrary to the textbook approach in macroeconomics where factor shares are taken to be constant, variations in the labour share across countries and over time are large. Figure 1 illustrates the recent experiences of the US, the UK, Germany and France over the period 1960 to 2002. The US has the most stable labour share, which fluctuates between 55 and 59 per cent. France and Germany have, for most of the period, a lower labour share than the two anglo-saxon countries, and exhibit a hump-shaped pattern with the labour share increasing up to around 1981 and declining thereafter; while the UK has experienced a decline over the period.[1] Despite a substantial reduction in the difference between those four countries, in 2002 their labour shares ranged from 53% in France to 58% in the US.

Figure 1 – Compensation per employees over gross domestic product – 1960-2003



[1] The notable exception is the sharp increase and subsequent fall of the labour share during the labour government of 1974-1976, after a period of major conflict between unions and the conservative government of Heath.

The question we want to address in this paper is whether these differences in the factor distribution of income can help us explain differences in the distribution of personal incomes in OECD countries over the past forty years. Indeed, recent work by Piketty (2001, 2003) and Piketty and Saez (2003) has emphasised the importance of capital income for the highest income groups even in recent times, and Atkinson (2003) has suggested that the increase in inequality that took place in a number of OECD countries during the 1980s was in part due to the rise in the return to capital.

We start by presenting a theoretical framework that allows us to decompose the Gini coefficient of the distribution of personal incomes in a model economy. Our highly stylised set up considers four types of agents. The first are the jobless who receive the unemployment benefit. The second are unskilled workers who receive the unskilled wage. Lastly, there are skilled workers, which may own capital or not. Those who do not will simply receive the skilled wage, while those who do (the worker-capitalists) receive both the skilled wage and profits. There are then three sources of inequality: employment versus unemployment, skilled versus unskilled wages, and the distribution of capital. In fact, the Gini index for personal incomes can be expressed as a function of the labour share, the relative wage, the unemployment benefit, and the proportion of the population in each category. A smaller labour share, a higher relative wage, and a lower unemployment benefit, all increase income inequality.

Several of the variables that determine the Gini coefficient are, however, endogenous. In particular, the labour share, the relative wage, the unemployment rate, and the levels of employment of skilled and unskilled workers are jointly determined in the labour market. We model the wage and employment determination process as the outcome of wage bargaining between a union that represents both skilled and unskilled workers and a firm in a right-to-manage framework. A crucial assumption in our setup is a nested CES production function with three inputs: skilled workers, unskilled workers, and capital. We find that the equilibrium wage differential depends on the degree of risk-aversion of the representative worker and on the relative demand for labour, while equilibrium employment levels are a function of union bargaining power and the capital labour ratio. In this framework the bargained levels of employment and wages will in turn determine the overall labour share. To sum up, some of the variables that explain the Gini coefficient are themselves functions of labour market institutions as measured by the union bargaining power.

2. Theoretical considerations

2.1. The Gini coefficient in a model economy

In order to isolate the determinants on the Gini coefficient on the distribution of personal incomes we consider the following model economy. The labour force (or population) is normalised to one. Workers can be skilled or unskilled, receiving the skilled or unskilled wage, w_s and w_u respectively.

They may also be unemployed, in which case they receive the unemployment benefit B. Some individuals also own capital and receive profits. We assume that the owners of capital are always skilled workers. We then have four types of agents characterised as follows:

(i) A fraction u of the labour force are unemployed, and receive an unemployment benefit B;

(ii) A fraction l of the labour force are unskilled workers earning a wage $\tilde{w}_u$;

(iii) A fraction h of the labour force are skilled workers. Of those $h-\kappa$ have an income equal to the skilled wage $\tilde{w}_s$;

(iv) There are κ worker-capitalists, each of whom earns profits π and the skilled wage $\tilde{w}_s$.

Our assumptions imply that $h+l+u=1$. We further assume that $\tilde{w}_s > \tilde{w}_u > B$ and $\pi > 0$.

Output is produced according to a production function of the form $Y = F(K, L, H)$, which exhibits constant returns to scale, and where K, L, and H denote, respectively, the capital stock, unskilled employment, and skilled employment. Factors are paid their marginal products, so that the gross wages, w_s and w_u, and interest rate, r, are

$$w_s = \frac{dF(.)}{dH},\ w_u = \frac{dF(.)}{dL},\ r = \frac{dF(.)}{dK}.$$

Employers and employees have to pay unemployment contributions at a rate τ, so that the wages received by workers are $\tilde{w}_s = (1-\tau)w_s$ and $\tilde{w}_u = (1-\tau)w_u$.

We can now define the labour share, denoted θ, as the ratio of total employee compensation to value added. Employee compensation includes wages and employer/employee contributions, hence

$$\theta \equiv \frac{w_s H + w_u L}{Y} = \frac{w_s h + w_u l}{y} \qquad (1)$$

where y denotes output per capita. This expression in turn implies that the profits of each worker-capitalist are given by $\pi = (1-\theta)y/\kappa$. We assume that the entirety of employer/employee contributions are used to finance the unemployment benefit, so that $B = \tau\theta y/u$.[2] This implies that the payment of net wages, capital income, and unemployment benefit exhaust output, so that average income is equal to output per capita, y.

[2] We are implicitly assuming that profits go untaxed. While this is an extreme assumption, it simplifies the algebra, leaving the tax rate τ out of the definition of the Gini index reported in equation (3). However, we tried to introduce it in the regression, but it is higly collinear with the unemployment benefit and the unemployment rate, and therefore we have decided to stick to our assumption.

The degree of income inequality is measured by the Gini concentration index computed across subgroups of population. When there are N subgroups, the definition of the Gini concentration index is:

$$Gini = \frac{1}{2y}\sum_{i=1}^{N}\sum_{j=1}^{N}\left|y_i - y_j\right| \cdot n_i \cdot n_j \qquad (2)$$

where y_i is the income in subgroup i, which has relative weight n_i, and y is the average income. Given our assumptions about the population and their incomes, the Gini coefficient can be expressed as

$$Gini = (1-\kappa)(1-\theta) + lh\frac{\tilde{w}_s - \tilde{w}_u}{y} + u(1-u)\frac{\tilde{w} - B}{y} \qquad (3)$$

where $\tilde{w}$ is the average wage, and $b \equiv B/y$ is the benefit replacement ratio. The Gini coefficient is thus a function of population proportions (u, l, h), the number of capital owners κ, the labour share, the wage differential, and the unemployment replacement ratio. A higher labour share will reduce inequality by lowering profits and thus reducing the income of the richest individuals. A greater wage differential between the skilled and the unskilled will raise the Gini coefficient as it increases inequality within the group of employed individuals, while a larger unemployment benefit will reduce the Gini coefficient. The effect of the unemployment rate is ambiguous. This is a standard effect when there is inequality within and between groups. The unemployed have a low income but are all equal, while the employed have a higher income but there is inequality within this group. More unemployment, by increasing the number of individuals in the less unequal category, may increase or reduce overall inequality.

