A joint Initiative of Ludwig-Maximilians-Universität and Ifo Institute for Economic Research

Working Papers

TRADE UNIONS AND THE BURDEN OF THE PUBLIC DEBT

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CESifo Working Paper No. 587

October 2001

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ISSN 1617-9595

* I wish to thank Jan Erik Askildsen, Hans Fehr, Michael Hoel, Sören Bo Nielsen, Agnar Sandmo and two anonymous referees for comments on earlier versions of this paper. This paper was completed while the author was visiting the *Center for Economic Studies* at the University of Munich, and he gratefully acknowledges the facilities and hospitality provided during his visit.

CESifo *Working Paper No. 587*
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Abstract

This paper looks at intergenerational welfare effects of increased public debt when union power in pay bargaining generates structural unemployment. Debt policy works through capital accumulation as well as the price of a fixed asset that is owned by the old generation. Under a reasonable condition, the debt burden on future generations from postponement of the labor tax is larger than in the case of no union power. Under this condition, increased union power also reduces the consumption of future generations.

JEL Classification: E62, H60.

Keywords: public debt, trade unions, intergenerational welfare.

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1. Introduction

In many industrialized countries, structural fiscal deficits and growing unfunded social security commitments have raised concerns about the long-run consequences for intergenerational distribution and the political sustainability of the welfare state. A sizeable literature has adopted the overlapping generations modeling framework to examine intergenerational welfare effects of fiscal policy.[1] This literature has examined two channels through which public debt and unfunded social security affect the intergenerational distribution. The first channel of intergenerational effects works through capital accumulation, and the second through price changes of assets traded among members of different generations.[2]

In this literature, the labor market is conventionally assumed to be perfectly competitive. In many OECD countries, however – particularly in Europe where union influence in wage bargaining is institutionalized[3] – rates of unemployment and public spending on unemployment benefits are quite high. Moreover, as shown in Table 1, both unemployment and net public debt have increased considerably from the 1970s to the 1990s.[4] This suggests that the burden on future generations of increased public debt and the economic burden of high equilibrium unemployment could be interrelated and that the latter perhaps aggravates the negative welfare effects for future generations. In order to focus on this relationship, we analyze an overlapping generations (OLG) model of a small open unionized

[1] See for example Blanchard (1985), Persson (1985), Frenkel and Razin (1986), Auerbach and Kotlikoff (1987), Kehoe (1987), Fried and Howitt (1988), Chang (1990), Auerbach et al. (1991) and Buiter and Kletzer (1991).
[2] The asset price effect plays a crucial role in Fried and Howitt (1988) and Laitner (2000). A related study with a somewhat different focus is Chamley and Wright (1987).
[3] According to Layard et al. (1991), in most European countries over three-quarters of the work force have wages that are covered by collective bargaining.
[4] In addition, implicit social security debt has increased quite a lot in most European countries during this period. Generational accounting calculations reported by Raffelhüschen (1999) show that the intertemporal public liabilities (IPL) as a percentage of GDP for 1995 was 127.4 percent on average for the four large countries in Table 1 and 142.9 for the seven small countries. IPL measure how much additional wealth the government would have needed today in order to satisfy its intertemporal budget constraint, assuming the present fiscal policy applies to all future generations. Although IPLs are subject to large measurement errors, they

economy in which fiscal policy may affect the pay bargaining outcome and the rate of structural unemployment.[5] Our framework is sufficiently rich to capture effects running from unemployment and high public spending on unemployment benefits to public debt, as well as effects of a high public debt on wage formation and structural unemployment. The latter effects work through changes in wage taxes and unemployment benefits. When the life-cycle saving motive is important, workers are on average younger than capital owners are. Therefore, wage bargaining between trade unions of young workers and old capital owners represents an additional channel of intergenerational redistribution.[6] Although there has been a growing interest in trade union behavior in the context of OLG models, intergenerational distribution effects of fiscal deficits have not received much attention in the literature so far.[7]

In the next section, we present the model. Section 3 looks at the dynamic effects of fiscal policy working through wage formation and structural unemployment in addition to the capital accumulation and asset price channels. In section 4, we analyze the intergenerational distribution effects of increased union power. The final section concludes.

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nevertheless provide more unbiased estimates of the real excess fiscal burden on future generations inherent in present fiscal policy by accounting for future population aging and old age related public spending.

[5] We do not consider alternative models of unemployment such as search and efficiency wage models. For direct evidence of the importance of union power and insider forces for wage determination in British industry, see Nickell and Kong (1992).

[6] As demonstrated by Devereux and Lockwood (1991), bargaining between unions and capital owners could matter for intergenerational distribution even if full employment prevails.

[7] Devereux and Lockwood (1991) and Croix and Licandro (1995) have looked at how trade union power changes the incentives for capital accumulation. An interesting simulation study by Jensen (1997) introduces wage setting by monopoly unions in a computable OLG model of the Blanchard (1985) type to address the public debt problem in Denmark.

Table 1 **Unemployment and net public debt in Europe (averages of percentage points)**

	Unemployment[a]		
	1970-79	1980-89	1990-97
Large countries[b]	4.2	8.2	9.4
Small countries[c]	3.4	8.5	9.8
	Net public debt[d]		
	1979	1989	1997
Large countries	28.8	36.6	60.0
Small countries	15.0	30.8	46.3

2. An overlapping generations model with a fixed asset

Our analytical framework is an OLG model of a small open one-sector economy. Domestic output is an internationally traded good and is denoted Y. The real rate of interest is $r > 0$. Assuming full international capital mobility, r is equal to the exogenous world real interest rate. We extend previous work by Persson (1985), Eaton (1987) and Fried and Howitt (1988) by introducing pay bargaining over the rents from a fixed factor and by considering structural unemployment. We also extend their set of fiscal instruments and look at changes in profit taxes and unemployment benefits in addition to a tax on labor.[8]

In each time period t, there are two groups of households, the young and the old. There is no population growth. The young households supply one unit of labor each, consume

[a] Standardized rates, except for Austria and Denmark. Source: OECD Economic Outlook. Averages of country data.
[b] Germany, France, Italy and United Kingdom.
[c] Austria, Belgium, Denmark, Finland, Netherlands, Spain and Sweden.
[d] General government net financial liabilities, per cent of nominal GDP, Averages of country data.

output and save for retirement. The employed workers pay a labor tax τ, which comprises labor income taxes as well as payroll taxes. Unemployed workers receive an after-tax unemployment benefit b from the government.[9] The workers are also members of trade unions engaged in wage bargaining with firms; see section 2.2 below. The old retired households consume their capital income and accumulated wealth, leaving no bequest.

