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WAGE DIFFERENTIALS AND EMPLOYMENT IN A TWO-SECTOR MODEL WITH A DUAL LABOUR MARKET

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ABSTRACT

The concept of a dual labour market is analysed in a two-sector general equilibrium model. The primary sector pays efficiency wages, while there is no connection between efficiency and the relative wage level in the secondary sector. The two sectors produce different goods. Capital is assumed sector-specific. The results under different conditions in the labour market (market clearing, minimum wages and levelling of the wage distribution) are derived analytically.

Comparative statics are discussed by applying a linearized version of the model. The outcomes may be used to explain observed differences in wage and employment distributions in the US and Europe.

1. INTRODUCTION

Unemployment records differ significantly across nations or regions. Whereas the USA experienced an «employment miracle» in the eighties Europe was stuck with high rates of unemployment. And although it could be argued that the US economy was less severely hit by adverse demand and supply shocks this could not be the whole story. The main factor behind the difference in unemployment records seems to be the functioning of the labour market. For instance, in a macroeconomic setting one could assume that the European countries have a strong degree of indexation of wages to consumers' prices (real wage rigidity)

(*) The author is grateful to Frederick van der Ploeg, Sweder van Wijnbergen and Christian Mulder for some helpful discussions. The usual disclaimer of course applies.

and that the US has a significant proportion of overlapping nominal wage contracts (e.g. van de Klundert and van der Ploeg, 1989).

Here we take a different theoretical route by considering a two-sector model reflecting the characteristics of a dual labour market. Such an approach is inspired by the observation that the growth of employment in the US is concentrated in the service sector and consists of low-paid jobs mainly. This would be predicted by a dual labour market model where the secondary sector absorbs all workers who do not qualify for primary sector jobs. If so, there is a shadow side to the «employment miracle» in the US in the form of an unequal pay distribution. In contrast, institutional factors may prevent such a solution of the unemployment problem in Europe.

The dual labour market theory which has its origin in sociology (e.g. Doeringer and Piore, 1971; Ashton, 1986) may shed some light on these issues. The idea of a dual labour market has more recently gained solid ground in economics by the introduction of a two-sector model with a union sector and a non-union sector. A brief survey of this approach is presented in Greenhalgh et al. (1983), Oswald (1985) and Sinclair (1987). As observed by Akerlof and Yellen (1986) dual labor markets can also be explained by the assumption that the wage-efficiency nexus is important in some sectors but not in others. As stated by Dickens and Lang (1988) there is a renewed interest in the economic theory of a dual labour market, which may be related to the emergence of efficiency wage theories and the formal analysis of union behaviour.

Here we shall explore the duality concept by constructing a two-sector model which emphasizes the importance of the wage-effort nexus in some sectors of the economy. Empirical evidence for such a divergence between industries is presented in Krueger and Summers (1988). The primary sector pays efficiency wages while firms in the secondary sector consider the wage rate as given by market forces. In this respect the model resembles that of Bulow and Summers (1986). There are however important differences. First, the paper by Bulow and Summers builds upon Shapiro and Stiglitz (1984), who consider the possibility of shirking in the primary sector as the prime motive for paying efficiency wages. The present paper assumes that there is a wage-effort relationship in the primary sector, which may be based on a combination of factors. Firms in the primary sector may use wages as a screening device to select the more able members of the labour force as discussed among others by Weiss (1980) and Hahn (1987). Or firms in sector 1 may pay relatively high wages compared with firms in sector 2 to motivate the workers and to reduce turnover rates as for instance in Stiglitz (1974). The microfound-

dations of the wage-effort nexus will here be taken for granted. Second, Bulow and Summers fix the marginal product of labour in the secondary sector, whereas in our model the wage rate in the secondary sector is a variable of the system. This distinction is of importance for the explanation of the allocation of labour and structural unemployment.

In earlier formulations of the dual labour market theory the primary sector is supposed to have some control over the product market. As argued by Ashton (1986) recent research shows that the link between imperfect competition in product markets and efficiency wages is not as deterministic as suggested by older theories. It may therefore be legitimate to assume that product markets are competitive as we do here.

The model could explain the observed facts if duality has become more profound. For instance, an upgrading of labour requirements in the primary sector may lead to a loss of primary-sector jobs, a gain in secondary-sector jobs and a widening of the overall wage dispersion. This seems typical for the development in the US. However, in Europe there may be a floor with respect to real wages. Such minimum wage rates could be set by law or negotiated by labour unions. In the latter case something has to be said about union behaviour in the primary sector. Here we will consider two possibilities. First, encompassing unions may just bargain for a minimum real wage and accept payments in excess of this target in some sectors of the economy. Second, unions may oppose a large wage dispersion. In this case, which may be called the egalitarian society, the possibilities to exploit the wage-effort nexus in the primary sector will be partly frustrated. In both instances the introduction of efficiency wages causes unemployment because the distributional consequences are unacceptable. Such arrangements seem typical for European economies with strong trade union influence.

