

# **Fiscal deficits, asset prices and intergenerational distribution in an open unionized economy**

by

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## **Abstract**

This paper focuses on intergenerational welfare effects of fiscal deficits in an OLG model with wage bargaining and equilibrium unemployment. Changes in wage and profit tax rates alter the intergenerational distribution by affecting capital accumulation as well as the price of a fixed asset. The welfare effect on the first old generation crucially depends on the tax instruments applied. The intergenerational welfare effects of postponing labor taxes are qualitatively similar to the effects in a model without unions. Increased union power will depress output and the asset price, but the sign of the welfare effect in steady state is nevertheless ambiguous.

JEL classification: E62, H60

*Acknowledgement:* I wish to thank Michael Hoel, Søren Bo Nielsen, Agnar Sandmo and seminar participants at EPRU (Copenhagen), University of Oslo and University of Bergen for comments on earlier versions of this paper.

**Keywords:** Fiscal deficits, Intergenerational welfare, Union power

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## 1. Introduction

As a result of the remarkable growth of public debt and unfunded social security in many OECD countries since the 1970s – amplified by population aging and the slow-down of productivity growth – the attention of economists as well as policy-makers has been drawn to the potentially harmful long-run effects of lenient fiscal policies on the distribution of welfare between present and future generations. Indeed, in the 1980s one witnessed an upsurge of research on the intergenerational welfare effects of fiscal deficits – including the international spill-over effects transmitted through global capital markets – see e.g. Blanchard (1985), Persson (1985), Frenkel and Razin (1986), Auerbach and Kotlikoff (1987), Kehoe (1987), Fried and Howitt (1988), Chang (1990), Auerbach, Gokhale and Kotlikoff (1991) and Buiter and Kletzer (1991). Building on the seminal contributions by Samuelson (1958) and Diamond (1965), this literature has identified two distinct channels through which public debt policy affects intergenerational distribution, namely capital accumulation and price changes of assets traded among members of different generations.<sup>1</sup>

In this literature, the labor market is conventionally assumed to be perfectly competitive. In many OECD countries, however – particularly European countries where union power in wage bargaining is institutionalized<sup>2</sup> – rates of unemployment and public spending on unemployment benefits have been quite high for a long time. This suggests that the real burden of public debt and unfunded social security should not be seen in isolation from the burden of high equilibrium unemployment. Indeed, it could be worthwhile to extend the analysis of intergenerational welfare effects of public debt to an analytical framework permitting union power in wage bargaining, equilibrium unemployment and public spending on

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<sup>1</sup> The asset price effect plays a crucial role in Fried and Howitt (1988). A related study with a somewhat different focus is Chamley and Wright (1987).

<sup>2</sup> 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.

unemployment benefits. This extension of the analysis could also clarify the extent to which previous results in this literature hinge on the assumption of a perfectly competitive labor market. Since workers and capital owners on average represent different age groups, wage bargaining between labor and capital opens up an additional channel of intergenerational redistribution which is not present in competitive overlapping generations models. Taking wage bargaining and unemployment benefit rules into account could therefore add to our understanding of the intergenerational welfare effects of fiscal deficits and unfunded social security in unionized economies.<sup>3</sup>

This paper intends to cast light on these questions. We analyze an overlapping generations model of a small open unionized economy in which the government's debt policy affects intergenerational distribution through capital accumulation and asset price changes. The model also permits an analysis of the distribution of welfare between employed and unemployed individuals, as well as of the distribution and welfare effects of changes in the bargaining power of trade unions. Although there has been a growing interest in trade union behavior in the context of long-run growth models (see e.g. Devereux and Lockwood (1991) and Croix and Licandro (1995)), so far the intergenerational welfare effects of fiscal deficits have not received much attention.<sup>4</sup>

In the next section, we present the model. Section 3 analyzes the transitional and stationary equilibrium effects of a permanent increase in public debt. Section 4 considers the intergenerational distribution effects of increased union power. The conclusions are summarized in the final section.

