# A General Model of Fair Wages in an Open Economy[†]

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**Abstract**

We analyze the behavior of a multi-sector small open economy with involuntary unemployment due to fair wages. The equilibrium level of employment depends in an intuitively appealing way on the sectoral structure of the economy. It is shown that induced changes in employment are a driving force behind many of the comparative static results. Fair wage variants of the Heckscher-Ohlin and the Ricardo-Viner model, respectively, are derived as special cases.

JEL-Classification: F11, F16

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# 1 Introduction

In recent years, there is a growing interest among trade theorists for the connection between international trade and labor market distortions. The contributions to this literature employ microeconomic models of labor market distortions and combine them with a multi-sector model of an open economy. Typically, the labor market models employed in this context are either search theory or efficiency wage models. The search theoretic approach is followed by Davidson (1999) and Weiß (2001). Efficiency wages are used as an explanation for labor market distortions in an open economy context by Brecher (1992), Agell and Lundborg (1995), Schweinberger (1995), Matusz (1994) and Albert and Meckl (1998, 2001a). In the present paper, we follow the second strand of the literature and assume that there exists a labor market distortion due to the existence of efficiency wages. In particular, a situation is considered where efficiency wages are due to a conception of the workers on what constitutes a fair wage: The higher the wage rate relative to the standard of reference which the workers consider fair, the higher the effort supplied in equilibrium. This is in the spirit of Akerlof and Yellen (1990) who were the first to formulate explicitly the "fair wage-effort hypothesis". The equilibrium is characterized by involuntary unemployment.

Earlier applications of this hypothesis in a trade theoretic model are Agell and Lundborg (1995) and Albert and Meckl (1998). The present paper draws on both contributions. However, in contrast to both Agell and Lundborg (1995) as well as Albert and Meckl (1998), we employ a specification of the fair wage model which leads to the level of effort being independent from the sectoral structure of the economy. This feature of the model brings to the forefront changes in the equilibrium employment of physical labour as a driving force behind many comparative static results – which is arguably an effect that many observers would have in mind when thinking about the relation between international trade an unemployment. It will turn out that furthermore the simplification resulting from the constancy of equilibrium effort allows us to deal with very general production structures in a transparent way.

In Agell and Lundborg (1995), the employment effect for physical labour influences comparative static results, but the effect is supplemented by a change in equilibrium effort which may offset or reinforce the employment effect. In the model of Albert and Meckl (1998) both effects exactly offset each other, leading to a constant employment of labour in suitably defined efficiency units.[1] Hence, on a formal level the production side of their model bears a very close resemblance to the full employment model with no extra employment effects. The present paper starts off in section 2 by formulating

[1]The same production structure is used in Albert and Meckl (2001a).

a model of a fair wage economy exhibiting a general production structure with many goods and factors. In section 3, special production structures are considered, namely fair wage variants of the Heckscher-Ohlin and Specific Factor models. Section 4 concludes.

## 2 The Model

Consider a competitive small open economy, consuming and producing $n+1$ tradable goods. One good serves as *numéraire*, and its domestic production is denoted by $y_0$. Production of all remaining goods and domestic prices are denoted by the vectors $y$ and $p$, respectively.[2] There are $m+1$ internationally immobile factors of production, where the vector $v$ comprises $m$ factors for which fully flexible factor prices $r$ ensure full employment of the exogenously given respective endowments. In addition, there is labor $L$ for which equilibrium unemployment exists.

Unemployment is explained by a variant of the fair-wage effort hypothesis due to Akerlof and Yellen (1990). It is assumed that employees are able to choose their effort at work, and that the amount of effort supplied depends on their personal fairness conception. In particular, as in Akerlof and Yellen (1990), the effort workers are willing to supply depends positively on the differential between the actual wage rate they receive and a reference wage rate, which is called $s$ here. The reference wage from a single worker's point of view is not constant but assumed to depend positively on the expected wage rate $w^e$ and some standard wage rate $\bar{w}$ which is fixed in units of the *numéraire*. The standard wage rate may either be determined by collective bargaining or be equal to a minimum wage rate – which is assumed to be non-binding in the framework considered here.[3] Each worker – employed or unemployed – supplies one unit of labor, and hence $w^e$ equals labor income per head. It includes an income of zero for the unemployed, and therefore

$$w^e \equiv \frac{1}{\bar{L}} \sum_{i=0}^{n} w_i L_i \tag{1}$$

with $w_i$ as the wage rate in sector $i$, $L_i$ as the number of workers employed in that sector, and $\bar{L}$ as the economy's labor endowment. Formally, the reference wage is given by

$$s = s(w^e, \bar{w}) \tag{2}$$

[2]Unless stated otherwise, vectors are column vectors, transposes are denoted by a prime.

[3]More generally, one might think of $\bar{w}$ as some institutional variable which leads – as will be shown below – to a situation where the reference wage reacts less than proportionally to fluctuations in labour's marginal value product. Following a suggestion by Schweinberger (1995), foreign wage rates are another candidate for inclusion in $\bar{w}$.

with $s_{w^e}, s_{\bar{w}} > 0$. In addition, $s(\cdot)$ is assumed to be linearly homogeneous in $(w^e, \bar{w})$. The expected wage rate $w^e$ captures two variables which are commonly used as determinants of the reference wage rate in models of the fair wage type, namely the wage rate of those who are employed, and the level of unemployment. Agell and Lundborg (1995) consider the market wage rate and the level of unemployment – along with the rental rate of capital – as separate determinants of $s$. Albert and Meckl (1998, 2001a) consider only $w^e$, Albert and Meckl (2001b) have $\bar{w}$ as the single determinant of $s$. Schlicht (1992) uses $\bar{w}$ and the market wage rate as the two relevant variables, mentioning unemployment only in passing.

The effort function is given by

$$\varepsilon_i = \varepsilon_i(\gamma_i) \tag{3}$$

where $\gamma_i \equiv w_i/s$ denotes the differential between the wage rate paid in sector $i$ and the reference wage. In order to ensure the existence of a unique equilibrium, it is assumed that $\varepsilon(\cdot)$ takes on a value of zero up to some positive level of $\gamma_i$ and is increasing and strictly concave above this threshold.

