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Firing Costs in a New Keynesian Model with Endogenous Separations*

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Abstract

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1. Introduction

Among macroeconomists it is common knowledge that small-scale New Keynesian models reveal significant shortcomings in explaining inflation and output persistence as well as labor market dynamics.[1] Recently, labor market imperfections have been identified to potentially cut these Gordian knots. Besides the importance of labor markets for inflation dynamics, labor market regulations might be causative for the different performances in Europe and the United States. While many European countries are noted for high and persistent unemployment, the Anglo-Saxon complement performed relatively well as shown by Hopenhayn and Rogerson (1993), Ljungqvist (2001) and L'Haridon and Malherbet (2006). This phenomenon is widely known as "Eurosclerosis"[2], i.e. the more strict employment protection legislation (EPL, for short) in Europe - generating higher labor turnover costs - and the coherently more rigid labor market, depress business cycle fluctuations.[3] Although there is discordance in the literature since the effect of EPL on aggregate unemployment is ambiguous and hence EPL shows manifold idiosyncrasy. We begin our analysis at the intersection of labor and product markets. For this purpose we derive the baseline Krause and Lubik (2007) model (KL, henceforth) and implement productivity dependent firing costs. The baseline KL model reveals a distortion of the firm's decision process since the entry site is afflicted with costs while adjustments along the exit site are costless. Therefore, job creation and destruction are positively correlated which is in contradiction to empirical estimates. We introduce productivity dependent firing costs into this framework to establish a self-contained decision process and to account for the stylized fact of cross-country differences in EPL as well as differences within a country.[4] By introducing firing costs, we face the bonding critique, which pays tribute to the fact that the impact of firing costs crucially depends on the extent to which the additional costs can be transferred to the worker due to wage adjustments, as shown by Lazear (1998,1990) and Nickell (1997). To avoid this problem we follow the "standard view of firing costs" in the sense of Bertola and

[1] For the lack of internal propagation, i.e. the fact that the staggered price mechanism can not generate persistent real effects of monetary shocks, see Romer (1993), Chari et al. (2000) and Huang and Liu (2002). Shimer (2003) and Hall (2005) discuss potential failures along the labor market dimension in a partial equilibrium model.

[2] See e.g. Giersch (1985), Bentolila and Bertola (1990) and Chen et al. (2002).

[3] See e.g. Addison and Teixeira (2003) or Veracierto (2008).

[4] Dolado et al. (2005, 2007) discuss the differences of EPL within a country.

Rogerson (1997), i.e. we consider firing costs as a tax on job destruction, since this component is non-Coasean.
We show that the introduction of firing costs slightly increases the performance of the model along the labor market dimension, while the main implication - the interrelation between the size of the firing costs and the Beveridge curve - can not be verified in a stylized cross-country empirical analysis. The paper proceeds as follows. The next section has a closer look on the previous contributions to the literature and empirical evidence already initiated in this section. Section 2 derives the model and introduces firing costs, while section 3 closes and calibrates the model. Section 4 discusses the dynamics and the results of the model, section 5 provides a robustness check of the results to alternative calibrations and section 6 scrutinizes the effect of EPL on the Beveridge curve relation. In section 7 we will finally draw the conclusion.

2. A New Keynesian Model with Firing Costs

We now present a NK model with labor market frictions in the spirit of den Haan et al. (2000) and Krause and Lubik (2007). Households maximize their lifetime utility by choosing the optimal consumption path of a CES aggregate of differentiated products and real money holdings. Firms, acting on a monopolistically competitive market, maximize profits by setting prices and choosing optimal employment subject to Rotemberg (1982) price adjustment costs and labor turnover costs. Job creation is afflicted with hiring costs and job destruction is afflicted with productivity dependent firing costs. Separations are driven by job-specific productivity shocks affecting new and old jobs, drawn from a time-invariant distribution. These shocks generate a flow of workers into unemployment while the transition process from unemployment to employment is subject to search frictions, characterized by a matching function.

2.1. Consumer Preferences

We assume a discrete-time economy with an infinite living representative household who seeks to maximize its utility given by

$$U = E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\sigma} - 1}{1-\sigma} + \chi \log \left(\frac{M_t}{P_t} \right) \right]. \tag{1}$$

The degree of risk aversion is given by σ and χ is a positive scaling parameter. It is assumed that a household consists of a continuum of members, inelastically suppling one unit of labor and being represented by the unit interval.

In addition, household members insure each other against income fluctuations and have free and unlimited access to complete markets for state-contingent claims to avoid the problem of heterogeneity, i.e. we assume consumption pooling.[5] The household maximizes consumption and real money holding subject to the intertemporal budget constraint

$$C_t + \frac{M_t}{P_t} + \frac{B_t}{P_t} = \mathcal{W}_t + \frac{M_{t-1}}{P_t} + R_{t-1}\frac{B_{t-1}}{P_t} + bu_t + \Pi_t + T_t, \tag{2}$$

where b is the value of home production, such that bu_t accordingly is the income of unemployed household members. $\mathcal{W}_t$ is labor income, B_t is Bond holding which pays a gross interest rate R_t. Π_t are aggregate profits and T_t are real lump sum transfers from the government. The CES function $C_t = \int_0^1 \left[C_{it}^{\frac{\epsilon-1}{\epsilon}} di \right]^{\frac{\epsilon}{\epsilon-1}}$ is the Dixit-Stiglitz aggregator of different types of goods. To derive the households demand function, we have to make use of this aggregator and the associated minimum expenditure price index $P_t = \int_0^1 \left[P_{it}^{\frac{\epsilon-1}{\epsilon}} di \right]^{\frac{\epsilon}{\epsilon-1}}$ to arrive at $C_{it} = \left(\frac{P_{it}}{P_t} \right)^{-\epsilon} C_t$. The household takes the set of stochastic processes $\{P_t, \Pi_t, R_t, T_t, \mathcal{W}_t\}_{t=0}^{\infty}$ as given, while choosing the values of $\{B_t, C_t, M_t\}_{t=0}^{\infty}$. This intertemporal utility maximization leads to the following first-order conditions

$$C_t^{-\sigma} = \beta R_t E_t \left[\frac{P_t}{P_{t+1}} C_{t+1}^{-\sigma} \right], \tag{3}$$

$$\frac{M_t}{P_t} = \chi \frac{R_t}{R_{t-1}} C_t^{\sigma}. \tag{4}$$

[5] See Merz (1995), Andolfatto (1996) and Poilly and Sahuc (2008).

The demand for real balances is given by the money-demand function (4). Equation (3) is a standard Euler equation for intertemporal consumption flows. In addition, we assume that for the Euler equation the No-Ponzi condition holds.