The organization of the paper is as follows. The general equilibrium model with a primary and a secondary sector is specified in Section 2. The solution of the model is discussed in Section 3 with subsections devoted to the full-employment economy (US), real wage rigidity (binding minimum wages) and the egalitarian society, where the latter two cases are more typical for Europe. Comparative static results are discussed more fully in Section 4. The paper closes with some conclusions in Section 5.

2. A TWO-SECTOR MODEL WITH SEGMENTED LABOUR MARKETS

It will be assumed that the economy comprises two sectors with a qualitatively different output. In both sectors labour is combined with

a fixed and sector-specific capital stock to produce commodities. Efficiency wages are paid in the primary sector, while in the secondary sector there is no link between remuneration and efficiency. The wage paid by primary sector firms must be set against the workers' opportunities, which may be different for the employed and the unemployed (cf. Akerlof, 1982; Hahn, 1987; Summers, 1988). In a full-employment economy the outside opportunities depend on the wages paid by the secondary sector.

Denoting output by x , employment by ℓ , efficiency by e and capital by k the production function of sector 1 reads:

$$x_1 = f_1(e\ell_1; k_1), \quad f'_1 > 0, \quad f''_1 < 0 \quad (2.1)$$

where f' and f'' stand for respectively the first and second derivative of the production function with respect to labour expressed in efficiency units. As argued above, efficiency is positively related to the wage differential between sectors. Denoting the nominal wage rate in sector 1 by w_1 and in sector 2 by w_2 the efficiency function can be written as

$$e = e\left(\frac{w_1}{w_2}\right), \quad e(0) < 0, \quad e' > 0, \quad e'' < 0, \quad e(1) = 1, \quad e'(1) > 1 \quad (2.2)$$

The efficiency function has the required characteristics, which guarantee an interior solution in case of profit maximization (cf. Akerlof, 1982): (1) no positive effort is obtained at a zero wage; (2) the elasticity of e with respect to $\frac{w_1}{w_2}$ is declining for an increasing wage ratio; (3) the additional conditions for $\frac{w_1}{w_2} = 1$ imply $w_1 > w_2$ at the optimum. An example of a function with the required properties is given in Akerlof (1982):

$$e = -a + b \left[\frac{w_1}{w_2} \right]^\gamma, \quad \frac{1}{b} < \gamma < 1, \quad b - a = 1$$

The function is shown in Fig. 1.

With the price of output (p_1) and the nominal wage rate in sector 2 (w_2) given the representative firm in sector 1 faces the following

Figure 1.

problem under perfect competition:

$$\text{Max}_{\{\ell_1, w_1\}} \pi = p_1 f_1(e\ell_1; k_1) - w_1 \ell_1$$

subject to equation (2.2).

The first-order conditions for this problem are

$$p_1 f'_1 = \frac{w_1}{e} \quad (2.3)$$

$$p_1 f'_1 = \frac{w_2}{e'} \quad (2.4)$$

Combination of equations (2.3) and (2.4) yields the familiar «Solow condition»

$$\varepsilon \equiv \frac{e'}{e} \frac{w_1}{w_2} = 1 \quad (2.4a)$$

For an optimum the elasticity of the efficiency function (ε) should be equal to unity (cf. Solow, 1979, who assumed that effort was a function of the firm's own wage). The optimum is illustrated in Fig. 1 point S. With w_2 given the nominal wage rate in sector 1 can be found from this

equation. Substitution of the optimal value of w_1 in equation (2.2) gives the optimal level of efficiency. The outcome for e can be substituted in equation (2.3) to obtain the level of employment ℓ_1 .

In the secondary sector efficiency wages play no role; the wage-productivity relationship is weak or non-existent. Consequently, the demand for labour in sector 2 depends upon the wage, which is determined in the spot market for secondary jobs. The production function for sector 2 is

$$x_2 = f_2(\ell_2; k_2), \quad f_2' > 0, \quad f_2'' < 0 \quad (2.5)$$

Maximization of profits in the short run requires that marginal revenue equals marginal labour cost. With p_2 and w_2 given this condition can be written as

$$p_2 f_2' = w_2 \quad (2.6)$$

The aggregate supply of labour (ℓ_s) is exogeneously determined. Workers who cannot find a job in the primary sector apply for work in the secondary sector. The wage rate in sector 2 can be found by equating labour supply and labour demand in this sector:

$$\ell_s - \ell_1 = \ell_2 \quad (2.7)$$

For a given value of p_2 equations (2.7) and (2.6) simultaneously determine the wage rate and employment in the secondary sector. The mobility of labour between sectors may not be so perfect as assumed here. After all, there may be a substantial wage differential and there is rationing of jobs in the primary sector. Therefore, as observed among others by Hall (1975), Akerlof and Yellen (1986) and in another context also by McDonald and Solow (1985), workers who do not get a job in sector 1 could prefer searching above accepting work in the secondary sector. The search process can be modelled if a number of additional assumptions is made. For instance, one could make assumptions with regard to the recruitment of workers in sector 1. An assumption often made is that workers in the primary sector are exclusively recruited from the pool of unemployed. However, this may not be the only alternative (e.g. van de Klundert, 1990). In the present paper we will not further pursue this issue.

