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Abstract

This paper analyzes the impact of downward wage rigidity on the labor market. It shows that imposing downward wage rigidity in a matching model with cyclical fluctuations in productivity, endogenous match-destruction, and on-the-job search, quits are procyclical and layoffs countercyclical. It provides evidence that downward wage rigidity is empirically relevant in ten European countries. It finally shows that layoffs are countercyclical and quits are procyclical, as predicted by the model.

JEL Code: J63, J41, E3

KEYWORDS: Downward wage rigidity, Business cycles, Wage renegotiation.

1 Introduction

Downward wage rigidity has traditionally been a central concern in labor economics.[1] There are several reasons why firms may be reluctant to cut wages. Firms may be constrained by efficient nominal wage contracts (MacLeod and Malcomson 1993, Holden 1999), fairness standards (Kahneman, Knetsch and Thaler 1986, Campbell and Kamlani 1997) and the existence of loss aversion (Kahneman and Tversky 1979).

Concerning empirical work on downward wage rigidity in Europe, there is now a fairly large and rapidly growing literature base. Devicienti, Maida and Sestito (2007) investigate downward wage rigidity in Italy, Knoppik and Beissinger (2003) in Germany, Holden (1998) in the Nordic countries, Agell and Lundborg (2003) in Sweden, Smith (2000) and Nickell and Quintini (2003) in the UK. There are also some multicountry

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[1]See Bauer, Goette and Sunde (2007) for a brief survey of the literature.

studies based on the European Community Household Panel (ECHP) in Dessy (2002) and Beissinger and Knoppik (2009).

One of the limitations of studies using large nationally representative datasets is that they generally identify wage rigidity by the percent of respondents that experience a decline in nominal wages while working for the same employer in interviews a year apart. Self-reported wages gathered in two different interviews can lead to spurious changes in wages due to measurement error.

In this paper, I first add to this branch of literature by providing robust evidence of downward wage rigidity for ten European Countries using the ECHP.[2] Downward wage rigidity is detected by analyzing the relationship between wages and general economic conditions. The rationale of this strategy is to measure whether wages respond differently when conditions improve than when conditions decline.[3]

One question that emerges from this evidence is what the implications of wage rigidity on job duration are. If firms are not free to trigger renegotiation, when there is a cut on demand or a decrease in productivity, they will not be able to maintain the job. Therefore we should observe an effect of business cycles over job breaks.

There has been an extensive research assessing the importance of business cycle fluctuations over labor market outcomes in relation to job finding and job destruction rates. Davis, Haltiwanger and Shub (1996) indicate that unemployment inflows and outflows are very volatile and cyclical. Using U.S. firm level data they find that unemployment is clearly countercyclical, that layoffs account for most of its cyclical change and that quits increase in expansions and decline moderately during recessions.

Analyzing U.S. data, Shimer (2007) concludes that fluctuations in the destruction rate account for 25 percent of the variation in the unemployment rate. Fujita and Ramey (2009) claim that contemporaneous fluctuations in the separation rate explain 40 to 50 percent of the fluctuations in unemployment, depending on how the data are detrended.

In this paper, I formally discuss the relationship between rigidity, layoffs and quits, using a matching model framework. Equilibrium search, and matching models have primarily omitted business cycles and wage renegotiation. In the textbook versions of search-matching models once the agent and the firm have formed a match, as the economy is stationary, the surplus remains constant. Therefore, there is no reason to set rules for renegotiation.[4]

In the model presented in this paper, wages are set by Nash Bargaining in new matches. For ongoing matches, when conditions deteriorate surplus is not split in

[2] I analyze information of Austria, Denmark, The Netherlands, Belgium, France, Ireland, Italy, Greece, Spain and Portugal.

[3] These measures are robust to measurement error in self-reported wages. Wages are in the left hand side of our regressions, whenever the measurement error in wages is iid, estimates are unbiased.

[4] For good examples of classical search and matching models see Wolpin (1995) and Pissarides (1985).

the same proportions than in new matches, because firms are not allowed to trigger renegotiation. Allowing different wage setting mechanisms when the worker is an insider and when the worker is an outsider may be more consistent with some features of European institutions than continuous Nash bargaining. Firms and workers have no commitment when they are setting wages in the beginning of the match. Due to severance payments and difficulty of dismissal regulations, firms are not allowed to costlessly break the relationship. Hence the bargaining process in ongoing matches could differ from the one of new matches. Imposing some rigidity is also consistent with Shimer (2005), who argues that search and matching models, where wages are determined by continuous Nash bargaining cannot generate substantial movements along a downward sloping Beveridge curve in response to shocks to productivity of a plausible magnitude. Therefore, some models with more rigid wages are needed.

This paper proposes a model with cyclical fluctuations in productivity, endogenous job-termination and on-the-job search where downward wage rigidity is imposed. By means of simulating the model, I show that it predicts procyclical quits, countercyclical layoffs and countercyclical unemployment rates. I also show that with a reasonable parametrization, the model partially tackles the critique presented by Shimer (2005) on the scarce variability of vacancies and unemployment.

Using microdata from the same set of ten European countries, I analyze the cyclical patterns of job termination. The estimates of the separation model imply a strong negative relationship between unemployment rates and quits at the European level. I also find a significantly positive effect of the unemployment rate over the probability of layoffs. These results suggest that in Europe, quits are procyclical and layoffs countercyclical, as predicted by the model.

The rest of the paper is organized as follows. The model is described in Section 2. In Section 3, I describe the dataset. Section 4 presents two alternative empirical approaches to detect downward wage rigidity and the empirical strategy to measure the cyclical patterns of job terminations. Results for both, the pooled sample of countries and for each country individually are also presented in this section. Section 5 discusses the results and informally connects these results with the institutional background of each country. Section 6 concludes and presents recommendations for future research.

2 The Model

The labor market is described by a matching model with cyclical fluctuations in productivity, on-the-job search and endogenous match-destruction. To Introduced a cyclical component in the model is not trivial. There is not consensus on how much flexibility to allow on wages. There has been two main streams. One possible direction is to consider that one job is one wage and to not allow any renegotiation. Lippman and Mamer (1989) for example, set up cyclical variation in a rigid wage search model where no renegotiation is permitted. Their model predicts procyclical quits but says nothing about layoffs. The opposite direction is to allow for continuous Nash bargaining, where wages are consequently governed by the actual market condition. Mortensen (1994) considers a matching model with two sources of variation. It predicts countercyclical layoffs and procyclical quits.[5] The model presented in this section is halfway between both positions, wages can only be renegotiated upward.

