Is basic income a cure for unemployment in unionized economies? A general equilibrium analysis.*

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Abstract

A dynamic general equilibrium model of a unionized economy is developed to analyze the effect of unconditional basic income schemes on the unemployment rate. This paper assumes a starting situation where unemployment benefits are a fixed proportion of the wage rate. Two variants of the basic income proposal are then introduced. The *full basic income scheme* replaces the existing unemployment benefits by an unconditional income at least equal to these benefits at given wages. The *partial basic income* is lower (at given wages). The unemployment benefits do not disappear but are reduced in such a way that the net income of the unemployed remains unchanged at given wages. Assuming a proportional tax on earnings and a balanced budget of the State, it is shown that the equilibrium unemployment rate decreases if a partial basic income is implemented. The same conclusion holds for a sufficiently small full basic income.

Keywords: Basic income; unconditional income; wage bargaining; WS-PS model; unemployment.

JEL classification : H21, H23, J51, J68.

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1 Introduction

This paper is concerned with the following question : Could a basic income have favorable effects on the unemployment rate in unionized European countries? A basic or unconditional income consists of the payment of a grant to every adult citizen. This idea has taken various forms and has received various names : *social dividend* (Lange, 1936, and Meade, 1989) and *basic income* (Parker, 1989). The economics of basic income schemes has often been reduced to an arithmetic exercise or it has looked at labor supply effects in a competitive setting. To achieve a coherent view of the implications of a basic income in Europe, one needs a richer theoretical setting. It should have the essential features of a general equilibrium analysis with an explicit budget constraint for the State. It should emphasize the working of the labor market and allow for the possibility of involuntary unemployment. Finally, it should introduce some heterogeneity between the economic agents. The model presented in this paper is an attempt to combine these requirements. It is a dynamic and general equilibrium model of a unionized economy inspired by Manning (1993) and Cahuc and Zylberberg (1999). In this non competitive labor market, ex ante identical workers become heterogeneous endogenously : Part of them are ex post unemployed while others are employed and benefit from a higher utility level.

It is assumed that an unemployment benefit system initially exists. This paper considers the case where unemployment benefits are a fixed proportion of the wage rate. Two variants of thebasic income proposal are then introduced. The *full basic income scheme* replaces the existing unemployment benefits by an unconditional income at least equal to these benefits at given wages. The *partial basic income* is lower at given wages and does not replace the existing unemployment benefits. The unemployment benefits are reduced in such a way that the net income of the unemployed remains unchanged at given wages.

Several paper have analyzed the effects of a basic income in an efficiency wage setting (Bowles, 1992, Atkinson, 1995a, Groot and Peeters, 1997). Bowles (1992) assumes that the initial total amount of income-replacing payments has to remain unchanged and is distributed equally to all citizens. This leads to a drop in the fall-back position of employees and therefore the equilibrium wage falls, too. He concludes that a small unconditional grant can be introduced without reducing the pre-grant level of profits. Atkinson (1995a) analyzes the switch from unemployment benefits financed by a payroll tax to a basic income scheme and a flat income tax. He shows that this reform reduces the unemployment and wage levels in a dual labor market. Yet, this conclusion appears to depend on the institutional features of the unemployment benefit system. Considering also a dual labor market, Groot and Peeters (1997) concludes that “a moderate basic income can be compatible with lower unemployment, higher GDP, higher real incomes for workers, lower income inequality between workers, but a lower real income for the (voluntary) unemployed” (p. 593). Késenne (1993) develops a static macro model where output prices are exogenously fixed and wages are the outcome of an efficient bargain. His results emphasize the roles of labor supply responses (see also Késenne, 1991) and of fall-back positions in the bargaining process. The literature on optimum income taxation has also been used to see whether a basic income could be recommended (see chapters 2 and 3 of Atkinson, 1995a). When the marginal tax rate is assumed to be constant, the literature about the optimal linear income tax (starting with Sheshinski, 1972) is especially relevant. Earlier papers have been concerned with comparisons between alternative transfer and tax systems (comparisons between unconditional and conditional schemes can be found in the papers mentioned above and for instance also in Besley (1990), Creedy (1996), Drèze and Sneessens (1997) and Groot (1997)). A comparison between basic income schemes and reductions of pay-roll taxes will appear in Van der Linden (2000).

This paper is organized as follows. Section 2 presents the model. Section 3 develops the main comparative static results. Section 4 concludes the paper.

2 A dynamic general equilibrium model with wage-setters

2.1 The model

This model draws upon Manning (1991, 1993) and Cahuc and Zylberberg (1999). Let us consider a small economy facing an exogenous interest rate r[1]. Assume a deterministic setting with, in each period t, n identical firms, N homogeneous workers and M inactive individuals (n, N and M are exogenous[2]). Each of the n firm owners bargains over wages with a firm-specific union.[3] The former decides unilaterally on employment and on the level of investment. Firms and workers are infinitely lived agents with perfect foresight. In a given period t, the sequence of decisions is as follows :

1. Each firm decides upon its current investment level which will increase its capital stock in $t+1$. So, the capital stock is predetermined during the current period.

2. A decentralized bargaining over the current wage level takes place in each firm (wages are only set for one period). If an agreement is reached, the employees receive a *net* real wage w_t at the end of the period. Otherwise, workers immediately leave the firm and start searching a job. In firms where there is a collective agreement, the firm determines labor demand for the current period. Given w_t, the employment level is fixed by labor demand and production occurs. In the absence of a collective agreement, nothing is produced during the current period. Yet, the firm will have the opportunity to bargain and to hire workers (without hiring costs) in $t+1$.

3. A proportional tax on earnings, τ_t, is adjusted so that the current public budget constraint balances (no other taxes are introduced).

4. At the end of the period, an exogenous fraction q of the employees leaves the firm and enters unemployment.[4]

[1] There is implicitly an international financial market with perfect mobility.

[2] Van der Linden (1999) relaxes the assumption of a fixed workforce.

[3] If the wage bargain takes place at the sectoral level, all the results obviously remain unchanged if the model of the firm developed below is reinterpreted as the one of the sector.

[4] The following comment of Layard and Nickell (1990) (p.780) applies here, too :

> In reality, of course, turnover is also generated by exogenous demand shocks of various kinds.

