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Beyond the Labour Income Tax Wedge: The Unemployment-Reducing Effect of Tax Progressivity

Etienne Lehmann
Claudio Lucifora
Simone Moriconi
Bruno Van der Linden

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Abstract

This paper argues that, for a given overall level of labour income taxation, a more progressive tax schedule reduces the unemployment rate and increases the employment rate. From a theoretical point of view, higher progressivity induces a wage-moderation effect and increases overall employment since employment of low-paid workers is more responsive. We test these theoretical predictions on a panel of 21 OECD countries over 1998-2008. Controlling for the burden of taxation at the average wage, we show that a more progressive taxation reduces the unemployment rate and increases the employment rate. These findings are confirmed when we account for the potential endogeneity of both average taxation and progressivity. Overall our results suggest that policy-makers should not only focus on the detrimental effects of tax progressivity on in-work effort.

JEL-Code: E240, H220, J680.

Keywords: wage moderation, employment, taxation.

Etienne Lehmann
CREST, Timbre J360
15 boulevard Gabriel Péri
France – 92245 Malakoff Cedex
etienne.lehmann@ensae.fr

Claudio Lucifora
Catholic University of Sacro Cuore
Department of Economics and Finance
Largo Gemelli, 1
Italy – 20123 Milan
claudio.lucifora@unicatt.it

Simone Moriconi
Catholic University of Sacro Cuore
Department of Economics and Finance
Largo Gemelli, 1
Italy – 20123 Milan
simone.moriconi@unicatt.it

Bruno Van der Linden
IRES / Catholic University of Louvain
Place Montesquieu 3
Belgium – 1348 Louvain-la-Neuve
bruno.vanderlinden@uclouvain.be

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I Introduction

Many OECD countries after the Great Crisis, confronted with the need to combine fiscal consolidation measures with policies to curb unemployment, experienced both higher unemployment and larger public debt. Given the reduced scope for fiscal policies under this scenario, a better understanding of the effects of labour income taxation on the functioning of the labour market seems important. In particular, we need a better description of how the different dimensions of labour income taxation affect labour market performance and how their adverse effects on unemployment can be contained. Empirical studies have shown the existence of a positive relationship between the tax wedge on labour income and unemployment.[1] This paper investigates the effects of both average labour income taxation and tax progressivity on unemployment. It argues that, for a given overall level of labour income taxation, a more progressive tax schedule reduces unemployment.

We first review theoretical arguments in support of the unemployment-reducing effect of tax progressivity. The first mechanism is a *wage moderation effect*. Since a more progressive tax schedule makes any increase in the after-tax wage more costly for employers, the latter will resist more any wage increase claimed by employees, thus moderating the adverse wage effect on labour demand.[2] We also argue that these unemployment-reducing effects of tax progressivity are very likely to remain in the presence of labour supply responses. Although tax progressivity may be detrimental to incentives on in-work effort, as typically argued in public finance, tax progressivity remains beneficial for employment (and unemployment), with only an ambiguous total effect on aggregate production. The second mechanism is a *composition effect* that occurs because the labour demand for low-skilled workers is more sensitive to taxation as compared to high-skilled workers.

Next, we empirically investigate the effects of taxation on labour market performance using a panel data of 21 OECD countries over 1998-2008. We use the OECD tax database to derive our tax indicators. We measure the overall level of labour income taxation by the average tax rate for a single worker paid at the average wage and tax progressivity by comparing the tax wedges of workers paid 67% and 167% of the average wage. The latter aggregates the Coefficients of Residual Income Progression[3] (CRIP) at wage levels between 67% and 167% of the average wage (which we define as the *global* CRIP).

Our results confirm the usual finding that higher labour taxation increases unemployment. The estimated impact of the tax wedge on unemployment becomes larger when we control for tax progressivity. We show a sizeable unemployment-reducing effect of tax progressivity: for any given level of taxation, we find that a more progressive tax schedule reduces the unemployment rate and increases the employment rate.[4] The effect on the employment rate is mainly due to

[1]See Layard and Nickell (1999), Daveri and Tabellini (2000), Nickell et al. (2005) among others.
[2]See e.g. Hersoug (1984), Pissarides (1985, 1998), Lockwood and Manning (1993).
[3]As defined by Musgrave and Thin (1948).
[4]The employment rate is the share of the working age population that is employed. It is thus equal to the product of the participation rate and one minus the unemployment rate.

the impact on the unemployment rate and not on the participation rate. We also find that progressivity reduces production per employed worker. This is in line with the common wisdom on the detrimental effects of tax progressivity on in-work incentives. However, tax progressivity has no statistically significant effect on GDP, the negative effect on the intensive margins of the labour supply being compensated by the positive effect on employment. The design of an optimal tax schedule should not simply focus on the trade-off between the equity gain of a more progressive tax schedule against the adverse effect on the incentives to work harder (Mirrlees (1971)), but should also include the employment-enhancing (unemployment-reducing) effect of tax progressivity (see e.g. Hungerbühler *et alii* (2006) and Lehmann *et alii* (2011)).

Since the factors that drive changes in taxation are often correlated with other developments in the economy, as well as with changes in unemployment, omitted variable bias and reverse causality are likely to affect OLS estimates. Thus, we need to address the potential endogeneity of fiscal policies by means of instrumental variables (IV). Our IV strategy exploits exogenous variations in institutional, social and political factors that influence a country's fiscal policy, to identify the effect of taxation on unemployment (and employment). In practice, we instrument the tax wedge and tax progressivity indicators using the following variables: a narrative record for the tax components of fiscal consolidation policies, an index of distrust in civil services and a measure of the political orientation of the parliament. Results show that OLS tend to underestimate the effects of taxation on unemployment.

Our paper contributes to the literature that uses cross-country panel data to explain unemployment patterns in OECD countries.[5] Empirical studies typically investigate the impact of macroeconomics shocks and (time-varying) labour market institutions on aggregate unemployment. In this literature, labour income taxation is generally considered as exogenous and is captured by a single indicator, the tax wedge for the average worker, which is found to be a key determinant of the unemployment rate (Daveri and Tabellini (2000), Nickell *et alii* (2005)). We contribute to this literature in two ways. First, we include tax progressivity. Second, we address the endogeneity of taxation.

Another empirical literature to which our paper is related explores the effect of tax progressivity on wages using time series data, either at the aggregate level or for specific industries or sub-groups of workers.[6] The typical result is that tax progressivity reduces the gross wage, at least for blue-collar workers.[7] Note, however, that the change in aggregate wage may confound true wage responses with heterogeneous employment responses that alter the wage distribution. Such composition effects therefore make the results hard to interpret in term of a wage

[5]See the time series analysis on different OECD countries by Bean *et alii* (1986), Layard *et alii* (1991) and Nickell and Layard (1999) and the panel data analyses by Blanchard and Wolfers (2000), Daveri and Tabellini (2000), Algan *et alii* (2002), Belot and Van Ours (2004), Nickell *et alii* (2005), Griffith et alii (2007), Bassanini and Duval (2009) among others. See also Prescott (2004), Rogerson (2006, 2008) and Rogerson and Wallenius (2009) who account for the different trends in total hours of works across OECD by difference in tax policy in calibrated macroeconomic models.

[6]Malcomson and Sartor (1987), Lockwood and Manning (1993), Holmlund and Kolm (1995), see also the surveys by Sørensen (1997) and by Røed and Strom (2002).

[7]Hansen *et alii* (2000).

moderation effect.[8]

Finally, there is an extensive literature that uses micro-data to evaluate the effect of tax reforms and making-work-pay programs in selected countries. For example, policies such as the EITC (Earned Income Tax Credit) in the US or the WFTC (Working Families Tax Credit) in the UK have been shown to improve transitions from non employment to employment.[9] As these policies shifts the tax burden away from some disadvantaged groups (e.g. employed lone parents), we interpret them as a way to increase progressivity. Typically, this literature focusses on partial equilibrium effects while we are interested in the net effects of taxation at the aggregate level. In this respect, a reduced form approach based on aggregate data may be more appropriate. Moreover, the focus of this literature on specific programs for selected target groups of the population in a given country leads to evidence that cannot easily be generalized to other contexts. By exploiting a panel of countries we are able to exploit differences in tax reforms across countries and over time to assess the overall effects of fiscal policies on unemployment. Finally, part of the effects on unemployment goes through a wage moderating effect via collective bargaining. Unions generally care about a wide range of workers and hence look at the global shape of the tax schedule. So, the global CRIP that we use to measure progressivity provides a more relevant indicator than measures of tax progressivity at the individual level.

The paper is organised as follows. We review the theoretical arguments on the unemployment effects of tax progressivity in Section II. The empirical strategy is outlined in Section III, where we also discuss the validity of our instruments. The dataset is described in Section IV and the empirical results are discussed in Section V. Finally, Section VI concludes.

II Theoretical framework

In this section, we use a matching model *à la* Diamond-Mortensen-Pissarides to derive theoretical predictions about the effects of taxation on the steady-state unemployment rate. We start with a model without labour supply responses and then introduce participation and in-work decisions into the model.

II.1 The model without labour supply responses

Time is continuous and discounted at the common rate $r > 0$. All agents are risk-neutral. An homogeneous consumption good is produced by different types of perfectly substitutable labour indexed by the corresponding productivity level i. The different labour markets are perfectly separated: a type i individual can only occupy a type i job.[10] Let y_i, L_i, N_i, u_i, δ_i and w_i denote respectively the productivity, the level of employment, the number of participants, the

[8] Brunello and Sonedda (2009) use panel data to estimate the effect of tax progressivity on wages. Manning (1993), uses quarterly time series for the UK, and estimates also an auxiliary unemployment equation augmented with a tax progressivity indicator.

[9] See Eissa and Liebman (1996) and Blundell and Shepard (2012) among many others.

[10] These assumptions of perfect substitution and of perfect separation are only made to simplify the exposition.

unemployment rate, the exogenous job destruction rate and the pre-tax earnings (or labour cost) for individuals of type i (henceforth called the (gross) wage), with obviously $1 - u_i = L_i/N_i$.

We assume congestion externalities in the matching process. Following Diamond (1982), Mortensen and Pissarides (1999) and Pissarides (1985, 2000), we assume that the flow of hirings is given by a matching function $\mathcal{M}_i(v_i, N_i - L_i)$ of the stock v_i of vacant jobs of type i and the stock $N_i - L_i$ of unemployed of type i. Function $\mathcal{M}_i(.,.)$ is assumed to be increasing and concave in each of its argument and to exhibit constant returns to scale. The rate at which jobs are filled is a decreasing function $q_i(.)$ of the tightness ratio $\theta_i = v_i/(N_i - L_i)$ in labour market i, with $q(\theta_i) \equiv \mathcal{M}_i(1, 1/\theta_i)$. Symmetrically, the rate at which an unemployed finds a job is an increasing function $p_i(.)$ of tightness θ_i, with $p_i(\theta_i) \equiv \mathcal{M}_i(\theta_i, 1) = \theta_i q_i(\theta_i)$. The equality between exits $\mathcal{M}_i(v_i, N_i - L_i)$ out of and entries $\delta_i L_i$ into unemployment gives the employment level and the unemployment rate at the steady state:

$$L_i = \frac{p_i(\theta_i)}{\delta_i + p_i(\theta_i)} N_i \qquad \text{and} \qquad u_i = \frac{\delta_i}{\delta_i + p_i(\theta_i)} \tag{1}$$

On each labour market i, a filled job generates a profit flow $y_i - w_i$ and it provides an expected inter temporal profit denoted J_i:

$$J_i = \frac{y_i - w_i}{r + \delta_i} \tag{2}$$

Firms create vacancies as long as the flow cost of search $c_i > 0$ is smaller than the expected returns to search. The latter is equal to the rate $q_i(\theta_i)$ at which jobs are filled times the inter temporal value J_i of a filled job. As firms create more and more vacancies, tightness increases and the job filling rate decreases. This occurs until the following free-entry condition is met:

$$\frac{c_i}{q(\theta_i)} = J_i = \frac{y_i - w_i}{r + \delta_i} \tag{3}$$

Combining Equation (1) and the free-entry condition (3) leads to labour demand in market i. The fraction $1 - u_i$ of participants of type i who are employed is a decreasing function of the gross wage w_i. This relationship is denoted LD in Figure 1. A rise in the gross wage reduces the inter-temporal profit (2) made on a filled job. So, firms find it less profitable to create jobs, tightness decreases and the unemployment rate increases.

We consider a non-linear income tax function $T(.)$ that only depends on wages w. The average tax rate at wage w_i is denoted $\tau_i \equiv T(w_i)/w_i$ and the *net wage* is $n_i \equiv (1 - \tau_i)w_i$. We call $1 - \tau_i$ the *retention rate*. A change in the average tax rate τ_i does not affect job creation if it holds at a constant gross wage w_i. In the left part of Figure 1 where the gross wage w_i is on the vertical axis, a rise in the average tax rate τ_i does not shift the LD curve. Conversely, keeping the net wage n_i fixed, a rise in the average tax rate increases labour cost w_i, thereby inducing firms to create less jobs. In the right part of Figure 1 where the net wage n_i is on the vertical axis, a rise in the average tax rate τ_i shifts the LD curve inwards.

