Dismissal Protection or Wage Flexibility – Or When Do Low Skilled Workers Become More Employed?

by

Jens Rubart[‡]

Darmstadt, February 2006

– *Preliminary Version* –

Abstract

Due to increased technological change which lead to an increased demand for skilled workers, it becomes more and more difficult for low skilled workers to find a job. How should a society or political decision makers react? Recently, German politicians are engaged in a discussion about the introduction of combined and minimum wages as well as the reduction of employment protection mechanisms in order to increase the employment status of low skilled workers.

However, a detailed macroeconomic examination of the effects of the above mentioned labor market policies in an environment which exhibits structural changes is still missing. Based on findings by Lindquist (2004) and Pierrard and Sneessens (2004), in this paper a dynamic general equilibrium model with equilibrium unemployment due to search an matching frictions is developed. Within this framework, the effects of labor market policies, in particular the introduction of minimum wages and firing costs, are analyzed.

We show that a reduction of employment protection mechanisms are rather ineffective to increase the employment status of low skilled workers. However, it is shown that the higher a relative wage rigidity is the lower is low skilled employment.

JEL - Classification: E32, J21,J23, J24, J31, J41

Keywords : DGE Model, Heterogenous Labor, Skill Biased Technological Change, Search Unemployment, Employment Protection, Minimum Wages

[‡]Institute of Economics, Darmstadt University of Technology, Residenzschloss, D-64283 Darmstadt, Germany and Center for Empirical Macroeconomics, University of Bielefeld, e-mail: rubart@vwl.tu-darmstadt.de.

1 Introduction

"As a result of structural change triggered by globalization, it is particularly the low skilled workers who are falling through the cracks of the labor market."[1]

Recently, continental European labor markets are faced with the problem of high and increasing unemployment. In particular, the observed unemployment rates are almost determined by a decreasing demand for low skilled workers. Furthermore, since the enormous increase in unemployment during the 1970s and 1980s, unemployment is particularly determined by structural or long-term unemployment.[2] One explanations of this pattern is educational mismatch. That means, in an economy that is faced with structural changes due to an increasing importance of knowledge based industries the level of education becomes the most important determinant of job creation and the employment pattern of an economy. A second explanation of this pattern is that continental European countries exhibit rather rigid labor market institutions that prevent wages to adjust flexible in response to demand shifts or that raise reservation wages of unemployed workers because of too generous unemployment and social benefit payments.

Because of the fact that the observed unemployment rates exhibit strong path dependency and, furthermore, that skills can not be generated in a rather short time horizon, continental European labor market politicians are faced with the question which policy might support the increase of the employment status of low skilled workers. Recently, two strategies are in the German politico-economic discussion. The first one concerns the introduction of combined wages and minimum wage rules. This strategy attempts to define minimum wage rules for low skilled workers which are subsidized by the government or the employment authority. Furthermore, a second attempt of this strategy is to increase the worker's earnings by this subsidy up to an average wage level. The second policy discussed concerns the reduction of labor market regulations. In particular, employment protection mechanisms like dismissal protection shall be reduced for specific groups of workers.

Of course, the effects of minimum wages and employment protection mechanisms on the employment pattern are well known from microeconomic analysis. However,

[1] See K. Zimmermann, IZA Compact, 01/06.

[2] For Germany long term unemployment, i.e. a duration of unemployment for more than 12 months, accounts in 1990 (2004) for 46.8 % (51.8 %) of German unemployment. For comparison, for the U.S. 5.5% an 12.7 % are reported. Furthermore, the OECD average remaind rather constant around 31 %. See OECD (2005) for further details.

the outcomes of the above mentioned policies are not studied within a dynamic framework which also considers structural change due to technological progress. For example, one could argue that, whether increases in productivity are high enough or even rather low skill biased, then low skilled employment might increase regardless the wage structure determined by policy makers.

Based on recent findings of Rubart (2006) we develop a dynamic general equilibrium model which accounts for heterogeneous labor and equilibrium unemployment due to search and matching frictions where wages are set by a Nash-bargaining procedure. This rather standard framework is, furthermore, enlarged by the introduction of a minimum wage rule and a dismissal protection mechanism due to firing costs.

The importance of rigid wages is based on the findings of Hall (2003, 2005b) and Shimer (2004) who show that rigid wages that prevent wages to adjust flexible improve the performance of a search and matching framework to account for key facts of the business cycle. However, the studies cited above assume a wage concerning the contract length an consider a homogeneous type of labor, only. However, when minimum wages or rigid wage distributions are considered one has to distinguish between different types of labor. In particular, we find rather fixed wages at the lower tail of the wage distribution, i.e. for the wages earned by low skilled workers. A closely related examination is given by the work Pierrard and Sneessens (2003, 2004) who discuss the effects of rigid relative wages in order to explain the unemployment pattern of low skilled workers in Belgium.

The second innovation of this paper is the consideration of employment protection mechanisms due to the introduction of firing costs. This extension is particularly based on the suggestions by Saint-Paul (1996), Kohns (2000) and Delacroix (2003). There, we assume that firms have to pay a 'firing tax' to the government when they attempt to close a job. Then, the government pays a lump-sum transfer to unemployed workers. This framework enables further to consider two important labor market policies, employment protection and unemployment benefits, in a single model.

The remainder of this paper is organized as follows, in section two we present a collection of stylized facts of OECD labor markets. In section three the basic framework of the model is introduced. The model extensions by minimum wages and firing costs are discussed in section five. Section six concludes.

2 Stylized Facts

A general explanation that coincides with the observed pattern of the employment status of different kinds of workers is the hypothesis of the so-called skill-biased technological change, i.e. that new technologies increase the demand for skilled workers and lower the demand for low skilled workers although the supply of skilled workers increased (see e.g. Autor et al. (1998), Katz and Autor (1999), or Acemoglu (2002) for detailed surveys). Recently, the increased investment in information and communication technologies are seen as such a major technological advance. The most important indicator of the existence of skill biased technological change is the increase of the wage spread between high and low skilled workers. Table 1 below, summarizes the main arguments of the SBTC - hypothesis for four OECD countries.

Table 1: Education, Employment and Demand for Skills

	Unemployment				Labour Force Participation			Supply and Demand for Skills		
	total	less secondary	upper secondary	tertiary	less secondary	upper secondary	tertiary	degrees in tert. educ.	wage spread OECD	wage spread own calc.
France										
1971-82	–	—	—	—	—	—	—	—	—	—
1982	7.7	—	—	—	—	—	—	8.3	1.94	—
1988	9.9	—	—	—	—	—	—	11.8	1.99	—
1995	11.6	14.0	8.9	6.5	60.3	82.8	87.7	—	1.99	—
2002	8.9	11.8	6.8	5.2	65.7	81.5	89.1	12.0	—	—
Germany										
1971-82	3.1	—	6.4	1.7	—	—	—	—	—	—
1982	5.7	—	—	—	—	—	—	7.4	1.63	1.49
1988	6.2	13.7	6.9	7.2	45.8	61.9	78.8	9.4	1.62	1.51
1995	8.2	13.3	7.9	4.9	56.8	77.1	88.5	13.0	1.61	1.50
2002	8.7	15.3	9.0	4.5	60.1	77.3	87.5	13.0	—	1.54
U.K.										
1971-82	5.0	—	7.5	2.4	—	—	—	—	—	—
1982	10.3	—	—	—	—	—	—	12.0	1.74	—
1988	8.7	13.1	7.4	6.7	75.5	80.5	87.3	18.3	1.82	—
1995	8.7	12.2	7.4	3.7	61.8	82.1	88.8	—	1.87	—
2002	5.1	8.5	4.1	2.4	57.8	82.7	90.0	18.0	—	—
U.S.										
1971-82	4.9	—	7.8	2.0	—	—	—	—	—	—
1982	9.7	—	—	—	—	—	—	16.6	1.79	1.66
1988	5.5	10.1	5.9	3.0	43.8	69.9	78.2	21.5	1.88	1.81
1995	5.5	10.0	5.0	2.7	59.8	79.1	88.2	24.0	2.10	1.98
2002	5.8	10.2	5.7	3.0	63.5	78.5	85.7	28.0	—	2.00

Sources: Greiner et al. (2004), Nickell and Bell (1996), OECD (1989), OECD (1993), OECD (1996), OECD (2003), OECD (2004)

It is obvious that most of the variation in unemployment rates is found for the group of low skilled workers, whereas the unemployment rate for high skilled is rather constant or decreasing. Furthermore, for any country we find an increase in the supply of high skilled workers as well as a constant or increasing pattern of the wage spread. Although table 1 might lead to the conclusion that the considered variables underly a steady evolution, it is shown by the data that the respective variables exhibit cyclical variations at business cycle frequencies.[3]

The importance of labor market rigidities due to institutional settings when analyzing continental European labor markets is particularly highlighted by Nickell (1997), Blanchard and Wolfers (2000) or Heckman (2003) who refer the rigidity of the labor market of continental European countries as the major source of the high unemployment and the low economic performance.[4] However, one should correct the statements concerning the high unemployment rates, because we observe high unemployment rates for low skilled workers. The unemployment rate of skilled workers is nearly the same across main OECD countries like the U.S., U.K., France or Germany, see e.g. table 1.