The model builds on the Mortensen and Pissarides (1994), but now firms are heterogeneous and wages are assumed to be downward rigid. Each firm has a job that can be filled, or vacant and searching. Jobs that are not searching for a worker or producing are destroyed. Similarly, workers can be producing or searching. To search while employed is also allowed like in Mortensen (1993).[6] I assume that searching while working is less productive than searching when the worker is unemployed.

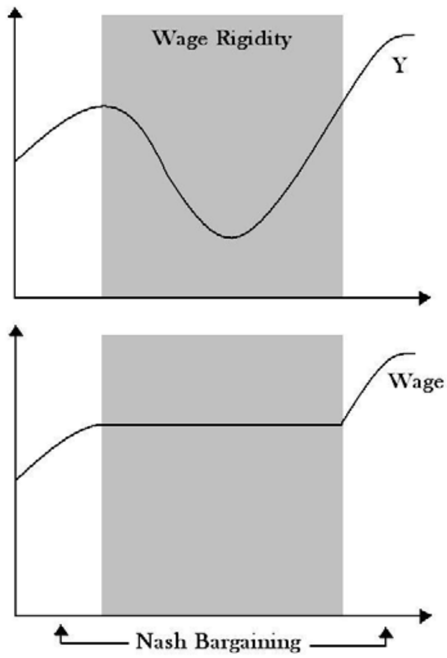

Figure 1: Wage Setting Dynamics

At the moment of hiring, the wage is chosen so as to split the current surplus in fixed proportion. I impose downward wage rigidity, hence if the surplus change, the wage response will be asymmetric, see Figure 1. There are two cases, if conditions improve the worker renegotiates to maintain her proportion of the new surplus and the wage raises. If conditions deteriorate the firm has to afford the whole loss meanwhile the value of the job remains positive.[7]

[5]Mortensen (1994) imputes a layoff when both parts break the match due to the surplus extinction. This definition might not be complete if we think in a layoff as a job destruction initiated by the firm.

[6]This *on-the-job search* only implies that it is not necessary to be unemployed to look for a new job, it is not the same offer and counter-offer scheme like in Burdett-Mortensen (1998). The outside option is always the unemployment.

[7]I consider a layoff as a match break initiated by the firm and a quit as a match break initiated by the worker.

Let me assume that the net output of a firm-worker match i at time t is the sum of a fixed productivity p that is constant across matches and time, plus an aggregate component that depends on the state of the economy. The state of the economy, y_t is time specific, and its dynamic between t and $t+1$ is described by a transition function $F(y_{t+1}|y_t)$ with lower bound y_d and upper bound y_u. The elasticity of the match productivity to the state of the economy is heterogeneous and is denoted by σ_i. This elasticity is the only source of heterogeneity between firms and it is exogenously distributed according to a given cumulative distribution function $G(\sigma)$. The productivity of a match with elasticity σ_i in time t is $p + \sigma_i y_t$.[8]

The productivity of each match and its opportunity cost at t depend on the current economic conditions y_t. As I have assumed that the wage is downward rigid, the best wage of each spell is a state variable valuing each match. As the wage is monotonous respect to y_t, the best wage can be fully characterized by the match sensibility σ_i and the best general economic condition of each spell $y^*_{i,t}$.[9] Therefore there are three state variables that determine the value of a job: y_t that is time specific, σ_i that is match specific and $y^*_{i,t}$ that is time and match specific.

When a match is created $y_t = y^*_{i,t}$, hence the expected value of the job for the firm, when it posts a vacancy, and the expected value of a job for the worker when she is searching, are only functions of the current economic conditions y_t. When the current macroeconomic condition is known, the worker and the firm have the option to break the relationship, being the unemployment and a vacancy their outside options.[10] The worker decides to search or not search for a job in the current period and if she finds, she start working with the new job in the following period.

Finally, let me assume a constant returns to scale matching function $m\left(v(y_t), u(y_t)\right)$, and free entry condition, that in this context means that there is an infinite number of firms that go into the market until the exhaustion of all rents.

2.1 Value Functions

The unemployed worker searches only if the expected value of searching is greater than its cost. If she decides to search, she will find a job with probability

$$m(v(y_t), u(y_t))/u(y_t) = m(\frac{v(y_t)}{u(y_t)}, 1) \equiv \lambda_w(\frac{v(y_t)}{u(y_t)}),$$

[8]This a simple way to generate heterogeneity on firms whose positions in the distribution of firms may change if the outside conditions change. To have changes in the relative position is important to generate quits. If a better state of the economy improves every firm homogeneously, as the rank is preserved, the worker would never quit.

[9]The best economic condition is representative of the highest wage if our parametrization of the model consider only procyclical productivity for every match. If a particular match productivity were countercyclical the worst economic condition would have to be considered. In the simulations of the model the latter case does not occur.

[10]I assume that the cyclicality of each match is not observable until the match is done. This is not a critical assumption but it clearly simplifies the algebra avoiding directed search.

therefore the value of unemployment, $U(y_t)$, is defined as:

$$\begin{aligned} U(y_t) &= b + \\ & \frac{1}{1+r}\max\left\{ \int_{y_d}^{y_u} U(y)dF(y|y_t); \left[1-\lambda_w(\frac{v(y_t)}{u(y_t)})\right]\int_{y_d}^{y_u} U(y)dF(y|y_t) - c_1 + \right. \\ & \left. \lambda_w(\frac{v(y_t)}{u(y_t)})\int_{\sigma}\left[\bar{F}(R(\sigma)|y_t)\int_{R(\sigma)}^{y_u} W(y,y,\sigma)dF(y|y_t) + F(R(\sigma)|y_t)\int_{y_d}^{y_u} U(y)dF(y|y_t))\right] dG(\sigma)\right\}, \end{aligned}$$

where r is the interest rate, b is the unemployment benefit, c_1 is the cost of searching and $W\ (y_{t+1}, y_{t+1}, \sigma_i)$ is the value of a new job, which depends on three states variables, y_{t+1}, $y^*_{i,t+1}$ that is newly created match is equal to y_{t+1} and σ_i. The unemployed worker decides to search if the expected value of the job over the conditional distribution of y_{t+1} plus the cost of searching is greater than the expected value of the vacancy.