We denote b_i the instantaneous value in unemployment among type i individuals. This value sums untaxed unemployment benefits and the value of time out of work. The expected

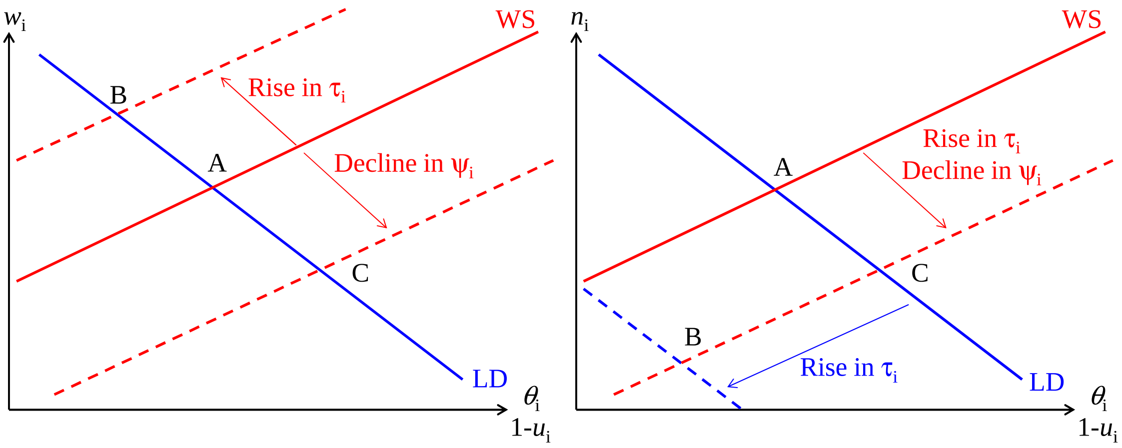

Figure 1: The effects of taxation

lifetime utility of a type i employed individual E_i, respectively an unemployed one U_i, verifies the following asset equations in steady state:

$$r\ E_i \quad = \quad w_i - T\left(w_i\right) + \delta_i \left(U_i - E_i\right) \tag{4a}$$

$$r\ U_i \quad = \quad b_i + p_i\left(\theta_i\right)\left(E_i - U_i\right) \tag{4b}$$

The permanent income rE_i of an employed worker of type i is equal to her instantaneous utility $w_i - T(w_i)$ minus the average loss $\delta_i \left(E_i - U_i\right)$ in case of job destruction. A symmetric interpretation applies for unemployed workers. We assume Nash bargaining over the wage and denote $\gamma_i \in [0,1)$ workers' bargaining power. In Appendix A we show that the first-order condition of the maximization of the Nash product can be written as:

$$\frac{E_i - U_i}{1-\tau_i} = \frac{\gamma_i}{1-\gamma_i}\Psi_i\ J_i \tag{5}$$

where Ψ_i is the Coefficient of Residual Income Progression (hereafter the *local CRIP*) at wage w_i defined by Musgrave and Thin (1948) as:

$$\Psi(w) \equiv \frac{1-T'\left(w\right)}{1-\frac{T(w)}{w}} = 1 + \frac{d\ln\left(1-\frac{T(w)}{w}\right)}{d\ln w} \tag{6}$$

A one percent increase in the gross wage w_i increases the net wage n_i by a relative amount equals to the local CRIP $\Psi_i = \Psi(w_i)$. The latter is also equal to one plus the wage elasticity of the retention rate $1-(T(w)/w)$. A higher local CRIP comes from a lower marginal tax rate $T'(w_i)$ or a higher average tax rate τ_i and is associated with less tax progressivity. With a lower local CRIP, a marginal increase of the gross wage remains as costly for the employer, but provides less additional income to the worker. Consequently, the worker has less incentives to claim a higher gross wage. A more progressive tax schedule therefore affects the sharing rule (5) as does a decrease in the worker's bargaining power (Pissarides (1985, 1998), Lockwood and Manning (1993)). This is the *wage moderating effect* of a more progressive tax schedule. We then obtain the following gross and net wage setting equations, denoted WS in Figure 1 (See Appendix A):

$$w_i = \frac{\gamma_i\ \Psi_i}{1-\gamma_i+\gamma_i\ \Psi_i}\,(y_i+c_i\ \theta_i)+\frac{1-\gamma_i}{1-\gamma_i+\gamma_i\ \Psi_i}\ \frac{b_i}{1-\tau_i} \tag{7a}$$

$$n_i = \frac{\gamma_i\ \Psi_i}{1-\gamma_i+\gamma_i\ \Psi_i}\,(1-\tau_i)\,(y_i+c_i\ \theta_i)+\frac{1-\gamma_i}{1-\gamma_i+\gamma_i\ \Psi_i}\ b_i \tag{7b}$$

In the absence of taxation, Nash bargaining implies that workers extract a share γ_i of the total surplus $J_i + E_i - U_i$ while the firm extracts a share $1-\gamma_i$. Therefore, the worker's pay is a weighted average of the instantaneous value in unemployment on the one hand and of the productivity level y_i augmented with the expected hiring cost per unemployed $c_i\ \theta_i$ on the other.[11] As the latter increases when the labour marker becomes more tight, i.e. when the unemployment rate decreases, the wage Equations (7a) and (7b) are represented by upward-sloping curves labelled WS in Figure 1.

To analyse the impact of labour taxation on wage formation, we first consider a rise in the average tax rate τ_i, holding tax progressivity Ψ_i constant. This reduces the total surplus of the match that the worker and the employer share when they bargain over the wage. The surplus J_i accruing to the firm decreases via a rise in the gross wage w_i. This corresponds in the left panel of Figure 1 to an upward shift of the WS curve (see (7a)). The surplus $E_i - U_i$ accruing to the worker shrinks via a reduction in the net wage n_i. This corresponds in the right panel of Figure 1 to a downward shift of the WS curve (see (7b)). Taking labour demand into account, the equilibrium shifts from A to B, where employment and the net wage are lower while the unemployment rate and the gross wage are higher. It is worth noting that if b_i consisted only of unemployment benefits indexed on the net wage, the tax rate would have no effect on the unemployment rate nor on the gross wage (see e.g. Pissarides (1998, 2000)). This is because a rise in the tax rate, by decreasing the net wage, also decreases the level of unemployment benefits. This effect turns out to offset the direct increasing impact of the tax rate on the gross wage.[12] Put another way, the effect of the average tax rate τ_i relies on an imperfect indexation of unemployment benefits plus the value of time out of work on the net wage.

Second, we consider a more progressive tax schedule (a lower Ψ_i) holding the average tax rate τ_i unchanged. From (5), this affects the sharing rule as does a decrease in the relative bargaining power $\gamma_i/(1-\gamma_i)$. A locally more progressive tax schedule therefore reduces the workers' *effective bargaining power* $\gamma_i\ \Psi_i/(1-\gamma_i+\gamma_i\ \Psi_i)$, that is the weight of productivity in the wage Equations (7a) and (7b). The WS wage curve shifts downwards in the two panels of Figure 1, so the equilibrium moves from A to C. Employment increases while the unemployment rate, the net and the gross wages decrease. This *wage moderating effect* of tax progressivity thus provides a first argument justifying why we expect a more progressive tax schedule to decrease the unemployment rate.

[11] For $c_i\ \theta_i = c_i v_i/\,(N_i - L_i)$. When a job-seeker is hired, the employer saves the cost of searching for an other applicant.

[12] Plugging $b_i = \rho\ (1-\tau_i)w_i$ into (7a), Equations (3) and (7a) would become a two-equation system in w_i and θ_i that does not depend on τ_i.

The local CRIP at at given wage w only captures progressivity in the neighbourhood of w. The following example illustrates the limitation of the local CRIP at w. Consider a piecewise-linear tax system. Assume the only change from one year to the next is a small shift of a threshold between two consecutive tax brackets from above to below a given wage level w (e.g. a "bracket creep" phenomenon). Then, the marginal tax rate at w experiences a dramatic change, inducing a large shift of the local CRIP at wage w, while the overall tax system has been almost unchanged. We therefore choose to capture the progressivity of the tax system by a "global CRIP" that is equal to the (log of) the ratio of the retention rates at wages levels w_1 and w_0 with $w_1 > w_0$. The *global CRIP* between w_0 and w_1 is defined as:

$$\Psi_{w_0}^{w_1} \equiv \ln \left(\frac{1 - \frac{T(w_1)}{w_1}}{1 - \frac{T(w_0)}{w_0}} \right) = \int_{w_0}^{w_1} (\Psi(w) - 1) \frac{dw}{w} \tag{8}$$

where the last equality is obtained by the integration of (6) between w_0 and w_1. The global CRIP aggregates the local CRIPs between w_0 and w_1 and a lower global CRIP is associated with a globally more progressive tax schedule between wages w_0 and w_1. The equality

$$\frac{n_1}{n_0} = \frac{w_1}{w_0} \ \exp(\Psi_{w_0}^{w_1})$$

stresses that the global CRIP measures how the tax system reduces after-tax wage inequality between gross wage w_0 and w_1.

In this section, we consider for tractability a model with individual bargaining. In practice, in most OECD countries, wages are mainly set through collective bargaining. This implies that unions simultaneously negotiate wage levels of workers with different productivity levels. In this respect, consider a union confronted with a reform of the tax system that affects differently different workers - i.e. due to the heterogeneous effects of the local CRIPs on slightly different workers. Due to the complexity of real-world tax systems, unions are typically not aware of the details of such tax reform. Unions would typically react to the reform negotiating an identical (collective) wage response for all workers. The resulting overall wage moderating effect is unlikely to be identifiable on the basis of the changes in individual-specific CRIPs. Conversely, unions would be more likely aware of the global progressivity of the tax schedule, and so of the change in the global CRIP. This has also implications for our empirical exercise, whereby the wage moderating effect is expected to be better captured by the global CRIP indicator rather than by any local CRIP at any given wage level.

In addition to the *wage moderating effect*, a lower global CRIP may also reduce the aggregate unemployment rate if employment of low-paid workers at wage w_0 is more elastic to a change in the retention rate than employment for high-paid workers at wage $w_1 > w_0$. The idea that low-paid employment is more responsive than high-paid employment is quite common in the literature (see e.g. Juhn *et alii* (1991), Kramarz and Philippon (2001), Immervoll *et alii* (2007)). An increase in the log of the retention rate $1 - \tau_0$ at w_0 would lead to an increase in low-paid employment that outweighs the decrease in employment induced by an equivalent decrease in the log of the retention rate $1 - \tau_1$ at wage w_1. This leads to a *composition effect* according to which a lower global CRIP reduces unemployment. In addition to this mechanism, there is no way to decrease the global CRIP between w_0 and w_1 without reducing the local CRIPs in between, which also contributes to reduce unemployment trough the wage moderating effect.

Prediction 1. *In the model with exogenous labour supply, a rise in the retention rate (a decline in the average tax rate) and a more progressive tax schedule (a decline in the global CRIP) reduce the unemployment rate and increase the employment rate.*

II.2 Extensive and intensive margins of labour supply

Extensive margin. The next step introduces participation decisions in each labour market. For this purpose, we assume that individuals have different values I of being out of the labour force. When an individual enters into the labour force, she is unemployed and searches for a job. Among individuals of type i, only those for which $I \leq U_i$ choose to participate to the labour market, where:

$$U_i = \frac{(r + \delta_i) b_i + p_i(\theta_i)\ n_i}{r\,(r + \delta_i + p_i(\theta_i))}$$

from (4a), (4b) and $n_i = w_i - T(w_i)$. The value I of being out of the labour force is assumed continuously distributed among individuals of type i according to the CDF $G_i(.)$. Let $\overline{N_i}$ denote the exogenous size of the working age population of type i. The participation rate in the population equals $G_i(U_i)$, the size of the labour force is $\overline{N_i}\ G_i(U_i)$.

From Equations (1) and (3), the fraction of employed participants $1 - u_i$ is independent of the size of the labour force. Because of congestion externalities, firms recruit workers more easily when the size of the labour force increases. Whenever the participation rate increases holding the gross wage w_i constant, firms create more jobs until tightness, thereby the unemployment rate, return to their initial values. The level L_i of employment thus increases in the same proportion as the size of the labour force. Consequently, total employment $\overline{N_i}\ G_i(U_i)(1 - u_i)$ and the employment rate $G_i(U_i)(1 - u_i)$ are decreasing in the gross wage through labour demand and are increasing in the net wage through the participation margin.