To present the model, let us move backwards.

Workers

Each of the N homogeneous workers supplies one unit of labor. His instantaneous utility function is $v(R_t)$, where R_t denotes net real income in period t ($v' > 0, v'' \leq 0$). At the end of period t, each employee leaves the firm with an exogenous probability q, $0 < q < 1$. He is then unemployed at the beginning of period $t+1$ and will be hired by a firm with probability a_{t+1}. This probability is endogenous (see below). Hence, in period t, the intertemporal discounted utility of a job in a given firm, V_e^t, is given by the following expression[5] :

$$V_e^t = v(w_t + B_t) \ + \ \beta\{q[a_{t+1}\overline{V_e^{t+1}} + (1-a_{t+1})V_u^{t+1}] \ + \ (1-q)V_e^{t+1}\}, \qquad (1)$$

where B_t denotes the level of the basic income at time t, $\overline{V_e^{t+1}}$ is the intertemporal discounted utility of a job on average in the economy in period $t+1$ and V_u^{t+1} is the intertemporal discounted utility of being unemployed in $t+1$. Both actually are (perfectly) anticipated utilities. $\overline{V_e^{t+1}}$ is of the same form as (1) with only one difference : The average net real wage in the economy, $\overline{w_t}$, replaces w_t.

Let Z_t be the exogenous level of unemployment benefits. The instantaneous utility of an unemployed, v_u^t, is equal to $v(Z_t)$ with a partial basic income (i.e. when $B_t < Z_t$) and $v(B_t)$ with a full basic income ($i.e. B_t \geq Z_t$). The intertemporal discounted utility of being unemployed at time t, V_u^t, is given by

$$V_u^t = v_u^t + \beta\{a_{t+1}\overline{V_e^{t+1}} + (1-a_{t+1})V_u^{t+1}\}. \qquad (2)$$

Firms

The n firms produce an homogeneous good and sell it on a competitive market at a price normalized to 1. Let L_t and K_t denote the level of labor and capital in a given firm. Assume that each firm is endowed with the same homogeneous of degree 1 Cobb-Douglas technology : $(AL_t)^\alpha K_t^{1-\alpha}, A > 0, 1 > \alpha > 0$.[6] According to the sequence of decisions explained above, the capital stock is predetermined when bargaining takes place. Conditional on K_t, labor demand can be written as :

$$L_t = K_t A^{\frac{\alpha}{1-\alpha}} \left(\frac{w_t(1+\tau_t)}{\alpha}\right)^{\frac{1}{\alpha-1}}. \qquad (3)$$

Let $\pi_t(K_t)$ be current optimal profits net of investment.[7] π_t is a linear function of the currently available capital stock :

$$\pi_t(K_t) = (1-\alpha)K_t \left(\frac{w_t(1+\tau_t)}{\alpha A}\right)^{\frac{\alpha}{\alpha-1}}. \qquad (4)$$

This is ignored here, since we do not wish to introduce such explicit stochastic elements into the model. However, we feel that our model will mimic closely the consequences of a stochastic (...) model.

[5] To save on notations, no subscript is added to designate the firm.

[6] A note is available upon request, showing that the steady state properties of this paper can also be derived under the assumption of decreasing returns to scale. Furthermore, allowing A to vary exogenously with t would not change the conclusions of this paper.

[7] In other words, $\pi_t(K_t) = \max_{L_t}[(AL_t)^\alpha K_t^{1-\alpha} - w_t(1+\tau_t)L_t]$, where τ_t is the marginal tax rate.

Wage-setting

Following Manning (1991, 1993), assume that the union's objective is the product $L_t^{\psi}(V_e^t - V_g^t)$, where ψ is a nonnegative parameter representing union's preferences for employment relative to an intertemporal rent for currently occupied workers. Redundant workers are assumed to be immediately rehired in another firm with probability a_t. Hence, the outside option is

$$V_g^t = a_t\overline{V_e^t} + (1 - a_t)V_u^t. \tag{5}$$

Assume that the current real wage w_t is set to maximize a Nash product. Remember that w_t is only set for the current period during which the capital stock is given. Without an agreement, the workers leave immediately the firm. Their utility is then equal to V_g^t. The optimal discounted profits at time t, $\Pi_t(K_t)$, are defined as $\Pi_t(K_t) = \pi_t(K_t) - I_t^* + \beta\Pi_{t+1}(K_{t+1})$, where I_t^* denotes the optimal level of investment in period t and $\beta = \frac{1}{1+r}$.[8] In the absence of an agreement, nothing is produced but future profits and, hence, investment are not affected. Therefore, the firm's component in the Nash product, i.e. the difference between intertemporal discounted profits in case of an agreement, Π_t, and in the absence of an agreement, $-I_t^* + \beta\Pi_{t+1}$, is simply π_t defined in (4). It is plausible and therefore assumed that the firm-specific union and the firm owner take the tax rate τ_t, the average wage $\overline{w}_t$, the unemployment outflow rate a_t and the level of benefits, Z_t and B_t, as given when they bargain over wages. Remembering (4) and ignoring constant and predetermined terms, the Nash program writes

$$\max_{w_t}(w_t)^{\frac{\alpha(1-\gamma)}{\alpha-1}} L_t^{\psi\gamma}(V_e^t - V_g^t)^{\gamma}, \tag{6}$$

where γ is the so-called bargaining power of the union, $0 \leq \gamma \leq 1$, and L_t is given by (3). The first-order condition of this problem can be written as

$$V_e^t - V_g^t = \mu w_t v'(w_t + B_t), \text{ with } \mu \equiv \frac{\gamma(1-\alpha)}{\alpha(1-\gamma)+\psi\gamma} \geq 0. \tag{7}$$

Notice that the intertemporal rent of an employee, $V_e^t - V_g^t$, is positive if $\gamma > 0$. This property holds true in equilibrium. The second-order condition is satisfied if $\mu < 1$. The latter can be rewritten as $\gamma < \frac{\alpha}{1-\psi}$. This inequality is assumed to hold.