Our framework of analysis makes a number of simplifications, which are worth mentioning. First, both the distributions of wealth and of wages have been compressed, since we only have two types of workers (skilled/unskilled) and one type of wealth-owner. Second, two sources of income are missing. One are the rents on assets such as land or intellectual property rights and patents, which we ignore as they are a very minor fraction of the total. The other are pensions. Note, however, that pensions can come from three sources: they can be provided by pension funds, in which case they are capital income; they can be private pensions paid by a company to its former employees, in which case they are (most often) counted as labour payments in the company's balance sheet; and they can be public pensions. It is only the third component that we have not included. This could in principle be an important source of income differences;[3] however the data are rarely available. Lastly, note that we have focussed on gross income inequality, with the only tax we have considered being the unemployment insurance contribution.

[3] Indeed Bourguignon et al. (2002) show that a major source of differences in distribution between the US and Mexico is the level of public pensions in those two countries.

The above expression for the Gini coefficient, although an identity, captures the main components of the distribution of income. Given the distribution of agents in the economy, inequality depends on three factors, namely, the way in which total output is divided between profits and wages, the distribution of wages within the labour force, and welfare provision as captured by the unemployment benefit. If we had information on all the right-hand-side variables we could simply decompose the Gini coefficient into its various components, and examine how much wage inequality or the distribution of wealth contribute to overall income inequality. There are two major problems in doing so. First, some of the data required, such as the distribution of wealth or the number of employed individuals at each level of education, are not available. Second, a number of variables in equation (3) are endogenous. In particular, the unemployment rate, and the levels of skilled and unskilled employment are functions of the two wages; wages may in turn be a function of the unemployment benefit; and the labour share is itself a combination of wages and employment levels. In order to account for the endogeneity of the variables of interest we would like to instrument for them in our empirical analysis. This raises the question of which are the good instruments for each of these variables. For some of them, it is possible to draw on the existing literature. For example, the level of unemployment benefits and the tax wedge have been shown to be major determinants of the unemployment rate (see Nickel and Nunziata, 2001). For others, it is less clear. In order to understand which are the potential determinants of w_s, w_u, h, l and u, the next section presents a simple model of wage and employment determination.

2.2. Wage and employment determination in a unionised economy

We examine wage and employment determination in a bargaining model in which a single union bargains with the representative firm in a right-to-manage framework. Before examining the union's problem, we consider the production structure of the economy.

Output and factor shares

We choose a particular form for the production function, and assume that output is produced using capital and a labour aggregate according to a CES function of the form

$$Y = \left[\alpha K^{-\sigma} + (1-\alpha)\left(H^{\beta} L^{1-\beta}\right)^{-\sigma} \right]^{-1/\sigma} \tag{4}$$

where K is the (given) stock of capital, H and L are respectively the levels of skilled and unskilled employment, and $-1 < \sigma < \infty$, and $0 < \alpha < 1, 0 < \beta < 1$. The elasticity of substitution between capital and labour is $1/(1+\sigma)$, and that between the two types of labour is one.

Differentiating the production function we can obtain factor demand functions,

$$r = \alpha\left(\alpha + (1-\alpha)x^{-\sigma}\right)^{-(1+\sigma)/\sigma} \tag{5a}$$

$$w_u = (1-\alpha)(1-\beta)\left(\alpha + (1-\alpha)x^{-\sigma}\right)^{-(1+\sigma)/\sigma} x^{-\sigma}\frac{K}{L} \tag{5b}$$

$$w_s = (1-\alpha)\beta\left(\alpha + (1-\alpha)x^{-\sigma}\right)^{-(1+\sigma)/\sigma} x^{-\sigma}\frac{K}{H} \tag{5c}$$

where $x \equiv \frac{H^{\beta}L^{1-\beta}}{K}$ is the ratio of the labour aggregate to capital. We can the express the relative demand for labour and the labour share as

$$\frac{H}{L} = \frac{\beta}{1-\beta}\frac{w_u}{w_s} \tag{6}$$

$$\theta = \frac{1-\alpha}{1-\alpha+\alpha x^{\sigma}} \tag{7}$$

We can see from these equations that the relative demand for labour depends exclusively on the relative wage, while the labour share is a function of the level of skilled and unskilled employment and the stock of capital, that is $\theta = \theta(L, H; K)$. Defining the capital-labour ratio as $k \equiv K/(H+L)$, and noting that $x = \frac{1}{k}\frac{(H/L)^{\beta}}{1+H/L}$, we can express the labour share as a function of the capital labour ratio and the relative employment ratio,

$$\theta = \theta(k, H/L). \tag{8}$$

Wages, employment, and union power.

We model the wage and employment determination process as the outcome of wage bargaining between a single union and a single firm in a right-to-manage framework. The union bargains over wages with the firm, and then the latter sets employment. We assume that the union represents both the skilled and unskilled, and that it has a utilitarian utility function of the form

$$V = L[U(w_u) - U(B)] + H[U(w_s) - U(B)]$$

where $U(.)$ is the workers' utility function, which is assumed to exhibit constant relative risk-aversion and takes the form $U(x) = x^{\rho}$, with $0 < \rho < 1$. The bargaining process is then

$$\max_{w_u, w_s}\left(L[U(w_u) - U(B)] + H[U(w_s) - U(B)]\right)^{\gamma}\left(Y - w_u L - w_s L\right)^{1-\gamma} \tag{9}$$

The union maximises this expression with respect to w_s and w_u, taking into account the fact that, for a given unskilled wage, changing the skilled wage affects both skilled and unskilled employment (and vice versa). Using the relative demand function (6), the resulting first-order conditions can be expressed as two functions of *H* and *L* (see appendix 2)

$$\phi(H, L; b, \rho, \gamma, \alpha, \beta, \sigma, K) = 0 \tag{10a}$$

$$\varphi(H, L; b, \rho, \gamma, \alpha, \beta, \sigma, K) = 0 \tag{10b}$$

These two equations together determine the levels of skilled and unskilled employment. The equilibrium levels of employment are a function of the level of unemployment benefit, b, the bargaining power of the union, γ, the degree of risk-aversion of workers, ρ, the capital stock, K, and the technological parameters, α, β, σ. That is

$$H^* = H(b, \rho, \gamma, \alpha, \beta, \sigma, K) \tag{11a}$$

$$L^* = L(b, \rho, \gamma, \alpha, \beta, \sigma, K) \tag{11b}$$

The firm's demand functions then give the two wages.

Two remarks are in order. First, for equations (10) to determine employment, the elasticity of substitution must be non-unitary ($\sigma \neq 0$). Otherwise it can be shown that although (10a) and (10b) determine the ratio H/L, the actual levels of employment are indeterminate (see appendix 2). Second, recall that from the demand functions we have

$$\frac{w_s}{w_u} = \frac{\beta}{1-\beta}\frac{L}{H}, \tag{12}$$

so that the relative wage is given only by the ratio of unskilled to skilled employment.