As displayed by Figure 1, a decline in the local CRIP Ψ_i, holding the average tax rate τ_i constant, decreases the net wage n_i but increases the exit rate out of unemployment $p_i(\theta_i)$. The total impact on the incentives to participate is therefore theoretically ambiguous. We show in Appendix A that a decline in Ψ_i increases (decreases) the participation rate if the unemployment rate is inefficiently high (low). This is because a decline in the local CRIP affects the labour market outcome only by reducing the workers' effective bargaining power. For a given retention rate τ_i, participation is maximised whenever the effective bargaining power satisfies the Hosios (1990) condition.[13] However, the effect of tax progressivity on the unemployment rate is unchanged by the introduction of the participation decision.

[13]This point was suggested by Pierre Cahuc.

Figure 1 also shows that a rise in the tax rate τ_i, holding progressivity Ψ_i constant, decreases the net wage n_i, increases the gross wage w_i and reduces the exit rate out of unemployment $p_i(\theta_i)$. Searching for a job thus becomes less interesting (i.e. U_i decreases), inducing pivotal individuals to exit the labour force. The participation rate decreases. The employment rate and the level of employment decrease because the size of the labour force is lower (a labour supply effect) and a smaller fraction of participating agents is employed (a labour demand effect).

The empirical literature concludes that the extensive responses (i.e. participation decisions) are concentrated on low-wage subgroups such as low-skilled workers or secondary earners (e.g. Juhn *et alii* (1991), Immervoll *et alii* (2007) or Meghir and Phillips (2010)). This suggests that increasing by 1% the retention rate $1-\tau_i$ on the bottom half of the wage distribution and decreasing the retention rate by 1% on the top half would increase overall participation through a composition effect on participation. From (8), such a change in the profile of the retention rate is associated with a decline in the global CRIP, that is, with a globally more progressive tax schedule.

Prediction 2. *In the model with endogenous participation, a rise in the average tax rate increases the unemployment rate and decreases the employment rate and the participation rate. A rise in tax progressivity (a decline in the CRIP) decreases the unemployment rate. It increases (decreases) the participation rate if the unemployment rate is inefficiently high (low).*

Extensive and intensive margins in a competitive setting. The preceding conclusions that tax progressivity reduces unemployment are in deep contrast with a long tradition in public finance where tax progressivity reduces incentives to work. We argue that these two views are not contradictory as they focus on different objectives, employment on the one hand, in-work effort on the other hand.

The public finance literature typically assumes away frictions on the labour market, so full employment prevails. However, even in such a frictionless environment, one should not only consider the intensive margin of the labour supply. The empirical literature suggests that the extensive margin is key (e.g. Heckman (1993), Meghir and Phillips (2010), Røed and Strøm (2002)). In a competitive setting, an individual chooses to work if and only if her net income $w_i - T(w_i)$ is larger than her instantaneous value of staying out of the labour force, which is assumed continuously distributed. The extensive margin elasticity is empirically higher for low-skilled workers. An increase in the log of the retention rate $1-\tau_0$ at w_0 would lead to an increase in low-paid participation that outweighs the decrease in participation induced by an equivalent decrease in the log of the retention rate $1-\tau_1$ at wage w_1. This leads to a *composition effect in participation* according to which a lower global CRIP increases participation, thereby employment. In sum, we expect that a more progressive tax schedule increases employment and decreases output per worker, leading to an ambiguous impact on total production.[14]

[14] Immervoll et al. (2007) use a microsimulation model with intensive and extensive labour supply responses to compute the efficiency costs of two prototypical tax reforms that increase tax progressivity. They show that

Introducing the intensive margin in the matching framework. Turning back to environments with unemployment and wage negotiation, Sørensen (1997, 1999), Hansen (1999), Fuest and Huber (2000) Røed and Strøm (2002) and Parmentier (2006) have considered the impact of tax progressivity when in-work effort is endogenous. Increasing income tax progressivity reduces in-work effort through the traditional labour supply effect. Therefore jobs tend to become less productive, which may also be detrimental to employment. Moreover, a more progressive tax schedule still reduces the share of the surplus that accrue to the workers, which is beneficial to employment through the above-mentioned wage moderation effect. In general, the total effect on employment is ambiguous. This ambiguity can be resolved under some further specific assumptions. For instance, Cahuc and Zylberberg (2004) obtain that the wage moderation effect dominates the labour supply effect under multiplicatively separable preferences. A more progressive tax schedule then always increases employment and always decreases the unemployment rate and output per employed. The effect on total production remains ambiguous. Hansen (1999) obtains similar analytical results under different specifications. Numerical simulations under different assumptions for individual preferences find that employment is increasing in tax progressivity while output per worker is reduced (Sørensen (1999), Parmentier (2006)). The following predictions are derived in Appendix A under additively separable preferences.

Prediction 3. *In the model with bargaining over wages and in-work effort, a rise in tax progressivity (a decline in the CRIP) reduces in-work effort. It also reduces the unemployment rate if taxation is initially not too progressive. The effect on total production is ambiguous.*

III Empirical strategy

We estimate the effects of average tax rates and tax progressivity on unemployment rates and on other labour market indicators in 21 OECD countries using information drawn from different data sources, over the period 1997-2008. Our measures of labour taxation are based on average tax rates (ATR) of single individuals at different points of the earnings distribution, namely: 67% of the average wage, the average wage (i.e. 100%) and 167% of the average wage, provided by the OECD tax database. These indicators are harmonized over time and across OECD countries.[15] They encompass income taxation by central and local governments and employers and employees social security contributions.[16] Since the wage distribution differs across countries and over time, the average tax rates computed at 67%, 100% and 167% of the

their "working poor policy" which pays more attention to the disincentive effects along the participation margin entails less efficiency costs than their "demogrant policy". This suggests distortions along the extensive margin are quantitatively much more important to consider than the intensive margin.

[15] The OECD Tax database is drawn from `http://www.oecd.org/tax/tax-policy/oecdtaxdatabase.htm`, Section B) 3.b, Table I.5. Since the OECD tax database only starts in 2000, we use the information provided by the OECD taxing wage database to extend the relevant time series back to 1997. Details on the two database and their harmonization are given in the Data Appendix.

[16] While the focus on singles allows us to avoid many confounding factors originating from household composition and intra-household participation decisions, it also has a drawback since we are missing the contribution of specific policies which are restricted to households with kids, as the EITC or the WFTC.

average wage reflect actual taxation at different percentiles of the wage distribution. From the above information, we compute tax retention rates:

$$\text{retj}_{i,t} = 1 - \frac{T(j \times AW_{i,t})}{j \times AW_{i,t}} = 1 - ATRj_{i,t} \qquad \text{for} \qquad j \in \{67\%, 100\%, 167\%\}$$

with respect to the average wage ($AW_{i,t}$) in country i and year t. The retention rates are expressed in percentage points. The two measures of taxation that we use in the empirical analysis are: the average tax burden, measured by the logarithm of the retention rate at 100% of the average wage, $ln(ret100)$; the tax progressivity indicator, which consists in the logarithm of the ratio of retention rates at 167% and 67% of the average wage, $ln\left(\text{ret167}_{i,t}/\text{ret67}_{i,t}\right)$. The latter corresponds to the global CRIP we defined in (8), where w_0 and w_1 are respectively 67% and 167% of the average wage.[17]

We adopt the following specification:

$$Y_{i,t} = \beta_1 \ln\left(\text{ret100}_{i,t-1}\right) + \beta_2 \ln\left(\frac{\text{ret167}_{i,t-1}}{\text{ret67}_{i,t-1}}\right) + \mu \cdot \mathbf{Z}_{i,t-1} + \nu \cdot \mathbf{X}_{i,t} + \alpha_i + \varphi_t + \varepsilon_{i,t} \qquad (9)$$

where $Y_{i,t}$ is an indicator of labour market performance in country i and year $t \in \{1998, ..., 2008\}$, $\mathbf{Z}_{i,t-1}$ and $\mathbf{X}_{i,t}$ are vectors of control variables, α_i and φ_t are, respectively, country- and time-fixed effects, while $\varepsilon_{i,t}$ is the error term. The parameters of interest for the empirical analysis are β_1 and β_2. The vector $\mathbf{Z}_{i,t-1}$ includes a baseline set of labour market institutions, namely, the average unemployment benefits replacement ratio ($UBRR$), union density ($UnionDensity$), an index of the degree of coordination in wage bargaining ($wcoord$) and a synthetic index of employment protection (EPL). These control variables are introduced with a one-year lag, to allow for changing institutions to produce their effects on labour market performance as well as to mitigate reverse causality biases. The vector $\mathbf{X}_{i,t}$ includes cyclical control variables, such as the output gap ($outputgap$), the change in inflation ($inflchange$), the degree of trade openness ($Openness$) and the long term interest rate on government's bonds ($irate$).[18] More details on all the variables used in the empirical analysis are provided in the data Appendix B.

Our main labour market performance indicator is the aggregate unemployment rate, measured in percentage points. As tax reforms take time to produce their effects, we enter the tax indicators with a one-year lag. According to our theoretical predictions we expect a rise in the retention rate (a decrease in the average tax rate) to reduce the unemployment rate (i.e. $\beta_1 < 0$), while a rise in the global CRIP (a less progressive tax schedule) is expected to increase unemployment (i.e. $\beta_2 > 0$). When the employment rate is considered instead, we expect $\beta_1 > 0 > \beta_2$.

One reason for concern in estimating equation (9) by OLS is the potential endogeneity of the tax indicators. Changes in taxation can be driven by different economic considerations, such as (exogenous) long-term fiscal consolidation plans, (endogenous) fiscal policies induced by

[17] Given w_0 and w_1, the ratio w_1/w_0 is constant over time and across countries.

[18] These data are drawn from: OECD labour Force Statistics, OECD Economic Outlook, OECD Main Economic Indicators, ICTWSS database and World Bank Development Indicators.

cyclical variation in output (and unemployment), as well as other developments in the economy affecting both the choice of taxation as well as unemployment. For example, a negative shock to unemployment that reduces the tax base and increases social expenditures can generate a decline in retention rates to balance the budget of the State. Alternatively, a government can react to an increase in unemployment by cutting taxes and reducing the CRIP to stimulate employment. In both cases above, reverse causality is likely to bias the estimates. Unmeasured labour market policies or institutions can also be responsible for an omitted variable bias if they are correlated with the unemployment rate and our tax indicators.

While the macro-empirical literature on the determinants of unemployment does not generally address such endogeneity issues,[19] we take a number of steps in this direction. First, the one-year lagged tax indicators help mitigating reverse causality biases. Second, we implement an instrumental variable estimator based on exogenous variations in institutional, social and political factors that influence a country's fiscal policy, to identify the causal effect of taxation on unemployment (and employment). We instrument the tax wedge and tax progressivity indicators using the following time-varying and country-specific variables: a narrative record for the tax components of fiscal consolidation policies, an index of trust in civil services and a measure of the political orientation of the parliament.

Our first instrument is based on data on countries' fiscal consolidation plans motivated by long-term structural considerations. Devries *et alii* (2011) gather these data for 17 OECD countries from 1978 to 2009, using the narrative approach pioneered by Romer and Romer (2010). Devries *et alii* (2011) construct a variable that takes a value equal to the size of the fiscal consolidation plan legislated in country i at time t, zero otherwise. Fiscal consolidations are reconstructed using historical records available in official documents (i.e. budget reports, central bank reports, IMF reports, OECD Economic Surveys and other country-specific sources), with the aim of identifying size, timing, and main motivation for the fiscal actions undertaken by each country. In order to guarantee the exogeneity of fiscal measures with respect to cyclical fluctuations, only long-term structural fiscal plans primarily designed to put public debt on a sustainable path are taken into account. Hence, tax hikes to choke off domestic demand are ignored. As an example, consider the fiscal consolidation efforts undertaken by European countries to access the Monetary Union. For some of them, although the requirements were agreed under the terms of the 1992 Maastricht Treaty, it was not up until the very last moment that consolidation measures were taken and implemented. The precise timing of the tax hikes provides an exogenous source of variation for labour taxation. We construct our instrument in two steps. First, since Devries *et alii* (2011)'s data distinguish the "tax hikes" from the "spending cuts" components of fiscal consolidation plans, we only use the tax hikes component which describe the exogenous part of the (positive) *change* in the level of taxes between two consecutive years. Second, since we want an instrument for the *level* of labour taxes in a

[19]See Nickell *et alii* (2005), Blanchard and Wolfers (2000), Griffith *et alii* (2007), Bassanini and Duval (2009) and Arpaia and Mourre (2010) for a survey. A notable exception is Nunziata (2005).

given year, we construct the country-specific ($Taxconsol$) variable in year t as an index which cumulates all the tax hike episodes that occurred up to $t-1$. In other words, the index captures the component of the level of taxes observed at time t generated by the aggregate consolidation efforts through tax increases implemented over the years. Note that the $Taxconsol$ variable in the Devries *et alii* dataset is only available for 17 out of the 21 countries in our sample. The missing observations for Greece, New Zealand, Norway and Switzerland are set to zero. In the robustness checks section we provide additional evidence imputing the missing information on (exogenous) long-term structural changes in taxation from an external source (Guichard *et alii* (2007).