Notice that given the state of the economy, not every job is going to be profitable. What is equivalent to say that given the sensitivity of the match, σ, the match is going to be profitable only in some states of the economy y. $R(\sigma)$ represents the threshold on the space y over which a match with sensitivity σ is profitable.[11] Given that there is free entry of firms, the value of a vacancy is zero, and therefore the threshold $R(\sigma)$ is implicitly defined by the following equation:

$$J(R(\sigma), R(\sigma), \sigma) = 0,$$

where $J(y_t, y^*_{i,t}, \sigma_i)$ is the value of a match for the firm when the economy is in state y_t, the best state of the economy of the spell is $y^*_{i,t}$ and the sensitivity to the cycle of the match is σ_i.

The value of a job for the worker is equal to the wage, $w(y^*_{i,t}, \sigma_i)$, received today plus the future value of the job. The future value of the job depends on the decisions that the worker takes today and the expected decisions that the firm will take tomorrow conditional on y_t. The worker has to decide if it is profitable to quit or to stay in the job. If she chooses to stay she has to decide between searching from the job or staying without searching.

To sum up, the worker has to decide between:

- To quit: If the expected value of unemployment is greater than the value of staying in the job.
- To stay: If the value of staying is greater than the value of quitting. The value of staying depends on the options the worker takes:
  - On-the-job Search: If the value of searching (Φ) is greater than the value of not searching (Ω), the worker searches. In the latter case she receives an

[11] As usual $\bar{F}(R(\sigma)|y_t) = 1 - F(R(\sigma)|y_t)$.

offer with probability $\xi\lambda_w(\frac{v(y_t)}{u(y_t)})$, where ξ is the reduction in the searching efficiency due to search while working. As usual, the worker will quit if it is in her own convenience. The worker pays a cost c_2 if she search on the job.

- No Search: If the value of searching is smaller than the value of not searching, the worker does not search. If the worker does not quit nor searches or if her search has not been successful, tomorrow she will face the value of her current job but in a different state of the economy y_{t+1}. As wages can not be cut off, there are three possible cases:
  * If y_{t+1} goes below a threshold $R(y^*_{i,t}, \sigma_i)$, where the value of this job for the firm would falls below the value of a vacancy, the worker will be dismissed,
  * If y_{t+1} is between $R(y^*_{i,t}, \sigma_i)$ and $y^*_{i,t}$, there is no change on the best economic condition of the spell, and the wage does not change.
  * If y_{t+1} is greater than the current maximum $y^*_{i,t}$, the match has a new maximum $y^*_{i,t+1} = y_{t+1}$., and the wage raises.

Therefore, the value of a job when the economy is in state y_t, the best state of the economy of the spell has been $y^*_{i,t}$ and the sensitivity to the cycle of the match is σ_i is defined by:

$$W(y_t, y^*_{i,t}, \sigma_i) \quad = \quad max\left\{U(y_t); w(y^*_{i,t}, \sigma_i) + \frac{1}{1+r}\max\left[\Phi(y_t, y^*_{i,t}, \sigma_i); \Omega(y_t, y^*_{i,t}, \sigma_i)\right]\right\},$$

where $\Phi(y_t, y^*_{i,t}, \sigma_i)$ the value of searching on-the-job and is defined by:

$$\begin{aligned}\Phi(y_t, y^*_{i,t}, \sigma_i) \quad = \quad & \xi\lambda_w(\frac{v(y_t)}{u(y_t)})\int_{R(y^*_{i,t},\sigma_i)}^{y_u}\int_{\sigma} max\left[W(y,y,\sigma); W(y, max(y, y^*_{i,t}), \sigma_i)\right] dG(\sigma)dF(y|y_t)\\ & +\xi\lambda_w(\frac{v(y_t)}{u(y_t)})\int_{y_d}^{R(y^*_{i,t},\sigma_i)}\int_{\sigma} max\left[W(y,y,\sigma); U(y)\right] dG(\sigma)dF(y|y_t)\\ & +\left[1-\xi\lambda_w(\frac{v(y_t)}{u(y_t)})\right]\Omega(y_t, y^*_{i,t}, \sigma_i) - c_2, \qquad (1)\end{aligned}$$

The threshold $R(y^*_{i,t}, \sigma_i)$ identifies when the worker will be dismissed and is implicitly defined by the following equation:

$$J(R(y^*_{i,t}, \sigma_i), y^*_{i,t}, \sigma_i) = 0,$$

Notice that the first line of (1) represents the expected utility of the worker in the case she receives an offer and the state of economy is better than $R(y^*_{i,t}, \sigma_i)$. In such event, the worker can choose to accept or reject the offer. If the value of her current job is higher than the value of the alternative job, she rejects the offer and she keeps her current job. the second line of (1) represents the expected utility of the worker in the case she receives an offer and the state of economy is worse than $R(y^*_{i,t}, \sigma_i)$. In this case the worker can reject the offer but her outside option is the value of the unemployment. The third line of (1) represents the expected utility of the worker if she does not receive any offer, minus the cost of searching on the job.

$\Omega(y_t, y^*_{i,t}, \sigma_i)$ is the value of staying in the job without searching and is defined by:

$$\begin{aligned}\Omega(y_t, y^*_{i,t}, \sigma_i) &= \int\limits_{y_d}^{R(y^*_{i,t},\sigma_i)} U(y_{t+1}) dF(y|y_t) + \int\limits_{R(y^*_{i,t},\sigma_i)}^{y^*_{i,t}} W\left(y, y^*_{i,t}, \sigma_i\right) dF(y|y_t) \\ &+ \int\limits_{y^*_{i,t}}^{y_u} W\left(y, y, \sigma_i\right) dF(y|y_t).\end{aligned}$$

The value of a job for the firm has practically the same structure as the value of a job for the worker. The main difference is that when the match breaks, the firm gets the value of a vacancy. The value of a vacancy is only function of the current economic condition, because $y^*_{i,t+1}$ and σ_i are match specific. The vacancy is going to be filled with probability $m\left(v(y_t), u(y_t)\right)/v(y_t)$. As I assume constant returns to scale in the matching function:

$$m\left(v(y_t), u(y_t)\right)/v(y_t) = m\left(\frac{v(y_t)}{v(y_t)}, \frac{u(y_t)}{v(y_t)}\right) \equiv \lambda_f\left(\frac{u(y_t)}{v(y_t)}\right)$$