Potential Instruments for the Labour Market Variables

The analysis in the previous sections has highlighted the determinants of the labour market variables present in our expression for the Gini coefficient. For example, the level of unemployment benefits and the tax wedge have been shown to be major determinants of the unemployment rate (see Nickel and Nunziata, 2001). For others, it is less clear. In order to understand which are the potential determinants of w_s, w_u, h, l, and u, let us review the main results of previous section model of wage and employment determination. Note that the labour share, the relative wage, and the unemployment rate (see equations (8) and (12)) are all functions of the levels of skilled and unskilled employment. Equations (11) indicate that H and L are functions of the degree of bargaining power and of the unemployment benefit. Bargaining power can be proxied by union density, hence union density and the benefit replacement ratio are potential instruments. Three further instruments will be used: from equation (8) we see that the labour share also depends on the capital-labour ratio; the supply-side effects on the relative wage will be measured by the supply of skills in the economy as a whole; and the tax wedge will be used as an instrument for unemployment, in line with existing empirical work.

3. Empirical Analysis

3.1. Empirical specification

Our first attempt to understand what determines Gini coefficients in OECD economies consists of estimating the identity for the Gini coefficient obtained in section **2.1**. We saw that the Gini coefficient of personal incomes could be expressed as a function of labour share, wage premium to skill, replacement rate, unemployment share and population shares. Of those variables we lack data on the number of capital owners, of skilled and of unskilled workers (data typically exist for the distribution of skills in the population, not in the labour force). We therefore express the Gini coefficient as a function of four variables

$$Gini = G\left(\underset{-}{\theta}, \frac{w_s - w_u}{\underset{+}{y}}, \underset{-}{b}, \underset{\pm}{u}\right), \tag{13}$$

where the signs underlying each variable are in accordance with equation (3); the variable $b = \frac{B}{y}$ measures the replacement rate in the population, whereas the wage differential will be proxied by taking the 1st and the 9th decile in the earnings distribution.[4] We experimented with both the relative difference and the more conventional measure based on percentile ratio, using the latter alternative for better econometric performance. We thus estimate the following relationship

$$Gini_{it} = \alpha_0 + \alpha_1 \cdot \theta_{it} + \alpha_2 \cdot \frac{w_{it}^{90}}{w_{it}^{10}} + \alpha_3 \cdot b_{it} + \alpha_4 \cdot u_{it} + \alpha_5 \cdot b_{it} \cdot u_{it} + \delta_i + \lambda_t + def_{it} + \varepsilon_{it}$$

where we have taken into account the possibility of interaction between repacement rate and unemployment rate; δ_i are country fixed effects and λ_t are year fixed effects. We also control for different definitions used to compute the Gini index (concerning the nature of the recipient unit and the type of income taken into account).

3.2. The data

We collected data on 16 OECD countries over the period 1960-96. Detailed data sources are presented in Appendix 1. As is well known, the data on income inequality are problematic and international comparisons difficult (see Atkinson and Brandolini, 2001). For this reason we use two different sources for our income inequality measure: one measure is obtained from Brandolini (2003), who collected comparable measure of income inequality for several OECD countries; the other measure is derived from Deininger and Squire (1996), which has become the standard dataset for empirical studies of income inequality. In the text we report the estimates for the former measure, whereas in the appendix we replicates the estimates for the latter. Unfortunately these two datasets on

[4] We also run regressions with the relative wage of high- to low-skill workers, which gave equivalent results, but a somewhat worse fit of the equation.

income inequality overlap only partially, and therefore the results are not directly comparable (see figure A.1 in Appendix 1). The data collected by Brandolini is more comparable across countries and over time, and most of our analysis will be based on them. However, as a robustness check, we replicate our regression equations using the Deininger and Squire data.

We combine different datasets in order to obtain information about earnings differentials, labour market institutions, educational attainments and capital endowment (see Appendix 1 for details). Table 1 reports some descriptive statistics of the main variables in our regressions. While the potential sample size is 592 observations (16 countries × 37 years), many observations are missing , thus reducing the available sample to 233 observations (among which US, UK, Germany, Sweden Italy and Canada are the most represented countries – see table 2). When we couple these data with existing information on earnings differentials the sample is further reduced (to 142 observations). In order not to loose too many observations, we have replaced the missing observation for the P9010 variable with its country-specific sample mean. As can be noticed from table 3 (which reports a reduced sample in the 2nd and 5th column) this fictitious enlargement of the sample allows us to retain relevant information that otherwise would be excluded due to missing observations on earnings differentials.

Table 1 – Descriptive statistics – sample means

country	gini1	gini2	p9010	ls1	ur	ben
australia	32.83	38.08	2.83	0.49	5.32	0.22
belgium	27.75	26.81	2.34	0.52	6.64	0.41
canada	36.03	31.32	4.24	0.53	7.42	0.26
denmark	32.86	32.08	2.17	0.55	5.01	0.44
finland	21.76	29.77	2.45	0.51	5.68	0.25
france	38.33	42.13	3.44	0.52	6.52	0.30
germany	36.22	31.23	2.84	0.54	3.85	0.29
italy	34.71	34.67	2.33	0.46	6.07	0.05
japan	.	34.86	3.06	0.51	2.20	0.11
korea	.	34.18	3.97	0.41	.	.
netherlands	28.55	28.54	2.61	0.55	5.11	0.45
new zealand	27.23	34.06	3.03	0.48	2.91	0.31
norway	22.64	34.75	2.08	0.48	2.73	0.23
sweden	47.12	31.69	2.10	0.58	3.17	0.19
united kingdom	27.52	25.98	3.27	0.58	6.31	0.22
united states	37.58	35.49	4.16	0.58	5.86	0.12
Total	33.98	32.56	3.03	0.52	5.00	0.26

Legend:
gini1 = Gini index on personal income distribution, from Brandolini 2003
gini2 = Gini index on personal income distribution, from Deininger and Squire 1996
p9010 = ratio between 90th and 10th percentile in earnings distribution, from OECD
ls1 = labour share on value added at market price, from OECD-Stan database
ur = unemployment rate, from Nickell-Nunziata 2001
ben = unemployment benefit from OECD 2001

Table 2 – Sample sizes

country	gini1	ls1	p9010	ben	ur	sample
australia	6	44	25	40	36	6
belgium	4	44	8	40	41	4
canada	24	43	12	40	36	24
denmark	10	34	11	40	39	10
finland	14	44	21	40	41	14
france	6	41	39	40	41	6
germany	28	44	15	40	41	27
italy	23	44	11	40	41	23
japan	na	44	25	40	41	na
korea	na	34	16	na	na	na
netherlands	9	35	23	40	41	9
new zealand	3	34	14	40	36	3
norway	10	34	12	40	36	10
sweden	26	44	24	40	41	25
united kingdom	36	44	31	40	41	36
united states	37	44	28	40	41	36
Total	236	651	315	600	593	233

3.3. Basic components of the Gini coefficient

Table 3 presents our basic results. Four alternative country fixed effect equations are estimated for each measure of inequality, with and without earning inequality measures and including and excluding year fixed effects. We find that all four variables have the expected signs, and, with the

exception of the unemployment rate, have significant coefficients. The labour share has a strong negative impact on the distribution of income, while the wage differential (proxied by the p9010 differential) has a positive impact. The impact of the labour share is economically significant: evaluated at sample means, the estimated elasticity ranges between 0.28 (5th column) and 0.89 (1st column). This implies that reducing the labour share by one standard deviation would raise the Gini coefficient between 0.8 and 2.3 points. The estimated elasticity of the wage differential is smaller, ranging between 0.22 and 0.57, but its impact is large, with an increase in the decile ratio of one standard deviation raising the Gini coefficient between 2 and 4 points.[5] Results are substantially unchanged when we use the alternative series for income inequality, but the fact that the unemployment rate becomes insignificant (see table A.1 in Appendix 1). Notice that we have also included a linear time trend, which bears a positive and singificant sign, indicating a rising inequality trend.

