DISCUSSION PAPER SERIES

IZA DP No. 1681

Labour Market Institutions and the Personal Distribution of Income in the OECD

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July 2005

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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ABSTRACT

Labour Market Institutions and the Personal Distribution of Income in the OECD*

We examine what determines differences across countries and over time in the distribution of personal incomes in the OECD. We first model the wage determination process and show that unemployment, the labour share, and the wage differential are all functions of labour market institutions. Next we show that in a model economy with only four types of agents – capitalists, skilled and unskilled workers, and unemployed – the Gini coefficient of personal incomes can be expressed as a function of the above three variables. Labour market institutions hence affect income inequality, though the sign of their impact is ambiguous. Stronger unions and/or a more generous unemployment benefit tend to reduce inequality through reduced wage differentials, a higher labour share, and also higher unemployment. We then use a panel of OECD countries for the period 1970-96 to examine these effects. We find, first, that the labour share remains an important aspect of overall inequality patterns, and, second, that stronger unions and a more generous unemployment benefit tend to reduce income inequality. High capital-labour ratios also emerge as a strong equalising factor, which has in part offset the impact of increasing wage inequality on the US distribution of personal incomes.

JEL Classification: D31, D33

Keywords: income inequality, labour share, trade unions

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* We thank the participants to the seminars at IZA-Bonn, Universidad Autonoma (Barcelona), IGIER Bocconi, Florence, Milan University, Freie Universitat SASE conference (Budapest). We especially thank Andrea Bassanini, Andrea Cornia, Peter Gottschalk and Claudio Lucifora for helpful comments. Daniele Checchi gratefully acknowledges the financing of the Italian Ministry of Education (Cofin n. 2003137385).

1. Introduction

Over the past two decades a large literature has sought to understand the evolution of wage inequality in OECD countries; see Gottschalk and Smeeding (1997). Different patterns across countries have been documented, and labour market institutions have been shown to play an important role in determining the distribution of wages. In this paper we try to understand what are the determinants of differences in *income* inequality across countries and over time in OECD countries. In doing so, we focus on to aspects largely neglected by the literature. The first one is the role of the labour and capital shares as determinants of the personal distribution of income. We argue that wage inequality is only one of the components of personal income inequality, and that both the labour share and unemployment play an important role. The second consists of understanding the impact of labour market institutions on overall income inequality, as opposed to only on relative wages.

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 approximately here

One of the questions 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.

[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 other question concerns the impact of labour market institutions. The effect of institutions on relative wages has been well documented. For example, stronger unions tend to compress the wage distribution, which in turn would tend to reduce income inequality. However, these institutions also affect the unemployment rate and, potentially, the labour share, and hence will affect the distribution of income through channels other than wages.

We start by presenting the theoretical framework. First, we consider how labour market outcomes –that is, the relative wage, the labour share and the unemployment rate- are determined in an economy with non-competitive labour markets. Crucially for our purposes, we suppose the aggregate production function is CES, implying that the labour share is not constant but rather depends on factor inputs. Since labour markets are not competitive, labour market institutions, by affecting employment levels, become an essential determinant of the labour share. We capture this idea with a model with two types of workers. Skilled workers are subject to efficiency wage considerations, which imply no market clearing. For the unskilled the wage and employment determination process is the outcome of wage bargaining between a union that represents unskilled workers and a firm in a right-to-manage framework. We find that the equilibrium employment levels are a function of union bargaining power, the unemployment benefit, and the capital-labour ratio. The bargained levels of employment and wages will in turn determine the overall labour share, wage ratio, and unemployment rate, making them a function of labour market institutions.

The second step is 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. But these are in turn all functions of wages and employment levels, and hence of union bargaining power, the unemployment benefit, and the capital labour ratio. The effect of both higher union power and unemployment benefits on inequality is ambiguous: on the one hand they increase the unemployment rate, which tends to raise the Gini coefficient; on the other, they reduce the relative wage and increase the labour share, both of which tend to reduce inequality.

We test these propositions in a panel of OECD countries for the period 1970-96. Our empirical results are in line with the predictions of the model. We find that the labour share remains a fundamental aspect of overall inequality patterns, with an effect roughly as important as that of relative wages. Our results also show that that stronger unions and a more generous unemployment benefit tend to reduce income inequality. The effect of labour market institutions tends to be large, and explains a large fraction of the variation across countries. The other variable that emerges from our analysis as having a large impact is the capital-labour ratio. High capital-labour ratios tend to increase the labour share, and hence reduce income inequality. In fact, this appears to have been a major force dampening the increase of income inequality in the US over the last few decades.

The 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; Alderson 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 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. Two features have dominated this literature. One has been the increase in income inequality in a number of countries; the other the sharp rise in the relative wages 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.

The paper is organised as follows. Section 2 presents our theoretical model. Section 3 presents the data and our results. We then perform a number of simulation exercises. Section 4 concludes.

2. Theoretical considerations

2.1. The determinants of the relative wage and the labour share

2.1.1. Technological determinants

We consider an economy with three inputs, capital, denoted by K, skilled workers, H, and unskilled workers denoted by L. Output is produced according to a constant return to scale production function $Y = F(K, L, H)$. As is well known, a Cobb-Douglas production function implies constant labour and capital shares. In order to explain observed variations in labour shares, a more general production function, such as a CES, is needed. We assume that output is produced using capital and a "labour aggregate". Production is a CES function of K and the labour aggregate, while the latter is assumed to be a Cobb-Douglas function of skilled and unskilled labour. That is, output is produced according to

$$Y = \left[\alpha K^{-\sigma} + (1-\alpha)\left(H^{\beta} L^{1-\beta}\right)^{-\sigma}\right]^{-1/\sigma} \qquad \text{with } -1 \leq \sigma < \infty,\ 0 < \alpha < 1, 0 < \beta < 1 \tag{1}$$

This production function allows for different degrees of substitutability across factors. The elasticity of substitution between skilled and unskilled labour is 1, while that between capital and the labour aggregate is $1/(1+\sigma)$. For $\sigma = 0$ the production function would be Cobb-Douglas in the three inputs, as in (1). In line with existing evidence,[2] we assume that the elasticity of substitution between capital and the labour aggregate is less than one, which requires $\sigma > 0$.

Differentiating the production function we can obtain factor demand functions,

[2] This is consistent with the evidence reported in Hamermesh (1993), Rowthorn (1999), Krusell, Ohanian, Rios-Rull, and Violante (2000), and Antras (2004).

$$r = \alpha\left(\alpha + (1-\alpha)x^{-\sigma}\right)^{-(1+\sigma)/\sigma} \tag{2a}$$

$$w_u = (1-\beta)(1-\alpha)\left(\alpha + (1-\alpha)x^{\sigma}\right)^{-(1+\sigma)/\sigma} x^{\sigma}\frac{K}{L} \tag{2b}$$

$$w_s = \beta(1-\alpha)\left(\alpha + (1-\alpha)x^{\sigma}\right)^{-(1+\sigma)/\sigma} x^{\sigma}\frac{K}{H} \tag{2c}$$

where r is the interest rate, and w_s and w_u are respectively the (gross) skilled and unskilled wages. We have defined $x \equiv K / H^{\beta} L^{1-\beta}$, and it is hence a measure of the capital-labour ratio.

The labour share, denoted θ, is defined as the ratio of total employee compensation to value added. With two types of workers this is simply

$$\theta \equiv \frac{w_s H + w_u L}{Y} \tag{3}$$

Defining the relative wage as $\omega \equiv w_s / w_u$, and using equations (2) we obtain the inverse relative demand for labour and the labour share as

$$\omega = \frac{\beta}{1-\beta}\frac{L}{H} = \frac{1}{1-\beta}\cdot\frac{1}{h} \tag{4}$$

$$\theta = \frac{(1-\alpha)}{1-\alpha+\alpha x^{-\sigma}} \tag{5}$$

Together with (2), these equations imply that the labour share and the relative demand for labour depend on the capital-labour ratio and the relative employment ratio, that is, $\omega = \omega(h)$ and $\theta = \theta(k,h)$. The comparative statics are straight forward, with

$$\frac{\partial\omega}{\partial h} < 0,$$

$$sign\left[\frac{\partial\theta}{\partial x}\right] = sign[\sigma], \quad sign\left[\frac{\partial\theta}{\partial h}\right] = -sign[\sigma(\omega-1)], \qquad sign\left[\frac{\partial\theta}{\partial K}\right] = sign[\sigma].$$

A higher relative employment ratio reduces the relative wage, while the impact of the capital-labour ratio and relative employment on the labour share depends on the elasticity of substitution. For $\sigma = 0$, the labour share is simply $\theta = 1-\alpha$, and neither K nor h will affect it. Our assumption of $\sigma > 0$ and supposing, reasonably, that $\omega > 1$, we have $\partial\theta/\partial x > 0$ and $\partial\theta/\partial h < 0$. That is, a higher capital-labour ratio will increase the labour share, while greater relative skilled employment will reduce both the labour share and the relative wage.[3]

[3] The case where $\sigma < 0$ is discussed in Appendix I.

2.1.2. Institutional determinants

If labour markets were competitive, (4) and (5) would imply that a country's capital-labour ratio and its relative supply of skilled would be the sole determinants of the labour share and the relative wage. However, labour markets are not competitive. Employment levels hence differ from factor supplies, and anything that affects employment would in turn affect θ and ω. In order to understand which are the potential determinants of these variables we examine wage and employment determination with two types of labour.

We assume that wages for the two types of workers are determined in different ways. For skilled workers, we suppose that imperfect information on the part of the firm about whether or not employees are shirking forces the former to pay wages above the market clearing level, which in turn leads to unemployment, as in the efficiency wage model of Shapiro and Stiglitz (1985). For unskilled workers, 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 unskilled wages with the firm, and then the latter sets employment.

Efficiency wages for skilled workers

Consider a simple, one-period efficiency wage model. Suppose skilled agents receive a net wage $\tilde{w}_s = (1-\tau)w_s$, where a fraction τ corresponds to the tax wedge, which is paid to the government as employer and employee contributions. Workers are assumed to be risk-averse with utility $U(w_i) = w_i^{\rho}$, with $0 < \rho \leq 1$. Then, the utility of shirking is simply $U^S = (1-p)\left((1-\tau)w_s\right)^{\rho} + pB^{\rho}$ and that of not-shirking $U^N = ((1-\tau)w_s - e)^{\rho}$, where p is the probability of being caught if shirking, B the unemployment benefit (or the monetary equivalent of leisure if the latter is unavailable), and e is the monetary cost of effort.[4] The resulting efficiency wage, $\overline{w}_s$, is given by the solution to

$$((1-\tau)\overline{w}_s - e)^{\rho} = (1-p)\left((1-\tau)\overline{w}_s\right)^{\rho} + pB^{\rho} \tag{6}$$

Simple differentiation shows that $\overline{w}_s$ is increasing in B and e, and decreasing in p. Given $\overline{w}_s$ and the level of unskilled employment, the inverse demand for skilled labour, equation (2c), determines skilled employment, H.

[4] It would be straightforward to allow for the dynamic flows into and out of employment. For simplicity, we assume here that labour markets are separated by skills, such that an unemployed skilled worker cannot work as unskilled. Notice that B goes untaxed, as in most institutional set-ups.

Union bargaining and the unskilled wage

Consider now the determination of the unskilled wage and employment level. We assume that the union represents only the unskilled, and that it has a utilitarian utility function of the form

$$V = \frac{L}{\overline{L}}U(\tilde{w}_u) + \frac{\overline{L} - L}{\overline{L}}U(B) \tag{7}$$

where $\overline{L}$ is the unskilled labour force, $U(.)$ is the workers' utility function, $U(\tilde{w}_i) = \tilde{w}_i^{\rho}$, and the net wage is given by $\tilde{w}_u = (1-\tau)w_u$. The bargaining process is then governed by

$$\max_{w_u}\left(\frac{L}{\overline{L}}\left[((1-\tau)w_u)^{\rho} - B^{\rho}\right]\right)^{\gamma}\left(Y - w_u L - w_s H\right)^{1-\gamma} \tag{8}$$

The bargaining solution is obtained by maximising this expression with respect to w_u, taking into account the fact that, for a given skilled wage, changing the unskilled wage affects both skilled and unskilled employment. The resulting first-order conditions can be expressed as a function of L (see Appendix I),

$$\rho(1-\tau)^{\rho} = \left(\frac{1-\gamma}{\gamma}(1-\beta)\frac{\theta}{1-\theta} + \varepsilon_L\right)\left((1-\tau)^{\rho} - \left(\frac{B}{w_u}\right)^{\rho}\right) \tag{9}$$

where ε_L is the elasticity of the demand for unskilled labour. Since ε_L, w_u, and θ are functions of H and L, equation (9) determines unskilled employment , for a given H.

Equilibrium and comparative statics

The equilibrium of the model is then given by equation (9) together with (2b), (2c) and (6) that is, by

$$\rho(1-\tau)^{\rho} = \left(\frac{1-\gamma}{\gamma}(1-\beta)\frac{\theta}{1-\theta} + \varepsilon_L\right)\left((1-\tau)^{\rho} - \left(\frac{B}{w_u}\right)^{\rho}\right) \tag{9}$$

$$w_u = (1-\beta)(1-\alpha)\left(\alpha + (1-\alpha)x^{\sigma}\right)^{-(1+\sigma)/\sigma} x^{\sigma}\frac{K}{L} \tag{10}$$

$$\overline{w}_s = \beta(1-\alpha)\left(\alpha + (1-\alpha)x^{\sigma}\right)^{-(1+\sigma)/\sigma} x^{\sigma}\frac{K}{H} \tag{11}$$

$$\overline{w}_s = \varphi(B, e, p) \tag{12}$$

where $\varphi(B,e,p)$ is implicitly defined by (6). Together these four equations determine the equilibrium levels of skilled and unskilled employment, H and L, and the two wages as a function of model parameters: the unemployment benefit, B, the bargaining power of the union,

γ, the capital stock, K, as well as the preference parameters, ρ and e, and the technological parameters, α, β, σ, and p.