The value of a vacancy, $V(y_t)$, is defined by:

$$\begin{aligned}V(y_t) &= -c_3 + \frac{1}{1+r}\left\{\left[1 - \lambda_f\left(\frac{u(y_t)}{v(y_t)}\right)\right] \int\limits_{y_d}^{y_u} V(y) dF(y|y_t)\right. \\ &\left. + \lambda_f\left(\frac{u(y_t)}{v(y_t)}\right) \int\limits_{\sigma} \int\limits_{R(\sigma)}^{y_u} J(y, y, \sigma) dF(y|y_t) dG(\sigma)\right\}\end{aligned}$$

Where $J(y_{t+1}, y^*_{i,t+1} = y_{t+1}, \sigma)$ is the value of a new match for the firm and r is the interest rate. $V(y_t)$ is the sum of three terms:

- The cost of the vacancy, c_3.
- The expected value, over the distribution of y_{t+1} conditional on y_t, of the vacancy tomorrow times the probability of this event.
- The expected value, over the join distribution of y_{t+1} and σ_i given y_t, of a match, times the probability of getting a worker.

The value of the match for the firm is defined by:

$$J(y_t, y^*_{i,t}, \sigma_i) = \max\left\{p + \sigma_i y_t - w(y^*_{i,t}, \sigma_i) + \frac{1(NO\ QUIT)}{1+r}\left[\Psi(y_t, y^*_{i,t,}, \sigma_i) + \Theta(y_t, y^*_{i,t}, \sigma_i)\right]; V(y_t)\right\}$$

Where $\Psi(y_t, y^*_{i,t}, \sigma_i)$ is the expected value of the match for the firm if the worker is searching and $\Theta(y_t, y^*_{i,t}, \sigma_i)$ is the expected value of the job for the firm if the worker is not searching. Due to the free entry condition, the value of a vacancy is zero. $\Psi(y_t, y^*_{i,t}, \sigma_i)$ is defined by:

$$\begin{aligned}
\Psi(y_t, y^*_{i,t}, \sigma_i) \quad = \quad & 1\left(\Omega(y_t, y^*_{i,t}, \sigma_i) < \Phi(y_t, y^*_{i,t}, \sigma_i)\right) \times \{ \\
& \left[1 - \xi\lambda_w(\frac{v(y_t)}{u(y_t)})\right]\left[\int_{R(y^*_t,\sigma_i)}^{y^*_{i,t}} J(y, y^*_{i,t}, \sigma_i) dF(y|y_t) + \int_{y^*_{i,t}}^{y_u} J(y, y, \sigma_i) dF(y|y_t)\right] + \\
& \xi\lambda_w(\frac{v(y_t)}{u(y_t)}) \int_{R(y^*_{i,t},\sigma_i)}^{y^*_{i,t}} \int_\sigma 1\left[W(y, y, \sigma) < W(y, y^*_{i,t}, \sigma_i)\right] J(y, y^*_{i,t}, \sigma_i) dG(\sigma) dF(y|y_t) + \\
& \xi\lambda_w(\frac{v(y_t)}{u(y_t)}) \int_{y^*_{i,t}}^{y_u} \int_\sigma 1\left[W(y, y, \sigma) < W(y, y, \sigma_i)\right] J(y, y, \sigma_i) dG(\sigma) dF(y|y_t)\}
\end{aligned} \tag{2}$$

where 1(.) is an indicator function that takes the value one if the condition holds. Note that the second row in (2) is the expected value of the job for the firm, if the worker does not receive any offer. The third line in (2) represents the value of the job if the worker receives an offer but she rejects it, being the economy in a state worse than $y^*_{i,t}$. The fourth line in (2) represents the value of the job if the worker receives an offer, but she rejects it being the economy in a state better than $y^*_{i,t}$. $\Theta(y_t, y^*_{i,t}, \sigma_i)$, is defined by:

$$\begin{aligned}
\Theta(y_t, y^*_{i,t}, \sigma_i) \quad = \quad & 1\left(\Omega(y_t, y^*_{i,t}, \sigma_i) > \Phi(y_t, y^*_{i,t}, \sigma_i)\right) \times \\
& \left[\int_{R(y^*_t,\sigma_i)}^{y^*_{i,t}} J(y, y^*_{i,t}, \sigma_i) dF(y|y_t) + \int_{y^*_{i,t}}^{y_u} J(y, y, \sigma_i) dF(y|y_t)\right]
\end{aligned}$$

Also note that as the value of a vacancy is zero:

$$c_1 / \int_\sigma \left[\int_{R(\sigma)}^{y_u} J(y_{t+1}, y^*_{i,t+1} = y_{t+1}, \sigma) dF(y_{t+1}|y_t)\right] dG(\sigma) = m(1, \frac{u(y)}{v(y)}).$$

This equation implicitly defines the equilibrium ratio of vacancies to searching workers, $v(y_t)/u(y_t)$, a measure of market tightness.

2.2 Wages

When the firm and the worker create a new match, the wage is determined splitting the surplus in fixed proportions. The surplus of a match is $S(y_t, y^*_{i,t}, \sigma_i) = J(y_t, y^*_{i,t}, \sigma_i) + W(y_t, y^*_{i,t}, \sigma_i) - U(y_t)$. The main difference with standard matching models is that now the surplus splitting rule is only relevant when $y_t = y^*_{i,t}$. If $y_t < y^*_{i,t}$, as wages are downward rigid, the firm loses part of its fraction of the surplus, and the Nash bargaining with the original β and $(1-\beta)$ does not describe the surplus splitting.[12]