Table 3 – Determinants of personal income inequality – OLS regressions
robust standard errors - t-statistics in parentheses

Model :	1	2	3	4	5	6
# obs :	233	142	233	233	142	233
Depvar:	gini1	gini1	gini1	gini1	gini1	gini1
labour share	-43.737	-32.971	-39.004	-48.455	-43.910	-49.112
	(-7.84)	(-4.19)	(-6.62)	(-5.12)	(-4.68)	(-5.39)
unemply. benefit	-36.585	-6.033	-34.538	-37.130	-4.124	-34.363
	(-7.98)	(-1.05)	(-7.38)	(-7.82)	(-0.65)	(-7.23)
unemply. subsidy	-0.916	0.101	-0.714	-1.021	0.122	-0.780
	(-4.30)	(0.48)	(-3.34)	(-4.17)	(0.50)	(-3.24)
benefit× unemply.	2.476	-0.277	2.236	2.536	-0.534	2.215
	(3.84)	(-0.51)	(3.48)	(3.56)	(-0.81)	(3.22)
time	0.155	0.155	0.107	0.151	0.160	0.090
	(6.90)	(5.04)	(4.44)	(11.70)	(6.33)	(3.54)
p9010		3.564	3.596		3.688	3.995
		(3.41)	(3.68)		(2.76)	(2.97)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Definitns	Yes	Yes	Yes	Yes	Yes	Yes
Countries	Yes	Yes	Yes	Yes	Yes	Yes
Years				Yes	Yes	Yes
R^2	0.938	0.963	0.941	0.945	0.971	0.948

[5] The controls for definition include whether the income is gross or net, and whether the recipient is household equivalent or person equivalent. We also experimented with errors clustered by countries, with a decline in significance in the unemployment rate and its interaction.

3.4. Auxiliary regressions and IV estimation

Next, we take into account the possibility of endogeneity, in line with our model, and study the determinants of the potentially endogenous variables. Table 4 reports OLS country fixed effect estimates of auxiliary regressions. In columns 1 (country fixed effect) and 2 (country and year fixed effects) we find that the labour share is increasing in both union density rates (a proxy for union bargaining power) and in the capital/labour ratio (as implied by our model). We have also taken into account the fact that when minimum wage legislation applies, union leaders are partially relieved from negotiating wage increases for unskilled workers since the minimum wage is doing the job.[6] In this case, unions may use their bargaining power to obtain higher wages for skilled workers, thus increasing the total wage share. We included the price of oil in national currency in order to capture exogenous shocks to raw materials' (this variables also captures the effect of competitive devaluations, and the J-effect on internal inflation).[7] Lastly, we have considered the potential role of the supply of skills. Time series of labour force composition by skills are not available over a long time span; therefore we relied on two potential proxies derived from educational attainment, i.e. measures of human capital. The one reported in the text is the average years of education in the adult population. It displays a negative correlation with the labour share, suggesting that once the skill level rises, wage differential in favour of skilled workers declines, shifting outwards the demand for skilled labour. As a consequence, an inequality adverse union will tries to compensate the worsening of the condition of unskilled workers (in terms of relative employment), leading to concessions in terms of wage share.[8]

In columns 3 and 4 we report the analysis of the possible determinants of the wage differential. We include union bargaining power (which tends to compress the wage distribution) and the minimum wage (compressing the wage distribution from below). A greater relative supply of skilled labour (proxied by our human capital variable) tends to reduce the wage premium, while the time trend exhibits a positive and significant coefficient, capturing the upwards trend in earnings inequality, potentially associated to skill-biased technical change. In columns 5 and 6 we replicate well-known results on the determinants of unemployment, which is positively correlated with the unemployment subsidy and with the tax wedge, respectively due to the higher reservation wage and the higher labour cost that they create (though this last effect appears only when year fixed effects are excluded).

---

6 Using the minimum wage as an explanatory variable is problematic, it is missing for several countries (Denmark, Finland, Germany, Italy, Norway, Sweden and UK for most of the sample period). In order not to loose degrees of freedom, we have replaced the missing observation with a unitary value, which is thus cleared away with the country fixed effect.

7 Unfortunately this variable alternates sign depending on whether or not time fixed effects are included. For this reason, we will discard it as potential instrument.

8 The alternative measure is given by the population share with "at least some secondary schooling". Since these two measures are collinear (correlation coefficient is 0.84), we have chosen the one with the stronger statistical significance.

These results support the model in section 2. Stronger unions obtain a greater labour share and smaller wage differentials, both of which tend to reduce income inequality. A similar effect is obtained through minimum wage legislation. The unemployment benefit legislation has ambiguous effect, since it improves the relative income of the unemployed, but at the same time it raises the number of unemployed people. A similar argument can be made for the tax wedge, which in our theoretical model was considered as the only source of public funding of unemployment benefit schemes. Greater educational attainment in the population has an inequality-reducing effect, through the double channel of relative convenience of labour input to capital, and the reduction of the wage differential.[9] For symmetric reasons, an increase in the capital-labour ratio raises labour productivity, increasing the labour share and reducing income inequality. All these results are supported if we estimate a reduced form equation, where the two alternative measures of income inequality are regressed directly onto the variables describing labour market institutions (see table A.2 in Appendix 1).

The comparison between the OLS results obtained in table 3 and IV estimates are reported in table 5; instruments have been selected from the pool of regressors used in table 4, with an eye to the results of the Sargan test for overidentifying restrictions. Our preferred version is reported in columns 3 and 4 of table 5, while the corresponding estimates for the Deininger and Squire series of income inequality are in table A.3 of Appendix 1. These results show that OLS-estimation provides downward-biased estimates of the actual effect of the labour share and wage inequality on income inequality. This bias could be merely due to measurement errors. It could also be a sign that some unobservable variable which correlates with both income inequality and labour market institutions - such as the political orientation of the government or the attitude of the population towards redistribution- has been omitted. The impact of passive labour market policies remains significant and negative, while the unemployment rate and the time trend loose significance.[10]

[9] See the discussion of the relationship between educational attainment and income inequality in Checchi 2004.

[10] For this version of the regression equation we excluded the interaction between unemployment rate (which we take as potentially endogenous) and the unemployment benefit (that we consider exogenous), since it would have required the reconstruction of the interaction after the first stage, using the predicted values for the unemployment arte.