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<sup>3</sup> As demonstrated by Devereux and Lockwood (1991), bargaining between unions and capital owners could matter for intergenerational distribution even if full employment prevails. Our focus is however different from the latter paper which was concerned with the general equilibrium effects of a move from binding to non-binding wage/employment contracts.

<sup>4</sup> An interesting paper by Jensen (1997) adopts a computable overlapping generations model of the Blanchard (1985) type to address the public debt problem in Denmark. Apart from the questions that are addressed, the modeling of union behavior and asset markets are also quite different from ours, however.

## 2. An overlapping generations model with a fixed asset

Our analytical framework is an overlapping generations model of a small open one-sector economy with a constant population. In each period there are two generations, a young which supplies labor and saves for retirement, and an old retired generation which consumes its accumulated wealth. Domestic output ( $Y$ ) is the numeraire goods which is traded in a competitive world market. The real rate of interest ( $r$ ) is positive and exogenous. Technology is defined by a neoclassical aggregate production function  $Y_t = F(L_t, K_t, T)$ , which exhibits constant returns to scale.  $L_t$  is labor input in period  $t$ . There is no international labor mobility. The full employment labor supply is normalized to 1.  $K_t$  is a reproducible stock of capital at the beginning of period  $t$ . It is a perfect substitute for the consumption good.  $T$  is a stock of domestic capital which is fixed in supply (like land) and owned by domestic agents. Assuming that factor prices are equal to their marginal products, aggregate (before-tax) profit ( $p_t$ ) is

$$(1) \quad p_t = Y_t - w_t L_t - r K_t = m_t T$$

where  $m_t$  is the marginal product of fixed capital and  $w_t$  is the real wage. There is no physical depreciation. National (non-human) wealth at the end of period  $t$  ( $W_{t+1}$ ) is

$$(2) \quad W_{t+1} = K_{t+1} + P_t T + W_{t+1}^f = S_t - B_{t+1}$$

where  $W_{t+1}^f$  is foreign assets,  $B_{t+1}$  is the stock of real public debt, and  $S_t$  is the saving of the young generation in period  $t$ . It purchases  $T$  at the end of period  $t$  at price  $P_t$  and resells it to the next generation at price  $P_{t+1}$ .

There is a government which issues debt, offers unemployment benefits, and collects taxes on wage income and profits. The exogenous tax rates are  $\tau_t$  and  $S_t$ , respectively. The following arbitrage condition must be fulfilled in equilibrium:

$$(3) \quad \frac{(1 - S_{t+1})m_{t+1} + P_{t+1}}{P_t} = 1 + r$$

The LHS of (3) is the gross return from possessing one unit of  $T$  from period  $t$  to period  $t+1$ .

This must equal the gross return on foreign assets and reproducible capital,  $1+r$ .

## 2.1 The full employment equilibrium

We first look at the bench-mark case of full employment and no unions. The budget constraint of the government is  $B_{t+1}=(1+r)B_t-t_t w-S_t p_t$ . In this case there is no public spending on unemployment benefits. The decision problem of generation  $t$  is to maximize utility  $u(c_t, x_{t+1})$  subject to the intertemporal budget constraint  $c_t+(1+r)^{-1}x_{t+1}=y_t$ , where  $y_t=(1-t_t)w$  is after-tax wage income. Consumption in the two periods ( $c$  and  $x$ ) are both normal goods. The consumption function of the young is  $c(y_t)$ , where the marginal propensity to consume ( $c_y$ ) is positive and less than one. Hence, the young generation saves  $S_t=y_t-c(y_t)$ . In the competitive equilibrium, both  $w$  and  $m$  must be constant over time. If the profits tax rate is constant, it follows from (2) that the constant asset price is:

$$(4) \quad P = \frac{(1-S)m}{r}$$

To analyze the effects of fiscal policies involving an increase in public debt, the economy is assumed to be in a steady state initially. In period  $t$ , before the young generation buys the fixed capital from the old generation, an unanticipated change in fiscal policy is announced and implemented. This could trigger a jump in the equilibrium price of the fixed asset ( $P_t$ ) due to capitalization effects, changing the consumption ( $x_t$ ) of the old generation (generation  $t-1$ ).