2.1. Production, consumption and wealth

There are three inputs, domestic labor L_t, reproducible capital K_t, and a fixed factor T. K_t is the stock of capital at the beginning of period t and is measured in output units. Technology is defined by an aggregate production function $Y_t = F(L_t, K_t, T)$, which exhibits constant returns to scale. Firms pay a proportional profit tax σ to the government, and maximize after-tax profits, taking the bargained wage and the real interest rate as given. The real labor cost is denoted w_t. It is determined by wage bargaining between unions and firms. Profits (π_t) are

$$\pi_t = Y_t - w_t L_t - rK_t = m_t T, \tag{1}$$

where m_t is the marginal product of the fixed factor T. In equilibrium, the marginal products of K_t and L_t are equal to r and w_t, respectively. The demand for labor is $L_t = L(w_t)$, with wage elasticity $-\varepsilon_t$, where $\varepsilon_t > 0$, and $\pi_t = \pi(w_t)$ is the profit function. The derivative of the latter is $-L_t$. The output supply function is written as $Y = Y(w_t)$. It is also decreasing in w.[10] The aggregate labor supply is normalized to 1. Unemployment is therefore $1 - L_t$.

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[8] To make the notation simple, we do not introduce implicit social security debt. Since there is no uncertainty, implicit public debt have the same intergenerational effects as explicit net public debt.

[9] Since there are no payroll tax on unemployment benefits, we assume that the tax rate is larger for the employed than for the unemployed, see Nickell and Layard (1999).

[10] We suppress the effect of r in $L(w)$ and $Y(w)$. Due to the fixed factor T, ε depends on a complicated scale effect in addition to the constant-output labor-demand elasticity. To see what is involved, suppose that F is separable: $Y = F(L,Q(K,T))$, where $Q(K,T)$ is linearly homogeneous. For given Y, the constant-output labor-demand elasticity depends on the cost share of labor and on the elasticity of substitution between L and Q. This effect has been studied extensively. Hamermesh (1993, p.93) concludes his review of the empirical literature by suggesting that "a reasonable confidence interval is [0.15, 0.75]." The scale effect depends on the cost share of T and on the substitution elasticity between K and T. It becomes large if the cost share of T becomes small. To

The utility of an employed individual of generation t is $U(c_t, x_{t+1}) - \ell$, where c_t and x_{t+1} are consumption as young and old respectively, and $\ell > 0$ is the disutility of work. Hence, U is the utility function of an unemployed worker. We assume that ℓ is constant. Both goods are normal goods. Letting $y_t = (1 - \tau_t)\, w_t$ be the after-tax wage income of an *employed* worker, his budget constraint can be written as $c_t + (1 + r)^{-1} x_{t+1} = y_t$. For an *unemployed* worker, y_t is replaced by the net unemployment benefit b_t in the budget constraint. Constrained utility maximization yields the consumption functions $c(y_t)$ and $c(b_t)$ for employed and unemployed individuals, respectively.[11]

National wealth at the beginning of period t is W_t and is measured in output units. It is the sum of reproducible capital, the value of the fixed capital, and foreign assets, W_t^*:

$$W_t = K_t + P_t T + W_t^*. \tag{2}$$

The endogenous asset price at the beginning of period t is P_t. K, T and W^* are perfect substitutes in wealth portfolios. In equilibrium, the following arbitrage conditions must therefore be fulfilled:

$$(1-\sigma_t)\pi_t + (P_{t+1} - P_t)T = rP_tT, \qquad t = 1,2,.... \tag{3}$$

The LHS of (3) is the capital income from the ownership of T during period t. It must be equal to the interest income from a corresponding investment in foreign assets. From (3), we derive

$$P_{t+1} = \frac{1}{T}\sum_{j=1}^{\infty} \frac{(1-\sigma_{t+j})\pi_{t+j}}{(1+r)^j}. \tag{4}$$

the asset price at the end of period t, P_{t+1}, as the present value of future after-tax profits: T is then sold to generation t, which resells it to generation $t + 1$ for the price P_{t+2} at the end of period $t + 1$, and so on.

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illustrate, consider a Cobb-Douglas production function in which the labor share is 2/3 and the share of T is 1/6.

2.2. Wage determination

Behind the production function there is a fixed number of identical firms and unions engaged in wage bargaining.[12] We adopt the Nash bargaining model; see Binmore et al. (1986) for a strategic justification. Following Nickell and Layard (1999), we also assume that there will be bargaining over the wage rate only, but not the level of employment, and that firms maximize profits taking the bargained wage as given. This is consistent with the well-known stylized fact that firms appear to set employment unilaterally, see for example Farber (1986) and Oswald (1993).

We first consider the union objective. Various union welfare functions have been suggested in the literature. One factor that often makes a difference is whether lay-offs are by seniority or by random draw. In the theoretical literature on both labor unions and labor contracts, the most common assumption is that layoffs are by random draw; see Oswald (1993) for a survey. Since this assumption means that all members face the same probability of becoming unemployed, the representative member of the union wants to trade off the benefits of a high pay and job security. Therefore, the wage elasticity of the demand for labor is important under such preferences. Existing empirical evidence appears however to give stronger support to the assumption of layoffs by seniority than to random layoffs, see Oswald (1993). In this paper we consider both lay-off rules. The analytically simplest model is the seniority model suggested by Oswald (1993). Let us first show the implications of this model for wage determination before we look at the alternative assumption of lay-offs by random draw.