Investment

At the beginning of any period t, the level of investment, I_t, is chosen in order to maximize $\Pi_t(K_t)$, subject to $K_{t+1} = I_t + (1-\delta)K_t$, where δ is the positive depreciation rate.[9] This problem can easily be solved (see Cahuc and Zylberberg, 1999). Since the technology is homogeneous of degree one, the first-order conditions for profit maximization only

[8] More rigorously, Π_{t+1} should be understood as the maximum of intertemporal profits in two situations (whether an agreement is reached in $t+1$ or not). However, this distinction does not matter below (see Cahuc and Zylberberg, 1999).

[9] In the initial period, $t = 0$, the capital stock is exogenously fixed. Hence, the following holds in all periods except this one. Furthermore, as investment in the current period is only available for production in the next period, the so-called 'hold-up' problem (Grout, 1984) does not appear here. On this issue, see Cahuc and Zylberberg (1999).

determine the capital-labor ratio. From these conditions, another important relationship can be derived. The anticipated wage w_{t+1} should be given by:

$$(1+\tau_{t+1})w_{t+1} = C, \text{ where } C = \alpha A \left(\frac{\delta + r}{1-\alpha}\right)^{\frac{\alpha-1}{\alpha}} > 0. \tag{8}$$

This equation implies that the anticipated real wage cost is fixed by the structural parameters characterizing the firm and the economy r, δ, α, A. Since firms are identical, this anticipated wage is the same in each of them. Expression (8) is the familiar 'real input prices frontier' found in models where returns to scale are constant and competition on the market for goods is perfect. In these models, the firm breaks even if the marginal cost is equal to the price of output. Equation (8) expresses this condition.

2.2 The equilibrium

Since all firms and unions' characteristics are identical, in equilibrium, $w_t = \overline{w_t}$ and $V_e^t = \overline{V_e^t}$. Then (5) implies that

$$V_e^t - V_g^t = (1-a_t)(V_e^t - V_u^t). \tag{9}$$

This establishes a relationship between the exit rate from unemployment, a_t, the rent employed workers get compared to redundant ones and the difference in intertemporal utilities between an employed and an unemployed. Combining (1), (2), (7) and (9) leads to the following expression :

$$\frac{v(w_t + B_t) - v_u^t}{\mu w_t v'(w_t + B_t)} + \beta(1-q)\frac{w_{t+1}}{w_t}\frac{v'(w_{t+1} + B_{t+1})}{v'(w_t + B_t)} = \frac{1}{1-a_t}. \tag{10}$$

a_t can be rewritten as a function of the current and previous unemployment rates (hence, a_t is endogenous). For the current unemployment level is made of those who where unemployed at the beginning of this period and who are not currently hired. After division by the size of the labor force, N, this definition writes

$$u_t = (1-a_t)\left(u_{t-1} + q(1-u_{t-1})\right), \tag{11}$$

where u_t is the unemployment rate in period t. Substituting $(1-a_t)$ from this equation into (10) leads to an implicit wage equation where the current net real wage rate is a function of the current and past unemployment rate, the anticipated wage rate in $t+1$ and the current and anticipated levels of the allowances (B_t and, where appropriate, Z_t).

To reach clear-cut conclusions, let us henceforth assume a constant relative risk aversion utility function :

$$v(R_t) \equiv \frac{R_t^{\lambda}}{\lambda}, \text{ where } \lambda \leq 1, \lambda \neq 0, v' > 0, v'' \leq 0. \tag{12}$$

Let us also assume that the replacement ratio is constant in each period t ($\frac{Z_t}{w_t} = z, 0 < z < 1$)[10] and that the basic income is proportional to the level of the unemployment benefits ($B_t = \xi Z_t$, $\xi \geq 0$). Let

$$\mathcal{I}(\xi) \equiv \begin{cases} \xi & \text{if } \xi \geq 1 \text{ (the full basic income case)} \\ 1 & \text{if } \xi < 1 \text{ (the partial basic income case).} \end{cases} \tag{13}$$

Taking account of (11), the wage-setting ('WS') equation (10) becomes then :

$$\frac{1+\xi z}{\mu\lambda}\left(1 - \left[\frac{z\mathcal{I}(\xi)}{1+\xi z}\right]^{\lambda}\right) + \beta(1-q)\left(\frac{w_{t+1}}{w_t}\right)^{\lambda} = \frac{q+(1-q)u_{t-1}}{u_t}. \tag{14}$$

The budget of the State is assumed to be balanced in each period. The extent to which the inactive population is eligible for the basic income obviously influences this budget constraint. Let ν be the ratio of the eligible inactive population to the workforce ($\nu \leq \frac{M+n}{N}$). The balanced budget can be written as :

$$\tau_t(1-u_t) = \begin{cases} z(u_t + \xi(1-u_t+\nu)) & \text{if a partial basic income applies} \\ \xi z(1+\nu) & \text{if a full basic income applies.} \end{cases} \tag{15}$$

From (15), the marginal tax rate τ_t increases with the unemployment rate.

In each period t, a short-run (temporary) equilibrium can be defined conditional on the available capital stock, the lagged unemployment rate and the anticipated net wage w_{t+1}. This equilibrium is characterized by an aggregate labor demand curve (n times equation (3)), the wage-setting equation (14) and the budget constraint of the State (15). To analyze the dynamic behavior of this economy, capital accumulation has to be taken into account. Then, for $t \geq 1$, the assumption of perfect foresight implies that the net wage instantaneously reaches its long-term value defined in (8).[11] Combining equations (8) and (15) yields the following 'price-setting curve' ('PS') :

$$w_t = \begin{cases} \frac{C(1-u_t)}{1+\xi z(1+\nu)-(1+(\xi-1)z)u_t} & \text{if a partial basic income applies} \\ \frac{C(1-u_t)}{1+\xi z(1+\nu)-u_t} & \text{if a full basic income applies.} \end{cases} \tag{16}$$

This relationship between the net wage rate and the unemployment rate is downward-sloping and concave. The ratio $\frac{w_{t+1}}{w_t}$ can now be derived from (16) and substituted in the 'WS' equation (14). The latter is then a second-order scalar nonlinear difference equation where the current unemployment rate u_t is a function of the lagged unemployment level u_{t-1} and the future one u_{t+1}. Appendix 1 shows that this dynamic system is stable and that the equilibrium is a saddle point.