The latter must be equal to

$$(5) \quad x_t = (1-S_t)p_t + P_t T + (1+r)(K_t + W_t^f + B_t)$$

The unanticipated policy cannot change the three last terms in this expression. Hence, the policy can only affect the consumption of the old generation if the sum of the two first terms

changes. Let us consider an increase in public debt  $dB_{t+1} = -wdt_t$  in period  $t$ , brought about by a temporary cut in the wage tax for generation  $t$  ( $dt_t < 0$ ). From period  $t+1$  and onwards, all succeeding generations must pay higher taxes  $dt_{t+1} = r dB_{t+1}/w$  to service the increased public debt. Since neither current profits nor the asset price are affected by the policy (see (4) and (5)), the consumption of the old generation in period  $t$  ( $x_t$ ) does not change. Therefore, the intergenerational welfare effects are the same as in models without an endogenous asset price, see Persson (1985). Clearly, generation  $t$  will enjoy more consumption at the expense of all future generations. The new stationary equilibrium will be established after two periods, i.e. when generation  $t$  is gone. The stocks of foreign assets and national wealth will decrease in two steps because generation  $t$  will save some of its tax benefits for retirement consumption. The steady state effect on national wealth is

$$(6) \quad \frac{dW}{dB} = -1 - r(1 - c_y) < -1$$

where  $(1 - c_y)$  is the young generation's marginal propensity to save. National wealth decreases by more than the increase in  $B$  because future generations save less due to their lower after-tax wage income.

The intergenerational welfare effects of public debt depend critically on the tax instrument applied however. To illustrate, let us consider two alternative tax policies leading to the same increase in public debt as above. First, suppose that the *profits tax* and not the wage tax is increased to service the public debt in all future periods. As before, we let a temporary tax cut on wage income create the fiscal deficit in period  $t$ . Now  $dB_{t+1} = p dS_{t+1}/r$ . Using (4), the capitalization of higher future profits taxes depreciates the value of fixed capital by  $TdP = -p dS/r = -dB$ , i.e. the value falls by the same amount as the increase in public debt. Since the first term on the RHS of (5) does not change, the first old generation loses and must

necessarily cut its consumption, while the first young generation gains from the policy. The welfare of future generations does not change because the advantage of buying the depreciated fixed capital exactly offsets the higher profits tax. Hence, in this case the burden of the public debt is shifted *backwards* on the old generation in period  $t$  without affecting future generations.<sup>5</sup>

Finally, consider an unanticipated debt increase brought about by a temporary cut in the *profit* tax, and assume that the government announces a higher future profits tax to service the debt. The asset price will fall permanently as above, but now the consumption of the first old generation will not change because the tax cut  $pdS_t$  exactly offsets the capital loss (since  $rdS_{t+1} = -dS_t$ ). Hence, the sum of the two first terms on the RHS of (5) does not change. Neither the welfare of the first young generation nor all future generations will be affected. Thus, this particular debt policy implies Ricardian equivalence despite the absence of intergenerational altruism (see Barro (1974)).

## 2.2 Unions, wage bargaining and unemployment

We now introduce labor unions and take into account unemployment and public spending on unemployment benefits. Behind the aggregate production function there is a fixed number of pairs of firms and unions engaged in wage bargaining. Workers are immobile and unions firm-specific, each one representing the workers of that particular firm.<sup>6</sup> Firms are free to make their employment and investment decisions after the wage settlement (the right-to-manage assumption). Aggregate unemployment in period  $t$  is  $1-L_t$ . As before, profit maximization

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<sup>5</sup> From (2), it is easy to show that the stationary national wealth decreases due to the lower asset price because private saving by the young ( $S$ ) does not change.