2.3 Simulations

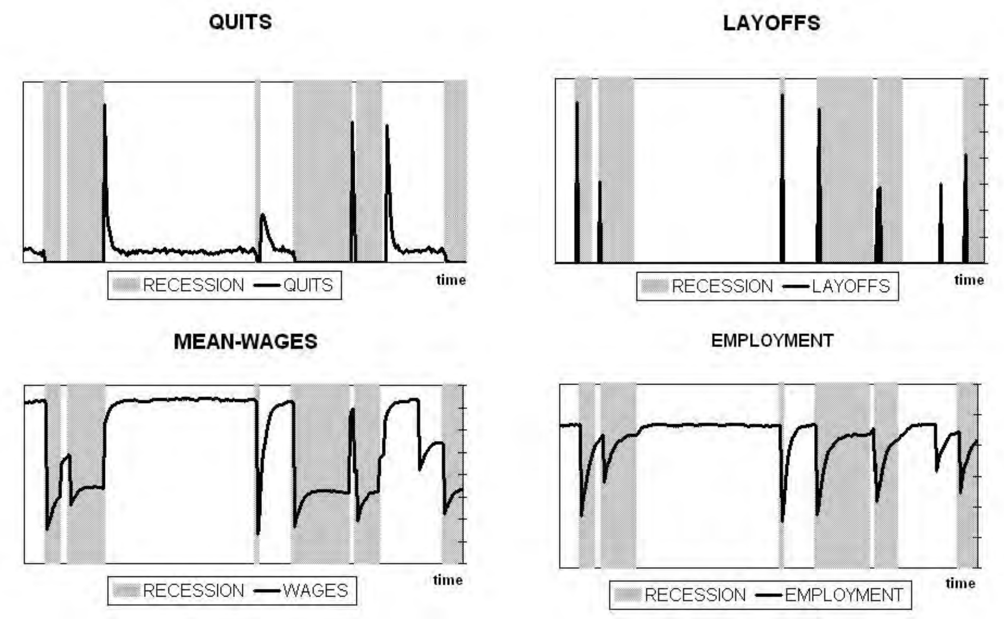

Figure 2: Simulated variables

Figure 2 presents simulated behaviors of quits, layoffs, employment levels and mean wage.[13] I simulate the value function in discrete time by the fixed point algorithm by value function iterations.[14] The model predicts procyclical quits. Moreover, due to the on-the-job search, quits are persistent during the expansion. Persistence is an interesting features of the model and it is not trivial to be generated. In the model of Wright (1986), for example, considering signal extraction, there is also persistence because quits occur as employees learn about the true nature of their jobs. In this model the persistence is due to the fact that the probability of finding a job while searching is not one, there are people that search while working during the expansion but the transition is only produced when the worker effectively finds a better job.

[12]see Figure 1

[13]See Section A1 for details on the parametrization and distributional assumption made on these simulations.

[14]I simulate the model with 10,000 individuals and 500 time periods. The convergence is very quick. The whole program takes approximately four hours to run.

Layoffs are clearly countercyclical. Due to the downward rigidity, some matches that have set wages during the expansion are not able to continue when the economic conditions fall down and have to be destroyed.

Changes on employment are clearly procyclical as expected. The model also predicts procyclicality on mean-wages, on the mean-wage block of Figure 2, we observe two different kinds of responses:

- Movements on the mean that occur in the same state of the cycle is mainly due to the composition effect generated by the fact that people on *good* jobs does not search, this fact produce selection within the cycle.

- Movements on the mean that occur when there has been an upward change on the cyclical state is mainly due to the renegotiation,

Shimer (2005) argues that the textbook search and matching model cannot generate the observed business-cycle-frequency fluctuations in unemployment and job vacancies in response to shocks to productivity of a plausible magnitude. With a simple numerical exercise I show that imposing downward wage rigidity in a matching model with cyclical fluctuations in productivity and on-the-job search may help to tackle this critic.

Calibration's details are in the appendix. I find that vacancies are approximately three times more variable than productivity and that unemployment is almost five times more volatile than productivity. The vacancy unemployment ratio varies more than twice than productivity. The Mortensen-Pissarides's (1994) model predicts similar volatility for the vacancy-unemployment ratio and productivity.[15] The model is in the good direction but is it not still able to generate enough variation in the latter ratio that has been estimated to be around 20 times the variation in productivity.[16]

3 Data

The empirical analysis is based on the European Community Household Panel (ECHP) which is a large scale annual longitudinal survey providing household and personal information on income and socioeconomic characteristics for 15 member states of the European Union (EU). The ECHP has been centrally designed and coordinated by the Statistical Office of the European Union (Eurostat). The great advantage of the ECHP is the uniform questionnaire asked in the EU-countries which makes the direct comparison of data across countries and over time possible.

The ECHP started in 1994 and ended in 2001, thereby it comprise eight waves. In the first wave in 1994 a sample of about 60,000 nationally representative households with approximately 130,000 individuals aged 16 years and over were interviewed in

[15] See Shimer (2005a).

[16] Estimates for the United States by Shimer (2005)

the then 12 participating member States. Germany, UK and Luxembourg, have two sources of information, ECHP and local national surveys: SOEP, BHPS, and PSELL respectively. Austria, Finland and Sweden joined the ECHP-project in 1995, 1996 and 1997, respectively. I analyze information of ten countries: Denmark, The Netherlands, Belgium, France, Ireland, Italy, Greece, Spain, Portugal and Austria.[17]

I have 770,000 observations distributed over eight waves. The analysis is conducted for full time workers in the private sector. I exclude the first and the last percentile of the wage distribution in order to partially avoid outsider's interference. I finally have approximately 180,000 observations of 64,635 individuals.

As a measure of the state of the economy I use the unemployment rate. To study which labor market condition is the most relevant, I use three aggregated indicators, the initial unemployment rate, the minimum unemployment rate of the each spell[18] and the current unemployment rate which have been obtained from the Organization for Economic Co-operation and Development (OECD).[19]

Wages are at constant prices across time. I deflate them by the consumer price index from each country also obtained from the OECD. All real wages are considered at year 2000 prices. The data give details on the net current monthly wage and salary earnings of each individual.

