

Wage Bargaining, Social Security and Capital-Labour Substitution *

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This paper analyses the role played by a social security system in union-firm bargaining and in the resulting wage-productivity spiral. In a first step, we derive the incidence of social security on the bargaining process itself. In a second step, the macromodel is extended to include the budget constraint of the social security system. Both the distributive effect of wage bargaining and the existence of payroll taxes reinforce capital-labour substitution. Moreover, the social security system has a pro-cyclical effect in case of a demand shock and a counter-cyclical effect in case of a wage shock.

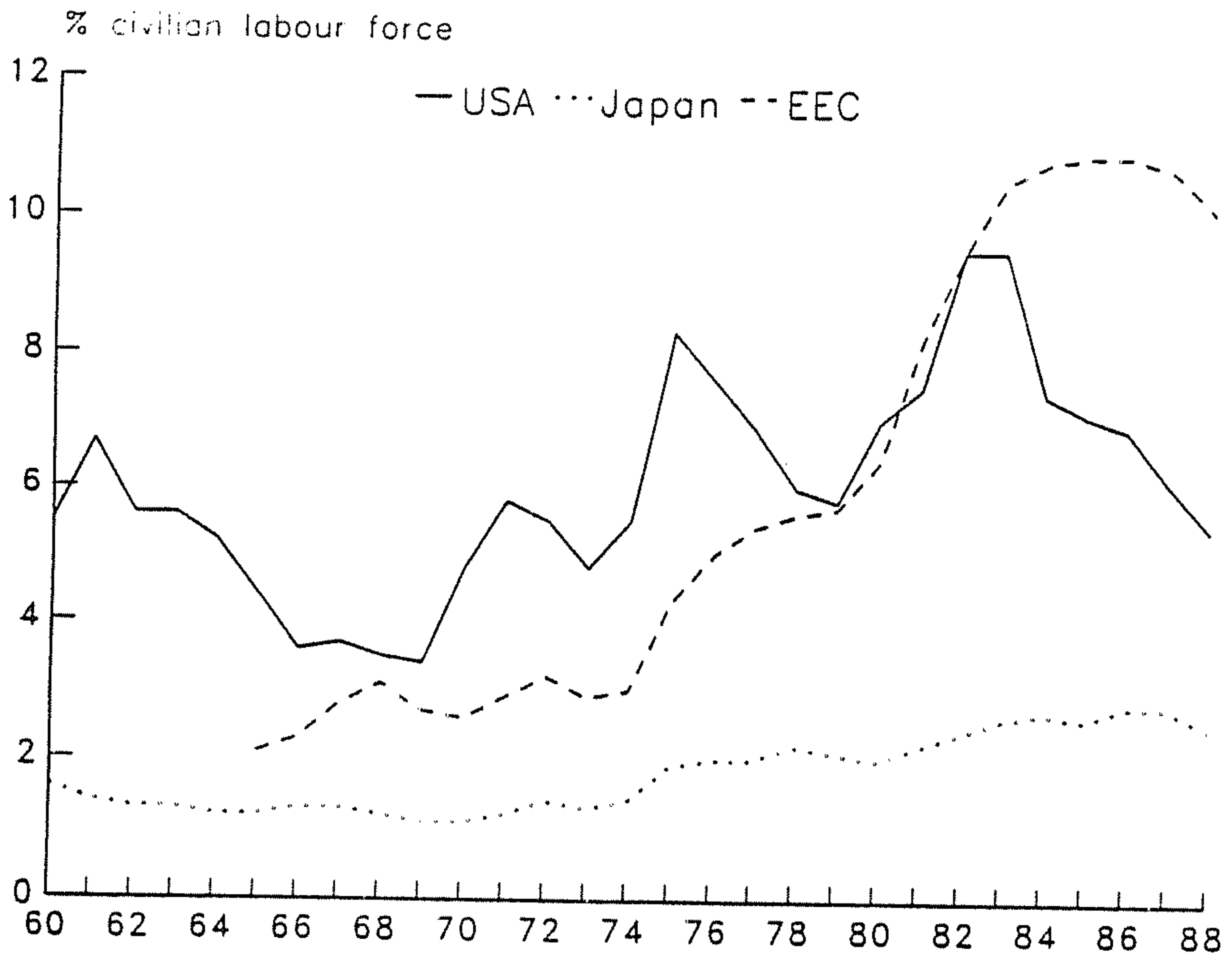
Introduction

The bad performance of the European economies in dealing with unemployment has been often debated. Figure 1 shows how European unemployment has risen gradually, while US unemployment displays a lot more variability around its average level, but with relatively minor changes in the average level itself.

The rapid growth of the labour force cannot explain the rise in unemployment (see for instance BEAN, LAYARD AND NICKELL (1986)), even though female participation has increased in many countries; in recent years, the growth in the labour force has not been markedly faster than in the 1960s.

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FIGURE 1 : Standardized unemployment rate