In the seniority model the median voter is always employed and therefore only cares about the pay. His utility is therefore the utility of an employed individual, $U(c_t, x_{t+1}) - \ell$.

Then $\varepsilon = 1 + (w L / \pi) = 6$. Still, the constant-output labor-demand elasticity is only 1/3 in this case.

[11] We have suppressed the dependence of c on the interest rate.

[12] We do not consider nation-wide wage settlements. It is well known that centralization could matter for real wages and aggregate employment, see for example Hoel (1991).

Inserting the consumption functions, the indirect utility is written $V(y_t)$ - ℓ, where as before, $y_t = (1 - \tau)\, w_t$. The derivative V_y is positive. Following Oswald (1993), the generalized Nash objective can be written:

$$\Omega_t^{sen} = \left(V(y_t) - \ell - \hat{V}\right)^{\beta} \left((1-\sigma_t)\pi(w_t) - \hat{\pi}\right). \tag{5}$$

In (5), $\hat{V}$ and $\hat{\pi}$ are the status quo or disagreement points and β is the usual measure of union power in wage determination, see Layard et al. (1991) and Nickell and Layard (1999). The equilibrium wage is the wage that maximizes (5), subject to the firm choosing L to maximize profits. This wage contract is efficient. Omitting time subscripts, the first-order condition can be expressed as:

$$\frac{\beta(1-\tau)V_y(y)}{V(y) - \ell - \hat{V}} = \frac{(1-\sigma)L(w)}{(1-\sigma)\pi(w) - \hat{\pi}}, \qquad y = (1-\tau)w. \tag{6}$$

It follows immediately that a higher β leads to a higher w. In regard to the effects of fiscal policy, it is easy to show that a sufficient condition for a positive wage cost effect of an increase in τ, is first, that $V(y)$ is isoelastic, and second, that the tax increase does not decrease $\hat{V} + \ell$ by the same proportion as the decline in $V(y)$, for a given w. It seems realistic to assume that the utility of the median voter will be relatively less affected by an increase in the labor tax (which includes payroll taxes) in a strike, say, than in his ordinary work. We therefore assume that the effect of an increase in τ on w is positive.

Considering next an increase in the profit tax rate σ. A standard assumption in the literature is that the status equal point, $\hat{\pi}$, is zero, in which case a change in σ has no effect on w. The same is true if $\hat{\pi}$ is proportional to (1 - σ). If $\hat{\pi} > 0$, an increase in σ will decrease w because some of the tax burden is shifted on to the workers.

Finally, an increase in the net unemployment benefit b will only have an effect on the wage bargain if the status quo point $\hat{V}$ increases. In the present framework, the median voter

does not risk to be unemployed, but this assumption may be too restrictive in a macroeconomic context. We return to this question below.

Next we look at the alternative union model, in which lay-offs are by random draw. Now the representative union member has the following preferences:

$$V^{draw} = (V(y) - \ell)L(w) + A(1 - L(w)) = (V(y) - \ell - A)L(w) + A. \tag{7}$$

A represents outside opportunities and is exogenous in the wage bargain. It is the expected utility that the member will obtain if he is not employed by the firm. Following Nickell and Layard (1999), we express *A* as the weighted average of the utility as unemployed and the utility of working in an alternative job:

$$A = \bar{u}V(b) + (1 - \bar{u})(V((1 - \tau)\bar{w}) - \ell). \tag{8}$$

In (8), $\bar{u}$ is the aggregate unemployment rate and $\bar{w}$ is the average wage cost in the economy.[13] Letting *A* also be the status quo point of the union, the Nash objective becomes

$$\Omega^{draw} = (V^{draw} - A)^{\beta}((1 - \sigma)\pi(w) - \hat{\pi}). \tag{9}$$

Substituting from (7), we obtain the following first-order condition for a maximum:

$$\frac{\beta(1 - \tau)V_y(y)}{V(y) - \ell - A} + \frac{\beta L_w(w)}{L(w)} = \frac{(1 - \sigma)L(w)}{(1 - \sigma)\pi(w) - \hat{\pi}}. \tag{10}$$

There are two main differences from the first-order condition (6) in the seniority model. One difference is the second term in (10), which reflects that this union cares about the elasticity of the demand for labor. And second, *A* is not exogenous at the macroeconomic level; see (8). In equilibrium, $w = \bar{w}$ and $1 - L(w) = \bar{u}$. Using (8), we can therefore close the model by expressing the denominator of the first term in (10) as:

$$V(y) - \ell - A = (1 - L(w))(V(y) - \ell - V(b)). \tag{11}$$

[13] Nickell and Layard (1999) assume that the probability of becoming unemployed is also a function of exogenous parameters affecting the separation rate out of employment and the search effectiveness of the unemployed.

The comparative static effects are derived in Section A1 of the Appendix. In regard to the effects of changes in τ, β and σ, we obtain the same qualitative effects as in the seniority model discussed above. A difference, though, is the effect of an increase in net unemployment benefits (b), which increases the wage in the present model. Such an effect is consistent with most empirical evidence; see for example, Layard et al. (1991).

On the basis of the union models, we obtain the following wage function:

$$w = w(\underset{(+)}{\tau}, \underset{(+)}{b}, \underset{(0)}{\sigma}, \underset{(+)}{\beta}). \tag{12}$$

The signs of the partial derivatives of the wage function are shown beneath the arguments in (12). The effects of an increase in the labor income tax (w_τ), unemployment benefit (w_b) and union power (w_β) on the bargained wage are positive, and the effect of an increased profits tax (w_σ) is zero. We also assume that y_τ, the partial derivative of after-tax income y with respect to τ, is negative:

$$y_\tau = -w + (1-\tau)w_\tau < 0. \tag{13}$$

The precise condition under which this assumption holds is given in the Appendix.