Once H and L are determined, we can obtain our three main variables of interest, the labour share, the relative wage, and the unemployment rate, which we can express as functions of the stock of capital and labour market institutions (as well as of the preference and technology parameters).

$$\theta = \theta(K, B, \gamma), \tag{13}$$

$$\omega = \omega(K, B, \gamma), \tag{14}$$

$$u = u(K, B, \gamma). \tag{15}$$

We are interested in the comparative statics with respect to union power, the unemployment benefit and the stock of capital. All comparative statics are derived in Appendix I. Consider first the effect of union power. It is possible to show that

$$\frac{dL}{d\gamma} < 0, \quad \frac{dH}{d\gamma} < 0, \quad \frac{du}{d\gamma} > 0, \quad \frac{d\theta}{d\gamma} > 0, \quad \frac{dh}{d\gamma} > 0, \quad \frac{d\omega}{d\gamma} < 0.$$

As in the standard wage bargaining model, the direct effect of greater union bargaining power is to reduce unskilled employment. This reduces the marginal product of skilled labour, and skilled employment falls in order to maintain the skilled wage at $\overline{w}_s$. Let $u \equiv 1 - (L + H)/(\overline{L} + \overline{H})$ be the overall unemployment rate, with $\overline{H}$ being the skilled labour force. Since both types of employment are reduced, u increases. Furthermore, under the assumption that $\sigma > 0$, the labour share also increases, the reason being that lower levels of employment result in a higher capital-labour ratio. The effect of an increase in γ on unskilled employment can be shown to be stronger than that on H, implying an increase in relative employment, and hence a reduction in the relative wage.

Concerning an increase in the stock of capital, we have

$$\frac{dL}{dK} > 0, \quad \frac{dH}{dK} > 0, \quad \frac{du}{dK} < 0.$$

A higher capital stock raises the marginal product of labour (both unskilled and skilled), leading to greater employment of both types of workers for a given wage. In the case of unskilled workers, unions react by demanding higher wages, which results in an increase in w_u. In case of skilled worker, given a constant efficiency wage, the raise in capital is accompanied by an increase in skilled employment. Moreover, the indirect effects on L through the change in H and vice versa reinforce these direct impacts. Under reasonable conditions, we all can also show that

$$\frac{d\theta}{dK} > 0, \quad \frac{dh}{dK} > 0, \quad \frac{d\omega}{dK} < 0.$$

A greater capital stock has a direct positive effect on θ, as a higher K increases the marginal product of labour, and indirect negative impacts through the increase in both types of employment. The positive effect dominates, implying that a greater stock of capital increases the labour share, and that the relative wage falls.

A higher unemployment benefit has two effects. On the one hand, it increases the outside option for unskilled workers, hence unions will bargain for a higher wage and accept a lower level of employment. At the same time, a higher B increases the efficiency wages that the firm must pay to skilled workers, which requires the firm to employ fewer skilled workers in order to increase their marginal product. The reduction in H tends to reduce the marginal product of the unskilled and hence partially offsets reduction in L, hence the overall effect is ambiguous. If the direct effect dominates, so that $dL/dB < 0$, it is then possible to show that

$$\frac{dH}{dB} < 0, \quad \frac{du}{dB} > 0, \quad \frac{d\theta}{dB} > 0.$$

That is, a higher unemployment benefit reduces both skilled and unskilled employment, increasing the rate of unemployment and raising the labour share. The effect on the relative wage is ambiguous, as both the skilled and the unskilled wage increase.

2.2. The Gini coefficient in a model economy

Having established that labour market institutions affect labour shares, the relative wage, and the unemployment rate, we turn to their impact on the distribution of personal incomes. Our empirical measure of income inequality will be the Gini coefficient. We hence decompose this measure of inequality into its various components for a model economy with four types of agents.

The labour force (or population) is normalised to one, that is, $\overline{L} + \overline{H} = 1$. Following our set-up in the previous section, workers can be either employed and receive the skilled or unskilled wage, $\widetilde{w}_s = (1-\tau)w_s$ and $\widetilde{w}_u = (1-\tau)w_u$, or unemployed, in which case they receive the unemployment benefit B.[5] Some individuals also own capital and receive profits. We assume that the owners of capital are always skilled workers (who are employed). Furthermore, we assume that the entirety of employer/employee contributions, τ, are used to finance the

[5] B can also be interpreted as a subsistence wage earned in the informal sector, if an unemployment benefit does not exists.

unemployment benefit, so that $B = \tau\theta y / u$.[6] This implies that the payment of net wages, capital income, and unemployment benefit exhaust output, and average income is equal to output per capita, y.

We then have four types of agents characterised as follows:

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

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

(iii) A fraction s of the labour force is made of skilled workers. Of those $s-\kappa$ own no capital and have an income equal to the net skilled wage $\tilde{w}_s$;

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

Our assumptions imply that $s+l+u=1$. We further suppose that $\tilde{w}_s > \tilde{w}_u > B$, while from our definition of the labour share we can express the profits of each worker-capitalist are given by $\pi = (1-\theta)y/\kappa$. We further suppose that those who own capital are never unemployed.

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:

$$Gini = \frac{1}{2y}\sum_{i=1}^{N}\sum_{j=1}^{N}\left|y_i - y_j\right| \cdot n_i \cdot n_j \tag{16}$$

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

$$Gini = (1-\kappa)(1-\theta) + ls\frac{\tilde{w}_s - \tilde{w}_u}{y} + u(1-u)\frac{\tilde{w} - B}{y} \tag{17}$$

where $\tilde{w}$ is the average net wage.[7] The Gini coefficient is thus a function of population proportions (u,l,s), the number of capital owners κ, the labour share, the wage differential, and the unemployment subsidy. 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 between groups of employed individuals, while a larger unemployment benefit will reduce the Gini coefficient. The

[6] 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 (17). However, we tried to introduce it in the regression, but it is highly collinear with the unemployment benefit and the unemployment rate, and therefore we have decided to stick to our assumption.

[7] In deriving equation (17) we have implicitly assumed that capitalists cannot be unemployed.

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 is 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;[8] however the data are rarely available. Third, we do not distinguish between personal income distribution and household income distribution, since we are implicitly assuming the two as coincident.[9] Lastly, note that we have focussed on gross income inequality, with the only tax we have considered being the unemployment insurance contribution. We also model the tax rate in a naïve way, considering immediate readjustments after a change in unemployment, thanks to the balanced budget constraint; available alternatives not considered here are the lowering of the replacement rate and or a reduction in coverage (Atkinson and Brandolini 2003).

3. Empirical Analysis

3.1. Empirical specification

We saw in equation (17) that the Gini coefficient of personal incomes could be expressed as a function of the labour share, the wage premium to skill, the replacement rate, and population shares. Our theoretical model obtained in section 2 allows the identification of the determinants of employment and wages for both skilled and unskilled workers, and through them of the wage differential, the labour share, and the unemployment rate. We start by estimating these relationships. Once we have identified which labour market institutions are relevant for the

[8] 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.

[9] Kenworthy 2003 and Esping Andersen 2004 claim that most of the rising trend in household income inequality is attributable to changing patterns of income distribution within the family, associated with increased labour market participation of women and young people.

labour market outcomes, we proceed to the analysis of their impact onto the personal distribution of income. Here we will tackle the problem of endogeneity of labour market outcomes with alternative strategies, either using instrumental variable estimation (where labour market institutions work as potential instruments for labour market outcomes) or estimating a system of four simultaneous equations. Finally, when applying the model to counterfactual exercises, we simulate the four-equation system using alternative set of exogenous variables. In all cases, we control for country fixed effects, with and without year dummies effects. In addition, as robustness checks, in the Appendix III we report corresponding tables for a subset of six countries (US, UK, Germany, Sweden Italy and Canada) for which we there are a sufficient number of observations.

Denoting by θ_{it} the labour share, by ω_{it} the relative wage, and by u_{it} the unemployment rate for country i in year t, our strategy will consist of estimating the following relationships

$$\theta_{it} = a_0 + \underset{+}{a_1} \cdot \chi_{it} + \underset{+}{a_2} \cdot b_{it} + \underset{+}{a_3} \cdot \gamma_{it} + a_4 \cdot \mu_{it} + \delta_i + \lambda_t + \varepsilon_{it} \tag{18}$$

$$\omega_{it} = c_0 + \underset{-}{c_1} \cdot \chi_{it} + \underset{\pm}{c_2} \cdot b_{it} + \underset{-}{c_3} \cdot \gamma_{it} + c_4 \cdot \mu_{it} + \delta_i + \lambda_t + \varepsilon_{it} \tag{19}$$

$$u_{it} = d_0 + \underset{-}{d_1} \cdot \chi_{it} + \underset{+}{d_2} \cdot b_{it} + \underset{+}{d_3} \cdot \gamma_{it} + d_4 \cdot \mu_{it} + \delta_i + \lambda_t + \varepsilon_{it} \tag{20}$$

where $\chi_{it} = \log\left(\frac{K_{it}}{H_{it} + L_{it}}\right)$ denotes the log of capital per worker, $b_{it} = \frac{B_{it}}{\overline{w}_{it}}$ is the unemployment benefit replacement rate, γ_{it} captures wage-push factors, and will be proxied by union membership rates in the labour force and by the so-called Kaitz index (namely, the ratio between the minimum wage and the median wage), and μ_{it} captures additional country specific factors (like oil price, educational attainment, tax wedge) that have been included in previous analyses of either of these three variables. The signs reported below the coefficients to be estimated indicate our theoretical expectations.

When we move to our variable of interest, the personal distribution of income, we cannot proceed by direct estimation of equation (17). In facts, 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. However, there are problems in doing so, since 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. Therefore we consider the estimation of the following relationship

$$Gini_{it} = g_0 + \underset{-}{g_1} \cdot \theta_{it} + \underset{+}{g_2} \cdot \omega_{it} + \underset{+}{g_3} \cdot u_{it} + \underset{-}{g_4} \cdot b_{it} + \underset{\pm}{g_5} \cdot u_{it} \cdot b_{it} + \delta_i + \lambda_t + def_{it} + \varepsilon_{it} \qquad (21)$$

where the signs underlying the coefficient are in accordance with equation (17). In order to go closer to that specification, we have taken into account the possibility of interaction between replacement rate and unemployment rate; 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) with the variable def_{it}. The estimated coefficient g_1 captures the relative contribution of factor income distribution to personal income inequality as measured by the Gini index; in the highly simplified framework of our model, it could be interpreted as a measure of the between-group inequality (where groups are to be defined in accordance to their position in the production process). Vice versa, the estimated coefficient g_2 measures the contribution of the wage differential, and in conjunction with the coefficients g_3, g_4 and g_5 can be interpreted as the contribution of within-group inequality, since in our simplified model all capitalists earn the same income (and therefore inequality among them is nil), whereas we observe inequality among the workers (who can earn either the skilled wage, the unskilled wage or the unemployment benefit).

Equation (21) cannot be directly estimated, since some variables are potentially endogenous and could be correlated with unobservable and/or unmeasured variables (such as the degree of risk-aversion or the level of skilled and unskilled employment) that may also affect personal income inequality through other channels. If we are interested in obtaining an unbiased estimate of the impact of the functional distribution of income onto the personal distribution (coefficient g_1), as well as assessing the contribution of the within-group components (coefficients g_2 and g_3), we have two strategies available. One is to resort to instrumental variable estimation, where the potentially endogenous variables are projected onto some variables that should possess the property of being correlated with the endogenous variable but not with our left hand side variable, the Gini index on the personal distribution of incomes. Using the estimates obtained from equations (18), (19) and (20), we can re-estimate equation (21) as[10]

[10] Notice that the interaction term has been suppressed to avoid resorting to non-linear estimation.

$$Gini_{it} = g_0 + \underset{-}{g_1} \cdot \hat{\theta}(\chi_{it}, b_{it}, \gamma_{it}) + \underset{+}{g_2} \cdot \hat{\omega}(\chi_{it}, b_{it}, \gamma_{it}) + \underset{+}{g_3} \cdot \hat{u}(\chi_{it}, b_{it}, \gamma_{it}) + \underset{-}{g_4} \cdot b_{it} + \delta_i + \lambda_t + def_{it} + \varepsilon_{it} \quad (22)$$

The alternative strategy is the estimation of a simultaneous equation system given by equations (18), (19), (20) and (21), through three-stage least squares methods.

Since we are also interested in assessing the overall impact of labour market institutions on income inequality, we will also estimate the reduced form equation obtainable when we replace (18)-(20) into equation (21), which yields

$$Gini_{it} = h_0 + \underset{\pm}{h_1} \cdot \chi_{it} + \underset{\pm}{h_2} \cdot b_{it} + \underset{\pm}{h_3} \cdot \gamma_{it} + \delta_i + \lambda_t + def_{it} + \varepsilon_{it} \quad (23)$$

The reduced form equation shows that the overall effect of labour market institutions is ambiguous. For example, stronger unions tend to increase the labour share and compress the wage distribution, both of which reduce inequality. However, they also increase the unemployment rate, which raise the Gini coefficient. In the literature surveyed by Atkinson and Brandolini 2003 there are only a couple of papers reporting some effects of labour market institutions (namely union density) onto income inequality. Most of the existing literature use information related to cyclical factors (often proxied by output per capita and unemployment), globalisation (proxied by import penetration or financial developments), sectoral composition and demographics, educational attainment in the population and availability of natural resources. Our paper extends the list of potential determinants of personal income inequality, by adding further measures of labour market institutions (minimum wage, unemployment benefit, in addition to union density). Furthermore, we make explicit the channels through which union wage bargaining affect income inequality, by raising labour share and reducing wage differentials. We are not aware of any other paper explicitly considering factor shares as one potential determinant of personal income inequality.