The profit maximization problem for the representative firm in sector $i$ is given by

$$\max_{w_i, L_i, v_i} \Pi_i = p_i F_i(\varepsilon_i(\gamma_i)L_i, v_i) - w_i L_i - r' v_i \tag{4}$$

with $F_i(\cdot)$ as the linear-homogenous production function for sector $i$, $L_i$ as the input of physical labor in sector $i$, and $v_i$ as the $m \times 1$ vector of flexprice factor inputs in that sector. It is assumed that each firm takes treats $w^e$ – and hence the reference wage $s$ – parametrically. Assuming interior solutions, the resulting first order conditions are

$$p_i \frac{\partial F_i}{\partial(\varepsilon_i L_i)} \frac{\partial \varepsilon_i}{\partial w_i} \frac{L_i}{s} - L_i = 0 \tag{5}$$

$$p_i \frac{\partial F_i}{\partial(\varepsilon_i L_i)} \varepsilon_i - w_i = 0 \tag{6}$$

$$p_i \frac{\partial F_i}{\partial v_i} - r = 0 \tag{7}$$

According to (5), the optimal wage rate for given $L$ equates the rise in revenue due to a marginal increase in $w$ to the marginal cost of increasing $w$. Equations (6) and (7) simply state that in the optimum the marginal value products for $L$ and $v$ equal their respective nominal prices. Alternatively, dividing (6) by $\varepsilon_i$ gives the condition that the marginal value product of efficient labor be equal to the wage of an efficiency unit of labor. Solving (6) for the marginal value product of efficient labor and substituting into (5) gives

$$\frac{\partial \varepsilon_i}{\partial \gamma_i} \frac{\gamma_i}{\varepsilon_i} = 1. \tag{8}$$

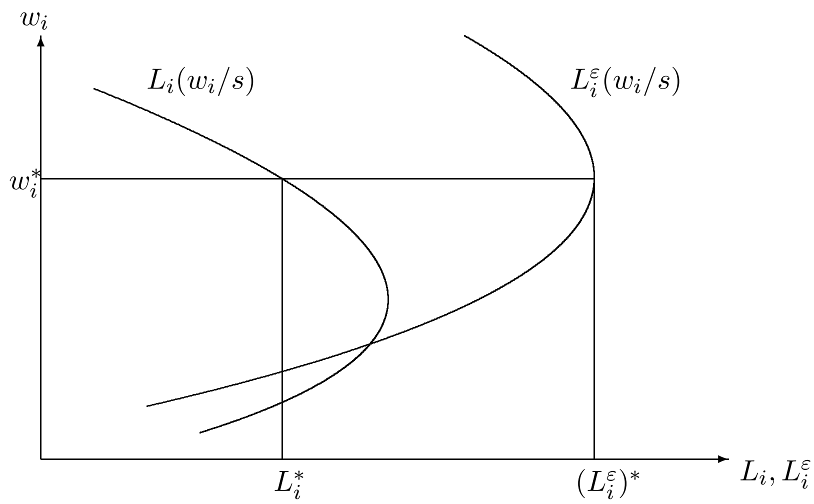


Figure 1: The Level of Employment with Efficiency Wages

This is a variant of the familiar Solow condition (Solow 1979), according to which the optimal wage rate is such that the elasticity of the effort function is equal to one. Here, the argument of the effort function is the differential between the actual wage rate and the standard of reference rather than the wage rate itself as in Solow (1979). Therefore, the condition yields an optimal wage rate, taking as given the standard of reference $s(\cdot)$. The latter is determined in general equilibrium as described below. The profit maximizing labor input in sector $i$ follows from (6).

In graphical terms, the determination of employment in sector $i$ is shown in figure 1. The curve $L_i(w_i/s)$ gives combinations of wage rate and labor input for which the value marginal product of labor is equal to the wage rate, taking $s$ as given but taking into account the dependency of $\varepsilon$ on $w$.[4] The resulting employment of efficient labor is given by the curve $L_i^\varepsilon(w_i/s)$. The slope of $L_i(w_i/s)$ follows from implicitly differentiating (6) which gives, after some rearranging of terms

$$\frac{dL_i}{dw_i} = -\left(\frac{\partial^2 F_i}{\partial(\varepsilon_i L_i)^2}\,\varepsilon_i p_i\right)^{-1}\left(p_i\,\frac{\partial^2 F_i}{\partial(\varepsilon_i L_i)^2}\,\frac{\partial \varepsilon_i}{\partial \gamma_i}\,\frac{L_i}{s} - \frac{\partial(w_i/\varepsilon_i)}{\partial w_i}\right) \tag{9}$$

The first term (including the minus) is positive, the first term inside the second brackets is negative, while the sign of the last term depends on whether the wage rate is above or below its profit maximizing value $w^*$:

[4]It is not uncommon in the efficiency wage literature to identify the curve $L_i(w_i/s)$ with a labor demand curve – see, e.g., Weiss (1991, p. 20). As the firms are wage setters by assumption, and hence only one point on the curve is relevant, this terminology is avoided here.

including the minus, the term is negative for $w > w^*$, positive for $w < w^*$, and zero for $w = w^*$. Hence, $L_i(w_i)$ is downward sloping for wages at least as high as $w^*$ but – as drawn – may be upward sloping for lower values of $w$. From $L_i^\varepsilon(w_i/s) = \varepsilon_i(w_i/s)L_i(w_i/s)$, the slope of the curve $L_i^\varepsilon(w_i/s)$ is given by

$$\frac{dL_i^\varepsilon}{dw_i} = \left(\frac{\partial^2 F_i}{\partial(\varepsilon_i L_i)^2}\, p_i\right)^{-1} \left(\frac{\partial(w_i/\varepsilon_i)}{\partial w_i}\right) \tag{10}$$

which becomes zero at $w = w^*$. Hence, for a given value of $s$ the employment of efficient labor reaches its maximum at $w^*$.

With homogeneous labor it is natural to assume identical effort functions in all sectors. This implies that firms choose to pay equal wage rates in all sectors of the economy, i.e., $w_i = w$, $\gamma_i = \gamma$, and in equilibrium

$$w = \gamma^* s(w^e, \bar{w}), \tag{11}$$

where $\gamma^*$ is the profit-maximizing wage differential, depending solely on the effort function.[5] As equilibrium effort $\varepsilon(\gamma^*)$ depends solely on the effort function as well, it remains constant throughout the analysis. Hence, one can equivalently describe the model in terms of physical labor ($L$) or in terms of efficient labor ($\varepsilon L$). In fact, the constancy of equilibrium effort turns out to be the single feature which makes the present model much more easily tractable than the one by Agell and Lundborg (1995).[6]

Equation (11) represents the essence of introducing the fair wage concept in the standard general equilibrium model. With all firms having chosen the same optimal wage differential $\gamma^*$, an unambiguous relation between the wage rate and the level of employment results. This is most easily seen by writing (11) as

$$w = \gamma^* s\left(\frac{wL}{\bar{L}}, \bar{w}\right). \tag{11'}$$

or alternatively as

$$L = L(w, \bar{L}, \bar{w}). \tag{12}$$

Note that the function is upward sloping, i.e., for given levels of $\bar{w}$ and $\bar{L}$ an equilibrium increase in the wage rate is associated with an increase in

[5]In Albert and Meckl (1998, 2001a), there are sector specific wage rates despite identical effort functions in all sectors which is due to the assumption of the productivity of effort being different between the sectors.