The model must be closed by introducing demand. All income is flowing to consumers. The representative household maximizes utility,

which depends on quantities consumed of both goods, subject to the usual budget constraint. To make the analysis tractable it is assumed that the utility function is of the Cobb-Douglas type. The share of income spent on each commodity is therefore constant. Denoting quantities consumed by the same symbol as quantities produced, that is postulating equilibrium in both markets, we may write,

$$p_1x_1 = \alpha y \quad (2.8)$$

where y is total income:

$$y = p_1x_1 + p_2x_2 \quad (2.9)$$

Finally, the nominal level of prices is determined by a simple quantity equation:

$$y = vM \quad (2.10)$$

where M indicates a given quantity of money.

The complete model comprises the equations (2.1)-(2.10), which can be solved for the endogenous variables, viz., x_1 , x_2 , ℓ_1 , ℓ_2 , e , w_1 , w_2 , p_1 , p_2 and y . General equilibrium results for different institutional settings of the labour market are discussed in the next section.

3. WAGE DIFFERENTIALS AND (UN)EMPLOYMENT

In many countries minimum wages are set by law. They may be binding in the sense that equilibrium wages in the secondary sector may fall below the minimum. In such a case unemployment of low-productivity workers may be the combined result of efficiency wages in sector 1 and a constraint on wages in sector 2. A binding minimum wage rate may also be the outcome of negotiations between employers and labour unions. Payments in excess of the minimum may then be acceptable or not. In the latter case labour unions want a say in the wage distribution. Levelling of the wage dispersion is connected with what was called above the egalitarian society. The three possible states, full employment, binding minimum wages with or without levelling will be analysed in the sequel of this section.

3.1. The full-employment economy

From equations (2.1), (2.2), (2.8), (2.9) and (2.10) we get:

$$p_1 = \frac{\alpha M}{f_1(e\ell_1)} \quad (3.1)$$

$$p_2 = \frac{(1 - \alpha) M}{f_2(\ell_2)} \quad (3.2)$$

where we have set $v = 1$ for convenience. Substitution of (3.1) in (2.3) and of (3.2) in (2.6) results in:

$$w_1 = \frac{\alpha M e f'_1(e\ell_1)}{f_1(e\ell_1)} \quad (3.3)$$

$$w_2 = \frac{(1 - \alpha) M f'_2(\ell_2)}{f_2(\ell_2)} \quad (3.4)$$

The exposition may be simplified considerably without altering any of the substantive conclusions by assuming Cobb-Douglas production functions: $f_1(e\ell_1) = \varepsilon_1 (e\ell_1)^{\beta_1}$ and $f_2(\ell_2) = \varepsilon_2 (\ell_2)^{\beta_2}$. Equations (3.3) and (3.4) may then be written as:

$$w_1 = \frac{\alpha \beta_1 M}{\ell_1} \quad (3.5)$$

$$w_2 = \frac{(1 - \alpha) \beta_2 M}{\ell_2} \quad (3.6)$$

The semi-reduced form equations (3.5) and (3.6) are shown in Fig. 2, which resembles the well-known diagram of the Ricardo-Viner model (e.g. Dixit and Norman, 1980, Chapter 2). However, it should be born in mind that in the present case (relative) prices are substituted out. The curves relate nominal wages (normalized by fixing the amount of money) to levels of employment. In a competitive labour market the equilibrium would be at point Q with full employment as assumed in equation (2.7) and uniform wages across sectors. In the present model wages in the primary sector are set by firms according to equations (2.2) and (2.4a).

Figure 2.

For an explicit solution it is necessary to specify the effort function. With the Akerlof specification, shown in Section 2, it is easy to derive:

$$\frac{w_1^*}{w_2^*} = \left[\frac{a}{(1-\gamma)b} \right]^{\frac{1}{\gamma}} \equiv A \quad (3.7)$$

$$e^* = \frac{\gamma}{1-\gamma} a \quad (3.8)$$

where asterisks mark optimal values of the variables. The wage setting by firms in sector 1 generates a wage differential which together with the full employment condition (2.7) results in the equilibrium solution shown in Fig. 2.

Upgrading of labour requirements in the production process of the primary sector may show up in an increase of the parameter a . This corresponds to a downward shift of the effort function given in Fig. 1. To put it differently, the old efficiency levels elicited for given levels of the relative wage rate have become less effective. Under these circumstances firms in the primary sector have to pay higher relative wages to induce the required efficiency level. As can be deduced from Fig. 2 a higher level of the compound parameter A would result in a reallocation of workers from the primary to the secondary sector.

Comparative static results can be easily obtained by combining equations (3.5), (3.6) and (3.8) into

$$\ell_2 = \frac{(1 - \alpha)\beta_2 A}{\alpha\beta_1} \ell_1 \quad (3.9)$$

Equation (3.9) is drawn in Fig. 3 together with the full employment condition (2.7). The initial solution is at point S . A rise in labour supply shifts the 45°-degree curve upward and the new equilibrium is at point S' .