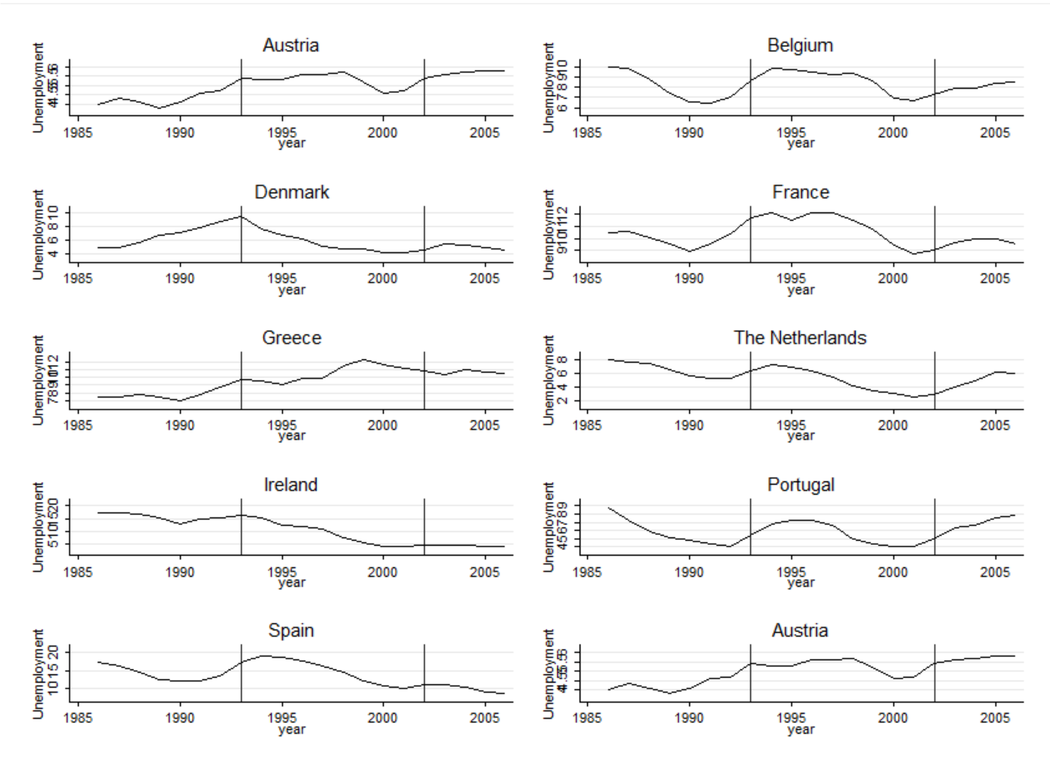

Figure 3: Unemployment Rates - Country Samples (Data from OECD)

[17]See Peracchi (2002) for a good description of this data-set.

[18]As I have unemployment information since 1980, I am able to use observations whose reported initial date is before the start of the survey in 1994.

[19]http://www.oecd.org

When analyzing dynamics, I consider a job break if the worker has a new job or if she has stopped her previous one between two consecutive waves. I am not able to recognize if there has been more than one movement in this interval.[20]

One of the main problems of this sample is that, due to the short temporal dimension, in several countries there is not enough cyclical movements, measured in terms of the unemployment rate evolution. On Figure 3, it can be seen that between 1994 and 2001 only Austria, Greece, Italy and Portugal have had some change in their unemployment rate short-term trend.

4 Empirical Strategy and Results

This section presents country by country and pooled estimates. In Subsections 4.1 and 4.2, I present empirical evidence of downward wage rigidity. In the Subsection 4.3, I show that business cycles also have important effects on probabilities of layoff and quit, and these effects are consistent with the model predictions presented in Figure 2.

Most of studies trying to detect downward wage rigidity with micro-data from representative data sets, identify wage rigidity by the percent of respondents experience a decline in nominal wages while working for the same employer in interviews a year apart. One limitation of this approach is that self-reported wages gathered in two different interviews can lead to spurious changes in wages, due to measurement error.

In this section I propose two empirical strategies to detect downward wage rigidity that are robust to measurement error in self reported wages.

The first one builds on an approach originally presented by Beaudry and DiNardo (1991). Beaudry and DiNardo were originally concerned in studying whether market conditions affect the wage setting. They tested three possible options: full renegotiation, where both sides are able to renegotiate and therefore wages are totally flexible. A totally rigid market where only the initial conditions of each spell matter. And an intermediate case, where wages are downward rigid and then, the best economic condition of the spell is statistically sufficient to explain the current wage. They find the last possibility to be the most relevant one. Similar studies have been done with Canadian and British data by McDonald and Worswick (1999) and by Devereux and Hart (2007), respectively. They have also found that the best economic condition effect is relevant.

In a second approach presented in Section 4.2, I directly measure if wages respond differently when conditions improve than when conditions decline, trusting again in the unemployment rate as an index of the state of the economy.

As in both approaches log-wages are in the left-hand side of the equations. There-

[20] In some countries there are important discrepancies between interview's date and the wave's year. The whole analysis is made considering year of the interview instead of wave.

fore, a standard multiplicative *iid* measurement error in self-reported wages[21] would not affect my estimates.

4.1 Downward Wage Rigidity: Best economic Condition Effect

In this subsection, I use the Beaudry and DiNardo's strategy to indirectly test for downward wage rigidity in Europe. I test between three alternative hypothesis:

- Full Rigidity: If wages were totally rigid, the initial state of the economy would be significant in a wage equation.
- No Rigidity: If there is no rigidity wages will only be correlated with the current economic conditions.
- Downward Rigidity: If firms are constrained to start renegotiations, the best state of the economy would be significant a wage equation.

Therefore I estimate:

$$\ln w_{i,t+j} = \Omega_1 X_{i,t+j} + \Omega_2 C(t,j) + \epsilon_{i,t} \tag{3}$$

$$C(t,j) = \begin{cases} U_{t+j} & \text{Initial Unemployment rate} \\ U_t & \text{Current Unemployment rate} \\ \min(U_{t+k})_{k=0}^{j} & \text{Minimum Unemployment rate} \end{cases}$$

Where $w_{i,t+j}$ is the wage of an individual i on time $t+j$ who began to work on time t, that depends on her individual characteristic X_i, a relevant labor market condition link variable $C(t,j)$ and an error term.

The covariates X_i, used for estimation include age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status.

Table 1 presents OLS and within-groups estimates of Ω_2 considering all countries together. I replicate Beaudry and DiNardo (1991) analysis for real wages.

In the first three columns, I present estimates for the pooled sample of ten European countries without specifying the contract type. Results are consistent with Beaudry and DiNardo (1991). I find significant negative coefficients for every variable considered alone. As the three indicators are presumably correlated, I also show regressions including three indicators together, the initial unemployment rate becomes almost non-significant. In row (5), I show results including the actual unemployment rate and the minimum unemployment rate both coefficients are significantly different from zero.

[21] That is an additive iid measurement error in log-wages.