[6]Note that this feature does not depend on there being only two variables as determinants of the fairness standard (namely $w^e$ and $\bar{w}$), as opposed to three variables in Agell and Lundborg (1995). Rather, it depends on those variables being combined into the index $s(\cdot)$ relative to which the fairness of the wage rate is assessed.

the level of employment. Intuitively, an increase in aggregate labor income – and hence an increase the expected wage rate $w^e$ – is brought about in the present model by a combined increase in the wage rate *and* the level of employment. Because of the fixed standard wage rate $\bar{w}$ in conjunction with the linear homogeneity of $s(\cdot)$, wages vary less than proportionately with changes in $w^e$, leaving room for changes in employment in the same direction. Formally, it follows from (11′) that

$$\hat{w} = \frac{1}{\eta}(\hat{L} - \hat{\bar{L}}) + \hat{\bar{w}} \tag{13}$$

with

$$\eta \equiv \left.\frac{\hat{L}}{\hat{w}}\right|_{\bar{w},\bar{L}=const.} = \frac{1 - \frac{w^e}{s}\frac{\partial s}{\partial w^e}}{\frac{w^e}{s}\frac{\partial s}{\partial w^e}} > 0 \tag{14}$$

being the elasticity of the employment level w.r.t. the wage rate for constant levels of $\bar{w}$ and $\bar{L}$. Equation (14) illustrates the above said: Employment and the wage rate move in the same direction because an increase in aggregate labor income leads to a less than proportional increase wages, leaving room for employment gains. The elasticity of the level of employment w.r.t. the wage rate is the larger, the less the reference wage $s$ – and hence the market wage rate $w$ – varies with variations in $w^e$. Another property of the fair wage constraint is worth mentioning: It can be seen in (13) that for a constant level of $\bar{w}$, as long as the wage rate $w$ is constant so is the rate of employment $\frac{L}{\bar{L}}$. Stated differently, an increase of the labour endowment leads *ceteris paribus* to a proportional increase in the employment level. Equally, for a constant rate of employment the wage rate changes proportionally with the standard wage rate $\bar{w}$. Note that these results depend only on the fair wage constraint itself and are therefore independent from the assumptions made w.r.t. the production structure of the economy.

Figure 2 illustrates the fair wage constraint in a labour market diagram. Two special cases of the fair wage approach which are contained in this general framework are also depicted. The vertical line results for the case $s$ equals $w^e$ which is the variant Albert and Meckl (1998, 2001a) analyze. Now the unemployment rate is dependent only on the effort function, i.e. the optimal wage differential is invariant to changes of the wage level. Equation (11′) degenerates to

$$w = \gamma^* \frac{wL}{\bar{L}}$$

and solving for $L$ yields

$$L = \frac{\bar{L}}{\gamma^*}.$$

As the employment level is fixed, the model behaves as the standard competitive model with exogenously fixed labour supply except the constant involuntary unemployment. The opposite extreme, the horizontal line, is the outcome if the exogenous fairness standard $\bar{w}$ is the only determinant of $s$. In this case, considered by Albert and Meckl (2001b), a constant wage rate follows. Using again (11′), $w$ is given by

$$w = \gamma^* \bar{w}.$$

Immediately it can be seen that this specification coincides with a model of exogenous wage rigidity.

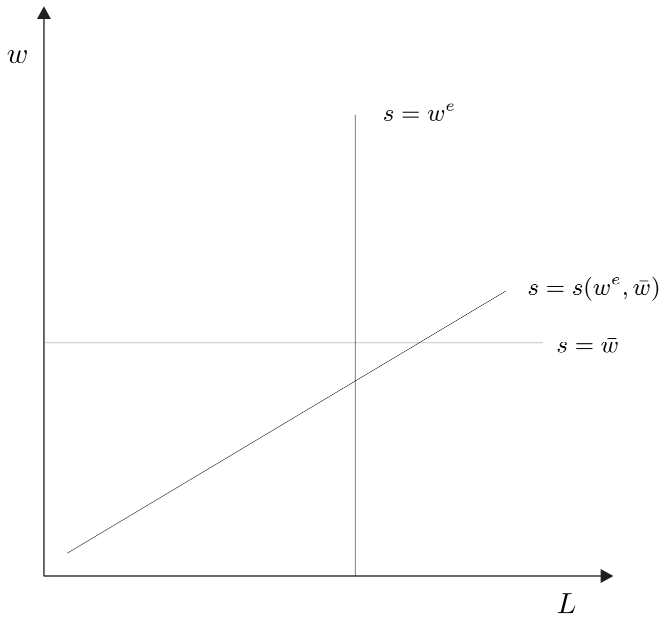

Figure 2: The fair wage constraint

General equilibrium for the small open economy can be described in a compact way by (12) in conjunction with the following system of equations:

$$a_{0L^\varepsilon}\left(\frac{w}{\varepsilon}, r\right)\frac{w}{\varepsilon} + \sum_{j=1}^{m} a_{0j}\left(\frac{w}{\varepsilon}, r\right) r_j = 1 \tag{15}$$

$$a_{iL^\varepsilon}\left(\frac{w}{\varepsilon}, r\right)\frac{w}{\varepsilon} + \sum_{j=1}^{m} a_{ij}\left(\frac{w}{\varepsilon}, r\right) r_j = p_i \qquad i = 1, \ldots, n \tag{16}$$

$$\sum_{i=0}^{n} a_{ij}\left(\frac{w}{\varepsilon}, r\right) y_i = v_j \qquad j = 1, \ldots, m \tag{17}$$

$$\sum_{i=0}^{n} a_{iL^\varepsilon}\left(\frac{w}{\varepsilon}, r\right) y_i = L^\varepsilon \tag{18}$$

$$L^\varepsilon = \varepsilon L \tag{19}$$

$$\varepsilon = \varepsilon(\gamma) \tag{20}$$

$$\frac{\partial \varepsilon}{\partial \gamma}\frac{\gamma}{\varepsilon} = 1 \tag{21}$$

with $m + n + 6$ equations determining an equal number of endogenous variables, namely $w$, $r$, $\gamma^*$, $\varepsilon$, $L$, $L^\varepsilon$, $y_0$, and $y$. Here, $a_{iL^\varepsilon}$ is the input coefficient of efficient labour in sector $i$, while $a_{ij}$ is the respective input coefficient for $v_j$. It is assumed that the labor endowment $\bar{L}$ is sufficiently large to make it a non-binding constraint to the production sector.