The share of people who report no confidence in civil services ($NoTrust$) is our second instrument. It is the percentage of interviewed individuals in World Value Survey (WVS) of a given country that responded "*none at all*" to the question: "*how much confidence do you have in the civil service?*".[20] This indicator captures individuals' perception about the importance of rent-seeking behaviours in the public sector. The more people believe that public institutions are trustworthy, the more they are willing to let the State implement redistributive policies. So, we expect a higher value of $NoTrust$ (i.e. a lack of confidence in public services) to be positively correlated with the global CRIP (i.e. with less progressive tax schedules), while we expect no direct effect on unemployment, being excludable from the unemployment equation. Available evidence supports these properties. Sapienza *et alii* (2007) argue that respondents' beliefs regarding the functioning of the civil service are not directly correlated with economic activity, thus with unemployment performance. Moreover, studies that obtain a direct effect of trust on economic activity use a measure of 'trust in others', rather than trust in specific institutions such as public services (see e.g. Algan and Cahuc (2006, 2010) and Guiso *et alii* (2008)).[21] Since low confidence in public services may also affect unemployment insurance generosity, it is important to include the unemployment benefit replacement ratio among the controls.

The difference between the shares of seats of left-wing and centrist parties minus the share of seats of right-wing parties in the parliament is our third instrument ($Leftism$).[22] This is because left-wing politicians typically support higher tax levels and more progressive taxation as opposed to right-wing parties (Summers *et alii* (1993), Persson and Tabellini (2000), Ardagna (2004) or Nunziata (2005) among others). A long-standing literature in political economy argues however that the political orientation of parties may affect, besides taxation, also monetary and fiscal policies, as left-wing politicians, compared to right-wing ones, are more likely to implement Keynesian policies. To take this into account, we include in the controls the output gap and

[20] The World Value Survey is available every five years. Our *Notrust* indicator is thus stepwise. Data construction is detailed in Appendix B.

[21] Algan *et alii* (2011) construct a composite index of distrust for public institutions, which combines distrust for the civil service with distrust for the parliament and the justice system. We neglect the latter two dimensions of distrust, as we are mostly interested in describing the social propensity to finance public good provision and redistribution.

[22] The leftism variable in our first stage regression is entered with a lag. So in year t, this variable is measured at $t-2$ given that tax indicators are already lagged once in the unemployment equation.

indicators of monetary policy such as the real interest rate and change in inflation. Moreover, there is evidence suggesting that adverse economic performance may reduce the probability of re-election of incumbent politicians (Drazen, 2000). This would imply an increase in leftism after a negative shock to the economy, if the incumbent is right-wing, and the opposite if the incumbent is left-wing. This "probability of re-election channel" induces *de facto* a non-linearity in the effects of the business cycle (e.g. unemployment) on leftism, which we exploit for identification.[23]

One could argue that both distrust and leftism are correlated with the share of Active Labour Market Policies (ALMP) in GDP. However, when we add this indicator to the list of controls, it never turns out to be statistically significant while our parameters of interest remain unaffected. We therefore do not include ALMP in the main specification, while we return to it in the robustness checks section V.2.

IV Data and descriptive statistics

We assemble a unique data set which combines information, drawn from different sources on taxation and other labour market institutions, on labour market performance and other socio-economic characteristics for 21 OECD countries over the period 1997-2008. The countries we consider are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States.

To get a broad overview of our tax data, we plot in Figure 2, the average value by country, over the sample period, of both the average tax retention rates *ret100* and (the exponential of) our global CRIP, namely *ret167*/ret67. Figure 3 shows, for the same indicators, the country's change between the 1997-1999 and the 2006-2008 sub-periods. In Figure 2, we also report the overall sample means (dashed horizontal and vertical lines) that partition the graph into four quadrants according to the level of OECD countries' tax burden (i.e. in terms of average taxation and tax progressivity). In Figure 3, dashed horizontal and vertical lines are drawn at zero so that each quadrant provides the sign of the observed changes.

In terms of the levels of average tax burden and progressive taxation (Figure 2), the overall patterns shows, with notable exceptions, a positive correlation between the two tax indicators, suggesting that countries that tax more (i.e. with lower average retention rates, *ret100*) are also characterised by a higher progressivity (i.e. a lower global CRIP, *ret167/ret67*). The bottom-left quadrant shows countries with a high tax burden, these are mainly Nordic and some continental European countries. In the upper-right quadrant we find mostly Anglo-Saxon and Mediterranean European countries (as well as Switzerland and Japan) characterised by a relatively lower tax burden.

[23]We find support to this hypothesis in the data: out of 35 country-specific economic crisis episodes - defined as GDP being at least one percentage point below its potential level in a given year, or by half a point for two consecutive years -, left-wing parties obtained a relative majority in the first election after the crisis in 21 cases, while right-wing parties prevailed in the other 14.

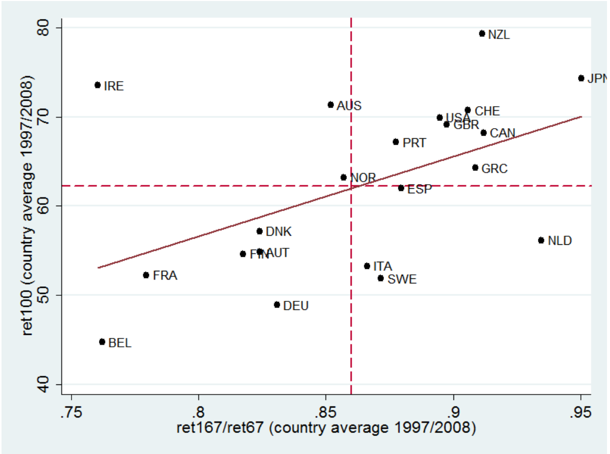

Figure 2: Average of the tax retention rates (100%APW) and the progressivity (167% vs 67%APW) by country over the 1997-2008 period. Sources: OECD Tax Database and OECD Taxing wages and authors' calculation.

When we focus on changes in the tax structure (Figure 3), the majority of countries exhibit small variations over the 1997-2008 period and appear to be located in the upper-right quadrant suggesting that many countries have reduced their tax burdens. A non negligible number of countries however (France, Greece, Italy, New Zealand, Austria and Great Britain) show an increase in global progressivity. The overall pattern of changes in countries' tax structure (i.e. both changes in the level and progressivity of taxation) show a weakly positive correlation. Some countries, however, stand out from the fitted line showing substantial changes in the structure of taxation which suggest that a significant reform of the tax system occurred: Japan and The Netherlands, where the average level of taxation increased while progressivity remained relatively stable; Ireland, which decreased substantially the tax burden both in terms of average taxation and progressivity. The imperfect correlation between changes in tax burden and changes in progressivity enables us to identify the effects of tax progressivity separately from the effects of overall tax burden.

V Empirical results

V.1 Main results

Table 1 presents results with the harmonised aggregate unemployment rate as dependent variable. OLS estimates are reported in Columns (1) and (2), IV estimates are shown in columns (3) to (5). In Column (1) we report results that are consistent with the specification typically used in the literature, whereby taxes affect the unemployment rate only through the average tax wedge (See e.g. Nickell and Layard (1999); see Bassanini and Duval (2009) for a review). We find that a one percentage point increase in the average retention rate $ret100_{t-1}$ (i.e. a one percentage point decrease in the labour tax wedge) has a favourable impact on the unemployment

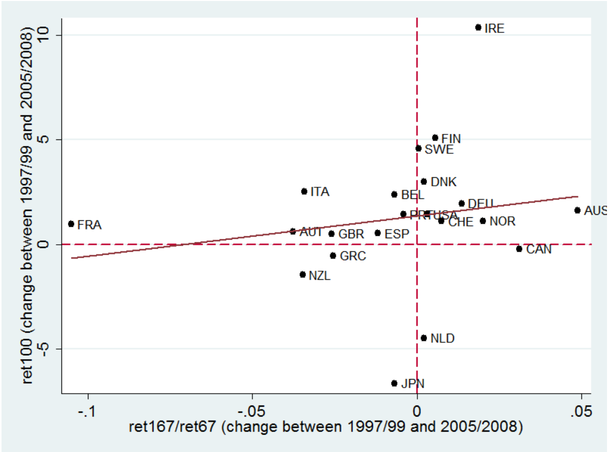

Figure 3: Changes of the tax retention rates (100%APW) and the progressivity (167% vs 67%APW) by country over the 1997-2008 period. Sources: OECD Tax Database and OECD Taxing wages and authors' calculation.

rate in t, for the average OECD country and year, of about 0.11 percentage points.[24] This order of magnitude is in the bottom range of previous findings which are between 0.1 (Nickell *et alii* (2005)) and 0.5 (Daveri and Tabellini (2000) for Continental-European countries). In Column (2) we show results with a specification that includes tax progressivity. Consistent with Prediction 1, a lower average tax rate (a higher value of $\ln(ret100)_{t-1}$) and a more progressive tax schedule (a lower value of $\ln(\frac{ret167}{ret67})_{t-1}$) reduce the unemployment rate. The effect of the average tax rate is statistically significant at the 1% level, the one of progressivity at the 5% level.

However, as previously discussed, OLS estimates may be biased and inconsistent due to the endogeneity of the tax variables. In Columns (3), (4) and (5), we deal with those issues by implementing an instrumental variable estimator. In particular, in Column (3), we re-estimate the specification of Column (1) using the variables $Taxconsol$ and $Leftism$ (lagged twice) to instrument $\ln(ret100)_{t-1}$. In Column (4), we introduce tax progressivity but consider this variable as exogenous and instrument $\ln(ret100)_{t-1}$ only, as in Column (3). In Column (5), we instrument both $\ln(ret100)_{t-1}$ and $\ln\left(\frac{ret167}{ret67}\right)_{t-1}$, using the whole set of instruments, that is those used in columns (3) and (4) to which we add the $NoTrust$ variable (lagged five years). First-stage estimates reported in Table 7 of Appendix C show that the $Taxconsol$ and $Leftism$ indicators have a strong statistically significant impact on the $\ln(ret100)_{t-1}$ variable, while the $NoTrust$ indicator is mainly correlated with the global CRIP $\ln\left(\frac{ret167}{ret67}\right)_{t-1}$ variable. First-stage estimates are comforting in terms of instruments' correlation with the endogenous regressors, while the Hansen J test confirms the validity of the over-identifying restrictions.[25]

[24]The mean of $ret67$, $ret100$ and $ret167$ over the sample are respectively 66.35%, 62.19% and 57.42%. So, when $ret100_{t-1}$ rises by one percentage point, the change in the unemployment rate amounts to $\frac{-6.617}{62.19} \cdot 1 = -0.11$ percentage points.

[25]In Table 7, the p-values of the Kleibergen-Paap under-identification test show that we can reject the null hypothesis that our model is under-identified. While the F statistics with one instrument (in Columns (3) and (4)) is somewhat below the threshold level of 10, conventionally used as a rule of thumb by Staiger and Stock, Shea Partial R^2 in Columns (3)-(5) confirm that excluded instruments explain a non-negligible fraction of the variance of the endogenous variables in all specifications. Moreover the Anderson and Rubin test in Table 1,

	OLS estimates		IV estimates		
	(1)	(2)	(3)	(4)	(5)
$\ln(ret100)_{t-1}$	–6.617**	–7.913***	–22.069***	–28.869***	–53.420***
	(2.716)	(2.809)	(7.835)	(9.262)	(16.302)
$\ln\left(\frac{ret167}{ret67}\right)_{t-1}$		6.088**		11.943***	56.801***
		(2.534)		(4.391)	(20.544)
UBRR_{t-1}	0.055**	0.066***	0.125***	0.166***	0.315***
	(0.024)	(0.025)	(0.045)	(0.056)	(0.098)
$\text{UnionDensity}_{t-1}$	0.089	0.109*	0.005	0.020	0.085
	(0.056)	(0.056)	(0.070)	(0.073)	(0.138)
wcoord_{t-1}	–0.502**	–0.505***	–0.536***	–0.551***	–0.605**
	(0.197)	(0.193)	(0.183)	(0.191)	(0.304)
EPL_{t-1}	1.084***	1.079***	1.384***	1.457***	1.714**
	(0.369)	(0.348)	(0.405)	(0.410)	(0.674)
outputgap_t	–0.440***	–0.439***	–0.510***	–0.529***	–0.596***
	(0.066)	(0.065)	(0.079)	(0.083)	(0.114)
inflchange_t	–0.113	–0.109	–0.195*	–0.212*	–0.267*
	(0.083)	(0.084)	(0.104)	(0.110)	(0.158)
irate_t	–0.359***	–0.406***	–0.582**	–0.737***	–1.303***
	(0.134)	(0.133)	(0.232)	(0.272)	(0.442)
Openness_t	0.049***	0.052***	0.053***	0.061***	0.092***
	(0.014)	(0.014)	(0.015)	(0.017)	(0.024)
R^2	0.90	0.90	0.88	0.87	0.67
N	231	231	231	231	231
Hansen J test			0.3579	0.5513	0.6473
Anderson Rubin F test			0.0269	0.0095	0.0000

Table 1: Tax wedge, tax progressivity and the standardised unemployment rate *UNR*. Robust standard errors in parentheses. Significance levels: $*$: 10%, $**$: 5%, $***$: 1%. p-values of Hansen J over-identification tests and of Anderson and Rubin F test of significance of endogenous regressors are provided. Instruments in Columns (3) and (4) are $Taxconsol$ and $Leftism$ (lagged twice). In Column (5), we add $Notrust$ (lagged five years) defined in Appendix B.