Figure 3.

Employment in both sectors increases proportionally. An increase in the parameter A rotates the ray through the origin in an upward direction. The resulting equilibrium is at point S'' with a lower value for ℓ_1 and a higher value for ℓ_2 compared to the initial equilibrium. A change in preferences in favour of the output of the primary sector (i.e. an increase in α) has just the opposite effect. The ray through the origin rotates downwards so that ℓ_1 increases and ℓ_2 declines. It should be observed that such a change can be brought about by subsidizing the primary sector (e.g. Bulow and Summers, 1986). Productivity shocks, that is changes in the parameters ε_1 and ε_2 , have no effect on employment in the present example with Cobb-Douglas production functions. They have an influence on real wages through their effect on prices as may be deduced from equations (3.1) and (3.2). More elaborate comparative static results are presented in Section 4.

3.2. Binding minimum wages

If the minimum wage set by the authorities is higher than w_2^* , for instance $w_{\min}$ in Fig. 2 there will be less employment in both sectors. The optimal values of the variables are now denoted by double asterisks and the corresponding rate of unemployment is u^{**} . Nominal wage rigidity is no serious problem. Unemployment can be inflated away by increasing the stock of money which is clear from equations (3.5) and (3.6). Things are different if the minimum wage rate is indexed as may be the case. In such a case of real wage rigidity with the minimum wage rate binding in sector 2 we may write:

$$w_2 = \vartheta p_c \quad (3.10)$$

with the consumers' price, p_c , defined as

$$p_c = p_1^\alpha p_2^{1-\alpha} \quad (3.11)$$

Substitution of (3.1), (3.2) and (3.8) in equation (3.11) and subsequently of the result in equation (3.10) gives:

$$w_2 = \frac{\vartheta M \alpha^\alpha (1-\alpha)^{1-\alpha}}{\varepsilon_1^\alpha \varepsilon_2^{1-\alpha} \left[\frac{\gamma}{1-\gamma} a \ell_1 \right]^{\alpha \beta_1} \ell_2^{(1-\alpha)\beta_2}} \quad (3.12)$$

From the equality of (3.6) and (3.12) we get

$$\ell_2 = B \ell_1^{\frac{\alpha \beta_1}{1-\beta_2+\alpha \beta_2}}, \quad \text{with} \quad B \equiv \left[\frac{(1-\alpha)^\alpha \varepsilon_1^\alpha \varepsilon_2^{1-\alpha} \beta_2 \left(\frac{\gamma a}{1-\gamma} \right)^{\alpha \beta_1}}{\alpha^\alpha \vartheta} \right]^{\frac{1}{1-\beta_2+\alpha \beta_2}} \quad (3.13)$$

Formula (3.13) is shown in Fig. 4. As can be easily checked the exponent of the curve is smaller than unity (*). The curve runs through the

(*) Suppose $\frac{\alpha \beta_1}{1-\beta_2+\alpha \beta_2} < 1$, then $\alpha < \frac{1-\beta_2}{\beta_1-\beta_2}$. This inequality holds because $\alpha < 1$ and $(1-\beta_2) > (\beta_1-\beta_2)$ or $\beta_1 < 1$.

Figure 4.

origin, where its first derivative is infinite. Therefore, there must be a point of intersection in the positive quadrant with the line determined by equation (3.9). The solution is feasible if the point of intersection S_1 does not lie above the line corresponding to labour supply (equation 2.7). In the latter case the minimum wage rate will not be binding. The result shown in Fig. 4 confirms our earlier observation that a binding (real) wage constraint in sector 2 leads to a loss of employment in both sectors.

Upgrading of labour requirements in the primary sector (i.e. an increase in parameter a) leads to an upward shift of both curves in Fig. 4 as can be checked from the equations (3.9) and (3.13). To detect the effects on employment in both sectors one needs a little more algebra, which will be postponed till the next section. A similar argument applies in case of a demand shock (change in α), or an introduction of a subsidy which comes to the same thing. Supply shocks can easily be handled. An increase in labour supply (ℓ_s) has no effects other than on the rate of unemployment. Positive productivity shocks (an increase in ε_1 and/or ε_2) raise employment in both sectors. The curve based on equation (3.13) shifts upwards. This is easy to understand. A rise in productivity relaxes the constraint given in equation (3.10) irrespective of the sector in which it originates. To put it differently, in case of real wage rigidity supply-side measures aimed at increasing labour productivity may stimulate employment.