As in the standard full employment case, the properties of the model depend crucially on the relative numbers of goods and factors. Turn to the case of an equal number of goods and factors first. With $m = n$, factor prices $\frac{w}{\varepsilon}$ and $r$ are uniquely determined by equations (15) and (16). Equations (20) and (21) give $\varepsilon$ and $\gamma^*$, $L$ is determined in (12). $L^\varepsilon$ follows from (19), and the outputs $y_0$ and $y$ are uniquely determined in (17) and (18). One can easily verify that hence a variation in factor endowments, including the endowment of labour, has no influence on factor prices. In addition, an increase in labour endowment leads to a proportionate increase in employment while an increase in $\bar{w}$ leads to a decrease in employment with no effect on the wage rate $w$.

With more goods than factors, i.e. $n > m$, the comparative static results just stated continue to hold. However, as in the full employment model, there is only one vector $p$ ensuring that all goods are produced in equilibrium, in which case their respective output levels are indeterminate.[7] In the opposite case of more factors than goods ($m > n$), there is no unique relation between goods prices and factor prices. The latter are rather determined in general equilibrium together with the level of employment and the output vector.

# 3 Two special cases

## 3.1 The Heckscher-Ohlin case

Considering the HO-case of a $2 \times 2$ economy with intersectorally mobile factors, it turns out that the model now consists of three recursively connected blocks. This is seen be analyzing the adapted set of equations, denoted below:

$$a_{0L^\varepsilon}\left(\frac{w}{\varepsilon}, r\right)\frac{w}{\varepsilon} + a_{0K}\left(\frac{w}{\varepsilon}, r\right) r = 1 \tag{22}$$

[7] It may be worth noting that in a model where involuntary unemployment is caused by a binding minimum wage, the features just described apply as well in the case of $m = n$. The difference is due to the fact that contrary to the minimum wage model the wage rate is determined endogenously in our model.

$$a_{1L^{\varepsilon}}\left(\frac{w}{\varepsilon}, r\right)\frac{w}{\varepsilon} + a_{1K}\left(\frac{w}{\varepsilon}, r\right) r = p \tag{23}$$

$$a_{0K}\left(\frac{w}{\varepsilon}, r\right) y_0 + a_{1K}\left(\frac{w}{\varepsilon}, r\right) y_1 = K \tag{24}$$

$$a_{0L^{\varepsilon}}\left(\frac{w}{\varepsilon}, r\right) y_0 + a_{1L^{\varepsilon}}\left(\frac{w}{\varepsilon}, r\right) y_1 = L^{\varepsilon} \tag{25}$$

In addition, equations (12), (19), (20) and (21) continue to apply. Firstly, for a given relative price for good 1 the two factor prices $r$ and $w/\varepsilon$ are as usually unambiguously determined by (22) and (23). Then the level of employment in physical as well as in efficiency units follows from (12) and (19), respectively. In a final step, (24) and (25) give the output levels of $y_0$ and $y_1$.

The similarity to the standard HO-model is obvious. So it comes at no surprise that the theorem of factor price equalization holds, at least in a slightly modified version. Assuming internationally equal technologies, the interest rate $r$ and the effective wage $\frac{w}{\varepsilon}$ will not differ in a diversified equilibrium. But this is not true for the market wage rate unless the equilibrium effort $\varepsilon^*$ is the same in all countries. As $\varepsilon^*$ is determined only by the effort function (3) wages are identical if the effort functions coincide. Note that the social norms captured by the reference wage $s(\cdot)$ do not influence a potential wage differential. International differences in $s(\cdot)$, given identical effort functions, would only be reflected in different unemployment rates between countries.

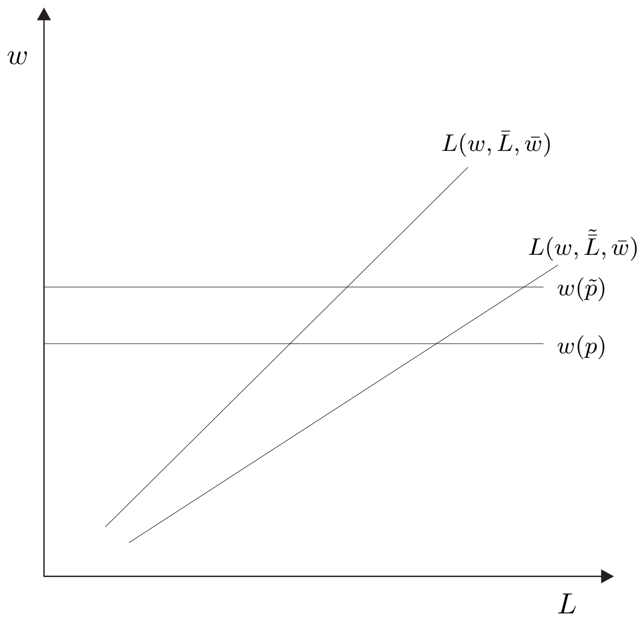


Figure 3: HO-case: The labour market

The essential properties of the model's behaviour can be clearly illustrated by depicting the economy's labour-market as in figure 3, focusing on the case of diversification. The upward sloping fair wage constraint is taken from the general version of the model. As argued above, it is independent from the production structure of the economy and reflects combinations between $w$ and $L$ which are compatible with the profit maximizing wage differential $\gamma^*$. The horizontal line is the analogue to the well known infinitely elastic labour demand of the full employment HO model.[8] The value marginal product of physical labour, given the equilibrium effort $\varepsilon^*$, is bound to the price-determined wage rate by varying the output structure adequately.

We explore now the variations of the endogenous variables in equilibrium following a change of the the relative $p$. To this end we assume that $y_1$ is labour-intensive. A rise of p increases $w$ more than proportionally being the price of the factor used intensively. In figure 3 this results in an upward shift of $w(p)$ to $w(\tilde{p})$. Due to the rise of the market wage rate the employment increases because for higher wages the fair wage constraint allows a lower unemployment rate.