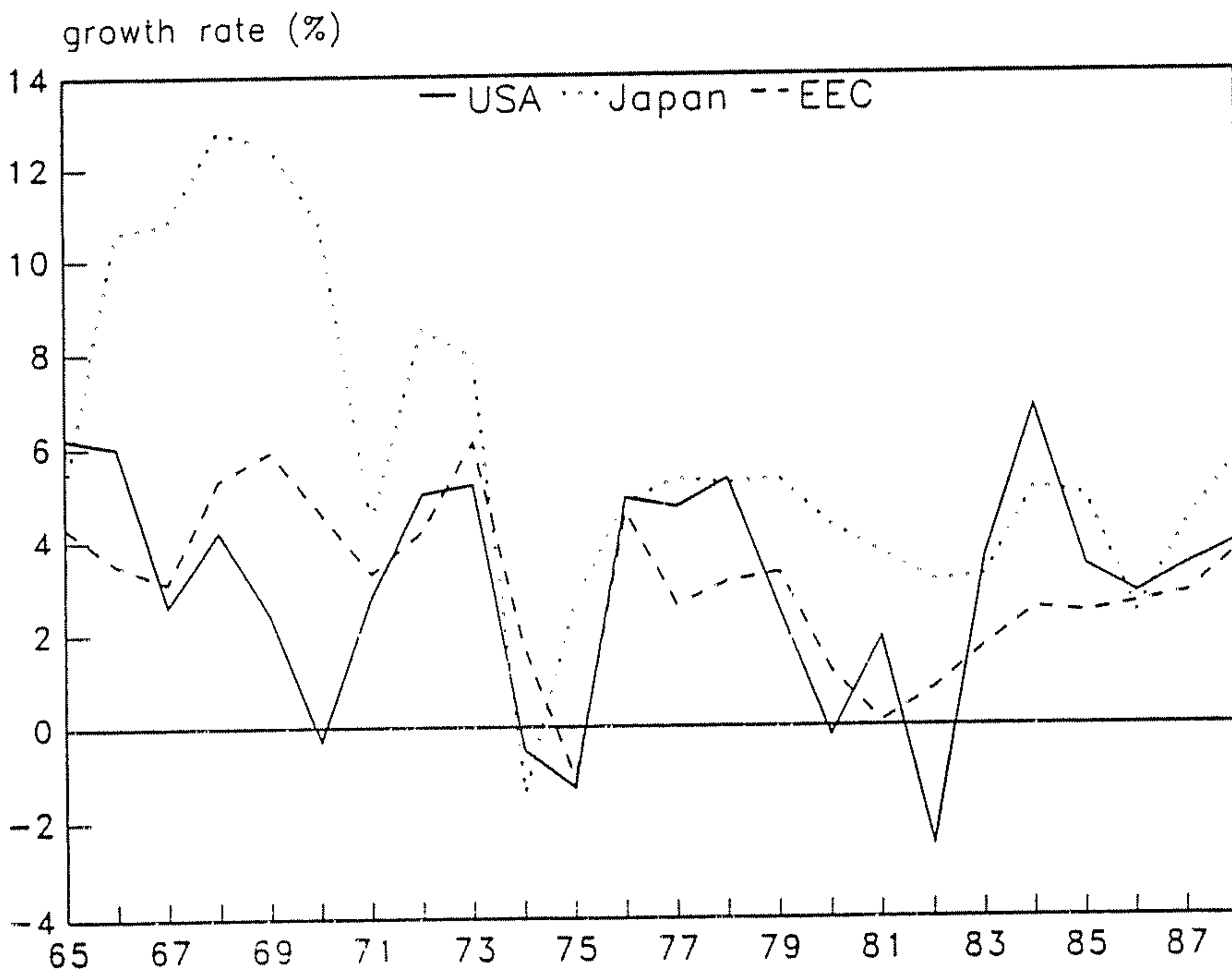
Source : OECD, IRES

One important characteristic of the differences between the USA and the EEC is that they do not reflect differences in economic growth. Growth has been more or less the same in both economies (the average growth rate of the real gross domestic product (1973-1988) is 2.4% for the EEC and 2.7% for the USA). Figure 2 illustrates this point, showing the greater variance of US output. A more detailed analysis is given in ALOGOSKOUFIS and MANNING (1988).

The European Unemployment Programme EUP (See DREZE (1991)) has recently estimated a macroeconomic model in 10 countries (US, the 8 major EEC countries and Austria) in order to identify the reasons for the differences and the similarities in unemployment experience. Concerning wage formation, the EUP notes that "Wage formation in Europe is largely governed by the distributive goals of unions - in contrast to the US

situation where wage formation comes closer to playing a market-clearing role.(...). Real wages incorporate measured productivity gains quite rapidly in Europe, with long-run elasticity close to 1. Measured productivity does not enter significantly in the US wage equation." Therefore, *capital-labour substitutability* and the *full incorporation of productivity gains* in real wages are important factors in the explanation of European unemployment. However, these long-run considerations about the so-called 'wage-productivity spiral' are based on an implicit bargaining process between firms and unions. In order to go deeper into this question, we develop in section 1 a firm-union bargaining model where the agents take into account this long-run capital-labour substitutability.

FIGURE 2 : Real gross domestic product (growth rate)



Source : OECD

Another related question raised by the EUP (see MEHTA and SNEESSENS (1991)) is concerned with the role of the *wedge between real labour costs and real labour income* in the explanation of the long-run equilibrium unemployment rate. This wedge arises mainly because of taxes and social security contributions. To incorporate this feature in our study, we first analyse the incidence of this wedge on the bargaining process itself (section 2). We then extend the model to include the budget constraint of the social security system (section 3). This last point is the main novelty of the paper.

In section 4, we are mainly concerned with the estimation of the model. Previous work has shown that wage indexation (price-wage spiral) and distributive goals of social negotiation (productivity-wage spiral) are crucial in explaining unemployment. A new spiral is added to the list : unemployment increases the social security contribution rate because of the budget constraint, inducing higher labour costs (with a greater wedge between labour costs and labour income), and thus reinforcing capital-labour substitution and unemployment. The social security system will turn out to have a pro-cyclical effect in case of a demand shock and a counter-cyclical effect in case of a wage shock.

1. The distributive goals of bargaining

The small model we develop here focuses on wages, prices and productivity. The firms are assumed to operate in a monopolistically competitive environment. Each firm maximizes its profit, determining the optimal combination of inputs and the output price. The production factors are substitutable.

Since the main preoccupation of the model is to analyse long-term links, we assume constant returns to scale so that the price-elasticity of goods supply is infinite. As a consequence, output is determined by the demand side of the economy. We keep this aggregate demand exogenous. This is clearly a shortcut, but it is a convenient assumption to isolate the long-term supply side elements of the wage-employment relationship.

Wages are determined at the firm level in a bargaining process : the unions act as if the wage-employment pair were constrained to be on the long-run labour demand schedule (which includes long-run factor substitution), so that the firm has the right to manage its employment level. The main reference on the "Right-to-Manage" type of bargaining is NICKELL and ANDREWS (1983) ¹. The introduction of monopolistic competition in wage bargaining model of the right-to-manage type is treated in CAHUC and LAURENT (1989) and ARNSPERGER and DE LA CROIX (1990).

In the next sections, we treat the firm and the union as representative agents : the microeconomic relationships which result from the bargaining process are therefore extended to the whole economy without explicit aggregation. However, during the negotiation, the agents do not take into account the effect of their decisions on the aggregate variables.

1.1. Employment and price determination

The representative firm of the economy sells an output Q at price P , using labour, capital and an amount of imported goods M bought at price P^M . The money wage is W and the user cost of capital is R . The production function $Q(K,L,M)$ is homogeneous of degree one. The firm maximizes its profit in a monopolistic competition environment : $P(Q)$ is the inverse of the demand function with constant elasticity $1/\epsilon$. The standard maximization programme is :

$$\max_{K,L,M} \Pi = P[Q(K,L,M)] Q(K,L,M) - WL - RK - P^M M$$

whose first-order conditions are :

$$(1) \quad \begin{aligned} Q_L &= \mu W/P \\ Q_K &= \mu R/P \\ Q_M &= \mu P^M/P \end{aligned}$$

¹ Recent surveys on this literature are found in HOLMLUND (1989) and CAHUC (1990).

where $\mu = \varepsilon/(1+\varepsilon)$ is the mark-up rate. Since the production function is homogeneous, we get the estimable form of (1) :

$$(2) \quad \begin{aligned} Q/L &= f(Q_L) = f(\mu W/P) \\ Q/K &= g(Q_K) = g(\mu R/P) \\ Q/M &= h(Q_M) = h(\mu P^M/P) \end{aligned}$$

These equations can be log-linearised ². Let us write labour productivity in terms of growth rates, as in equation (a) of Table 1. Let a be labour productivity, α_1 labour saving technical progress and α_2 the elasticity of average labour productivity with respect to the real wage (all variables are taken in growth rates). If the production function is CES, α is constant and equal to the rate of substitution between capital and labour.

