A note on trade unions, unemployment insurance and endogenous growth

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Abstract One of the most important economic problems in Europe today is the apparently permanent high rate of unemployment associated with unionised labour markets. The effects of unionisation on economic growth are recognised by the most part of the growth theoretical literature framed in the standard overlapping generations model to be either negative (Daveri and Tabellini, 2000) or at most neutral (Corneo and Marquardt, 2000), with some exceptions (e.g., Irmen and Wigger, 2002). Developing a model in line with this strand of literature, we show a rather unusual result: the unionisation of the labour market in the conventional double Cobb-Douglas economy may always promote economic growth when unemployment benefits are financed by a consumption tax rather than a wage tax, and the union's preference weight on raising wages is sufficiently low.

Keywords Endogenous growth; OLG model; Unions; Unemployment

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1. Introduction

One of the most important economic problems in Europe today is the apparently permanent high rate of unemployment experienced especially in countries with unionised labour markets. Theoretical studies using the standard overlapping generations (OLG) model to examine the effects of unionization on economic growth have generally found negative (Daveri and Tabellini, 2000) or at best neutral effects (Corneo and Marquardt, 2000). An exception is Irmen and Wigger (2002), who compared the growth performance of an economy with unionised labour and unemployment with that of a competitive equilibrium economy with full employment in a two-period OLG context where a Romer-type externality represents the engine of endogenous growth.[1] In particular, they viewed a trade union as an institution that can (*i*) transfer resources from the old (dissavers) to the young (savers), and (*ii*) influence the factor income distribution in the whole economy, thus affecting aggregate savings.

Since only the young save in the OLG context, an increase in wages may enhance savings, which may in turn raise economic growth despite a corresponding reduction in the employment rate. Irmen and Wigger (2002) showed in fact that a rise in the relative importance the union puts on raising wages rather than maintaining employment (and thus a higher unemployment), spurs economic growth if the sum of the elasticity of substitution between capital and efficient labour and the output elasticity of efficient labour is smaller than unity, because saving increases in that case. This means that a union-growth-enhancing mechanism is triggered if and only if the degree of substitutability between the production inputs and the reduction in output due to the reduced employment rate are both low enough.

[1] In a context different from the OLG model, another exception is represented by Aghion and Howitt (1994), who exploited the Schumpeterian idea of creative disruption to show that the unemployment occurrence can actually promote economic growth.

Different from Irmen and Wigger (2002), in this paper we consider a double Cobb-Douglas economy and we introduce the fiscal sector (represented by an unemployment benefit system financed at a balanced budget by the government) in a context where the labour market is unionised and, hence, involuntary unemployment exists.

The objective of this paper, therefore, can roughly be captured by the following question: can unionised-wage economies with unemployment grow faster than competitive-wage economies with full employment when both the utility and production functions are of the Cobb-Douglas type? The answer is yes, provided that individuals belonging to the working-age cohort are entitled to (even infinitesimal) benefit payments for the time of unemployment.

In particular, similar to Corneo and Marquardt (2000) and Daveri and Tabellini (2000), we build a simple OLG model of endogenous growth that highlights both a wage setting union's formulation and a public provided unemployment benefit system. According to Corneo and Marquardt (2000) and different from Daveri and Tabellini (2000), (*i*) the union's wage-setting programme is assumed to be of the "right-to-manage" type (where the union cares about wages and employment and then seeks to set the wage above the competitive level), rather than the "monopoly wage-setting union"; and (*ii*) the productivity parameter in the production function is assumed to be proportional to the average *per worker* (rather than *per capita*) stock of capital in the economy.[2] As to this point, we

[2] Notice that, similar to Corneo and Marquardt (2000) and different from Daveri and Tabellini (2000), Irmen and Wigger (2002) considered a trade union (formed by the young working-age population) who cares about wages and employment and then fixes the wage over the prevailing competitive level, while allowing firms to freely choose the employment rate on the basis of their labour demand curves. However, similar to Daveri and Tabellini (2000) and different from Corneo and Marquardt (2000), they assumed the productivity parameter of the learning-by-investing externality to be equal to the average *per capita* (rather than *per worker*) stock of capital in the economy, but assuming however the existence of one individual per generation only. Even with the assumption of a single individual per generation, the existence of unions and unemployment makes the distinction between per capita and per worker stock of capital as an index of labour efficiency in the production function relevant for the results, because the representative agent is partially unemployed in this context.