The importance of market frictions can be explained by outward shifts of the so-called Beveridge curve. This also incorporates mismatch problems, i.e. that an unemployed worker does not match to the job because of certain characteristics. Whereas the Beveridge curve remains rather stable for the U.S. a significant shift to the right is observed for the German economy (table 1). In general, there are two explanations of this behavior, skill mismatch, i.e. the unemployed worker does to match to the job's requirements and to rigid labor market institutions which raise the worker's reservation wage above the wage he would be employed as, for example, shown by Blanchard and Wolfers (2000) or Heckman (2003).

[3] See Lindquist (2004) or Rubart (2006) for recent studies of the cyclical variations of relative wages and relative employment.

[4] A further explanation given by Blanchard and Giavazzi (2003) who state that high product market rigidities also account for the low economic performance. However, product and labor market rigidities are highly correlated such that the impact of each source is difficult to determine.

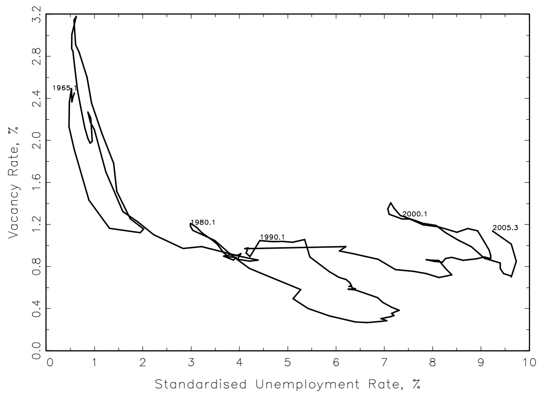

Figure 1: Beveridge Curve, Germany, 1965.1-2005.3

Source: OECD Main Economic Indicators, own calculations

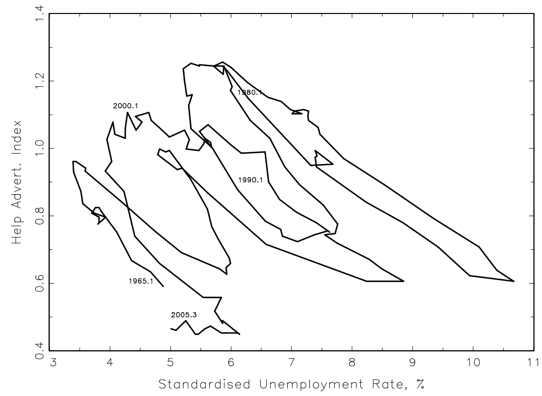

Figure 2: Beveridge Curve, U.S., 1965.1-2005.3

Source: OECD Main Economic Indicators, own calculations

Labor Markets are characterized by various kinds of institutions. In general, these institutions determine the behavior of key outcomes of this particular market, for example the transition rates in and out of employment, the evolution of long term unemployment, and, in particular, the wage setting procedures.[5]

According to Nickell et al. (2003) labor market institutions are treated in general as: unemployment benefits, trade unions (union density), employment protection, labor taxes and all kinds of wage inflexibility. As, amongst others, shown by Blau and Kahn (2001) an important factor determining the wage distribution is the existence of minimum wages, too.[6] Although the existence of minimum wages is very important, there is a lack of time series data of this variable.

In this study, we concentrate particularly on two main indicators: union density and benefit replacement rates.[7] The impact of trade union power is examined at a higher extend, because trade unions have an important impact on the U.S. and German wage setting. The main difference in the characteristics of trade unions is that in the U.S. unions affect the wage setting on the firm level whereas in Germany unions determine the economy wide wage setting procedure (see e.g. table 2 below).

[5] See, for instance, Blanchard and Wolfers (2000) for a study on the role of institutions as an explanation of the rise in European Unemployment.

[6] See Dolado et al. (1996), Blau and Kahn (1999), and Lee (1999) or Gosling and Lemieux (2001) for detailed discussions of the impact of minimum wages in explaining the wage distribution.

[7] According to Nickell et al. (2003) trade union density represents the ratio of total reported union members to employees and benefit replacement rates are constructed as benefit entitlements before tax as a percentage of previous earnings before tax. Cf. Nickell et al. (2003): 427.

The evolution of a collection of labor market institutions during the 1980s and 1990s are described by table 2 below. There, it is obvious that union density has declined over time for each country, on the other hand, the number of employees covered by collective wage bargaining behaves differently. In particular, for Germany and France we observe the highest level of bargaining coverage and also an increase in this measure. On the other hand, for the U.S. and U.K. this rate has decreased. Concerning the differences how minimum wages are determined, e.g. by law or in collective agreements, table 2 shows that the highest minimum wages are set in Germany and France, too. A slightly different pattern is observed for benefit replacement rates. For the U.S. and U.K. a significant decline is observed whereas this ratio remained rather constant for the Germany and France. This observation coincides with the minimum wage rules which are shown by the data for these two countries. In particular, such benefit payments determine reservation wages.

Table 2: A Collection of Labor Market Institutions

Year	U.S.	U.K.	Germany	France	U.S.	U.K.	Germany	France
	Employment Protection[a]				Union density			
1980	0.10	0.35	1.65	1.30	0.23	0.56	0.35	0.19
1995	0.10	0.35	1.41	1.50	0.15	0.37	0.29	0.10
	Bargaining Coverage				Benefit Replacement Rates			
1980	26 %	70 %	91 %	85 %	0.34	0.33	0.39	0.62
1995	18 %	47 %	92 %	95 %	0.27	0.22	0.36	0.58
	Minimum Wages[b]							
	0.39 (1993)	0.40 (1993)	0.55 (1991)	0.50 (1993)				

Sources: Nickell et al. (2003), Bierhanzl and Gwartney (1998), Dolado et al. (1996)

[a] Index numbers, taken from Nickell et al. (2003).

[b] Minimum wages as a fraction of average earnings (Dolado et al. (1996): 321).

Table 3 compares the unemployment insurance payments of the above mentioned OECD countries.

Table 3: Unemployment Benefits

	Unemployment Insurance			Unemployment Assistance	
	Payment	max. Benefit[a] in USD (yearly)	Duration (months)	max. Benefit in USD. (yearly)	Duration (months)
Germany[b]	60 %	30.890	12	27.286	no limit
Germany[c]	30% (min.)	21.600	no limit	–	–
France	75 %	60.184	60	4.479	no limit
U.K.	Flat Rate	4.084	6	4.084	no limit
U.S.	50 %	15.600	6	–	–

Source: OECD (2002) and own calculations

[a]Payments in per cent of gross earnings, except Germany (net earnings). 1999 purchasing power parity unites are used by the OECD to calculate the USD values.

[b]Note that the German data describe the benefit payments before the so-called Hartz-IV reform.

[c]Please note, that the results shown in this table give only a very rough description and does not include all possibilities of payments which are offered by the new unemployment benefit system in Germany which started in January 2005. A more detailed survey can be found, for example, in Sachverständigenrat (2004), pp 229ff..

Consistent with the aggregate findings reported by table 2, table 3 shows that the most generous social security payments are paid in European OECD countries. In particular, France grants the highest payments during the first 60 month after becoming unemployed. After the termination of unemployment insurance payments all countries, except Germany, pay significant lower unemployment assistance payments. Without loss of generality we can state that, compared to the U.S. and U.K., France and Germany show the highest degree of labor market institutions and, furthermore, the strongest relation between institutions and the wage setting.