2.2. Firm's Problem

Monopolistically competitive firms maximize their profits by setting their price with respect to the household's demand function, the production function and the employment evolution equation. Each firm consists of a continuum of different jobs. While aggregate productivity A_t is common to all firms, the specific productivity a_{it} is idiosyncratic and every period it is drawn in advance of the production process from a time-invariant distribution with c.d.f. $F(a)$. The firm specific production function is the product of aggregate productivity, the number of jobs and the aggregate over individual jobs and can be written as

$$y_{it} = A_t n_{it} \int_{\tilde{a}_{it}}^{\infty} a \frac{f(a)}{1 - F(\tilde{a}_{it})} da \equiv A_t n_{it} H(\tilde{a}_{it}). \tag{5}$$

$\tilde{a}_{it}$ is an endogenously determined critical threshold and $H(\tilde{a}_{it})$ is the conditional expectation $E\left[a | a \geq \tilde{a}_{it}\right]$. If the specific productivity of a job is below this threshold, it is not profitable and separation takes place. This consideration results in an endogenous job destruction rate $\rho_{it}^{n} = F(\tilde{a}_{it})$.

Aside from endogenous job destruction we assume an exogenous separation rate ρ^{x}. This exogenous rate, being time stable, is neither affected by incentives nor cyclical factors. Although their is no consensus in the literature on the proper determination of the separation margin, following Fujita et al. (2007), Fujita and Ramey (2007, 2008) and Ramey (2008) empirical evidence seems to favor endogenous separations, since the standard deviation of the separation rate in the data is 5.8 %. Thus, the separation rate is not constant and hence not exogenous. Balleer (2009) shows that the separation rate increases after a positive technology shock and that technology shocks are not responsible for the high volatility in job finding rate and unemployment, i.e. the standard model generates the volatility of these variables conditional on technology shocks. Since conditional and unconditional moments significantly vary in their conclusions, one should be careful using unconditional moments to interpret the model's performance. Furthermore, endogenous separations can explain the negative correlation of the separation rate with productivity and the standard deviation of unemployment. The total number of separations at firm i is then given by

$$\rho_{it} = \rho(\tilde{a}_{it}) = \rho^x + (1 - \rho^x)F(\tilde{a}_{it}). \tag{6}$$

Since job creation is subject to hiring frictions, i.e. matching frictions, we formulate a Cobb-Douglas type matching function with constant returns to scale[6]

$$\Psi(u_t, v_t) = m u_t^{\mu} v_t^{1-\mu}. \tag{7}$$

Where u_t is the number of unemployed worker and v_t is the number of open vacancies, assumed to lie on the unit interval $v_t = \int_0^1 v_{it} di$. $\mu \in (0, 1)$ denotes the elasticity of the matching function with respect to unemployment while the match efficiency is governed by $m > 0$. The matching function gives the number of new employment relationships at the beginning of the next period. It is homogeneous of degree one, strictly increasing in each of its arguments, strictly concave and twice continuously differentiable. An additional assumption is that firms actively search for workers in the unemployment pool and all unemployed workers search passively for jobs and following Trigari (2004) that every unmatched worker is part of the unemployment pool, i.e. there is no out of labor force option.
The homogeneity assumption leads to the probability of a vacancy being filled in the next period $q(\theta_t) = m\theta_t^{-\mu}$ and an analogous approach for the probability that an unemployed worker finds a job leads to $p(\theta_t) = \theta_t q(\theta_t)$, where $\theta_t = v_t/u_t$ is labor market tightness. Connecting the results for job creation and job destruction enables us to determine the evolution of employment at firm i as

$$n_{it+1} = (1 - \rho_{it+1})(n_{it} + v_{it} q(\theta_t)). \tag{8}$$

The firm is able to control the evolution of employment by adjusting the number of posted vacancies and by setting the critical threshold, which then influences the separation rate. As we will illustrate later on the worker is paid according to his specific productivity and we follow this approach by establishing the theorem that firing costs also depend on the worker's specific productivity. Following the interpretation from den Haan et al. (2000), i.e. exogenous separations are

[6] In their empirical analysis Petrongolo and Pissarides (2001) find that the Cobb-Douglas function with constant returns to scale is the most appropriate specification.

worker-initiated and only endogenous separations are involuntarily, we associate firing costs only to endogenously separated workers.[7] Initially we define the firing costs function for a specific worker as a linear real-valued function given by[8] $g(a_{it}) = ka_{it}$, which consistently yields the total firing costs

$$G(a_{it}) = k\int_0^{\tilde{a}_{it}} a\frac{f(a)}{1-F(\tilde{a}_{it})}da, \tag{9}$$

weighting the aggregate over the individual productivity for those worker's whose productivity is below the critical threshold with a parameter $k > 0$. k determines the share of the productivity that is paid as a firing tax. It is quite intuitive that if we would allow $k = 0$ we would obtain the baseline model without firing costs. Furthermore, the function is twice continuously differentiable, strictly convex and strictly increasing in a. One should notice that we likewise could have introduced a firing cost function that features the individual real wage as an argument. However, our approach is w.l.o.g. since the wage also depends on the idiosyncratic productivity, i.e. this is only a scaling issue. We now want to focus on the firms maximization problem. The firm maximizes the present value of real profits given by

$$\Pi_{i0} = E_0\sum_{t=0}^{\infty}\beta^t\frac{\lambda_t}{\lambda_0}\left[\frac{P_{it}}{P_t}y_{it} - \mathcal{W}_{it} - cv_{it} - G(a_{it}) - \frac{\psi}{2}\left(\frac{P_{it}}{P_{it-1}} - \pi\right)^2 Y_t\right]. \tag{10}$$

Where the first term in parenthesis is real revenue, the second term is the wage bill, which is given by the aggregate of individual wages

$$\mathcal{W}_{it} = n_{it}\int_{\tilde{a}_{it}}^{\infty} w_t(a)\frac{f(a)}{1-F(\tilde{a}_{it})}da. \tag{11}$$

This follows from the fact that the wage is not identical for all workers, instead it depends on the idiosyncratic productivity. The third term reflects the total costs of posting a vacancy, with $c > 0$ giving real costs per vacancy. The next term

[7] Since all separations take place simultaneously an identification problem arises due to moral hazard. The firm is not able to identify whether the endogenously separated worker would have quitted himself and hence has to pay firing costs. Therefore, this assumption is for the sake of completeness.

[8] Abowd and Kramarz (2003) and Kramarz and Michaud (2004) show in their empirical work that the estimated function for severance payments is roughly linear.

gives the total firing costs and the last term formalizes staggered price setting by a quadratic price adjustment term which follows mainly Rotemberg (1982) in his approach, in which the adjustment costs are proportional to the price change. The degree of the price adjustment costs is measured by the parameter $\psi \geq 0$. Using the first-order conditions of the firm's maximization problem gives the job creation condition

$$\frac{c}{q(\theta_t)} = E_t \beta_{t+1}(1-\rho_{t+1}) \left[\varphi_{t+1} A_{t+1} H(\tilde{a}_{t+1}) - \frac{\partial \mathcal{W}_{t+1}}{\partial n_{t+1}} + \frac{c}{q(\theta_{t+1})} \right]. \tag{12}$$

This condition reflects the hiring decision as a trade-off between the costs of a vacancy and the expected return. Where $1/q(\theta_t)$ is the duration of the relationship between firm and worker. Along our considerations we derive the job destruction condition, which equalizes the costs of firing workers with the resulting benefit, given by

$$\varphi_t A_t \tilde{a}_t + \frac{c}{q(\theta_t)} - w_t(\tilde{a}_t) + \frac{k}{n_t} [1 - H(\tilde{a}_t) + \tilde{a}_t] = 0. \tag{13}$$