A comparison of estimated coefficients reported in Columns (3)-(5) with those in Columns (1)-(2) indicate that OLS estimates of $\ln(ret100)$ suffer from an attenuation bias. According to IV estimates, a one percentage point increase in the average retention rate implies a reduction of the unemployment rate, for the average OECD country, between 0.35 (Column 3) and 0.86 (Column 5) percentage points - i.e. an order of magnitude that is closer to the one suggested by Daveri and Tabellini (2000). As far as progressivity is concerned, let us consider the effect of a half-percentage point decrease in the average tax rate at 67% of the average wage, together with a half-percentage point increase in the average tax rate at 167% of the average wage. Such a tax reform induces a rise in tax progressivity that decreases the global CRIP $\ln(\frac{ret167}{ret67})_{t-1}$ by 0.016 points, thereby reducing unemployment by an amount between 0.19 percentage points[26] (Column 4, where tax progressivity is assumed to be exogenous) and 0.92 (Column 5). We

which is robust to weak instruments and heteroskedasticity, rejects at the 5% or 1% the null hypothesis that the endogenous regressors are not significant in the second stage.

[26]Namely, $\beta_2\ \left(\frac{0.5}{\text{ret167}} - \frac{-0.5}{\text{ret67}}\right) = 11.9\ \left(\frac{0.5}{57.4} + \frac{0.5}{66.4}\right) = 0.19.$

interpret the contrast between the magnitude of OLS and IV estimates as evidence that reverse causality introduces an attenuation bias. A government may react to an adverse shock on unemployment by reducing average labour taxes, in particular on low-paid jobs, to curb the rise in unemployment. Such reactions generate a positive correlation between the unemployment rate and $\ln(ret100)_{t-1}$ and a negative correlation between the unemployment rate and $\ln(\frac{ret167}{ret67})_{t-1}$ that attenuate the OLS estimates of tax indicators and may even reverse their signs. Omitted factors affecting the unemployment rate can be an additional source of attenuation.

For the other control variables we find that higher unemployment benefits increase unemployment; union density plays no significant role; more coordination in wage bargaining has a favourable effect; the synthetic index of employment protection legislation has a statistically significant positive effect on the unemployment rate. An increase in the output gap is associated with lower unemployment, while the negative coefficients of the real interest rate on government's bonds and the change in inflation suggest that policies that guarantee prices stabilisation or raise the interest rate may be associated with higher unemployment. Finally there is a positive association between trade openness (imports plus exports relative to GDP) and the unemployment rate.

Overall, estimates in Table 1 yield three interesting considerations. First, omitting the role of tax progressivity leads to underestimate the impact of average taxation on unemployment. Second, IV estimates, when compared to OLS, show a considerable increase in the magnitude of coefficients, both in terms of $\ln(ret100)_{t-1}$, as well as $\ln(\frac{ret167}{ret67})_{t-1}$. Last but not least, the impact of tax progressivity is shown to be quantitatively as important as the impact of average taxation.

	OLS estimates		**IV estimates**		
	(1)	(2)	(3)	(4)	(5)
$\ln(ret100)_{t-1}$	4.260	6.778*	17.327*	26.837**	51.798***
	(3.651)	(3.787)	(10.264)	(11.719)	(19.358)
$\ln\left(\frac{ret167}{ret67}\right)_{t-1}$		–11.829***		–17.433***	–61.884**
		(3.622)		(5.405)	(26.906)
R^2	0.97	0.98	0.97	0.97	0.95
N	231	231	231	231	231
Hansen J test			0.6264	0.9520	0.4635
Anderson Rubin F test			0.1807	0.0554	0.0073

Table 2: Tax wedge, tax progressivity and the employment rate *erate*. Robust standard errors in parentheses. Significance levels: $*$: 10%, $**$: 5%, $***$: 1%. p-values of Hansen J overidentification tests and of Anderson and Rubin F test of significance of endogenous regressors are provided. Instruments in Columns (3) and (4) are $Taxconsol$ and $Leftism$ (lagged twice). In Column (5), we add $Notrust$ (lagged five years) defined in Appendix B. These estimates are obtained using country-fixed effects, time-fixed effects and the same controls as in Table 1.

In Table 2 we replicate the same regressions as in Table 1 replacing the unemployment rate by the employment rate as the dependent variable. Henceforth, we only report the estimated parameters of the explanatory variables of interest. Most previous findings are confirmed also when the effects of taxation are estimated on the employment rate, though, as expected, the signs are now reversed as compared to Table 1. Focussing on our preferred specification in Column (5), we find that a one percentage point increase in the average retention rate determines an increase of the employment rate, for the average OECD country, up to 0.83 percentage points. Similarly, a one percentage point increase in $\left(\frac{ret167}{ret67}\right)_{t-1}$ - split into half a percentage point decrease in the average tax rate at 67% of the average wage and half a percentage point increase in the average tax rate at 167% - causes an increase in the employment rate up to 1.01 percentage points. Here as well, a comparison of the coefficients of $\ln(ret100)_{t-1}$ indicate that neglecting progressivity tends to underestimate the impact of the average tax wedge on employment.

	$\log(1-urate)_t$ (1)	$\log(prate)_t$ (2)	$\log(erate)_t$ (3)=(1)+(2)	$\log\left(\frac{GDP}{Emp}\right)_t$ (4)	$\log\left(\frac{GDP}{Pop}\right)_t$ (5)=(3)+(4)
	OLS estimates				
$\ln(ret100)_{t-1}$	0.116***	0.010	0.126**	–0.017	0.109
	(0.037)	(0.039)	(0.061)	(0.072)	(0.088)
$\ln\left(\frac{ret167}{ret67}\right)_{t-1}$	–0.135***	–0.066*	–0.200***	0.118*	–0.083
	(0.034)	(0.040)	(0.057)	(0.062)	(0.065)
R^2	0.88	0.98	0.97	1.00	1.00
N	231	231	231	231	231
	IV estimates				
$\ln(ret100)_{t-1}$	0.777***	0.113	0.890***	–0.508	0.382
	(0.238)	(0.143)	(0.331)	(0.406)	(0.307)
$\ln\left(\frac{ret167}{ret67}\right)_{t-1}$	–0.824***	–0.226	–1.050**	1.437***	0.387
	(0.297)	(0.228)	(0.449)	(0.473)	(0.378)
R^2	0.55	0.98	0.94	0.99	1.00
N	231	231	231	231	231
Hansen J test	0.7480	0.1920	0.4353	0.1378	0.1767
Anderson Rubin F test	0.0000	0.5088	0.0052	0.0000	0.0122

Table 3: Decomposing the effects of taxation on different indicators. Robust standard errors in parentheses. Significance levels: $*$: 10%, $**$: 5%, $***$: 1%. p-values of Hansen J over-identification tests and of Anderson and Rubin F test of significance of endogenous regressors are provided. These estimates are obtained using country-fixed effects, time-fixed effects and the same controls as in Table 1. The instruments are $Taxconsol$, $Leftism$ (both lagged twice) and $Notrust$ (lagged five years).

In Table 3, we decompose the effects of taxation on different labour market performance indicators. In Column (1) we use the logarithm of one minus the unemployment rate. In Column (2) we take the logarithm of the participation rate, while in Column (3) the logarithm of the employment rate is used instead. In this way, adding the estimates of Column (1) and Column (2), by construction, we obtain estimates reported in Column (3).[27] Similarly, in Column (4) we

[27]Note that, for consistency with the decomposition exercise, in Column (1) we use the (non-harmonised) unemployment rate, *urate*, instead of the standardised unemployment rate, *UNR*, provided by OECD, as in Table

use the logarithm of GDP per worker as dependent variable, while in Column (5) the logarithm of GDP per individual in the working-age-population is used. Since the latter ratio is the product of the employment rate times GDP per employed worker, the sum of estimates in Column (3) and Column (4), by construction, give the estimates reported in Column (5). The top panel reports OLS estimates as in Column (2) of Tables 1 and 2. The bottom panel report IV estimates using the same identification strategy as in Column (5) of Tables 1 and 2.

Results show that a higher taxation increases the unemployment rate while more progressivity decreases it. Focusing on Column (3), we find that lower taxation and higher progressivity decrease the employment rate considerably, however these effects seem to be mainly driven by the variations in the unemployment rate rather than by the changes in the participation rate. For, the latter is not statistically significantly affected in Column (2), both under OLS and under IV. These results suggest that the emphasis that is usually placed on labour supply decisions along the extensive margin to explain the employment effects of changes in taxation, instead of the unemployment-reducing effect, could be misleading.

In order to quantify the impact of labour taxation along the intensive margin (in-work effort), we use the logarithm of GDP per worker as dependent variable in Column (4). In line with Prediction 3, we find that a rise in progressivity (a decline in the global CRIP $\ln(\frac{ret167}{ret67})_{t-1}$) significantly reduces GDP per employed worker. Therefore our finding that progressivity reduces unemployment and increases employment is not inconsistent with the common wisdom that tax progressivity has a detrimental effect on incentives to work harder. Conversely, the effect of $\ln(ret100)_{t-1}$ is never statistically significant. Despite the negative impact of progressivity on output per worker shown in Column (4), we find that the overall effect on output (Column (5)) is not statistically significant. This suggests that the effect of progressivity on the employment rate is large enough to offset its negative impact on the intensive margin. Hence, once unemployment responses are taken into account, rising tax progressivity is not necessarily detrimental to output. In sum, Table 2 reconciles our view that tax progressivity reduces unemployment (Column (1)) and increases employment (Column (3)) with the traditional view that it generates negative incentives in terms of in-work effort (Column (4)). It also shows that the total effect on production is ambiguous (Column (5)).

Estimates in Tables 1, 2 and 3 implicitly assume that the effects of taxation are homogeneous across the whole labour force. In Table 4, we report estimates where we distinguish unemployment rates by skill and by age. The top panel reports OLS estimates while the bottom panel shows IV estimates. Some caution is needed when interpreting these estimates, since the distribution of wages can vary a lot between these groups, while retention rates are not specific to each sub-population considered. Still, a rough comparison of the magnitude of the coefficients of $\ln(ret100)_{t-1}$ and $\ln(\frac{ret167}{ret67})_{t-1}$ can improve our understanding of the diverse effects of taxation on unemployment across different groups of workers. Estimates in Columns (1) and (2) suggest that the impact of taxation and progressivity is larger (and statistically more robust)

1. We have checked that this change has little effects on the estimates.

	Skill		Age	
	Low-skilled	High-skilled	Young	Adults
	OLS estimates			
$\ln{(ret100)}_{t-1}$	–11.531***	–5.866*	–20.966***	–10.027***
	(3.915)	(3.419)	(6.572)	(3.091)
$\ln\left(\frac{ret167}{ret67}\right)_{t-1}$	12.518***	10.755***	21.465***	12.090***
	(3.592)	(3.111)	(7.454)	(2.796)
R^2	0.87	0.78	0.92	0.88
N	231	231	231	231
	IV estimates			
$\ln{(ret100)}_{t-1}$	–70.765***	–54.549**	–124.102***	–64.722***
	(24.795)	(23.816)	(37.135)	(18.796)
$\ln\left(\frac{ret167}{ret67}\right)_{t-1}$	97.487***	64.506**	118.986**	65.948***
	(29.585)	(28.173)	(47.110)	(24.142)
R^2	0.52	0.44	0.78	0.58
N	231	231	231	231
Hansen J test	0.4212	0.3426	0.9320	0.8251
Anderson Rubin F test	0.0000	0.0145	0.0000	0.0000

Table 4: Effects on the unemployment rates of different subgroups. Significance levels: $*$: 10%, $**$: 5%, $***$: 1%. p-values of Hansen J over-identification tests and of Anderson and Rubin F test of significance of endogenous regressors are provided. These estimates are obtained using country-fixed effects, time-fixed effects and the same controls as in Table 1. The instruments are $Taxconsol$, $Leftism$ (both lagged twice) and $Notrust$ (lagged five years).

for low-skilled workers than for high-skilled ones.[28] Results reported in Columns (3) and (4) show a similar pattern, whereby the impact of taxation and progressivity on unemployment is larger for younger workers (i.e. age group 15-24), as compared to prime-age workers (i.e. age group 25-54).