Equations (1) contain implicitly the price equation : using the properties of a homogeneous function (Euler's theorem), we get :

$$(3) \quad Q = Q_L L + Q_K K + Q_M M \Rightarrow P = \mu(WL/Q + RK/Q + P^M M/Q)$$

This can be log-linearised to obtain equation (b) of Table 1 with

$$\beta_1 = WL/(WL + RK + P^M M) \text{ and } \beta_2 = RK/(WL + RK + P^M M).$$

² If the production function is CES with $\sigma = 1/(\phi+1)$ being the elasticity of substitution between the inputs :

$$Q = [\phi_1(e^{\tau_1} L)^{-\phi} + \phi_2(e^{\tau_2} K)^{-\phi} + \phi_3(e^{\tau_3} M)^{-\phi}]^{-1/\phi}$$

The estimable form becomes :

$$\ln(Q/L) = -\sigma \ln(\phi_1) - \sigma \ln(\mu) + \sigma \phi \tau_1 t + \sigma \ln(W/P)$$

$$\ln(Q/K) = -\sigma \ln(\phi_2) - \sigma \ln(\mu) + \sigma \phi \tau_2 t + \sigma \ln(R/P)$$

$$\ln(Q/M) = -\sigma \ln(\phi_3) - \sigma \ln(\mu) + \sigma \phi \tau_3 t + \sigma \ln(P^M/P)$$

This specification will be tested in the section 4. See LAMBERT et al. (1984) for an application.

TABLE 1 : The basic model

structural model :

$$(a) \quad \dot{a} = \alpha_1 + \alpha_2 (\dot{w} - \dot{p})$$

$$(b) \quad \dot{p} = \beta_1 (\dot{w} - \dot{a}) + \beta_2 \dot{r} + (1 - \beta_1 - \beta_2) \dot{p}^M$$

$$(c) \quad \dot{w} = \dot{p} + \dot{a} + \dot{z}_1$$

reduced form : (employment equation)

$$\dot{l} = \dot{y} - \frac{\alpha_1}{1 - \alpha_2} - \frac{\alpha_2}{1 - \alpha_2} \dot{z}_1$$

1.2. Wage Bargaining

The firm and the union determine the real wage, $WR = W/P$, knowing the reaction functions defined in equations (1). The basic framework is a non-cooperative model of alternating offers, but its outcome can be approached by the non-cooperative Nash solution (see BINMORE, RUBINSTEIN and WOLINSKI (1987)). Interpreting the fall-back levels as the income streams of each player during a dispute, let us assume zero fall-back utility level for the union, meaning essentially that there are no strike payments. For the firm, the real fall-back profit is $\pi_0 - RK - PMM$: during a dispute, the firm is not able to avoid the cost of capital and the payment of the imported goods. π_0 is an exogenous reference level. The bargaining programme is :

$$\max_{WR} b \ln U[L(WR), WR] + (1-b) \ln [L(WR) (A(WR) - WR) - \pi_0]$$

$U[L(WR), WR]$ is the utility of the union while $L(WR) (A(WR) - WR) - \pi_0$ is the firm's net profit. The first-order condition is :

$$b \frac{U_{LL}WR + U_{WR}}{U(L, WR)} + (1-b) \frac{LWR (A-WR) + L(AWR-1)}{(Q-WRL-\pi_0)} = 0$$

Reordering terms to get elasticities and denoting $\eta_{A.WR} = \sigma$, we obtain :

$$(4) \quad W = \frac{b(\eta_{U.L}\eta_{L.WR} + \eta_{U.WR})(1-\pi_0/Q) + (1-b)(\sigma + \eta_{L.WR})}{b(\eta_{U.L}\eta_{L.WR} + \eta_{U.WR}) + (1-b)(1 + \eta_{L.WR})}$$

This equation is not a closed-form wage equation since the various elasticities are not necessarily constant. One way of obtaining a closed form is to assume that the production function is Cobb-Douglas ($\sigma=1$, $\eta_{L.WR}$ constant), that the utility function of the union is log-linear and that π_0/Q is constant : the nominal wage is then fully indexed on the price and follows the productivity of labour. In the more general case of a CES production function, $\eta_{L.WR}$ is no longer constant (it is a function of the labour share), and (4) is to be treated as an implicit wage equation.

π_0/Q is the unit fall-back reference level. Sufficient conditions³ to have a positive wage are :

$$\frac{\eta_{U.WR}}{\eta_{U.L}} > |\eta_{L.WR}|$$

$$b > \frac{-\sigma + |\eta_{L.WR}|}{(\eta_{U.L}\eta_{L.WR} + \eta_{U.WR} - \sigma + |\eta_{L.WR}|)(1-\pi_0/Q)}$$

The first condition says that the unions have to have a strong enough preference for wages. Equivalently, it says that the union has always an incentive to increase the wage. Note that in the pure monopoly union case, the union does not take into account the firm's fall-back profit, so that it will increase the wage until the optimality condition $\eta_{U.WR}/\eta_{U.L} = |\eta_{L.WR}|$ is verified.

The second condition requires that union power be large enough. If union power is maximum ($b \rightarrow 1$), then WR tends to $A(1-\pi_0/Q)$, so that profits are brought down to their fall-back level.

³ A full derivation of necessary conditions is given in ARNSPERGER and DE LA CROIX (1990).

In terms of growth rates, we obtain equation (c) of Table 1; z_1 represents the variation in the following elements : union power, union preferences, elasticity of labour with respect to wages, elasticity of substitution between production factors, and unit reference profit. If z_1 is independent of the variations in productivity, the elasticity of the real wage with respect to productivity is 1.

For the following analysis, we use two simplifying assumptions both relying on previous estimates of Belgian wage equations ⁴. First, we assume z_1 independent of productivity so that the productivity gains are fully incorporated in the real wage. Secondly, we take z_1 independent of the unemployment rate. This last assumption aims at simplifying the model in order to emphasize the two spirals that will be treated, without adding a third one (wage-unemployment) which is generally considered as weak for Belgium (at least at the macroeconomic level).