3.2. The data

We collected data on 16 OECD countries over the period 1960-96. Detailed data sources are presented in Appendix II. 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 Appendix III we replicates the estimates for the latter.

Unfortunately these two datasets on income inequality overlap only partially, and therefore the results are not directly comparable (see figure A.1 in Appendix II). The data collected by Brandolini provides detailed information on the way in which data are collected, allowing us to build a series that is more comparable 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. Data on labour shares are from OECD Stan Database (see figure A.2 in Appendix II). We use the standard definition of total compensation per employee over value added, avoiding any correction based on imputing incomes to self-employees. The wage differential is proxied by taking the ratio between 1st and the 9th decile in the earnings distributions (from OECD specific database).[11]

We combine different datasets in order to obtain information about earnings differentials, labour market institutions, educational attainments and capital endowment (see Appendix II 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 A.1 in Appendix III). Table 2 reports the descriptive statistics of our entire dataset, whereas Table A. in Appendix III shows the correlation matrix among the same variables). It is interesting to notice that income inequality exhibits (unconditional) correlation with labour market outcomes (labour share, wage differential, unemployment rate) and with only few labour market institutions (namely unemployment benefit and minimum wage).

3.3. Determinants of labour market outcomes

Table 3 examines the determinants of the labour share. The stronger impact on labour share is exerted by the capital/labour ratio (as implied by our model), independently from the specification adopted. In column 1 we find that the labour share is increasing in union density rates (a proxy for union bargaining power), and this effect persists when country fixed effects are taken into account (column 2); however this effect disappears when cyclical factors are properly accounted for using year fixed effects (column 3 with country and year fixed effects). We have also taken into account the fact that when minimum wage legislation applies, employment of unskilled workers declines, followed by the employment of skilled workers, with a positive global

[11] We experimented with both the relative difference and the more conventional measure based on percentile ratio, using the latter alternative for better econometric performance.

effect on wage share.[12] Similar effect is played by the unemployment benefit, which also has a positive (but weakly significant) impact on labour 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).[13] 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 potential proxies derived from educational attainment, which are often used as measures of human capital. The one reported in the text is the average years of education in the adult population. Once country differences are controlled for, it displays a negative correlation with the labour share, suggesting that as the number of skill individual increases, the unemployment rate of the skilled rises, reducing the incentives to shirk and hence allowing firms to pay a lower skilled wage. When we compare our results with Bentolila and Saint Paul (2003), who consider sectoral data for 12 countries over a shorter time span, they find significant correlation of labour share (corrected for self-employment) with capital/output ratio, strike activity, employment adjustment costs (proxied by previous changes in employment) and total factor productivity, whereas oil price is found statistically insignificant. While the correlation with capital/output ratio varies according to sectors (according to the existing substitutability-complementarity relationship between factors), they find a weakly significant negative sign for labour conflict, that they interpret as lagged response to wage push. If we refer to Blanchard (1997), he found that labour share movements were mostly affected by supply shocks, with significant reaction lags. We can therefore summarise our findings by saying that *we find support to the traditional view that factor share responds to relative factor endowment* (here proxied by capital per worker) but *there is evidence that wage push factors* (union density, minimum wage and unemployment benefit) *have some impact onto the shares.*

In table 4 we report the analysis of the potential determinants of the wage differential. We include union bargaining power (which tends to compress the wage distribution), the minimum wage (compressing the wage distribution from below), the unemployment benefit (which on theoretical ground has an ambiguous effect on the relative wage, leading to an increase of both skilled and unskilled wages) and capital/labour ratio (leading to a reduction in the wage differential). 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

[12] 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 cleared away with the country fixed effect.

[13] 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.

coefficient, capturing the upwards trend in earnings inequality, potentially associated to skill-biased technical change. The most significant correlations are found with factor endowments: an increase in the capital/labour ratio reduces the wage ratio, because unskilled workers exploit relatively better the improved employment situation; on the other side, an increase in skill availability in the labour force tend to depress their relative price. Once again we find some impact of labour market institutions: not surprisingly, the minimum wage help to reduce the wage differentials, but a similar negative correlation is found with the unemployment benefit. Eventually, some negative impact can also be found for union density, even if this may capture some cyclical component, because this effect disappear when year fixed effects are controlled for. Koeninger et alt. (2005) study wage inequality in a framework similar to ours. When estimating the determinants of the p90/p10 ratio for 11 countries over a similar time interval, they find a negative impact of unemployment benefits (both in terms of coverage and duration), minimum wage, union density and positive correlation with the fraction of population with college education. All these results but the final one survive even when first differences are considered. Overall our results are consistent with their analysis, since both papers find that *union bargaining compresses wage differentials*.[14] Differently from us, Koeninger at al. (2005) consider import penetration and R&D intensity, to account for possible existence of skill biased technological change, without finding coherent effects.[15] We limit ourselves to a linear time trend, which is identical across countries and attracts a positive sign.

Lastly, table 5 replicates well-known results on the institutional determinants of unemployment, which is positively correlated with union density and minimum wage. Unemployment declines with fixed capital accumulation, thanks to the increase in workers' productivity and rising labour demand. Contrary to our theoretical expectation, the coefficient on the unemployment benefit is not significant in this equation, while tax wedge has a negative impact.[16] Note that both coefficients are coherent with theoretical expectations and are significant when we do not include country dummies, consistently with previous work (see for example Nickell 1997). More recently, Nickell et al. (2005) have studied the determinants of the unemployment rate for 20 countries over the period 1961-92, including a list of shocks (labour

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[14] This is also consistent with micro-data analysis: see DiNardo et al. 1996 and more recently Card et alt. 2003.

[15] A further difference with their analysis is that they consider employment protection. While in their theoretical model they assume that skilled and unskilled workers should face different firing cost, due to the lack of data in the empirical analysis they resort to the unique series available, produced by OECD. However this series exhibit little variation across years, as witnessed by its statistical insignificance when first differences are considered. For this reason we have decided not to take EPL into our regressions.

[16] While the standard expectation is of a positive sign (because a higher tax wedge under wage bargaining leads to net wage resistance, and therefore increases labour costs and decreases employment), general equilibrium consideration may lead to the opposite expectation (see Corneo 1995).

demand, total factor productivity, real import, money supply and real interest rates) and the lagged dependent variable. They find positive and significant correlation with the unemployment benefit (especially the replacement rate) and the rate of change of union density, a weaker effect for the tax wedge and absence of statistical significance for the employment protection.

By jointly considering these group of estimates, we may summarised the evidence by stating that *labour market institutions matters in affecting labour market outcomes: union bargaining (here captures by union density and unemployment benefit) mostly affect wage differentials and unemployment rates; statutory minimum wages also affect factor shares. Capital accumulation, in terms of both equipment (fixed capital) and educational attainment (human capital) also affect our dependent variables.*

3.4. The determinants of personal income inequality

In table 6 we report our estimate of equations (21) and (22) for the largest available sample.[17] In Appendix III we report the same model estimated using different data: in table A.5 we restrict the sample to six countries for which we have at least 20 yearly observations (US, UK, Germany, Sweden Italy and Canada); in table A.6 we replicate the same estimates while using a measure of income inequality from different source (Deininger and Squire 1996); lastly, in table A.7 we replace the original labour share variable with a corrected measure, that takes into account the self-employment and attributes to the self-employed the average earnings of employees. All results are comparable to those in table 6.

The 1st column of table 6 abstract from country and year fixed effect, which are subsequently included in 2nd and 3rd columns; in addition a linear time trend and dummies controlling for changes in definitions[18] are also taken into account. We find that all variables have significant coefficients with the expected signs, with the exception of the unemployment rate. The labour share exhibits a negative correlation with the personal distribution of income, while

[17] The sample size hinges crucially on the availability of data on wage differentials. If we concentrate on personal income inequality only, the available sample is made of 233 observations. When we consider the overlapping with information on wage 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 A.3, where we report the OLS estimate of equation (21), the sample reduction due to the availability of data on wage differentials (2nd and 5th columns) does not affect sign and significance of the other regressors. When we expand the sample by replacing missing values with sample means for wage differentials (3rd and 6th columns), signs and significance are almost unaffected. However this fictitious enlargement of the sample allows us to retain relevant information that otherwise would be excluded due to missing observations on earnings differentials. Fort his reason, in the sequel we will consider this extended sample.

[18] 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, without significant changes (available from the authors).

the wage differential has a positive correlation.[19] The unemployment benefit appears negatively related to income inequality, whereas the unemployment rate has an insignificant coefficient. However, the unemployment rate has a positive and significant sign when we move to instrumental variable estimation. Note that we have also included a linear time trend, which bears a negative and significant sign, indicating a declining inequality over the sample period.

The comparison between the OLS results obtained in 3rd and 4th column and IV estimates reported in 5th and 6th columns indicates that OLS-estimation provides downward-biased estimates of the actual effect of the labour share and wage inequality on income inequality, and an upward bias for the effect of the unemployment benefit.[20] This bias could be merely due to measurement errors, but it could also indicate 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. It is interesting to note that, while the impact of passive labour market policies remains significant and negative, the unemployment rate and the time trend gain statistical significance under IV estimation. As a robustness check, in column 7 and 8 we also report the same model estimated in first differences, with and without country fixed effects: the labour share retains sign and significance, even if the effect is attenuated, whereas the wage differential is close to non-significance, while the variables related to unemployment are both non significant.

Our preferred specification, in terms of sign, significance and size of the effects, is reported in the 5th column of table 6. Evaluated at sample means, the estimated elasticity for labour share is equal to –0.61, which implies that reducing the labour share by one standard deviation would raise the Gini coefficient by 2.47 points. The estimated elasticity of the wage differential is greater, reaching the value 1.63: increasing the decile ratio of one standard deviation would raise the Gini coefficient by approximately 1.27 points. Much smaller is the impact of unemployment benefit, whose elasticity measures 0.12; similar value is also attained by the unemployment rate elasticity, equal to 0.14. These values seem too high to be considered long run elasticities; for this reason we computed quinquennial averages of the data, and we have re-estimated the same model (see table A.4 in Appendix III). In this case we find that the medium-long run impact of the labour share is in the order of –1/3, while the impact of the wage differential fluctuates between 5 and 15. Similar large range of variation is observed for the

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[19] Kenworthy 2003 uses household income inequality and personal earnings inequality (proxied by p90/p10 ratio) computed from LIS (Luxemburg Income Study), with one observation for 14 countries. By regressing the former onto the latter, he finds a coefficient comprised between 0.61 and 0.68, depending on various specifications, which is much lower than our figures. But sample size and countries are not comparable.

[20] The instrument have been selected from the regressors used in tables 3, 4 and 5 with an eye to the results of the Sargan test for overidentifying restrictions.

unemployment benefit coefficient (comprised between –20 and –15), while the unemployment rate coefficient is estimated around 0.4.

Results are basically unchanged when we restrict the sample to fewer countries (table A.5 in Appendix III) and when we use the corrected labour share measure (table A.7 in Appendix III), although the unemployment rate loses some significance. On the contrary, when we use the alternative series for income inequality (which now includes Korea and Japan in the sample – see table A.6 in Appendix III), the labour share is less significant, with a coefficient, which is half in size. On the contrary the wage differential and the unemployment subsidy are still highly significant, with coefficients of similar sizes, while the unemployment rate is totally insignificant.

We now consider the alternative strategy of estimating a simultaneous equation system made by equations (18), (19), (20) and (21), through three-stage least squares methods. The estimated coefficients are reported in table 7.[21] The results obtained so far are confirmed: our three endogenous variables (labour share, wage differential and unemployment rate) are correlated with income inequality, whereas the unemployment benefit exerts its impact only indirectly, through the labour share. The equation for the determination of the labour share is coherent with what we have already found in least square estimation (table 3), including country and year fixed effects. Similarly for the wage differential the pressure for wage compression deriving from union presence and/or from minimum wage legislation is consistent with least square estimates reported in table 4, even if capital accumulation and unemployment benefit loose significance. What is less satisfying is the unemployment equation, where the tax wedge continues having a negative impact, accompanied by a positive correlation with capital/labour ratio.[22] The predictive ability of the model is good, as can be seen from figures 2 and 3 that compare the actual and the predicted dynamics of Gini index of income inequality and labour shares respectively. This is rather impressive if one considers the block recursive nature of the model, such that in addition to its own prediction error, the prediction for the Gini index cumulates the prediction errors for the other three endogenous variables. In particular our model capture the trend reversal of income inequality in most European countries at the end of the 1970s (notably the Netherlands, France and United Kingdom), partially explained by the contemporaneous decline in labour share occurred in the same period.

Figures 2 and 3 approximately here

[21] Notice that sample size declines from 210 to 135 observations, because we cannot use the extended series for the wage differential.

[22] The former sign reverts to positive when the sample is restricted to 6 countries for which we have more consistent observations (89 observations), while the latter becomes insignificant if year fixed effects are neglected.

3.5. Counterfactual exercises

Through simulations, we have performed a number of counterfactual exercises. To give an intuitive idea, let's go into the details of figure 4. By making use of the estimated coefficients obtained in table 7, we have obtained the predicted values for labour share, wage differential and unemployment rate for all the country/year observations available in the sample (and even outside the estimation sample, as witnessed by the predicted Japanese inequality index reported in figure 2). We have the predicted the Gini inequality index by means of these predicted values. In the case of figure 4, in addition to the standard prediction (continuous line) we have also produced two additional ones, by replacing the predicted US labour share (long-dashed line) and US wage differential (short-dashed line) with the corresponding values for France. We notice that inequality in US would have been 10 Gini points lower if US earnings differentials would have been comparable to French ones. However, the higher labour share experienced by US economy helps to contain income inequality, which would be even higher if labour share would have declined as it occurred in continental Europe.