3.3. The egalitarian society

In the foregoing analysis a binding minimum wage does not influence the equilibrium wage distribution. The dispersion of wages may be

smaller in the case of a wage floor if it is assumed that the effort function depends negatively on the relative size of employment in the primary sector (e.g. Bulow and Summers, 1986). It may be argued that as the primary sector increases in size it becomes more difficult to elicit desired efficiency levels. Here we shall follow a different route by assuming that minimum wages are not only tied to prices but also to other wages as a package deal of centralized wage negotiations between unions and employers organizations. Therefore, in addition to equation (3.10) we write:

$$w_1 = \omega w_2, \quad \text{with} \quad \omega < A \quad (3.14)$$

Throughout the analysis we assume that the minimum wage rate is binding. The introduction of equation (3.14) implies that a second equation of the model besides the full employment condition (2.7) has to be skipped for consistency. Due to the levelling equation (3.14) firms in sector 1 are not fully free to set the wage in order to maximize profits (*). The Solow condition, equation (2.4a) cannot longer be adhered to. The relevant efficiency level can now be obtained by substituting equation (3.14) in the effort function, which gives:

$$e = -a + b\omega^\gamma \quad (3.15)$$

Combining equation (3.14) with equations (3.5) and (3.6) results in

$$\ell_2 = \frac{(1 - \alpha)\beta_2\omega}{\alpha\beta_1}\ell_1 \quad (3.16)$$

Taking equation (3.15) into account the equivalent of equation (3.13) reads:

$$\ell_2 = B'\ell_1^{\frac{\alpha\beta}{1-\beta_2+\alpha\beta_2}}, \quad \text{with} \quad B' \equiv \left[\frac{c_1^\alpha c_2^{1-\alpha} (1 - \alpha)\beta_2 (-a + b\omega^\gamma)^{\alpha\beta_1}}{\vartheta\alpha^\alpha (1 - \alpha)^{1-\alpha}} \right]^{\frac{1}{1-\beta_2+\alpha\beta_2}} \quad (3.17)$$

(*) Levelling may induce a cost-push inflation if firms in the primary sector are free to set nominal wages and unions insist on catching up secondary-sector nominal wages. The analysis of such a leap-frogging inflation is beyond the scope of the present paper.

Figure 5.

Equations (3.16) and (3.17) are drawn in Fig. 5 along with equations (3.9) and (3.13) derived in Subsection 3.2. The new curves lie both below the corresponding old ones. The outcome with respect to differences in employment may therefore be uncertain. However, the loss in efficiency caused by the compression of the wage distribution may be substantial. Firms in sector 1 are driven to a point left of S on the effort curve in Fig. 1 where the elasticity is greater than one: $\varepsilon > 1$. This is reflected in a relatively larger downward shift of the bent curve (equation (3.17)) compared with equation (3.13). As a result employment in the secondary sector will be lower, while employment in the primary sector may go either way. The minimum wage solution without levelling is obtained at point S_1 in Fig. 5. With levelling the solution is given by point S_2 . The corresponding employment levels are indicated by three asterisks. The solution shown assumes that employment in the primary sector does not change. Unemployment increases as a result of compressing the wage distribution. The implications of wage levelling may be understood more fully by considering a small change in the parameter ω . This will be done in Section 4.3.

By way of summarising the results found in this section Fig. 6 shows how the different cases may be related. Binding minimum wages lead to unemployment and higher (real) wages in both sectors of the economy. Levelling of the wage distribution combined with minimum wages increases unemployment still further, which may explain the difficulties in a number of European countries.

Figure 6.

4. COMPARATIVE STATICS

Simple comparative static results are most easily obtained by rewriting the relevant equations in rates of change (indicated by a dot over the variable) and solving out.

4.1. The full-employment economy

The four equations which determine sectoral wages and employment are (2.7), (3.5), (3.6) and (3.7). In linearized form these equations can be writtens as:

$$\partial \dot{l}_1 + (1 - \partial) \dot{l}_2 = \dot{l}_s \quad (4.1)$$

$$\dot{w}_1 = \dot{M} - \dot{l}_1 + \dot{\alpha} \quad (4.2)$$

$$\dot{w}_2 = \dot{M} - \dot{l}_2 - \frac{\lambda}{1 - \lambda} \dot{\alpha} \quad (4.3)$$

$$\dot{w}_1 - \dot{w}_2 = \frac{1}{\gamma} \dot{a} \quad (4.4)$$

Equation (4.1) follows from differentiating (2.7). The parameter ϑ relates to the share of primary sector employment at the point of linearisation. The parameter λ in equation (4.3) equals the share of expenditure with respect to sector 1 in the initial equilibrium. Because α may change over time this initial share is denoted by a different symbol. In deriving equation (4.4) it is assumed that the parameters b and γ are constant. Solving (4.1)-(4.4) for the levels employment yields:

$$\dot{l}_1 = \dot{l}_s - \frac{(1 - \vartheta)}{\gamma} \dot{a} + \frac{1 - \vartheta}{1 - \lambda} \dot{\alpha} \quad (4.5)$$

$$\dot{l}_2 = \dot{l}_s + \frac{\vartheta}{\gamma} \dot{a} - \frac{\vartheta}{1 - \lambda} \dot{\alpha} \quad (4.6)$$