note that in a context with unemployment, assuming the production externality to be defined in either per worker or per capita terms may lead to different final outcomes as regards economic growth and the unemployment dynamics.[3] We think however that assuming the labour productivity index in the production function to be influenced by the learning-by-doing of the employed rather than that of all the young (employed and unemployed) individuals in the economy is still in the spirit of the seminal Romer (1986), in which learning-by-doing is precisely the engine of growth.[4] *A fortiori*, thinking about the existence of a positive production externality also determined by the stock of capital per unemployed is at odds with the common belief that the unemployment time may actually reduce the skills of individuals, thus favouring – loosely speaking – a process of "unlearning-by-not-doing" in a Romer-type model.

Moreover, we assume that the unemployment benefit expenditure is financed with a proportional tax levied only upon the consumption of the younger (working-age) generation rather by earmarking proportional wage taxes paid by either the employed people (as assumed by Daveri and Tabellini) or both firms and employees (as assumed by Corneo and Marquardt). Finally, different from Corneo and Marquardt we abstract from the analysis of public pensions and focus exclusively on the effects of unionisation on economic growth.

As regards the results of such an investigation, while Daveri and Tabellini claimed that unionisation is growth-reducing, Corneo and Marquardt argued that it is growth-neutral. In contrast with both contributions, in this paper we show that unionisation always promotes economic growth.

[3] See the discussion in Ono (2007), where the unemployment dynamics in the model by Corneo and Marquardt (2000) is studied, but assuming both labour efficiency to depend on the per capita stock of capita and a more general union objective function.

[4] The use of capital per capita as a measure of labour efficiency in a Romer-type growth model could be established, however, by exploiting the concepts expressed in the ideas-based growth models by Jones (2005a), where it is the whole number of individuals in the economy (and, hence, the number ideas produced) that matters for growth.

Our finding, therefore, is line with Irmen and Wigger (2002), but, given the difference between the underlying mechanisms behind the positive effect of unionisation in the two papers, it deserves some comments: since, the growth-promoting effect of unionised labour shown by Irmen and Wigger holds to the extent that the degree of complementarity between capital and labour is relatively strong, then in the Cobb-Douglas case the condition required by a unionised-wage economy with unemployment to grow faster than a competitive-wage economy with full employment can never be satisfied.[5] In other words, the union-growth-enhancing effect described by Irmen and Wigger (2002) requires that the technology is relatively favourable to labour income when facing with employment drops caused by unionisation.[6] This is because in an OLG context capital accumulation occurs only by labour income, which is, in such a case, relatively favoured by employment reductions.

Different from Irmen and Wigger (2002), we find that a union-growth-enhancing effect can exist even if the technology of production is of the Cobb-Douglas type. In particular, the mechanism behind our result can be briefly summarised as follows: a rise in the union's relative wage intensity increases both the wage earned by the young and the unemployment rate (i.e. it reduces the employment rate). A higher wage rate (unemployment rate) affects in a positive (negative) way both savings and capital accumulation. The positive saving-effect dominates the negative unemployment-effect as long as the government provides an (even infinitesimal) unemployment benefit to the young-age cohort (assumed to be financed by consumption taxes). In this case, therefore, an economy with unionised labour and unemployment grows always faster than an

[5] With a Cobb-Douglas production function, in fact, the sum of the elasticity of substitution between capital and efficient labour (equal to one) and the output elasticity of efficient labour (equal to one minus the output elasticity of capital) is always greater than unity.

[6] In fact, they claimed that "the technology must be such that the effect of a reduction in employment on the functional distribution of income in favor to labor more than outweighs the effect on aggregate output that accrues to labor." (Irmen and Wigger, 2002, p. 58).

economy with competitive labour and full employment. By contrast, if the government does not provide an unemployment benefit, then both the positive saving-effect and negative unemployment-effect of a rise in the union's relative wage intensity compensate each other exactly, and hence unionisation is growth neutral in spite of a reduced employment rate.

The novelty of this result is that in a double Cobb-Douglas context the rate of per capita income growth in a unionised-wage economy with unemployment under the hypotheses of per worker labour efficiency and unemployment benefits financed by a consumption tax, may be always higher than the rate of per capita income growth in a competitive-wage economy with full employment, no matter the size of the unemployment benefit.