<sup>6</sup> We assume for simplicity no mobility of labor between firms and no nation-wide wage settlements. As shown by Hoel (1991), both mobility and centralization could matter for real wages and aggregate employment.

yields a downwards sloping labor demand function  $L_t = n(w_t)$ . The profit function is  $p(w_t)$ , where  $p_w = -L$ .

Turning to union preferences, we assume that the utility functions of the employed and unemployed are identical except for a constant  $g$  representing the disutility of work. Hence  $u(c_t, x_{t+1}) - g$  is the utility of an employed individual. The indirect utility functions of the two groups are written  $v(y_t) - g$  and  $v(b_t)$ , where  $y_t$  is after-tax wage income of the employed workers and  $b_t < y_t - \gamma$  is the unemployment benefit. Of course,  $v_y > 0$  and  $v_b > 0$ . The indirect utility function is strictly concave. We let the union's welfare function be the expected utility of a representative member:

$$(7) \quad \Omega_t^U = D_t n(w_t) + v(b_t),$$

where  $D_t = v(y_t) - v(b_t) - g > 0$  is the utility difference between employed and unemployed individuals. Following Devereux and Lockwood (1991), we can think of the underlying bargaining process as dynamic. In the first stage, the firm unilaterally chooses the level of capital, and at the second stage, conditional on this, the firm and union bargain over the wage. Due to zero capital adjustment costs, the dynamic bargaining problem can be reduced to a static one in which the maximand (8) is independent of future interest rates and the utility of future union members. Letting the utility as unemployed represent the union's threat point, the Nash bargaining outcome is the wage that maximizes

$$(8) \quad \Omega_t = b \log(D_t n(w_t)) + \log((1 - s_t)p(w_t))$$

The parameter  $b$  represents the bargaining power of unions. Maximizing (8) yields the following wage function:

$$(9) \quad w_t = w_{(+)(+)(0)(+)}(t, b, s, b)$$



The signs of the partials are shown beneath the arguments in (9), see the Appendix. The effects of increased benefits ( $w_b$ ) and union power ( $w_b$ ) on the bargained wage are both positive, and the effect of an increased profits tax ( $w_s$ ) is zero. It is well known from the literature on union wage setting that the sign of the tax effect ( $w_t$ ) is ambiguous, see e.g. Lockwood and Manning (1993). A sufficient condition for a positive tax effect is that the absolute value of the elasticity of the demand for labor ( $\epsilon$ ) is not smaller than one, see the Appendix. According to Layard and Nickell (1986), the tax effect is likely to be positive.

Adding unemployment benefit spending, the government's budget constraint is

$B_{t+1} = (1+r)B_t - Z_t$ , where  $Z_t$  is net tax revenues:

$$(10) \quad Z_t = t_t w_t n(w_t) - (1 - n(w_t))b_t + s_t p(w_t)$$

An important property of (10) is the marginal effect on  $Z_t$  of a change in the real wage ( $w_t$ ):

$$(11) \quad \frac{\partial Z}{\partial w} = -aL, \quad a = \frac{\epsilon b}{w} - (1 - \epsilon)t + s$$

The sign of  $a$  is ambiguous. The effect on net tax revenues is definitely negative ( $\alpha > 0$ ) if the demand for labor is elastic ( $\epsilon > 1$ ), but it could be positive ( $\alpha < 0$ ) if labor demand is sufficiently inelastic. In the latter case, the positive effect on wage tax revenues dominates the combined effect on  $Z$  of increased expenditures on unemployment benefits and lower profit tax revenues.

Using the wage function (9),  $Z_t$  can be written as a function of the fiscal instruments and union power (see the Appendix):

$$(12) \quad Z_t = Z(\underset{(+)}{t}, \underset{(-)}{b}, \underset{(+)}{s}, \underset{(?)}{b})$$

A priori we cannot exclude the possibility of adverse effects of  $t$  and  $b$  on net tax revenues. We assume, however, that  $Z_t > 0$  and  $Z_b < 0$ .