Equations (4.5) and (4.6) give rise to a number of interesting observations. An upward shift of the effort function ($\dot{a} < 0$) raises employment in the primary sector and lowers employment in the secondary sector. Such a shift may be the result of a better education and motivation of the labour force, which makes it easier for firms in the primary sector to attract efficient workers. A quantitative increase in the labour force ($\dot{l}_s > 0$) leads to a proportional rise in employment in both sectors, which is understandable because the nominal wage ratio does not change. However, if a mutation in the supply of labour is accompanied by a change in the qualitative composition of the labour force this result does not hold. For instance, an inflow of relatively less educated workers will make it more difficult for firms in sector 1 to maintain their share in total employment. Therefore, it must be concluded that the effort function will deteriorate ($\dot{a} > 0$), leading to a shift in employment from the primary to the secondary sector. As a result the bulk of the increase in labour supply must be absorbed in the secondary sector.

A similar reasoning applies in the case of a shift in demand. A shift towards the primary sector ($\dot{\alpha} > 0$) raises employment in that sector at the expense of employment in sector 2, as follows from equations (4.5) and (4.6). Such a reallocation of labour may not be possible without affecting the effort function. To attract additional workers with the same efficiency level as the employed workers firms in the primary sector may have to increase the wage differential. Such a change in opportunities may eventually prevent a reallocation of labour on impact of a change in demand for commodities. The upshot of this discussion is that the effort function may not be invariant to changes in the parameters or exogenous

variables of the model. As a specification of the effort function which takes such complications properly into account is difficult comparative static conclusions should be formulated with the required cautiousness.

To study the effect of different shocks on the purchasing power of wages in different sectors we first linearize equation (3.11)

$$\dot{p}_c = \lambda \dot{p}_1 + (1 - \lambda) \dot{p}_2 \quad (4.7)$$

The real consumers' wage for both sectors can then be expressed in the following manner:

$$\dot{w}_1 - \dot{p}_c = \dot{w}_1 - \dot{p}_1 + (1 - \lambda)(\dot{p}_1 - \dot{p}_2) \quad (4.8)$$

$$\dot{w}_2 - \dot{p}_c = \dot{w}_2 - \dot{p}_2 - \lambda(\dot{p}_1 - \dot{p}_2) \quad (4.9)$$

The real producers' wage in both sectors can be found by linearizing equations (3.1) and (3.2) and combining the outcomes with equations (4.2) and (4.3).

$$\begin{aligned} \dot{w}_1 - \dot{p}_1 = \dot{\varepsilon}_1 - (1 - \beta_1)\dot{\ell}_s - \frac{(1 - \beta_1)(1 - \vartheta)}{1 - \lambda}\dot{\alpha} + \\ + \frac{\beta_1\gamma + (1 - \beta_1)(1 - \vartheta)}{\gamma}\dot{a} \end{aligned} \quad (4.10)$$

$$\dot{w}_2 - \dot{p}_2 = \dot{\varepsilon}_2 - (1 - \beta_2)\dot{\ell}_s + \frac{(1 - \beta_2)\vartheta}{1 - \lambda}\dot{\alpha} - \frac{(1 - \beta_2)\vartheta}{\gamma}\dot{a} \quad (4.11)$$

For the relative price of goods (terms of trade) we get:

$$\begin{aligned} \dot{p}_1 - \dot{p}_2 = (\dot{\varepsilon}_2 - \dot{\varepsilon}_1) + (\beta_2 - \beta_1)\dot{\ell}_s + \frac{1 - \beta_1(1 - \vartheta) - \beta_2\vartheta}{1 - \lambda}\dot{\alpha} + \\ + \frac{\beta_1(1 - \vartheta) + \beta_2\vartheta - \gamma\beta_1}{\gamma}\dot{a} \end{aligned} \quad (4.12)$$

The interpretation of the results may be made easier by assuming symmetry in production, i.e. $\beta_1 = \beta_2 = \beta$ and $\varepsilon_1 = \varepsilon_2 = \varepsilon$. Expression (4.12) can then be simplified to

$$\dot{p}_1 - \dot{p}_2 = \frac{1 - \beta}{1 - \lambda}\dot{\alpha} + \frac{(1 - \gamma)\beta}{\gamma}\dot{a} \quad (4.12a)$$

Under these circumstances supply shocks have no effect on the terms of trade, while their effects on real producers' wages are obvious. A shift in preferences in favour of the primary sector ($\dot{\alpha} > 0$) leads to an improvement in the terms of trade of that sector. The producers' wage in sector 1 declines. The ultimate effect on the consumption wage in the primary sector may go either way. If $\vartheta > \lambda$, an increase in α raises the purchasing power of workers in the primary sector. As the wage ratio does not change workers in the secondary sector must benefit in the same proportion, as can be easily checked. Upgrading of labour requirements in sector 1 ($\dot{a} > 0$) induces a higher producers' wage in the primary sector. The terms of trade move in favour of sector 1. Therefore, the consumers' wage of workers in the primary sector increases. Workers in the secondary sector are now worse off. This result accentuates the aspect of duality. If conditions in the primary sector get tougher more workers have to be employed in the secondary sector, while at the same time their purchasing power declines.