Beside the effects of institutions on wage setting mechanisms a further determinant of labor market rigidity is employment protection legislation. By relating an employment protection index to the growth of relative employment, we obtain

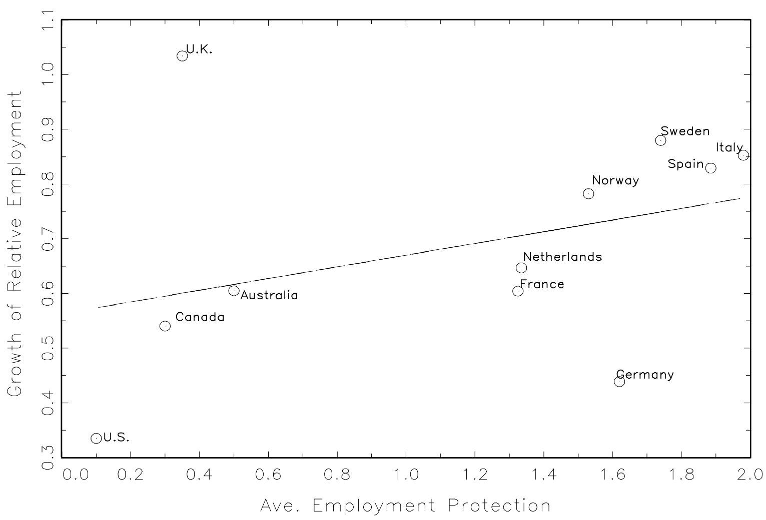

Figure 3: Employment Protection and Relative Employment

For any considered country a significant increase of the relative employment position of skilled workers is reported by figure 3.[8] However, as suggested by the positive slope of the regression line, which states that higher employment protection goes at hand with an increase in the relative employment position of skilled workers.

3 The Model

3.1 Basic Framework

The model discussed in this paper is based on the seminal work by Kydland (1984), Merz (1995) and on suggestions made by Cahuc and Zylberberg (2004) as well as Heckman et al. (1998). The model economy consists of two sectors, a household sector which supplies labor and physical capital to the production sector. The labor force is differentiated into two skill groups, high and low skilled workers, which are assumed to be imperfect substitutes in production. The production sector consists of many small firms using capital and both types of labor services in order to produce

[8]The data on relative employment are taken from Layard et al. (1999) for the years 1980 and 1989. The growth rate is calculated as $x_{1989}/x_{1980} - 1$. The employment protection index is taken from the labor market institutions database by Nickell et al. (2003), the data applied in the regression are the arithmetic means of the variables in 1980 and 1989. The solid line is calculated by OLS : $constant : 0.56(4.54)$, $\beta : 0.106(1.15)$, $R^2 : 0.12$, t-statistics in parentheses.

a single good which can be either consumed or invested. The market for final goods is characterized by perfect competition, whereas the labor market is characterized by search and matching frictions. It is assumed that jobs for high and low skilled workers are destroyed in any period at an exogenous rate $\psi_i \in (0, 1)$ with $i = s, u$. Furthermore, we assume a two sided search process, i.e. both unemployed workers of each skill group (s=skilled, u=unskilled) and firms with vacant jobs seek for new job matches.

The Labor market

The economy's labor force is assumed to be constant and is normalized to one. Let $n_{i,t}$ denote the ratio of labor of the skill group $i = s, u$, i.e. $N = 1 = l_s + l_u$. Each type of labor can either be employed or unemployed, i.e. $l_i = h_i + u_i$. The employment of each skill group evolves according to

$$h_{s,t+1} = (1 - \psi_s)h_{s,t} + M_{s,t} \quad (1)$$

$$h_{u,t+1} = (1 - \psi_u)h_{u,t} + M_{u,t}, \quad (2)$$

where $\psi_i \in (0, 1)$ denotes an exogenous rate of job destruction and $M_{i,t}$ gives the number of newly created jobs in period t. New job matches are created through a 'standard' matching technology,

$$M_i = M(s_{i,t}u_{i,t}, v_{i,t}). \quad (3)$$

For simplicity it is assumed that both skill groups are separated from each other, i.e. low skilled workers can not apply for high skilled jobs and vice versa. The matching technology given by eqn. 3 implies the following transition probabilities from unemployment to employment and from an unfilled to a filled job vacancy of type i:

$$p_{i,t} = \frac{M_{i,t}}{s_{i,t}(1 - h_{i,t})} \quad (4)$$

$$q_{i,t} = \frac{M_{i,t}}{v_{i,t}}. \quad (5)$$

The market tightness for each type of worker, θ_i, follows as

$$\theta_{s,t} = \frac{v_{s,t}}{(1 - h_{s,t})} \quad (6)$$

$$\theta_{u,t} = \frac{v_{u,t}}{(1 - h_{u,t})}. \quad (7)$$

With the definition $li, t = u_{i,t} + h_{i,t}$ the respective employment and unemployment rates of each skill group follow as $\tilde{h}_{i,t} = h_{i,t}/l_{i,t}$ and $\tilde{u}_{i,t} = u_{i,t}/l_{i,t}$, i.e.

$$\tilde{u}_{i,t} = 1 - \tilde{h}_{i,t}. \tag{8}$$

The household sector

We assume a representative household with many inhabitants. For simplicity, the total number of the household's members is normalized to one. The household chooses investment in physical capital, I_t, and the search intensities, $s_{i,t}$ of the respective skill group in order to maximize the present discounted value of its life-time utility. Household's members receive income from lending capital to firms at the interest rate r_t and from having a fraction of both types of its members $n_{i,t}$ work at the respective wage rates $w_{i,t}$. The households maximization problem reads as follows:

$$U_t = \max_{c_t, s_{i,t}, k_{t+1}, h_{i,t+1}} \sum_{t=0}^{\infty} \beta^t U(c_t, h_{s,t}, h_{u,t}) \tag{9}$$

subject to

$$\begin{aligned} c_t + I_t + \sum_i \kappa_i(s_{i,t})(1 - h_{i,t}) &= \sum_i w_{i,t} h_{i,t} + r_t k_t && (10)\\ k_{t+1} &= (1 - \delta)k_t + I_t && (11)\\ h_{s,t+1} &= (1 - \psi_s)h_{s,t} + p_{s,t} s_{s,t}(1 - h_{s,t}) && (12)\\ h_{u,t+1} &= (1 - \psi_u)h_{u,t} + p_{u,t} s_{u,t}(1 - h_{u,t}), && (13) \end{aligned}$$

where $c_t, k_t, r_t, h_{i,t}$ denote consumption, physical capital, the interest rate, and the respective type of labor. Furthermore, $s_{i,t}, \psi_i$ and $p_{i,t}$ represent the search intensity, the rate of job destruction and the rate an unemployed workers finds a new job. The costs of an unemployed worker of type i for searching for a new job is given by the function $\kappa_i(s_{i,t})$. If a job is productive, the worker of type i receives a negotiated wage $w_{i,t}$ (see below). Furthermore, it is assumed that the different types of workers pool their incomes which leads to a perfect insurance against the loss of income during unemployment.

The production sector

Following Merz (1995) firms choose the plans for the amount of capital they rent from households and for the number of vacancies, $v_{i,t}$ they post at constant vacancy cost a_i in order to maximize the present discounted value of their stream of future profits.

Firms sell their output y_t at a price that is normalized to one. The production factors, capital and labor are bought at the interest rate r_t and the wage rate $w_{i,t}$, respectively. The firm's decision problem follows as

$$\max_{k_t,v_t} E_t \sum_{t=0}^{\infty} \beta^t \lambda_t \Pi_t \tag{14}$$

subject to

$$\begin{aligned} h_{s,t+1} &= (1-\psi_s)h_{s,t} + q_{s,t}v_{s,t} && (15)\\ h_{u,t+1} &= (1-\psi_u)h_{u,t} + q_{u,t}v_{u,t}. && (16) \end{aligned}$$

Note that Π_t denotes the firms profits, i.e.

$$\Pi_t = f(k_t, h_{s,t}, h_{u,t}, z_t) - \sum_i w_{i,t}h_{i,t} - r_t k_t - \sum_i a_i V_{i,t} \tag{17}$$

The production technology is assumed according to Heckman et al. (1998). This captures two important effects, first the assumption of imperfect substitution between the different kinds of labor, a rather standard assumption in the literature of skill biased technological change, and, furthermore, imperfect substitution between labor and physical capital. The latter assumption accounts for the fact that, in the short run, labor can not be substituted by capital immediately.[9] According to Greiner et al. (2004) the production technology is further augmented by positive externalities of technological change, $\varepsilon_s, \varepsilon_u > 0$,

$$f(\cdot) = z_t \left(\alpha \Big(\gamma (z_t^{\varepsilon_s} h_{s,t})^{\sigma_1} + (1-\gamma)(z_t^{\varepsilon_u} h_{u,t})^{\sigma_1} \Big)^{\frac{\sigma_2}{\sigma_1}} + (1-\alpha) k_t^{\sigma_2} \right)^{\frac{1}{\sigma_2}} \tag{18}$$

where z_t denotes a shock in technology which affects overall productivity as well as the individual productivity of each skill group due to an external effect which is captured by the assumption of $\varepsilon_i > 0$. Furthermore, α denotes the labor share of total income. The parameters σ_1 and σ_2 determine the substitution elasticities between both types of workers as well as between labor and physical capital.