### 2.3 Saving, assets and union welfare

Aggregate private saving of generation  $t$  ( $S_t$ ) is

$$(13) \quad S_t = L_t S_t^y + (1 - L_t) S_t^b \equiv S(\underset{(-)}{t}, \underset{(?)}{b}, \underset{(0)}{S}, \underset{(?)}{b})$$

In (13),  $S_t^y = y_t - c(y_t)$  is the saving of an employed individual and  $S_t^b = b_t - c(b_t)$  is the saving of an unemployed ( $S^y > S^b$ ). The aggregate private savings function ( $S$ ) in (13) reflects the labor demand function  $L = n(w)$  as well as the wage function (9). The properties of the savings function are examined in the Appendix. The labor tax effect ( $S_t$ ) is negative because a tax increase reduces the incomes of both groups. The sign of the effect of an increase in benefits ( $S_b$ ) is indeterminate since those who loose their jobs will save less than before. An increase in the profits tax has neither an effect on  $w$  nor on private saving ( $S_s = 0$ ). Increased union power ( $b$ ) has an ambiguous effect on aggregate private saving because the wage hike increases the saving of the employed and reduces the saving of those who loose their jobs.

We now look at the determinants of the asset price, national wealth and union welfare in steady state. Using the profits function  $p(w) = mT$  and the wage function (9), the asset price (4) can be written as a function of the fiscal instruments and union power:

$$(14) \quad P = P(\underset{(-)}{t}, \underset{(-)}{b}, \underset{(-)}{S}, \underset{(-)}{b})$$

In steady state,  $rB = Z$ , and using (2), (10) and (13), national wealth can be expressed as

$$(15) \quad W(\underset{(-)}{t}, \underset{(?)}{b}, \underset{(-)}{S}, \underset{(?)}{b}) \equiv S(\underset{(-)}{t}, \underset{(?)}{b}, \underset{(0)}{S}, \underset{(?)}{b}) - \frac{1}{r} Z(\underset{(+)}{t}, \underset{(-)}{b}, \underset{(+)}{S}, \underset{(?)}{b})$$

Finally, consider the partial effects of changes in  $t$ ,  $b$ ,  $S$  and  $b$  on union welfare (7) in steady state. We first look at the effect of a change in the real wage:

$$(16) \quad \frac{\partial \Omega^U}{\partial w} = (1 - t)v_y L + Dn_w > 0$$

Applying the first-order condition, it is easy to see that this derivative must be positive, see (A1) in the Appendix. Moreover, using (16), the union welfare function can be written

$$(17) \quad \Omega^U = \Omega^U(\underset{(-)}{t}, \underset{(+)}{b}, \underset{(0)}{s}, \underset{(+)}{b})$$

### 3. Effects of fiscal deficits

There are three ways in which to service a higher future government debt: 1) Increased wage tax, 2) decreased unemployment benefits, and 3) increased profits tax. The comparative-static results (in steady state) of these three experiments are summarized in Table 1. Increasing  $t$  (line 1), increases the wage, depresses profits, output, saving and the asset price, reducing national wealth and union welfare. Reducing unemployment benefits leads to quite different results (line 2). Now the wage decreases, boosting profits, output and the asset price. Nevertheless, national wealth and union welfare fall, just as in line 1 in Table 1. Increasing the profits tax rate (line 3) does not affect the wage or output, but triggers a fall in the asset price and the value of national wealth. Long-run union welfare does not change in this case.