A key distinctiveness of New Keynesian models is their capability to elucidate the reciprocity of output and inflation. In these models inflation dynamics are defined by the New Keynesian Phillips curve (NKPC, for short)

$$\hat{\pi}_t = \beta E_t \hat{\pi}_{t+1} + \kappa \hat{\varphi}_t, \tag{14}$$

where $\kappa = (\epsilon - 1)/\psi$ depends on the degree of price adjustment costs and the elasticity of substitution and the marginal costs φ_t are given by

$$\varphi_t = \frac{\partial \mathcal{W}_t / \partial n_t}{A_t H(\tilde{a}_t)} + \frac{\xi_t - c/q(\theta_t)}{A_t H(\tilde{a}_t)}.$$

Subsequently, we will shed light on the wage setting process to derive an expression for the individual real wage which will allow us to study the firm's separation decision more precisely and further determine the critical threshold.

2.3. Wage Setting

Following Trigari (2004) a matched firm-worker pair has an unambiguously higher expected return than an unmatched pair. This is a consequence from the timeconsuming and expensive search and matching process. If a firm and a worker have matched, the job shares an economic rent which is splitted in individual Nash bargaining by maximizing the Nash product

$$w = argmax\Big\{(W_t - U_t)^{\eta}(J_t - V_t)^{1-\eta}\Big\}. \tag{15}$$

The first term is the worker's surplus, the latter term is the firm's surplus and $0 \leq \eta \leq 1$ is the exogenously determined, constant relative bargaining power. U_t and V_t are the worker's and the firm's threat points, respectively.[9] J_t is the asset value of a filled job for the firm and for the worker W_t is the asset value of being employed and accordingly U_t is the asset value of being unemployed.
It has to be strongly emphasized that we introduce firing costs and consistently respect the bonding critique, i.e. we treat the firing costs as a wasteful tax paid outside the firm-worker pair. We therefore isolate the implications of firing costs from counteracting wage effects. Coherently, we neither include the firing costs in the asset value function for the firm J_t nor in the bargaining problem.[10]
Consistently, the individual real wage satisfies the optimality condition

$$W_t(a_t) - U_t = \frac{\eta}{1-\eta} J_t(a_t). \tag{16}$$

To obtain an explicit expression for the individual real wage we have to determine the asset values and substitute them into the Nash bargaining solution (16).
For the firm the asset value of the job depends on the real revenue, the real wage and if the job is not destroyed, the discounted future value. Otherwise the job is destroyed and hence has zero value. In terms of a Bellman equation the asset value is given by

$$J_t(a_t) = \varphi_t A_t a_t - w_t(a_t) + E_t\beta_{t+1}\left((1-\rho_{t+1})\int_{\tilde{a}_{t+1}}^{\infty} J_{t+1}(a)\frac{f(a)}{1-F(\tilde{a}_{t+1})}da\right). \tag{17}$$

The asset value of being employed for the worker consists of the real wage, the discounted continuation value and in case of separation the value of being unem-

[9] Due to a free entry condition the equilibrium value of V_t is zero.
[10] Introducing firing costs into the asset value function of the firm J_t leaves our qualitative results unaffected.

ployed

$$W_t(a_t) = w_t(a_t) + E_t\beta_{t+1}(1-\rho_{t+1})\int_{\tilde{a}_{t+1}}^{\infty} W_{t+1}(a)\frac{f(a)}{1-F(\tilde{a}_{t+1})}da + E_t\beta_{t+1}\rho_{t+1}U_{t+1}. \quad (18)$$

Analogously, the asset value of a job seeker is given by

$$\begin{aligned} U_t = b + E_t\beta_{t+1}\theta_t q(\theta_t)(1-\rho_{t+1})\int_{\tilde{a}_{t+1}}^{\infty} W_{t+1}\frac{f(a)}{1-F(\tilde{a}_{t+1})}da \\ +E_t\beta_{t+1}(1-\theta_t q(\theta_t)(1-\rho_{t+1}))U_{t+1}. \end{aligned} \quad (19)$$

Unemployed worker receive the value of home production b, the discounted continuation value of being unemployed and if she is matched she receives the value of future employment. Inserting these value functions into the Nash bargaining solution yields the individual real wage

$$w_t(a_t) = \eta(\varphi_t A_t a_t + c\theta_t) + (1-\eta)b. \quad (20)$$

The wedge between the real wage and the reservation wage is increasing in every time-dependent component and the worker's bargaining power.
The firm will endogenously separate from a worker if and only if

$$J_t(a_t) < -ka_t, \quad (21)$$

i.e. if the worker's asset value is lower than the associated firing costs.[11]
The threshold is then defined by

$$\tilde{a}_t = \frac{1}{(1-\eta)\varphi_t A_t + k}\left[(1-\eta)b + \eta c\theta_t - \frac{c}{q(\theta_t)}\right]. \quad (22)$$

Yet we assumed that $k > 0$ such that the threshold is unambiguously lower than in the baseline KL model which is a quite intuitive result if one remembers that whenever the firm wants to adjust the evolution of employment it changes the critical threshold. Hence, if workers are afflicted with firing costs the firm will decrease the number of laid-off workers, since some workers are protected by these additional costs, making the retaining option the preferred one. Therefore this equation is able to verify the stylized fact of depressed job destruction flows and

[11] See Kugler and Saint-Paul (2000, 2004) and Lechthaler et al. (2008).

since the derivative is given by

$$\frac{\partial \tilde{a}_t}{\partial k} = -\frac{1}{((1-\eta)\varphi_t A_t + k)^2}\left[(1-\eta)b + \eta c\theta_t - \frac{c}{q(\theta_t)}\right], \tag{23}$$

and straightforward

$$\frac{\partial \tilde{a}_t}{\partial k} < 0, \tag{24}$$

we infer that the more strict EPL, the larger the effect on job destruction will be. This result gives proof for the relevance of EPL for cross-country differences. The overall effect of labor market tightness is ambiguous, due to the existence of two effects working in opposite directions. The direct effect of a ceteris paribus rise in labor market tightness increases the wage (consider eq. (20)) and therefore increases the separation probability. The indirect effect yields an increase in hiring costs $c/q(\theta_t)$ and coherently in an incentive to keep matches in order to avoid these high rehiring costs.

3. Model Solution

We solve the corresponding linear rational expectation model using the method shown by Sims (2002). Therefore we need to log-linearize the model around its steady state and write down the model in its particular state-space representation. In addition, we need to define the aggregate income given by

$$Y_t = \mathcal{W}_t + \Pi_t = A_t n_t \int_{\tilde{a}_{it}}^{\infty} a \frac{f(a)}{1 - F(\tilde{a}_{it})} da. \tag{25}$$

For the given stochastic processes $\{A_t, \phi_t\}_{t=0}^{\infty}$ a determined equilibrium is a sequence of allocations and prices $\{\tilde{a}_t, jcr_t, jdr_t, m_t, n_t, \varphi_t, \pi_t, R_t, \rho_t, \theta_t, u_t, v_t, w_t, y_t\}_{t=0}^{\infty}$, which for given initial conditions satisfies equations (3),(4),(6),(8),(12),(14),(20),(22), (25),(26),(27),(31),(33), the definition for labor market tightness and the law of motions for real money balances and employment.
As a last step, we calibrate the model and define the occurring shocks.