The reverse situation occurs when we make use of US labour share and wage differentials in European countries, as we do for example in figure 5 with UK and Norway. The first country is characterised by a relatively high stable labour share and therefore the replacement of US labour share does not affect income inequality, as on the contrary occurs to the second country. Both countries are however badly hit in their income inequality if they should change to US type wage differentials.

Figures 4 and 5 approximately here

But using the movements of endogenous variables to detect the relative contribution to income inequality may be misleading, because the impact of labour share could be attenuated (or even reversed) by unemployment variations. For this reason, in order to obtain more reliable policy indications, we performed counterfactual simulations by replacing the dynamics of exogenous variables, including labour market institutions (union density and unemployment benefit) and capital accumulation (capital per worker and educational attainment). In figure 6 we replace US union density and US unemployment benefit in the prediction of income inequality for Sweden and France, while in figure 7 we do the same for Canada and UK. We notice that generally speaking income inequality would be higher if European countries should have experienced US-type labour market institutions, but this has country specific variations. In the case of Sweden, a country characterised by high density rates (due to the so called "Ghent system", where unions run unemployment benefit schemes on behalf of the state), a decline of density rates at US level would have induced a 6 Gini points increase in inequality, while a similar move would have left unaffected France, where union coverage is high but membership is even lower than US.[23] The impact of unemployment benefit changes is more limited, because the US-Europe gap is lower.[24] All European countries considered in this exercise would have experienced an increase in income inequality, and the impact seems stronger in Canada, which is typically considered a US-type economy with stronger workers protection in the market.

Figures 6 and 7 approximately here

Eventually we also considered the role of capital accumulation, in both versions of fixed capital and human capital. As it can be seen in figure 8, according to the estimated model this may have very significant impact on income inequality. Looking at the left panel, where Italian inequality has been recalculated using US values for capital per worker and average years of education in the population, we notice that inequality would be much higher if we were to consider the highly educated US labour force instead of the low educated Italian population. According to the estimated model in table 7, the educational attainment has two countervailing effects: on one side, the increased supply of human capital reduces the wage differential, but on the other, by making skilled labour cheaper, it also induces substitution between skilled and unskilled, thus depressing the labour share. The overall effect is therefore ambiguous, and can only by judged case by case. The same effect practically does not exist when we consider the German population, with higher educational attainment.

Figure 8 approximately here

In order to provide some information about the order of magnitude of these impacts, in table 8 we have estimated the reduced form for income inequality corresponding to equation (23). The table reports the OLS standardised beta coefficients, that are to be read as the change, in terms of a fraction of a standard deviation in the dependent variable, induced by a standard deviation change in the exogenous variable. The first two columns consider the entire sample,

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[23] For a comparison of different models of unionisation see Checchi and Lucifora 2002.

[24] Looking at table 1, the sample-average replacement rate in US is 0.12, to be compared with 0.19 of Sweden, 0.22 of UK, 0.26 of Canada and 0.30 of France.

controlling for country and year effects, while 3rd and 4th column restrict the sample to 6 countries for which w have longer series of income inequality (US, UK, Germany, Sweden Italy and Canada). Commenting on the second column, we find that capital accumulation exhibits the strongest correlation with income inequality, with the overall impact being negative for capital equipment and positive for human capital.[25] Two labour market institutions, union density and unemployment benefit, negatively affect income inequality with comparable magnitude impact: while a third institution, minimum wage, is marginally significant, but still with negative sign with respect to income inequality. Finally, the tax wedge, which probably works as a proxy of the welfare state size, also exhibits a strong and negative correlation with income inequality.[26]

4. Conclusions

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 have found that labour market institutions significantly affect income inequality through several channels: stronger unions obtain larger wage share and compress wage differentials; also higher minimum wages reduce wage differentials. Despite the associated increase in the unemployment, as long as the unemployed receive a wage subsidy, this represent an additional source of inequality reduction. We could view greater unionisation as a mechanism

[25] Barro 2000 finds an inverted U-shaped relationship with GDP per capita; by considering that all countries in our sample are developed country (and therefore lies on the downward sloping of the Kuznets' curve), his finding is consistent with our finding of a negative correlation with fixed capital endowment. He also finds a negative correlation with secondary school enrolment and a positive correlation with tertiary enrolment; these findings are more difficult to compare with ours, since we have a stock measure, combining three levels of educational attainment.

[26] The same effects can be found even when we change the source of income inequality measure, except the effects of union density and tax wedge, now becoming statistically insignificant: see Table A.8 in Appendix III.

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. The only indication we are able to extract from our model is that fixed capital accumulation has a negative correlation with income inequality, but this is attenuated by a positive association with proxies for human capital accumulation.

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Tables and figures

Figure 1 – Compensation of employees over GDP – 1960-2003

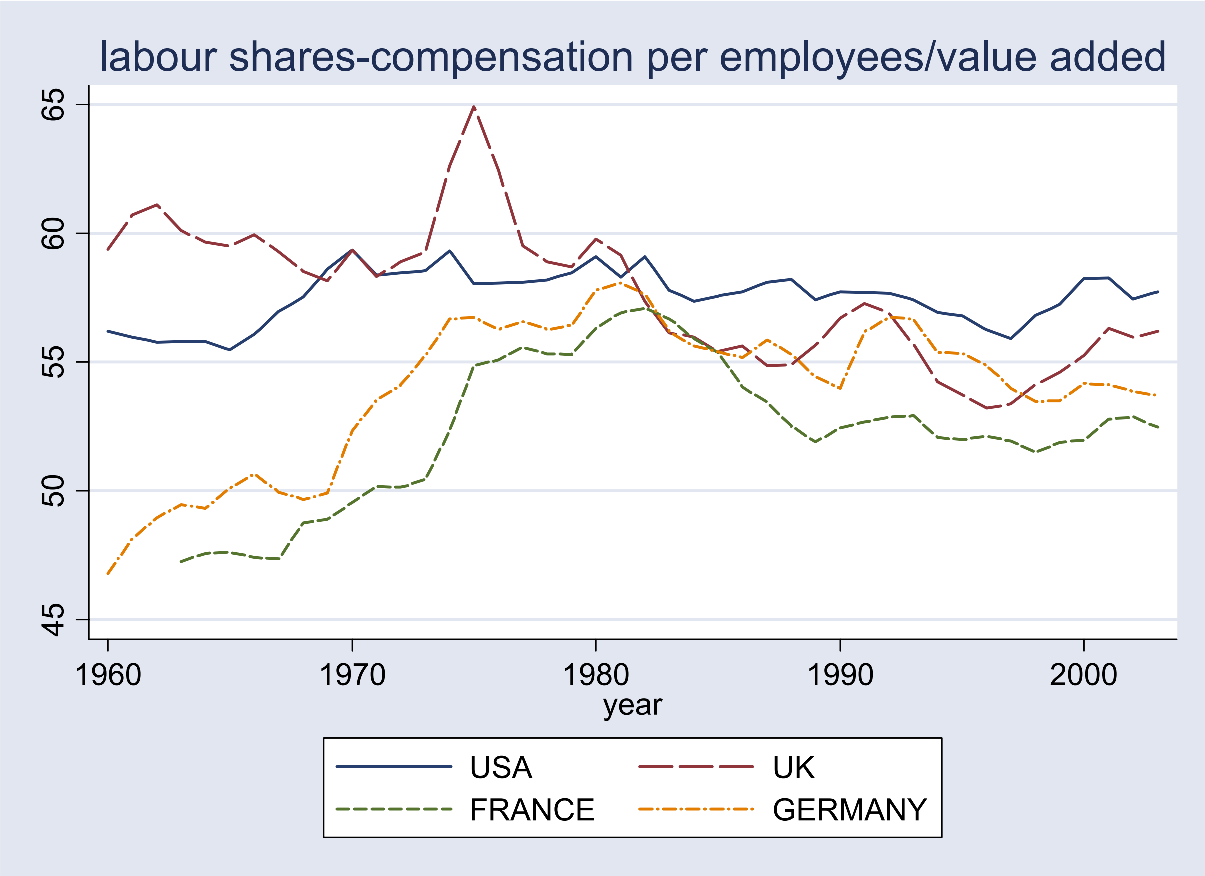

Figure 2 – Predictive ability of the model estimated in table 7 – Gini index on income inequality