The magnitude of the wage rate change is exactly the same as in the standard HO-model, because $\varepsilon^*$ is independent of $p$. Using Jones' (1965) popular hat notation we confirm this formally. Rewriting the above equations in terms of rates of changes, they become

$$\theta_{0L}\hat{w} + \theta_{0K}\hat{r} = 0 \tag{22'}$$

$$\theta_{1L}\hat{w} + \theta_{1K}\hat{r} = \hat{p} \tag{23'}$$

$$\lambda_{0K}(\hat{y}_0 + \hat{a}_{0K}) + \lambda_{1K}(\hat{y}_1 + \hat{a}_{1K}) = 0 \tag{24'}$$

$$\lambda_{0L}(\hat{y}_0 + \hat{a}_{0L}) + \lambda_{1L}(\hat{y}_1 + \hat{a}_{1L}) = \hat{L} \tag{25'}$$

$$\frac{1}{\eta}(\hat{L} - \hat{\bar{L}}) + \hat{\bar{w}} = \hat{w} \tag{13}$$

where $\theta_{ij}$ represents the cost share of factor $j$ in sector $i$, and $\lambda_{ij}$ is the fraction of factor $j$ being employed in sector $i$.[9] In the derivation of (22′) and (23′), use has been made of

$$\sum_j \theta_{ij}\hat{a}_{ij} = 0. \tag{26}$$

With (22′) and (23′) yielding $\hat{w} > \hat{p} > \hat{r}$, the magnification effect as well as the Stolper-Samuelson theorem are reproduced. The change of the factor

[8] As argued above in fn. 4, there is no true labour demand curve in the present framework because firms are wage setters.

[9] One can easily verify that $\theta_{iL} = \theta_{iL^\varepsilon}$, and $\lambda_{iL} = \lambda_{iL^\varepsilon}$. Furthermore, with constant effort $\hat{w} = \left(\hat{\frac{w}{\varepsilon}}\right)$ and $\hat{a}_{iL} = \hat{a}_{iL^\varepsilon}$. In order to ease the notation, we use in all these cases the variables relating to physical instead of efficient labor.

price ratio is linked to the price change by the well known equation

$$\hat{w} - \hat{r} = \left(\frac{\hat{w}}{\varepsilon}\right) - \hat{r} = \frac{1}{(\theta_{1L} - \theta_{0L})}\hat{p}. \tag{27}$$

Hence, our model predicts that different effort functions may lead to international wage differentials but the rate of change of the factor price ratio, the wage and interest rate are equalized. So the international wage differentials are independent from terms of trade variations. Our results differ from Agell and Lundborg (1995) insofar as their fair wage concept produces a varying equilibrium effort. In their model, depending on the direction of the effort change the effect on the physical factor price ratio can be stronger or weaker than the effect on the efficient factor price ratio.

As has been said above the employment increases with the rising wage rate. Equation (14) gives the resulting percentage change. We obtain that the elasticity of the endowment w.r.t. a price change may differ between countries: The unemployment reduction is the stronger the more important the exogenous fairness standard $\bar{w}$ is. Therefore the same change of the market wage might be accompanied by different employment reactions. In this respect Agell and Lundborg's (1995) results are very similar, but their model structure is far more complex. They find that an increase of $p$ decreases the unemployment more in countries where the effort depends strongly on the wage-interest-rate ratio. Their and our approach coincide also in the possibility of reversals of factor abundance thus influencing the trade patterns. The internationally different reactions of the employment rate could lead to this effect. Consequently, the countries cannot clearly be identified as being labour or capital intensive.

We show now how the change of the output structure following a price variation is influenced by the employment effect. To this end we manipulate equations (24) and (25) to get

$$\begin{aligned} \hat{y}_1 &= \frac{\lambda_{0K}}{\lambda}\hat{L} + \frac{\lambda_{0K}\delta_L + \lambda_{0L}\delta_K}{\lambda\theta}\hat{p} \\ \hat{y}_0 &= -\left(\frac{\lambda_{1K}}{\lambda}\hat{L} + \frac{\lambda_{1K}\delta_L + \lambda_{1L}\delta_K}{\lambda\theta}\hat{p}\right) \end{aligned} \tag{28}$$

where $\lambda \equiv \lambda_{1L} - \lambda_{1K}$, $\theta \equiv \theta_{1L} - \theta_{0L}$, $\delta_L \equiv \lambda_{0L}\theta_{0K}\sigma_0 + \lambda_{1L}\theta_{1K}\sigma_1$, $\delta_K \equiv \lambda_{0K}\theta_{0L}\sigma_0 + \lambda_{1K}\theta_{1L}\sigma_1$, and $\sigma_i$ is the elasticity of substitution between capital and efficient labour in sector $i$.[10]

What distinguishes the present model from the standard HO-model is of course the endogeneity of $\hat{L}$. From (22′), (23′) and (13), holding $\bar{L}$ and $\bar{w}$ constant, $\hat{L}$ may be expressed as

$$\hat{L} = \eta\frac{(1 - \theta_{0L})}{\theta}\hat{p}. \tag{29}$$

[10]See Caves et al. (1993, p. 646-7) for a step-by-step derivation of this result.

Hence, the employment increases following an increase in $p$ if and only if $\theta$ is positive, i.e., if and only if $y_1$ is labour intensive. Substituting for $\hat{L}$ in (28), we obtain

$$\begin{aligned} \hat{y}_1 &= \frac{1}{\lambda\theta}\big(\eta\lambda_{0K}(1-\theta_{0L}) + \lambda_{0K}\delta_L + \lambda_{0L}\delta_K\big)\hat{p} \\ \hat{y}_0 &= -\frac{1}{\lambda\theta}\big(\eta\lambda_{1K}(1-\theta_{0L}) + \lambda_{1K}\delta_L + \lambda_{1L}\delta_K\big)\hat{p} \end{aligned} \tag{30}$$

With $\eta = 0$, the standard Heckscher-Ohlin result – as derived by Jones (1965) – follows. Interestingly, (30) shows that the additional effect from the induced change in employment leads to both the increase in $y_1$ and the decrease in $y_0$ being larger than in the standard model. This holds irrespective of whether employment increases or decreases.[11] The result is illustrated graphically in figures 4 and 5.