Let us from now on concentrate on the steady state. In such a state, the unemployment rate, the marginal tax rate and the net real wage rate are constant. Therefore, the wage-setting equation (14) defines the equilibrium unemployment rate u^* :

$$u^* = \frac{q}{\frac{1+\xi z}{\mu\lambda}\left(1 - \left[\frac{z\mathcal{I}(\xi)}{1+\xi z}\right]^{\lambda}\right) - (1-\beta)(1-q)} \tag{17}$$

[10] This assumption is supported by Figure 2.2 in OECD (1996). Other assumptions such as $Z_t = zw_{t-1}$ would lead to similar conclusions in a steady state.

[11] Consequently, the net real wage accommodates any change in the tax rate.

Knowing u^*, the steady state marginal tax rate and net real wage rate are easily computed from, respectively, (15) and (16). Figure 1 illustrates this solution. The equilibrium (w^*, u^*) is at the intersection of the vertical wage-setting curve 'WS' (17) and the downward-sloping price-setting curve 'PS' (16). Union-firm bargaining generates a positive rent for the employed workers. From (7) and (12), the latter is equal to :

$$V_e^* - V_g^* = \mu\,(w^*)^\lambda (1+\xi z)^{\lambda-1} > 0 \text{ if } \gamma > 0. \tag{18}$$

Furthermore, from (1), (2) and (12), it is easily seen that

$$V_e^* - V_u^* = (w^*)^\lambda \, \frac{(1+\xi z)^\lambda - (\mathcal{I}(\xi) z)^\lambda}{\lambda[1-\beta(1-q)(1-a^*)]} > 0. \tag{19}$$

Substituting (18) and (19) into (9) indicates how the steady-state exit rate from unemployment, a^*, is influenced by the bargaining process :

$$\mu = \frac{1-a^*}{\lambda[1-\beta(1-q)(1-a^*)]}\,[1+\xi z]\left(1 - \left[\frac{z\mathcal{I}(\xi)}{1+\xi z}\right]^\lambda\right) \tag{20}$$

INSERT FIGURE 1 APPROXIMATELY HERE.

3 The effect on basic income schemes in steady state

This section is concerned with the impact of the basic income schemes on the equilibrium unemployment rate, the net wage and the marginal tax rate. To avoid clutter, no superscript is added to indicate that the endogenous variables are at their steady-state level. This section starts with a result summarizing standard properties of the 'WS-PS' model. Next it turns to the main results of the paper.

Result 1 *The equilibrium unemployment rate is strictly bounded between zero and one. It increases with the interest rate r, the separation rate q, the mark-up μ and the replacement ratio z. On the contrary, the equilibrium unemployment rate is lower the more relative risk averse workers are.*

The proof is left to Appendix 2. Before the main propositions of this paper are formally derived, let us intuitively explain the mechanisms through which the basic income influences the steady-state unemployment rate (17). Unions bargain in order to create a positive rent for their members. In a way or another, this amplifies the allocative inefficiency generated by unemployment benefits. Everything else equal, because the partial basic income is not withdrawn when an unemployed is hired, it reduces the reservation wage effect created by unemployment benefits. At given wages, the full basic income pushes up the instantaneous income people obtain both in unemployment and in employment. These two effects cancel out if workers are risk neutral. When workers are risk averse, the effect on utility is higher when people are unemployed. This induces a negotiated compensation for the employed workers that will eventually deteriorate the employment level.

Behind this general intuitive explanation, two underlying mechanisms are actually at work. The first one is related to the literature about wage-setting in the presence of a non linear tax system (see e.g. Lockwood and Manning (1993)). According to this literature, an increase in the progressivity of taxation, loosely speaking, acts as an incentive for wage moderation. Similarly, Cahuc and Zylberberg (1996) have shown that an increase in progressivity decreases the equilibrium unemployment rate. This result applies here, too. The progressivity of taxation is measured by the so-called coefficient of residual income progression η_w^R, i.e. the elasticity of the net income of an employed worker ($R_t = B_t + w_t$) with respect to w_t. With a basic income, $\eta_w^R = (1+\xi z)^{-1} < 1$. Therefore, the first term in the denominator of (17) is $\left(\eta_w^R\right)^{-1}$. It is easily seen that the progressivity increases with the level of the basic income. So, the basic income has a first favorable effect on the equilibrium unemployment rate because it introduces some progressivity in taxation.

The second mechanism is captured by the ratio $\frac{z\mathcal{I}(\xi)}{1+\xi z}$ in (17). The latter is simply the 'effective replacement ratio' $\frac{max(Z_t,B_t)}{w_t+B_t}$. The partial basic income favors in-work net income (everything else equal, an increase in ξ raises net earnings without affecting the replacement ratio z). Hence, $V_e - V_u$ becomes higher (see (19) with $\mathcal{I}(\xi) = 1$). To keep the equilibrium condition (9), the exit rate from unemployment has to increase (see (20)). On the contrary, the full basic income influences both in-work net income and the income of the jobless workers. Everything else equal, as the full basic income rises, the latter increases relatively more. So, $V_e - V_u$ becomes now lower and this eventually pushes up the unemployment rate. Therefore, with a full basic income, the first and the second mechanism have opposite effects on unemployment in steady-state .

Result 2 *Compared to the case with an unemployment insurance system but without basic income, the equilibrium unemployment rate is always lower if a partial basic income scheme is implemented. The same holds when the unemployment insurance system is replaced by a full basic income scheme if the ratio between the basic income and the unemployment benefit, ξ ($\xi > 1$), is lower than $1 + \frac{z}{1-z}$, where z is the replacement ratio.*

Proof Let u_z denote the equilibrium unemployment rate when there is an unemployment insurance system (with a replacement ratio z) and no basic income scheme. u_z is immediately obtained by putting $\xi = 0$ in (17). The equilibrium unemployment rate u_z is higher than u defined in (17) if

$$\frac{1-z^\lambda}{\lambda} < \frac{1}{\lambda}\left(1 - \left[\frac{z\mathcal{I}(\xi)}{1+\xi z}\right]^\lambda\right).$$

The latter condition is verified if $1 + \xi z > \mathcal{I}(\xi)$. The last inequality is always satisfied in the case of a partial basic income ($0 < \xi < 1, \mathcal{I}(\xi) = 1$). With a full basic income, the same conclusion holds if $\xi < 1 + \frac{z}{1-z}$. ■