The technology shock, z_t is assumed to follow a stationary stochastic process which is described by the following law of motion:

$$z_{t+1} = \omega z_t + \epsilon_{t+1}^z, \tag{19}$$

with $\epsilon_t^z \sim i.i.d.\ \mathcal{N}(0, \sigma_z^2)$ and $\omega \in [0,1]$.

[9] See also Rowthorn (1999) for a study concerning imperfect capital labor substitution in business cycle models.

Wage Setting and Inequality

The wage is negotiated according to a Nash bargaining procedure once firms and workers meet in order to form a productive job. During this process firms and workers are considered as monopolists earning an economic rent if a job becomes productive. Therefore, this bargaining scheme allocates the rent surplus of a productive job between firms and workers.[10] For a worker of type i who matches to a firm, the value of a job is given by the real wage $w_{i,t}$ net of costs of search and disutility of work. For a firm, the value of a filled job follows from the difference between a worker's marginal product, the wages and the firm's advertising costs.[11]

The net surplus of the household is given by

$$W_i^h = w_{i,t} + \kappa_i(s_{i,t}) - u_{i_t}(c_t, h_{i,t}) + \frac{\kappa_{s_i,i}(s_{i,t})}{p_{i,t}}(1 - \psi_i - p_{i,t}s_{i,t}).$$

Note that the workers's surplus consists of the wage rate, the search costs of the current and the next period net the disutility of work. The net surplus of the firm is given by

$$W^f = f_{h_i}(\cdot) - w_{i,t} + \frac{a_i}{q_{i,t}}(1 - \psi_i).$$

The Nash bargaining criterion is given by

$$w_t = \text{argmax} \ \left(W_i^h\right)^{\phi_i}\left(W^f\right)^{1-\phi_i}, \tag{20}$$

where ϕ_i denotes the bargaining strength of the worker. The wage results as:

$$w_{i,t} = \phi_i \left[f_{h_i}(k_t, h_{s,t}, h_{u,t}, z_t) + \sum_i a_i\theta_{i,t}\right] + (1 - \phi_i)\left[\frac{U_{h_{i,t}}(\cdot)}{\lambda_t} - \kappa_i(s_{i,t})\right]. \tag{21}$$

As in Merz (1995) the wage results as a weighted sum of the marginal product of labor net of advertising costs and the disutility of work corrected for foregone search costs.

The wage spread due to the skill differences between both types of workers follows as

$$\frac{w_h}{w_u} = \frac{\phi_h\left[f_{h_s}(\cdot) + a_s\theta_{s,t}\right] + (1 - \phi_h)\left[\frac{U_{h_s}(\cdot)}{\lambda} - \kappa_{s_s}(s_{s,t})\right]}{\phi_u\left[f_{h_u}(\cdot) + a_u\theta_{u,t}\right] + (1 - \phi_u)\left[\frac{U_{h_u}(\cdot)}{\lambda} - \kappa_{s_u}(s_{u,t})\right]} \tag{22}$$

[10] *"Hence a realized job match yields some pure economic rent, which is equal to the sum of the expected search costs of the firm and the worker. Wages need to share this economic (local monopoly) rent, in addition to compensating each side for its costs from forming the job."* See Pissarides (2000): 15.

[11] Please note that subscripts except i and $t, t+1$ denote partial derivatives.

For comparison, if we would consider a model with a perfect labor market wage inequality is given by:[12]

$$\frac{w_h}{w_u} = \frac{\gamma}{1-\gamma}\left[\frac{z^{\varepsilon_h}}{z^{\varepsilon_u}}\right]^{\sigma_1}\left[\frac{h_u}{h_s}\right]^{1-\sigma_1} \tag{23}$$

Comparing equations (22) and (23) it is obvious that wage inequality resulting in the recent model does not depend on the production technology, external effects of knowledge and the rate of substitution between different skill groups alone. An important determinant of the pattern of wage inequality is given by the bargaining power of workers, ϕ_i which governs the fraction of the firm's surplus is distributed to the worker. Furthermore, as can be seen easily, eqns (22) and (23) coincide in the case when ϕ_i converges to 1 and when no costs of vacancy creation would be assumed. Beside the fact, that the workers disutility of work and his search costs are introduced in the wage equation, an important factor which determines inequality (as well as the wage setting) is the workers bargaining power ϕ_i.

3.2 General Equilibrium

According to Langot (1995) the symmetric general equilibrium solution is obtained as follows: at first the optimal job search and vacancy creation behavior is computed, furthermore the wage rate is determined within a Nash-bargaining framework. Second, market clearing conditions in the good and capital markets are imposed. However, because the wage is not the price which clears, for example a Walrasian labor market, the solution of this problem is not a Pareto optimum.[13] Please note, that due to the time consuming matching process on the labor market, this market is characterized by a stochastic rationing pattern, i.e. there is a positive probability $1-q(\theta_i)$ that a hiring firm does not find a worker and a probability $1-\theta_i q(\theta_i)$ that an unemployed worker does not find a vacant job position.[14] An equilibrium of this economy is a set of variables

$$\begin{aligned}\Omega_t \quad = \quad & \{k_{t+1}, h_{s,t+1}, h_{u,t+1}, s_{s,t}, s_{u,t}, p_{s,t}, p_{u,t}, q_{s,t}, q_{u,t}, M_{s,t}, \\ & M_{u,t}, v_{s,t}, v_{u,t}, u_{s,t}, u_{u,t}, c_t, y_t, I_t, r_t, w_{s,t}, w_{u,t}, \theta_{h,t}\theta_{u,t}, z_t, \breve{z}_t, \tilde{z}_t\}\end{aligned}$$

which is determined by the household's and the firm's Euler equations as well as the respective resource constraints.

[12] A similar expression is obtained by Greiner et al. (2004).
[13] Cf. Langot (1995): 297.
[14] Cf. Pissarides (2000): 7.

The households maximization problem given by equations (9)-(13) lead to the following Euler equations

$$\beta E_t\Big\{\frac{U_c(c_{t+1})}{U_c(c_t)}(1+r_{t+1}-\delta)\Big\} \;=\; 1 \tag{24}$$

$$\begin{aligned}\beta E_t\Big\{-U_{h_s}(h_{s,t})+\lambda_{t+1}(w_{s,t+1}h_{s,t+1}+\kappa_s(s_{s,t+1}))+\\ \frac{\kappa_{h_s,s}(s_{s,t+1})}{p_{s,t+1}}\lambda_{t+1}(1-\psi_s-p_{h,t+1}s_{s,t+1})\Big\}-\frac{\kappa_{h_s,s}(s_{s,t})\lambda_t}{p_{s,t}} \;&=\; 0 \end{aligned}\tag{25}$$

$$\begin{aligned}\beta E_t\Big\{-U_{h_u}(h_{u,t})+\lambda_{t+1}(w_{u,t+1}h_{u,t+1}+\kappa_u(s_{u,t+1}))+\\ \frac{\kappa_{h_u,u}(s_{u,t+1})}{p_{u,t+1}}\lambda_{t+1}(1-\psi_u-p_{u,t+1}s_{u,t+1})\Big\}-\frac{\kappa_{h_u,u}(s_{u,t})\lambda_t}{p_{u,t}} \;&=\; 0, \end{aligned}\tag{26}$$

note that λ_t denotes the Lagrange multiplier of the household's optimization problem.