4.2. Binding minimum wages

If the minimum wages constraint is binding in sector 2 equation (4.1) should be replaced by

$$\dot{w}_2 = \dot{p}_c \quad (4.13)$$

Solution of the sub-model for the employment levels in both sectors taking $\dot{e} = \dot{a}$ (from (3.8)) into account gives:

$$\dot{e}_1 = \frac{1}{1 - \beta_2 + \lambda(\beta_2 - \beta_1)} \left[\lambda \dot{e}_1 + (1 - \lambda) \dot{e}_2 - \frac{\lambda \beta_1 (1 - \gamma)}{\gamma} \dot{a} + (1 - \beta_2) \dot{\alpha} \right] - \frac{1}{\gamma} \dot{a} \quad (4.14)$$

$$\dot{e}_2 = \frac{1}{1 - \beta_2 + \lambda(\beta_2 - \beta_1)} \left[\lambda \dot{e}_1 + (1 - \lambda) \dot{e}_2 - \frac{\lambda \beta_1 (1 - \gamma)}{\gamma} \dot{a} - \frac{\lambda (1 - \beta_1)}{1 - \lambda} \dot{\alpha} \right] \quad (4.15)$$

with $1 - \beta_2 + \lambda(\beta_2 - \beta_1) > 0$ (*).

(*) The inequality follows from $1 - \beta_2 > \beta_1 - \beta_2$ and $\lambda < 1$.

Positive productivity shocks ($\hat{e}_1, \hat{e}_2 > 0$) increase employment in both sectors, because the minimum wage constraint will be relaxed to a certain extent. Purchasing power goes up (p_c declines) and real producers' wage falls in both sectors. Supply-side measures aimed at increasing productivity lead to a lower unemployment level under real wage rigidity.

Upgrading of labour requirements in the primary sector ($\hat{a} > 0$) causes now a fall in employment in *both* sectors. A loss in efficiency in the primary sector induces a rise in the relative price of good 1 as appears from the formula:

$$\dot{p}_1 - \dot{p}_2 = \frac{(1 - \gamma)}{\gamma} \frac{\beta_1(1 - \beta_2)}{1 - \beta_2 + \lambda(\beta_2 - \beta_1)} \hat{a} \quad (4.16)$$

From equation (4.9) and (4.13) it follows:

$$\dot{w}_2 - \dot{p}_2 = \lambda(\dot{p}_1 - \dot{p}_2) \quad (4.17)$$

An improvement in the terms of trade of the primary sector leads to an increase in the real producers' wage in the secondary sector. Therefore employment in sector 2 declines. The fall in employment in sector 1 follows from the connection between nominal wages in both sectors as given in equation (4.4) and the relation between the employment ratio and the wage rate implied by equations (4.2) and (4.3). Ultimately, the decline in employment in the primary sector is greater than in the secondary sector.

Finally, it should be noted that a shift in preference in favour of the primary sector ($\hat{\alpha} > 0$) raises employment in that sector, while employment in the other sector falls. This result is qualitatively the same as in the case of full employment.

4.3. The egalitarian society

In Section 3.3 we introduced a parameter ω to account for the fact that centralized wage negotiations may give rise to a compression of the wage distribution. In this section we discuss the effects of a change in this parameter, ω , ignoring exogenous changes in productivity or demand. Equation (4.4) should now be replaced by

$$\dot{w}_1 - \dot{w}_2 = \dot{\omega} \quad (4.18)$$

As observed before, firms in sector 1 are forced to operate on a section of the effort function where the elasticity is greater than unity. This can be expressed in rates of change as:

$$\dot{e} = \varepsilon(\dot{w}_1 - \dot{w}_2), \quad \text{with } \varepsilon > 1 \quad (4.19)$$

Solving equations (4.2), (4.3), (4.13), (4.18) and (4.19) for the employment variables yields

$$\dot{e}_1 = \frac{\lambda\beta_1}{1 - \beta_2 + \lambda(\beta_2 - \beta_1)}(\varepsilon - 1)\dot{\omega} - \dot{\omega} \quad (4.20)$$

$$\dot{e}_2 = \frac{\lambda\beta_1}{1 - \beta_2 + \lambda(\beta_2 - \beta_1)}(\varepsilon - 1)\dot{\omega} \quad (4.21)$$

If levelling of wages becomes more succesful ($\dot{\omega} < 0$) employment in the secondary sector declines. The terms of trade then move against sector 2:

$$\dot{p}_1 - \dot{p}_2 = - \frac{(\varepsilon - 1)\beta_1(1 - \beta_2)}{1 - \beta_2 + \lambda(\beta_2 - \beta_1)}\dot{\omega} \quad (4.22)$$

Recalling equation (4.17) it can be seen that the producers' wage in the secondary sector rises, so that employment declines. The outcome for $\dot{e}_1$ is ambiguous. The direct effect of a fall in w_1 is positive, but there is also a negative indirect effect which relates to what is happening in sector 2. The indirect effect dominates for sufficiently high values of ε . Eventually both effects cancel out leaving employment in the primary sector unchanged. The full burden of levelling then falls on workers in the secondary sector.