The remainder of the paper is organised as follows. In Section 2 we develop the model and the main results are analysed and discussed. Section 3 concludes.

2. The model

2.1. Individuals

Consider an economy with overlapping generations, identical two-period lived individuals (Diamond, 1965) and stationary population. Life is divided into youth (working period) and old-age (retirement period). Individuals belonging to generation t have a homothetic and separable lifetime utility function (U_t) defined over both the first and second period of life consumption bundles, $c_{1,t}$ and $c_{2,t+1}$, respectively. Let N_t be the number of individuals. When young, each individual inelastically supplies one unit of labour on the labour market, and earns a unitary wage income at the non-competitive rate w_t. Therefore, in each period the labour market does not clear and involuntary unemployment occurs. The aggregate unemployment rate is defined in terms of fractions of units of time (e.g., hours) not worked as $u_t = (N_t - L_t)/N_t$, where L_t is the labour

demand.[7] Moreover, when unemployed, the young are entitled to a benefit payment $b_t = z\, w_{c,t}$, with $0 < z < 1$ being the so-called replacement rate and $w_{c,t}$ the prevailing competitive wage. We also assume that only a proportional (non-distorting) tax on the consumption of the young at the rate $\tau_t > 0$ is levied by the government and used to finance the unemployment benefit expenditure at a balanced budget.[8]

In old age, agents are retired and live on the proceeds of their savings (s_t) plus the accrued interest at the rate r_{t+1}.

The representative individual born at time t faces the following programme:

$$\max_{\{c_{1,t},\, c_{2,t+1}\}} U_t = \ln(c_{1,t}) + \beta \ln(c_{2,t+1}), \tag{P}$$

subject to

$$\begin{aligned} c_{1,t}(1+\tau_t) + s_t &= w_t(1-u_t) + b_t u_t \\ c_{2,t+1} &= (1+r_{t+1}) s_t \end{aligned},$$

where $0 < \beta < 1$ is the subjective discount factor.

Maximisation of (P) gives the following first and second period of life consumption functions:

$$c_{1,t} = \frac{1}{(1+\beta)(1+\tau_t)}\left[w_t(1-u_t) + b_t u_t\right], \tag{1}$$

$$c_{2,t+1} = \frac{\beta}{1+\beta}(1+r_{t+1})\left[w_t(1-u_t) + b_t u_t\right], \tag{2}$$

whereas the savings function is:

[7] It should be noted that the results of the present paper were exactly the same if we assumed the existence of employed and unemployed individuals separately. However, the use of a single (representative) individual which is partially employed and unemployed may resemble the structure of the Italian unemployment insurance system, where benefits are paid to workers being provisionally laid off.

[8] We have chosen an age-related consumption tax rate levied only on the young essentially because in this way the nature of the unemployment benefit policy is purely redistributive within the working-age generation.

$$s_t = \frac{\beta}{1+\beta}\left[w_t(1-u_t)+b_t u_t\right]. \tag{3}$$

2.2. Firms

Following Corneo and Marquardt (2000), we assume the technology of production faced by each firm as:

$$Y_{i,t} = B\left(\frac{K_t}{L_t}\right)^{1-\alpha} K_{i,t}{}^{\alpha} L_{i,t}{}^{1-\alpha}, \tag{4}$$

where the index i denotes the typical firm, Y_i is total output produced by firm i, $K_{i,t}$ and $L_{i,t}$ are the capital input and the labour input hired in that firm, respectively, K_t / L_t is the average capital per-worker in the whole economy, which is taken as given by each single firm, $B > 0$ represents a scale parameter and $0 < \alpha < 1$ is capital's weight in technology. Production function Eq. (4) thus implies an externality of capital investment as typified by Romer (1986).