1.3. The wage-productivity spiral

Table 1 contains the reduced form of equations (a) and (c) determining employment growth. The term $1/(1-\alpha_2)$ comes from the so-called wage-productivity spiral. This spiral acts as a multiplier on the trend of technical progress α_1 and on the effect of the 'exogenous' wage z_1 . This simple model has been estimated on Belgian data in order to assess the magnitude of the elasticities α_1 and α_2 . The full specification of the model will be given in section 4 (Table 3).

The estimates of the coefficients illustrate how wage bargaining based on the distribution of value added can be harmful for employment. The elasticity of substitution α_2 being equal to 0.57, the effects on employment of technical progress and of exogenous wage increases are multiplied by 2.33. The autonomous growth of labour productivity is equal to 3.3% per year; without the redistribution of productivity gains, this growth would

⁴ cf. DREZE (1991), SNEESSENS-DREZE (1986), and the estimates of the Belgian Planning Bureau for its model Maribel I.

only be equal to 1.4%. An increase of 1% in z_1 will increase labour productivity (and thus unemployment) by 1.3%.

As DREZE (1991) has pointed out, the incorporation of productivity gains into real wages induces capital-labour substitution, which is wasteful in economies operating under inefficient unemployment. If that substitution had stopped when it became wasteful (i.e. after the first oil shock), the rise of unemployment in Europe could have been avoided. A question naturally arises : how is this inefficiency possible since the wage equation results from a voluntary choice by the union ? The answer can be based on an inductive argument : if we observe a full incorporation of the productivity gains into the real wage, it means essentially that the term z_1 (incorporating $\eta_{U.WR}$ and $\eta_{U.L}$) is independent of labour productivity and therefore of the unemployment rate at given output and labour supply. This implies that the elasticities of the union utility function are not a function of the state of the labour market, so that the interests of the unemployed workers are not taken sufficiently into account.

2. The incidence of taxes on the bargaining

To refine the analysis of the wage-price-productivity spiral, we have to consider explicitly the wedge separating labour cost from labour income. This wedge is caused by three factors : (1) there is a difference between the consumption price used to index the wage and the value-added price used in profit maximization; (2) personal taxation reduces labour income; (3) social security contributions increase labour cost ⁵. Figure 3 shows the importance of the wedge created by personal taxes and social security contributions. In this paper, we consider only this last factor, which has been the least explored.

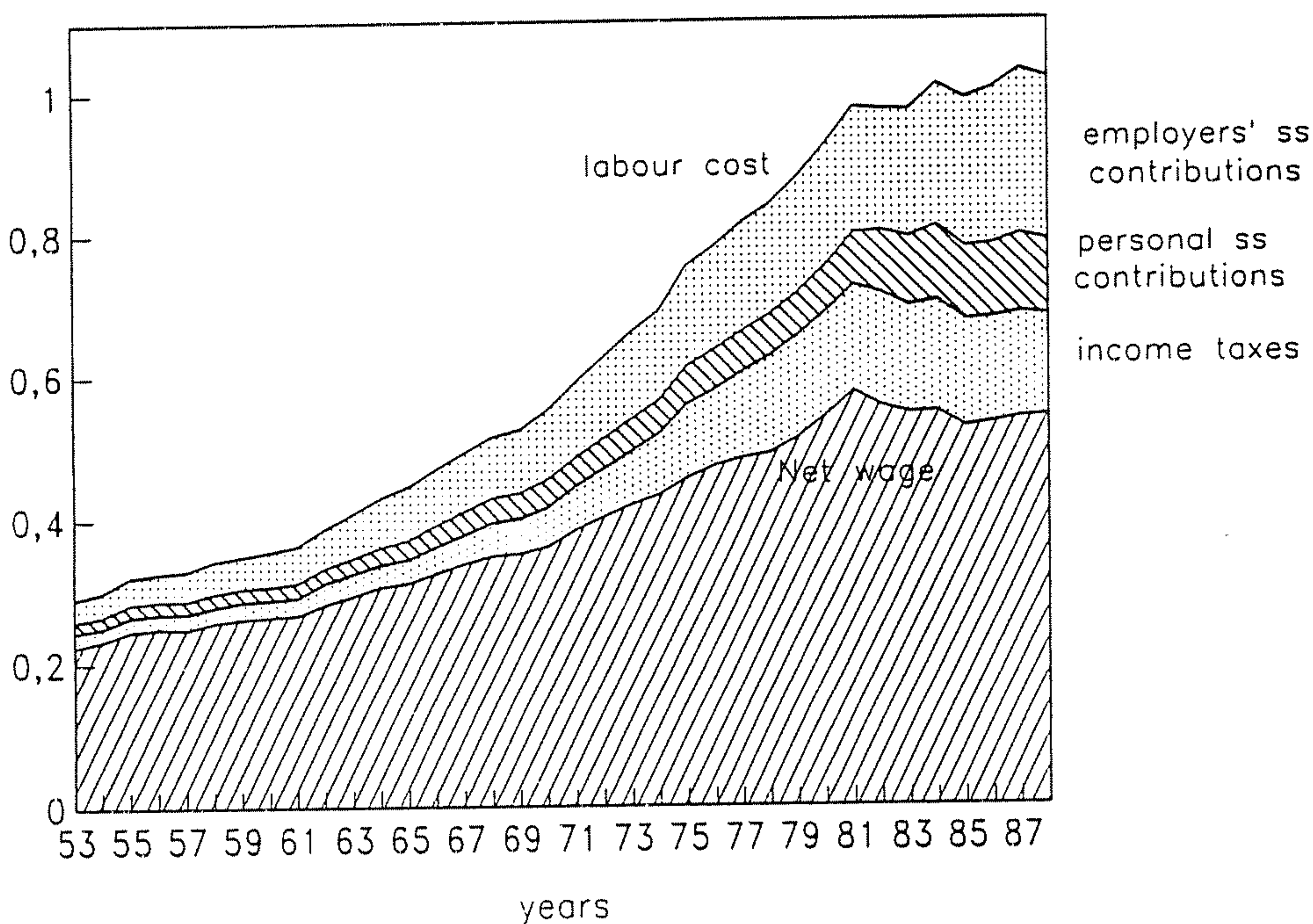
For the union and for the firm, the existence of the social security

⁵ Social security contributions cover both the contributions paid by the employers and the contributions paid by the workers.

system represents mainly a cost ⁶. Let us incorporate social security contributions into the bargaining function of section 1 : the labour cost WRC is now equal to the gross wage WR ⁷ times an exogenous rate (1+CS).