2.3 Income, saving and government debt

Letting B_t be the net public debt at the beginning of period t, the budget constraint of the government is

$$B_{t+1} = (1+r)B_t - Z_t, \qquad Z_t = \tau_t w_t L(w_t) - \big(1 - L(w_t)\big)b_t + \sigma_t \pi(w_t). \tag{14}$$

Z_t is net tax revenues. Using the wage function (12), Z_t can be written as a function of fiscal instruments and union power (β):

$$Z_t = \tau_t w_t L(w_t) - \big(1 - L(w_t)\big)b_t + \sigma_t \pi(w_t) \equiv Z(\tau_t, b_t, \sigma_t, \beta). \tag{15}$$

The effect of an increase in σ is positive: $Z_\sigma = \pi > 0$. This is the only partial derivative in (15) that has an unambiguous sign. Omitting time subscripts, the effect of an increase in β on Z is:

(16) $$Z_\beta = -\left[\left(\varepsilon(w)-1\right)\tau + \sigma + \frac{\varepsilon(w)b}{w}\right]L(w)w_\beta .$$

This effect works through the wage effect on net tax revenues. It is clearly negative if $\varepsilon \geq 1$. If ε is sufficiently small, however, $Z_\beta > 0$. A necessary and sufficient condition for $Z_\beta < 0$ is:

(17) $$\varepsilon(w) > \frac{\tau - \sigma}{\tau + \frac{b}{w}}.$$

In what follows, we will assume that (17) is always fulfilled. Therefore, $Z_\beta < 0$. Due to the scale effect underlying ε, this assumption seems quite reasonable; see footnote 10. Given (17), it immediately follows that $Z_b < 0$.

The effect of an increase in τ on Z is crucial for our analysis of debt policy. Omitting time subscripts, this effect is

(18) $$Z_\tau = wL(w) - \left[\left(\varepsilon(w)-1\right)\tau + \sigma + \frac{\varepsilon(w)b}{w}\right]L(w)w_\tau , \qquad 0 < Z_\tau < wL.$$

From (16), we recognize that the last term in (18) is the effect operating through the increase in w, which was assumed to be negative, see (17). Therefore, $Z_\tau < wL$. On the other hand, if ε is sufficiently large, Z_τ is negative. In other words, we cannot in general exclude a "Laffer" effect if the labor demand is very elastic and the w_τ effect is strong. However, to focus on empirically interesting results, we assume that $Z_\tau > 0$. To summarize: $Z = Z(\underset{(+)}{\tau}, \underset{(-)}{b}, \underset{(+)}{\sigma}, \underset{(-)}{\beta})$.

Another variable that turns out to be important for our analysis of debt policy is R_t, the total after-tax income of the young generation t, i.e. the sum of the incomes of the employed and unemployed individuals. Using the wage function (12), and omitting time subscripts, we can express R as a function of the fiscal instruments and union power in the same period:

(19) $$R = L(w)y + \left(1 - L(w)\right)b = R(\underset{(-)}{\tau}, \underset{(?)}{b}, \underset{(0)}{\sigma}, \underset{(?)}{\beta}).$$

For familiar reasons, $R_\sigma = 0$. The signs of R_b and R_β are both ambiguous because we do not know the sign of the wage effect on R.[14] Let us look at the effect of an increase in τ on R:

$$R_\tau = \left[y_\tau - (y-b)\varepsilon \frac{w_\tau}{w} \right] L < 0. \tag{20}$$

This effect is clearly negative: First, the effect on y is negative, and second, those who become unemployed face an income reduction. It is useful to show the relation between net tax revenues (Z_t) and R_t:

$$R_t = w_t L_t - Z_t + \sigma_t \pi_t . \tag{21}$$

Note that since the young do not pay the profit tax and the latter is included in Z, we must add the profit tax revenues in (21). Differentiating (21) with respect to τ, using (15) and (19), and omitting time subscripts, we obtain the following identity:

$$R_\tau \equiv -Z_\tau + (1-\varepsilon-\sigma) L(w) w_\tau . \tag{22}$$

This identity is important for our analysis of the burden of the public debt.

Total private saving of the young is denoted S_t. It is equal to the sum of the savings of the employed and the unemployed. Using (13) and (19), we obtain:

$$S = R - L(w)c(y) - (1-L(w))c(b) \equiv \underset{(-)}{S}(\underset{(-)}{\tau}, \underset{(?)}{b}, \underset{(0)}{\sigma}, \underset{(?)}{\beta}). \tag{23}$$

The properties of (23) are straightforward to derive. For the usual reason, $S_\sigma = 0$. Moreover, $S_\tau < 0$ because a higher τ increases unemployment and reduces y. The sign of S_b is ambiguous since the induced wage increase reduces employment: Those who lose their jobs save less, counteracting the increase in saving by those who keep their jobs or are unemployed at the

[14] It is easy to show that if $\varepsilon < y / (y - b)$, an increase in w leads to a higher R. In this case $R_b > 0$ and $R_\beta > 0$. These effects could be turned around by high labor demand elasticity, however.

outset. [15] Finally, increased β has an ambiguous effect on *S* because a higher wage increases the saving of the employed and reduces the saving of those who lose their jobs.

S_t is equal to the aggregate private wealth at the beginning of period $t + 1$: $S_t = W_{t+1} + B_{t+1}$. Using (14), (15) and (23), we can therefore express national wealth as a function of the fiscal policy in the preceding period:

$$W_{t+1} = S(\tau_t, b_t, \sigma_t, \beta) - (1+r)B_t + Z(\tau_t, b_t, \sigma_t, \beta). \tag{24}$$

The consumption of the old generation in period *t* can be expressed as:

$$x_t = (1-\sigma_t)\pi(w(\tau_t, b_t, \sigma_t, \beta)) + P_{t+1}T + (1+r)(K_t + W_t^* + B_t). \tag{25}$$

An important feature of this model is that an unanticipated increase in τ_t or b_t reduces profits, which reduce x_t.

3. Effects of fiscal policy

All our policy experiments assume that the economy is initially in a steady state, and that a change in fiscal policy in period *t* involves an unexpected increase in B_{t+1}. From period $t + 1$ and onwards, one tax or transfer instrument is used to stabilize the debt at its new higher level. Since there are no bequests, and *r* is constant, a new steady state will be attained from period $t + 2$ and onwards, Then generation *t* has vanished, and all subsequent generations behave in the same way. The asset price P_{t+1}, will normally change in response to the change in policy, but from then on it will be constant. We first look at the steady state effects, and then we will analyze the effects of the policies on the two generations living in period *t*.