Setting $L_{i,t} = L_t$, $K_{i,t} = K_t$ and $Y_{i,t} = Y_t$, the aggregate time-t production function takes place according to $Y_t = B\left(K_t / L_t\right)^{1-\alpha} K_t{}^{\alpha} L_t{}^{1-\alpha}$, where $L_t = (1-u_t)N_t$ is the total labour force employed at the aggregate level. Defining $k_t := K_t / N_t$ and $y_t := Y_t / N_t$ as the per capita stock of capital and output, respectively, the aggregate intensive-form production function can be written as $y_t = B k_t$. Assuming total depreciation of capital at the end of each period and knowing that final output is sold at unit price, profit maximisation implies that the inputs of production are paid their marginal product, i.e.:

$$r = \alpha B - 1, \tag{5}$$

$$w_t = (1-\alpha) B k_t (1-u_t)^{-1}. \tag{6}$$

Exploiting Eq. (6) the unemployment rate is given by:

$$u_t = 1 - \frac{w_{c,t}}{w_t}, \tag{7}$$

where $w_{c,t} = (1-\alpha)Bk_t$ is the equilibrium competitive wage.

2.3. Unions

Following both Corneo and Marquardt (2000) and Daveri and Tabellini (2000), the wage rate is assumed to be set for the whole economy by a trade union, while the remuneration of capital is assumed to be competitively determined. Following more in detail Corneo and Marquardt (2000), we assume that: (*i*) at every date the union pursues two targets, i.e. a high real wage and a low unemployment rate, and then chooses the wage that best compromises between these two aims; (*ii*) the trade-off faced by the union is captured assuming the following union's objective function (which resembles the Stone-Geary formulation adopted in the seminal papers by Dertouzos and Pencavel, 1981, Pencavel, 1984 and MacCurdy and Pencavel, 1986):[9]

$$V_t = (w_t - w_{c,t})^{\gamma} \cdot (1-u_t)^{1-\gamma},$$

where the competitive wage $w_{c,t}$ is the time-t reference or comparison wage of the union, and γ is a preference parameter that captures the union's relative intensity between the two targets (i.e. wages versus employment). In particular, the higher (lower) γ, the more the union is wage-oriented (employment-oriented); (*iii*) the union fixes the wage according to the following programme:

$$\max_{\{w_t\}} V_t, \tag{PP}$$

subject to the firm's labour demand Eq. (7), that is we are assuming that the union wishes to determine the wage rate, while leaving employers to choose employment according to their labour demand curve.

[9] See Oswald (1985) for an excellent survey on different specifications of union preferences and objectives used in several works on the economic theory of trade unions.

Maximisation of Eq. (PP) therefore gives:

$$w_t = \frac{1-\gamma}{1-2\gamma} w_{c,t} . \tag{8}$$

Eq. (8) says that the union's wage is a mark up over the market wage. Notice that a necessary and sufficient condition for the existence of a finite positive solution of programme (PP) is $0 < \gamma < 1/2$, which is assumed to be always fulfilled.[10]

Given the constraint imposed by the union model specification on the value that the union attaches to raising wages relative to employment, it is important to note that some empirical works about trade union models with similar union's objective functions (i.e. Stone-Geary preferences), have produced estimates of the parameter γ coherent with the constraint $0 < \gamma < 1/2$. To this purpose, two important contributions are Dertouzos and Pencavel (1981) and Pencavel (1984). The empirical estimates they found as regards the γ coefficient (amongst other estimates of several structural parameters in the union's objective function) is that it can be ranged between 0 and 0.5.[11]

Now, combining Eqs. (7) and (8), the (constant) unemployment rate is:

$$u = \frac{\gamma}{1-\gamma} . \tag{9}$$

Eq. (9) implies that a rise in wages due to a higher γ should be accompanied by a decrease in employment.

[10] This is a technical condition that must be verified to avoid nonsensical results. Notice that it is the same as in Corneo and Marquardt (2000).

[11] To this purpose see Table 1 in Dertouzos and Pencavel (1981, p. 1173), which also claims that "With respect to the parameters of the union's objective function, the estimate of [γ] is significantly less than .5 and greater than 0." (p. 1172); see also Table II in Pencavel (1984, p. 226). Note, however, that there is no generalised consensus as regards the value of the union's relative wage intensity. For instance, recently Dumont et al. (2006) have produced estimates of the parameter that corresponds to γ in our model, finding that it may fairly be higher than 1/2. It should be noted, however, that they are framed in a context rather different than ours because they considered an efficient bargaining union model with a non-competitive output market.