V.2 Robustness checks

In this section, we check the robustness of our results to alternative identification strategies based on different sets of instruments. Results are reported in Table 5. To ease comparisons, in Columns (1a) and (1b), we reproduce our results from the baseline specification (Column (5) of Table 1, for the unemployment rate *UNR*; Column (5) of Table 2 for the employment rate *erate*). The bottom part of Table 5 shows first-stage results (note these are identical whether the dependent variable in the second stage is the unemployment or the employment rate).[29] In Columns (2a) and (2b), we replace the missing information for Greece, New Zealand, Norway and Switzerland in the $Taxconsol$ instrument from the Devries *et alii* dataset by information

[28] These two skill categories are based on educational attainment. Low-skilled workers completed up to secondary education, while high-skilled workers completed tertiary education or more. The inclusion of individuals with a high school degree into the low-skilled category can be disputed. However, this aggregation choice is unavoidable due to the switch from the ISCED76 to the ISCED97 classification, which recoded lower-secondary education from level 1 (primary) to level 2 (secondary).

[29] Column (1a) displays the Shea Partial R^2 and the F statistic of the significance test of excluded instruments for the first-stage estimation of $\ln(ret100)$; Column (1b) provides the same statistics for $\ln(\frac{ret167}{ret67})$.

drawn from an alternative OECD dataset on fiscal consolidation provided by Guichard *et alii* (2007). Although the information in the latter dataset relies on a statistical algorithm (i.e. based on countries' structural changes in the cyclically adjusted primary balance), rather than on the narrative approach, the sequence of tax hikes show a rather similar pattern in both dataset.[30] Finally, in Columns (3a) and (3b), we use the ratio of public debt over GDP ($t-2$) as an instrument instead of the tax hike indicator. The latter captures the idea that highly indebted governments need to use fiscal policy to consolidate their budget (Galí and Perotti, 2005). To mitigate the risk of reverse causality, we lag the variable twice. Moreover, the inclusion of cyclical controls is expected to account for any effect of public debt on unemployment going through the channels of demand-management policies.[31] Results reported in Table 5 show that the IV estimates are robust to theses changes in the instruments.

	Baseline Identification		Using Guichard *et alii*		Using Public Debt	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
	Second-stage results					
	UNR	erate	UNR	erate	UNR	erate
$\ln(ret100)_{t-1}$	–53.420**	51.798**	–53.578*	55.010*	–56.535***	58.393***
	(16.302)	(19.358)	(21.789)	(26.371)	(14.151)	(17.255)
$\ln\left(\frac{ret167}{ret67}\right)_{t-1}$	56.801**	–61.884*	64.397**	–74.531*	63.523**	–71.713*
	(20.544)	(26.906)	(23.437)	(32.208)	(23.186)	(31.723)
R^2	0.67	0.95	0.63	0.94	0.62	0.94
N	231	231	231	231	231	231
Hansen J test	0.6473	0.4635	0.8837	0.5448	0.8142	0.7471
Anderson Rubin F test	0.0000	0.0073	0.0000	0.0115	0.0000	0.0000
	First-stage statistics					
	$\ln(ret100)$	$\ln\left(\frac{ret167}{ret67}\right)$	$\ln(ret100)$	$\ln\left(\frac{ret167}{ret67}\right)$	$\ln(ret100)$	$\ln\left(\frac{ret167}{ret67}\right)$
F of Excluded	6.214	8.678	6.351	6.028	17.812	7.672
Shea Partial R^2	0.0840	0.0623	0.0761	0.0493	0.1226	0.0486
KP under	0.0003		0.0004		0.0004	
KP weak	4.87		4.59		4.96	

Table 5: Robustness checks about instruments. Significance levels: $*$: 10%, $**$: 5%, $***$: 1%. p-values of Hansen J over-identification tests and of Anderson and Rubin F test of significance of endogenous regressors are provided. These estimates are obtained using country-fixed effects, time-fixed effects and the same controls as in Table 1. The instruments are $Leftism$, $Notrust$ and, for Columns (1 a, b) $Taxconsol$, for Columns (2 a, b) $Taxconsol$ extended for the missing countries by Guichard *et alii* (2007), for Columns (3 a, b) Public debt.

Additionally, we run a set of more traditional robustness checks in Table 6. In particular, we

[30]We checked the consistency of the two indicators - i.e. narrative and statistical - for the countries in which information on both approach was available.

[31]Note that in the textbooks IS-LM and AS-AD models, aggregate demand depends on public *deficits*, not on public *debt*.

experiment a different set of control variables, alternative specifications of the baseline equation, various estimation methods to control for unobserved country-specific shocks, as well as a different clustering of the error term to account for common unobserved effects. In Table 6, for each sensitivity check, we report the estimated coefficients of the tax variables and the Hansen test of the over-identifying restrictions. The various robustness checks experimented are discussed hereafter. We present all estimates using both the unemployment rates (Columns (1) to (3)) and the employment rates (Columns (4) to (6)). To the exceptions of Rows (3) and (14), robustness checks leave our results almost unaffected.

In our baseline equation, we use the output gap to control for overall business cycle conditions, assuming that output fluctuations are exogenous with respect to the unemployment rate. As the inclusion of output gap in the list of controls may trigger a simultaneity bias, we omit this variable in Row (1). Similarly, in Row (2) we omit from the baseline equation the trade-to-GDP ratio to account for the potential endogeneity of trade flows with respect to labour market performance. Next, while in our baseline specification all the tax variables are assumed to be pre-determined and entered with a year lag, in Row (3) we instead take contemporaneous tax indicators.[32] The estimates remain similar but the Hansen test is now rejected. This suggests that reverse causality is an important concern to take into account. In Row (4) we add to the set of controls the OECD ratio of expenditures in active labour market policies over GDP, to account for confounding factors, as discussed at the very end of Section III. We further experiment how results are altered by considering only country-fixed effects (i.e. excluding the time dummies; Row (5)), replacing country-fixed effects and time dummies with country-specific time trends (Row (6)) and including in the specification both time dummies and country-specific trends (Row (7)). To account for the presence of cross-section correlated error terms, in Row (8), we replace the time-fixed effects with a Correlated Common Effect Pooled (CCEP) estimator (Pesaran (2006)), while in Row (9) we implement the Newey-West HAC estimator that delivers heteroskedasticity and autocorrelation consistent estimates. In Rows (10) to (13), we successively exclude from our sample the countries that show the largest changes in the structure of taxation (i.e. France, Ireland, Japan and The Netherlands), as illustrated in Figure 3. Finally, to capture the medium-run effects and to partially smooth the year-to-year variations, we replicate the estimates using three years averages. In this case the sign of the estimated coefficients are unchanged, while significance falls as a result of the reduction in the number of observations.

VI Conclusion

This paper argues that tax progressivity has unemployment-reducing and employment enhancing effects. We develop a simple theoretical model in which tax progressivity may be detrimental to labour supply along the intensive margin, while the overall effects on employ-

[32]In this specification, since we want to isolate the effect of contemporaneous tax indicators, we still enter control variables for labour market institutions with a one-year lag and instruments with a two-years lag.

ment and unemployment are beneficial for overall labour market performance. We empirically test the effects of tax progressivity on employment and unemployment using a panel data of 21 OECD countries gathered for the 1997-2008 period. We propose a new measure of global tax progressivity based on a comparison between the fiscal wedges at 67% and 167% of the average wage. We find that tax progressivity has a significant unemployment-reducing impact of a similar order of magnitude as the unemployment-increasing effect of average labour market taxation. These effects are more concentrated among low-skilled workers and among young workers. These results are in line with theories claiming that tax progressivity reduces unemployment because it generates a wage moderation effect that boosts the labour demand and because it shifts the tax burden away from groups of workers whose employment is the most responsive to taxation. We also find that a more progressive tax schedule increases the employment rate, but decreases production per worker. The net impact on total production is statistically non-significant. Our central result that tax progressivity increases employment (and decreases unemployment) thus comes hand in hand with the standard disincentive effect of tax progressivity on the intensive margin of the labour supply as commonly argued in the public finance and macroeconomic literatures.

Consequently, we add a new effect to be taken into account in the optimal design of labour income taxation. Optimal progressivity not only trades off the equity gain of a higher progressivity against the efficiency loss due to the disincentive effect along the incentive margin. One should also take into account the efficiency gains of a more progressive tax schedule on labour market performance through a reduction in unemployment and a rise in employment.

	Unemployment rate *UNR*			Employment rate *erate*		
	$\ln{(ret100)}_{t-1}$	$\ln\left(\frac{ret167}{ret67}\right)_{t-1}$	Hansen J test (pvalue)	$\ln{(ret100)}_{t-1}$	$\ln\left(\frac{ret167}{ret67}\right)_{t-1}$	Hansen J test (pvalue)
1. no output gap	-51.26 **	76.24***	0.12	50.18**	-82.03***	0.006
	(21.76)	(24.54)	(0.727)	(24.33)	(30.42)	(0.936)
2. no trade openness	-64.39***	62.73***	0.04	66.74**	-70.23**	0.006
	(21.6876)	(25.03)	(0.952)	(25.73)	(32.73)	(4.941)
3. contemporaneous tax indicators	-46.23***	76.10**	6.22	41.98**	-45.89**	4.788
	(18.84)	(22.84)	(0.02)	(17.39)	(23.20)	(0.029)
4. control for ALMP	-53.77***	63.24***	0.204	51.91**	-65.21**	0.521
	(17.39)	(23.20)	(0.651)	(19.90)	(28.13)	(0.470)
5. country fixed effects, only	-53.91***	65.63***	0.067	61.44***	-92.73***	2.401
	(16.95)	(18.50)	(0.796)	(23.40)	(28.81)	(0.121)
6. country specific trends, only	-53.53**	66.53***	0.184	52.09***	-68.45***	0.455
	(16.97)	(21.70)	(0.685)	(19.60)	(27.54)	(0.499)
7. country specific trends and time dummies	-53.11***	56.84***	0.213	51.57***	-62.30***	0.477
	(16.21)	(20.42)	(0.644)	(19.28)	(26.81)	(0.489)
8. country fixed effects and CCEP estimator	-51.83***	59.46***	0.368	58.93***	-99.31***	0.329
	(15.42)	(19.84)	(0.544)	(26.13)	(33.52)	(0.566)
9. HAC standard errors	-53.42***	56.80**	0.177	51.79**	-61.89**	0.439
	(20.15)	(22.61)	(0.674)	(24.57)	(33.05)	(0.507)
10. France excluded	-65.50***	67.05**	0.055	66.60***	-77.49**	0.002
	(18.59)	(22.83)	(0.814)	(23.11)	(31.00)	(0.965)
11. Ireland excluded	-44.01***	43.28**	0.353	46.01***	-55.82**	0.716
	(21.09)	(15.66)	(0.552)	(16.71)	(23.65)	(0.397)
12. Japan excluded	-71.79**	51.93**	0.490	66.34**	-60.36**	0.381
	(29.84)	(22.24)	(0.483)	(34.22)	(26.90)	(0.537)
13. Netherlands excluded	-61.04**	62.76**	0.147	63.41**	-73.57**	0.524
	(21.97)	(25.19)	(0.701)	(26.50)	(32.66)	(0.469)
14. three years averages	-43.23**	31.13	1.129	-42.27*	-32.08**	2.377
	(18.79)	(22.59)	(0.288)	(24.16)	(32.76)	(0.123)

Table 6: Robustness checks. IV estimates with robust standard errors. The instruments are $Taxconsol$, $Leftism$ (both lagged twice) and $Notrust$ (lagged five years). Hansen J provides the p-value of the Hansen test for over-identification. Significance levels: $*$: 10%, $**$: 5%, $***$: 1%

A Theoretical model

We here consider the general model with an intensive labour supply margin. Let ℓ_i be the effort provided by employed individuals and the money-equivalent of this disutility.[33] One can think of ℓ_i as hours of work or as the intensity of in-work effort. We assume that providing effort ℓ_i leads to a flow of output $f_i(\ell_i)$, with $f_i'(.) > 0 > f_i''(.)$ and a flow of disutility ℓ_i. Denoting w_i the total gross wage (and not the wage rate), Equation (4a) becomes:

$$r\ E_i = w_i - T(w_i) - \ell_i + \delta_i\,(U_i - E_i) \tag{10}$$

The case without the intensive margin is retrieved by setting the disutility $\ell_i = 0$ and $f(\ell_i) = y_i$. Equations (2) and (10) imply respectively:

$$J_i = \frac{f_i(\ell_i) - w_i}{r + \delta_i} \qquad \text{and} \qquad E_i - U_i = \frac{w_i - T(w_i) - \ell_i - r\ U_i}{r + \delta_i} \tag{11}$$