We assume a money growth rule that reflects monetary policy

$$\phi_t = \phi_{t-1}^{\rho_m} e^{\alpha_{m,t}}, \tag{26}$$

where $\phi_t = M_t/M_{t-1}$ is nominal money growth, $0 < \rho_m < 1$ is the autocorrelation of the shock and $\alpha_{m,t} \sim N(0, \sigma_m)$ is an i.i.d. error term following an univariate normal density distribution with standard deviation σ_m and $cov(\phi_{t-1}, \alpha_{m,t}) = 0 \; \forall \; t$. Analogously, the productivity shock is formulated as

$$A_t = \rho_A A_{t-1} + \alpha_{A,t}. \tag{27}$$

The i.i.d. error term is $\alpha_{A,t} \sim N(0, \sigma_A)$ with $cov(A_{t-1}, \alpha_{A,t}) = 0 \; \forall \; t$.
We calibrate the model on a quarterly basis for the United States and set parameter values according to stylized facts and the relevant literature.
Risk aversion σ is set to the value 2, the discount factor β is 0.99. The markup on real marginal costs is set to 10 % as in Trigari (2004), which leads ϵ to be 11. For the sake of simplicity we assume symmetric bargaining such that $\eta = 0.5$.[12] Such that the wage is linearly depending on labor market tightness. We set $\mu = 0.4$ according to the empirical estimation by Blanchard and Diamond (1989). Steady state inflation is set to one. Exogenous job destruction ρ^x is set to 0.068 according to den Haan et al. (2000). The steady state separation rate $\bar{\rho}$ is 0.10 according to den Haan et al. (2000). The endogenous separation rate in steady state can be computed to 0.034. The critical threshold can be computed by building the inverse function, i.e. $\tilde{a} = F^{-1}(\rho^n)$. The steady state unemployment rate is set to $\bar{u} = 0.12$ reflecting the shortcoming of the unemployment rate namely the non-conformity of effective searchers and unemployed workers.[13] Steady state firm matching rate is $\bar{q} = 0.7$ according to den Haan et al. (2000) and close to the 0.8541 set by Fujita and Ramey (2005). The value of ψ is set to 40 to balance estimations from Lubik and Schorfheide (2004) ($\psi = 20$) and the corresponding value of Calvo (1983) price staggering ($\psi = 105$). Since idiosyncratic productivity follows a lognormal c.d.f., the parameters μ_{LN} and σ_{LN} have to be calibrated. The distribution function is normalized, such that $\mu_{LN} = 0$. The parameter for the

[12] Asymmetric bargaining would lead to the problem of a violation of the IIA assumption. See Bayindir-Upmann and Gerber (2003) for the Kalai-Smorodinsky solution which avoids this problem.

[13] See Cole and Rogerson (1999) for further discussion.

variance σ_{LN} is 0.12, since Cooley and Quadrini (1999) find that job destruction is almost seven times as volatile as employment and the parameter should reflect the volatility of the job destruction rate. Finally, we calibrate the shock process. We follow Cooley and Quadrini (1999) to obtain $\sigma_m = 0.00623$ and $\rho_m = 0.49$ for the monetary shock. For the productivity shock the autocorrelation ρ_A is 0.95 like in Cooley and Quadrini (1999) and the standard deviation is 0.0049.
As a starting point, we set $k = 0.1$, i.e. 10 % of the worker's productivity is paid as a firing tax. This value reflects the low level of EPL observable in the U.S. labor market, while later on we will provide a robustness check of this and other pivotal parameters.

4. Discussion

In this section we discuss the implications of an expansionary monetary and a positive productivity shock in the model with firing costs.

4.1. Monetary Policy Shock

Consider a one percent increase in money growth. Households increase present consumption via the money demand equation (4) such that the firm increases output to match this additional demand which is evident from the left upper panel in Figure 4. In order to increase output, the firm has to increase employment and hence adjusts the critical threshold downwards. Therefore, the model reveals a separation driven employment adjustment mechanism as we can deduce from the left bottom panel in Figure 1. We conclude that the firm increases employment by protecting more jobs from being separated rather than by posting more vacancies. As a consequence separations drop and the decrease in unemployment is larger than the drop in vacancies, such that labor market tightness increases. This increase is on the one hand responsible for the rise of hiring costs (consider the job creation condition (12)), which reduces incentives to post vacancies, and on the other hand for the pressure on real marginal costs. As we can conclude from the NKPC, the increase in marginal costs directly raises inflation. The rise in marginal costs is primarily caused by the increase in labor market tightness affecting the hiring cost component and only secondarily a consequence of an increase in real wages which is reflected by the larger increase in real marginal

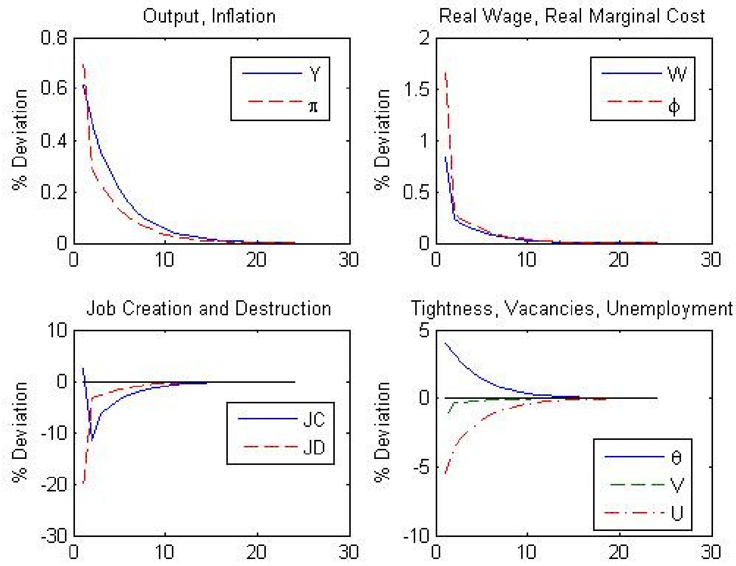

Figure 1: Monetary Shock: Fully Flexible Wage.