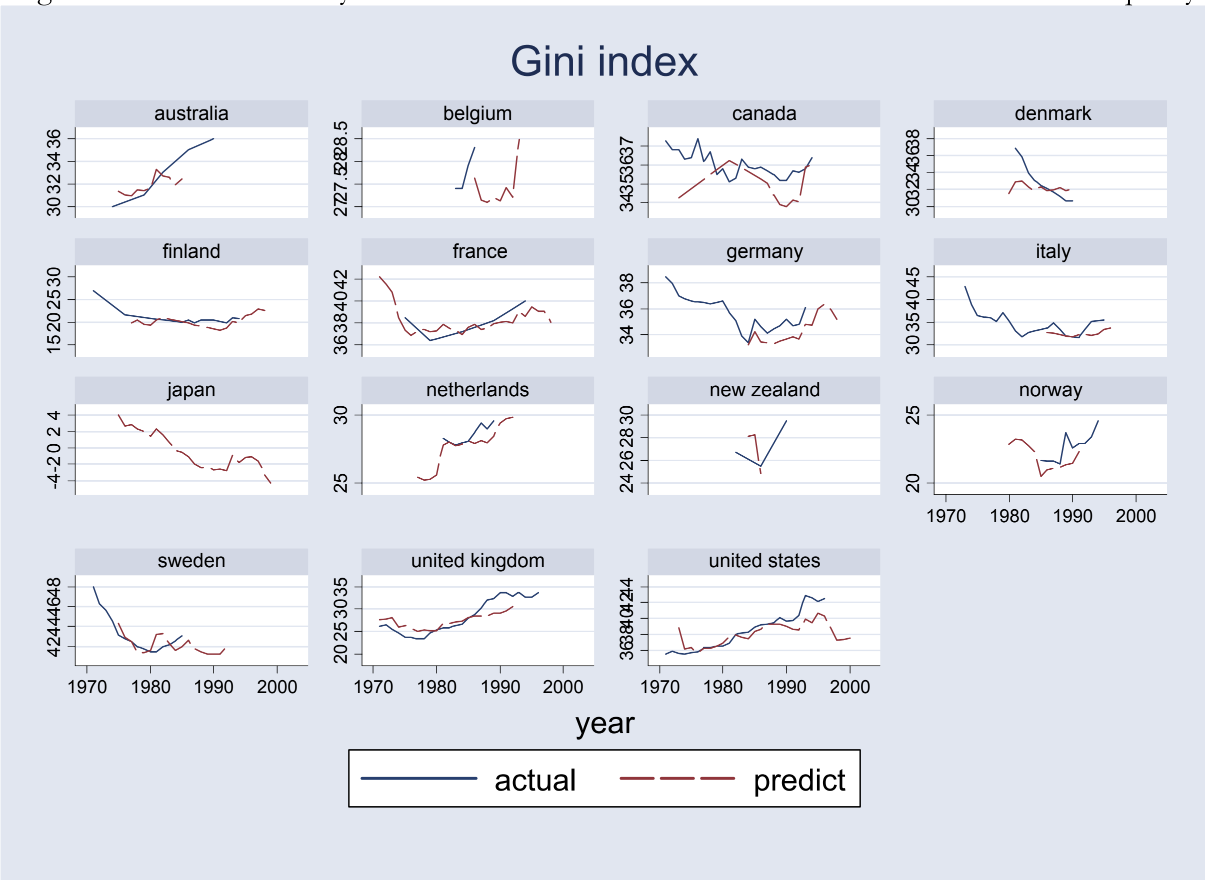

Figure 3 – Predictive ability of the model estimated in table 7 – Labour share

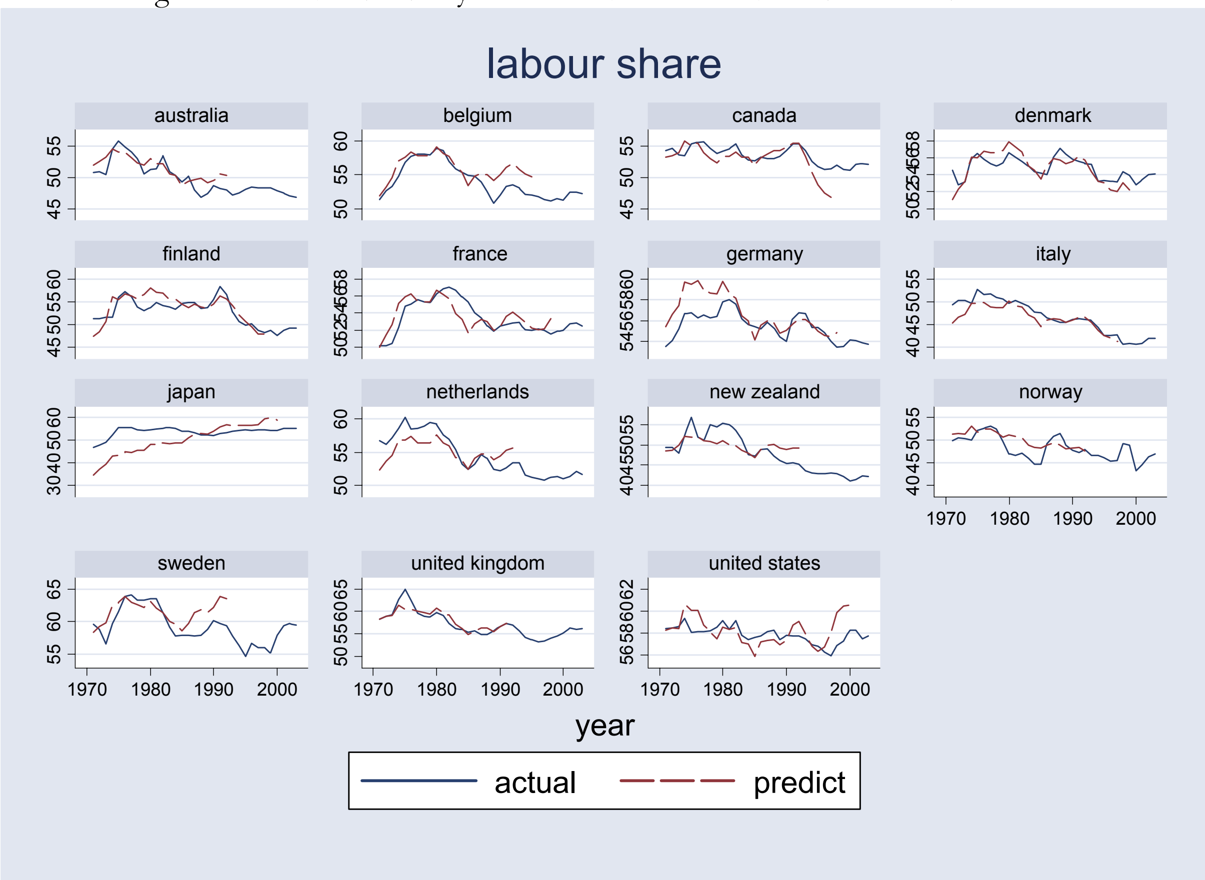

Figure 4 – Counterfactual 1: US inequality with French labour market outcomes

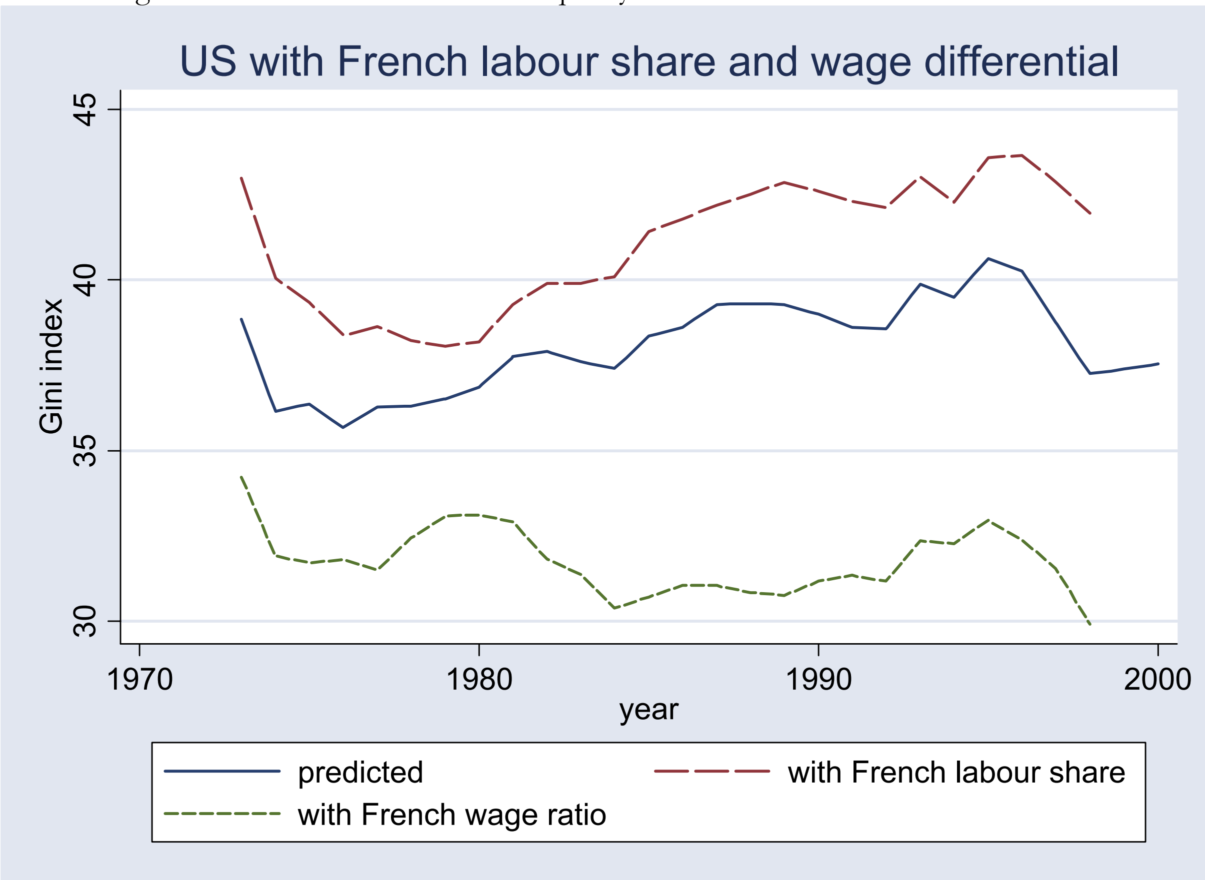

Figure 5 – Counterfactual 2: UK and Norway inequalities with US labour market outcomes

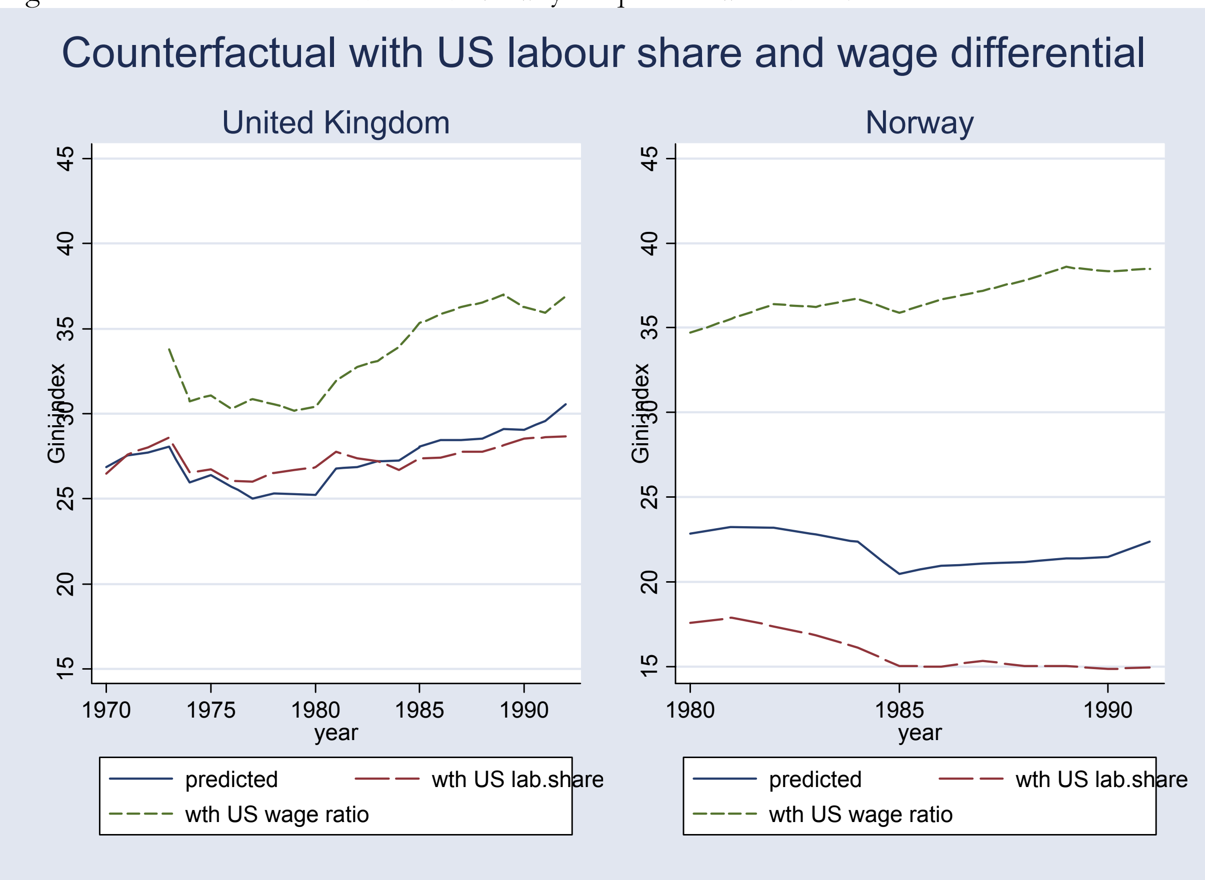

Figure 6 – Counterfactual 3: Sweden and France inequalities with US labour market institutions

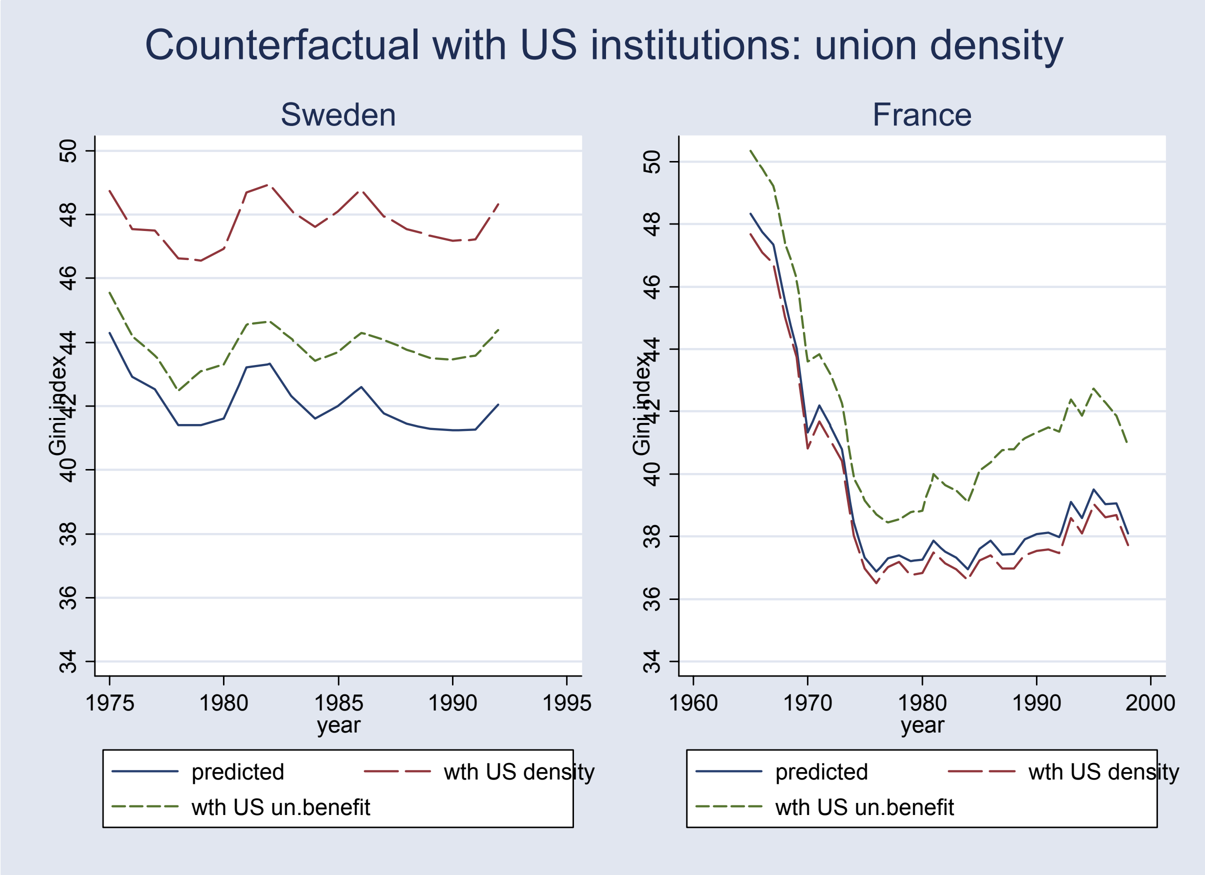

Figure 7 – Counterfactual 4: UK and Canada inequalities with US labour market institutions

