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ABSTRACT

Earnings-Related Unemployment Benefits in a Unionised Economy*

We show that a stronger earnings relationship of unemployment compensation reduces wages and increases employment in an economy in which wages are determined by a trade union that maximises the rent from unionisation. The opposite result applies for a utilitarian union. Using manufacturing and non-manufacturing data for 16 OECD countries, estimates suggest that a 10% increase in the earnings relationship is associated with a 1.9% fall in manufacturing wages, a 0.6% reduction in non-manufacturing wages and a 7.3% reduction in unemployment.

JEL Classification: E 24, J 51, J 65

Keywords: earnings relationship, OECD, panel data, trade union, unemployment, unemployment benefits

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1. Introduction

In virtually all models of collective wage determination, a rise in unemployment compensation has adverse employment consequences. The political and social constraints that are associated with lowering benefits, however, have rendered such a policy an inconvenient tool to combat unemployment. Attention has, therefore, turned towards reforms in the structure of unemployment insurance (UI) systems. Cahuc and Lehmann (2000) and Jacobsen and Kreiner (2002), for example, investigate differential benefits for the short- and long-term unemployed. Holmlund and Lundborg (1988, 1999) analyse the so-called Gent system of unemployment insurance, in which the receipt of benefits is conditional on union membership. Orszag and Snower (2002) propose a system of individual savings accounts which can partly substitute encompassing UI systems.

In this paper, we examine a reform of the UI system that is employment enhancing without suffering from the problems that are associated with reductions in the level of benefits. More specifically, we show that a change from a constant or flat-rate, to an earnings-related UI system will lower wages and unemployment if the trade union maximises the employees' rent from unionisation. This prediction stands in contrast to the result for a utilitarian union. The intuition behind these differential effects is the following: the payoff of a rent-maximising union is given by the product of employment and the utility differential between wages and unemployment benefits. For any given level of benefits, this utility differential increases with wages. Hence, if the earnings relationship of benefits is strengthened, a given wage increase will become less attractive to the union since higher wages also drive up benefits and, thus, reduce the utility differential between wages and unemployment compensation. Therefore, the rent-maximising union will accept lower wages. For a utilitarian union there is a second effect; namely the increase in utility for all its members owing to a higher wage, which is due to the stronger earnings relationship of benefits. Since this second effect dominates the first, the optimal wage of a utilitarian union increases with a stronger earnings relationship.

In Section 2, evidence on UI systems in OECD countries is provided. In Section 3, the literature on the employment effects of earnings-related unemployment benefits in various models of wage determination is surveyed. It is argued that collective bargaining is the most appropriate assumption with respect to the mechanism of wage determination since bargaining coverage in the vast majority of OECD countries exceeds 50% (OECD 1997b, Booth et al. 2000). Therefore, in Section 4, the impact of earnings-related unemployment benefits is investigated in a model of collective wage determination. In Section 5, the predictions of the model are tested by estimating how the degree of the earnings relationship of benefits influences manufacturing and non-manufacturing wages and unemployment, using data for 16 OECD countries over the period from 1961 to 1995. The empirical results give strong support to the model's prediction under the assumption of the rent-maximising union. The estimates show that a 10% increase in the earnings relationship of unemployment reduces the rate of unemployment by 7.3%, manufacturing wages by 1.9% and non-manufacturing wages by 0.6%. Section 6 concludes the paper.

2. Unemployment Benefit Systems in the OECD

UI systems in the OECD countries have multiple facets. Among other things they differ according to their level and duration, the link between earnings and benefits, eligibility conditions, the availability of additional income support such as housing benefits, the treatment of children, and the existence of family allowances (Atkinson and Micklewright 1991, Grubb 2000, OECD 1991, 1997a, 1998a, 1999).

In this paper, we focus on the earnings relationship of unemployment compensation. For simplicity of analysis, it is assumed that unemployment benefits can be characterised by a ***flat-rate*** fixed component a, $a \geq 0$, and an earnings-related part bw, where w is the wage earned prior to the unemployment spell and $b > 0$ measures the sensitivity of benefits to earnings. The parameter b is bounded from above by $1 - a/w$ since benefits could otherwise exceed wages. Denoting the level of unemployment benefits by B, the benefit equation is defined as:

$$B - (a + b \cdot w) = 0. \tag{1}$$

The parameters a and b vary substantially over time and especially across countries. In New Zealand and the UK, for instance, unemployment benefits were unrelated to wages in 1989, which implies that $b = 0$ and that $a > 0$. An earnings-related UI system in which benefits are proportional to wages prevailed in Belgium, Denmark, Germany, Greece, Italy, the Netherlands, Spain, Sweden, Switzerland, and the United States, in 1989. This system implies $b > 0$ and $a = 0$. Austria, France, Ireland and Japan had a linear, albeit not a proportional, positive relationship between income and unemployment compensation in 1989, which entails that a, $b > 0$.[1] In the

[1] See OECD (1991, pp. 228-229). The classification of Ireland is somewhat ambiguous since it is also declared to have a flat-rate system (OECD 1999). New Zealand does not have an UI but an unemployment assistance scheme (OECD 1998a, pp. 15-17).

countries for which $b > 0$ applies, benefits are usually related to individual, as opposed to average earnings.

In addition to unemployment compensation, jobless workers often receive other transfer payments. Moreover, countries in which benefits are characterised by a strong earnings-related component, usually have minimum payments and ceilings for unemployment compensation. Therefore, the relationship between wages and benefits is more complex than suggested by the above classification. For simplicity, a linear relationship between benefits and wages is assumed throughout the theoretical analysis. This restriction is relaxed in the empirical section.

In the theoretical and empirical analysis below we distinguish between the *earnings relationship* of benefits and the *level* of unemployment compensation. A stronger *earnings relationship* implies an increase in the parameter b and a reduction in a, such that the *level* of benefits B remains unaltered. We refer this alteration as a *structural* variation. Changes in the parameter a represent a pure *level* effect, whereas alterations in the parameter b combine *structural* and *level* effects.

3. Survey of Literature on Earnings-Related Benefits

In their seminal paper, Atkinson and Micklewright (1991) argue that not only the level of unemployment benefits but also the structure of the UI system is an important determinant of the employment performance of an economy. Following their analysis, numerous investigations on the impact of the UI system on the employment performance of an economy have been conducted. An important element of benefit systems is the link between the earnings *prior to* and the benefit level *during* the unemployment spell. Theoretically, the employment effects of such earnings-related unemployment benefits depend, to a large extent, on the underlying mechanism of wage determination.

Virtually all theoretical studies that examine the earnings relationship of unemployment benefits assume that the labour market is imperfectly competitive. Vijlbrief and van de Wijngaert (1995) show, for a unionised economy, that a stronger individual earnings relationship of benefits increases unemployment, assuming that the union has a utilitarian objective. Theoretically, this union objective is well established. Other specifications of the union's maximand, such as the hypothesis of a rent-maximising union, have also been used extensively. Empirically, wages and employment have been found to increase union utility, inter alia. However, the actual objective of unions is an open issue (Pencavel 1991, pp. 81-92, Booth 1995, pp. 101-108). This ambiguity with respect to the adequate specification of the union objective poses a severe problem for the analysis of earnings-related unemployment benefits since the result by Vijlbrief and van de Wijngaert (1995) depends crucially on the assumption of a utilitarian union, as shown below.