Maximising the (log of) the Nash product with respect to the wage and in-work effort leads to:

$$\frac{\gamma_i\,(1 - T_i')}{E_i - U_i} = \frac{1 - \gamma_i}{J_i} \qquad \text{and} \qquad \frac{\gamma_i}{E_i - U_i} = \frac{(1 - \gamma_i)\, f_i'(\ell_i)}{J_i}$$

where $T_i' \equiv T'(w_i)$. Using (6) and $\Psi_i = \Psi(w_i)$, the first of these two equations gives the sharing rule (5). The second of these equations imply the labour supply condition:

$$\left(1 - T_i'\right) f_i'(\ell_i) = 1 \tag{12}$$

which determines effort ℓ_i as a decreasing function of the marginal tax rate, independently of any other variable. Combining the sharing rule (5) with (11) leads to:

$$\gamma_i\ \Psi_i\,(f_i(\ell_i) - w_i) = (1 - \gamma_i)\left(w_i - \frac{\ell_i + r\ U_i}{1 - \tau_i}\right)$$

Moreover, we get from (4b) and the sharing rule (5):

$$\frac{r\ U_i}{1 - \tau_i} = \frac{b_i}{1 - \tau_i} + p_i(\theta_i)\frac{\gamma_i\ \Psi_i}{1 - \gamma_i} J_i = \frac{b_i}{1 - \tau_i} + c_i \frac{\gamma_i\ \Psi_i}{1 - \gamma_i}\ \theta_i \tag{13}$$

where the second equality uses the free-entry condition (3). The (gross) wage equation is

$$w_i = \frac{\gamma_i\ \Psi_i}{1 - \gamma_i + \gamma_i\ \Psi_i}\,(f_i(\ell_i) + c_i\ \theta_i) + \frac{1 - \gamma_i}{1 - \gamma_i + \gamma_i\ \Psi_i}\frac{b_i + \ell_i}{1 - \tau_i}$$

which gives (7a) in the case of exogenous labour supply by taking $\ell_i = 0$ and $f(\ell_i) = y_i$. Equation (7b) follows directly. Combining this wage equation with the free-entry condition (3) leads to:

$$\left(1 + \frac{\gamma_i\ \Psi_i}{1 - \gamma_i}\right)\frac{r + \delta_i}{q_i\,(\theta_i)} + \frac{\gamma_i\ \Psi_i}{1 - \gamma_i}\theta_i = \frac{1}{c_i}\left(f_i\,(\ell_i) - \frac{b_i + \ell_i}{1 - \tau_i}\right) \tag{14}$$

Equation (14) determines implicitly equilibrium tightness θ_i as a decreasing function of the average tax rate τ_i and of the CRIP Ψ_i, while the sign of the relationship with in-work effort ℓ_i is ambiguous. Using (1), it also determines the fraction $1 - u_i$ of participants of type i that are employed.

With an endogenous labour supply margin, productivity is a function of effort and the disutility of effort plays a role similar to the value in unemployment b_i. For a given level of effort ℓ_i, a rise in progressivity (a decrease in the CRIP Ψ_i) increases employment through the

[33] Introducing a more complex increasing and convex expression for this disutility leads to more cumbersome expressions without adding any new insight.

same wage moderating. Moreover, a rise in tax progressivity decreases effort ℓ_i. This reduction has two opposite effect on the total surplus of a match. On the one hand, production decreases. On the other hand, the disutility of work also decreases. The net effect of hours of work on employment depends on how the term $f_i(\ell_i) - (b_i + \ell_i)/(1 - \tau_i)$ in the left-hand side of (14) varies with effort ℓ_i. Using (12) a reduction in effort ℓ_i increases (decreases) this term whenever taxation is regressive (progressive) i.e. when $\Psi_i > 1$ (i.e. $\Psi_i < 1$). Therefore, by continuity, and provided that the taxation is not too progressive so that the labour supply effect of tax progressivity remains dominated by the wage moderating effect, a rise in tax progressivity (a reduction in the CRIP Ψ_i) increases employment and decreases the unemployment rate.

Let us denote $X_i \equiv \frac{\gamma_i \ \Psi_i}{1-\gamma_i}$. From (14), the effect of the CRIP Ψ_i on tightness happens only through a change in X_i. A rise in the CRIP Ψ_i holding the average tax rate τ_i constant increases participation only if it increases the value of unemployed. Rewriting (13) as:

$$r\ U_i = b_i + c_i\ X_i\ \theta_i(1 - \tau_i)$$

implies that a rise in the CRIP for a fixed τ_i increases participation if and only if $X_i\ \theta_i$ is increasing in X_i. Denoting the elasticity of the job filling rate by $\eta_i(\theta_i) \equiv -\theta_i q'(\theta_i)/q_i'(\theta)$ and differentiating (14) in θ_i and in $X_i = \frac{\gamma_i \ \Psi_i}{1-\gamma_i}$ gives

$$\frac{d\theta_i}{\theta_i} = -\frac{X_i\ \frac{r+\delta_i}{q_i(\theta_i)} + X_i\ \theta_i}{\eta_i(\theta_i)(1 + X_i)\ \frac{r+\delta_i}{q_i(\theta_i)} + X_i\ \theta_i}\ \frac{dX_i}{X_i}$$

Hence, $X_i\ \theta_i$ is increasing in X_i, thereby participation is decreasing in progressivity, if and only if $X_i > \eta(\theta_i)(1 + X_i)$. Given the definition of X_i, the latter condition is equivalent to

$$\frac{\gamma_i\ \Psi_i}{1 - \gamma_i + \gamma_i\ \Psi_i} > \eta_i(\theta_i)$$

that is to effective bargaining power being higher than the efficient one prescribed by the Hosios (1990) condition (see Pissarides (2000)), i.e. by unemployment rate being inefficiently high.

B Data Appendix

Main variables used in the analysis

UNR: unemployed persons divided by the labour force (harmonised; OECD economic outlook).

Urate: unemployed persons divided by the labour force (non harmonised; OECD Employment Database based on National Labour Force Surveys).

Erate: persons in employment divided by the working age population (non harmonised; OECD Employment Database based on data from National Labour Force Surveys).

Prate: persons in the labour force divided by the working age population (non harmonised; OECD Employment Database based on data from National Labour Force Surveys).

ATR, 67, 100, 167 AW: average tax rates (ATR) including taxes, social security contributions (net of cash benefits received) for the average worker (single person, no child) at 67%, 100% and 167% of average earnings. These data are drawn from the OECD tax Database for the years 2000-2008 and extended back to 1997, using information from OECD Taxing Wages (historical model B). The two datasets are constructed using the same methodology, the only difference being that computations from Taxing Wages historical model B use as a benchmark the average production worker (APW) rather than the average worker (AW). We used the common support of the two datasets (i.e. the years 2000-2004) to rescale the ATRs from OECD Taxing Wages to the corresponding ATRs from the OECD Tax Database. This allowed us to exploit the yearly variation of OECD Taxing Wages' ATRs between years 1999/2000, 1998/1999, and 1997/1998 to extend the relevant time series from the OECD Tax Database back to 1997.

Instruments

NoTrust: percentage of respondents that give answer 4 (i.e., 'none at all') to questions $E069\_8$ in WVS1-5, V212 in EVS4, V207 in EVS3, q553i in EVS2, v546 in EVS1 (how much confidence in civil service). The period is as follows:

1980-89: coverage by EVS1/WVS1 but for CHE, covered by EVS2. Surveys carried in 1981 for AUS, BEL, DEU, DNK, ESP, FIN, FRA, GBR, IRE, JPN, NLD; 1982 for CAN, NOR, NOR, SWE, USA;

1990-94: coverage by EVS2/WVS2. Surveys carried in 1990 for AUT, BEL, CAN, DEU, DNK, ESP, FIN, FRA, GBR, ITA, JPN, NLD, NOR, PRT, SWE, USA. Notice that we have two observations for ESP (in year 1990) corresponding to both WVS2 and EVS2 being carried that year.

1995-99: coverage by EVS3/WVS3. Surveys carried in 1995 for AUS, ESP, JPN, USA; 1996 for CHE, FIN, NOR, SWE; 1997 for DEU; 1998 for GBR, BEL, GBR, NZL; 1999 for AUT, BEL, DEU, DNK, ESP, FRA, GBR, GRC, IRE, ITA, NLD, PRT, SWE, USA. Notice that we have two observations for ESP (1995 and 1999), DEU (1997 and 1999), GBR (1998, 1999), and USA (1999), corresponding to both WVS3 and EVS3 being carried in those countries.

2000-04: coverage by WVS4 but for FIN and NZL, covered by EVS3 and WVS5, respectively. This period is generally not covered by any EVS wave, thus the majority of European countries is not surveyed. Surveys carried in 2000 for CAN, ESP, FIN, JPN; 2004 for NZL.

2005-08: coverage by EVS4/WVS5. Surveys carried in 2005 for AUS, FIN, ITA, JPN; 2006 for CAN, DEU, FRA, GBR, NLD, SWE, USA; 2007 for CHE, ESP; 2008 for AUS, CHE, DEU, DNK, ESP, FRA, GRC, IRE, NLD, NOR, PRT. Notice that we have two observations for AUS (2005 and 2008), CHE (2007 and 2008), DEU (2006, 2008), ESP (2007, 2008), FRA (2006, 2008), NLD (2006, 2008), POL (2005, 2008), corresponding to both WVS5 and EVS4 being carried.

Observations were averaged out by country and period thus obtaining an unbalanced panel of 21 countries covering the period 1990-2008 in five years averages. Missing observations were obtained by linear interpolation. The initial observation covering the period 1980-89, has not been used in the empirical analysis, but provided the basis to obtain the observation for the period 1990-94 by linear interpolation for countries where observations were missing for this period.

Leftism: Difference between the shares in legislative seats of left-wing and centrist parties minus the share in legislative seats of right-wing parties. Authors' calculations using data from "Electoral, Legislative, and Government Strength of Political Parties by Ideological Group in Capitalist Democracies, 1950-2006: A Database", by Duane Swank. See `http://www.marquette.edu/polisci/faculty_swank.shtml`.

Taxconsol: Cumulated sum of documented tax increases drawn by historical sources and records based on the methodology developed by Romer and Romer (2010), drawn by Devries *et alii*, 2011 (see `http://www.imf.org/external/pubs/cat/longres.aspx?sk=24892.0`).

For estimates presented in Table 5 (columns 2a and 2b), observations for the missing countries (Greece, Norway, New Zealand, Switzerland) have been reconstructed applying the methodology by Guichard *et alii* 2007 to the cyclically adjusted current receipts, general government, as a percentage of potential GDP (OECD Economic Outlook).

Pcdebt: General government gross financial liabilities, as a percentage of GDP (OECD Economic Outlook).

Other variables used in the analysis

Unemployment rates by skill level: Unemployed persons divided by the labour force by age group and educational attainment. Low skilled workers completed up to secondary education, while high skilled workers completed tertiary education or more. Young workers have an age comprised between 15 and 24 years. Old workers have an age comprised between 25 and 54 years. These are authors' calculation based on World Bank's Development Indicators.

EPL: Unweighted sum of the OECD synthetic index of employment protection legislation (OECD Employment Outlook).

UnionDensity: union density (% of unionised workers; OECD Employment Outlook).

UBRR: average unemployment benefit replacement rates (average of replacement rates across various earnings levels, family situations and durations of unemployment; OECD Benefits and Wages Database).

Wcoord: coordination of wage bargaining (classification is based on Kenworthy's 5-point classification of wage-setting coordination scores; ICTWSS Database).

Irate: Long-term interest rate on government bonds (OECD Economic Outlook).

Outgap: Percentage deviation of output from trend (OECD Economic Outlook).

Inflchange: Change in the inflation between two consecutive years (authors' calculation using data from the OECD Economic Outlook).

Openness: The trade-to-GDP ratio is the sum of exports and imports of goods and services relative to GDP (OECD International Trade Indicators database).