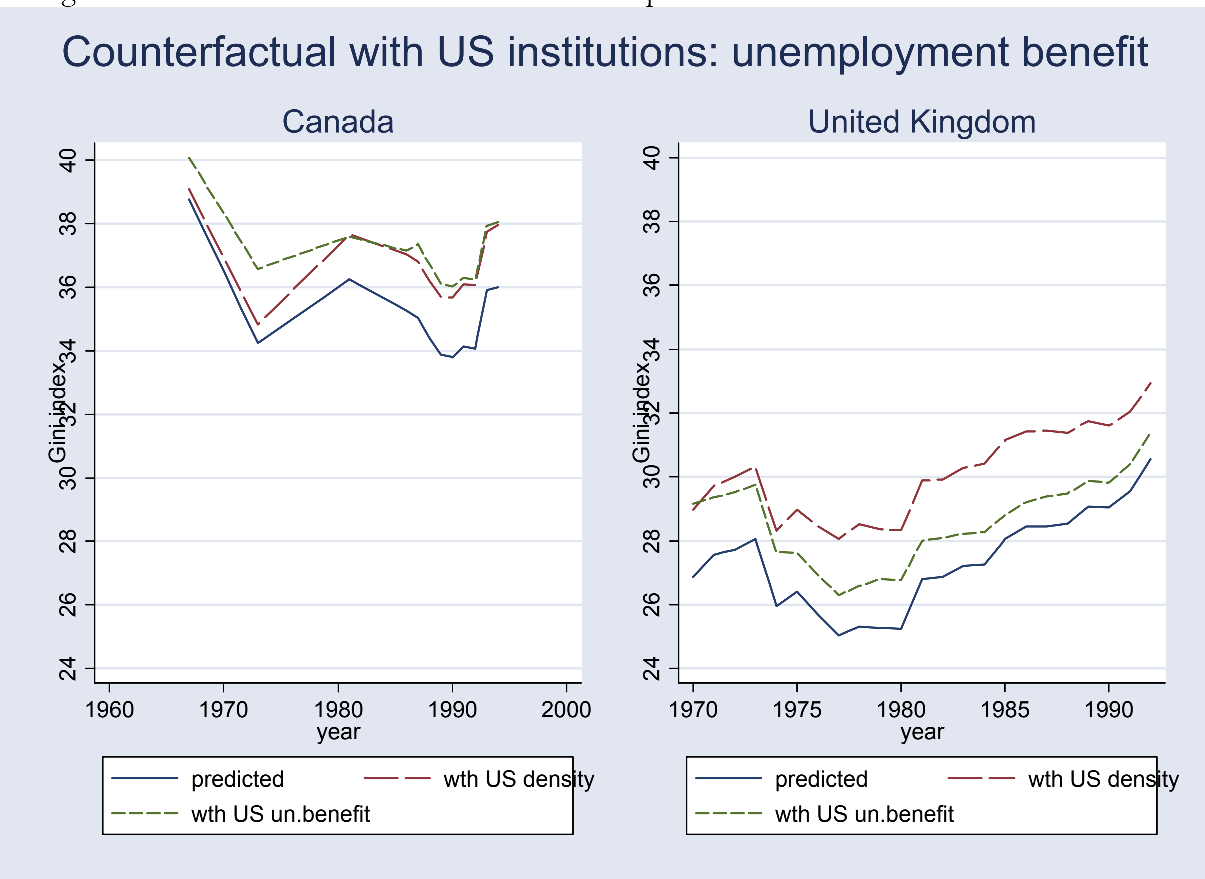

Figure 8 – Counterfactual 5: Italy and Germany inequalities with US human and physical capital

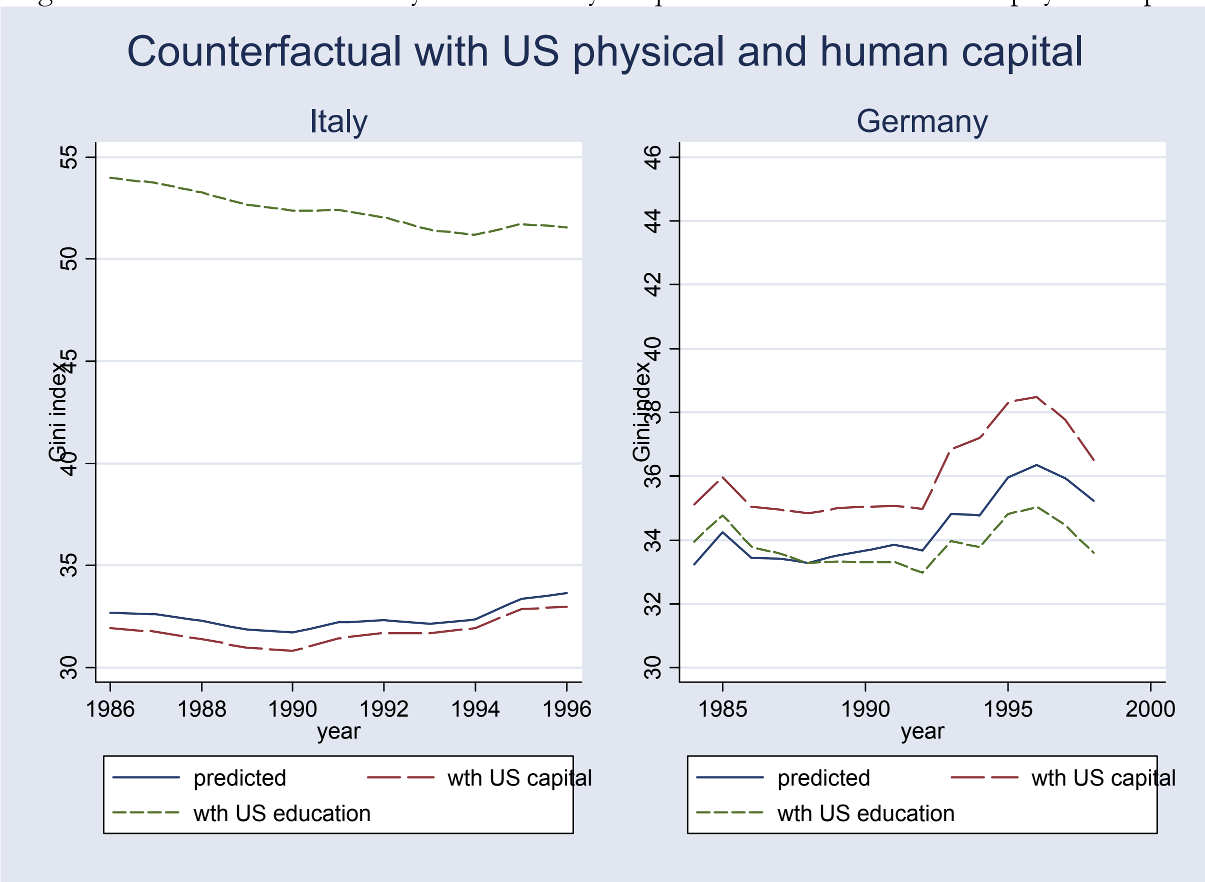

Table 1 – Descriptive statistics for main countries – sample means by countries

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	na	34.86	3.06	0.51	2.20	0.11
Korea	na	34.18	3.97	0.41	na	na
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 – Descriptive statistics for variables in the dataset – sample means

Variable	Obs	Mean	Std.Dev.	Min	Max
gini1	236	33.981	7.295	19.900	54.300
p9010	315	3.028	0.690	1.953	4.640
ls1	651	52.060	5.419	32.268	64.909
ur	593	4.999	3.324	0.000	16.800
ben	600	0.257	0.142	0.003	0.670
udnet	585	0.427	0.181	0.099	0.911
fminim	704	0.667	0.275	0.241	1.000
ty25	656	9.603	1.799	3.457	12.876
lkapw	528	10.187	0.512	7.646	11.173
tw	566	0.492	0.125	0.237	0.831
loil	689	4.436	2.498	-0.333	10.991

Legend:
gini1 = Gini index on personal income distribution, from Brandolini 2003
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
udnet = union density, from Nickell-Nunziata 2001
fminim = ratio of minimum wage to median wage, from OECD
ty25 = average years of schooling of population 25 and over, whether studying or not, from Cohen and Soto 2001
lkapw = (log of) capital per worker, from Summer and Heston 1991, updated with mark 5.6 of the Penn tables
tw = tax wedge, from Nickell-Nunziata 2001
loil = (log of) oil price in national currency, from IMF Financial Statistics

Table 3 – Determinants of labour share – OLS regressions

robust standard errors - t-statistics in parentheses - * significant at 10%; ** significant at 5%; *** significant at 1%

	1	2	3
log capital per worker	-0.036	10.98	8.56
	[0.04]	[16.19]***	[12.49]***
unemployment benefit	1.236	1.583	3.094
	[1.03]	[0.72]	[1.73]*
union density rates	5.529	11.714	-1.054
	[4.59]***	[5.94]***	[0.65]
ratio minimum/median wage	-2.37	9.298	3.768
	[2.99]***	[3.28]***	[1.42]
log oil price in national currency	-0.425	0.957	-0.91
	[3.94]***	[7.30]***	[3.63]***
average years of education	0.537	-4.143	-1.221
	[3.03]***	[13.35]***	[1.78]*
Constant	yes	yes	yes
Country fixed effects		yes	yes
Country+Year fixed effects			yes
Observations	455	455	455
R^2	0.19	0.80	0.88

Table 4 – Determinants of p90/p10 decile ratio – OLS regressions

robust standard errors - t-statistics in parentheses - * significant at 10%; ** significant at 5%; *** significant at 1%

	1	2	3
log capital per worker	-0.137	-0.58	-0.369
	[0.94]	[4.73]***	[4.11]***
unemployment benefit	-0.683	-0.726	-0.765
	[3.19]***	[2.50]**	[2.36]**
union density rates	-1.385	-0.419	-0.147
	[9.92]***	[1.49]	[0.48]
ratio minimum/median wage	-0.853	-2.405	-1.815
	[5.18]***	[4.65]***	[4.02]***
average years of education	0.11	-0.493	-0.508
	[6.39]***	[5.73]***	[4.08]***
time trend	-0.01	0.066	0.053
	[2.02]**	[6.37]***	[4.81]***
Constant	yes	yes	yes
Country fixed effects		yes	yes
Country+Year fixed effects			yes
Observations	260	260	260
R^2	0.65	0.97	0.98

Table 5 – Determinants of unemployment rate – OLS regressions

robust standard errors - t-statistics in parentheses - * significant at 10%; ** significant at 5%; *** significant at 1%

	1	2	3
log capital per worker	-0.976	-2.333	-2.097
	[2.28]**	[4.80]***	[3.32]***
unemployment benefit	4.438	-1.212	-0.078
	[5.22]***	[0.73]	[0.05]
union density rates	-1.383	7.912	4.581
	[1.58]	[3.96]***	[1.98]**
ratio minimum/median wage	-1.718	13.484	14.281
	[2.58]**	[4.49]***	[6.05]***
tax wedge	4.634	-7.701	-10.215
	[3.11]***	[2.95]***	[4.01]***
time trend	0.21	0.337	0.247
	[11.30]***	[13.35]***	[4.38]***
Constant	yes	yes	yes
Country fixed effects		yes	yes
Country+Year fixed effects			yes
Observations	448	448	448
R^2	0.45	0.71	0.78

Table 6 – Determinants of personal income inequality – full sample – OLS and IV estimates

robust standard errors - t-statistics in parentheses - * significant at 10%; ** significant at 5%; *** significant at 1%

	1	2	3	4	5	6	7	8
	OLS	OLS	OLS	IV	IV	IV	1st differen	1st differen
labour share at market price	0.229	-0.297	-0.365	-0.261	-0.365	-1.345	-0.141	-0.134
	[1.90]*	[4.19]***	[3.37]***	[0.33]	[2.03]**	[3.58]***	[2.94]***	[2.81]***
extended p90/p10 decile ratio	-1.219	4.212	5.145	0.973	17.942	26.848	0.745	0.697
	[2.51]**	[3.99]***	[3.71]***	[0.34]	[4.52]***	[4.14]***	[1.69]*	[1.58]
unemployment rate	-0.697	0.021	0.033	-2.679	0.784	1.138	0.029	0.025
	[6.11]***	[0.28]	[0.31]	[2.61]***	[2.42]**	[2.45]**	[0.56]	[0.48]
unemployment benefit	-8.52	-21.6	-23.398	2.284	-17.328	-11.079	0.124	1.953
	[3.45]***	[5.47]***	[6.45]***	[0.26]	[3.98]***	[1.73]*	[0.03]	[0.42]
time trend		0.038	0.091	0.636	-0.222	-0.423		
		[1.02]	[1.39]	[3.67]***	[2.46]**	[2.62]***		
Constant	yes	yes	yes	yes	yes	yes	yes	yes
Country fixed effects		yes	yes	yes	yes	yes		yes
Country+Year fixed effects			yes			yes		
Observations	210	210	210	210	210	210	202	202
R^2	0.51	0.93	0.94	0.12	0.87	0.79	0.05	0.15
Sargan test (p-value)				0.05	0.07	0.80		

Endogenous: labour share, unemployment rate, p90/p10.

Instruments: (log)capital×worker, tax wedge, years of education, minimum wage, bargaining coordination.

Table 7. – Determinants of personal income inequality – 3SLS regressions
Absolute value of z statistics in brackets - * significant at 10%; ** significant at 5%; *** significant at 1%

dependent variable:	income inequality (Gini)	labour share	p90/p10 decile ratio	unemployment rate
labour share at market price	-0.723			
	[4.25]***			
p90/p10 decile ratio	7.389			
	[3.50]***			
unemployment rate	0.294			
	[2.05]**			
unemployment benefit	-5.593	7.864	-0.426	5.771
	[1.35]	[2.20]**	[1.47]	[1.34]
union density rates		1.862	-2.005	23.406
		[0.45]	[6.05]***	[4.59]***
ratio minimum/median wage		3.437	-3.505	41.527
		[0.58]	[7.38]***	[6.50]***
log capital per worker		22.136	0.289	13.821
		[5.71]***	[0.90]	[3.12]***
average years of education		-7.783	-0.104	
		[5.06]***	[0.83]	
log oil price in national currency		-2.567		
		[2.88]***		
tax wedge				-36.702
				[5.94]***
time trend	0.136		0.058	-2.687
	[0.10]		[0.53]	[1.67]*
Constant	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes
Country+Year fixed effects	yes	yes	yes	yes
Observations	135	135	135	135
Root mean squared error	1.3	1.06	0.08	1.31
R^2	0.96	0.94	0.99	0.81

Controls for changes in definition included.