Result 3 *The equilibrium unemployment rate decreases with the ratio between the partial basic income and the unemployment benefits, ξ. In the full basic income case, the equilibrium unemployment rate increases with (resp., is independent of) ξ if workers are risk averse (resp., risk neutral). The equilibrium real net wage decreases with ξ.*

Proof Consider first the partial basic income case ($0 < \xi < 1$). Carrying out the first-order partial derivative of (17) with respect to ξ yields

$$\frac{\partial u}{\partial \xi} = -\frac{qz}{D^2 \mu \lambda}\left[1 - (1-\lambda)\left(\frac{z}{1+\xi z}\right)^{\lambda}\right] \; < \; 0, \tag{21}$$

where D is the denominator of (17). The expression between brackets is strictly positive if $\lambda = 1$. The same is true if $0 < \lambda < 1$ since $0 < \left(\frac{z}{1+\xi z}\right)^{\lambda} < 1$. When λ is negative, the expression between brackets is negative. Therefore the whole expression is negative, too. In the full basic income case ($\xi \geq 1$), it can easily be checked that (17) is independent of ξ and z if workers are risk-neutral ($\lambda = 1$). For $\lambda < 1$,[12] let $\kappa = \frac{\xi z}{1+\xi z}$, $0 < \kappa < 1$. κ increases with ξ. The denominator of (17) can now be rewritten as $\frac{1-\kappa^{\lambda}}{\mu\lambda(1-\kappa)} - (1-\beta)(1-q)$. In a two-dimensional space, consider the two points $E \equiv (\kappa, v(\kappa))$ and $F \equiv (1, v(1))$, where v is the utility function (12). $\frac{1-\kappa^{\lambda}}{\lambda(1-\kappa)}$ is the slope of the chord EF. From the properties of the function v, this slope decreases with κ. Therefore, the equilibrium unemployment rate increases with κ and, hence, with ξ.
Combining this result and (16), it is easily seen that the real net wage decreases with ξ in the full basic income case. The same conclusion cannot be derived for the partial basic income. For there are cases where the decrease in unemployment (21) outweighs the partial effect $\frac{\partial w_t}{\partial \xi} < 0$ derived from (16). However, unreported numerical simulations show that this only happens for small values of ξ in cases where the equilibrium unemployment rate is very high (say, above 35%) in the absence of a basic income. ■

As a corollary, the equilibrium marginal tax rate typically increases with ξ (see (8)). The bold face curves in Figure 1 illustrates Result 3 in the case of a partial basic income (with a full basic income the curve 'WS' shifts to the right).

The previous results can be rephrased in a clear-cut qualitative message. If, for whatever reason, the unions' power and preferences and the replacement ratio are given, the introduction of a *partial* basic income lowers the equilibrium unemployment rate. Moreover, the highest possible *partial* basic income (exactly equal to the unemployment benefits) is recommended if the reduction of the unemployment rate is the unique government's goal. It should however be emphasized that the replacement ratio but not the level of unemployment benefits has been taken as given. Since the net wage typically is a decreasing function of the basic income-unemployment benefit ratio, ξ, so does *the level* of unemployment benefits. Therefore, the recommended basic income should be equal to the level of unemployment benefits *reached when the wages have adjusted as a consequence of the introduction of the basic income.* Furthermore, it should be highlighted that this reform generally increases the marginal tax rate.

[12] I thank Etienne Lehmann for suggesting the following proof.

No discussion of the pros and cons of a basic income proposal is complete without at least a rough quantification of its main effects. As a first step towards this requirement, consider the following numerical example based on plausible values of the parameters. Let $\alpha = 0.7, \gamma = 0.6, \psi = 0$, hence $\mu = 0.64, \lambda = -1$ (relative risk aversion = 2), $\beta = 0.95$ ($r \approx 5\%$), $\nu = 0.1, q = 0.2$ and $z = 0.4$. In other words, the bargaining is modeled as the maximization of an asymmetric Nash product and the unions do not value the level of employment[13]. The assumption $\nu = 0.1$ means that, on average in the EU, about one-quarter of the inactive population aged 18-64 would be eligible for a basic income. Considering only the population aged 18-64 stems from the focus of this paper on the unemployment insurance mechanism[14]. Moreover, it is here assumed that some *participation* criteria restrict eligibility.[15] In this context, the assumption of an eligibility rate of 25% is simply an example. Remember that ν only influences the marginal tax rate and that linear taxes have no effect on the steady-state unemployment rate in the 'WS-PS' model. The value of the separation rate q is in accordance with the results of Burda and Wyplosz (1994). $z = 0.4$ is an hypothesis that could be supported by the data available in OECD (1996)[16].

Figure 2 illustrates Results 2 and 3. Introducing a partial basic income substantially reduces the equilibrium unemployment rate (from about 9% when $\xi = 0$ to 6.5% when $\xi = 0.3$ (i.e. a basic income-net wage ratio, ξz, equal to 12%) and less than 4% when $\xi = 1$). It should be added that the unemployment rate varies monotonically along the dynamic path between two equilibria. The marginal tax rate τ is nearly proportional to ξ. Let us take $\xi = 0.3$ as a benchmark. Then, the marginal tax rate is about 15% (compared to 4% when $\xi = 0$) and the levels of the net wage and the unemployment benefits are 10% lower (compared to their level when $\xi = 0$). Compared to a situation without basic income, the *instantaneous* income of an employed worker, $w + B$, is nearly unchanged and the *instantaneous* income of an unemployed is obviously 10% lower. Because the relative decrease in net wages is rising with ξ,[17] the unemployed would not necessarily benefit from a higher *instantaneous* income if a full basic income was implemented. In the current example, compared to the benchmark $\xi = 0.3$, the *instantaneous* income of the unemployed is comparatively lower for any full basic income such that ξ is below 1.5 (or, put differently, such that the basic income-net wage ratio is less than 60%).

Let us now look at the results in an *intertemporal perspective*. Considering intertemporal utility levels, the introduction of a partial basic income is in this example a Pareto improvement if the ratio ξ is sufficiently low ($\xi \leq 0.3$). For, compared to a situation

[13] The assumption $\psi = 0$ is in accordance with the so-called seniority model. Moreover, sufficiently close to the steady state, each union member is certain to keep his job since new hirings should compensate the number of quits that occurred at the end of the previous period. Hence, the assumption $\psi = 0$ is plausible in the neighborhood of the steady state.