The firm's decision problem which is given by equations (14) - (16) lead to

$$f_k(\cdot)-r_t \;=\; 0 \tag{27}$$

$$\frac{\lambda_t a_s}{\lambda_{t+1}q_{s,t}}-\beta E_t\Big\{f_{h_s}(\cdot)-w_{s,t+1}+\frac{a_s}{q_{s,t+1}}(1-\psi_s)\Big\} \;=\; 0 \tag{28}$$

$$\frac{\lambda_t a_u}{\lambda_{t+1}q_{u,t}}-\beta E_t\Big\{f_{h_u}(\cdot)-w_{u,t+1}+\frac{a_u}{q_{u,t+1}}(1-\psi_u)\Big\} \;=\; 0. \tag{29}$$

The equilibrium is determined by the household's and the firm's Euler equations (24)-(29), as well as equations (3), (1), (2), (4), (5), (6), (7), (8), (11), (18), (19), (21) and the aggregate resource constraint which is given by

$$c_t+I_t+\kappa_s(s_{s,t})+\kappa_u(s_{u,t})+a_s v_{s,t}+a_u v_{u,t}=y_t. \tag{30}$$

In order to solve and to calibrate the model we have to specify the functional forms of the household's utility function, the functions of search costs, the production and the matching technologies

$$U(c_t,h_{s,t},h_{u,t}) \;=\; \frac{c_t^{1-\Phi}}{1-\Phi}-\frac{h_{s,t}^{1+\nu_s}}{1+\nu_s}-\frac{h_{u,t}^{1+\nu_u}}{1+\nu_u} \tag{31}$$

$$\kappa_s(s_{s,t}) \;=\; \bar{\kappa}_s s_{s,t}^{\mu} \tag{32}$$

$$\kappa_u(s_{u,t}) \;=\; \bar{\kappa}_u s_{u,t}^{\mu}. \tag{33}$$

The aggregate production function was already introduced by equation (18):

$$f(\cdot)=z_t\left(\alpha\Big(\gamma(z_t^{\varepsilon_s}h_{s,t})^{\sigma_1}+(1-\gamma)(z_t^{\varepsilon_u}h_{u,t})^{\sigma_1}\Big)^{\frac{\sigma_2}{\sigma_1}}+(1-\alpha)k_t^{\sigma_2}\right)^{\frac{1}{\sigma_2}} \tag{34}$$

in order to study the effects of skill augmenting technology shocks we rewrite eqn. (34) to

$$f(\cdot) = z_t \left(\alpha \left(\gamma (\breve{z}_t^{\varepsilon_s} h_{s,t})^{\sigma_1} + (1-\gamma)(\tilde{z}_t^{\varepsilon_u} h_{u,t})_1^{\sigma} \right)^{\frac{\sigma_2}{\sigma_1}} + (1-\alpha) k_t^{\sigma_2} \right)^{\frac{1}{\sigma_2}} \tag{35}$$

where we assume that the two skill-augmenting technology shocks, $\breve{z}_t, \tilde{z}_t$ follow uncorrelated stationary stochastic processes.

The matching technologies are specified analogue to Merz (1995) or Pierrard and Sneessens (2003)

$$M_{s,t} = v_{s,t}^{\rho_1} (s_{s,t} \cdot u_{s,t})^{(1-\rho_1)} \tag{36}$$

$$M_{u,t} = v_{u,t}^{\rho_2} (s_{u,t} \cdot u_{u,t})^{(1-\rho_2)}, \tag{37}$$

with $\rho_1, \rho_2 \in [0, 1]$.

4 Dismissal Protection and Minimum Wages

4.1 Model Extensions

As mentioned already in the introduction, the importance of wage stickiness and employment fluctuations is described in recent studies by Hall (2003, 2005b,a) or Shimer (2004). However, the cited studies concentrate almost on homogeneous labor, only. Furthermore, wage rigidities are modeled with respect to the contract length. However, as shown by table 1 continental European countries exhibit a rather rigid wage structure in comparison to anglo-saxon countries. By following the approaches of Pierrard and Sneessens (2003, 2004) a wage indexation scheme is introduced into the model. That means, wages for low skilled workers are set as a constant fraction of the high skilled workers wage. This pattern displays a rather stylized fact of central European labor markets where a rather constant wage spread is observed on the aggregate level.

As mentioned above, the analysis of minimum wages is based on the model outlined in section 3.1 in which the wage equation (eqn. 21) for low skilled workers is replaced by the following condition:

$$w_u = \varrho w_s, \tag{38}$$

i.e. the wages paid to low skilled workers are determined as a given fraction, $\varrho \in [0, 1]$ of wages bargained by skilled workers. Concerning the wages of low skilled workers we assume $\varrho = 0.4$, i.e. low skilled workers earn 40% of the wage of skilled workers. This measure coincides with the actual German unemployment insurance payments as reported in table 3.

The introduction of employment protection mechanisms, however, requires a revision of the model framework that is outlined in section 3.1. Based on Bentolila and Bertola (1990) Hopenhayn and Rogerson (1993), Saint-Paul (1996), Kohns (2000, 2002) and Delacroix (2003) we extend the model by introducing firing costs and a simple government rule of unemployment assistance payments, where the structure of unemployment assistance refers to Burda and Weder (2002).

In general, firing costs can be classified into severance payments and firing taxes. Severance payments can be seen as a transfer from the firms to the workers and depends on the wage proportionally. Because severance payments are be determined in a efficient contract or bargaining process, they influence equilibrium wages but not equilibrium unemployment.[15] Therefore, by following Delacroix (2003) the subsequent analysis concentrates on firing taxes, only.

In principle, when firms attempt to close a job, they have to pay an amount of b per closed job to an agency which distributes the total amount between unemployed workers of both types. This leads on the one hand to a reduced job creation of low skilled workers, because of the lower productivity and, on the other hand, to an increased reservation wage which hinders job search activities.

A Revision of the Household's and the Firm's Problem

As in section 3.1, we assume a representative household with a large number of inhabitants which are normalized to one.[16] The household chooses investment in physical capital, I_t, and the search intensities, $s_{i,t}, i = s, su, u$ of the respective skill group in order to maximize the present discounted value of their life-time utility. Households receive income from lending capital to firms at the interest rate r_t and from having a fraction of both types of its members $n_{i,t}$ work at the respective wage rates $w_{i,t}$. The households maximization problem reads as follows:

$$U_t = \max_{c_t, s_{i,t}, I_t} \sum_{t=0}^{\infty} \beta^t U(c_t, h_{s,t}, h_{u,t}) \tag{39}$$

[15] Cf. Delacroix (2003): 651.

[16] Please note, that a detailed solution of the model can be obtained from the author upon request.

subject to

$$\begin{aligned} c_t + I_t + \sum_i \kappa_i(s_{i,t})(1-n_{i,t}) &= \sum_{i=s,u} w_{i,t}h_{i,t} + \sum_{i=s,u} \tau_i^h(1-h_{i,t}) + r_t k_t & (40)\\ k_{t+1} &= (1-\delta)k_t + I_t & (41)\\ h_{s,t+1} &= (1-\psi_s)n_{s,t} + p_{s,t}s_{s,t}(1-h_{s,t}) & (42)\\ h_{u,t+1} &= (1-\psi_u)n_{u,t}+, & (43)\end{aligned}$$

where the expression $\tau_i(1-n_{i,t})$ denotes the benefits obtained from an unemployed type-i worker. From equations (39) - (43), the Lagrange function follows as

$$\begin{aligned} \max_{c_t,s_{i,t},k_{t+1},h_{i,t+1}} \mathcal{L}^{\mathcal{H}} &= E_t\Big\{\sum_{t=0}^{\infty}\beta^t\Big[U(c_t,h_{s,t},h_{u,t})\\ &+\lambda_t\Big(\sum_{i=s,u} w_{i,t}h_{i,t} + \sum_{i=s,u}\tau_i^h(1-h_{i,t}) + r_t k_t\\ &-c_t - I_t - \sum_i \kappa_i(s_{i,t})(1-n_{i,t})\Big) & (44)\\ &+\xi_{1,t}\big(h_{s,t+1} - (1-\psi_s)h_{s,t} - p_{s,t}s_{s,t}(1-h_{s,t})\big)\\ &+\xi_{2,t}\big(h_{u,t+1} - (1-\psi_u)h_{u,t} - p_{u,t}s_{u,t}(1-h_{u,t})\big)\Big]\Big\},\end{aligned}$$