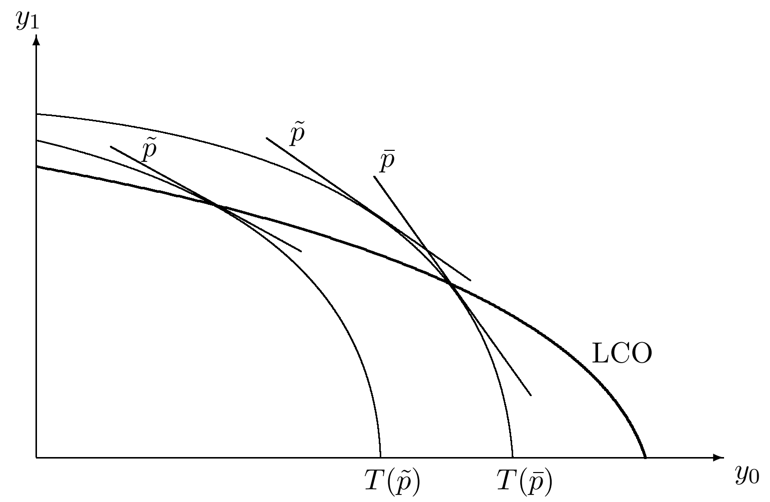


Figure 4: Heckscher-Ohlin with Good 1 capital intensive

Figure 4 shows the case of $y_1$ being capital intensive. Hence, an increase in $p$ leads to a decrease in economy-wide employment. $T(\tilde{p})$ and $T(\bar{p})$ are two representative transformation curves for different levels of labour input. On each transformation curve, only one point is a possible equilibrium point, namely the one where the relative price $p$ is such that it is optimal for the production sector to employ the amount of labour for which the respective curve is drawn. Two such points are the tangency point between the price line $\bar{p}$ and $T(\bar{p})$, and the tangency point between the price line $\tilde{p}$ and $T(\tilde{p})$,

[11]In contrast to this result, Agell and Lundborg (1995) highlight the possibility that an induced decrease in the employment of efficient labour may lead to the decrease in the output of both goods. This follows from the variation of the equilibrium effort which cannot be signed unambiguously in their model.

respectively. Following Herberg and Kemp (1971), who consider a different type of labour market distortion, the line connecting all such tangency points is called the "locus of competitive outputs" (LCO in figure 4). Assuming diversification, equilibrium in the small open fair wage economy will be on a point along this locus.[12] The slope of the locus of competitive outputs is equal to minus the reciprocal value of the cost incurred by marginally increasing the output of $y_1$, measured in units of the *numéraire*. Hence, its absolute value gives the reciprocal value of the shadow price of $y_1$. Due to the labour market distortion, the shadow price of $y_1$ differs from its market price, as shown by the fact that the price lines are non-tangent to the locus of competitive outputs. In the present case of $y_1$ being capital intensive, its shadow price exceeds its market price. Note that following the argument above, the tangency point between $\tilde{p}$ and $T(\tilde{p})$ has to be to the left and *above* the tangency point between $\tilde{p}$ and $T(\bar{p})$: The decrease in labour input induced by a rise in $p$ leads both to a larger decrease in $y_0$ and a larger increase in $y_1$ compared to the case of constant (full) employment.

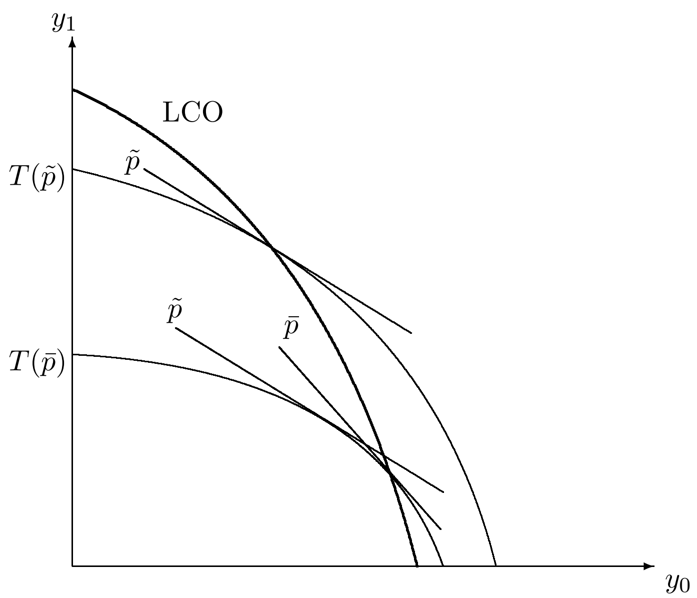


Figure 5: Heckscher-Ohlin with Good 1 labour intensive

Figure 5 depicts the case where good 1 is labour intensive and therefore an increase in $p$ results in an increase in economy-wide employment. The reasoning is analogous to the one above. In particular, the shadow price of $y_1$ is lower than its market price in the present case of $y_1$ being labour

[12] Agell and Lundborg (1995) use the more specific term "fairness constrained production possibility frontier" to describe the analogous locus in their model.

intensive. In addition, the tangency point between between $\tilde{p}$ and $T(\tilde{p})$ has to be above and *to the left* of the tangency point between $\tilde{p}$ and $T(\bar{p})$: The increase in labour input induced by a rise in $p$ leads both to a larger increase in $y_1$ and a larger decrease in $y_0$ compared to the case of constant (full) employment.

At last, shortly discuss the effects of an labour endowment change. In figure 3 it is illustrated that the fair wage constraint turns to the right proportionally, because *ceteris paribus* an increase of $\bar{L}$ yields a proportional increase of the employment level. But as the wage rate stays constant, $L$ rises proportional to $\bar{L}$ in equilibrium as well. Therefore, the output change following the endowment rise is given by (28) with $\hat{p} = 0$.

### 3.2 The Ricardo-Viner case

We choose the Ricardo-Viner model (Jones 1971) as a simple example for the more factors than goods case. Labour is intersectorally mobile whereas capital is specific to the respective sector. Hence, the economy produces two goods $y_0$, $y_1$ with three factors $L$, $K_0$ and $K_1$. The modified equation system is as follows:

$$a_{0L^\varepsilon}\left(\frac{w}{\varepsilon}, r_0\right)\frac{w}{\varepsilon} + a_{0K}\left(\frac{w}{\varepsilon}, r_0\right) r_0 = 1 \tag{31}$$

$$a_{1L^\varepsilon}\left(\frac{w}{\varepsilon}, r_1\right)\frac{w}{\varepsilon} + a_{1K}\left(\frac{w}{\varepsilon}, r_1\right) r_1 = p \tag{32}$$

$$a_{0K}\left(\frac{w}{\varepsilon}, r_0\right) y_0 = K_0 \tag{33}$$

$$a_{1K}\left(\frac{w}{\varepsilon}, r_1\right) y_1 = K_1 \tag{34}$$

$$a_{0L^\varepsilon}\left(\frac{w}{\varepsilon}, r_0\right) y_0 + a_{1L^\varepsilon}\left(\frac{w}{\varepsilon}, r_1\right) y_1 = L^\varepsilon \tag{35}$$

In addition, equations (12), (19), (20) and (21) continue to apply, as was the case in the HO variant of the model.