[14] Other components of the Welfare State such as retirement pensions and family benefits have been left aside.

[15] About the concept of *participation income*, see Atkinson (1995b).

[16] It turns out to be a bit higher than the Belgian aggregate net replacement ratio at the beginning of the nineties (see Dor, Van der Linden and Lopez-Novella, 1997).

[17] For instance, it amounts to 29% if $\xi = 1$ (compared to the initial situation where $\xi = 0$).

without basic income, the intertemporal utilities of the currently employed, the currently unemployed and the eligible inactive population are raised while the well-being of the ineligible inactive people remains unaffected. Although unreported simulation results indicate that this property is not atypical, there is no claim that it applies for a very wide range of values of the parameters. In particular, this property heavily depends on the level of the discount factor[18] and on the degree of unconditionality of the basic income.[19] Yet, the fact that the introduction of a partial basic income can be a Pareto improvement is as such a valuable result.

Finally, in addition to the marginal tax rate, it is interesting to have a look at the average wedge (in the case of an occupied worker), θ, defined by the equality $B + w = (1-\theta)w(1+\tau)$ with $B = \xi z w$. Hence, $\theta = 1 - \frac{1+\xi z}{1+\tau}$. As Figure 2 shows, θ is a U-shaped function of ξ. It amounts to 3.5% when ξ equals 0.3.

INSERT FIGURE 2 APPROXIMATELY HERE.

4 Conclusion

To contribute to the debate about the consequences of a basic income, this paper has developed a dynamic and general equilibrium model in which collective bargaining causes unemployment. Ex ante identical workers are heterogeneous ex post : Some of them are unemployed while others are employed and benefit from a higher utility level. The analysis has assumed that an unemployment insurance system initially exists with unemployment benefits proportional to the net wage. Two reforms have been considered : The so-called partial and full basic income schemes. Both have been taken proportional to the level of unemployment benefits. The coefficient of proportionality is by assumption lower than one when the basic income is partial and higher or equal to one in the case of the full scheme. Whatever the reform under consideration, the public budget has to be balanced.

The paper has shown that two mechanisms are at work. The partial basic income increases the progressivity of taxation and it favors in-work net income. Both mechanisms lower the equilibrium unemployment rate. In the full basic income case, the first mechanism still has a favorable effect on unemployment. But the second one has the opposite effect (if workers are risk averse). For, as the full basic income rises, out-of-work income increases relatively more than net earnings.

The main results of the paper have been derived in a steady state. First, compared to a situation with an unemployment insurance system but without basic income, the equilibrium unemployment rate is always lower if a partial basic income scheme is implemented. The same holds if the unemployment insurance system is replaced by a full basic income scheme provided that the ratio between the basic income and the unemployment benefits is not too high. Second, the equilibrium unemployment rate is a decreasing function of the

[18]As β shrinks, the unemployed more heavily discount the future gains coming from an improved probability of hiring.

[19]As ν tends to one, the trade-off between the well-being of the workforce and the one of the inactive population often becomes unavoidable.

ratio between the partial basic income and the unemployment benefits. Third, if workers are risk averse, the equilibrium unemployment rate is an increasing function of the ratio between the full basic income and the unemployment benefits. If workers are risk neutral, the full basic income has no effect on the equilibrium unemployment rate. Fourth, the equilibrium marginal tax rate typically increases with the basic income-unemployment benefits ratio while the net wage rate generally decreases. Finally, a numerical example has put forward the following important implications of basic income schemes in steady state. In an intertemporal perspective, a sufficiently small partial basic income-unemployment benefits ratio can be a Pareto improvement. As expected from the formal analysis, the net wage is a decreasing function of the basic income-unemployment benefits ratio. This property has two main consequences. First, the *instantaneous* income of the unemployed shrinks as the basic income is introduced (while their intertemporal income can be increasing because of improved prospects of employment). Second, the *level* of the full basic income is not necessarily higher than the one of a partial basic income. All these properties have been derived in steady state with a constant returns to scale technology but would also come out under the hypothesis of decreasing returns.

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Appendix 1

This appendix deals with the dynamic properties of the equilibrium. For $t \geq 1$, the ratio $\frac{w_{t+1}}{w_t}$ in equation (14) can be derived from equation (16). It can be checked that for $t \geq 1$ the unemployment rate fluctuates according to the following second-order equations :

$$\theta_1 \left(\frac{\theta_2 - \theta_3 u_t}{\theta_2 - \theta_3 u_{t+1}} \frac{1 - u_{t+1}}{1 - u_t} \right)^{\lambda} - \frac{q + (1-q) u_{t-1}}{u_t} + \theta_4 = 0, \tag{22}$$

with a partial basic income scheme and

$$\theta_1 \left(\frac{\theta_2 - u_t}{\theta_2 - u_{t+1}} \frac{1 - u_{t+1}}{1 - u_t} \right)^{\lambda} - \frac{q + (1-q) u_{t-1}}{u_t} + \theta_4 = 0, \tag{23}$$

with the full basic income scheme. In these expressions,

$$\begin{aligned} \theta_1 &= \beta(1-q),\ 0 < \theta_1 < 1, \\ \theta_2 &= 1 + \xi z (1+\nu),\ \theta_2 > 1, \\ \theta_3 &= 1 + (\xi - 1) z,\ 0 < \theta_3 < 1 \text{ since } \xi < 1, \\ \theta_4 &= \frac{1 + \xi z}{\mu \lambda} \left(1 - \left[\frac{z \mathcal{I}(\xi)}{1 + \xi z} \right]^{\lambda} \right),\ \theta_4 > 0. \end{aligned}$$

Let $F^j(u_{t-1}, u_t, u_{t+1}) = 0$ $(j = 1, 2)$ denote respectively the second-order scalar nonlinear difference equations (22) and (23). Let us linearize $F^j(u_{t-1}, u_t, u_{t+1}) = 0$ around the steady state u^{j*} (defined in (17)). Remember that the steady state is defined differently whether $\xi < 1$ (i.e. $j = 1$) or $\xi \geq 1$ (i.e. $j = 2$). The linearized difference equation can be converted to an equivalent first-order planar map :

$$\begin{pmatrix} u_{t+1} - u^{j*} \\ u_t - u^{j*} \end{pmatrix} = \mathcal{A}^j \begin{pmatrix} u_t - u^{j*} \\ u_{t-1} - u^{j*} \end{pmatrix} \tag{24}$$

In this expression, $\mathcal{A}^j$ is the 2×2 matrix

$$\begin{pmatrix} -\frac{F_2^j(u^{j*})}{F_3^j(u^{j*})} & -\frac{F_1^j(u^{j*})}{F_3^j(u^{j*})} \\ 1 & 0 \end{pmatrix} \tag{25}$$

where F_k^j denotes the first-order partial derivative of F^j with respect to its kth argument.