Table 1: Wage Rigidity - Pooled Sample

Log(monthly real wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.043	-0.003	0.001	-0.058	-0.002	-0.002	levels
	(50.15)**	(2.54)**	(0.85)	(57.88)**	(1.64)	(2.56)*	
(2)	-0.045			-0.055			levels
	(97.56)**			(96.22)**			
(3)		-0.037			-0.040		levels
		(72.00)**			(59.20)**		
(4)			-0.019			-0.013	levels
			(38.82)**			(22.91)**	
(5)	-0.040	-0.009		-0.051	-0.008		levels
	(49.97)**	(9.09)**		(59.40)**	(6.41)**		
(6)	0.03	-0.024		-0.001	-0.021		job-fixed
	(1.61)	(29.85)**		(0.71)	(25.06)**		effects

Note: Each row in the first three columns represents a wage equation where workers with every type of contracts are considered. Each row in the last three columns represents a wage equation where only workers with permanent contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1 percent; * significant at 5 percent. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included. Real wages have been deflated to be expressed in year 2000 prices.

In row 6, coefficients are reestimated using the same data but only exploiting within job variation.[22] Now, the minimum unemployment rate becomes the most important job market indicator and the actual unemployment rate is not significant. Results obtained with this specification is consistent with the model and with results presented in Beaudry and DiNardo (1991) with U.S. data. There are significant differences between OLS in levels and within groups.[23] These differences may be suggesting a positive correlation between the state of the economy and the match unobservable characteristics and is consistent with Bowlus (1995), where she finds that mismatching occurs more during recessions.

Considering only permanent contracts, results do not change significantly. The main difference is in row (1) where now the effect of the minimum unemployment rate is only marginally significant.

In Table 1, as in Beaudry and DiNardo (1991) and in Devereux and Hart (2005), real wages are taken as the relevant measure of labor income. McDonald and Worswick (1999) use nominal wages instead of real wages. Downward wage rigidity is generally considered to be a nominal phenomena, thus nominal wage would also be a relevant variable. In Table 2, I estimate previous specifications but with log-nominal-wages.

[22]Note that within job variation partials out the effect on unobserved worker fixed heterogeneity and unobserved firm fixed heterogeneity.

[23]Hausman tests reject the null at a 1 percent level for both samples.

Table 2: Wage Rigidity - Pooled Sample

Log(monthly nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.022	-0.011	0.000	-0.035	-0.004	-0.001	levels
	(26.32)**	(8.44)**	(0.07)	(35.98)**	(2.60)**	(1.65)	
(2)	-0.029			-0.036			levels
	(64.74)**			(64.33)**			
(3)		-0.029			-0.031		levels
		(58.28)**			(47.67)**		
(4)			-0.015			-0.011	levels
			(31.58)**			(19.12)**	
(5)	-0.021	-0.014		-0.030	-0.012		levels
	(35.79)**	(22.37)**		(36.15)**	(10.01)**		
(6)	-0.024	-0.011		-0.031	-0.009		job-fixed
	(41.45)**	(15.68)**		(50.23)**	(10.82)**		effects

Note: Each row in the first three columns represents a wage equation where workers with every type of contracts are considered. Each row in the last three columns represents a wage equation where only workers with permanent contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included.

When analyzing nominal wages, estimates are qualitatively and quantitatively equivalent to results presented in Table 1. The minimum unemployment rate is always significantly negative. The main difference is in the estimated coefficient of the current economic condition, which is now significantly different from zero in every specification. These results show the importance of the best economic condition of each spell in the wage setting, and consequently they prove the empirical relevance of downward wage rigidity in Western Europe.

Table 3 presents results country by country. The initial unemployment rate has been shown to be not significant in wage equations once the current or the best economic condition has been included, therefore Table 3 only presents specifications where the current and the minimum unemployment rate were considered.[24] As before there are significant differences when match fixed effects are removed. In the equation in levels the effect of the actual unemployment rate is always significantly negative (but only Greece) and the effect of minimum unemployment rate is significantly negative in Belgium, Denmark, Ireland, The Netherlands, Portugal and Spain. The effect of the minimum unemployment rate is more homogeneous in the within-group estimates, where I find a negative and significant effect of the best economic condition in every

[24]For estimates of all the previous specification, for nominal and real wages, see the appendix: Table 9 for Austria, Table 10 for Belgium, Table 11 for Denmark, Table 12 for France, Table 13 for Greece, Table 14 for Ireland, Table 15 for Italy, Table 16 for The Netherlands, Table 17 for Portugal and Table 18 for Spain

Table 3: Wage Rigidity - Country Samples

Log(monthly real wages)

	OLS		Within-Groups	
	Actual rate	Minimum rate	Actual rate	Minimum rate
Austria	-0.07	0.02	-0.02	-0.04
	(8.47)**	(2.86)**	(3.80)**	(3.97)**
Belgium	-0.02	-0.01	-0.01	-0.01
	(6.77)**	(3.57)**	(2.37)*	(1.93)
Denmark	-0.01	-0.04	0.02	-0.03
	(1.82)	(7.17)**	(4.02)**	(4.90)**
France	-0.02	0.01	0.00	-0.03
	(8.96)**	(1.65)	(1.36)	(8.36)**
Greece	0.07	0.03	0.04	0.08
	(18.61)**	(8.51)**	(12.80)**	(7.97)**
Ireland	-0.01	-0.03	0.02	-0.02
	(1.86)	(12.94)**	(4.54)**	(5.75)**
Italy	-0.06	0.01	0.01	-0.01
	(20.10)**	(4.83)**	(3.85)**	(3.13)**
The Netherlands	-0.03	-0.03	0.00	-0.02
	(8.19)**	(6.15)**	(0.07)	(5.02)**
Portugal	-0.06	-0.00	0.01	-0.01
	(32.81)**	(0.30)	(5.27)**	(4.17)**
Spain	-0.02	-0.01	0.00	-0.02
	(14.40)**	(9.72)**	(0.20)	(7.81)**

Note: Each row in the first two columns represents a wage equation in levels for each country. Each row in the last two columns represents a within-match wage equation for each country. Workers with every type of contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included. Real wages have been deflated to be expressed in year 2000 prices.

country but only in the striking case of Greece.

4.2 Downward Wage Rigidity: Asymmetric response

Downward wage rigidity implies an asymmetric response of wages to changes in economic conditions. Depending on the sign of the variation there will be different effects. If conditions improve wages do react, but when conditions are worse, wages are inelastic. An alternative way to check for this rigidity is to directly test for this asymmetry. As before, I use the unemployment rate as an indicator of the state of the economy and I test whether the elasticity of wages differ according to sign of the cycle.