FIGURE 3 : Labour cost and net wage

BF millions 1985 per worker



The problem is :

$$\max_{WR} b \ln U[L(WRC), WR] + (1-b) \ln [L(WRC) (A(WRC) - WRC) - \pi_0]$$

⁶ To be more complete, we would have supposed that the social security system changes the union's objective function since it reduces the uncertainty about future incomes : the employment objective should have less weight and the union's relative preference for wages should increase. But, since our model is not adapted for such analysis we just consider the cost aspect of the social security system.

⁷ The gross wage is equal to the net wage plus personal income taxes.

The first-order condition is :

$$(5) \quad WR(1+CS) = \frac{b(\eta_U.L\eta_L.WR + \eta_U.WR)(1-\pi_0/Q) + (1-b)(\sigma + \eta_L.WR)}{b(\eta_U.L\eta_L.WR + \eta_U.WR) + (1-b)(1 + \eta_L.WR)}$$

Comparing equations (4) and (5), we see that the wage share in value added is modified : the wage share (net of contributions) is reduced by the incorporation of taxes in the total labour share.

If we consider the elasticities as constant, the *wage cost* is indexed on labour productivity, implying that a rise in the social security contribution rate is fully compensated by a decrease in the net wage. However, if the production function or the unions' utility function is not log-linear, the full compensation of the social security contribution is no longer straightforward.

In the last section, we estimate a four-equation model where the real wage is a function of past wages, productivity and social security contribution. In this model, the elasticity of wages with respect to the contribution rate is -0.63. We therefore conclude that in response to a contribution rate increase, the union will accept some wage reduction. This reduction allows to share the tax increase between workers and firms. This can be compared with estimates by COTIS and LOUFIR (1990) : For France, they find elasticities of gross wage to social contributions between -0.88 and -1.26. A five-country equation including Belgium shows also an elasticity of -0.85 (or -1.2 with a constant) ⁸. Cotis and Loufir results tend to prove that at least a large share of social security contributions is supported by employees. Unfortunately, it does not seem possible to discriminate between a full repercussion of social contributions on the gross wage and a partial one. In general, there is no agreement on this topic ⁹.

⁸ This is not entirely comparable with our estimates because they do not use data after 1984 which are important with respect to social contributions increases.

⁹ For Belgium, SNEESSENS-DREZE (1986), VAN POECK-VAN GOMPEL (1990) and DE BRUYNE-VAN ROMPUY (1990) do not find any repercussion of payroll taxes on the gross wage. DEIMEZIS et al. (1990) find some repercussion in manufacturing industries but not in services industries.

TABLE 2 : The extended method

structural model :

- (a) $\dot{a} = \alpha_1 + \alpha_2 (\dot{w} + \dot{c}s - \dot{p})$
- (b) $\dot{p} = \beta_1 (\dot{w} + \dot{c}s - \dot{a}) + \beta_2 \dot{r} + (1 - \beta_1 - \beta_2) \dot{p}^M$
- (c) $\dot{w} = \dot{p} + \dot{a} + \dot{z}_1$
- (d) $\dot{z}_1 = -\Gamma \dot{c}s + \tilde{z}_1$
- (e) $\dot{c}s = -\delta_1 \dot{z}_1 + \delta_2 (\dot{l}s - \dot{y} + \dot{a}) + \dot{z}_2$

reduced form : (employment equation)

$$\dot{l} = \dot{y} + \frac{-\alpha_1 - \alpha_2 \left[\frac{1-\Gamma}{1-\Gamma\delta_1} \right] [\delta_2 (\dot{l}s - \dot{y}) + \dot{z}_2]}{1 - \alpha_2 - \alpha_2 \delta_2 \left[\frac{1-\Gamma}{1-\Gamma\delta_1} \right]} + \frac{-\alpha_2 - \alpha_2 \delta_1 \left[\frac{1-\Gamma}{1-\Gamma\delta_1} \right]}{1 - \alpha_2 - \alpha_2 \delta_2 \left[\frac{1-\Gamma}{1-\Gamma\delta_1} \right]} \dot{z}_1$$

This allows us to decompose the evolution of z_1 (which is equal to $w-a-p$ following equation(c)) into two components : a reaction to a change in the social security contribution rate and an exogenous component \tilde{z}_1 (reflecting variations in unions' preferences, etc.). This is modelled in equation (d) of Table 2.

3. The budget constraint of social security

In this section, we add to the previous model the budget constraint of the social security system. The basic idea is that when unemployment increases, the contribution rate tends to rise in order to finance the unemployment compensations. This increases the cost of labour, inducing capital-labour substitution and unemployment.

3.1. Descriptive statistics

The increase in the contribution rates in order to finance the social security system has been particularly important during the last decade. The origin of this increase may be found in figure 4, which presents the implicit (or observed) contribution rates for the four main branches of the wage-earners regime in Belgium. We observe a constant growth of the rate for the state pension scheme and for the health-disablement insurance. The contribution rate of the family allowance scheme seems to be virtually constant. The increase in the rate of unemployment insurance is very substantial. Obviously, it is realistic to assume that the contribution rate is a function of the expenditures of each insurance scheme. Concerning health and pension, the expansion of the system during the period between World War II and the end of the seventies has pushed taxes up. As far as unemployment insurance is concerned, the government has been forced to increase substantially the contribution rate after the second oil shock. The unemployment resulting from the first oil shock was covered by direct subsidization of the central government. After 1981, however, the deficit became too large for this subsidization to be sustainable.

3.2. Modeling The Budget Constraint

We can model the social security problem ¹⁰ as follows :