Table 8 – Determinants of personal income inequality – reduced form – OLS
Robust normalized beta coefficients - * significant at 10%; ** significant at 5%; *** significant at 1%

	1	2	3	4
	full sample	full sample	reduced sample	reduced sample
union density rates	-0.328***	-0.423***	-0.053	0.187
ratio minimum/median wage	-0.055	-0.315*	0.405	0.313
unemployment benefit	-0.216**	-0.342***	-0.191*	-0.302***
tax wedge	-0.341***	-0.371***	-0.422***	-0.527***
log capital per worker	-0.422**	-0.965***	-0.831***	-1.918***
average years of education	-0.076	1.393***	-0.061	2.200***
Constant	yes	yes	yes	yes
Time trend	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes
Country+Year fixed effects		yes		yes
Observations	211	211	154	154
R^2	0.95	0.96	0.93	0.95

Controls for changes in definitions and oil price included.

Appendix I: Wage and Employment Determination

Production

Before deriving the equilibrium wages, we consider a number of comparative statics obtained from the production function. From equation (1b), we obtain the elasticities of demand for the two types of labour

$$\varepsilon_L = -\frac{\partial L}{\partial w_u}\frac{w_u}{L} = \frac{1}{1-(1-\beta)\left[\theta(1+\sigma)-\sigma\right]} \tag{A.1}$$

$$\varepsilon_H = -\frac{\partial H}{\partial w_s}\frac{w_s}{H} = \frac{1}{1-\beta\left[\theta(1+\sigma)-\sigma\right]} \tag{A.2}$$

From equations (1) to (5) we have

$$\begin{aligned}
& sign\left[\frac{\partial\theta}{\partial x}\right] = sign[\sigma], \\
& \frac{\partial x}{\partial L} < 0, \quad \frac{\partial x}{\partial H} < 0, \quad \frac{\partial x}{\partial K} > 0, \\
& \frac{\partial\omega}{\partial H} < 0, \quad \frac{\partial\omega}{\partial L} > 0, \quad \frac{\partial\omega}{\partial h} < 0, \\
& \frac{\partial w_u}{\partial H} > 0, \quad \frac{\partial w_u}{\partial K} > 0, \quad \frac{\partial w_s}{\partial L} > 0, \quad \frac{\partial w_s}{\partial K} > 0, \\
& \frac{\partial\varepsilon_L}{\partial\theta} > 0, \quad \frac{\partial\varepsilon_H}{\partial\theta} > 0.
\end{aligned} \tag{A.3}$$

Also, from (2c), we have $\partial w_s / \partial H < 0, \partial w_s / \partial L > 0,$ and $\partial w_s / \partial K > 0,$ which can be shown to imply

$$\frac{\partial H}{\partial L} = -\frac{\partial w_s / \partial L}{\partial w_s / \partial L} = \frac{H}{L}(1-\beta)\left[\theta(1+\sigma)-\sigma\right]\varepsilon_H > 0 \tag{A.4}$$

$$\frac{\partial H}{\partial K} = -\frac{\partial w_s / \partial K}{\partial w_s / \partial K} = \frac{H}{K}(1+\sigma)(1-\theta)\varepsilon_H > 0 \tag{A.5}$$

$$\frac{dh}{dL} = \frac{1}{L}\frac{\partial H}{\partial L} - \frac{H}{L_2} = -\frac{H}{L^2}(1+\sigma)(1-\theta)\varepsilon_H < 0 \tag{A.6}$$

The Bargaining Model

The bargaining problem is given by

$$\max_{w_u}\left(\frac{L}{\overline{L}}\left[((1-\tau)w_u)^{\rho} - (B)^{\rho}\right]\right)^{\gamma}\left(Y - w_u L - w_s L\right)^{1-\gamma} \tag{A.7}$$

The union takes into account the fact that, given the skilled wage $\overline{w}_s$, the reduction in L due to an increase in w_u will reduce skilled employment. The resulting first-order condition is

$$w_u{}^{\rho-1}\left[\rho(1-\tau)^{\rho}+\left((1-\tau)^{\rho}-\left(\frac{B}{w_u}\right)^{\rho}\right)\varepsilon_L\right]=\frac{1-\gamma}{\gamma}\frac{L((1-\tau)^{\rho}w_u^{\rho}-(bY)^{\rho})}{Y-Hw_s-Lw_u} \qquad \text{(A.8)}$$

Using the fact that

$$\frac{Y-Hw_s-Lw_u}{Lw_u}=\frac{1-\theta}{(1-\beta)\theta}$$

we can write (A.8) as

$$\rho(1-\tau)^{\rho}=\left(\frac{1-\gamma}{\gamma}(1-\beta)\frac{\theta}{1-\theta}+\varepsilon_L\right)\left((1-\tau)^{\rho}-\left(\frac{B}{w_u}\right)^{\rho}\right) \qquad \text{(A.9)}$$

Comparative Statics

Let

$$f(\theta,\varepsilon_L,\gamma)=\frac{1-\gamma}{\gamma}(1-\beta)\frac{\theta}{1-\theta}+\varepsilon_L \qquad \text{(A.10)}$$

$$g(L,\theta,b)=(1-\tau)^{\rho}-\left(\frac{B}{w_u}\right)^{\rho} \qquad \text{(A.11)}$$

so that (A.9) is simply $f(\theta,\varepsilon_L,\gamma)=g(L,\theta,b)$. We define

$$\Delta\equiv g\left[\frac{\partial f}{\partial\theta}+\frac{\partial f}{\partial\varepsilon_L}\frac{\partial\varepsilon_L}{\partial\theta}\right]\frac{\partial\theta}{\partial x},$$

$$\Delta_1\equiv\Delta\left[\frac{\partial x}{\partial L}+\frac{\partial x}{\partial H}\frac{dH}{dL}\right]+f\frac{\partial g}{\partial w_u}\frac{\partial w_u}{\partial L},$$

$$\Delta_2\equiv\Delta\left[\frac{\partial x}{\partial K}+\frac{\partial x}{\partial H}\frac{\partial H}{\partial K}\right]+f\frac{\partial g}{\partial w_u}\frac{\partial w_u}{\partial K},$$

$$\Delta_3\equiv\left[\Delta\frac{\partial x}{\partial H}+f\frac{\partial g}{\partial w_u}\frac{\partial w_u}{\partial H}\right]\frac{\partial H}{\partial\overline{w}_s}\frac{\partial\overline{w}_s}{\partial B}.$$

<u>Case 1</u>: $\sigma>0$

Using (A.3)-(A.6) and the fact that for $\sigma>0$ implies $\partial\theta/\partial x>0$, we can establish: $\Delta<0$, $\Delta_1<0$, $\Delta_2>0$, while Δ_3 may be positive or negative. We can now obtain the comparative statics:

$$\frac{dL}{d\gamma}=-g\frac{\partial f/\partial\gamma}{\Delta_1}<0 \qquad \text{(A.12)}$$

$$\frac{dL}{dK}=-\frac{\Delta_2}{\Delta_1}>0 \qquad \text{(A.13)}$$

$$\frac{dL}{dB}=-\frac{f\cdot\partial g/\partial B+\Delta_3}{\Delta_1} \qquad \text{(A.14)}$$

From (A.3)-(A.6) we can now establish

$$\frac{dL}{d\gamma} < 0, \quad \frac{dH}{d\gamma} < 0, \quad \frac{dx}{d\gamma} > 0, \quad \frac{d\theta}{d\gamma} > 0, \quad \frac{dh}{d\gamma} > 0, \quad \frac{d\omega}{d\gamma} < 0,$$

$$\frac{dL}{dK} > 0, \quad \frac{dH}{dK} > 0.$$

The effects of K on ω and θ are ambiguous, as the increases in H, L and K have effects of opposite sign. However, we can obtain

$$\frac{dh}{dK} = \frac{1}{L}\frac{dH}{dK} - \frac{H}{L^2}\frac{dL}{dK} = (1+\sigma)(1-\theta)\varepsilon_H \frac{H}{LK}\left[1 - \frac{dL}{dK}\frac{K}{L}\right]$$

$$\frac{d\theta}{dK} = \frac{\partial\theta}{\partial x}\left[\frac{\partial x}{\partial L}\frac{dL}{dK} + \frac{\partial x}{\partial H}\frac{dH}{dK} + \frac{\partial x}{\partial K}\right] = \frac{\partial\theta}{\partial x}\frac{x}{K}(1-\beta)\varepsilon_H\left[1 - \frac{dL}{dK}\frac{K}{L}\right]$$

If the elasticity of unskilled labour with respect to capital is less than one, then these two expressions are positive, implying $d\omega/dK < 0$ and $d\theta/dK > 0$.

The effects of an increase of B are ambiguous. However, if $dL/dB < 0$, it is then possible to show that

$$\frac{dH}{dB} = \frac{\partial H}{\partial L}\frac{dL}{dB} + \frac{\partial H}{\partial w_s}\frac{\partial \overline{w}_s}{\partial B} < 0$$

$$\frac{d\theta}{dB} = \frac{\partial\theta}{\partial x}\left[\frac{\partial x}{\partial L}\frac{dL}{dB} + \frac{\partial x}{\partial H}\frac{dH}{dB}\right] > 0$$

Case 2: $\sigma = 0$

In this case $\partial\theta/\partial x = 0$, hence $\Delta = 0$, $\Delta_1 < 0$, $\Delta_2 > 0$, and $\Delta_3 < 0$. Then

$$\frac{dL}{d\gamma} < 0, \quad \frac{dL}{dK} > 0, \quad \frac{dL}{dB} < 0.$$

It is straightforward to show that the effects on ω are as in case 1, while there is no impact on θ.

Case 3: $\sigma < 0$

In this case $\partial\theta/\partial x < 0$, hence $\Delta > 0$, $\Delta_3 < 0$, and Δ_1 and Δ_2 can be positive or negative. From the expressions in (A.12) to (A.14), it is clear that the comparative statics cannot be signed.

Appendix II: 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. When self-employed are assigned the average earnings of dependent employees, corrected labour share are obtained (also reported in figure A.2). Since we do not find this assumption very convincing, we stick to the simple labour share. Results with corrected labour share are available upon request.

Data on unemployment rates are from Nickell and Nunziata 2001, whereas the replacement rate of the unemployment subsidy is obtained on a biannual base by OECD 2002 (and then replicated for the missing years). The wage differential is computed as the ratio between the 9^{th} and 1^{st} earnings decile, on data on earnings distribution from OECD (Trends in earning dispersion database). The Kaitz index (minimum to median wage) is obtained from OECD (Minimum wage database). For countries were minimum wages are non-existent (for example for they are replaced by national contract, this variable has been set equal to unity (Denmark, Finland, Germany, Italy, Norway, Sweden and UK for most of the sample period). Data on union density (ratio between union membership and active dependent employment) are from .

The capital stock is derived from the Penn World Tables, Mark 5.6 (see Summer and Heston 1991). Since data on labour force composition by skills are not available over a long time span, we relied on two potential proxies derived from educational attainment, i.e. measures of human capital. In the text we have used the average years of education in the adult population, obtainable from Cohen and Soto 2001.[27] The oil price in national currency is computed from IMF Financial Statistics. Finally, the tax wedge measure is obtained from Nickell and Nunziata 2001.

[27] 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.

Appendix III – Additional tables and figures

Table A.1 – 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

Table A.2 – Pairwise correlation matrix (* indicates statistical significance above 95%)

	gini1	p9010	ls1	ur	ben	udnet	fminim	ty25	lkapw	tw	loil
gini1	1.000										
p9010	0.360*	1.000									
ls1	0.151*	-0.058	1.000								
ur	-0.317*	-0.008	0.063	1.000							
ben	-0.471*	-0.433*	0.124*	0.320*	1.000						
udnet	-0.111	-0.682*	0.204*	-0.005	0.221*	1.000					
fminim	0.135*	-0.743*	0.088*	-0.094*	0.025	0.593*	1.000				
ty25	-0.066	0.057	0.339*	0.365*	0.223*	0.020	-0.045	1.000			
lkapw	-0.052	-0.288*	0.332*	0.440*	0.243*	0.066	0.336*	0.646*	1.000		
tw	-0.058	-0.473*	0.108*	0.313*	0.293*	0.403*	0.593*	-0.010	0.347*	1.000	
loil	-0.027	-0.199*	-0.428*	0.219*	-0.115*	0.049	0.037	-0.195*	-0.006	0.229*	1.000

Legend:

gini1 = Gini index on personal income distribution, from Brandolini 2003
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
udnet = union density, from Nickell-Nunziata 2001
fminim = ratio of minimum wage to median wage, from OECD
ty25 = average years of schooling of population 25 and over, whether studying or not, from Cohen and Soto 2001
lkapw = (log of) capital per worker, from Summer and Heston 1991, updated with mark 5.6 of the Penn tables
tw = tax wedge, from Nickell-Nunziata 2001
loil = (log of) oil price in national currency, from IMF Financial Statistics