The firm's problem, which is described already by equations (14) - (**??**) is modified as follows. The firm's profits are defined as

$$\Pi = f(\cdot) - \sum_i w_{i,t}h_{i,t} - r_t k_t - \sum_i \tau_i^f\psi_i h_{i,t} - \sum_i a_i v_{i,t}, \tag{45}$$

where $\sum_{i=s,u}\tau_i^f\psi_i h_{i,t}$ denote the sum of firing costs the firm is faced with when closing a job. As in section 3.1, the firm has to solve the following optimization problem

$$\max_{k_t,v_t,h_{i,t+1}} E_t\sum_{t=0}^{\infty}\beta^t\lambda_t\Pi_t, \tag{46}$$

subject to

$$\begin{aligned} n_{h,t+1} &= (1-\psi_h)n_{h,t} + q_{h,t}v_{h,t} & (47)\\ n_{u,t+1} &= (1-\psi_u)n_{u,t} + q_{u,t}v_{u,t}). & (48)\end{aligned}$$

Furthermore, it is assume that the total amount of the firing tax is equal to the amount of unemployment benefits, i.e. we assume a simple budget equation for the social security system:

$$\sum_{i=s,u}\tau^f\psi_i n_{i,t} = \sum_{i=s,u}\tau_i^h(1-n_{i,t}). \tag{49}$$

Wages are set according to a Nash bargaining rule. As in section 3.1 (see eqn. (21)), the bargained wage of a type-i worker is given by

$$w_{i,t} = \phi_i \Big[f_{h_i}(\cdot) + \sum_i a_i \theta_{i,t} - \tau_i^f \psi_i \Big] + (1 - \phi_i) \Big[\frac{u_{n_{i,t}}(\cdot)}{\lambda_t} - \kappa_i(s_{i,t}) + \tau_i^h \Big]. \tag{50}$$

4.2 Calibration

The calibration is chosen in accordance with the literature. The parameters of the utility function as well as search and advertising costs are taken from Merz (1995). One should note that it is assumed that firms have higher advertising costs if they look for high skilled workers and that low skilled workers have higher search costs than workers of the other skill group.

The levels of employment as well as the unemployment rates of the different skill groups, $\tilde{u}_i$, are chosen according to the empirical evidence as reported by table 1, i.e. total unemployment of the respective skill group follows as: $u_i = h_i \cdot \tilde{u}_i$. The elasticity of substitution between both types of labor services, σ_1, is chosen analogue to Heckman et al. (1998) who estimated an elasticity of 1.4, furthermore we follow their empirical results of a elasticity of substitution between capital and labor which is close to 1. The external effects of new technologies are specified in line with the results of Greiner et al. (2004). The values of the worker's bargaining power ϕ_i are chosen in a way that both firms and work share the surplus of a productive job equally which coincides, in general, with the results of a centralized wage bargaining which is often found in continental European countries. The parameters of the matching technologies as well as the search costs are chosen in accordance to Merz (1995) and Pierrard and Sneessens (2003), in general we assume that a skilled worker has lower search costs than an low skilled worker and for the firm we assume the opposite case, i.e. it is more expensive to hire a worker with a university degree than a worker without such a degree. Although the quarterly job destruction rate for the German manufacturing sector is reported between 3-4%, lower job destruction rates are chosen which are in accordance to German Panel Data estimates as well as the findings of Ridder and van den Berg (2003). There, aggregate job destruction rates are reported between 1-2%.[17] The destruction rates used for the calibration are chosen in accordance to the latter observation. Furthermore, we assume, for simplicity, that the productivity shocks follow the same autoregressive process.

[17]The measures for the manufacturing sector are based on job flow data taken from the Bundesagentur für Arbeit (WZ93/BA). Many thanks to Alfred Garloff for his suggestions concerning German job destruction rates.

Table 4: Parameter Settings

$\bar{h}_s$	$\bar{h}_u$	$\bar{\bar{u}}_s$	$\bar{\bar{u}}_h$	$\bar{z}, \bar{\tilde{z}}, \bar{\check{z}}$	α	β
0.25	$1 - \bar{N}_h$	0.05	0.10	1	0.64	0.99
δ	$\bar{R}$	Φ	γ	μ	ν_s, ν_u	$\bar{\kappa}_h$
0.025	$1/\beta$	0.5	0.5	1.0	0.8	0.025
$\bar{\kappa}_u$	ψ_s	ψ_u	$\sigma_1(\sigma_2)$	ρ_1	ρ_2	a_h
$2 \times \kappa_h$	0.01	0.02	0.3 (0.1)	0.7	0.7	$2 \times a_u$
a_u	ϕ_h	ϕ_u	ε_h	ε_u	$\omega_z, \omega_{\tilde{z}}, \omega_{\check{z}}$	$\epsilon_z, \epsilon_{\tilde{z}}, \epsilon_{\check{z}}$
0.025	0.5	0.5	1.5	1.0	0.95	0.007

Unfortunately, during the simulations it turned out that the assumed job creation and job destruction rates lead to situations where the model solution exhibited imaginary eigenvalues which lead to overshooting and cyclical impulse response functions. By assuming higher job destruction rates, i.e. $\psi_s = 0.01$, $\psi_u = 0.04$ we could avoid this problem.[18]

Because of the non-availability of proper data on firing costs, particular firing taxes, the following calibration of firing costs is assumed, where the firing costs are determined by the worker's wage

Table 5: Calibration of Firing Costs

h_s	$\tau_s^f = \frac{1}{2} \times w_s$
h_u	$\tau_u^f = \frac{1}{2} \times w_u$

In contrast to a severance payment which is, in general bargained between the worker and the firm, the firing cost assumed in this model can be seen as a tax. As mentioned above, the total sum of firing taxes are distributed as a lump-sum transfer to the workers. For simplicity, we assume, that the amount of transfer payments is distributed equally across unemployed workers, i.e.

$$\tau_s^h(1 - h_{s,t}) = 0.5 \times \sum_{i=s,u} \tau_i^f \psi_i h_{i,t} \quad \text{and} \quad \tau_u^h(1 - h_{u,t}) = 0.5 \times \sum_{i=s,u} \tau_i^f \psi_i h_{i,t}. \tag{51}$$

For the subsequent analysis the steady state of the deterministic part of the models are computed numerically by a Newton-Raphson method provided by DYNARE[19].

[18] The weighted average of the calibrated job destruction rate is 0.034, a about twice as high as reported for the U.S. and three times higher as reported for Germany (cf. Ridder and van den Berg (2003)).

[19] Dynare is a pre-processor and a collection of MATLAB or SCILAB routines which solve non–linear models with forward looking variables. See `http://www.cepremap.cnrs.fr/dynare/`. See Juillard (1996) for details.

The obtained impulse response functions rely on a first order approximation of the stochastic model around its steady state.

4.3 Discussion

In the center of the discussion of the model's outcomes are the employment effects of skill-biased technology shocks. Without neglecting effects of neutral or low skill biased shocks the first one accounts significantly for the rise of unemployment in Germany during the 1990s (see, for example, Puhani (2005)). Figure 4 below shows the responses of employment of low skilled workers after an unanticipated increase in skill-biased technology. Under the assumption of flexible wage setting (dotted line) and firing costs (line with squares) one finds, at first, an increase in employment for about 3 years. Since then low skilled employment turns negative, i.e. unemployment increases. Secondly, in accordance with Hopenhayn and Rogerson (1993), firing costs have a slightly positive impact on the employment status in an environment with flexible wage setting mechanisms[20], because the response of employment is slightly higher and the persistency of this shock exceeds the one of the model with flexible wage setting for one quarter.

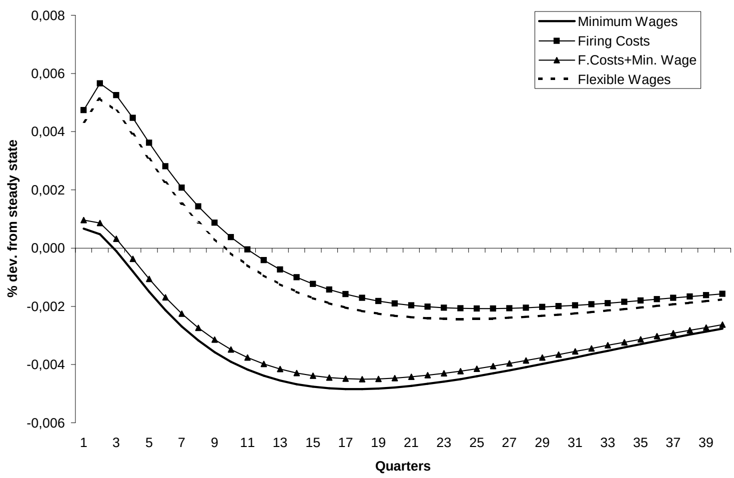

Figure 4: Employment of low skilled workers

However, the obtained responses change significantly whether minimum wages are considered (solid line, line with triangles). Then, the positive impact of an increase in technology persists for three quarters only. Since then employment of

[20]Please note, that the impulse response functions of the model with flexible wages refer to the model framework outlined in section 3.1. Furthermore, as shown by Rubart (2006) the delayed response of employment after technology shocks is also found in the time series data for the U.S. and Germany.

this skill group falls below its steady state level for the rest of the considered time period of 10 years.