3.1. Steady state effects

Since there is no population growth, $r\,B = Z$ and $W = S - Z / r$ in steady state. An increase in *B* will therefore require a higher τ or σ, a cut in *b*. From (4), we see that if *w* and π are constant, we obtain the following asset price:

[15] Increased generosity of unemployment insurance could reduce precautionary saving; see Engen and Gruber

(26) $$P = \frac{(1-\sigma)\pi}{rT}.$$

Let C denote aggregate consumption in any given period:

(27) $$C = c(y)L(w) + c(b)\big(1 - L(w)\big) + x.$$

The consumption of the young generation is therefore $C - x$. Moreover, $x = (1 + r)\,S$. Using the fact that the young's consumption can be expressed as $R - S$, $C = R + r\,S$. Hence:

(28) $$C = \underset{(-)}{R}(\underset{(-)}{\tau}, \underset{(?)}{b}, \underset{(0)}{\sigma}, \underset{(?)}{\beta}) + rS(\underset{(-)}{\tau}, \underset{(?)}{b}, \underset{(0)}{\sigma}, \underset{(?)}{\beta}) \equiv \underset{(-)}{C}(\underset{(-)}{\tau}, \underset{(?)}{b}, \underset{(0)}{\sigma}, \underset{(?)}{\beta}).$$

From the partial derivatives, we see that debt service through increased τ reduces C since both R and S decline. The corresponding effect of a cut in b cannot be signed unambiguously, however. If ε is large, the positive employment effect could dominate and increase C even though both y and b fall. If the increase in B is serviced by raising the profit tax, this will not affect C. Table 2 summarizes the steady state effects of a permanent increase in B, depending on the fiscal instrument used to service the debt. The comparative-static effects are straightforward to derive.

Table 2 **Long-run effects of increased public debt**

	Effect on:								
Debt service:	w	π	Y	S	R	P	W	C	*Union* welfare[a]
Increase in τ	+	–	–	–	–	–	–	–	–
Decrease in b	–	+	+	?	?	+	?	?	–
Increase in σ	0	0	0	0	0	–	–	0	0

[a] The random layoff model.

(1995). Such effects are not captured by the present model, which only focuses on life-cycle saving.

For example, the qualitative effects on union welfare basically follow from the fact that it is increasing in *w* in both union models. We can therefore conclude that steady state union welfare falls if the increased debt is serviced by an increase in τ or decrease in *b*, and does not change if σ is increased.[16]

It is also worth noticing that a Ricardian equivalence result follows from increased public debt through postponement of profit taxation; see line 1 in Table 2. Although *P* and *W* fall permanently, this fiscal policy has no real effects as long as the wage effect of a change in σ is zero.[17] To summarize:

PROPOSITION 1. *If future wage income taxes are increased to service the public debt, steady state employment, output, national wealth, asset price, aggregate consumption and union welfare decline. If future unemployment benefits are reduced, steady state union welfare declines, and employment, output and the asset price increase. If future profit taxes are increased, the asset price and national wealth decline. This policy has no effects on steady state employment, output, consumption and union welfare.*

Let us now take a closer look at the burden of increased debt on future generations if it is serviced by increased τ. We differentiate (28), using that $r\,B = Z$ and $d\tau = r\,dB / Z_\tau$:

$$-\frac{dC}{dB} = \frac{rL}{Z_\tau}\left[\left(1 + r(1-c_y)\right)(-y_\tau) + \left(y - b + r(S^y - S^b)\right)\frac{\varepsilon w_\tau}{w}\right]. \tag{29}$$

In (29), $S_y = (y - c(y))L$ is the saving of the employed and $S_b = (b - c(b))(1 - L)$ is the saving of the unemployed. It is instructive to compare this positive expression with the effect of increased *B* if there is no change in *w*. Then $w_\tau = 0$, $Z_\tau = w\,L$, $y_\tau = -w$, and (29) simplifies to

[16] There is no simple relation between union welfare and *C* in steady state. For example, a decrease in *b* lowers union welfare, but we cannot exclude that *C* increases. The main reason is that the union welfare function also includes leisure.

[17] The welfare of the first old generation does not change because the gain from the short run fall in the profit tax is equal to the present value of the future increase in profit taxes. This is an example of the danger of "deficit delusion": Creation of new public debt does not necessarily have an effect on the intergenerational distribution. For more examples, see Kotlikoff (2001).

(30) $$\frac{dC^f}{dB} = -r\left[1 + r\left(1 - c_y\right)\right].$$

We refer to this case at the full employment case, and C^f stands for aggregate consumption under full employment (L = 1). Since 1- c_y is positive, the decline in C is greater than $r\,dB$ because future generations save less as young due to their lower after-tax wage income, reducing the steady state capital income.[18]

Comparing (29) and (30), we cannot in general exclude the possibility that the debt burden is smaller under unemployment than under full employment. We observe that the last term in (29) is new. This term adds to the burden of the public debt because those who become unemployed cut their consumption. The term consists of two elements, the income differences between the employed and unemployed, (y - b) and r (S^y - S^b). The latter term represents the reduction in consumption as old due to lower first-period saving by the unemployed. A second difference between (29) and (30) relates to the first term in (29):

$$\frac{rL}{Z_\tau}\left(1 + r(1 - c_y)\right)(-y_\tau).$$

If ($-y_\tau$) L / Z_τ > 1, and the marginal propensities to save are the same, the real burden of the debt under unemployment must clearly be larger than under full employment. We cannot exclude, however, that the sum of the two terms in (29) is smaller than the single term in (30).