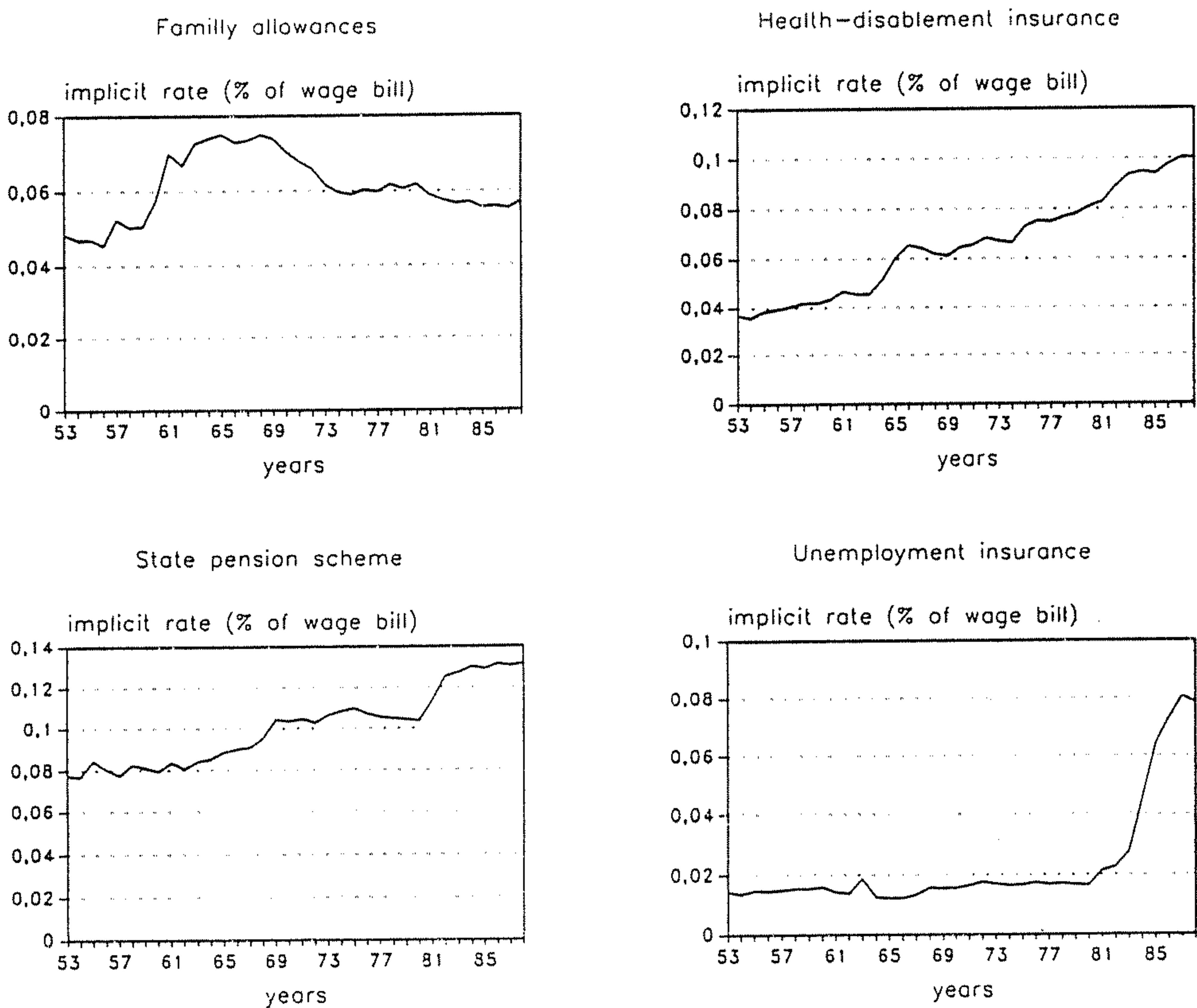
$$(6) \quad \text{receipts} = \text{unempl. expend.} + \frac{\text{other expenditure}}{\text{as a share of GDP}}$$

$$\text{CSWL} = W^U (\text{LS-L}) + \text{PQZ3}$$

¹⁰ The model we are developing here could also be seen as the budget constraint of the whole State if we consider that Z3 is the total expenses of the government net of other taxes. We have chosen to focus on the social security system which is only a part of the whole State in order to emphasize the link between unemployment and deficit.

CS is the social security contribution rate, W^U is unemployment compensation, LS-L is total unemployment and Z3 represents the share of other social security expenditures in GDP. This last factor is exogenous to our problem.

FIGURE 4 : Implicit contribution rate



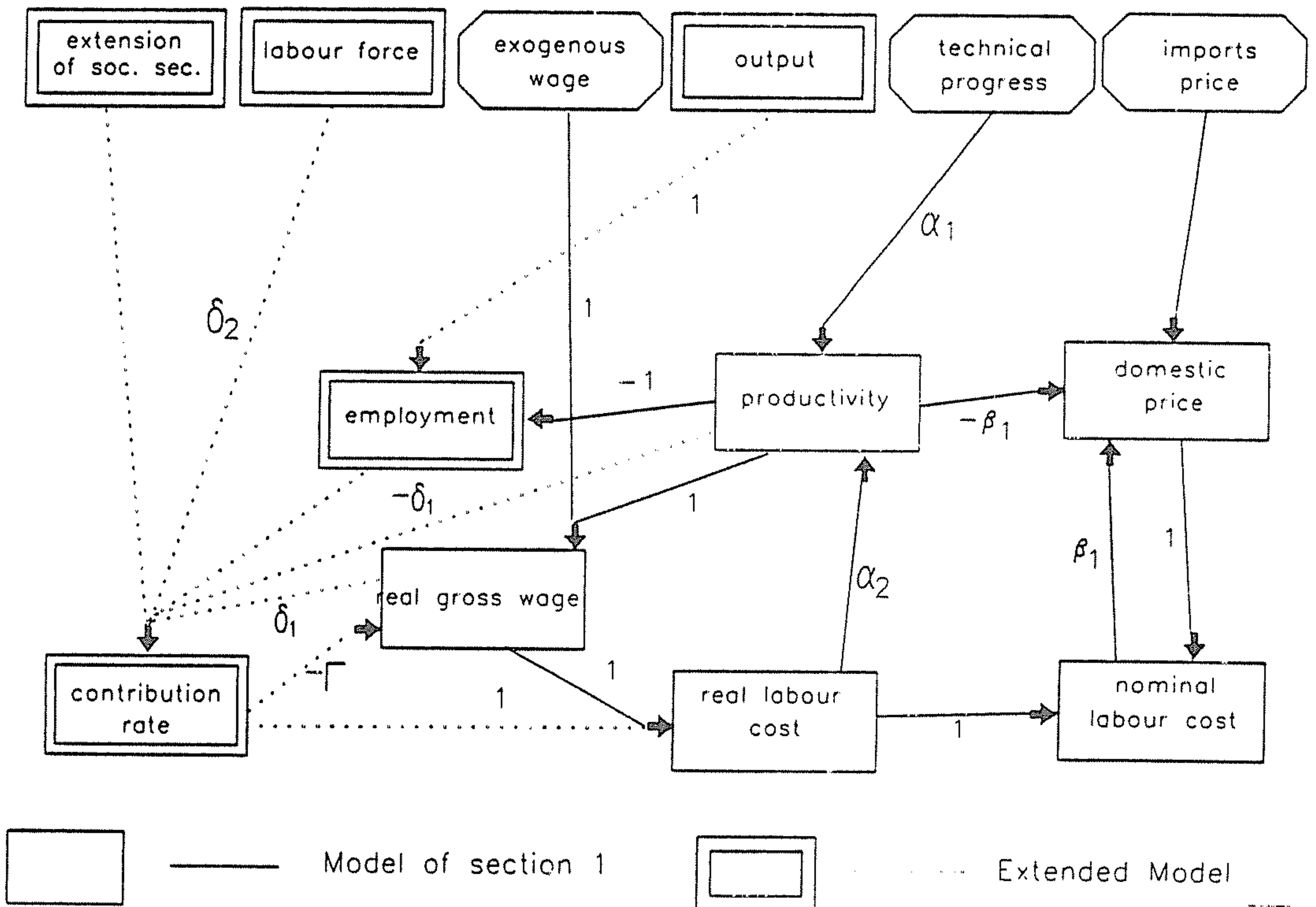
From equation (4) we know that $W = P (Q/L) Z1$. As the unemployment compensation W^U is a proportion of the previous wage of the unemployed workers, let us suppose that these are fully indexed and follow labour productivity : $W^U = P (Q/L) Z4$ ¹¹. Equation (6) becomes :