In (25), the first-order partial derivatives of F^j can be written as

$$\begin{aligned} F_1^j(u^{j*}) &= -\frac{1-q}{u^{j*}}, \\ F_2^j(u^{j*}) &= \zeta^j + \frac{q+(1-q)u^{j*}}{(u^{j*})^2}, \\ F_3^j(u^{j*}) &= -\zeta^j, \end{aligned}$$

where

$$\begin{aligned} \zeta^1 &= \lambda\theta_1 \frac{\theta_2 - \theta_3}{(\theta_2 - \theta_3 u^{1*})(1-u^{1*})}, \\ \zeta^2 &= \lambda\theta_1 \frac{\theta_2 - 1}{(\theta_2 - u^{2*})(1-u^{2*})}. \end{aligned}$$

For $j = 1, 2$, since $\theta_2 > 1$ and $\theta_3 \in]0, 1[$, it can be checked that ζ^j has the same sign as λ.

The characteristic polynomial is $P^j(\omega) = \omega^2 - (tr\mathcal{A}^j)\omega + (det\mathcal{A}^j)$ where

$$\begin{aligned} (tr\mathcal{A}^j) &= -\frac{F_2^j(u^{j*})}{F_3^j(u^{j*})} = 1 + \frac{q+(1-q)u^{j*}}{\zeta^j (u^{j*})^2}, \\ (det\mathcal{A}^j) &= \frac{F_1^j(u^{j*})}{F_3^j(u^{j*})} = \frac{1-q}{\zeta^j u^{j*}}, \text{ with } sgn(det\mathcal{A}^j) = sgn(\zeta^j). \end{aligned}$$

With one predetermined variable, the saddle point property is required in order to have a unique nonexploding solution. This property is guaranteed if $(tr\mathcal{A}^j)^2 - 4(det\mathcal{A}^j) > 0$ and if $[P^j(1) < 0$ and $P^j(-1) > 0]$ or $[P^j(1) > 0$ and $P^j(-1) < 0]$. Let us check these conditions. First, $(tr\mathcal{A}^j)^2 - 4(det\mathcal{A}^j)$ is always positive if ζ^j is negative. When $\zeta^j > 0$, $(tr\mathcal{A}^j)^2 - 4(det\mathcal{A}^j)$ is positive if

$$\left(1 + \frac{q}{\zeta^j (u^{j*})^2}\right)^2 + \frac{1-q}{\zeta^j u^{j*}} \left(\frac{2q}{\zeta^j (u^{j*})^2} + \frac{1-q}{\zeta^j u^{j*}} - 2\right) > 0. \tag{26}$$

There is no proof that this condition is always satisfied. Yet, numerical simulations show that it is verified if $0.01 < q < 0.4$ and $0 \leq u^{j*} \leq 1$. Since this sub-space covers the range of plausible values, condition (26) should be considered as fulfilled.

Let us now turn to the second set of conditions. Carrying out the calculation yields

$$\begin{aligned} P^j(1) &= -\frac{q}{\zeta^j (u^{j*})^2}, \text{ with } sgn[P^j(1)] = -sgn[\zeta^j], \\ P^j(-1) &= 1 + tr\mathcal{A}^j + det\mathcal{A}^j = 2 + \frac{q + 2(1-q)u^{j*}}{\zeta^j (u^{j*})^2}. \end{aligned}$$

When $\lambda > 0$, it is easily seen that $P^j(1) < 0$ and $P^j(-1) > 0$. Put another way, the linearized dynamic system (24) has the saddle point property. When $\lambda < 0$, $P^j(1)$ is positive but $P^j(-1)$ is not necessarily negative. Yet, unreported numerical simulations show that u^{j*} sharply decreases for $\lambda < 0$, so that the sign of $P^j(-1)$ turns out to be negative for plausible values of the parameters. The saddle point property holds here, too.

Appendix 2

This appendix proves Result 1. ¿From (17), u is positive if

$$\frac{1+\xi z}{\mu\lambda}\left(1-\left[\frac{z\mathcal{I}(\xi)}{1+\xi z}\right]^{\lambda}\right) > (1-\beta)(1-q).$$

Whatever the sign of λ, the left-hand side is positive. Unreported numerical simulations show that this inequality is verified for plausible values of the parameters. u is lower than 1 if

$$\frac{1+\xi z}{\mu\lambda}\left(1-\left[\frac{z\mathcal{I}(\xi)}{1+\xi z}\right]^{\lambda}\right) > 1-\beta(1-q).$$

This inequality is satisfied according to unreported numerical simulations (again for plausible values of the parameters).
Let D be the denominator of (17), if $\lambda \neq 0$. Carrying out the appropriate first-order derivatives yields :

$$\begin{aligned}
\frac{\partial u}{\partial r} &= \frac{\partial u}{\partial \beta}\frac{\partial \beta}{\partial r} = \frac{q(1-q)}{D^2(1+r)^2} \ > \ 0, \\
\frac{\partial u}{\partial q} &= \frac{1}{D}\left(1-\frac{q(1-\beta)}{D}\right) \ > \ 0 \text{ since } u<1, \\
\frac{\partial u}{\partial \mu} &= \frac{q}{D^2\mu^2}\frac{1+\xi z}{\lambda}\left(1-\left[\frac{z\mathcal{I}(\xi)}{1+\xi z}\right]^{\lambda}\right) \ > \ 0, \\
\frac{\partial u}{\partial z} &= -\frac{q\xi}{\mu\lambda D^2}\left[1-\left(\frac{z\mathcal{I}(\xi)}{1+\xi z}\right)^{\lambda}\left(1+\frac{\lambda}{\xi z}\right)\right] \ > \ 0.
\end{aligned}$$