Again, the consequences of an increase of $p$ are depicted using a labour market diagram. In figure 6, the value of the marginal product of labour (VMPL) in sector 1 rises proportionally with $p$. Accordingly the economy's VMPL curve shifts to the right. In the new equilibrium the wage rate has risen but less than in the case of exogenous labour supply, because the level of employment has as well increased. Due to the increase of the wage rate the output in sector 0 shrinks whereas the sector 1 expands. Hence, the direct price effect dominates the induced employment effect for $y_0$ resulting in an locus of competitive outputs that is everywhere decreasing.

As in the HO-model, the effect of price changes on output changes is derived. Rewriting the system of equations in terms of rates of changes

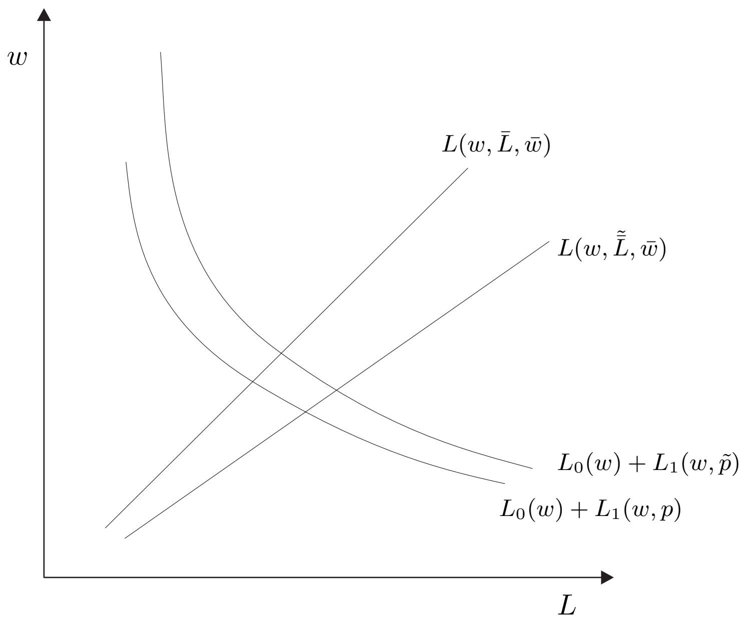

Figure 6: RV-case: The labour market

gives

$$\theta_{0L}\hat{w} + \theta_{0K}\hat{r}_0 = 0 \tag{31'}$$

$$\theta_{1L}\hat{w} + \theta_{1K}\hat{r}_1 = \hat{p} \tag{32'}$$

$$\hat{y}_0 + \hat{a}_{0K} = 0 \tag{33'}$$

$$\hat{y}_1 + \hat{a}_{1K} = 0 \tag{34'}$$

$$\lambda_{0L}(\hat{y}_0 + \hat{a}_{0L}) + \lambda_{1L}(\hat{y}_1 + \hat{a}_{1L}) = \hat{L} \tag{35'}$$

$$\frac{1}{\eta}(\hat{L} - \hat{\bar{L}}) + \hat{\bar{w}} = \hat{w} \tag{13}$$

Now, substitute in (35′) for $\hat{y}_0$ and $\hat{y}_1$ from (33′) and (34′), respectively, and for $\hat{L}$ from (13), holding constant $\bar{w}$ and $\bar{L}$. This yields the following relation between changes in the equilibrium wage rate, taking into account changes in $L$, and changes in the relative goods price:

$$\hat{w} = \frac{\lambda_{1L}\gamma_{1L}}{\gamma + \eta}\hat{p}, \tag{36}$$

Here,

$$\gamma_{iL} \equiv -\frac{\hat{a}_{iL} - \hat{a}_{iK}}{\hat{w} - \hat{p}_i}$$

denotes the elasticity of labour's marginal product curve in sector $i$ and $\gamma \equiv \lambda_{0L}\gamma_{0L} + \lambda_{1L}\gamma_{1L}$. As in the full employment variant of the RV model, the wage increases less than proportionately with the goods price. In fact, (36) reduces to the respective equation from the full employment model for $\eta = 0$. Hence, one can see that the wage increase is smaller here than in the full employment model, allowing for an increase in employment. The latter follows from (14) and (36) as

$$\hat{L} = \eta \frac{\lambda_{1L}\gamma_{1L}}{\gamma + \eta}\hat{p}, \tag{37}$$

where it may be worth noting that in contrast to the HO variant of the model, employment definitely increases following an increase in $p$. From (26), (33′), (34′) as well as the definition of $\gamma_{iL}$, output changes are given by

$$\begin{aligned} \hat{y}_0 &= -\gamma_{0L}\theta_{0L}\hat{w} \\ \hat{y}_1 &= -\gamma_{1L}\theta_{1L}(\hat{w} - \hat{p}), \end{aligned} \tag{38}$$

and after substituting for $\hat{w}$ from (36) this becomes

$$\begin{aligned} \hat{y}_0 &= -\frac{\theta_{0L}}{1-\theta_{0L}}\sigma_0 \frac{\lambda_{1L}\gamma_{1L}}{\gamma+\eta}\hat{p} \\ \hat{y}_1 &= \frac{\theta_{1L}}{1-\theta_{1L}}\sigma_1 \frac{\lambda_{0L}\gamma_{0L}+\eta}{\gamma+\eta}\hat{p} \end{aligned} \tag{39}$$

Again, with $\eta = 0$ this collapses to the result from the full employment variant of the model. One can see again the above stated result, namely that despite the induced increase in employment a rise in $p$ still leads to a reduction in $y_0$, i.e., a downward sloping locus of competitive outputs. However, the output of $y_0$ decreases by less while the output of $y_1$ increases by more than in the full employment RV model.

The result is illustrated in figure 7. In contrast to the HO model with a labour intensive good 1, the increase in employment in the RV case leads *ceteris paribus* to an increase of *both* outputs. Therefore, the tangency point between $\tilde{p}$ and $T(\tilde{p})$ has to be above and *to the right* of the tangency point between $\tilde{p}$ and $T(\bar{p})$.