Table 4 – Determinants of potentially endogenous variables – OLS regressions
robust standard errors - t-statistics in parentheses

Model :	1	2	3	4	5	6
# obs :	429	429	292	292	541	541
Depvar:	lab.sh.	lab.sh.	p9010	p9010	un.rate	un.rate
union density	0.063 (3.05)	0.022 (1.33)	-0.989 (-4.41)	-0.858 (-3.91)		
minimum wage	0.096 (3.54)	0.048 (1.79)	-3.256 (-6.38)	-2.217 (-4.14)		
capital ×worker	0.110 (17.35)	0.071 (10.43)				
oil price	0.013 (9.40)	-0.022 (-4.97)				
yrs of educat	-0.045 (-16.40)	-0.008 (-1.18)	-0.343 (-4.33)	-0.292 (-3.19)		
time			0.031 (4.01)	0.022 (2.98)		
unempl benefit					8.994 (6.58)	3.745 (3.32)
tax wedge					16.969 (7.61)	-0.351 (-0.17)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Countries	Yes	Yes	Yes	Yes	Yes	Yes
Years		Yes		Yes		Yes
R^2	0.813	0.886	0.962	0.971	0.494	0.742

Legend:
union density = union density, from Nickell-Nunziata-Ochel database
capital×worket = log of capital per worker, from Summer-Heston database
oil price = log of the oil price in national currency
minimum wage = ratio of minimum to median wage, form OECD database (set equal to 1 in countries where missing)
years of education = Years of schooling of population 25 and over, whether studying or not, from Cohen-Soto 2001
unemploy. benefit = replacement rate for unemployment benefit, from OECD database
tax wedge = tax wedge, from from Nickell-Nunziata-Ochel database

Table 5 – Comparison between OLS and IV estimates
robust standard errors - t-statistics in parentheses

Endogenous: labour share, unemployment rate, p9010
Instruments: (log)capital×worker, union density, tax wedge, years of education, population share with some secondary school attainment.

Model :	ols	ols	iv	iv
# obs :	188	188	188	188
Depvar:	gini1	gini1	gini1	gini1
labour share	-23.540	-38.293	-15.729	-57.917
	(-2.82)	(-4.00)	(-1.15)	(-2.73)
p9010	4.939	6.674	11.421	15.162
	(4.66)	(4.92)	(3.95)	(4.73)
unempl benefit	-21.141	-21.884	-17.736	-17.018
	(-4.47)	(-5.36)	(-4.83)	(-3.79)
unempl rate	0.040	0.050	0.185	0.466
	(0.55)	(0.56)	(0.73)	(1.66)
time	0.056	0.077	-0.026	-0.139
	(1.75)	(1.84)	(-0.34)	(-1.22)
Constant	Yes	Yes	Yes	Yes
Definition	Yes	Yes	Yes	Yes
Countries	Yes	Yes	Yes	Yes
Years		Yes		Yes
R-sq	0.933	0.947	0.915	0.924
Sargan (pvalue)			0.01	0.15

To be completed:

⇨ what would have been the level of inequality that would have been observed in country A if it had experienced the labour market institutions of country B?

⇨ especially in the case of union density, what would have been the level of inequality if unions had retained the density of the 70's?

4. Conclusions

This paper adds to the recent revival of interest in the factors shaping the distributions income across countries (Bourguignon and Morrisson, 1990, 1998; Li, Squire, and Zou, 1998; Barro, 2000; Aldermand and Nielsen, 2002; Breen and García Peñalosa, 2004). For decades empirical work on cross-country differences in the distribution of income consisted of tests of the Kuznets hypothesis taking the form of regressions of inequality on the level of GDP and its square. Only recently have variables other than the level of income been considered, such as the level of human capital, the degree of democratisation, or labour market institutions. Although this approach is helpful in understanding the underlying causes of inequality, it leaves little room for policy recommendations as in most cases the particular mechanism through which these variables impact inequality is not understood. By focussing on the basic determinants of the distribution of income we want to understand whether, say, labour market institutions play a role because they affect the unemployment rate, the distribution of wages, or the way in which capital and labour are rewarded.

The paper is also related to the literature on the evolution of inequality in industrial economies over the past three decades. This literature has been dominated by two features. On the one hand, the increase in income inequality in a number of countries, and on the other the sharp rise in the relative wage in the UK and the US (Atkinson, 1997, 2003; Gottschalk and Smeeding, 1997; Bound and Johnson, 1992; Juhn, Murphy, and Brooks, 1993). Our paper emphasises two aspects. First, that although wage inequality is a crucial aspect of the income distribution, the distribution of wealth still plays a substantial role as captured by the negative impact of the labour share in our regressions for the Gini coefficient. Second, our analysis highlights the differences between an increase in the relative wage and in wage inequality. Understanding the evolution of inequality requires knowing the proportions of agents receiving each salary and not only the relative salaries, and looking at the labour share is a (crude) way of capturing both .

A number of recent papers have been concerned with the labour share. The focus of these works has been to understand the determinants of either the evolution of the labour share over time in OECD, or cross-country differences (Blanchard, Nordhaus, and Phelps, 1997; Rodrik, 1999; de Serres, Scarpetta and de la Maisonneuve, 2002; Bentolila and Saint-Paul, 2003). We present a different perspective, trying to understand not the determinants but the effects of differences in the rewards to capital and labour across countries and over time.

Our analysis has important policy implications. The first one concerns the role of redistribution. The view that a widening wage dispersion has been the major cause of the recent increase in income inequality leaves little role for policy. The increase in wage dispersion has been, it is argued, caused by trade and innovation. Since both increased openness and technological change are seen as desirable, greater inequality has been perceived as an unavoidable by-product of the

growth process. Income redistribution can then be used to reduce net-income inequalities, but would not affect the distribution of market incomes. In contrast, the negative impact of the labour share on the Gini coefficient indicates that the distribution of wealth across agents is still a major source of inequality, and hence leaves room for policy to affect inequality in the long-run. Income redistribution will have the effect of reducing differences in the accumulation of wealth across agents and hence affect gross-income inequalities in the future.

The second aspect concerns the role of labour market institutions as a source of equalisation. We can view greater unionisation as a mechanism that reduces the rewards to capital and hence partly offsets the effect of an unequal distribution of wealth on inequality. A caveat is, however, in order. Our empirical results imply that greater unionisation tends to increase the labour share and reduce inequality, in line with our theoretical framework. Our analysis is, however, static and takes the stock of capital as given. This implies that we are ignoring the impact of labour market institutions on investment, which would in turn affect the capital labour ratio, the labour share, and hence the distribution of income.

Appendix I: Data sources

Data on income inequality are obtained from two alternative sources: the variable GINI1 is obtained from Brandolini 2003, whereas the variable GINI2 is derived Deininger and Squire 1996 (downloaded on 22/10/1998), by selecting "high quality data" only. In both cases we have controlled for the type of income ("gross", "disposable" or "net") and the type of recipient ("household", "household equivalent" or "person equivalent"). As it can be seen by the figure A.1 below, the two indices provide very similar information for Italy, United Kingdom and United States, whereas diverging for others countries (especially for nordic countries).