To see more clearly what is involved, let us consider the special case of homothetic utility. Then the employed and unemployed have the same rate of saving. Let s denote the common rate of saving. Now $S = s\,R$ and from (28), $C = (1 + r\,s)\,R$. Therefore, (29) simplifies to

(31) $$-\frac{dC}{dB} = r(1 + rs)\frac{-R_\tau}{Z_\tau}.$$

[18] This result also follows from the models of Persson (1985) and Fried and Howitt (1988). Persson showed that $-dW^*/dB = 1 + r\,(1 - c_y)$, which also comes out of the present model. Net foreign assets (W^*) decrease by more than the increase in B because the saving of the young declines.

Comparing (31) and (30), we see that the debt burden is larger under unemployment than under full employment if and only if $-R_\tau > Z_\tau$. Using (22), this condition is equivalent to

(32) $$\varepsilon + \sigma > 1.$$

Moreover, $-R_\tau = Z_\tau$ if and only if $\varepsilon + \sigma = 1$. We have thus proved:

PROPOSITION 2. *If utility is homothetic, the burden on future generations of public debt serviced by an increase in τ is larger the corresponding burden under full employment if and only if $\varepsilon + \sigma > 1$. The debt burdens are equal if and only if $\varepsilon + \sigma = 1$.*

The key to understanding this result is equation (21): $-R = Z - (wL + \sigma\pi)$. If the burden of the debt is largest under unemployment, the decline in R resulting from the increase in τ must be larger than the increase in Z, see (31). Therefore, $\varepsilon + \sigma > 1$. An elastic labor demand is sufficient for this condition to hold because if $\varepsilon > 1$, the tax-induced wage increase will then reduce wL in (21). This has a negative effect on R in addition to the effect running through Z. The profit tax rate enters condition (32) because profit taxes do not affect R, the disposable income of the young, only Z. When w goes up due to the increase in τ, profit tax revenues decline, decreasing Z without affecting R.

3.2. Dynamic effects

Let us now consider the effects on generation $t-1$ and t when the public debt is increased in various ways in period t. We first prove the following result:

PROPOSITION 3. *When the same fiscal instrument is used to create and service the debt, an unanticipated increase in B does not affect the consumption of the first old generation.*

The proof is shown in the Appendix. This result means that even though an unanticipated debt policy changes profits in the same period as the debt is created, the present value of future profits changes in the opposite direction if the same fiscal instrument is used to service the

debt in all future periods. The first old generation is therefore not affected after all. Table 3 presents the intergenerational welfare effects of various debt policies.

Table 3 **Welfare effects of debt policies under pay bargaining**

	First old generation	First young generation		Future generations	
Debt policy	Consump-tion	Union welfare[a]	Consump-tion	Union welfare[a]	Aggr. con-sumption
Postponement of labor income taxation (τ)	0	+	+	–	–
Postponement of profit taxation (σ)	0	0	0	0	0
Increasing unemployment benefits (b_t), reducing future b	0	+	?	–	?
A temporary cut in τ, increasing future σ	?	+	+	0	0
A temporary increase in b, increasing future σ	–	+	?	0	0

[a] The random layoff model.

First we look at the effects of a postponement of labor taxation. The qualitative effects are the same as in a full employment model in which w does not change. Due to Proposition 3, the first old generation is not affected even though P declines permanently. This is because present profits increase due to $w_\tau > 0$. The present young generation gains and all subsequent generations lose both in terms of aggregate consumption and union welfare; see Table 3, the first row. The new steady state is attained from period $t + 2$ and onwards, when generation t has left the economy. The policy increases employment and output in period t, but reduces future employment and output permanently (Proposition 1).

The second row in Table 3 confirms the Ricardian equivalence result from postponement of profit taxation that was mentioned in the previous section.

If the government creates new debt by increasing b_t, the first old generation is not affected if future benefits are cut to service the debt (Proposition 3). $L(w)$ and $Y(w)$ fall in period t and increase in all future periods, but union welfare changes in the opposite direction. Future aggregate consumption could increase or decrease, see Table 3, the third row.

Next we look at a debt policy involving a cut in τ_t and increased future profit taxes to service the debt. This case is interesting because the debt burden is *not* shifted on to future generations. In the present setting, this policy involves

$d\tau_t = -dB / Z_\tau < 0$ and $d\sigma_{t+j} = d\sigma = (r/\pi)\, dB > 0$.

The tax cut decreases w_t and increases y_t. Therefore employment, output, profits, the young's income and union welfare increase in period t. A fall in P is the only permanent effect of the policy. This is due to a higher future tax on profits, but does not involve any real effects on future consumption, employment or output. As before, the incidence of all future profit taxes is on the first old generation. To calculate the effect on x_t, we utilize that $T\, dP_t = -(\pi / r)\, d\sigma = -dB$ and $d\tau_t = -dB / Z_\tau$. Differentiation of (25) yields:

$$\frac{dx_t}{dB} = \left\{ -w_t + \left[1 - \tau_t + \frac{(\tau_t w_t + b_t)\varepsilon_t}{w_t} \right] w_{\tau,t} \right\} \frac{L_t}{Z_{\tau,t}}. \tag{33}$$

The term inside the square brackets is clearly positive. Due to the first negative term, however, the sign of (33) cannot be determined unambiguously, see Table 3, row 4. If w_τ is large, the total effect could be positive, leading to an *increase* in the welfare of generation $t-1$ as well. In this case the debt policy involves a Pareto improvement.[19] If the total effect is negative, the burden of the debt is shifted on to the old asset-holding generation. In any case,

[19] Recalling that the profit tax is neutral, it is not surprising that a swap from taxation of labor income to profits could lead to a Pareto improvement.

future generations are not affected by the policy even though σ increases permanently. The latter result clearly hinges critically on the neutrality of the profit tax.