Using a model of collective wage determination, Bräuninger (2000) examines how the relationship between individual earnings and benefits affects replacement rates for skilled and unskilled workers, given a utilitarian union objective and imperfectly competitive output markets. He shows that a change in the structure of the benefit system that gives more weight to the flat-rate component, will lead to higher unemployment for unskilled workers. This is because the flat-rate component will have a stronger impact on the level of unemployment benefits for unskilled workers than for skilled workers. Therefore, Bräuninger's (2000) results are determined by differential level effects for the two groups of workers.

The model of Beissinger and Büsse (2001) also assumes imperfectly competitive output markets and a trade union that seeks to maximise the rent from unionisation. The authors demonstrate that the employment consequences of an exogenous shock will be stronger the closer unemployment benefits are tied to average earnings, relative to a system of flat-rate benefits. Moreover, Beissinger and Büsse (2001) consider an open-economy extension and show that the employment effects of the benefit system in the home country depend on the type of benefit system abroad and on the location of the shock.

It is noteworthy for the interpretation of the findings derived in Section 4 that neither Bräuninger (2000) nor Beissinger and Büsse (2001) examine a shift from a flat-rate to an earnings-related benefit system, while simultaneously controlling for the impact on the level of unemployment compensation. Since their objective is a comparison of two different systems of unemployment benefits, the analyses combine structural effects, i.e. the shift from flat-rate to earnings-related benefits or vice versa, with a level impact, that is variations in the absolute magnitude of transfers. In terms of the model in Section 2, Bräuninger (2000) and Beissinger and Büsse (2001) investigate an increase in the measure of the earnings relationship b without simultaneously adjusting the flat-rate element a, to hold constant the level of unemployment benefits B.

Turning to efficiency wage approaches, Heer and Morgenstern (2002) use the Shapiro-Stiglitz (1984) shirking model to show that unemployment is independent of the earnings relationship of benefits. This is because work effort in the Shapiro-Stiglitz model is dichotomous. Thus, the decision not to shirk and to provide a high level of effort depends solely on the absolute magnitude of variables such as wages, taxes, and unemployment benefits

(Stiglitz 1999). Accordingly, variations in marginal incentives that are due to a more progressive tax system (cf. Pissarides 1998 or Goerke 2002, p. 104) or owing to a stronger earnings relationship of the UI system, have neither wage nor employment consequences. However, if a continuous variability in the employee's effort choices is feasible as, for example, in the approach by Pisauro (1991), efficiency wages and unemployment will be a declining function of the earnings relationship of benefits (Goerke 2000). This effect arises because a higher wage increases unemployment benefits at the margin such that the increase in effort due to the wage hike is mitigated. Hence, firms become more hesitant to increase the wage. This result is robust to an inclusion of a balanced-budget requirement.

Using search-theoretic approaches, Hey and Mavromaras (1981) and Atkinson (1995, p. 201) argue that the distinction between flat-rate and earnings-related unemployment benefits is unimportant for labour market outcomes. This is because variations in parameters other than the earnings-relationship have qualitatively the same impact in their setting regardless of the specification of the benefit system. In Schluter's (1997) search-theoretic model, the employment effects of earnings-related benefits will be negative if the payroll tax exceeds a critical level. High tax rates in conjunction with generous replacement rates dilute the incentives to accept a job offer. Moreover, given differential productivities of workers, only earnings-related benefits can induce sufficiently high wages and replacement rates for adverse employment effects to occur.

In line with the prediction by Schluter (1997), Pissarides (2000, pp. 210-212) argues that a stronger earnings relationship of benefits reduces employment. For flat-rate benefits, the wage is a means to share the given surplus from a job between the firm and a worker. If unemployment benefits become earnings-related, increasing the wage will change the distribution of this surplus, but also raise the joint payoff of workers and firms since the transfer from the UI system is increased. Since the firm's gain from a job shrinks, employment declines. By contrast, Heer and Morgenstern (2002) find that earnings-related unemployment benefits raise employment in a Pissarides-type search-theoretic framework. This difference in predictions arises since a stronger earnings relationship, for a given level of benefits, reduces the worker's gain from a higher wage in their setting, while the firm's payoff remains unaffected.

This survey illustrates that the labour market effects of an earnings-related UI system depend on the mechanism of wage determination, on whether structural changes in the benefit formula are considered or level effects are allowed for. A framework of collective wage determination is used in the next section to show that the employment effects of a change in the earnings-relationship in UI, moreover, depend on the objective function of the union.

4. Collective Wage Determination and the Earnings Relationship of Unemployment Benefits

4.1 Wage Determination

Using a model of collective wage determination, this section derives the wage effects of changes in the structure of unemployment benefits. Collective wage determination is assumed because it is the most widespread mechanism of wage formation in the OECD countries. Although union density in OECD member states varied between 9% (France) and 91% (Sweden) in 1994, bargaining coverage was substantially higher than density and often reached 80% or even 90% (OECD 1997b).[2]

Following the standard approach in the economic analysis of trade unions, we assume that the exogenously given number of union members M is greater than or equal to the number of employees N, $M \geq N$, to prevent underbidding by the unemployed. Each member has a strictly concave indirect utility function $u(\cdot)$, $u'(\cdot) > 0$, $u''(\cdot) < 0$, where u is a function of income. Accordingly, the utility of the N employed members earning the wage w is given by $u(w)$.

In the economic analysis of trade unions there has been a long-lasting debate about union objectives.[3] Frequently, a trade union is assumed either to maximise the sum of the utility from wages $u(w)$ for its N employed members, plus the utility $u(y)$ from the alternative income y for the remaining $(M - N)$ members, or to maximise the expected utility of the median member (McDonald and Solow 1981, Oswald 1982, Sampson 1983). An alternative union objective is based on the assumption that relative, as opposed to absolute, payoffs determine the union's behaviour. This maximand is exemplified by the Stone-Geary utility function (Dertouzos and Pencavel 1981) or the rent from unionisation (Rosen 1970, de Menil 1971, p. 22, and Calvo 1978).[4] To illustrate the importance of the union objective for the wage and employment effects

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[2] A bargaining coverage of less than 50% prevailed in only 5 of the 19 countries that are examined by the OECD (1997b); namely Canada, Japan, New Zealand, the United Kingdom and the United States. See also Booth et al. (2000).

[3] Oswald (1982, 1985), Farber (1986), Pencavel (1991, pp. 54-62) and Booth (1995, pp. 87-94) survey the relevant literature.

[4] Pemberton (1988) shows that an according objective can also be derived for a setting in which the interests of union members and the leadership are assumed to diverge, while both being reflected in the union's behaviour.

of earnings-related unemployment benefits, our analysis is based on a general specification of the union's maximand. In particular, the utilitarian and rent-from-unionisation objectives are special cases of a general trade union objective Z:

$$Z \equiv Nu(w) - [N - aM]u(y) \qquad\qquad a \in \{0, 1\}. \tag{2}$$

If $a = 1$, the utilitarian objective will result, while $a = 0$ applies for the union that maximises the rent from unionisation, where the rent is not necessarily measured in terms of monetary units but depends on the resulting utility levels.[5]

For the analysis in this section, the specification of the alternative income y is of major importance. In order to demonstrate the impact of an earnings-related UI system most clearly, it is assumed that the relationship $y = a + bw$ holds. This assumption can be justified as follows: in general, the alternative income y might be influenced by wages paid in other labour markets, the utility from leisure, and the level of unemployment benefits B. Since the union under consideration cannot directly influence the wage paid in other labour markets and the utility from leisure, we focus on the benefit component of the alternative income. As benefits are generally tied to individual earnings, unemployment compensation B is independent of the bargained wage for those unemployed who have already been without a job prior to the wage settlement. Furthermore, the alternative income of workers who lose their jobs because of higher wages will be influenced by the strength of the earnings relationship if ceilings or floors for unemployment compensation are not binding because the benefits of such workers are based on the latest negotiated wage. This also applies for workers who are affected by normal turnover in labour markets. Therefore, throughout the analysis, the alternative income y is assumed to be unemployment compensation B.