Data on labour shares are obtained from the OECD-Stan dataset, reconstructed backward to the 60's from the Research Group at the Bank of France, and made available to us by Emilie Daudey (see Daudey, 2004). They are defined as the ratio between "compensation per employees" and "gross domestic product (income approach)", at current prices, for the entire economy. In alternative specification we have restricted to the manufacturing sector, without significant differences (apart from the different mean values). Graphs of the variables are reported in figure A.2.

Data on unemployment rates are from Nickell and Nuziata 2001, wherear the replacement rate is obtained on a biannual base by OECD 2002 (and then replicated for the missing years).

Figure A.1 – Gini indices on income inequality

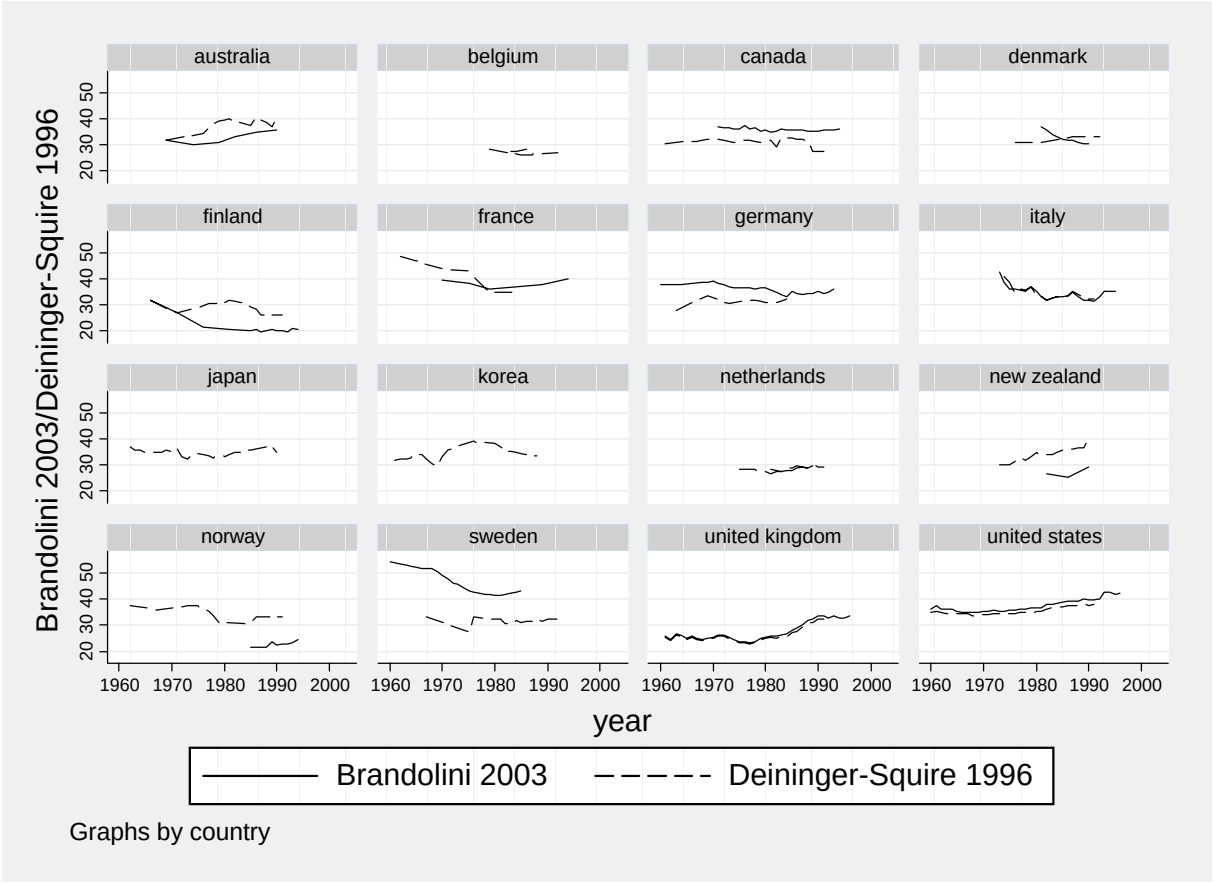


Figure A.2 – Labour shares – Total economy

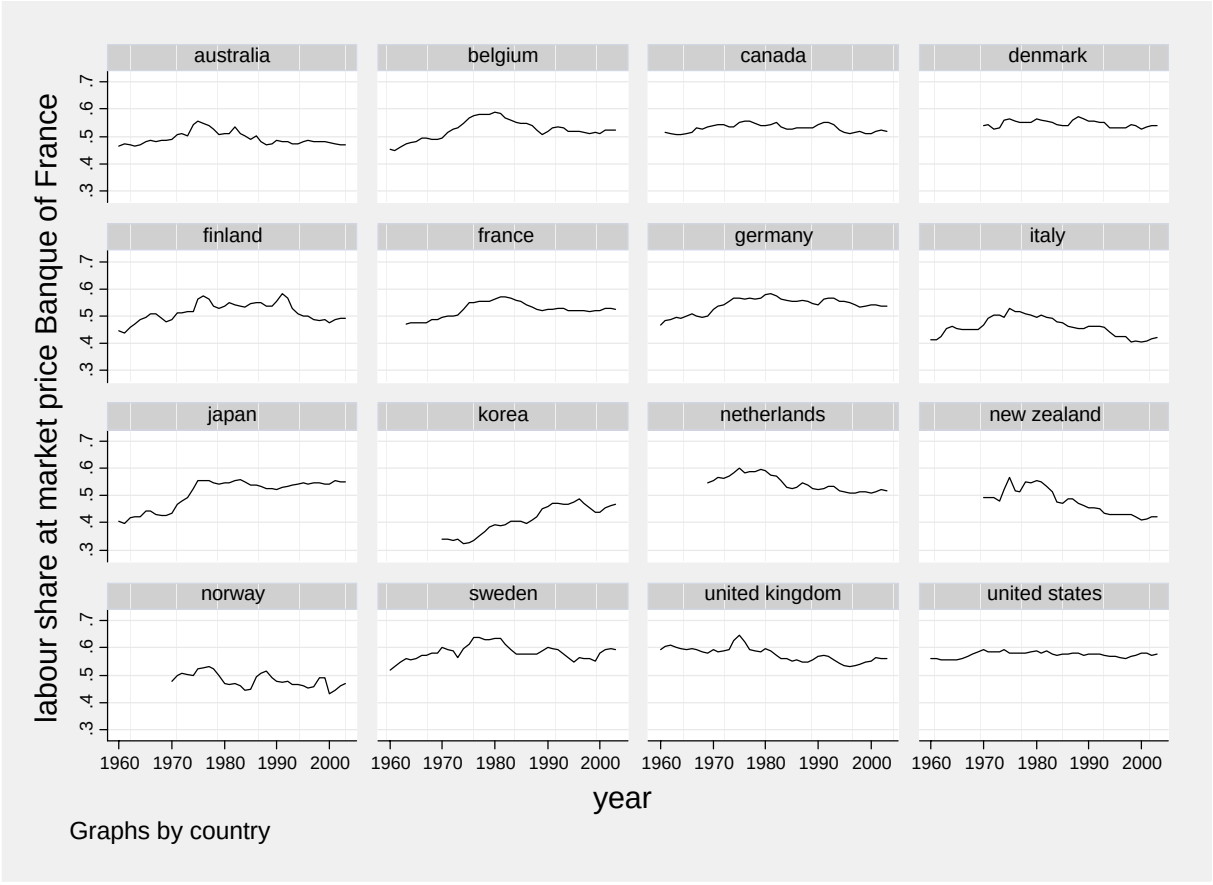


Table A.1 – Determinants of personal income inequality – OLS regressions
robust standard errors - t-statistics in parentheses