costs than in real wages. We therefore infer that the dynamics of the system towards the new steady state are mainly driven by job creation and destruction. In contrast to the baseline KL model, the introduction of firing costs changes the dynamics of the model. Since the reaction in the threshold is smaller, job destruction is damped, which leads to an increase of the wage bill compared to the baseline KL model (consider (11)). This directly increases the marginal costs although the hiring costs decrease in relation to the baseline model. This decrease follows from the fact that the reaction in unemployment is damped and hence labor market tightness reacts less strongly. This consistently implies that the drop in vacancies is reduced compared to the baseline model. The increase in marginal costs leads to a strong rise in inflation (consider (14)) and hence decreases the reaction of output (consider (3)). Turning to the second moments of the simulation presented in Figure 7 yields the insight that the results are manifold. We obtain improvement along the correlations given in Figure 7, but this improvement is relatively small, crucially depending on the calibration of the firing costs. As we will see later, unrealistic high values of the firing cost parameter create the well known Beveridge curve, i.e. the strong negative correlation of unemployment and vacancies. Furthermore, we still find a positive correlation between job creation and destruction, which is inconsistent with the data while the correlation between the job creation rate and employment is −0.5617. However, the improvement in the standard deviations is quite small, e.g. the standard deviations of inflation and labor market tightness are now closer to there empirical values. We admit that there is also a deterioration in some standard deviations, as for instance in the wage, being now more volatile as in the data. As in the baseline KL model the values for inflation and output persistence are in line with the data, but they are almost entirely created by the autocorrelation in the shock term, i.e. there is no evidence for endogenous persistence. Our results are therefore still consistent with the findings of Chari et al. (2000) and Huang and Liu (2002) such that there is still a lack of internal propagation.

4.2. Productivity Shock

We now turn to the discussion of the technology shock. Since productivity A_t increases, less labor input is needed and employment falls (consider (5)). Coherently, job destruction initially rises while job creation slightly decreases. This is also a consequence of sticky prices, since aggregate demand remains unchanged. The job creation condition implies that vacancies increase and so does labor market tightness. Real marginal costs drop due to the increase in productivity and the NKPC relation causes inflation to fall. This decrease in the price level leads households to increase present consumption via (3). The firm rises output by increasing job creation and mainly by significantly decreasing job destruction, simultaneously increasing employment. We likewise obtain the separation driven employment adjustment mechanism that we have detected before. As we have seen in the discussion of the monetary shock, firing costs lead to different dynamics of the system. The reaction in the threshold is smaller such that the increase in job destruction is smaller compared to the baseline model. This is due to the fact that separations are now afflicted with costs and hence are not as profitable as in the baseline model. Consistently, the fall and the consecutive increase in job creation is smaller compared to the baseline KL model. In addition, this spills over to the saddle path of vacancies leading to a more smoother adjustment towards the new steady state. This pattern is also visible in the dynamic behavior of unemployment and labor market tightness. Since unemployment on impact does not increase as strong as in the baseline model and vacancies change only slightly, the drop in labor market tightness is smaller. Furthermore, the decrease

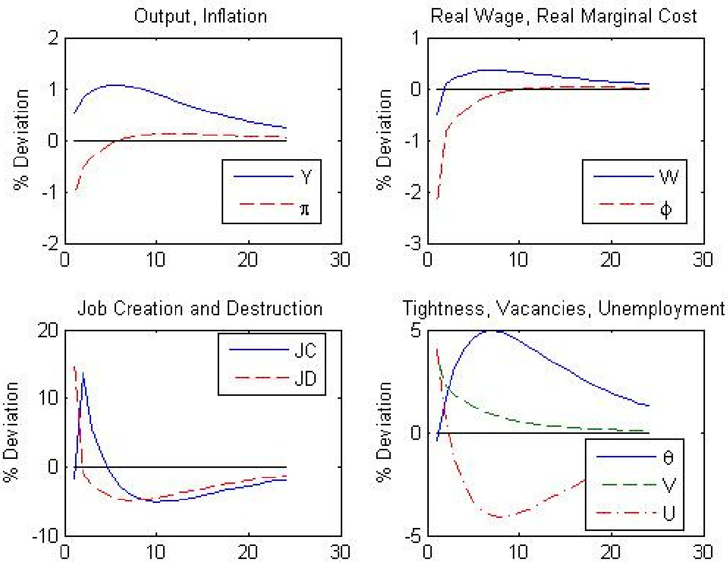

Figure 2: Productivity Shock: Fully Flexible Wage.

of unemployment over the cycle is smaller than in the baseline KL model. This is an intuitive implication of firing costs, depressing job flows over the cycle. As we can infer from the upper right panel in Figure 2, there is only a very small effect on output dynamics. This is due to the nature of the shock only indirectly affecting demand, i.e. through the price level. From Figure 2 upper left panel we can infer that the change in inflation dynamics is very small. The reason for this is the fact that while hiring costs increase - consider the increase of labor market tightness in relation to the baseline model - the real wage slightly decreases and hence real marginal costs virtually remain unaffected. In relation to the implications for business cycle statistics of the monetary shock, the productivity shock performs better. We obtain improvement along almost every dimension in standard deviations. Especially the standard deviation of the job creation and the destruction rate are significantly closer to their empirical counterparts. Furthermore, the correlation of unemployment and vacancies is weakly negative, such that the model tends to create a Beveridge curve. In addition, we still observe the positive correlation of job creation and destruction whereas the correlation between the job creation rate and employment is again negative (-0.6053). As we have seen before, the autocorrelation values of output and inflation are close to their empirical pendants but they are entirely created by the shock persistence,

such that there is still no endogenous persistence.
Up to the present we can conclude that search frictions and productivity dependent firing costs are not able to significantly improve the model's performance neither along the labor market dimension nor the inflation dynamics dimension. Particularly remarkable is the tendency of the model to create the Beveridge curve. However, the quest for additional sources of real rigidity remains to increase the inherent propagation mechanism.

5. Robustness Issues

Since our results crucially depend on the calibration of the model, we analyze the robustness to alternative calibrations. Decreasing the worker's bargaining strength η, to a sufficiently small value, changes the dynamics of the model significantly. The reason for this strong dependence is the fact that small values for the bargaining strength increase the value of an existent match. Consistently, incentives to separate from a worker decrease and hence job destruction falls. In line with this observations is the fact that the wage falls on impact and concordantly converges from below its initial value towards the steady state. However, this effect is not strong enough to break the positive relation between job creation and destruction. In contrast to the baseline KL model firing costs significantly attenuate the increase in correlation between job creation and destruction due to the additional affliction of the exit site with costs. The corresponding dynamics of this alternative calibration are not in line with empirical data and hence our results remain unaffected. The parameter for the exogenous separations ρ^x set closer to the steady state separation rate 0.1 is able to generate the Beveridge curve. As already mentioned, firing costs increase the model's ability to create the Beveridge curve, such that the correlation obtained in the baseline KL model with $\rho^x = 0.1$ of $corr(u,v) = -0.45$ is further improved to $corr(u,v) = -0.7567$. Furthermore, we obtain a negative correlation of job creation and destruction, i.e. $corr(jcr, jdr) = -0.0094$. We can conclude that this shortcoming of the baseline KL model is removed. It has to be emphasized that an increase in the exogenous separation rate on the one hand leads to an improvement along the labor market dimension while on the other hand the model completely fails along the inflation dynamics dimension. For instance, prohibitively high firing costs, i.e. a model

Flexible	corr(u,v)		corr(jcr,jdr)	
	M	R	M	R
k=0.1	0,9089	-0,1474	0,0728	0,3297
k=0.5	0,2291	-0,5577	-0,1111	0,0006
k=1	-0,2444	-0,7050	-0,1772	-0,0542
k=2	-0,5165	-0,8154	-0,2058	-0,0687
k=10	-0,9809	-0,8711	-0,3077	-0,0378

Figure 3: Alternative Calibrations for k.

with purely exogenous job destruction, creates standard deviations of output and inflation of 0.0059, 202.4432 respectively. Furthermore, we consider an alternative calibration of the match elasticity μ. A low match elasticity leads to a more persistent reaction of job creation and coherently to a sustained vacancy posting. This follows immediately since the lower match elasticity decreases the elasticity of the probability of filling a vacancy. This calibration is therefore able to generate the Beveridge curve, i.e. $corr(u,v) = -0.7172$, and account for the negative correlation of job creation and destruction, i.e. $corr(jcr, jdr) = -0.1837$. As before, firing costs lead to a stronger Beveridge curve relation. However, following Blanchard and Diamond (1989) empirical evidence finds a value of 0.4 for the match elasticity.