The union under consideration is a monopoly union that sets the wage for the firm in which its members work. The firm maximises profits p. It has a constant stock of capital. Capital costs are normalised to zero such that profits equal revenues less labour costs, wN. The union's behaviour is constrained by the labour demand curve $N = N(w)$, which is determined by the first-order condition $p_N = 0$.

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[5] The rent from unionisation is often defined as the difference in monetary payoffs due to unionisation, $N(w - y)$ (Pencavel 1991, p. 62, Booth 1995, p. 90). Assuming a linear, instead of strictly concave, utility function u does not affect our results. Therefore, we also employ the term 'rent from unionisation' for the more general case of $u'' < 0$.

Denoting the utility from obtaining the wage w by $u \equiv u(w)$ and the utility from benefits B by $\bar{u} \equiv u(B)$, the first-order condition for the union's maximisation problem which implicitly defines the optimal wage, is given by:

$$Z_w = N_w(u - \bar{u}) + N(u' - \bar{u}'b) + aM\bar{u}'b = 0\,, \tag{3}$$

where the first term signifies the loss in the union's payoff that is associated with a higher wage, owing to the reduction in employment. The second and third term indicate the increase in the union's payoff due to the utility gain of its employed and unemployed members from higher wages. A wage setting trade union balances these two effects. Note that if a = 0, the first-order condition $Z_w = 0$ will imply $u' - \bar{u}'b > 0$, that is, the utility function $u(\cdot)$ must not be too concave (or b must not be too high), since the marginal utility from wages has to exceed the marginal utility from benefits multiplied by b. The second-order condition for the union's maximisation problem $Z_{ww} < 0$ is assumed to hold.[6]

Equation (3) is used in the next sub-section to determine theoretically the wage and employment effects of a stronger earnings relationship of unemployment benefits. Because the firm's first-order condition $p_N = 0$ is independent of unemployment compensation, for a given wage, it follows that wages and employment are inversely related.

4.2 Stronger Earnings Relationship of Unemployment Compensation

To determine the effects of a stronger earnings relationship of benefits, assume that the earnings-related element, b, of the UI system is increased, while the flat-rate component, a, is reduced such that the level of benefits, B, remains unchanged after the adjustment in wages has taken place. Totally differentiating the union's first-order condition given by Equation (3) under the unemployment benefits constraint given by Equation (1), yields:

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[6] The second-order condition is given by:

$$Z_{ww} = N_{ww}(u - \bar{u}) + 2N_w(u' - \bar{u}'b) + Nu'' + (aM - N)\bar{u}''b^2 < 0.$$

A sufficient set of conditions for the second-order condition to hold is $N_{ww} \leq 0$ and $(u'' - \bar{u}''b^2) < 0$ for a = 0. If a = 1, then the additional sufficiency requirement $(u' - \bar{u}'b) > 0$ will have to be fulfilled.

$$\begin{bmatrix} Z_{ww} & Z_{wa} \\ B_w & B_a \end{bmatrix}\begin{bmatrix} \mathrm{d}w \\ \mathrm{d}a \end{bmatrix} = \begin{bmatrix} -Z_{wb} \\ -B_b \end{bmatrix}[\mathrm{d}b], \tag{4}$$

where $Z_{ww} < 0$ holds by the second-order condition and $B_w = b$, $B_a = 1$, $B_b = w$. Moreover:

$$Z_{wb} = -N_w \bar{u}' w - (N - aM)(\bar{u}'' bw + \bar{u}') = Z_{wa} w - (N - aM)\bar{u}' . \tag{5}$$

The wage impact of an increase in the earnings-related element b, holding the level of benefits B constant is found to be:

$$\frac{dw}{db}_{|dB=0} = \frac{B_b Z_{wa} - B_a Z_{wb}}{Z_{ww} B_a - B_w Z_{wa}} = \frac{\bar{u}'(N - aM)}{Z_{ww} - bZ_{wa}} . \tag{6}$$

The denominator of (6) will be negative if $Z_{wa} \geq 0$, that is, if a higher level of benefits does not lower the wage, which will always be true in the case of a rent-maximising union, and the labour demand curve is weakly concave ($N_{ww} \leq 0$), which is the sufficiency requirement for a maximum of the union’s optimisation problem. Thus, under fairly weak assumptions, a stronger earnings relationship will induce a utilitarian union to increase the wage if there is at least one unemployed member ($a = 1$, $N < M$) (cf. Vijlbrief and van de Wijngaert 1995). If, instead, the union maximises the rent from unionisation ($a = 0$), then the model will predict a wage reducing effect of a stronger earnings relationship of unemployment benefits.

A negative relationship between wages and the earnings relationship of the UI system in the case of a rent-maximising monopoly union ($a = 0$) arises since only the N employed members determine the reaction to the more pronounced earnings relationship of benefits. An increase in the earnings relationship reduces the union's gain from a higher wage $N(u' - \bar{u}' b)$. This is because employed union members only value utility from wages $u(w)$ in excess of utility from benefits $\bar{u}(B)$. At the margin, this utility differential ($u' - \bar{u}' b$) decreases with b for a given level of benefits. Hence, the rent-maximising union will opt for a lower wage in response to a stronger earnings relationship of benefits.

The reason for a positive relationship between wages and the strength of the earnings relationship of the UI system in the case of a utilitarian monopoly union ($a = 1$) is the following:

suppose that the earnings relationship of benefits is strengthened. From Equation (3) it can be seen that only the last two terms are influenced by the increase in b, since labour demand is unaffected by variations in unemployment benefits and because $\bar{u}$ only depends on the level of benefits B, which is held constant by assumption. The second term shrinks because of the reduction in the marginal difference between wages and benefits for the employed members. The third term indicates that a higher wage is rendered more attractive for all members of the union, because the relationship between wages and b is now tighter. However, since $M > N$, it follows that the overall impact on wages from the increase in b is positive.

4.3 Extensions

The connection between the strength of the earnings relationship of unemployment benefits and employment is not restricted to a monopoly union model. In particular, the same results can be derived in a wage bargaining framework or for efficient negotiations, if the bargaining outcome is determined by the Nash-solution. This is the case since first, the firm's payoff is unaffected by the earnings relationship of the UI system, for a given wage-employment outcome. Second, the union's contribution to the Nash-product consists of the difference between the payoff, which is contained in the objective in Equation (2), and the payoff in the case of no agreement. Since this conflict point is independent of the bargaining outcome, it will not be affected by the earnings relationship. Hence, the consequences of earnings-related unemployment benefits are determined solely by their impact on union utility.