The long-run effects of increased debt and taxes in Table 1 (line 1) are qualitatively similar to the corresponding effects in the competitive model discussed in section 2 above. This can be shown by looking at the steady state effect on national wealth of an increase in  $B$

$$(20) \quad \frac{dW}{dB} = -1 + \frac{rS_t}{Z_t} < -1.$$

The effect on  $W$  is greater than the change in  $B$  because  $S_t < 0$  and  $Z_t > 0$ , see (13) and (14). This effect is quite similar to the case of a market clearing real wage, compare (6) above. A difference though, is that in a unionized economy the induced wage effect of increased taxes depresses employment, output and the asset price. The long-run effects of an increase in  $S$  are also qualitatively similar to the corresponding effects in the competitive case. In particular, the debt neutrality result of section 2 carries over to the unionized economy because the change in

the profits tax does not affect the wage settlement. Due to the capitalization effect, the increased profit tax does not represent a burden on future generations.

### 3.1 *Transitional effects*

We now consider the transitional effects of a temporary cut in the labor income tax rate ( $t_t$ ) in period  $t$ . The policy change is not anticipated and occurs before the fixed capital  $T$  is sold to the young generation. The new stationary equilibrium will materialize after two periods, i.e. when generation  $t$  is gone. Therefore, it is sufficient to consider the welfare effects on three groups: 1) the first old generation ( $t-1$ ), 2) the first young generation ( $t$ ), and 3) all future generations. The results are reported in Table 2.

As already reported in Table 1, future generations loose if the increased debt is serviced by either a higher  $t$  or a lower  $b$ , and are not affected by a higher  $S$ . Generation  $t$  must clearly gain in all three cases since it is neither affected by asset price depreciation nor by the future cut in  $b$ . The welfare of generation  $t-1$  depends on the sum  $(1-S_t)p_t + P_t T$ , see (5). The change in current after-tax profits is  $-(1-\sigma)Lw_t dt$  in all three cases reported in Table 2. The asset price effect will however depend on how the debt is serviced in the future. In the first case (an increase in  $t$ ), the positive effect on  $P_t$  will exactly cancel the effect on current profits, i.e. the welfare of generation  $t-1$  does not change. In the second case (a decrease in  $b$ ), the asset price increases because a fall in future wages will increase profits. Hence, the welfare of generation  $t-1$  will clearly increase. The last case (a permanent increase in  $S$  to service the debt) involves a welfare effect of an ambiguous sign. To see this we utilize that in steady state  $TdP = -(p/r)dS$  and  $dS = (r/p)dB$ . Differentiation yields the following effect on the consumption of generation  $t-1$ :

$$(21) \quad \frac{dx}{dB} = \frac{\left\{ \left( 1 - t + \left( \frac{b}{w} + t \right) e \right) w_t - w \right\} L}{Z_t}$$

Since the numerator has an ambiguous sign, the sign of this effect cannot be determined unambiguously. If the wage effect of the temporary tax cut ( $w_t$ ) is large, the numerator could be positive, leading to an *increase* the welfare of generation  $t-1$  as well (since  $Z_t > 0$ ), i.e. in this case the debt policy involves a Pareto improvement. Since the equilibria we are considering involve inefficiency in terms of unemployment, Pareto-improving fiscal policies are clearly possible.

#### 4. The effects of increased union power

In this section we examine how union power affects national income and wealth as well as intergenerational distribution of welfare. Suppose that the economy is in a steady state and that  $b$  increases (permanently) in period  $t$ . This will move the wage upwards along the labor demand curve and reduce profits. The wage increase will however also affect the public sector net surplus ( $Z_t$ ), see (12). Knowing already the effects on intergenerational welfare of a change in public debt, we assume that the labor tax rate ( $t$ ) is permanently changed at once to counteract any effect of the change in  $b$  on  $Z$  and the future public debt. Differentiating (11), the induced tax rate effect of a change in  $b$  such that  $dZ=0$  is

$$(22) \quad \frac{dt}{db} = \frac{a w_b L}{Z_t} \quad (dZ = 0)$$

The sign of this derivative is ambiguous since  $a$  could be positive or negative. Differentiating the wage function (8) with respect to  $b$  and using (22), the final effect on  $w$  is

$$(23) \quad \frac{dw}{db} = \frac{w L w_b}{Z_t} > 0 \quad (dZ = 0)$$

Hence, the wage will increase and generate more permanent unemployment. The wage increase will hurt the first old generation because current profits will fall and the expected fall in future profits will depreciate the asset price. The first young and all subsequent generations will be affected in the same way by the increase in union power. Therefore, the new steady state will be attained after one period.