Finally, we consider alternative calibrations for the firing cost parameter k. Figure 3 presents our results clearly indicating that higher firing cost generate a Beveridge curve and break the positive correlation between job creation and destruction. To be explicit, this improvement of the model is due to the affliction of separations with costs, hence breaking the distortion of the firm's decision process and particularly leading to different dynamics of job destruction, labor market tightness and vacancies.

6. The Inexorable Beveridge Curve

In the precedent discussion of the robustness of our results we concluded that the Beveridge curve relation is improved by assuming higher firing costs. This implies that the stricter the EPL, the stronger the Beveridge curve relation. However, we need to compare this insight with empirical evidence. For this purpose, we consider a cross-country analysis of the Beveridge curve relation containing 15 OECD countries. We use quarterly data for unemployment and vacancies from 1970:Q1

Country	BC	EPL V1	EPL V2
Australia	-0,6912	1,1879	1,4690
Austria	-0,5812	1,9350	2,1539
Belgium	-0,5380	2,1760	2,5000
Czech Republic	-0,7148	1,9030	1,9390
Finland	-0,2692	2,0209	2,1219
Germany	-0,2398	2,2140	2,4700
Hungary	-0,4590	1,5229	1,7480
Japan	0,2555	1,8430	1,7860
Netherlands	-0,3998	2,1200	2,2660
Norway	-0,1841	2,5630	2,6150
Portugal	-0,4598	3,4580	3,4860
Spain	-0,1879	3,0539	3,0649
Sweden	-0,6175	2,2410	2,6179
Switzerland	-0,4301	1,1419	1,5970
United Kingdom	-0,3489	0,7450	1,1000

Figure 4: Beveridge Curve Relation and EPL Values.

to 2008:Q4 provided by the OECD. We generate artificial data for the vacancy rate by dividing the number of registered unfilled job vacancies through total civilian employment. In addition, we use a harmonized unemployment rate being the number of unemployed persons as a percentage of the civilian labor force with two exemptions. For Austria and Germany we use the registered unemployment rate by reason of superior data availability. With this two time series we are able to compute the order of correlation between unemployment and vacancies, i.e. the Beveridge curve relation. Our results are presented in Figure 4. Values for the strictness of EPL are taken from the OECD database and represent overall values for 2003. Furthermore, we distinguish between version 1 and version 2 of the EPL concept. Since numbers for collective dismissals are only available since the late 1990s, version 1 is an unweighted average of the summary measures for regular and temporary contracts only. As a final step, we generate the order of correlation between the Beveridge curve and the two EPL concepts. The corresponding figures are presented in Figure 5 and 6. Recall that the model's prediction is a negatively sloped regression line, with a higher value of EPL resulting in a more strict Beveridge curve relation. However, the empirical analysis yields a slightly positive regression line with slope 0.055 for EPL based on version 1, 0.022 for EPL based on version 2 respectively. The measure of correlation based on EPL version 1 is 0.1507, 0.055 based on EPL version 2 respectively. To be capable of giving a statement related to the performance of our regression we need a measure for the variability explained by the model. For this purpose, we compute the coefficient of determination being 0.025 and 0.022 for version 1, version 2 respec-

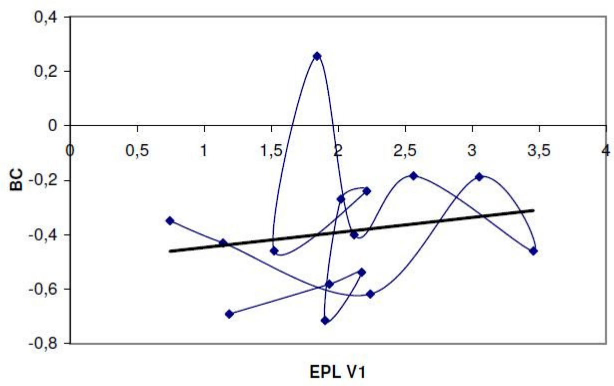

Figure 5: Correlation Beveridge Curve - EPL Version 1.

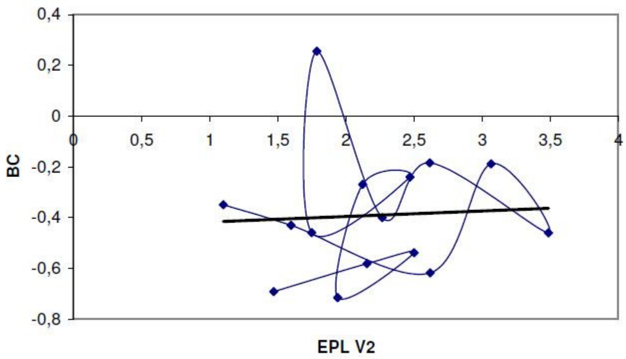

Figure 6: Correlation Beveridge Curve - EPL Version 2.

tively. Even if the positive outlier - Japan - is disregarded in the analysis, the coefficient of determination is not significantly improved, being around 0.08 for both EPL concepts. We conclude that the variability in the data is not explained by our regression such that there is no interrelation between the Beveridge curve relation and strictness of EPL. As an illustrative thought experiment consider Germany, a country known for its strict EPL (2.47) and the U.K., as an example of less strict EPL (1.1). The corresponding values for the Beveridge curve are -0.2398 for Germany and -0.3489 for the United Kingdom. The model would predict a stronger Beveridge curve for Germany as for the United Kingdom, while our empirical analysis clearly contradicts this conclusion.

Comparing the model's prediction with the empirical evidence yields the insight that the depicted interrelation between the strictness of EPL and the Beveridge curve can not be verified by the data.