Furthermore, the employment effects of a stronger earnings relationship will be unaffected by the imposition of a balanced-budget constraint in the empirically plausible case where the labour demand elasticity exceeds the unemployment rate. To illustrate this claim, note that there are basically two effects on the government budget, which work in opposite directions.[7] A stronger earnings relationship of the UI system will reduce wages and, hence, the rate of unemployment if the trade union maximises the rent from unionisation. Lower unemployment decreases expenditures on unemployment benefits, while the fall in wages reduces tax revenues. In order to evaluate the potentially conflicting effects, suppose that expenditures on unemployment benefits B for $1 - N$ unemployed people (labour supply being

[7] FitzRoy at al. (2002) provide an illuminating analysis of a general equilibrium model of collective wage and hours bargaining. They show that in the presence of a balanced-budget constraint there may be two equilibria, a high employment – low benefit and a low employment - high benefit level equilibrium. Since the level of benefits is held constant in the present analysis the issue of multiple equilibria will not arise in our model.

normalised to unity), are financed by a proportional income or payroll tax, t, levied on all employed workers. Hence, a balanced-budget is defined by $T = Nwt - B(1 - N) = 0$. Differentiating T with respect to b, holding constant the level of benefits $B = a + bw$, yields:

$$\frac{\mathrm{d}T}{\mathrm{d}b}_{|\mathrm{d}B=0} = \frac{\mathrm{d}w}{\mathrm{d}b} N\left[t - e\left(t + \frac{B}{w}\right)\right] = \frac{\mathrm{d}w}{\mathrm{d}b}\frac{B}{w}\left[U - e\right], \tag{7}$$

where e is the labour demand elasticity, $e \equiv - N_w w/N > 0$, the tax rate, t, has been substituted using $T = 0$, and the definition of the unemployment rate U, $U = 1 - N$, has been utilised as well. Equation (7) shows that if wages decline with a stronger earnings relationship of the UI system ($\mathrm{d}w/\mathrm{d}b < 0$), as the model of a rent-maximising trade union predicts, the budget will go into surplus as long as the unemployment rate U is less than the labour demand elasticity e. Since unemployment rates are usually below 0.2, i.e. 20%, $U < e$ is a plausible assumption. Given that a stronger earnings relationship induces a budget surplus, taxes could even be lowered if the government wants the changed structure of the UI system to be budget neutral. This result reinforces the finding that an enhanced earnings relationship of the UI system increases employment, provided that the trade union maximises the rent from unionisation.[8]

The intuition for the opposing effects of unemployment U and the labour demand elasticity e on the budget is the following: a high value of e implies that a decrease in wages increases employment substantially. The higher the labour demand elasticity is, the more probable it is that lower wages raise the tax base, i.e. the payroll wN, ensuring that tax receipts wNt become greater. In this case, a reform of the UI system generates a budget surplus. If unemployment is high, relative to the labour demand elasticity, however, the tax base effect may be dominated by a benefit base impact.

The findings in this section can be summarised as follows: in an economy in which wages are determined by collective bargaining, a utilitarian trade union will increase wages if the earnings relationship is strengthened while a rent-maximising union will set lower wages for a given level of benefits. Since the objective function of unions cannot be determined on

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[8] Theoretically, the employment effects of changes in income or payroll taxes in models of collective wage bargaining cannot be determined unambiguously (see, for example, Oswald 1982, Creedy and McDonald 1991, Goerke 1996, 2002, pp. 68-75, 125-133, or Koskela and Vilmunen, 1996). However, if lower taxes were to reduce employment, a reform of the benefit system would be rendered superfluous since employment could simply be raised by driving up tax rates.

theoretical grounds, the relationship between employment and the structure of the benefit system is ultimately an empirical issue. It will be investigated in the next section.

5. Empirical Estimates

5.1 Wage and Unemployment Equations

In this section, the wage and employment effects of earnings-related unemployment benefits are analysed employing biannual data for 16 OECD countries over the period from 1961 to 1995. Biannual data are used because sufficient information on unemployment benefits is only available every second year. The country sample is listed in the notes to Table 1 below. The influence of earnings-related benefits on wages is tested in a standard augmented Phillips curve framework for the manufacturing and non-manufacturing sector and the influence of earnings-related benefits on unemployment is tested in a reduced-form unemployment equation.

The following equations are estimated using pooled cross section and time-series analysis:

$$D\log w_{it}^{m} = a_0 + a_1 U_{it} + a_2 D\log p_{it}^{m,va} + a_3 D\log q_{it}^{m} + a_4 D\log q_{it}^{m,c} + a_5 D\log(1+t_{it}^{dir}) + a_6 D\log(1+b_{it}^{'}) + a_7 D\log(1+RR_{it}) + a_8 D\log w_{it}^{m,ind} + a_9 D\log p_{it}^{m,we} + CD'a + v_{1,it} \qquad (8)$$

$$D\log w_{it}^{nm} = l_0 + l_1 U_{it} + l_2 D\log p_{it}^{nm,va} + l_3 D\log q_{it}^{nm} + l_4 D\log q_{it}^{nm,c} + l_5 D\log(1+t_{it}^{dir}) + l_6 D\log(1+b_{it}^{'}) + l_7 D\log(1+RR_{it}) + l_8 D\log w_{it}^{nm,ind} + l_9 D\log p_{it}^{nm,we} + CD'l + v_{2,it} \qquad (9)$$

$$DU_{it} = g_0 + g_1 D\log g_{it} + g_2 D\log(1+t_{it}^{dir}) + g_3 D\log(1+t_{it}^{p}) + g_4 D\log(1+b_{it}^{'}) + g_5 D\log(1+RR_{it}) + g_6 D\log p_{it}^{we} + g_7 DIR_{it} + g_8 D\log q_{it}^{c} + v_{3,it} \qquad (10)$$

where the superscripts *m* and *nm* signify the manufacturing and the non-manufacturing sector, respectively, v is a stochastic disturbance term, and the subscripts i and t refer to the countries and the time period. No superscripts are attached to economy-wide variables. Moreover, w is total hourly labour costs, U is the rate of unemployment measured in percentage points, p^{va} is the value-added price deflator, q is output per hour worked, t^{dir} is the direct tax rate measured in decimal points, b' measures the strength of the earnings relationship of unemployment benefits and is defined below, *RR* is the economy-wide unemployment benefit replacement rate in decimal points, also defined below, w^{ind} is indirect hourly labour costs, which consist mainly of payroll taxes, insurance fees and cost of superannuation, p^{we} is the wedge between the value added price-deflator (which is the relevant price deflator for firms) and consumer prices (which is the relevant deflator for workers), g is government consumption deflated by consumer prices, t^p is payroll taxes and other indirect labour costs in proportion to total labour costs measured in decimal points, *IR* is the real interest rate which is measured in percentage points as the nominal interest rate on government bonds minus the contemporaneous consumer price inflation, *CD* are country dummies, and $q^{\,c}$ is the ratio of current labour productivity to the average labour productivity over the previous six years. The wedge between the value-added price-deflator and consumer prices, p^{we}, is defined as the ratio of consumer prices to the value added price-deflator. The rates (t^{dir}, b', t^p, and *RR*) are measured as $\log(1 + t^{dir})$, and so forth, so that their attached coefficients can be interpreted as percentage changes.

The deviation of labour productivity from its trend, $q^{\,c}$, is included in the equations to allow for slow adjustment in wage growth to shifts in labour productivity as suggested by Blanchard and Wolfers (2000). To illustrate the mechanism at work, suppose that labour productivity growth unexpectedly decreases from a steady growth rate, as it occurred in 1974. Since workers have adjusted their real wage growth aspirations to the steady growth rate in productivity, they may not be willing to accept a lower growth rate following a sudden reduction in productivity growth. Alternatively, workers may be slow to change their productivity growth expectations. From this it follows that real wages are growing in excess of the rate warranting full employment, which is given by the growth in the marginal productivity of labour or simply labour productivity, q, under the assumption of Cobb-Douglas technology. This partly explains the increase in unemployment in the OECD countries following the first oil price shock (Blanchard and Wolfers 2000).