¹¹ This is not fully correct since the government has put an upper limit to the compensation.

$$(7) \quad CS = (Z4/Z1) (LS/L-1) + Z3$$

This equation determines the rate CS that balances the budget of the social security system. This budget is a function of unemployment (LS-L) and of the difference between the wage and the unemployment allowance. Other factors (Z3) such as the expansion of social coverage (health insurance for all, pension for self-employed workers, ...) explain the evolution of the general contribution rate. In order to be able to compute the various elasticities, we estimate a log-linear approximation of (7) presented in equation (e) of Table 2. The variables are expressed in growth rates. z2 is a combination of z4 and z3 : it represents the growth of expenditures which is due to political decisions (exogenous increase in the unemployment allowances, increase in the level of social protection,...); it will be modelled using real transfers per capita (excluding unemployment compensation).

FIGURE 5 : Structural models



3.3. The role of the constraint on the spirals

The full model contains equations (a), (b), (c), (d) and (e). These structural relationships are presented in the following flow diagram (Figure 5). The model of section 1 (without social security) is compared with the extended model.

The reduced form presented in Table 2 shows the various spirals :

- $1-\beta_1$ is the usual wage-price spiral.
- $1-\alpha_2$ is the wage-productivity spiral of section 1.
- $1-\alpha_2\delta_2\left[\frac{1-\Gamma}{1-\Gamma\delta_1}\right]$ represents the new spiral : additional unemployment \rightarrow rise in the contribution rate \rightarrow capital-labour substitution \rightarrow additional unemployment.

The solution of the model requires :

$$0 < 1 - \alpha_2 - \alpha_2\delta_2 \left[\frac{1-\Gamma}{1-\Gamma\delta_1}\right] < 1$$

Considering Table 2 and Figure 5, we can make the following points concerning the introduction of a social security system ¹² :

1. If the equilibrium condition is satisfied, the existence of a social security system increases the perverse effect of the distributive goals of bargaining by adding a new spiral. This implies additional capital-labour substitution when unemployment increases.
2. The cyclical behavior of employment is reinforced ¹³ : the elasticity of labour with respect to demand is larger than 1, implying an additional drop in employment in case of an adverse demand shock.
3. As z_2 includes the movement of extension and generalization of the social security system (which benefits to the non-workers), we get an additional autonomous component in productivity : it may take the form of an additional trend if the social security coverage is always increasing. An economy that increases its social coverage has to have

¹² Let us recall that the social security system we are considering here is of the Bismarckian type : the receipts are taken off the *wage bill* of the firms. They do not come from VAT taxes or income taxes.

¹³ This remark must be moderated thanks to the well known contra-cyclical demand effect of the social security system which is not modeled here (automatic stabilizers).

higher productivity in order to finance this coverage.

4. In case of a wage shock (e.g. through a change in union preferences), the role played by the social security system is not clear. On the one hand, the additional spiral increases the effect of the shock; on the other hand, the rise in the wage enlarges the tax base and reduces the contribution rate. Comparing the effects of z_1 and \tilde{z}_1 on employment in Tables 1 and 2, we get the following proposition : if

$$(8) \quad \frac{\delta_1}{\delta_2} > \frac{\alpha_2}{1-\alpha_2}$$

then the social security system reduces the effects of a wage shock on employment. The tax base effect (δ_1) dominates the additional spiral effect (δ_2, α_2).

4. Empirical Model

4.1. Estimation and testing

We have estimated the model presented in section 3 on Belgian data in order to compute the value of the various elasticities with and without the adjustment of the contribution rate. The definition of the variables is given in the appendix.

The estimation is presented in Table 3. The following elements can be noted :

- The model is estimated over the period 1955-1988 with three-stage least squares, using annual data. The exogenous and lagged endogenous variables are used as instrumental variables.
- The dynamics of the equations has been modelled with error correction mechanisms. This takes into account the fact (1) that the effects of a change in factor cost on productivity are spread over time, (2) that there exist 'menu costs' so that prices do not respond immediately to a cost increase, and (3) that the government adjusts the contribution rate only when the rise in unemployment seems persistent.
- The degree of labour utilization has been added as an explanatory

variable in the productivity equation in order to capture the pro-cyclical variation of observed (as opposed to technical) productivity due to labour hoarding.

- The cost of capital in the price equation has been assumed constant.
- The social intervention variable z_2 is measured by the real social security transfer per capita (unemployment compensation not included).

With these estimates the long-run structural parameters can be computed as :

$$\dot{a} = 0.014 + 0.57(\dot{w} + \dot{c}s - \dot{p})$$

$$\dot{p} = 0.82(\dot{w} + \dot{c}s - \dot{a}) + 0.18 \dot{p}^M$$

$$\dot{w} = \dot{p} + \dot{a} - 0.63\dot{c}s + \dot{z}_1$$

$$\dot{c}s = -0.28(\dot{w} - \dot{p} - \dot{a}) + 0.19(\dot{l}s - \dot{y} + \dot{a}) + \dot{z}_2$$

The shocks are multiplied by $1/(1-\alpha_2) = 2.33$ due to the wage-productivity spiral alone. When we include the social security system, these shocks are multiplied by 2.61. 63% of the changes in the contribution rate are passed on to the net wage. Note that if the increases in the contributions are not shared between unions and firms ($\Gamma=0$) the multiplicative factor is 3.1.