Figure A.1 – Gini indices of income inequality

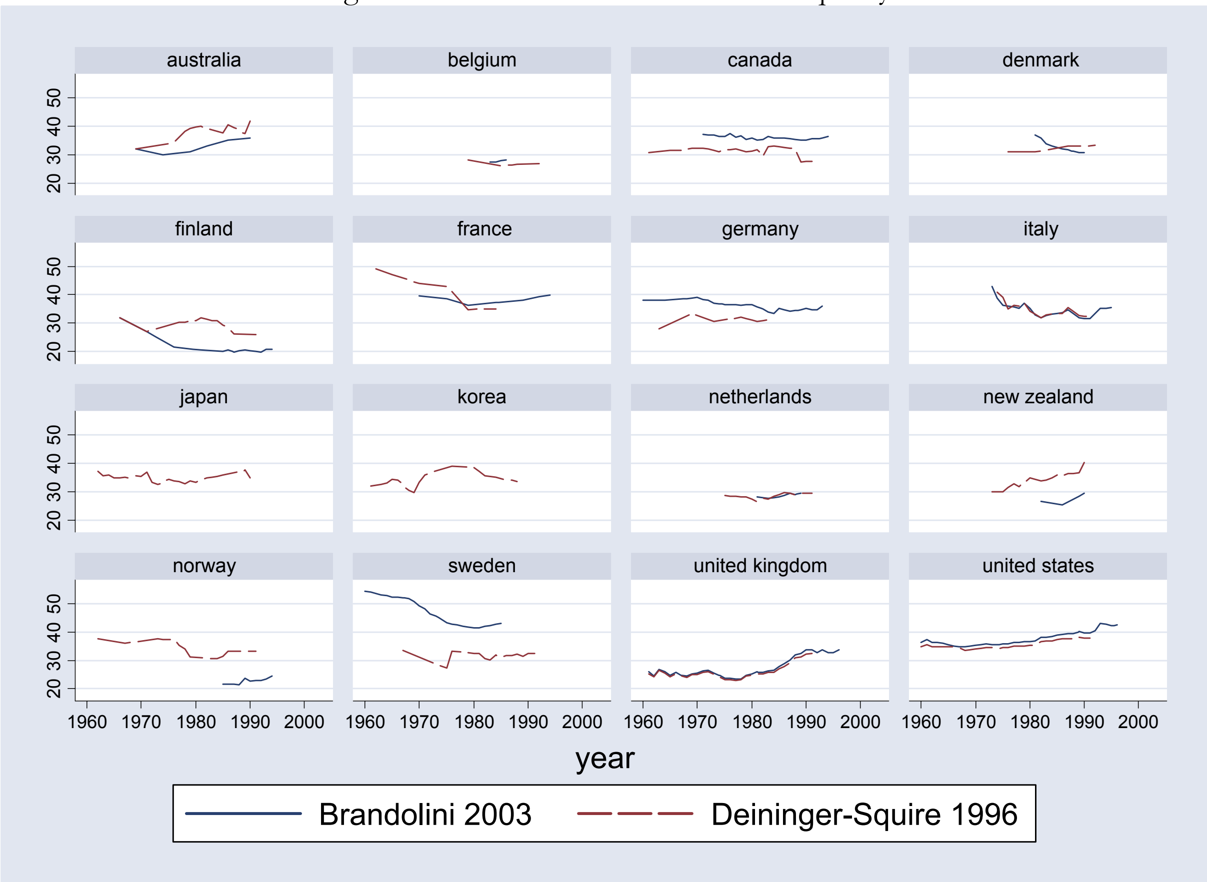

Figure A.2 – Labour shares

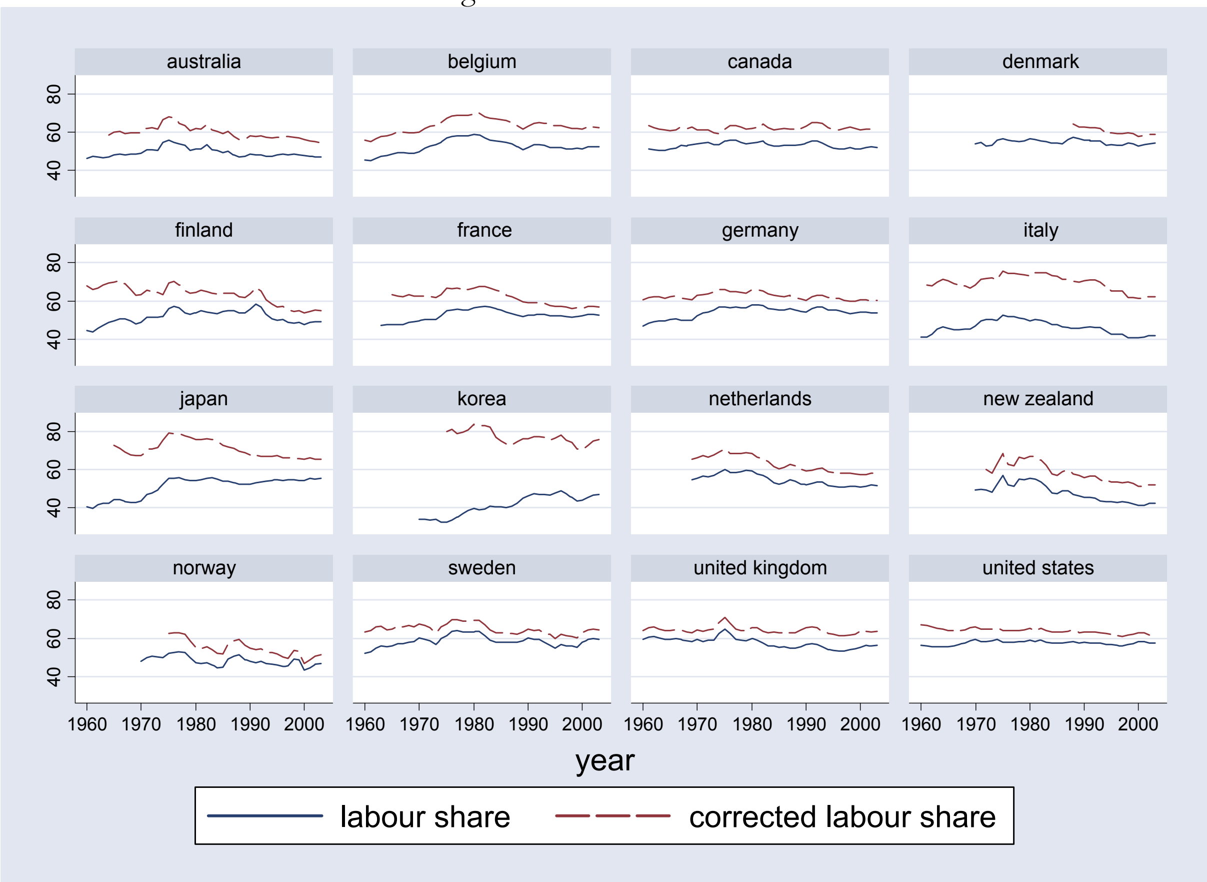

Table A.3 – Determinants of personal income inequality – sample extension – OLS
robust standard errors - t-statistics in parentheses - pvalue<0.05 = *, pvalue<0.01 = **

	1	2	3	4	5	6
	full sample	reduced sample	extended sample†	full sample	reduced sample	extended sample†
labour share at market price	-0.437	-0.33	-0.39	-0.478	-0.439	-0.486
	[7.84]***	[4.19]***	[6.62]***	[5.07]***	[4.68]***	[5.38]***
unemployment rate	-0.916	0.101	-0.714	-0.976	0.122	-0.735
	[4.30]***	[0.48]	[3.34]***	[4.03]***	[0.50]	[3.14]***
unemployment benefit	-36.585	-6.033	-34.538	-36.806	-4.124	-33.976
	[7.98]***	[1.05]	[7.38]***	[7.83]***	[0.65]	[7.23]***
unemp.benefit × unemp.rate	2.476	-0.277	2.236	2.434	-0.534	2.12
	[3.84]***	[0.51]	[3.48]***	[3.45]***	[0.81]	[3.13]***
p90/p10 decile ratio		3.564	3.596		3.688	4.125
		[3.41]***	[3.68]***		[2.76]***	[3.14]***
Constant	yes	yes	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes	yes	yes
Country+Year fixed effects				yes	yes	yes
Observations	233	142	233	233	142	233
R^2	0.94	0.96	0.94	0.94	0.97	0.95

† the missing observations for decile ratio are replaced by their country means.
Controls for changes in definition included

Table A.4 – Determinants of personal income inequality – quinquennial averages - full sample
robust standard errors - t-statistics in parentheses - * significant at 10%; ** significant at 5%; *** significant at 1%

	1	2	3	4
	OLS	OLS	IV	IV
labour share at market price	-0.376	-0.359	-0.755	-1.483
	[2.80]***	[1.30]	[4.22]***	[2.40]**
extended p90/p10 decile ratio	5.7	5.726	10.047	14.892
	[2.38]**	[2.03]*	[1.67]*	[1.55]
unemployment rate	0.356	0.426	0.445	0.583
	[1.57]	[1.30]	[0.88]	[0.79]
unemployment benefit	-21.53	-21.989	-16.883	-13.108
	[3.18]***	[2.81]***	[3.03]***	[1.73]*
time trend	-0.049	-0.041	-0.117	-0.32
	[0.48]	[0.33]	[0.77]	[1.30]
Constant	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes
Country+Year fixed effects		yes		yes
Observations	62	62	62	62
R^2	0.94	0.94	0.92	0.89
Sargan test (p-value)			0.18	0.11

Endogenous: labour share, unemployment rate, p90/p10
Instruments: (log)capital×worker, tax wedge, years of education, minimum wage, bargaining coordination.
Controls for changes in definition included

Table A.5 – Determinants of personal income inequality – restricted sample (US, UK, Germany, Sweden Italy and Canada).
robust standard errors - t-statistics in parentheses - * significant at 10%; ** significant at 5%; *** significant at 1%

	1	2	3	4
	OLS	OLS	IV	IV
labour share at market price	-0.311	-0.434	-0.525	-1.556
	[3.52]***	[2.86]***	[2.70]***	[5.39]***
extended p90/p10 decile ratio	3.756	5.534	10.883	16.634
	[3.36]***	[3.27]***	[2.14]**	[1.67]*
unemployment rate	-0.177	-0.03	0.029	0.154
	[1.66]	[0.15]	[0.06]	[0.17]
unemployment benefit	-24.005	-29.737	-20.352	-26.44
	[4.80]***	[6.30]***	[4.17]***	[3.13]***
time trend		0.114	-0.029	-0.12
		[1.41]	[0.22]	[0.44]
Constant	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes
Country+Year fixed effects		yes		yes
Observations	153	153	153	153
R^2	0.90	0.91	0.86	0.83
Sargan test (p-value)			0.04	0.00

Endogenous: labour share, unemployment rate, p90/p10
Instruments: (log)capital×worker, tax wedge, years of education, minimum wage, bargaining coordination.
Controls for changes in definition included

Table A.6 – Determinants of personal income inequality – measure for Gini index on income inequality from Deininger&Squire – full sample
robust standard errors - t-statistics in parentheses - * significant at 10%; ** significant at 5%; *** significant at 1%

	1	2	3	4
	OLS	OLS	IV	IV
labour share at market price	-0.087	-0.202	-0.018	-0.418
	[1.75]*	[3.13]***	[0.18]	[1.73]*
extended p90/p10 decile ratio	6.209	7.281	12.373	10.418
	[4.86]***	[5.43]***	[2.84]***	[1.82]*
unemployment rate	0.14	0.123	0.344	-0.429
	[1.64]	[1.25]	[1.04]	[0.57]
unemployment benefit	-11.784	-12.867	-9.594	-13.112
	[3.17]***	[3.38]***	[2.50]**	[2.76]***
time trend	0.007	0.046	-0.059	-1.275
	[0.23]	[1.13]	[0.72]	[0.55]
Constant	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes
Country+Year fixed effects		yes		yes
Observations	224	224	224	224
R^2	0.83	0.84	0.80	0.80
Sargan test (p-value)			0.41	0.90

Endogenous: labour share, unemployment rate, p90/p10
Instruments: (log)capital×worker, tax wedge, years of education, minimum wage, bargaining coordination.
Controls for changes in definition included

Table A.7 – Determinants of personal income inequality – full sample – corrected labour share (to account for self-employment)
robust standard errors - t-statistics in parentheses - * significant at 10%; ** significant at 5%; *** significant at 1%

	1 OLS	2 OLS	3 IV	4 IV
corrected labour share at mkt.price	-0.275	-0.239	-0.624	-1.381
	[4.03]***	[2.53]**	[2.92]***	[3.86]***
extended p90/p10 decile ratio	4.084	4.125	16.292	25.222
	[4.29]***	[3.08]***	[3.84]***	[3.42]***
unemployment rate	-0.012	0.04	0.633	1.151
	[0.17]	[0.41]	[1.77]*	[2.09]**
unemployment benefit	-29.221	-31.516	-29.668	-39.659
	[6.24]***	[7.83]***	[4.51]***	[4.82]***
time trend	0.064	0.122	-0.179	-0.402
	[1.81]*	[1.79]*	[1.69]*	[2.16]**
Constant	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes
Country+Year fixed effects		yes		yes
Observations	203	203	203	203
R^2	0.94	0.95	0.87	0.79
Sargan test (p-value)			0.38	0.35

Endogenous: labour share, unemployment rate, p90/p10
Instruments: (log)capital×worker, tax wedge, years of education, minimum wage, bargaining coordination.
Controls for changes in definition included

Table A.8 – Determinants of personal income inequality – full sample – reduced form – alternative measures for income inequality - OLS regressions
Robust normalized beta coefficients - * significant at 10%; ** significant at 5%; *** significant at 1%

	1 Gini (Brandolini)	2 Gini (Brandolini)	3 Gini (Deininger-Squire)	4 Gini (Deininger-Squire)
union density rates	-0.328***	-0.423***	-0.048	-0.158
ratio minimum/median wage	-0.055	-0.315*	-0.692**	-0.567*
unemployment benefit	-0.216**	-0.342***	-0.492***	-0.733***
tax wedge	-0.341***	-0.371***	-0.104	-0.104
log capital per worker	-0.422**	-0.965***	-0.258***	-0.561***
average years of education	-0.076	1.393***	0.052	-0.599
Constant	yes	yes	yes	yes
Time trend	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes
Country+Year fixed effects		yes		yes
Observations	211	211	225	225
R^2	0.95	0.96	0.82	0.85

Controls for changes in definitions and oil price included