2.4. Government

The per capita unemployment benefit expenditure at t ($b_t u_t$) is financed at a balanced budget through a consumption tax rate conditioned on age, that is

$$b_t u_t = \tau_t c_{1,t}. \tag{10}$$

Knowing that $b_t = z w_{c,t}$, then exploiting Eqs. (1), (8), (9) and (10) and rearranging terms, the budget-balancing tax rate is:

$$\tau = \frac{z\gamma(1+\beta)}{1-\gamma(1+z\beta)}. \tag{11}$$

It can easily be shown that the denominator of Eq. (11) is positive for any $0 < \gamma < 1/2$, i.e. the unemployment benefit policy is sustainable whatever the union's relative wage intensity. Moreover, although nothing theoretically prevents the possibility that the consumption tax that balances the unemployment benefit expenditure is either equal or greater than unity, in Table 1 we show, for different combinations of γ and z, and by assuming the subjective discount factor to be equal to $\beta = 0.3$,[12] that Eq. (11) is satisfied for tax rates significantly below unity,[13] in line with the generally observed consumption tax rates.

[12] Since it is assumed that every period consists of 30 years, our assumption of $\beta = 0.3$ corresponds to a discount factor of 0.96 per annum, which, in turn, implies a reasonable discount rate of almost 0.041 on an early basis (see, e.g., the numerical simulations by Heckman et al., 1998, p. 27; de la Croix and Michel, 2002, p. 50). Moreover, although the empirical evidence on time preference is scant and quite controversial, our assumption is in line with some empirical estimates (see Samwick, 1998; Gourinchas and Parker, 2002). In particular, Samwick (1998) estimated the distribution of rates of time preferences in a life cycle model using data on wealth holdings in the Survey of Consumer Finances, while Gourinchas and Parker (2002) provided evidence, among other things, of the time discount rate and risk aversion using Consumer Expenditure Survey (CEX) data for the years 1980 to 1993, arguring that "The discount rate is

In the first raw (column) of Table 1 we report different values of the union's relative wage intensity (replacement rate). The table clearly shows that budget-balancing tax rate that results from several combinations of both parameters of interest remains below unity even when the unemployment benefit expenditure is relatively high because the replacement rate and the weight the union attaches to wages (and thus the rate of unemployment) are high. These values in fact may in some cases correspond to the Value Added Tax (V.A.T.) applied in several European countries.

Table 1. The budget-balancing tax rate τ for different values of γ and z.

	$\gamma = 0.05$	0.10	0.15	0.20	0.25	0.30	0.35
$z = 0.60$	$\tau = 0.041$	0.088	0.142	0.204	0.276	0.362	0.465
0.70	0.048	0.103	0.166	0.24	0.326	0.462	0.552
0.75	0.051	0.11	0.179	0.258	0.351	0.462	0.597
0.80	0.055	0.118	0.191	0.276	0.376	0.496	0.643
0.85	0.058	0.126	0.204	0.295	0.402	0.531	0.689
0.90	0.062	0.134	0.216	0.313	0.428	0.567	0.737

2.5. Balanced growth

estimated at just over four percent, which is within conventional significance levels of the real interest rate of 3.44 percent." Gourinchas and Parker (2002, p. 70).

[13] The constraint $\tau < 1$ on Eq. (11) would require $z < \frac{1-\gamma}{\gamma(1+2\beta)}$. As shown in Table 1 this inequality can easily be satisfied for values of the union's relative preference of wages over employment ranged between 0 and 0.5 as well as for realistic values of the replacement rates. As regards the latter, we note that, even if the rules of application are different between countries, the unemployment benefit system is widely generous in Europe, especially in Scandinavian countries, and thus values of the replacement rate included between 0.6 and 0.9 are rather realistic (for instance, in Denmark unemployment benefits may even amount to 90 per cent of previous earnings).