C First-stage results

	[C1]	[C2]	[C3]	
	$\ln(ret100)_{t-1}$	$\ln(ret100)_{t-1}$	$\ln(ret100)_{t-1}$	$\ln(\frac{ret167}{ret67})_{t-1}$
$Taxhike_{t-2}$	–0.0148**	–0.0146**	–0.0141**	–0.0027
	(0.0071)	(0.0070)	(0.0071)	(0.0058)
$Leftism_{t-2}$	–0.0455***	–0.0380**	–0.0440***	–0.0405**
	(0.0136)	(0.0150)	(0.0139)	(0.0162)
$NoTrust_{t-5}$			–0.0797	0.2126***
			(0.0772)	(0.0658)
$\ln(\frac{ret167}{ret67})_{t-1}$		0.2064**		
		(0.0901)		
$UBRR_{t-1}$	0.0048***	0.0050***	0.0047***	–0.0004
	(0.0009)	(0.0009)	(0.0009)	(0.0006)
$UnionDensity_{t-1}$	–0.0061***	–0.0050***	–0.0062***	–0.0048***
	(0.0015)	(0.0016)	(0.0015)	(0.0016)
$wcoord_{t-1}$	–0.0012	–0.0015	–0.0016	0.0024
	(0.0060)	(0.0060)	(0.0060)	(0.0029)
EPL_{t-1}	0.0172	0.0157	0.0197*	0.0010
	(0.0112)	(0.0113)	(0.0105)	(0.0076)
outputgap	–0.0033*	–0.0033*	–0.0033*	0.0004
	(0.0018)	(0.0018)	(0.0018)	(0.0013)
inflchange	–0.0050**	–0.0047**	–0.0051**	–0.0011
	(0.0023)	(0.0022)	(0.0023)	(0.0018)
irate	–0.0094	–0.0110	–0.0097	0.0085***
	(0.0070)	(0.0068)	(0.0071)	(0.0028)
Openness	0.0005	0.0006*	0.0005	–0.0005**
	(0.0003)	(0.0003)	(0.0003)	(0.0002)
R^2	0.98	0.99	0.98	0.93
F Test of Excluded instruments	8.641	6.692	6.214	8.678
Shea Partial R^2	0.118	0.0953	0.0840	0.0623
Kleibergen-Paap under-identification test	0.0000	0.0002	0.0003	
Kleibergen-Paap weak-identification test	8.64	6.69	4.87	
N	231	231	231	231

Table 7: Columns [C1], [C2], and [C3] report the first stage results for estimates in Tables 1 and 2, Columns [3], [4], and [5], respectively. Robust standard errors in parentheses. Significance levels: $*$: 10%, $**$: 5%, $***$: 1%. p values of Kleibergen-Paap rank LM test for under-identification test

References

[1] Algan, Y. and P. Cahuc, 2006, Civic Attitudes and the Design of Labour Market Institutions: Which Countries Can Implement the Danish Flexicurity Model?' *CEPR Discussion Paper* No. 5489, February, Centre for Economic Policy Research.

[2] Algan, Y. and P. Cahuc, 2010, Inherited Trust and Growth, *American Economic Review*, 100(5), 2060-92.

[3] Algan, Y., P. Cahuc and M. Sangnier, 2011, Efficient and Inefficient Welfare States' *IZA Discussion Paper No. 5445.*

[4] Algan, Y., P. Cahuc and A. Zylberberg, 2002, Public employment and labour market performance, *Economic Policy*, 17(34), 7-66.

[5] Ardagna, S. , 2004, Fiscal Stabilizations: When do they work and why, *European Economic Review*, 48, 1047-74.

[6] Arpaia, A. and G. Mourre, 2010, 'Institutions and performance in European labour markets: taking a fresh look at evidence' *Journal of Economic Surveys*, 26(1), 1-41.

[7] Bassanini A., R. Duval, 2009, Unemployment, institutions and reform complementarities: re-assessing the aggregate evidence for OECD countries *Oxford Review of Economic Policy*, 25, 1.

[8] Bean, C., R. Layard, and S.J. Nickell, 1986, The Rise in Unemployment: A multi-country study *Economica*, 53: S1-S22.

[9] Belot, M. and J. Van Ours, 2004, Does the recent success of some OECD countries in lowering their unemployment rates lie in the clever design of their labour market reforms?, *Oxford Economic Papers*, 56(4), 621-642.

[10] Blanchard, O. and J. Wolfers, 2000, The role of shocks and institutions in the rise of European unemployment: the aggregate evidence, *Economic Journal* 110, C1-C33.

[11] Blundell, R. and A. Shepard, 2012, Employment, hours of work and the optimal taxation of low-income families, *Review of Economic Studies*, 79(2), 481-510.

[12] Brunello G. and D. Sonedda, 2009, Progressive taxation and wage setting when unions strategically interact, *Oxford Economic Papers*, 59, 127-140.

[13] Cahuc, P. and A. Zylberberg, 2004, *Labour Economics*, MIT Press, Cambridge, MA, US.

[14] Daveri, F., and G. Tabellini, 2000, Unemployment, growth and taxation in industrial countries, *Economic Policy*, 15, 47-88.

[15] Devries P., J. Guajardo, D. Leigh and A. Pescatori, 2011, A New Action-based Dataset of Fiscal Consolidation, *IMF* Working Paper 11/128, International Monetary Fund.

[16] Diamond, P., 1982, 'Wage determination and efficiency in search equilibrium', *Review of Economic Studies*, 49, 217-227.

[17] Doerremberg, P. and A. Peichl (2010), 'Progressive Taxation and Tax Morale', *IZA Discussion Paper*, No. 5378.

[18] Drazen, A., 2000, *Political Economy in Macroeconomics*, Princeton University Press, Princeton.

[19] Eichhorst, W., Feil, M. and P. Marx, 2010, Crisis, What Crisis? Patterns of Adaptation in European labour Markets, *IZA Discussion Paper*, 5045.

[20] Eisa, N. and J. Liebman, 1996, labour supply responses to the earned Income tax credit, *Quarterly Journal of Economics*, 111(2), 605-637.

[21] Falk, M. and Koebel, B., 2001, A Dynamic Heterogeneous Labour Demand Model for German Manufacturing, *Applied Economics*, 33, 339-348.

[22] Fitzenberger, B. (1999), Wages and Employment Across Skill Groups. An Analysis for West Germany, *ZEW Economic Studies*, 6, Physica, Heidelberg.

[23] Fuest, C. and B. Hubert, 2000, Is tax progression really good for employment? A model with endogenous hours of work, *Labour Economics*, 7, 79-93.

[24] Galí, J. and R. Perotti, 2003, Fiscal Policy and monetary integration in Europe, *Economic Policy*, October, pp.533-572.

[25] Griffith, R., Harrison R. and G. Macartney, 2007, Product market reforms, labour market institutions and unemployment, *The Economic Journal*, 117, C142-C166.

[26] Guichard, S., M. Kennedy, E. Wurzel and C. André, 2007, What Promotes Fiscal Consolidation: OECD Country Experiences, *OECD Economics Department* Working Paper, No. 553.

[27] Guiso, L., Sapienza, P., and L. Zingales, 2008, Long term persistence, *NBER Working paper* 14 278.

[28] Hamermersh, D., 1993, *Labour Demand*, Princeton University Press.

[29] Hansen, C. T., 1999, Lower tax progression, longer hours and higher wages, *Scandinavian Journal of Economics*, 101, 49-65.

[30] Hansen, C., Pedersen, L and. Sløk, 2000, Ambiguous effects of tax progressivity - theory and Danish evidence, *Labour Economics*, 7, 335-347.

[31] Heckman, J., 1993, What Has Been Learned about labour Supply in the Past Twenty Years?, *American Economic Review*, 83, 116-121.

[32] Hersoug, T., 1984, Union Wage Responses to Tax Changes, *Oxford Economic Papers*, 36, 37-51.

[33] Holmlund, B. and A. Kolm, 1995, Progressive taxation, wage setting and unemployment: theory and Swedish evidence, *Swedish Economic Policy Review*, 2, 423-460.

[34] Hosios, A.,1990, On the Efficiency of Matching and Related Models of Search and Unemployment, *Review of Economic Studies*, 57, 279-298.

[35] Hungerbühler, M., E. Lehmann, A. Parmentier and B. Van der Linden, 2006, Optimal redistributive taxation in a search equilibrium model, *Review of Economic Studies*, 73, 743-767.

[36] Immervoll, H., Kleven, H., Kreiner, C. T. and Saez, E., 2007, Welfare reforms in European countries: a Microsimulation analysis, *Economic Journal*, 117, 1-44.

[37] Juhn, C., K.M. Murphy, R.H. Topel, J.L. Yellen and M.N. Baily, 1991, Why has the Natural Rate of Unemployment Increased over Time?, *Brookings Papers on Economic Activity*, 75-142.

[38] Kramarz, F. and T. Philippon, 2001, The impact of differential payroll tax subsidies on minimum wage employment, *Journal of Public Economics*, 82, 115-146.

[39] Layard, R. and S. Nickell, 1999, Labor market institutions and economic performance, *Handbook of Labor Economics*, Orley C. Ashenfelter and D. Card Editors, Volume 3C, Chapter 46, 3029-84.

[40] Layard, R., S. Nickell and R. Jackman, 1991, *Unemployment: Macroeconomic performance and the labour market*, Oxford University Press.

[41] Lehmann, E., A. Parmentier and B. Van der Linden, 2011, Optimal income taxation with endogenous participation and search unemployment, *Journal of Public Economics*, 95, 1523-1537.

[42] Lockwood B. and Manning A., 1993, Wage Setting and the Tax System: Theory and evidences for the United Kingdom, *Journal of Public Economics*, 52, 1-29.

[43] Malcomson, J. and N. Sartor, 1987, Tax push inflation in a unionized labour market, *European Economic Review*, 31, 1581-1596.

[44] Manning, A., 1993, Wage bargaining and the Phillips curve: The identification and specification of Aggregate wage equations, *Economic Journal*, 103(416), 98-118.

[45] Meghir, C. and Phillips 2010, Labour Supply and Taxes, Chapter 3 in *The Mirrlees Review*, Dimensions of Tax Design, Institute for Fiscal Studies (eds), Oxford University Press, Oxford, UK.

[46] Mirrlees, J., 1971, An Exploration in the Theory of Optimum Income Taxation, *Review of Economic Studies*, 38(2), 175-208.

[47] Mortensen, D. and Pissarides, C. 1999, New developments in models of search in the labour Market, in O. Ashenfelter and D. Card (eds.), *Handbook of labour Economics*, vol. 3 B, North-Holland, Amsterdam.

[48] Musgrave, R. A. and Thin, T. 1948, Income tax progression, 1928-48, *Journal of Political Economy*, 56, 498-514.

[49] Nickell, S.J. and R. Layard, 1999, Labour market institutions and economic performance, in: Ashenfelter, O. and Card, D. *Handbook of labour Economics*, Amsterdam, North Holland, 3029-3084.

[50] Nickell, S.J., L. Nunziata, and W. Ochel, 2005, Unemployment in the OECD since the 1960s. What do we know?, *The Economic Journal*, 115, 1-27.

[51] Nunziata, L., 2005, Institutions and Wage Determination: a Multi-country Approach, *Oxford Bulletin Of Economics And Statistics*, 67, 435-466.

[52] OECD Taxing Wages, 2009, Special feature: consumption taxation as an additional burden on labour income *Organization of Economic Co-operation and Development.*

[53] OECD (2012), OECD Tax database, *Organization of Economic Co-operation and Development.*

[54] Parmentier, A., 2006, The effects of the marginal tax rate in a matching model with endogenous labour supply, *IRES Discussion Paper* $2006 - 11$.

[55] Pesaran, M., 2006, Estimation and inference in large heterogeneous panels with a multifactor error structure, *Econometrica*, 74(4), 967-1012.

[56] Persson, T. and G. Tabellini, 2000, *Political Economics: Explaining Economic Policy*, MIT Press, Cambridge, MA, US.

[57] Pissarides, C. A., 1985, Taxes, Subsidies and Equilibrium Unemployment,*Review of Economic Studies*, 52, 121-34.

[58] Pissarides, C. A., 1998, The impact of employment tax cuts on unemployment and wages: the role of unemployment benefits and tax structure, *European Economic Review*, 42, 155-183.

[59] Pissarides, C. A., 2000, *Equilibrium Unemployment Theory*, Second Edition, MIT Press, Cambridge, MA, US.

[60] Prescott, E., 2004, Why do Americans Work so Much More than Europeans?, *FED Minneapolis Quarterly Review*, 28, 2-13.

[61] Rogerson, R., 2006, Understanding differences in Hours worked, *Review of Economic Dynamics*, 9, 365-409.

[62] Rogerson, R., 2008,Structural Transformation and the Deterioration of European Labor Market Outcomes, *Journal of Political Economy*, 116, 235-259.

[63] Rogerson, R. and J. Wallenius, 2009, Micro and Macro Elasticities in a Life Cycle model with Taxes, *Journal of Economic Theory*, 144, 2277-92.

[64] Røed, K. and S. Strøm, 2002, Progressive Taxes and the Labour Market: Is the Trade-off Between Equality and Efficiency Inevitable?, *Journal of Economic Surveys*, 16, 77-110.

[65] Romer, Christina D., and David H. Romer, 2010, The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks, *American Economic Review*, 100 (3), 763-801.

[66] Sapienza, P., A. Toldra and L. Zingales, 2007, Understanding Trust, *NBER Working paper*, 13387.

[67] Sørensen, P. B., 1997, Public finance solutions to the European unemployment problem?, *Economic Policy*, 25, 223-64.

[68] Sørensen, P. B., 1999, Optimal Tax Progressivity in Imperfect Labour markets, *Labour Economics*, 6, 435-52.

[69] Summers L., Gruber J. and R. Vergara, 1993, Taxation and the structure of labour markets: the case of corporatism' *The Quarterly Journal of Economics*, 108, 385-411.