(t-statistics in parentheses)

Model :	1	2	3	4	5	6
# obs :	248	144	248	248	144	248
Depvar:	gini2	gini2	gini2	gini2	gini2	gini2
labour	-18.940	-36.758	-10.749	-22.109	-36.342	-19.981
share	(-3.73)	(-4.05)	(-2.32)	(-2.87)	(-3.61)	(-3.20)
unemply.	-16.165	-16.788	-13.541	-17.547	-18.695	-14.909
benefit	(-3.39)	(-2.40)	(-3.12)	(-3.43)	(-2.39)	(-3.31)
unemply.	-0.198	0.192	0.020	-0.239	0.265	-0.032
rate	(-0.99)	(1.30)	(0.10)	(-0.97)	(1.40)	(-0.15)
benefit	0.660	-0.723	0.567	0.829	-0.740	0.796
×unemply.	(1.11)	(-1.79)	(1.01)	(1.31)	(-1.45)	(1.41)
time	0.086	0.015	0.024	0.066	-0.065	0.034
	(3.15)	(0.39)	(0.87)	(1.90)	(-0.62)	(1.02)
p9010		5.174	6.526		4.645	7.201
		(4.05)	(4.88)		(2.83)	(4.90)
Const	Yes	Yes	Yes	Yes	Yes	Yes
Def	Yes	Yes	Yes	Yes	Yes	Yes
Countr	Yes	Yes	Yes	Yes	Yes	Yes
Years				Yes	Yes	Yes
R^2	0.806	0.912	0.834	0.818	0.926	0.846

Table A.2 – Determinants of personal income inequality – reduced forms - OLS regressions
robust standard errors - t-statistics in parentheses

Model :	1	2	3	4
# obs :	211	211	225	225
Depvar:	gini1	gini1	gini2	gini2
union	-13.202	-14.314	-2.157	-2.745
density	(-3.18)	(-3.50)	(-0.41)	(-0.46)
minimum	-1.190	-8.127	-9.574	-8.695
wage	(-0.28)	(-1.64)	(-2.28)	(-1.81)
capital	-8.354	-19.557	-2.690	-3.175
×worker	(-2.44)	(-4.60)	(-3.24)	(-3.15)
yrs of	-0.90	6.471	-0.565	-1.150
educatio	(-0.68)	(3.13)	(-0.20)	(-0.34)
tax wedge	-23.812	-26.533	-3.314	-5.188
	(-4.02)	(-4.14)	(-0.73)	(-1.00)
unemploy	-8.737	-15.308	-13.576	-14.741
benefit	(-2.22)	(-4.05)	(-3.08)	(-3.22)
time	0.488	0.276	0.199	0.263
	(3.15)	(1.59)	(0.70)	(0.75)
Constant	Yes	Yes	Yes	Yes
Definition	Yes	Yes	Yes	Yes
Countries	Yes	Yes	Yes	Yes
Years		Yes		Yes
R^2	0.947	0.958	0.815	0.825

Table A.3 – Determinants of personal income inequality – OLS and IV regressions
robust standard errors - t-statistics in parentheses

Endogenous: labour share, unemployment rate, p9010
Instruments: (log)capital×worker, union density, tax wedge, years of education, population share with some secondary school attainment.

Model :	1	2	3	4
# obs :	224	224	224	224
Depvar:	gini2	gini2	gini2	gini2
labour share	-8.744	-20.214	-3.518	-53.011
	(-1.75)	(-3.13)	(-0.36)	(-2.14)
p9010	6.209	7.281	12.129	5.933
	(4.86)	(5.43)	(2.87)	(1.16)
unemploy benefit	-11.784	-12.867	-9.726	-14.90
	(-3.17)	(-3.38)	(-2.85)	(-3.46)
unemploy rate	0.140	0.123	0.393	-0.729
	(1.64)	(1.25)	(1.18)	(-0.95)
time	0.007	0.046	-0.069	0.261
	(0.23)	(1.13)	(-0.79)	(1.40)
Constant	Yes	Yes	Yes	Yes
Definition	Yes	Yes	Yes	Yes
Countries	Yes	Yes	Yes	Yes
Years		Yes		Yes
R^2	0.830	0.844	0.803	0.795

Appendix II: The Bargaining Model

The bargaining problem is given by

$$\max_{w_u, w_s} \left(L\left[(w_u)^\rho - (B)^\rho \right] + H\left[(w_s)^\rho - (B)^\rho \right] \right)^\gamma \left(Y - w_u L - w_s L \right)^{1-\gamma}$$

The union maximises this expression with respect to w_s and w_u, taking into account the fact that, for a given unskilled wage, changing the skilled wage affects both skilled and unskilled employment (and vice versa). The resulting first-order conditions can be expressed as

$$w_s^{\rho-1}\left[\rho + \left(1 - \left(\frac{bY}{w_s} \right)^\rho \right) \varepsilon_H + \left(\left(\frac{w_u}{w_s} \right)^\rho - \left(\frac{bY}{w_s} \right)^\rho \right) \frac{\partial L}{\partial H} \varepsilon_H \right] = \frac{1-\gamma}{\gamma} \frac{H w_s^\rho + L w_u^\rho - (H+L)(bY)^\rho}{Y - H w_s - L w_u} \quad \text{(A2.1)}$$

$$w_u^{\rho-1}\left[\rho + \left(1 - \left(\frac{bY}{w_u} \right)^\rho \right) \varepsilon_L + \left(\left(\frac{w_s}{w_u} \right)^\rho - \left(\frac{bY}{w_u} \right)^\rho \right) \frac{\partial H}{\partial L} \varepsilon_L \right] = \frac{1-\gamma}{\gamma} \frac{H w_s^\rho + L w_u^\rho - (H+L)(bY)^\rho}{Y - H w_s - L w_u} \quad \text{(A2.2)}$$

where the term $\partial L / \partial H$ indicates that as the skilled wage changes, the level of skilled employment also changes, affecting the marginal product of unskilled labour and hence –for a given unskilled wage- the level of unskilled employment (and equivalently for $\partial H / \partial L$). The terms ε_H, and ε_L are the elasticities of the demands for the two types of labour.