7. Conclusion

The intention of this paper is to improve the performance of a New Keynesian model with endogenous separations along the labor market and inflation dynamics dimension as well as to identify the implications of firing costs in this context. To account for cross-country differences in EPL as well as differences within a country, we implement productivity dependent firing costs into the Krause and Lubik (2007) model by including the firing costs in the firm's decision problem and by strictly respecting the bonding critique. Our results are promising, since we are able to show that the model tends to generate the Beveridge curve, reduces the positive correlation of job creation and destruction and amplifies the volatility of key labor market variables. In addition, the model accounts for the cross-country differences in output volatility as shown by Samaniego (2008) and Veracierto (2008). The reason for this improvement along the labor market dimension is the implementation of firing costs, breaking the distorted decision problem and leading therefore to particularly different dynamics of job destruction, labor market tightness and vacancies. Our model mainly affects the exit site, while the entry site is only indirectly influenced. Therefore it is able to confirm the empirical findings from Messina and Vallanti (2006), i.e. firing costs have a stronger effect on job destruction as on job creation. However, the shortcoming of the KL model - the lack of internal propagation - also exists in the extended model. Furthermore, the positive correlation between job creation and destruction - although it is significantly reduced - is still present, caused by an excess sensitivity of job destruction. The privilege of the adjustment along the job destruction margin is only broken by high values of the firing cost parameter which is not in line with empirical evidence for the strictness of EPL for the U.S. labor market. However, this considerations to a certain extent give proof for the relevance of differences in EPL as an decisive criterion to explain cross-country differences in labor market performances. In this context we have in particular shown that the main prediction of the model, namely the interrelation between the strictness of the Beveridge curve relation and the strictness of EPL, can not be verified by the data. While it seems that EPL has no effect on the shape of the Beveridge curve it might be that changes in EPL cause shifts of the Beveridge curve. We leave further investigation of this issue to future research.

Mathematical Appendix

Matching

The probability that a vacancy is filled can be derived as follows

$$q(\theta_t) = \frac{\Psi(u_t, v_t)}{v_t} = \Psi(\frac{u_t}{v_t}, 1) = \frac{m u_t^{\mu} v_t^{1-\mu}}{v_t} = m u_t^{\mu} v_t^{-\mu} = m \left(\frac{u_t}{v_t}\right)^{\mu} = m\theta_t^{-\mu}. \quad (28)$$

An analogous approach for the probability that an unemployed worker finds a job leads to

$$\begin{aligned} p(\theta_t) &= \frac{\Psi(u_t, v_t)}{u_t} = \Psi(1, \frac{v_t}{u_t}) = \frac{m u_t^{\mu} v_t^{1-\mu}}{u_t} = m u_t^{\mu-1} v_t^{1-\mu} = m \frac{v_t^{1-\mu}}{u_t^{1-\mu}} \quad (29) \\ &= m \left(\frac{v_t}{u_t}\right) \left(\frac{v_t}{u_t}\right)^{-\mu} = m\theta_t \theta_t^{-\mu} = \theta_t q(\theta_t). \end{aligned}$$

Assuming that the matches going to a firm are proportionate to the ratio of its vacancies to total vacancies v_{it}/v_t, so that $v_{it} m_t / v_t = v_{it} q(\theta_t)$ is the inflow of new hires in $t+1$ into firm i. The job destruction rate consists of the gross job destruction given by

$$\rho_t n_{t-1} - \rho^x n_{t-1}. \quad (30)$$

We need to subtract the second term, because it reflects the exogenous job destruction and is therefore not relevant for the gross destruction of employment opportunities.
By dividing through n_{t-1} we arrive at the job destruction rate

$$jdr_t = \rho_t - \rho^x. \quad (31)$$

Gross job creation can be written as

$$(1 - \rho_t) v_{t-1} q(\theta_{t-1}) - \rho^x n_{t-1}. \quad (32)$$

Where the same consideration as above leads to the subtraction of the exogenous job destruction. Dividing by n_{t-1} leads to the job creation rate

$$jcr_t = \frac{(1-\rho_t)v_{t-1}q(\theta_{t-1})}{n_{t-1}} - \rho^x. \tag{33}$$

Tables

	U.S. Economy	Baseline		FC	
		M	R	M	R
Standard Deviations					
Output	1,6200	0,6507	1,7006	0,5822	1,5608
Inflation	1,1100	0,7358	0,3651	0,9059	0,3998
Real Wage	0,6900	0,6525	0,2980	0,9818	0,3653
Unemployment	6,9000	8,2507	4,2948	8,2238	4,0141
Vacancies	8,2700	2,2827	1,2800	1,6753	1,6024
Tightness	14,9600	6,0204	4,1700	6,7373	4,5500
JCR	2,5500	17,2708	7,6137	16,2571	6,6037
JDR	3,7300	23,0652	7,7242	23,2358	6,5710
Threshold	n.a.	12,4940	0,4184	12,5870	0,3559
RMC	n.a.	1,2747	0,6446	1,8939	0,7604
Correlations					
U,V	-0,9500	0.9688	0,2478	0.9089	-0,1474
JCR,JDR	-0,3600	0.1682	0,5205	0.0728	0,3297
Y, Inflation	0,3900	0.9745	-0,1079	0.9541	-0,1185
Autocorrelation					
Output	0,8700	0.9950	0,9950	0.9950	0.9950
Inflation	0,5600	0.5810	0,6005	0.4914	0.5459

Figure 7: Business Cycle Properties.

References

Abowd, John M. and Kramarz, Francis (2003): "The Costs of Hiring and Separations." *Labor Economics*, Vol. 10(5), pp. 499-530, October 2003.

Addison, John T. and Teixeira, Paulino (2003): "The Economics of Employment Protection." *Journal of Labor Research*, Vol. 24(1), pp. 85-129, January 2003.

Andolfatto, David (1996): "Business Cycles and Labor Market Search." *American Economic Review*, Vol. 86(1), pp. 112-132, March 1996.

Balleer, Almut (2009): "New Evidence, Old Puzzles: Technology Shocks and Labor Market Fluctuations." *Kiel Working Paper*, No. 1500, March 2009.

Bayindir-Upmann, Thorsten and Gerber, Anke (2003): "The Kalai-Smorodinsky Solution in Labor-Market Negotiations." *CESifo Working Paper*, No. 941, May 2003.

Bentolila, Samuel and Bertola, Guiseppe (1990): "Firing Costs and Labor Demand: How Bad is Eurosclerosis?" *Review of Economic Studies*, Vol. 57(3), pp. 381-402, July 1990.

Bertola, Guiseppe and Rogerson, Richard (1997): "Institutions and Labor Reallocation." *European Economic Review*, Vol. 41(6), pp. 1147-1171, June 1997.

Blanchard, Olivier J. and Diamond, Peter A. (1989): "The Beveridge Curve." *Brookings Papers on Economic Activity*, Vol. 20(1989-1), pp. 1-76, 1989.

Calvo, Guillermo A. (1983): "Staggered Prices in a Utility-Maximizing Framework." *Journal of Monetary Economics*, Vol. 12(3), pp. 383-398, 1983.

Chari, Varadarajan V., Kehoe, Patrick J. and McGrattan, Ellen R. (2000): "Sticky Price Models of the Business Cycle: Can the Contract Multiplier Solve the Persistence Problem?" *Econometrica*, Vol. 68(5), pp. 1151-1179, September 2000.

Chen, Yu-Fu, Snower, Dennis J. and Zoega, Gylfi (2002): "Firing Costs: Eurosclerosis or Eurosuccesses?" *CEPR Discussion Paper*, No. 3480, August 2002.