Finally we note that if the debt is created by a temporary increase in b_t, employment and profits decline, reducing x_t, see Table 3, row 5. In this case, the debt is again shifted backwards from the young and to the old generation. We have thus shown:

PROPOSITION 4. *If B increases due to a temporary cut in* τ *and* σ *is increased permanently to service the debt, the first young generation consumes more without affecting C. The sign of the effect on x is indeterminate. If the debt is created by a temporary increase in b, the first young generation consumes more at the expense of the first old generation, not future generations.*

4. Increased bargaining power of unions

We now consider the effects of a permanent (and unanticipated) increase in the bargaining power of unions (β) in period *t*. Since $w_\beta > 0$, this will move the wage upwards along the demand for labor schedule and reduce employment, output and profits. From (15) we see that net tax revenues decline. Sooner or later, a fiscal policy restraint must therefore take place to fulfil the intertemporal budget constraint of the government. To avoid mixing the result with those of a permanent increase in public debt, we assume that the fiscal restraint is already taking place in period *t* such that that Z_t and B_{t+1} do not change. Suppose that τ is increased at once to keep *Z* and *B* constant at their initial levels. A new steady state is therefore established after one period. Differentiating (15), and setting $dZ = 0$, the necessary permanent increase in τ is

$$(34) \qquad d\tau = -\left(\frac{Z_\beta}{Z_\tau}\right)d\beta, \qquad Z_\beta = -\left((\varepsilon - 1)\tau + \sigma + \frac{\varepsilon b}{w}\right)Lw_\beta < 0.$$

The labor tax must increase since $Z_\beta < 0$ and $Z_\tau > 0$; see (16) and (18). We also note that the condition for $Z_\beta < 0$ is exactly the same as the condition for $Z_\tau < w\,L$. The tax increase will have an additional positive effect on *w*, reducing employment, output and profits further. The first old generation definitely loses due to lower present and future profits. The sign of the steady state effect of increased β on union welfare is ambiguous: The direct effect is positive, but the indirect effect working through a higher τ is negative. The effect on *C* could go either way as well. In order to derive a condition under which *C* declines, we look at the special case of homothetic utility to abstract from aggregate demand effects of the induced change in the income distribution between employed and unemployed workers. As shown previously,

$$C = (1+rs)R = (1+rs)\left(-Z + wL + \sigma\pi\right), \tag{35}$$

see (21). As before, *s* is the rate of saving of the young. Differentiating *C* with respect to β, using (34) and the derivative $\frac{dw}{d\beta} = w_\tau \frac{d\tau}{d\beta} + w_\beta$, yields:

$$\left.\frac{dC}{d\beta}\right|_\tau = \frac{(1+rs)(1-\varepsilon-\sigma)wL^2 w_\beta}{Z_\tau}, \qquad \frac{d\tau}{d\beta} = -\frac{Z_\beta}{Z\tau} > 0. \tag{36a}$$

It follows that the sign of this effect depends critically on the sign of $(1-\varepsilon-\sigma)$. The sign of this expression was also critical for deciding whether the burden of the public debt was larger or smaller than the debt burden in the case of full employment (Proposition 2). Let us now look at the effects of increased union power if the other fiscal instruments are used to keep *Z* and *B* constant. We then obtain the following effects:

$$\left.\frac{dC}{d\beta}\right|_b = \frac{(1+rs)(1-\varepsilon-\sigma)L(1-L)w_\beta}{-Z_b}, \qquad \frac{db}{d\beta} = -\frac{Z_\beta}{Z_b} < 0. \tag{36b}$$

$$\left.\frac{dC}{d\beta}\right|_\sigma = (1+rs)(1-\varepsilon-\sigma)Lw_\beta, \qquad \frac{d\sigma}{d\beta} = -\frac{Z_\beta}{Z_\sigma} > 0. \tag{36c}$$

Again we see that although the effects differ, their signs critically depend on the sign of $(1 - \varepsilon - \sigma)$. We have therefore proved the following result:

PROPOSITION 5. *In the case of homothetic utility, an unexpected increase in* β *-- followed by a fiscal restraint stabilizing Z and B – reduces C in steady state if and only if* $\varepsilon + \sigma > 1$. *The effect on C is zero if and only if* $\varepsilon + \sigma = 1$. *These conditions are invariant to the fiscal instrument used to stabilize Z and B.*

To understand this result, we see from (35) that since *Z* does not change, the effect on *C* works through the change in the term $(w\,L(w) + \sigma\,\pi(w))$, the derivative of which is $(1 - \varepsilon - \sigma)\,L$. Therefore, the sign of this derivative is crucial for the sign of the effect of an increase in β on *C*, independently of the fiscal instrument used to keep *Z* and *B* constant. It was the same derivative that was decisive for the comparison of the sizes of the debt burdens under unemployment and full employment (Proposition 2). The latter question was shown to depend on the sign of the sum $R_\tau + Z_\tau$, which again hinges on the sign of $(1 - \varepsilon - \sigma)$; see (22).

5. Conclusions

This paper has looked at intergenerational distribution effects of public debt when union power in pay bargaining generates structural unemployment in a small open economy. Changes in fiscal policy affect capital accumulation as well as the price of a fixed asset, which the old generation sells to the young. This asset price channel of intergenerational distribution effects is important in the present model because changes in wage income taxes and unemployment benefits affect the wage bargaining outcome.[20] This changes present and future profits that are capitalized in the asset price. The debt policies consist of two elements. First, in period *t*, the public debt is created by a temporary tax cut or spending increase. And then, from period $t + 1$ and onwards, fiscal policy is tightened sufficiently to stabilize the new

[20] It is therefore not unions and structural unemployment *per ce* that matter, but rather the impacts of wage taxes and unemployment benefits on wage setting. For a simulation study of the effects of tax cuts in four different models, including search equilibrium and efficiency wage models, see Pissarides (1998). He concludes that the models generate broadly similar results: "But if the unemployment benefits are not indexed to wages (and held fixed in real terms), the employment effects of tax cuts can be sizeable." (pp. 178).

debt over time. The intergenerational effects of debt policy are sensitive to whether future debt service payments are financed by increased taxes on labor or profits. Future labor income taxes hurt future generations, but changes in future profit taxes only affect the welfare of the old wealth owners (generation $t-1$). We showed that postponement of labor taxation redistributes consumption from future generations to the present young generation *t*, without changing the consumption of the first old generation, a result that is qualitatively similar to the corresponding effects in a model with full employment. Even if future employment and output fall due to the effect of increased wage income tax on the pay bargain, the debt burden on future generations is not always reinforced by future unemployment. We derived a simple condition under which the debt burden on future generations *is* reinforced by future unemployment, using the debt burden under full employment as a benchmark. This condition says that the sum of the profit tax rate and the wage elasticity of labor demand must be greater than one. If this sum is smaller than one, however, the favorable effect of the induced wage increase on the wage income tax base reduces the future burden of the debt compared to the full employment case. In contrast, a postponement of profit taxation has no real effects since the incidence of the present value of current and future profit taxes is on the old generation. Therefore, if the debt is increased by a temporary tax cut on labor income, and future profit taxes are increased to service the debt, the young generation gains at the expense of the first old generation. Hence, the burden of the debt is shifted backward to the first old generations, not forwards on future generations.