Define

$$g \equiv w_u^{1-\rho} \frac{1-\gamma}{\gamma} \frac{H w_s^\rho + L w_u^\rho - (H+L)(bY)^\rho}{Y - H w_s - L w_u}, \quad \text{(A2.3)}$$

which can be expressed as

$$g(H,L) = \frac{1-\gamma}{\gamma} \frac{1 + \left(\frac{\beta}{1-\beta} \right)^\rho \left(\frac{H}{L} \right)^{1-\rho} - \frac{L+H}{L} \left(\frac{bL}{(1-\beta)\theta} \right)^\rho}{\frac{1}{1-\beta}\left(\frac{1}{\theta} - 1 \right)} \quad \text{(A2.4)}$$

where the fact that

$$\frac{w_s}{w_u} = \frac{\beta}{1-\beta} \frac{L}{H} \qquad \text{and} \qquad \frac{Y}{L w_u} = \frac{1}{(1-\beta)\theta}$$

has been used. We can now write (A2.1) and (A2.2) as

$$g(H,L)\omega^{1-\rho} = \rho + \varepsilon_H \left(1 - \left(\frac{bH}{\beta\theta} \right)^\rho + \frac{\partial L}{\partial H} \left(\left(\frac{1}{\omega} \right)^\rho - \left(\frac{bH}{\beta\theta} \right)^\rho \right) \right) \quad \text{(A2.5)}$$

$$g(H,L) = \rho + \varepsilon_L \left(1 - \left(\frac{bH}{(1-\beta)\theta} \right)^\rho + \frac{\partial H}{\partial L} \left(\omega^\rho - \left(\frac{bH}{(1-\beta)\theta} \right)^\rho \right) \right) \quad \text{(A2.6)}$$

From the production function, we have that

$$\varepsilon_H \equiv \frac{\partial H}{\partial w_s}\frac{w_s}{H} = \frac{1}{1-\beta(\theta(1+\sigma)-\sigma)}$$

$$\varepsilon_L \equiv \frac{\partial L}{\partial w_u}\frac{w_u}{L} = \frac{1}{1-(1-\beta)(\theta(1+\sigma)-\sigma)}$$

The elasticities of demand then depend only on the capital labour ratio, which itself is a function of H, L and K (and the technology parameters). The term $\partial L / \partial H$ can also be shown to depend on H, L and K, while the relative wage ω is a function of H / L. This implies that equations (A2.5) and (A2.6) can be expressed as functions of H and L, that is,

$$\phi(H, L; b, \rho, \gamma, \alpha, \beta, \sigma, K) = 0 \qquad \text{(A2.5')}$$

$$\varphi(H, L; b, \rho, \gamma, \alpha, \beta, \sigma, K) = 0 \qquad \text{(A2.6')}$$

These two equations together determine the levels of skilled and unskilled employment.

References

Aghion, P., Caroli, E. and García-Peñalosa, C. 1999. "Inequality and Economic Growth: The Perspective from the New Growth Theories", *Journal of Economic Literature*, 37(4): 1615-60.

Anand, S and Kanbur, S.M.R. 1993. "Inequality and Development: A Critique", *Journal of Development Economics* 41(1): 19-43.

Atkinson, Anthony. 1970. "On the Measurement of Inequality," *Journal of Economic Theory* 2, pp. 244-263.

Atkinson, Anthony. 1975. *The Economics of Inequality*. Second edition (1983). Oxford: Clarendon Press.

Atkinson, A.B. 1997. "Bringing the Income Distribution in from the Cold", *Economic Journal*, 107(441): 297-321.

Atkinson, A.B. and A. Brandolini. 2001. "Promise and Pitfalls in the Use of "Secondary" Data-Sets: Income Inequality in OECD Countries as a Case Study", *Journal of Economic Literature*, 39(3): 771-99.

Atkinson, A. and A.Brandolini. 2003. The Panel-of-Countries approach to explaining income inequality: an interdisciplinary agenda. mimeo

Barro, R.J. 2000. "Inequality and Growth in a Panel of Countries", *Journal of Economic Growth*, 5: 5-32.

Barro, R.J. and Lee, J.-W. 1993. "International Comparisons of Educational Attainment", *Journal of Monetary Economics*, 32 (3): 363-94.

Bourguignon, F. and Morrisson, C. 1990. "Income distribution, development and foreign trade: a cross-section analysis", *European Economic Review*, 34 (): 1113-32.

Bourguignon, F. and Morrisson, C. 1998. "Inequality and development and: the role of dualism", *Journal of Development Economics*, 57 (): 233-57.

Bourguignon, F., F.H.G. Ferreira and P.G. Leite, 2002. " Beyond Oaxaca-Blinder : Accounting for Differences in Household Income Distributions Across Countries", document de travail DELTA working paper 2002-04.

Brandolini, A. 2003. A bird-eye view of long-run changes in income inequality. Bank of Italy, mimeo.

Breen, R. and García-Peñalosa, C. "Income Inequality and Macroeconomic Volatility: An Empirical Investigation", forthcoming *Review of Development Economics*.

Champernowne, D.G. 1973. *The Distribution of Income between Persons.* Cambridge: Cambridge University Press.

Checchi, D. 2004. "Does educational achievement help to explain income inequality ?" chapter 4 in A. Cornia (ed), *Inequality, Growth and Poverty in an Era of Liberalization and Globalization*. Oxford University Press 2004

Cohen, D. and M. Soto. 2001. Growth and human capital: good data, good results. OECD Development Centre Technical paper n.179

Daudey, E. 2004. "The Sharing of Value-Added: Data Sources", mimeo, GREQAM.

De Serres, A., S.Scarpetta and C.De la Maisonneuve. 2002. Sectoral shifhts in Europe and the United States: how they affect aggregate labour shares and the properties of wage equations. OECD Economic Department wp.326.

Deininger, K. and Squire, L. 1996. "Measuring income inequality: a new data base", *The World Bank Economic Review* 10 (3): 565-591.

Förster, M. 2000. Trends and driving factors in income distribution and poverty in the OECD area. LABOUR MARKET AND SOCIAL POLICY- OCCASIONAL PAPERS NO. 42

Gastil, R. *Freedom in the World*, Westport: Greenwood.

Gottschalk, P. and Smeeding, T.M. 1997. "Cross-National Comparisons of Earnings and Income Inequality", *Journal of Economic Literature*, 35: 633-687.

Li, H., Squire, L. and Zou, H.-F. 1998. "Explaining International and Intertemporal Variations in Income Inequality", *Economic Journal* 108: 26-43.

Nickell, S. and L.Nunziata. 2001. Labour market institutions database

OECD 2002. *Benefits and wages – OECD indicators*. Paris

Ricardo, David. 1821. *Principles of Political Economy and Taxatio*n. 3 rd ed, in *The Works and Correspondence of David Ricard*o, ed. Piero Sraffa, Vol 1. Cambridge: Cambridge University Press.

Sen, Amartya. 1973. *On Economic Inequality*. Oxford: Oxford University Press, edition 1997.

Stiglitz, J.E. 1969. “The Distribution of Income and Welath among Individuals”, *Econometrica* 37: 382-397.
Summers, R. and Heston, A. “The Penn World Tables, Mark 5.6”.
Summers,R. and Heston, A. 1991. “The Penn World Table(Mark 5):An expanded set of international comparisons,1950–1988,” *Quarterly Journal of Economics* 106(2): 327–368.
Tinbergen, J. 1975. *Income Distribution.* Amsterdam: North Holland.