Equations (8) and (9) are standard augmented Phillips curves, which can, for example, be derived from a union bargaining or efficiency wage framework (see Layard and Nickell 1986).[9] In these models, wages and unemployment are negatively correlated, and wages are a positive function of the value added price-deflator and the wedge between real after-tax take-home pay,

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[9] Alternatively, Equations (8) and (9) can be obtained in an excess demand for labour framework (Franz and Gordon 1993). In the wage equations estimated by Layard and Nickell (1986), changes in wages are affected by changes in unemployment and not the level of unemployment. Changes in unemployment are not included in Equations (8) and (9) because their estimated coefficients were insignificant at the 1% level.

workers' purchasing power units (consumer prices), and real total hourly labour costs in purchasing power units of firms (value added price-deflator). This wedge is represented by the following terms: the direct tax rate, indirect wages and the ratio of consumer prices and the value added price deflator.

The augmented Phillips curve is estimated separately for the manufacturing and the non-manufacturing sector to allow for the possibility that the relationship between b' and wages differs for these sectors. This possibility arises from the fact that the degree of unionisation is significantly higher in manufacturing than non-manufacturing, apart from the transport sector (Booth *et al*. 2000, p. 18) and, hence, that changes in b' transmit to wages differently in the two sectors. Furthermore, the elasticities of the other regressors in the equations may diverge because of differences in wage determination among the sectors. If the elasticities are significantly different among the sectors, the estimated coefficient of b', in an economy-wide Phillips curve, will be biased.

Equation (10) is essentially a reduced-form aggregate demand and aggregate supply model, where the monetary and fiscal policy variables determine unemployment at business cycle frequencies, and wage push factors determine the low frequency movements in unemployment. In other words, the wage push factors determine the NAIRU, and fiscal and monetary policy variables determine the deviation of unemployment from the NAIRU. As shown by Madsen (1998), Equation (10) nests most modern theories of unemployment, such as trade union and efficiency wage models. In general, these models predict that increases in wage push factors raise unemployment because they drive wages above their initial equilibrium level. Demand side factors affect unemployment temporarily in these models.

The earnings relationship of benefits, b', predicted to have a negative coefficient in all equations for the rent-maximising union, is not directly observable but can be calculated on the basis of OECD's Database on Benefit Entitlements and Gross Replacement Rates. This database provides information on the gross replacement rates for an average production worker and a worker with two-thirds of the income of an average production worker. An average production worker, in the OECD's terminology, is defined as an adult full-time worker in the manufacturing sector, directly engaged in production activity, assumed not to be sick or ill during the year and obtaining average earnings, including average amounts of overtime and cash supplements (see OECD, 1998b, pp. 50-54, for further details). We denote the respective replacement ratios by

R_{100} and R_{67} and use the relevant information for the period from 1961 to 1995.[10] The replacement ratios are published on a biannual basis for three categories of workers, namely; 1) single persons; 2) persons with a dependent spouse without employment; and 3) persons with an employed spouse. R_{100} and R_{67} are calculated as an unweighted average of these three categories.

The earnings relationship of benefits is computed in the following way: assuming a linear relationship between benefits and earnings, unemployment benefits of an R_{100} person

$$w \cdot R_{100} = a + b \cdot w, \tag{11a}$$

where w is the wage of an average production worker prior to unemployment. For an R_{67} person we have:

$$w \, \frac{2}{3} R_{67} = a + b \cdot w \cdot \frac{2}{3}. \tag{11b}$$

From (11a) and (11b) it follows:

$$b = 3R_{100} - 2R_{67} \tag{12a}$$

and

$$a = 2w(R_{67} - R_{100}). \tag{12b}$$

To simplify we define $b' \equiv R_{100} - (2/3) \cdot R_{67}$. The economy-wide replacement rate RR is computed as the unweighted average over the 3 categories of workers of the replacement rate of a person with 100% and 66.7% of the income of an average production worker. More precisely, let B_i, i = 1, 2, indicate the benefit levels of people in the first year of unemployment who earned 66.7% and 100% of an average production worker's income respectively, and let j, j = 1, 2, 3, indicate the three categories of workers, namely a single person, a person with dependent spouse, and a person with a working spouse. Then RR is defined as:

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[10] It could be argued that the disincentive effects of unemployment compensation are determined by net rather than gross replacement rates, that is by the relationship between benefits levels, possibly reduced by taxes etc., and the net income, rather than the ratio of benefits to gross income. Since "it is not possible to calculate a time series of net replacement rates“ (OECD, 1998a, p. 38), we use the gross replacement ratio information in our empirical analysis.

$$RR = \sum_{i=1}^{2} \sum_{j=1}^{3} \frac{B_{ij}}{w_{ij}} \frac{1}{6}$$

Hence, the estimations are based on the assumption that union behaviour relates to workers with benefits between 66.7% and 100% of their previous wage. However, in many countries there are floors and ceilings for unemployment benefits. As long as the floors (ceilings) apply to workers with an income of less than 66.7% (more than 100%) of an average production worker's income, the subsequent estimates are unaffected by the existence of ceilings and floors. If, however, the data collected by the OECD reflect a floor on the level of unemployment benefits, our linear approximation will suggest that benefits rise continuously with earnings, while in fact they are initially independent of previous income and subsequently rise more strongly than the linear approximation indicates. Similar effects occur for ceilings below the full income of an average production worker.

5.2 Estimation Method

Since there are only 17 observations for each country [(1995 - 1961)/2] and eight or nine coefficients have to be estimated in each equation, single country estimates are sensitive to outliers and are deemed to be very inefficient and hence would yield coefficient estimates with very high standard errors attached to them. We consequently pool the data in order to resolve the small sample problem and test whether the coefficients can be restricted to be the same across countries.

Equations (8) to (10) are estimated using a generalised instrumental variable estimator, which assumes the following variance-covariance structure:

$$E\{v_{it}^2\} = s_i^2, \ \ i = 1, 2, \ldots N,$$

$$E\{v_{it}, v_{jt}\} = s_{ij}, \ \ i \neq j,$$

where s_i^2 is the variance of the disturbance terms for country $i = 1, 2, \ldots N$, s_{ij} is the covariance of the disturbance terms across countries i and j, and v is the disturbance term. The error terms are assumed to be contemporaneously correlated across countries, as the countries have simultaneously been exposed to shocks stemming from the same origin. Examples of such shocks are the oil price shocks, the labour movement mobilisation that took place in most OECD countries in the late 1960s (see Bruno and Sachs 1985), and the transition from fixed to floating exchange rates in the beginning of the 1970s. The cross-country variance correction, s_i^2, is undertaken since Bartlett-tests rejected the null hypothesis of variance constancy across countries for all countries at the 1-percent level. s_i^2 and s_{ij} are estimated using the feasible generalised least squares method which is described in Kmenta (1986, Ch. 12).