We also examined the effects of an unanticipated increase in the bargaining power of unions. The first old generation must lose due to a fall in current profits and the asset price. We showed that although increased union bargaining power depresses output permanently, the sign of the steady state effect on aggregate consumption is ambiguous. If the sum of the profit tax rate and the wage elasticity of labor demand is greater than one, however, future

aggregate consumption must decline. Therefore, the condition that causes an increase in union power to reduce future aggregate consumption is identical to the condition that leads to a larger public debt burden under unemployment than under full employment.

Appendix A1. The wage function

To derive the effect a marginal increase in τ on w in the union model in which lay-offs are by random draw, we first rewrite (10) when $\hat{\pi} = 0$, using (8), (11) and the equilibrium conditions:

$$(A1) \qquad yV_y(y) = \left(\varepsilon(w) + \frac{1}{\beta\mu(w)}\right)(V(y) - \ell - V(b))(1 - L(w)), \qquad \mu(w) \equiv \frac{\pi(w)}{wL(w)}$$

As before, $y = (1 - \tau)\, w$ and $\varepsilon(w) = -L_w w / L$. We note that since $\mu(w)$ is defined as the ratio of profits to labor cost, the first term on the RHS of (A1) is constant if the production function is Cobb-Douglas. Taking logs and differentiating with respect to τ, we obtain:

$$(A2) \qquad \frac{dw}{d\tau}\frac{1}{w} = \frac{1}{(1-\tau)\left[1 + \dfrac{\Phi(w) + \varepsilon(w)\Gamma(L(w))}{\Psi(y)}\right]}$$

In (A2), $\Gamma(L(w)) \equiv L(w) / (1 - L(w))$ is a decreasing function of w. The two other functions, $\Phi(w)$ and $\Psi(y)$ are defined as follows:

$$(A3) \qquad \Phi(w) \equiv \frac{\left[1 - \varepsilon(w) + \left(1/\mu(w)\right)\right] + (1 - \gamma(w) + \varepsilon(w))\beta\mu(w)\varepsilon(w)}{1 + \beta\mu(w)\varepsilon(w)}, \qquad \gamma(w) \equiv \frac{-L_{ww}w}{L_w},$$

$$(A4) \qquad \Psi(y) \equiv \theta(y) - 1 + \frac{yV_y(y)}{D(y)}, \qquad \theta(y) \equiv \frac{-V_{yy}(y)y}{V(y)}, \qquad D(y) \equiv V(y) - \ell - V(b).$$

The $\Phi(w)$ function reflects how the first term on the RHS of (A1), $\varepsilon + (1 / \beta\mu)$ reacts to a change in w. If the production function is Cobb-Douglas, $\varepsilon = 1 + (1 / \mu) = \gamma - 1$. Then we see from (A3) that $\Phi = 0$. If $\theta(y) > 1$, $\Psi(y) > 0$. In fact, it is easy to show that $\Psi(y) > 0$ if $V(y)$ is

isoelastic (θ constant), including the linear case ($\theta = 0$). The following conditions are necessary and sufficient for $w_\tau > 0$ in the wage function (12):

$$(A5) \qquad \Psi(y) > 0, \qquad \Psi(y) + \Phi(w) + \varepsilon(w)\Gamma(L(w)) > 0.$$

As we have seen, these are quite weak conditions that require large departures from isoelastic utility (as well as $\theta(y) < 1$) to be violated. We also see from (A1) that if

$$\Phi(w) + \varepsilon(w)\,\Gamma(L(w)) = 0,$$

$dy / d\tau \equiv y_\tau = 0$. In this special case, the union is able to prevent y from declining. We also exclude this possibility, and assume $y_\tau < 0$. Hence

$$(A6) \qquad \Phi(w) + \varepsilon(w)\Gamma(L(w)) > 0.$$

In regard to the effect on w of a marginal increase in b, a sufficient condition for $w_b > 0$ is (A6). As to w_β, it follows immediately from (9) $w_\beta > 0$. Moreover, $w_\sigma = 0$.

Appendix A2. Proof of Proposition 3

Anticipated consumption of generation $t-1$ is $x^a_t = (1 + r)(P_t T + K_t + W^*_t + B_t)$, i.e. it depends on P_t, which is equal to the anticipated present value of after-tax profits at the end of period $t - 1$ (see (4)). Therefore it suffices to show that the debt policy does not affect the latter. The result is obvious in the case of postponement of profit taxation because $w_\sigma = 0$. Consider a postponement of wage income taxation, i.e. $dB = -Z_\tau d\tau_t$, ($d\tau_t < 0$), and $d\tau_{t+\mathrm{j}} = r\,dB / Z_\tau$ for $j = 1,2,3\ldots$ Hence, $d\tau_{t+j} = -r\,d\tau_t$. The effects on present and future profits are $d\pi_t = L\,w_\tau dB / Z_\tau$ and $d\pi_{t+j} = -r\,L\,w_\tau dB / Z_\tau$ ($j = 1,2,3,\ldots$). Since P_t can be expressed as

$$P_t = \frac{(1-\sigma)}{(1+r)T}\left[\pi_t + \frac{\pi_{t+1}}{r}\right],$$

it follows that the present value of after-tax profits does not change. Hence, x_t does not change. A similar argument proves that x_t does not change if b is used to create and service the debt. ■

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