The last property cannot be shown analytically. Yet, an unreported numerical analysis shows that it is verified for plausible values of the parameters. Finally, relative risk aversion equals $1-\lambda$ and

$$\frac{\partial u}{\partial \lambda} = \frac{q(1+\xi z)}{\mu\lambda D^2}\left(\frac{1}{\lambda}\left(1-\left(\frac{z\mathcal{I}(\xi)}{1+\xi z}\right)^{\lambda}\right)+\ln\left(\frac{z\mathcal{I}(\xi)}{1+\xi z}\right)\left(\frac{z\mathcal{I}(\xi)}{1+\xi z}\right)^{\lambda}\right) \ > \ 0,$$

again on the basis of a numerical simulation. ∎

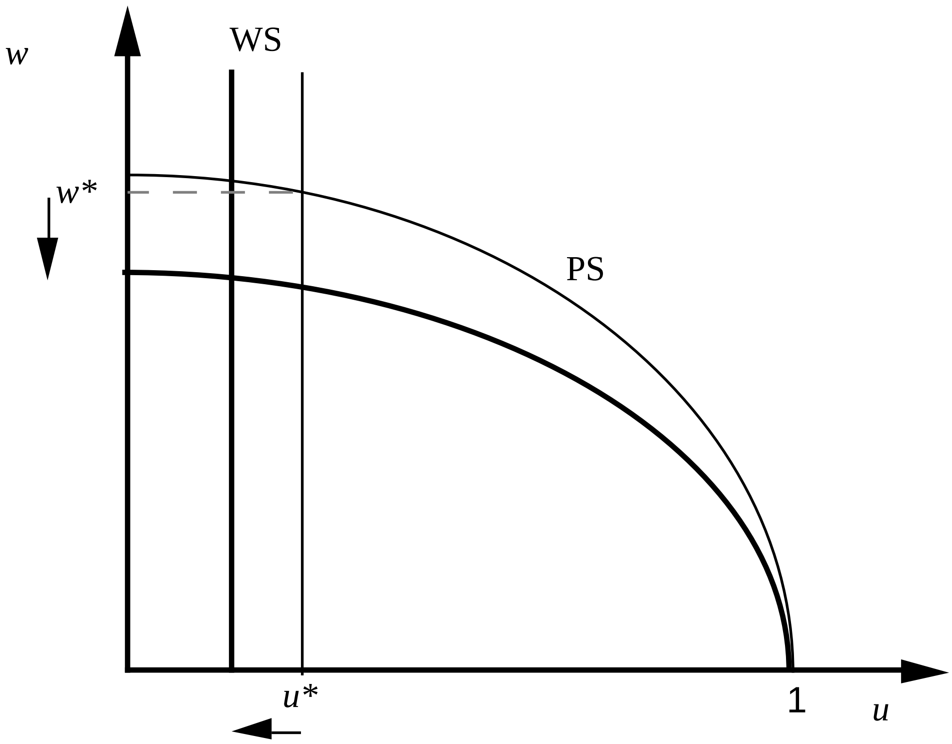

Figure 1: The steady-state equilibrium

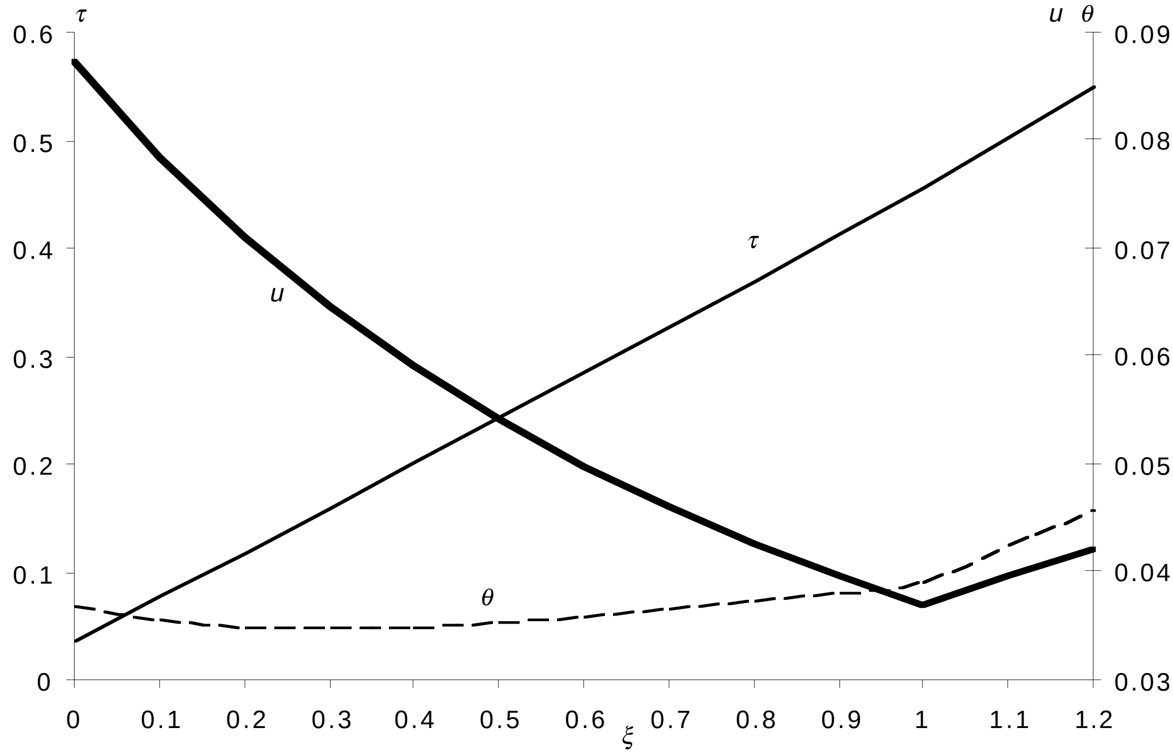

Figure 2: The equilibrium unemployment rate u, tax wedge τ and average tax rate θ