Instruments are used for the endogenous regressors (U, p^{va} and p^{we}) in Equations (8) and (9). The instruments are listed in the notes to Table 1. The issue of endogeneity may also arise for the replacement rate *RR* and the measure of the earnings relationship *b*', because the higher is unemployment, the larger is the political pressure to provide adequate living standards for the unemployed, such that high unemployment induces high replacement rates. Conversely, the government budget situation may deteriorate at high rates of unemployment and, therefore, give governments incentives to lower unemployment benefits. Since wages depend on unemployment, it follows that if *RR* is endogenous in the unemployment equation, then it will also be endogenous in the Phillips curves. Furthermore, the earnings relationship of the UI system may also be endogenous. In periods of substantial wage growth there may be a stronger desire to increase the earnings relationship *b*' to keep the relative income between the employed and the unemployed less sensitive to wage fluctuations. To check for exogeneity of *RR* and *b*', a Hausman-Wu test was undertaken. The null hypothesis of exogeneity could not be rejected at any conventional significance levels.[11] The problem associated with this test, however, is that it lacks power when the instruments are weak. Therefore, estimates with and without the use of instruments for *RR* and *b*', are reported.

Equations (8) to (10) are estimated without lags, as most of the adjustment has taken place within the two-year time-span that is covered by each data point. Lags were taken into account in the preliminary estimates but they were mostly insignificant and consequently excluded. Country dummies are included in the estimates of Equations (8) and (9), but not (10), because they were jointly insignificant in this equation, even at the 5% level.

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[11] Using the instruments that were employed for the unemployment rate (see notes to Table 1) Hausman-Wu tests for exogeneity gave the following t-statistics: -0.18 (log(1 + *b*')) and 1.01 (log(1 + *RR*)) for the manufacturing wage

5.3 Empirical Results

The results of estimating Equations (8) to (10) are presented in Table 1. The diagnostic tests are based on within individual OLS residuals in order to remove the fixed-country effects. The diagnostic tests do not indicate the presence of first-order serial correlation and heteroscedasticity, with the exception of some heteroscedasticity in the estimates of Equation (8). However, this heteroscedasticity is likely to be removed by the correction for cross-country differences in the residual variances in the estimates. The null hypothesis of cross-country coefficient constancy cannot be rejected at conventional significance levels, as indicated by the *F*-tests. It follows that the coefficient estimates, which are restricted to be the same across countries, are unbiased. Note that Leamer's (1978, p. 114) formula is used to calculate the critical *F*-values of diffuse priors, which takes into account that the likelihood of rejecting the null hypothesis grows with the sample size. The critical values are presented for each equation in Table 1.

Table 1: Parameter estimates of Equations (8) - (10)

The estimates of the augmented Phillips curves are shown in columns 1 and 2 in Table 1. The rate of unemployment puts significant downward pressure on wage growth in the two sectors, as predicted by the Phillips curve relation. The estimated coefficients of direct taxes are around 0.4, which suggests that less than half of direct tax increases are transmitted to higher wages. Furthermore, the theoretical possibility of an inverse relationship between income taxes and unemployment (see Oswald, 1982), is clearly rejected. The estimated coefficients of indirect labour costs of about 0.2 suggest that only a small fraction of indirect labour costs is passed on to total labour costs. It follows that workers are willing to trade increases in direct labour costs for indirect labour costs. The estimated coefficients of cyclical productivity are highly significant and with the correct negative sign suggesting that wages only partially adjust to a cyclical downturn in labour productivity in the short run. The adjustment is particularly slow in non-manufacturing. Surprisingly, the replacement rate only has the predicted positive impact on wages in the estimates for manufacturing.

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equation, -0.32 (log(1 + *b*')) and 0.11 (log(1 + *RR*)) for the non-manufacturing wage equation, and 0.91 (log(1 + *b*')) and 0.08 (log(1 + *RR*)) for the unemployment rate equation.

Turning to the focus parameter of the study, namely *b*', the estimates indicate that wages are negatively related to the measure of the earnings relationship of benefits in both the manufacturing and the non-manufacturing sector. The estimates are statistically highly significant. The estimated coefficient of *b*' differs substantially between the two sectors, by being -0.19 for manufacturing and -0.06 for non-manufacturing. Hence, changes in the strength of the earnings relationship of unemployment benefits can have large wage effects. The findings indicate that a 10% increase in *b*' lowers wages by 1.9% in manufacturing and by 0.6% in non-manufacturing. These results are consistent with the predictions of the rent-maximising union model. The findings suggest that changes in *b*' are a very effective tool for altering wages. Since a large proportion of the unemployed in the OECD countries are blue-collar workers, who have previously been employed in manufacturing (Layard *et al.* 1991), the evidence for the manufacturing sector is especially encouraging.

The estimated coefficients of the country dummies are significant, suggesting cross-country differences in the natural rate of unemployment. The natural rate of unemployment for Sweden, for which the country dummy has been omitted, is 9.6% for manufacturing (0.0722/0.0075) and 4.5% for non-manufacturing (0.0385/0.0085). The country dummies are statistically insignificant for manufacturing in the US, Japan, New Zealand, Austria, Denmark, the Netherlands and the UK, which indicates that these countries have the same natural rate as Sweden. The country dummy is lower for Switzerland but higher for the rest of the countries in the sample, particularly Spain. Regarding non-manufacturing the following countries have the same natural rate as Sweden: Japan, New Zealand, Austria, Germany and Switzerland, while the remaining countries have a higher natural rate. These results suggest a substantially higher natural rate in manufacturing than the rest of the economy.

The results of estimating the unemployment equation depicted in column 3 of Table 1 are consistent with the estimates of the wage growth equations. This indicates that no spurious relationships have been estimated. The coefficients of the wage push variables p^{we} and t^{p} are significant. An increase in oil prices, for example, which increases the wedge between consumer prices and the value added price-deflator by 10% implies an almost 25% (*not* percentage points) increase in the unemployment rate, given that the sample mean of U is 5.5%. Hence, supply side shocks can have potentially large effects on unemployment when firms have sticky prices. An increase in payroll taxes, which has ambiguous employment consequences in the model of collective bargaining, is clearly shown to raise unemployment. Moreover, the replacement rate has a positive impact on unemployment. Finally, the coefficient of *b*' is statistically highly significant and is estimated to be -4. This implies that a 10% increase in the measure of the earnings relationship of benefits *b*', holding constant the level of benefits, is associated with a fall in the rate of unemployment by 7.3%. Hence, the earnings relationship not only influences wages according to the predictions of the model of a rent-maximising union but also unemployment.

5.4 Robustness Checks

This sub-section analyses whether 1) the coefficient of *b*' differs across countries, 2) the estimates in the previous sub-section are sensitive to the selection of countries or 3) to non-linearities in *b*', and whether 4) the results are altered when instruments for ***RR*** and *b*' are used.

First, the coefficient of *b*' may be argued to vary across countries, since bargaining systems differ and because mechanisms of wage determination other than collective bargaining are more important in some countries than others. To investigate this issue, we tested whether we could impose the restriction of the same coefficients of log(1 + *b*') across countries in the estimates in Table 1. The null hypothesis could not be rejected for any of the estimates at conventional significance level. Therefore, regardless of the precise mechanism of wage determination, the quantitative impact of *b*' on wages and unemployment is statistically the same across countries. This very important result suggests that the negative correlation between the earnings relationship of benefits and wages or unemployment has general validity for the OECD countries.

To investigate the remaining issues, Equations (8) to (10) were re-estimated while allowing for each of these effects separately. Only the estimates of the key parameter, *b*', are reported to save space and because the parameter estimates of the other variables are not significantly affected. The results of are shown in Table 2.