At last, consider an increase of the labour endowment $\bar{L}$. In figure 6 the results can be identified. The fair wage constraint turns to the right proportionally. Due to the falling marginal product curve for labour, the new equilibrium is reached at a lower wage rate. Hence, the employment expands but less than proportionally, causing a rise in the unemployment rate. Formally, both results are derived by again substituting in (35′) for $\hat{y}_0$ and $\hat{y}_1$ from (33′) and (34′), respectively, and for $\hat{L}$ from (13), this time holding constant $\bar{w}$ and $p$. Solving for $\hat{w}$ and $\hat{L}$, respectively, gives

$$\hat{w} = -\frac{1}{\gamma + \eta}\hat{\bar{L}} \tag{40}$$

$$\hat{L} = \frac{\gamma}{\gamma + \eta}\hat{\bar{L}} \tag{41}$$

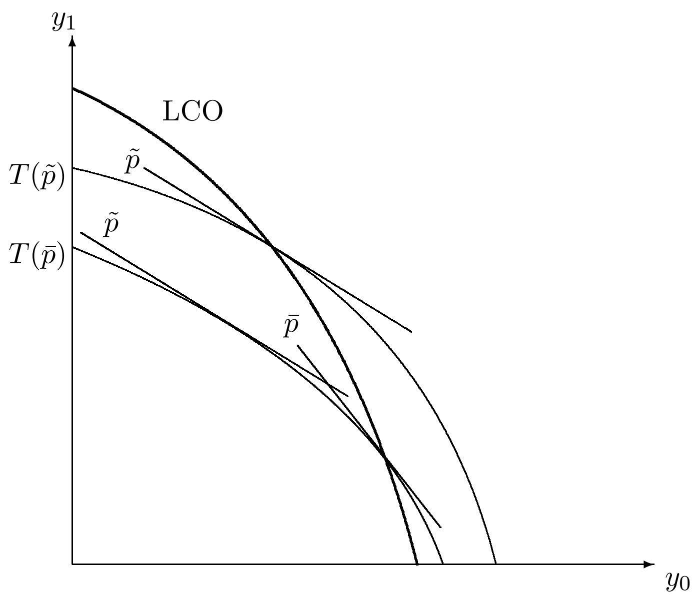


Figure 7: Locus of Competitive Outputs in the RV case

The lower wage rate must be accompanied by higher unemployment to make the workers provide the optimal effort.

# 4 Conclusion

This paper shows how involuntary unemployment due to fair wage considerations can be introduced in a straightforward way into a model of a small open economy. It formalizes the idea that market wages react less than fully to swings in the economy-wide value marginal product curve for labour. This results in the present framework from the behavior of profit maximizing, wage setting firms which in maximizing profits have to take into account fair wage considerations on the part of workers. There is involuntary unemployment in equilibrium, as workers would be willing to work for less than the going market wage, but firms are unwilling to hire them. The equilibrium level of unemployment is shown to depend on the sectoral structure of the economy, as is typical for many trade models exhibiting labour market distortions.

The particular way in which the economy's sectoral structure and the level of unemployment are related in the general version of the present model, can easily be deduced by drawing the analogy to the standard multi-sector competitive trade model with full employment: Whenever a sectoral shift increases the real wage (measured in units of the *numeraire*) in the full employment model, it increases employment in the fair wage model. Any increase in employment is accompanied by an increase in the wage which is smaller than in the respective full employment case. Due to the transparent relation between the fair wage model presented here and the respective variant of the full employment model, the results derived can be given intuitively appealing interpretations, even in the general case of many goods and factors.

## References


Agell, J. and P. Lundborg (1995), Fair Wages in the Open Economy, *Economica*, Vol. 62, pp. 335-51.

Akerlof, G. and J. Yellen (1990), The Fair Wage-Effort Hypothesis and Unemployment, *Quarterly Journal of Economics*, Vol. 105, pp. 255-83.

Albert, M. and J. Meckl (1998), *Efficiency Wages, Unemployment and Welfare: A Trade Theorists' Guide*, mimeo, University of Konstanz.

Albert, M. and J. Meckl (2001a), Efficiency-Wage Unemployment and Intersectoral Wage Differentials in a Heckscher-Ohlin Model, *German Economic Review*, Vol. 2, pp. 287-301.

Albert, M. and J. Meckl (2001b), Green Tax Reform and Two-Component Unemployment: Double Dividend or Double Loss?, *Journal of Institutional and Theoretical Economics*, Vol. 157, pp. 265-81.

Brecher, R.A. (1992), An Efficiency Wage Model with Explicit Monitoring: Unemployment and Welfare in an Open Economy, *Journal of International Economics*, Vol. 32, pp. 179-91.

Caves, R.E., J.A. Frankel and R.W. Jones (1993), *World Trade and Payments*, 6th ed., HarperCollins.

Davidson, C., L. Martin, and S. Matusz (1999), Trade and Search Generated Unemployment, *Journal of International Economics*, Vol. 48, pp. 271-99.

Herberg, H. and M. Kemp (1971), Factor Market Distortions, the Shape of the Locus of Competitive Outputs, and the Relation between Product Prices and Equilibrium Outputs, in: J. Bhagwati et al. (eds.), *Trade, Balance of Payments, and Growth*, Amsterdam, North-Holland, pp. 22-48.

Jones, R.W. (1965), The structure of simple general equilibrium models, *Journal of Political Economy*, Vol. 73, pp. 557-72.

Jones, R.W. (1971), A Three-Factor Model in Theory, Trade, and History, in: J. Bhagwati et al. (eds.), *Trade, Balance of Payments and Growth*, North-Holland, pp. 3-21.

Matusz, S.J. (1994), International Trade Policy in a Model of Unemployment and Wage Differentials, *Canadian Journal of Economics*, Vol. 27, pp. 939-49.

Schlicht, E. (1992), Wage Generosity, *Journal of Institutional and Theoretical Economics*, Vol. 148, pp. 437-51.

Schweinberger, A.G. (1995), Factor Market Distortions, the Gains from Trade and Comparative Advantage, *Schweizerische Zeitschrift für Volkswirtschaft und Statistik*, Vol. 131, pp. 361-75.

Solow, R. (1979), Another Possible Source of Wage Stickiness, *Journal of Macroeconomics*, Vol. 1, pp. 79-82.

Weiß, P. (2001), *Unemployment in Open Economies: A Search Theoretic Analysis*, Heidelberg, Springer.