Concerning the effects on relative employment, i.e. the ratio of skilled and unskilled workers, a persistent positive response of a skill-biased technology shock is observed (see figure 5 below). By comparing the effects of the different regimes of labor market institutions, regimes with a rigid wage structure (solid line, line with triangles) lead to a higher increase of this variable than regimes with more flexible wage setting mechanisms (dotted line, line with squares). However, the wage setting regime does not influence the persistency of the technological advance on the relative employment pattern.

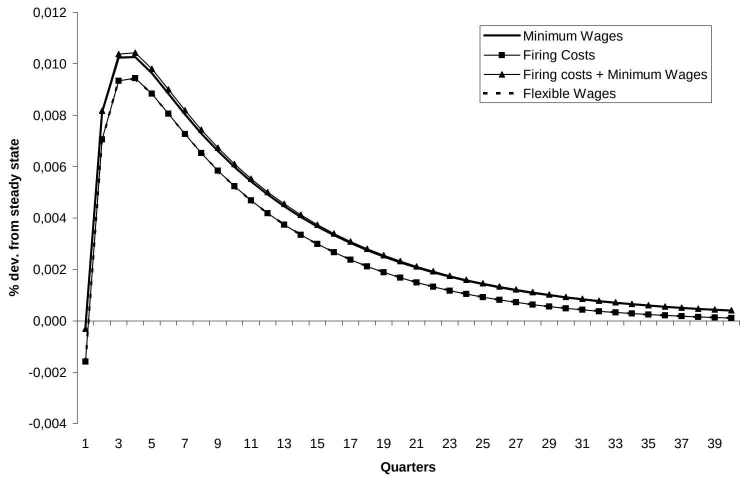

Figure 5: Relative Employment

Beside the effects of skill-biased technology shocks on the employment patter of low skilled workers, the question whether the responses are driven by too low job creation or too low incentives to search for new job positions remains. Figure 6 below shows the responses of the firm's vacancy creation. It is shown that once the economy is hit by a skill biased technology shock, the highest response vacancy creation is observed for economies with rather flexible wage setting mechanisms (dotted line, line with solid squares). The response of vacancy creation is lower when wage rigidities are assumed (solid line, line with triangles). However, more persistent responses of vacancy creation is obtained whether minimum wage rules or a flexible wage setting mechanism is assumed, there the impulse response functions return to the steady state after 10 years. When firing costs are considered, the vacancy creating activities return close to the respective steady state levels after five periods. This pattern is explained due to the fact that firing costs lower the option value of an open vacancy which prevents firms to open vacancies.

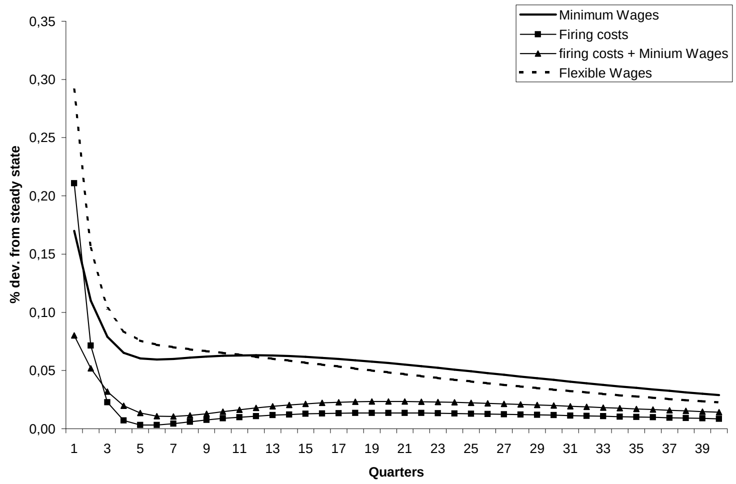

Figure 6: Vacancy creation after skill biased technology shocks

The persistent vacancy creation under minimum wages is explained by the fact that when low skilled workers become scarce in production their marginal product increases which also lead to a rise in vacancy creation.

The second determinant of employment in the recent model framework are the search activities of unemployed workers. Figure 7 below describes the responses of search activities of low skilled workers after a skill biased technology shock.

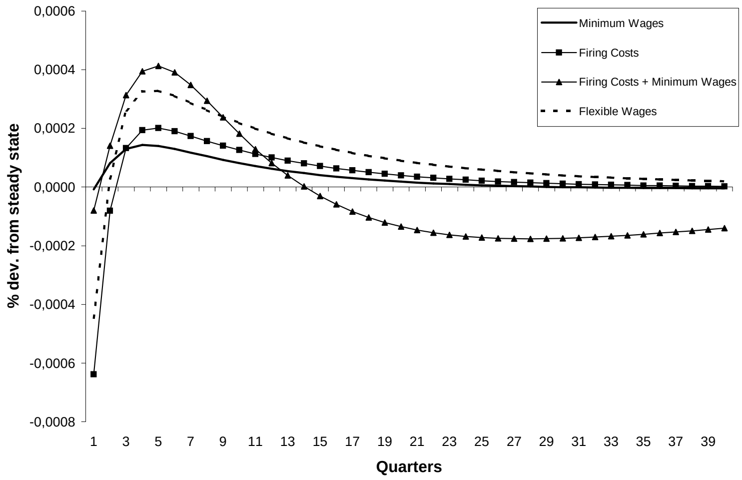

Figure 7: Search behavior of low skilled workers

Because of the loose of unemployment benefits when becoming employed as well as lower earnings under the minimum wage rule, search activities in a model with firing costs, unemployment benefits and minimum wages show the highest response, i.e. the highest incentive for unemployed workers to look for a new job. However the response falls below its steady state level after 4 years (line with triangles). Although this results seems counterintuitive, it is rational within the recent framework, because of the wage indexation low skilled workers earn a lower wage, on average, and therefore get lower unemployment benefits than under flexible wage setting rules. Therefore, the option value of becoming employed is higher than under regimes with flexible wage setting mechanisms (solid line) or firing costs and relatively high unemployment benefits (line with squares). The lowest response of search activities is found in a regime with minimum wages. There the expectation to earn a fixed fraction of a skilled workers wage, which also might be below the unemployed worker's reservation wage, does not lead to an increased search activity of this skill group. Therefore, although enough vacancies are created by firms, employment of low skilled workers remains rather low.

5 Concluding Remarks

Recently, there are many explanations of the sources of the rise of continental European, especially German, unemployment. In general, they can be subdivided into two branches of literature. One branch explains the observed pattern by too rigid labor market institutions, as for example Blanchard and Wolfers (2000) or Heckman (2003). The other branch refers to skill biased technology shocks that made low skilled workers redundant which therefore lead to the increased unemployment rates of this skill group (see e.g. Puhani (2005)).

The recent paper has shown that skill biased technology shocks alone do not lead per se to an increase in unemployment of low skilled workers. In addition, the existence of inflexible wage setting mechanisms and employment protection legislation in combination with skill biased technology shocks explains the observed pattern of continental European unemployment. Furthermore, due to the persistent decrease of low skilled worker's employment status in a regime with rather inflexible wage setting mechanisms a possible explanation of the observed hysteresis phenomena is given.

Against the background of the numerical examination one enabled to evaluate the arrangements discussed by German policy-makers in order to decrease unemployment, the introduction of combined and minimum wages as well as the reduction of dismissal protection mechanisms. While the latter policy does not affect the equilibrium outcome of the low skilled employment (cf. figure 4), the introduction of minimum wages deteriorates the employment pattern of this skill group. Therefore, policy measures that lead to a more rigid wage structure should be avoided, otherwise the triggered structural change induced by increasing globalization will lead to higher and persistent unemployment rates of low skilled workers.