Table 2. Coefficient estimates of earnings relationship on wages and unemployment

As a second robustness check, thus, Equations (8) to (10) were estimated, with the US, Japan, New Zealand and the UK omitted from the country sample. These countries were excluded from the estimates because they are the only ones in our sample of 16 countries for which the OECD (1997b) finds a bargaining coverage of less than 50%, as discussed in Section 2. Excluding these countries yields parameter estimates that are close to the ones in the previous sub-section and are statistically significant at conventional significance levels (first part of Table 2). The estimated coefficients of *b*' become –0.12 for manufacturing wages, –0.05 for non-manufacturing wages, and –2.25 for unemployment. These results are consistent with the *F*-tests for parameter constancy for *b*' across countries in the previous sub-section.

Third, *RR* and *b*' were instrumented using the following instruments at periods *t*, *t*-1 and *t*-2: direct tax rates, indirect tax rates, *M*1 deflated by consumer prices, real government consumption and commodity prices. The estimated coefficients of *RR* become less significant than in the non-instrumented estimates. The lower significance of the estimates is to be expected since good instruments for *RR* are not readily available. The coefficients of *b*' are estimated less precisely as well but are still significantly different from zero at conventional significance levels and, more importantly, have the same signs as the estimates in the previous sub-section. These results suggest that the findings in the previous sub-section are not driven by a potential endogeneity of *RR* and *b*'.

Finally, non-linearities in the earnings relationship of unemployment benefits were taken into consideration by including the term $D[\log(1+b_{it}^{'})]^2$ as an additional right-hand side variable in Equations (8) to (10). Because this variable uses up one additional lag, the estimation period commences in 1965. Since this implies that the number of countries exceeds the number of time-periods per country, the Kmenta estimator cannot be applied unless one country is dropped from the estimates. Hence, Switzerland is arbitrarily omitted from the estimates. For non-manufacturing wages the earnings relationship in UI has a stronger effect on wages when non-linearities are allowed for. The negative effects on manufacturing wages of the earnings relationship in UI are growing strongly with an increase in the earnings relationship. The relationship is positive for small values of *b*', but these values only apply for a small number of observations. For unemployment only the estimated coefficient of the higher order term is statistically significant and is negative.

Overall, the estimates suggest that the finding in the previous sub-section according to which a stronger earnings relationship of UI is associated with lower wages and unemployment, is almost unaltered when *b*' is allowed to vary across countries, instruments are used for *RR* and *b*', when the country sample is reduced to the countries for which the wage bargaining coverage exceeds 50%, and when a higher-order term is included to allow for non-linearities in the earnings relationship.

6. Summary and Conclusion

This paper has demonstrated that there will be a negative correlation between a stronger earnings relationship of unemployment benefits and wages if the union is a rent-maximiser. The intuition is that the gain in utility owing to higher wages for employed union members will shrink with a stronger earnings relationship if the level of benefits is held constant. Therefore, the rent-maximising union prefers lower wages and more employment. However, if the union is utilitarian, a stronger earnings relationship will increase the members' payoff at the margin. Thus, the utilitarian union prefers a higher wage. Since the firm's payoff is unaffected by alterations in the structure (or level) of unemployment benefits for a given wage, the above results carry over to a wage bargaining framework. It follows that the wage and unemployment effects of a stronger earnings relationship in unemployment benefits are an empirical issue.

Using data for a panel of 16 OECD countries over the period from 1961 to 1995, the linkage between the earnings relationship of UI systems and wages and unemployment was estimated. The results indicate that a stronger earnings relationship of unemployment benefits is associated with a significantly lower level of unemployment, as well as of wages, in both the manufacturing and the non-manufacturing sector. Our estimates reveal that a 10% increase in the measure of the earnings relationship of benefits is associated with a 7.3% reduction in the rate of unemployment, a 1.9% reduction in manufacturing wages, and a 0.6% reduction in non-manufacturing wages.

Since for most OECD countries it is relatively easy to change the earnings relationship of benefits, these results suggest that such a policy measure may be an effective tool for alleviating the OECD unemployment problem, particularly because a large proportion of the unemployed have previously been employed in manufacturing. This is even true for countries that already have fairly strong earnings-related elements in their UI systems. This is because the unemployment assistance payments that are usually paid to the unemployed who have either exhausted their insurance entitlements or who do not fulfil the eligibility requirements for insurance payments, are predominantly flat-rate based (OECD 1998a, p. 18). Thus, there appears to be ample scope for employment enhancing reforms of the unemployment benefit system in many OECD countries and these reforms do not simply have to be reductions in benefit levels or durations.

Data Appendix

Value-added price-deflator for manufacturing. Nominal GDP for manufacturing divided by real manufacturing GDP, OECD, *National Accounts, Vol. 2 (NA)*. **Value-added price-deflator for non-manufacturing**. Total nominal GDP minus nominal GDP for manufacturing divided by total real GDP minus real manufacturing GDP *(NA)*. **Total hourly labour costs in manufacturing**. Compensation to employees in manufacturing *(NA)* divided by weekly hours worked in manufacturing activities: ILO, *Yearbook (YB*) and manufacturing employment (employees) *(YB)*. **Indirect hourly labour costs in manufacturing and non-manufacturing**. Total hourly labour costs in manufacturing (Swedish Employers' Confederation, *Wages and Total Labour costs for Workers*) minus hourly wage rate in manufacturing *(IFS*). **Total hourly labour costs in non-manufacturing**. Indirect hourly labour cost in manufacturing plus hourly wage rate in non-manufacturing, which is calculated as $(wt \cdot et - wm \cdot em)/(et - em)$, where *wt* is the economy-wide average hourly wage rate *(YB)*, *et* is total employment *(YB)*, *wm* is the direct hourly wage rate in manufacturing *(IFS)*, and *em* is manufacturing employment *(YB)*. **Consumer prices**. IMF, *International Financial Statistics*, *(IFS)*. **M1**. *(IFS)*. **Exchange rates**. *(IFS)*. **World commodity prices inclusive oil measured in USD**. Enzo R Grili and Maw Cheng Yang, 1988, Primary Commodity Prices, Manufactured Goods Prices, and the Terms of Trade of Developing Countries: What the Long Run Shows, *World Bank Review*, 2, 1-47, and United Nations, *Monthly Bulletin of Statistics* (export unit values). **Unemployment rates**: *(YB*). **Macro replacement rate**. Unweighted average of the replacement rate of a person with 100% and 66.7% of the income of an average production worker for the following three categories: A single person, a person with a non-working dependent spouse, and a person with an employed spouse. From OECD’s Database on Benefit Entitlements and Gross Replacement Rates. $\boldsymbol{R_{100}}$. Unweighted average of the replacement rate of a person with 100% of the income of an average production worker for the following three categories: a single person, a person with dependent spouse, and a person with a dependent spouse, who is working. $\boldsymbol{R_{67}}$. Unweighted average of the replacement rate of a person with 66.7% of the income of an average production worker for the following three categories: a single person, a person with dependent spouse, and a person with a dependent spouse, who is working. **Direct tax rates**. Direct taxes and other contributions for the general government divided by nominal GDP *(NA)*. **Indirect tax rates**. Indirect taxes and other contributions for the general government divided by nominal GDP *(NA)*. **Labour productivity in manufacturing**. Real manufacturing GDP *(NA)* divided by employment *(YB)* and weekly hours worked in manufacturing *(YB)*. **Nominal long-term interest rate**. *(IFS)*. **Government consumption**. *(IFS)*.