Given the government budget Eq. (10) and knowing that $N_{t+1} = N_t$, equilibrium is given by the equality $k_{t+1} = s_t$. that is, the stock of capital installed at $t+1$ is determined as the amount of resources saved at t. Using Eq. (3), therefore, we get:

$$k_{t+1} = \frac{\beta}{1+\beta}\left[w_t(1-u_t) + b_t u_t\right]. \tag{12}$$

To analyse how unionisation affect economic growth, we now exploit the definition of unemployment benefits and combine Eqs. (8), (9) and (12) to obtain the growth rate of the per capita stock of capital in the unionised-wage economy (which obviously coincides with the growth rate of per capita income, since the unemployment rate is constant), that is:

$$g = (1+g_c)\cdot \mathrm{H}(\gamma, z) - 1, \tag{13}$$

where $\mathrm{H}(\gamma, z) = \frac{1-\gamma+z\gamma}{1-\gamma}$ and $g_c = \frac{\beta}{1+\beta}(1-\alpha)B - 1$ is the rate of per capita income growth when the labour market is competitive. Notice that g is independent of time so that the model does not exhibits transitional dynamics. Hence, a change in the union's wage, as expressed by a change in the relative wage intensity γ, implies an instantaneous adjustment of the economy to a new balanced growth path. If $\gamma = 0$ (corresponding to a competitive labour market), then $\mathrm{H}(0, z) = 1$ and $g = g_c$ for any $0 < z < 1$.

As regards the effects of unionisation, analysis of Eq. (13) gives the following proposition:

Proposition 1. *(1) The unionisation of the labour market is growth neutral if* $z = 0$. *(2) The unionisation of the labour market always promotes economic growth if* $0 < z < 1$.

Proof. The proof is straightforward since: (1) $\mathrm{H}(\gamma, 0) = 1$ if $z = 0$, and thus $g = g_c$ for any $0 < \gamma < 1/2$, and (2) $\mathrm{H}(\gamma, z) > 1$ if $0 < z < 1$, and thus $g > g_c$ for any $0 < \gamma < 1/2$. **Q.E.D.**

In contrast to Corneo and Marquardt (2000, Proposition 1, p. 299), Proposition 1 above shows that unionisation always promotes economic growth if the government finances an (even infinitesimal) unemployment benefit to the working age generation by levying consumption taxes. Only when unemployment benefits are absent, the unionisation is growth-neutral. Proposition 1 also shows that the more the union is wage-oriented (i.e., the higher γ), the more an economy with unionised labour and unemployment grows faster than a competitive equilibrium economy with full employment, even if the unemployment rate increases more rapidly. Moreover, for any given value of the union's relative wage intensity, the higher the replacement rate, the higher the rate of per capita income growth, with the unemployment rate being kept unaltered. Hence, a rise in the weight the union attaches to wages results in both higher unemployment and higher economic growth, while a higher replacement rate stimulates economic growth without reducing the employment rate.

The mechanism behind our result is the following. A rise in the union's relative wage intensity produces a twofold effect on savings and capital accumulation: (*i*) a positive wage effect (because of the increased wage earned by the young when employed), and (*ii*) a negative unemployment effect (because of the increased unemployment). If the government does not provide unemployment benefits to the young-aged, then both the positive wage-effect and the negative unemployment-effect on savings compensate each other exactly. This means that unionisation of the labour market is growth-neutral despite a positive unemployment rate. In contrast, the existence of a tax-financed unemployment benefit system implies that the positive effect of a rise in savings due to higher wages always outweighs the negative effect due to the reduced employment rate. The final effect, therefore, is a permanent increase in the total income of the young (i.e., sole savers in the economy) such that a unionised-wage economy always grows faster than a competitive-wage economy even if the employment rate shrinks.

The reason why in our model unionisation is always growth-enhancing while it is growth-neutral in Corneo and Marquardt and growth-reducing in Daveri and Tabellini is that in the latter two models unemployment benefits are exactly offset by the wage taxes that finance them, so that the

young do not receive any net transfer payment for unemployment. In contrast, in our model the young people actually receive an unemployment benefit which in turn causes a rise in their income in the working life and, hence, in savings. In particular, an even infinitesimal payment of benefit is sufficient to confirm the primacy in terms of economic growth of unionised labour in comparison with competitive labour. Needless to say, once the rate of per capita income growth is higher, the growth rate of both young-aged and old-aged consumption is higher as well, despite the existence of a consumption tax.[14] Hence, the lifetime welfare of the representative generation is higher in a unionised labour economy with unemployment than in a competitive equilibrium economy with full employment along the balanced growth path.

3. Conclusions

We studied the relationship between unionisation and economic growth in a basic double Cobb-Douglas one-sector OLG model of endogenous growth with per worker stock of capital as the engine of growth and unemployment benefits financed by consumption taxes.