5. CONCLUSIONS

A growing concern about poverty in the midst of plenty in industrialized countries may be an indication of a more pronounced duality in the economy with important consequences for the labour market. If primary sector jobs get lost because a more sophisticated production process requires relatively more workers with high productivity (upgrading) the secondary sector must absorb more labour. This will lead to a more unequal real wage distribution between workers in both sectors.

A growth in the labour force will have a similar effect if it upsets the productivity distribution as may be the case with immigration from developing countries.

Whereas such developments may prevail in the US, the situation in Europe is different. Minimum wage legislation or labour union power may set a floor to the wage rate in the secondary sector in a number of European countries. An intensification of duality will then show up in increased unemployment of low-productivity groups. The problem is most severe with real wage rigidity in the secondary sector. In the latter case monetary policy is of no help and unemployment must be fought by supply-side measures. The situation may even be worse if real wage rigidity and a levelling of the wage distribution go together. The compression of wage differentials causes additional unemployment of low-productivity workers.

Future research on the dual labour market may focus on the foundations of the efficiency-wage relationship in different sectors of the economy. In addition, a distinction could be made between groups of workers with different skills, which are imperfect substitutes in the production process. As in the present paper general equilibrium theory can be applied to integrate these different strands of analysis.

REFERENCES

- Akerlof G.A.: «Labor Contracts as Partial Gift Exchange», *Quarterly Journal of Economics*, 97, pp. 543-569, 1982.
- Akerlof G.A. and Yellen J.L.: «Introduction» in Akerlof and Yellen (eds.), *Efficiency Wage Models of the Labor Market*, Cambridge University Press, 1986.
- Ashton D.N.: *Unemployment under Capitalism*, The Sociology of British and American Labour Markets, Westport (Conn.), Greenwood Press, 1986.
- Bulow J.I. and Summers L.H.: «A Theory of Dual Labor Markets with Application to Industrial Policy, and Keynesian Unemployment», *Journal of Labor Economics*, 4, pp. 376-414, 1986.
- Dickens W.T. and Lang K.: «The Reemergence of Segmented Labor Market Theory», *American Economic Review*, 78, pp. 129-134, 1988.
- Dixit A.K. and Norman V.: *Theory of International Trade*, Cambridge University Press, 1980.
- Doeringer P.B. and Piore M.J.: *Internal Labor Markets and Manpower Analysis*, Lexington, Mass., Lexington Books, 1971.
- Greenhalgh C.A., Layard P.R.G. and Oswald A.J. (eds.): *The Causes of Unemployment*, Oxford, Clarendon Press, 1983.
- Hahn F.H.: «On Involuntary Unemployment», *Economic Journal*, Supplement, 97, pp. 1-16, 1987.
- Hall R.: «The Rigidity of Wages and the Persistence of Unemployment», *Brookings Papers on Economic Activity*, 2, pp. 301-335, 1975.
- Klundert Th. van de: «On Socioeconomic Causes of "Wait Unemployment"», *European Economic Review* (Forthcoming), 1990.

- Klundert Th. van de and van der Ploeg F.: «Fiscal Policy and Finite Lives in Interdependent Economies with Real and Nominal Wage Rigidity», *Oxford Economic Papers*, 41, pp. 459-489, 1989.
- Krueger A.B. and Summers L.H.: «Efficiency Wages and the Inter-Industry Wage Structure», *Econometrica*, 56, pp. 259-293, 1988.
- McDonald I.M. and Solow R.M.: «Wages and Employment in a Segmented Labor Market», *Quarterly Journal of Economics*, 100, pp. 1116-1141, 1985.
- Oswald A.J.: «The Economic Theory of Trade Unions - An Introductory Survey», *Scandinavian Journal of Economics*, 87, pp. 160-193, 1985.
- Shapiro C. and Stiglitz J.: «Involuntary Unemployment as a Worker Discipline Device», *American Economic Review*, 74, pp. 433-444, 1984.
- Sinclair P.: *Unemployment. Economic Theory and Evidence*, Oxford, Basil Blackwell, 1987.
- Solow R.M.: «Another Possible Source of Wage Stickiness», *Journal of Macroeconomics*, 1, pp. 79-82, 1979.
- Stiglitz J.: «Wage Determination and Unemployment in L.D.C.s.: The Labor Turnover Model», *Quarterly Journal of Economics*, 88, pp. 194-227, 1974.
- Summers L.H.: «Relative Wages, Efficiency Wages, and Keynesian Unemployment», *American Economic Review*, 78, pp. 383-388, 1988.
- Weiss A.: «Job Queues and Layoffs in Labor Markets with Flexible Wages», *Journal of Political Economy*, 88, pp. 526-538, 1980.

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