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Table 1. Parameter estimates of Equations (8)-(10).

Manufacturing wages		**Non-manufacturing wages**		**Unemployment**	
$D\log q_t^{m,c}$	-0.0399(9.87)	$D\log q_t^{nm,c}$	-0.1152(12.5)	$D\log q_t^{c}$	-1.87(12.2)
U_t	-0.0075(82.8)	U_t	-0.0085(34.5)	$D\log p_t^{we}$	9.48(34.8)
$D\log(1+t_t^{dir})$	0.4825(24.2)	$D\log(1+t_t^{dir})$	0.3390(32.8)	$D\log(1+t_t^{dir})$	4.34(17.4)
$D\log w_t^{m,ind}$	0.1902(84.7)	$D\log w_t^{nm,ind}$	0.2140(95.6)	$D\log(1+b_t^{'})$	-3.88(15.3)
$D\log p_t^{m,we}$	0.3621(21.2)	$D\log p_t^{nm,we}$	0.4920(30.2)	$D\log(1+RR_t)$	0.76(4.56)
$D\log p_t^{m,va}$	0.6828(96.3)	$D\log p_t^{nm,va}$	0.7350(122.)	DIR_t	8.14(43.9)
$D\log q_t^{m}$	0.1493(21.9)	$D\log q_t^{nm}$	0.3526(47.0)	$D\log(1+t_t^{p})$	0.75(12.4)
$D\log(1+b_t^{'})$	-0.1880(23.7)	$D\log(1+b_t^{'})$	-0.0585(18.3)	$D\log g_t$	-0.16(1.90)
$D\log(1+RR_t)$	0.0556(6.35)	$D\log(1+RR_t)$	-0.0906(11.4)	Con	0.35(19.8)
CD_{USA}	0.0033(0.25)	CD_{USA}	0.0238(2.66)		
CD_{JAP}	0.0034(0.17)	CD_{JAP}	0.0090(0.66)		
CD_{NZ}	-0.0111(1.01)	CD_{NZ}	0.0044(0.31)		
CD_{AUT}	0.0068(0.52)	CD_{AUT}	0.0078(0.86)		
CD_{BEL}	0.0378(3.32)	CD_{BEL}	0.0437(4.13)		
CD_{DEN}	0.0051(0.31)	CD_{DEN}	0.0258(3.14)		
CD_{FRA}	0.0277(2.47)	CD_{FRA}	0.0369(3.25)		
CD_{GER}	0.0204(2.13)	CD_{GER}	0.0154(1.42)		
CD_{GRE}	0.0341(2.26)	CD_{GRE}	0.0454(3.90)		
CD_{IRE}	0.0660(5.22)	CD_{IRE}	0.0703(7.27)		
CD_{ITL}	0.0547(4.34)	CD_{ITL}	0.0562(6.39)		
CD_{NET}	0.0212(1.45)	CD_{NET}	0.0210(2.29)		
CD_{SPA}	0.1103(6.51)	CD_{SPA}	0.0888(5.67)		
CD_{SWZ}	-0.0278(2.73)	CD_{SWZ}	-0.0112(1.20)		
CD_{UK}	0.0222(1.76)	CD_{UK}	0.0212(2.21)		
Con	0.0722(7.01)	Con	0.0385(4.20)		
R^2(Buse)	1.00	R^2(Buse)	1.00	R^2(Buse)	0.94
FP(144,112)	3.17	FP(144,112)	2.29	FP(128,128)	1.23
Leamer	16.40	Leamer	16.40	Leamer	14.60
$DW(M)$	1.99	$DW(M)$	2.17	$DW(M)$	1.92
BP(8)	35.73	BP(8)	13.77	BP(7)	17.68
Fb'(15,234)	0.99	Fb'(15,234)	1.08	Fb'(15,249)	1.01

Notes: Absolute t-statistics are given in parentheses. R^2 = Buse's raw moment *R*-squared. $DW(M)$ = modified Durbin-Watson test for first order serial correlation in fixed effect panel data models (see Bhargava *et al.* 1982). $c^2(i)$ = fixed effect model Breusch-Pagan test for heteroscedasticity using the explanatory variables of the model as regressors, based on within individual residuals, and is distributed as $c^2(i)$ under the null hypothesis of homoscedasticity. $FP(i,j)$ = F-test for cross-country coefficient constancy, and is distributed as $F(i,j)$ under the null hypothesis of coefficient constancy. $Fb'(i,j)$ = F-test for cross-country coefficient constancy of the estimated coefficient of $D\log(1+b'_t)$, and is distributed as $F(i,j)$ under the null hypothesis of coefficient constancy. Leamer = Leamer's critical value for the F-test for coefficient constancy across countries. The following instruments are used. For $D\log p_t^{we}$: $D\log p_{t-1}^{we}$, $D\log p_{t-2}^{we}$, $D\log p_{t-1}^{cpi}$, $D\log p_{t-2}^{cpi}$, $D\log p_t^{com}$, $D\log p_{t-1}^{com}$, $D\log p_{t-2}^{com}$, $D\log M1R_t$, $D\log M1R_{t-1}$, and $D\log M1R_{t-2}$, where p^{cpi} is consumer prices, p^{com} is world commodity prices in domestic currency, and $M1R$ is $M1$ deflated by consumer prices. For $D\log p_t^{va}$: $D\log p_{t-1}^{va}$, $D\log p_{t-2}^{va}$, $D\log p_{t-1}^{cpi}$, $D\log p_{t-2}^{cpi}$, $D\log p_t^{com}$, $D\log p_{t-1}^{com}$, $D\log p_{t-2}^{com}$, $D\log M1R_t$, $D\log M1R_{t-1}$, and $D\log M1R_{t-2}$. For U_t: U_{t-1}, U_{t-2}, $D\log p_{t-1}^{m,va}$, $D\log p_{t-2}^{m,va}$, $D\log p_t^{com}$, $D\log p_{t-1}^{com}$, $D\log p_{t-2}^{com}$, $D\log M1R_t$, $D\log M1R_{t-1}$, and $D\log M1R_{t-2}$.

The following countries are included in the estimates: The US, Japan, New Zealand, Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Spain, Sweden, Switzerland, and the UK. Estimation period: 1963-1995.

Table 2. Coefficient estimates of earnings relationship on wages and unemployment.

	$D\log(1+b_t^{'})$	$D[\log(1+b_t^{'})]^2$
Smaller country sample[1]		
Manufacturing wages	-0.12 (4.88)	
Non-manufacturing wages	-0.05 (2.16)	
Unemployment	-2.25 (2.41)	
Instruments[2]		
Manufacturing wages	-0.12 (10.20)	
Non-manufacturing wages	0.01 (2.43)	
Unemployment	-2.12 (3.34)	
Non-linearities in variables[3]		
Manufacturing wages	0.03 (5.20)	-0.04 (16.0)
Non-manufacturing wages	0.04 (4.11)	-0.02 (3.38)
Unemployment	0.05 (0.16)	-1.03 (6.01)

Notes. See notes to Table 1. The estimates are based on Equations (8) to (10). Estimation period: 1963 to 1995.

1. All countries reported in Table 1 except the US, Japan, New Zealand and the UK.
2. The following instruments at periods *t*, *t*-1 and *t*-2 are used for *b*' and *RR*: direct tax rates, indirect tax rates, *M*1 deflated by consumer prices, real government consumption and commodity prices.
3. The estimation period is from 1965 to 1995. Switzerland is excluded (see text).

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