Although, the model's capability to account for empirical facts can be improved, important insights on the interplay between asymmetric, especially skill biased, technology shocks and labor market institutions could be derived. The improvement of the model to account for business cycle facts is left for future research.

References

Acemoglu, D. (2002). Technical Change, Inequality and the Labor Market. *Journal of Economic Literature 40*, 7–72.

Autor, D. H., L. F. Katz, and A. B. Krueger (1998). Computing Inequality: Have Computers Changed the Labor Market. *The Quarterly Journal of Economics 113*(4), 1169–1213.

Bentolila, S. and G. Bertola (1990). Firing Costs and Labour Demand: How Bad is Eurosclerosis. *Review of Economic Studies 57*, 381–402.

Blanchard, O. J. and F. Giavazzi (2003). Macroeconomic Effects of Regulation and Deregulation in Goods and Labor Markets. *Quarterly Journal of Economics 118*(3), 879–907.

Blanchard, O. J. and J. Wolfers (2000). The Role of Shocks and Institutions in the Rise of European Unemployment: The Aggregate Evidence. *The Economic Journal 110*(1), C1–C33.

Blau, F. D. and L. M. Kahn (1999). Institutions and Laws in the Labor Market. In O. Ashenfelter and D. Card (Eds.), *Handbook of Labor Economics*, Volume 3A, Amsterdam, pp. 1399–1461. Elsevier Science B.V.

Blau, F. D. and L. M. Kahn (2001). Understanding International Differences in the Gender Pay Gap. NBER Working Paper No. 8200, Cambridge, Mass.

Burda, M. and M. Weder (2002). Complementarity of Labor Market Institutions, Equilibrium Unemployment and the Propagation of Business Cycles. *German Economic Review 3*(1), 1–24.

Cahuc, P. and A. Zylberberg (2004). *Labor Economics.* Cambridge, Mass.: The MIT Press.

Delacroix, A. (2003). Transitions into unemployment and the nature of firing costs. *Review of Economic Dynamics 6*, 651–671.

Gosling, A. and T. Lemieux (2001). Labour Market Reforms and Changes in Wage Inequality in the United Kingdom and the United States. NBER Working Paper, No. 8413, Cambridge, Mass., August.

Greiner, A., J. Rubart, and W. Semmler (2004). Economic growth, skill-biased technical change and wage inequality: A model and estimations for the U.S. and Europe. *Journal of Macroeconomics 26*(4), 597–621.

Hall, R. E. (2003). Modern Theory of Unemployment Fluctuations: Empirics and Policy Applications. *American Economic Review Papers and Proceedings 93*(2), 145–150.

Hall, R. E. (2005a). Employment Efficiency and Sticky Wages: Evidence from Flows in the Labor Market. *Review of Economics and Statistics 87*(3), 397–407.

Hall, R. E. (2005b). Employment Fluctuations with Equilibrium Wage Stickiness. *American Economic Review 95*(1), 50–65.

Heckman, J. J. (2003). Flexibility and job creation: Lessons for germany. In P. Aghion, R. Frydman, J. Stiglitz, and M. Woodford (Eds.), *Knowledge, Information, and Expectations in Modern Macroeconomics*, Princeton, New Jersey, pp. 357–393. Princeton University Press.

Heckman, J. J., L. Lochner, and C. Taber (1998). Explaining Rising Wage Inequality: Explorations with a Dynamic General Equilibrium Model of Labor Earnings with Heterogeneous Agents. *Review of Economic Dynamics 1*, 1–58.

Hopenhayn, H. and R. Rogerson (1993). Job Turnover and Policy Evaluation: A General Equilibrium Analysis. *Journal of Political Economy 101*(5), 915–938.

Juillard, M. (1996). DYNARE: A program for the resolution and simulation of dynamic models with forward variables through the use of a relaxation algorithm. CEPREMAP Working Paper, No. 9602, Paris.

Katz, L. F. and D. Autor (1999). Changes in the wage structure and earnings inequality. In O. Ashenfelter and D. Card (Eds.), *Handbook of Labor Economics*, Volume III, Amsterdam, pp. 1463–1555. Elsevier Science B.V.

Kohns, S. (2000). Different Skill Levels and Firing Costs in a Matching Model with Uncertainty – An Extension of Mortensen and Pissarides (1994). IZA Discussion Paper, No. 104, Bonn, January.

Kohns, S. (2002). *Qualifikationsunterschiede und die Dynamik der Arbeitsnachfrage*. Frankfurt / Main: Peter Lang.

Kydland, F. E. (1984). Labor-Force Heterogeneity and the Business Cycle. *Carnegie-Rochester Conference Series on Public Policy 21*, 173–208.

Langot, F. (1995). Unemployment and Business Cycle: A General Equilibrium Matching Model. In P.-Y. Henin (Ed.), *Advances in Business Cycle Research*, Berlin, Heidelberg, pp. 287–326. Springer.

Layard, R., R. Jackman, M. Manacorda, and B. Petrongolo (1999). European versus US Unemployment: Different Responses to Increased Demand for Skill. In R. Layard (Ed.), *Tackling Unemployment*, London, pp. 201–230. Macmillan Press Ltd.

Lee, D. (1999). Wage Inequality in the United States During the 1980s: Rising Dispersion or Falling Minimum Wage. *Quarterly Journal of Economics 114*, 977–1023.

Lindquist, M. J. (2004). Capital-skill complementarity and inequality over the business cycle. *Review of Economic Dynamics 7*(3), 519–540.

Merz, M. (1995). Search in the Labor Market and the Real Business Cycle. *Journal of Monetary Economics 36*, 269–300.

Nickell, S. (1997). Unemployment and Labor Market Rigidities: Europe versus North America. *Journal of Economic Perspectives 11*(3), 55–74.

Nickell, S. and B. Bell (1996). Changes in the Distribution of Wages and Unemployment in OECD Countries. *American Economic Review Papers and Proceedings 86*(2), 302–308.

Nickell, S., L. Nunziata, W. Ochel, and G. Quintini (2003). The Beveridge Curve, Unemployment, and Wages in the OECD from the 1960s to the 1990s. In P. Aghion, R. Frydman, J. Stiglitz, and M. Woodford (Eds.), *Knowledge, Information, and Expectations in Modern Macroeconomics*, Princeton, New Jersey, pp. 394–431. Princeton University Press.

OECD (1989). *Employment Outlook 1989*. Paris: OECD Publications.

OECD (1993). *Employment Outlook 1993*. Paris: OECD Publications.

OECD (1996). *Employment Outlook 1996*. Paris: OECD Publications.

OECD (2003). *Education at a Glance 2003*. Paris: OECD Publications.

OECD (2004). *Employment Outlook 2004*. Paris: OECD Publications.

OECD (2005). *Employment Outlook 2005*. Paris: OECD Publications.

Pierrard, O. and H. R. Sneessens (2003). Low-Skilled Unemployment, Biased Technological Shocks and Job Competition. IZA Discussion Paper, No. 784, Bonn, May.

Pierrard, O. and H. R. Sneessens (2004). Biased Technological Shocks, Wage Rigidities and Low-Skilled Unemployment. De Nederlandsche Bank, DNB Working Paper, No. 20, Amsterdam, December.

Pissarides, C. A. (2000). *Equilibrium Unemployment Theory* (2nd ed.). Cambridge, Mass.: The MIT Press.

Puhani, P. A. (2005). Transatlantic differences in labour markets. Darmstadt Discussion Papers in Economics, No.156, Darmstadt, November.

Ridder, G. and G. J. van den Berg (2003). Measuring Labor Market Frictions: A Cross-Country Comparison. *Journal of the European Economic Association 1*(1), 224–244.

Rowthorn, R. (1999). Unemployment, wage bargaining and capital-labour substitution. *Cambridge Journal of Economics 23*, 413–524.

Rubart, J. (2006). Heterogeneous Labor, Labor Market Frictions and Employment Effects of Technological Change. Theory and Empirical Evidence for the U.S. and Europe. Darmstadt Discussion Papers in Economics, No. 158, January.

Sachverständigenrat (2004). Erfolge im ausland – Herausforderungen im Inland. Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung: Jahresgutachten 2004/2005, Wiesbaden, November.

Saint-Paul, G. (1996). *Dual Labor Markets.* Cambridge, Mass.: The MIT Press.

Shimer, R. (2004). The Consequences of Rigid Wages in Search Models. NBER Working Paper, No. 10326, Cambridge, Mass., February.