The increase in  $w$  will reduce output and employment permanently. Still, the saving of each young generation and thus the stock of national wealth could increase. We now look for conditions which help to sign the effects on national wealth and welfare of a permanent increase in union power. National wealth will increase if and only if aggregate saving of the young generation increases, see (16). Differentiating the savings function (14) with respect to  $b$ , and using (22), yields:

$$(24) \quad \frac{dS}{db} = \frac{w_b L^2}{Z_t} \left[ (1 - c_y)(1 - t - a) - (S^y - S^b)e \right] \quad (dZ = 0)$$

The sign of this expression is ambiguous. If the first term inside the square brackets is negative ( $1 - \tau - \alpha < 0$ ), however, the total effect must be negative. In this case those who continue to be employed after the wage increase saves less due to a strong induced tax effect. Using the definition of  $a$  (see (12)), this condition can be expressed as a lower limit for the elasticity of the demand for labor:

$$(25) \quad e > \frac{(1 - s)w}{b + tw}$$

This is a sufficient (but not necessary) condition for the derivative in (24) to be negative. It is also sufficient for the effect on union welfare ( $W^U$ ) to be negative. The critical value on the RHS of (25) could be greater or smaller than one, since both the numerator and the denominator must be smaller than  $w$ .

We now derive a condition under which national wealth definitely will increase in steady state if union power increases. Assuming homothetic preferences, the savings functions of the employed and unemployed can be expressed as  $S^y = sy$  and  $S^b = sb$ , where  $s$  is the common rate of saving. Now equation (24) simplifies to

$$(26) \quad \frac{dS}{db} = \frac{w_b L^2 w s}{Z_t} (1 - e - s) \quad (dZ = 0)$$

Hence, if  $e < 1 - s$ , the effect on national wealth in steady state will be positive if preferences are homothetic.

## 5. Conclusions

We have showed that an unanticipated wage tax cut which increases public debt permanently (and which occurs before the fixed capital is sold to the young generation), leads to a temporary increase in aggregate output and employment due to the wage bargaining response. In the new steady state, however, a higher wage tax to service the debt reduces output, employment and welfare. Hence, the debt policy redistributes welfare from all future generations to the first young generation just as the competitive case. The welfare of the first old generation does not change in this case because temporarily higher profits compensate for a lower resale value of fixed capital. If, however, the future unemployment benefit rate is decreased to balance the budget, future output and employment increase. This will benefit the first old generation because the asset price appreciates. Hence, the intergenerational welfare effects of fiscal deficits depend critically on the tax instruments applied to increase and service the debt. The intergenerational welfare effects could even be reversed and only hurt the first old generation if the capital market anticipates that the profit tax is going to be used to service the debt in the future. The capitalization effect on the asset price will then relieve future asset

owners from the entire tax burden. If the fiscal deficit is generated by a profit tax cut, we showed that no intergenerational redistribution occurs (Ricardian equivalence). This is also the case if there is no union power. If a wage tax cut generates the fiscal deficit, however, the sign of the welfare effect on the first old generation is ambiguous. It could be positive, in which case the policy involves a Pareto improvement.

The effects of increased union power were also considered, assuming that the wage tax rate was adjusted to prevent fiscal deficits. The first old generation will lose because profits as well as the asset price will fall. Increased union power will depress output and the asset price, but the sign of the welfare effect in steady state is nevertheless ambiguous and could be positive if the demand for labor is sufficiently inelastic.