The elasticity of employment with respect to output is equal to 1 in the model without social security and to 1.12 in the extended model. The story is the following : a 1% drop in employment induces first a 0.19% rise in the contribution rate. This increases the cost of labour and therefore labour productivity by a factor of $0.57 \times 0.19\%$. The union agrees to a reduction of the wage in order to share the increase of the contribution rate between profits and the wage bill. This decreases the tax base of the social security system. The increasing productivity (and

therefore unemployment at given output) and the reduction of the tax base lead to additional increases in the contribution rate, etc. Therefore, the existence of a social security system has pro-cyclical repercussions on employment when we consider only the supply side effect at a given level of output.

TABLE 3 : Estimation results

$$\begin{aligned}
 a = & - 0.069 + 0.0056 T + 0.7 (w+cs-p) - 0.47(w+cs-p)_{-1} \\
 & (1.4) \quad (2.5) \quad (8.1) \quad (4.7) \\
 & + 0.6a_{-1} + 0.26(duc-0.6duc_{-1}) \\
 & (4.8) \quad (4.6) \\
 p = & + 0.04 + 0.71 [0.82 (w+cs-a) + 0.18 p^M] \\
 & (4.9) \quad (16.3) (19.8) \\
 & + (0.16 - 0.71) [0.82 (w+cs-p)_{-1} + 0.18 p_{-1}^M] + (1-0.18) p_{-1} \\
 & (3.8) \\
 w = & - 0.09 + 0.66a - 0.4a_{-1} + 0.95 p - 0.72p_{-1} \\
 & (3.3) \quad (5.0) \quad (7.2) \\
 & - 1.11cs + 0.95cs_{-1} + 1.13w_{-1} - 0.39w_{-2} \\
 & (2.3) \quad (2.0) \quad (10.5) \quad (3.8) \\
 cs = & 0.09 - 0.12 (w-p-a)_{-1} + 0.09 (ls-y+a) + 0.019z2 + 0.58cs_{-1} \\
 & (4.5) \quad (5.9) \quad (5.4) \quad (4.8) \quad (7.8)
 \end{aligned}$$

Method : 3SLS

instruments : w_{-1} , cs_{-1} , p_{-1} , a_{-1} , T , duc , $lduc_{-1}$, p^M , p_{-1}^M , $ls-y$, $z2$, w_{-2} .

Statistics :

	a	p	w	cs
R ²	0.99	0.99	0.99	0.99
S.E.R.	1.29%	1.21%	1.73%	0.31%
D.W.	1.72	2.16	2.14	2.06

This model suggests that the long-run supply-side effects of such social security system are not negligible. In the present situation of Belgium, where unemployment is diminishing slowly, our model tells that a 'virtuous circle' through the improvement of the social security budget may have important multiplicative effects on employment.

If we consider the wage shock, condition (8) is $1.43 > 1.33$, so that the social security system reduces the effects of a wage shock on employment. Finally, the inflationary spiral multiplies the shocks by $1/(1-\beta_1)=5.56$.

4.2. Policy conclusions

The social security system we have considered here is of the Bismarckian type : the receipts are taken off the wage bill of the firms ¹⁴ The advantage of this system is that its administration is left to an organization managed by the employers and the unions with equal representation of both sides. This formula is more independent from the government, but when unemployment increases, the contributions become insufficient and the government is forced to intervene with subsidies. Moreover, the model developed in this paper shows how this system substantially reinforces the wage-productivity spiral and introduces a systematic bias in favour of capital. This bias is inefficient in case of high and persistent unemployment. The alternative is to finance the system with taxes (direct or indirect) allowing to put the weight of unemployment on both capital and labour and therefore avoiding a substitution effect. The drawback of this proposition is that it increases the direct intervention of the government in social matters.

5. Conclusion

This paper has proceeded in two steps. In a first step, we have derived the supply block of a macroeconomic model from explicit wage

¹⁴ This system was introduced in Germany by Bismarck in 1883 (health insurance) and in 1889 (pension scheme).

bargaining in order to analyse the links between productivity, wages and prices. With respect to the literature about wage bargaining, we have incorporated long-run capital-labour substitution in the information set of the agents. We have shown how the spiral generated by the social negotiation can reinforce capital-labour substitution and explain some part of unemployment experience in countries where bargaining structures are important.

In a second step, the model has been extended to include a social security system financed with payroll taxes. We have first analyzed the effect of social security contributions on the bargaining function. Secondly, we have introduced a social security budget constraint in the macromodel. With respect to the previous articles written on the role of social security contribution in explaining Belgian unemployment (VAN DER LINDEN (1990) and DEWATRIPONT et al. (1989)), *we have endogenized the contribution rate*. This leads to three main effects :

- The existence of a social security system (financed with payroll taxes) increases the perverse effect of the distributive goals of bargaining by adding a new spiral. This implies additional capital-labour substitution when unemployment increases.
- The cyclical behavior of employment is reinforced : the elasticity of labour with respect to demand is larger than 1, implying an additional drop in employment in case of an adverse demand shock.
- In case of a wage shock the role played by the social security system depends on the value of the parameters. The estimation of the model for Belgium shows that the negative effect on unemployment of a wage shock is reduced by the social security system because the effect on the receipts (the fiscal base is increased) dominates the effect on the expenditures (due to unemployment).

The main elasticities are summarized in Table 4. These elasticities implies that, if the average yearly growth rate of production and real transfer per capital is 3% and if labour supply increases by 1% each year, the yearly fall in employment would be 0.56% with a social security system financed by payroll taxes and 0.29% otherwise. This illustrates the cost effect of such systems.

TABLE 4 : Elasticity of employment with respect to different shocks

	Wage-productivity spiral alone	presence of social security
Yearly loss due to technical progress	- 3.3 %	- 3.7%
Loss due to a 1% increase in \tilde{z}_1 (labour share)	-1.34%	- 1.32%
Gain due to a 1% increase in production	1%	1.14%
Loss due to a 1% increase in z_2 (transfers)	0	-0.036%
Loss due to a 1% increase in labour supply	0	-0.14%

In general, the systematic bias in favour of capital introduced by the payroll taxes could be avoided by financing the system with VAT or income taxes. This allows to put the weight of unemployment on both capital and labour and therefore avoids additional capital-labour substitution.

Appendix : Definition of the variables

All variables are annual and extend from 1953 to 1988.

- a real labour productivity (government not included)
- T linear trend (labour saving technical progress)
- w nominal gross wage (government not included)
- cs 1 + implicit social security contribution rate
- p output price (consumption deflator)
- duc degree of capital utilization (duc from Planning Bureau)
- p^M price of imports
- z_2 real social security transfer per capita
(unemployment compensations not included)
- ls labour supply : employment (government not included) + unemployed
- y real value added (government not included)

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