We found that the rate of per capita income growth in an economy with unionised labour and involuntary unemployment may be always higher than that of a competitive equilibrium economy with full employment, with the unemployment benefit policy being sustainable whatever the size of the replacement rate.[15] This result sharply contrasts Daveri and Tabellini (2000), who argued that

[14] It is worth noting that this result resembles the well-known result in the endogenous growth literature (e.g., Rebelo, 1991), arguing that while an income tax is harmful to economic growth, a consumption tax does not affect the individual incentive to accumulate capital and therefore is growth neutral.

[15] By passing we note that our results are rather robust to the assumption on the labour productivity parameter: indeed, following Daveri and Tabellini (2000) and Irmen and Wigger (2002), rather than Corneo and Marquardt (2000), and then assuming the productivity parameter in the production function to be proportional to the average per capita (rather than per worker) stock of capital, the growth-promoting effect of unionisation still remains valid (under some plausible

unionisation is always growth-reducing, and Corneo and Marquardt (2000), who found that it is growth-neutral, while sharing with Irmen and Wigger (2002) the result of the growth-promoting effect of unionisation. However, the mechanism behind our findings is at all different than that clearly pointed out by the latter authors, and in particular it is due to the beneficial effect that the unemployment benefits play on savings, rather than caused by a strong complementarity between capital and labour in production as well as a low degree of the output elasticity of labour. Moreover, it is worth noting that the growth-promoting effect of unionisation described in this paper holds *a fortiori* with a CES technology (when capital and labour are relatively complement but even with a relatively low degree of complementarity), while the results by Irmen and Wigger do not hold any longer when the production function is Cobb-Douglas. Therefore, the key distinction from earlier literature we want to highlight is that with this approach we do not need to assume problematically low values on elasticity of capital-labour substitution and output elasticity to foster economic growth, although needing a consumption tax to finance the unemployment benefit: notwithstanding, and interestingly, the growth-promoting effect of unionisation occurs even when the required tax really small. In this sense our paper contributes to complement the paper by Irmen and Wigger (2002) in the endogenous growth theoretical literature.

Finally, as regards the empirical relevance of our findings, we note that in our model the union-growth-enhancing mechanism only requires the existence of a (balanced budget) unemployment benefit system. In particular, the positive effect of unionisation on growth holds under the empirically well-founded Cobb-Douglas production function[16] and it will remain valid, *a fortiori*,

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conditions about the size of both the capital's weight in production and the replacement rate), as shown in a companion paper.

[16] Although the question of the estimate of the production function is not univocal, there exists evidence in favour of the use of the Cobb-Douglas technology as a good approximation for the most part of the data. For example, Zarembka (1970, p. 53) claimed: "… for most empirical purposes the elasticity [of substitution between capital and labour] should be assumed equal to unity and the Cobb-Douglas function employed rather than the CES function.", while according to

under technologies that relatively favour the distributive share of workers – when employment shrinks – which are, as known, the sole savers in the conventional OLG context. In contrast, the positive effect of unionisation as described by Irmen and Wigger (2002) needs the rather special (and even more empirically controversial) condition that capital and labour must be complement enough in production. Therefore, our findings shed new light on both the role played by unions in modern economies and possible policy implications (unemployment benefit programs) in promoting economic growth.

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Griliches and Ringstad (1971) "it is very hard to improve upon the simple Cobb-Douglas form." Moreover, also Mankiw et al. (1992) employed Cobb-Douglas technologies to estimate the Solow growth model, with the result that when international GDP growth is estimated in a Cobb-Douglas economy with human capital, the fit is quite good. Recently, Acemoglu (2003) analysed a model where technologies with both labour- and capital-augmenting technological changes can be undertaken by firms. He found that while in the short run, with capital-augmenting technical change, factor shares are not constant and the economy therefore can be characterised by a CES production function, in the long run when labour-augmenting technical change prevails, factor shares are constant and, hence, the Cobb-Douglas production function represents a good approximation. Moreover, in a context closely related to that by Acemoglu (2003), Jones (2005) studied the direction of technical change when the shape of the production function is governed by the distribution of ideas. He found that in the long run the technological change is labour-augmenting and, with Pareto distributions of ideas, the global production function is Cobb-Douglas.

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