## Appendix

To derive the wage function (8), we maximize (7) with respect to  $w_t$ . Omitting time subscripts, the first-order condition is

$$(A1) \quad \Omega_w = \frac{b(1-t)v_y}{D} + \frac{bn_w}{L} + \frac{-L}{p} = 0, \quad D = v(y) - v(b) - g$$

This condition can be expressed as

$$(A2) \quad \frac{yv_y}{\frac{wL}{pb} + e} = D$$

As before,  $y=(1-t)w$ . Assuming that the second-order condition is satisfied, the sign of  $w_t$  must be the same as the sign of the cross derivative:

$$(A3) \quad \Omega_{wt} = \frac{-bv_y}{D^2} \left[ D + \frac{Dyv_{yy}}{v_y} - yv_y \right]$$

To derive sufficient conditions for  $W_{wt}$  to be positive, we first note (using (A2)) that the expression inside the square brackets in (A3) is negative if and only if

$$(A4) \quad \frac{wL}{pb} + e - \frac{yv_{yy}}{v_y} > 1$$

By direct inspection of (A4), it is evident that condition (9a) in the text is sufficient for (A4) to hold (for  $w_t$  to be positive). Moreover, using (A2) we also see that condition (9b) is equivalent to (9a). The positive sign of  $w_b$  follows from the sign of the cross derivative:

$$(A5) \quad \Omega_{wb} = \frac{b(1-t)v_y v_b}{D^2}$$

which is clearly positive. Moreover,  $w_s$  is zero since  $W_{ws}=0$ .

### *The net tax function*

Differentiating (11) with respect to  $t$ ,  $b$ ,  $s$  and  $b$  yields:

$$\begin{aligned}
(A6a) \quad & Z_t = (w - a w_t) L \\
(A6b) \quad & Z_b = -1 + (1 - a w_b) L \\
(A6c) \quad & Z_s = p \\
(A6d) \quad & Z_b = -a w_b L
\end{aligned}$$

Since the sign of  $a = (eb/w) - (1-e)t + s$  is ambiguous, it is only possible to determine the sign of  $Z_s$ , which is positive. It is natural to assume that  $Z_t$  is positive and  $Z_b$  is negative. These assumptions involve the following two restrictions on  $a$ ,  $w_t$  and  $w_b$ :

$$(A7) \quad \frac{-(1-L)}{w_b} < a < \frac{w}{w_t}$$

*The savings function*

Omitting time subscripts, the aggregate saving of the young generation is

$$(A8) \quad S = n(w)(y - c(y)) + (1 - n(w))(b - c(b))$$

We first differentiate (A8) with respect to  $w$ :

$$(A9) \quad \frac{\partial S}{\partial w} = \left\{ (1 - c_y)y - (S^y - S^b)e \right\} \frac{L}{w}$$

The sign is ambiguous since the first term is negative and the second positive. Inserting the wage function (8) into (A8), we obtain the function  $S = S(t, b, s, b)$  with the following partials:

$$(A10a) \quad S_t = -\frac{1}{w} \left\{ (S^y - S^b)e L w_t + (1 - c_y) w Z_t \right\}$$

$$(A10b) \quad S_b = \frac{\partial S}{\partial w} w_b + (1 - c_b)(1 - L)$$

$$(A10c) \quad S_s = \frac{\partial S}{\partial w} w_s = 0$$

$$(A10d) \quad S_b = \frac{\partial S}{\partial w} w_b$$

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**Table 1 Long-run effects of increased public debt**

Policy	Effect on:							
	$w$	$p$	$Y$	$P$	$S$	$W$	$W^*$	$W^U$
experiment:								
Increase in $t$	+	–	–	–	–	–	?	–
Decrease in $b$	–	+	+	+	?	–	–	–
Increase in $\sigma$	0	0	0	–	0	–	?	0

*Table 2 Welfare effects of increased public debt (a temporary cut in  $\tau$ )*

Policy instrument for servicing the debt	First old generation	First young generation	Future generations
Increase in labor tax ( $t$ )	0	+	–
Decrease in unempl. benefits ( $b$ )	+	+	–
Increase in profit tax ( $\sigma$ )	?	+	0