Cole, Harold L. and Rogerson, Richard (1999): "Can the Mortensen-Pissarides Model Match the Business Cycle Facts?" *International Economic Review*, Vol. 40(4), pp. 933-960, November 1999.

Cooley, Thomas F. and Quadrini, Vincenzo (1999): "A Neoclassical Model of the Phillips Curve Relation." *Journal of Monetary Economics*, Vol. 44(2), pp. 165-193, September 1999.

Dolado, Juan J., Jansen, Marcel and Jimeno, Juan F. (2005): "Dual Employment Protection Legislation: A Framework for Analysis." *IZA Discussion Paper*, No. 1564, April 2005.

Dolado, Juan J., Jansen, Marcel and Jimeno, Juan F. (2007): "A Positive Analysis of Targeted Employment Protection Legislation." *IZA Discussion Paper*, No. 2679, March 2007.

Fujita, Shigeru, Nekada, Christopher J. and Ramey, Garey (2007): "The Cyclicality of Worker Flows: New Evidence from the SIPP." *Federal Reserve*

Bank of Philadelphia Working Paper, No. 07-5, February 2007.

Fujita, Shigeru and Ramey, Garey (2005): "The Dynamic Beveridge Curve." *University of San Diego, Economics Working Paper Series 2005-2008*, August 2005.

Fujita, Shigeru and Ramey, Garey (2007): "Reassessing the Shimer Facts." *Federal Reserve Bank of Philadelphia Working Paper*, No. 07-2, January 2007.

Fujita, Shigeru and Ramey, Garey (2008): "The Cyclicality of Separation and Job Finding Rates." *Federal Reserve Bank of Philadelphia Working Paper*, No. 07-19, January 2008.

Giersch, Herbert (1985): "Eurosclerosis." *Kiel Discussion Papers*, No. 112, 1985.

Den Haan, Wouter J., Ramey, Garey and Watson, Joel (2000): "Job Destruction and the Propagation of Shocks." *American Economic Review*, Vol. 90(3), pp. 482-498, June 2000.

Hall, Robert E. (2005): "Employment Fluctuations with Equilibrium Wage Stickiness." *American Economic Review*, Vol. 95(1), pp. 50-65, March 2005.

Hopenhayn, Hugo A. and Rogerson, Richard (1993): "Job Turnover and Policy Evaluation: A General Equilibrium Approach." *Journal of Political Economy*, Vol. 101(5), pp. 915-938, October 1993.

Huang, Kevin X. D. and Liu, Zheng (2002): "Staggered Price-setting, Staggered Wage-setting, and Business Cycle Persistence." *Journal of Monetary Economics*, Vol. 49(2), pp. 405-433, March 2002.

Kramarz, Francis and Michaud, Marie-Laure (2004): "The Shape of Hiring and Firing Costs." *IZA Discussion Paper*, No. 1170, June 2004.

Krause, Michael U. and Lubik, Thomas A. (2007): "The (Ir)relevance of Real Wage Rigidity in the New Keynesian Model with Search Frictions." *Journal of Monetary Economics*, Vol. 54(3), pp. 706-727, January 2007.

Kugler, Adriana D. and Saint-Paul, Gilles (2000): "Hiring and Firing Costs, Adverse Selection and Long-term Unemployment." *IZA Discussion Paper*, No. 134, March 2000.

Kugler, Adriana D. and Saint-Paul, Gilles (2004): "How Do Firing Costs Affect Worker Flows in a World with Adverse Selection?" *Journal of Labor Economics*, Vol. 22(3), July 2004.

Lazear, Edward P. (1988): "Employment at Will, Job Security and Work Incentives." in **Hart, Robert**, ed., "Employment, Unemployment and Labor Utilization." Unwin Hyman, Boston, 1988.

Lazear, Edward P. (1990): "Job Security Provisions and Employment." *Quarterly Journal of Economics*, Vol. 105(3), pp. 699-726, August 1990.

Lechthaler, Wolfgang, Merkl, Christian and Snower, Dennis J. (2008): "Monetary Persistence and the Labor Market: A New Perspective." *Kiel Working Paper*, No. 1409, March 2008.

L'Haridon, Olivier and Malherbet, Franck (2006): "Employment Protection Reforms in Search Economies." *IZA Discussion Paper*, No. 2304, September 2006.

Ljungqvist, Lars (2001): "How Do Layoff Costs Affect Employment?" *CEPR Discussion Paper*, No. 3051, November 2001.

Lubik, Thomas A. and Schorfheide, Frank (2004): "Testing for Indeterminacy: An Application to U.S. Monetary Policy." *American Economic Review*, Vol. 94(1), pp. 190-217, March 2004.

Merz, Monika (1995): "Search in the Labor Market and the Real Business Cycle." *Journal of Monetary Economics*, Vol. 36(2), pp. 269-300, November 1995.

Messina, Julián and Vallanti, Giovanna (2006): "Job Flow Dynamics and Firing Restrictions - Evidence from Europe." *European Central Bank Working Paper*, No. 602, April 2006.

Nickell, Stephen (1997): "Unemployment and Labor Market Rigidities: Europe versus North America." *Journal of Economic Perspectives*, Vol. 11(3), pp. 55-74, Summer 1997.

Petrongolo, Barbara and Pissarides, Christopher A. (2001): "Looking into the Black Box: A Survey of the Matching Function." *Journal of Economic Literature*, No. 39, pp. 390-431, June 2001.

Poilly, Céline and Sahuc, Jean-Guillaume (2008): "Welfare Implications of Heterogeneous Labor Markets in a Currency Area." *Banque de France Working Paper*, No. 199, February 2008.

Ramey, Garey (2008): "Exogenous vs. Endogenous Separation." Mimeo, October 2008.

Ramey, Garey and Watson, Joel (1997): "Contractual Fragility, Job Destruction, and Business Cycles." *The Quarterly Journal of Economics*, Vol. 112(3), pp. 873-911, August 1997.

Romer, David (1993): "The New Keynesian Synthesis." *Journal of Economic Perspectives*, Vol. 7(1), pp. 5-22, Winter 1993.

Rotemberg, Julio (1982): "Monopolistic Price Adjustment and Aggregate Output." *Review of Economic Studies*, Vol. 49(4), pp. 517-531, October 1982.

Samaniego, Roberto M. (2008): "Entry, Exit and Business Cycles in a General Equilibrium Model." *Review of Economic Dynamics*, Vol. 11(3), pp. 529-541, July 2008.

Shimer, Robert (2003): "The Cyclical Behavior of Equilibrium Unemployment and Vacancies: Evidence and Theory." *NBER Working Paper*, No. W9536, March 2003.

Sims, Christopher A. (2002): "Solving Linear Rational Expectations Models." *Computational Economics*, Vol. 20(1-2), pp. 1-20, October 2002.

Trigari, Antonella (2004): "Equilibrium Unemployment, Job Flows and Inflation Dynamics." *European Central Bank Working Paper*, No. 304, February 2004.

Veracierto, Marcelo L. (2008): "Firing Costs and Business Cycle Fluctuations." *International Economic Review*, Vol. 49(1), February 2008.