In other words, I estimate a wage-equation allowing for different parameters of the current unemployment rate if the economy is growing or not. I estimate the following equation:

$$\Delta(\ln w_{i,t}) = \Omega_2 d_t \; + \Omega_2 X_{i,t} + \Omega_3 U_t \; + \; \Omega_4 d_t U_t \;\; + \epsilon_{i,t}, \tag{4}$$

where

$$d_t = \begin{cases} 0 \text{ If } U_t > U_{t-1} \\ 1 \text{ If } U_t \leq U_{t-1}, \end{cases}$$

and $w_{i,t}$ is the current real wage, U_t is the current unemployment rate and $X_{i,t}$ are observable characteristics of the match.

Table 4: Wage Asymmetric Response

Δ log(monthly real wages)					
All Type of Contracts			Only Permanent Contracts		
Ω_1	Ω_3	Ω_4	Ω_1	Ω_2	Ω_4
0.006	-0.024	-0.060	0.007	-0.024	-0.063
(8.08)**	(28.65)**	(8.48)**	(27.54)**	(8.09)**	(8.41)**

Note: Estimates of equation (4) for workers with every type of contracts are presented in the first three columns. Estimates of equation (4) only for workers with permanent contracts are presented in the last three columns. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included. Real wages have been deflated to be expressed in year 2000 prices.

Results are presented in Table 4. I find strong evidence of asymmetry. The difference between Ω_2 and Ω_3 is statistically different from zero. The effect of the actual unemployment over wages in a growing economy is almost four times this effect in a decreasing one. Estimates are very precise and I find similar patterns between different types of contracts. As expected Ω_1 is statistically positive showing that the growth rate of wages is higher when the unemployment is decreasing.

4.3 Dynamics

As shown in Figure 2, the model predicts procyclicality on quits and countercyclicality on layoffs. These implications are tested trusting again in the negative association between state of the economy and unemployment rate.

To study the effect of the current unemployment rate on the probability of layoff, I estimate the discrete choice model fitting a probit for each country and the pooled sample.[25] Results are shown in Table 5.

There is evidence of counter-cyclicality of layoffs. This evidence is stronger in the pooled sample mainly due to scarce variation on unemployment rates at the country level. I find a significantly positive effect of unemployment rate on layoff probability in Belgium, Ireland, Italy, The Netherlands and Portugal.

[25]LOGIT and Conditional LOGIT have also been estimated with similar results.

Table 5: Cyclical Patterns of Job-Termination

Probit Estimates

	Probability of Layoff	Probability of Quit
	Actual Unemployment rate	Actual Unemployment rate
Austria	-0.060	-0.008
	(0.81)	(0.12)
Belgium	0.108	-0.049
	(2.52)**	(1.46)
Denmark	-0.038	-0.048
	(0.98)	(-1.39)
France	0.001	-0.185
	(0.03)	(7.02)**
Greece	-0.162	-0.104
	(4.63)**	(2.83)**
Ireland	0.40	-0.012
	(2.29)**	(0.880)
Italy	0.157	0.000
	(1.94)*	(0.010)
The Netherlands	0.094	-0.142
	(3.25)**	(6.63)**
Portugal	0.077	0.018
	(3.61)**	(0.95)
Spain	0.013	-0.050
	(1.37)	(4.51)**
Pooled Countries	0.019	-0.040
	(2.99)**	(7.18)**

Note: Each row in the first column shows probit estimates of the effect of the current unemployment rate on the probability of layoff for each country. Each row in the first column shows probit estimates of the effect of the current unemployment rate on the probability of quit for each country. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included.

Quits are mainly found to be procyclical. As before, results are more conclusive on the pooled sample where I find a significantly negative effect of the current unemployment rate on the quit probability. I find the same qualitative result for Austria, Belgium, Denmark, France, Greece, Ireland, The Netherlands and Spain but in most of the cases with low significance levels.

5 Discussion

Downward wage rigidity is an extreme case. Most of the estimates of the effect of the current unemployment rate on wages, presented in Section 4, were also significant.

Therefore, there is a link between wages and current economic conditions. Intuition behind these results suggests that workers are always able to renegotiate, therefore, when conditions improve, they bargain for a new wage. However, firms are not as mobile as workers. Hence, they are more constrained in wage renegotiations. Note that a model where only the workers are able to renegotiate is not totally equivalent to the model presented in Section 2. If only the workers are able to trigger renegotiations, wages are not going to be totally downward rigid; they will partially depend on the current economic conditions. This is because workers will try to avoid being dismissed; when the surplus is still positive, they will agree on a lower wage. This mechanism, which only imposes to the firm the requirement of a credible threat to trigger renegotiation, is the asymmetric version of the wage renegotiation scenario described in Postel-Vinay and Turon (2010), where both parties are required to have a credible threat to set a new wage.

In summary, the prevalence the prevalence of *the best economic condition effect* should be associated with constraints that limit a firm's capacity to renegotiate wages. Possible causes of these constraints include the requirement of severance payments, or other regulations, that make it difficult to dismiss workers. Note that also unions may generate a difference between the bargaining process of new matches and ongoing matches since unions represent only insiders.

Table 6: Institutional Background

	Difficulty of Dismissal - DOD (1998)	Overall Strictness of Protection against Dismissal (1998)	Union Density (1994)
Austria	4.3	2.9	46.2
Belgium	1.8	1.7	51.2
Denmark	1.5	1.5	71.4
France	3.0	2.6	9.8
Greece	2.8	2.3	n.a.
Ireland	2.0	2.3	49.6
Italy	3.3	1.6	38.8
The Netherlands	3.3	1.8	25.5
Portugal	4.5	3.1	31.8
Spain	3.3	4.3	11.0

Note: Measures produced by the OECD.

In this section I illustrate that there is evidence supporting these intuitions. In Section 4.1, I measure how significant is the *best economic condition effect* in different countries with different institutional backgrounds and union pressures. An interesting exercise is analyzing the covariance between the prevalence of the *best economic condition effect* and an index of asymmetries in wage renegotiation. For this purpose, I use indexes produced by the OECD measuring difficulty of dismissal, employment protection and union density for the selected sample of countries. Table 6 presents measures of the difficulty of dismissal and union pressure for different countries produced by the OECD.

I consider the coefficient of the minimum unemployment estimated by within-groups regressions reported in Table 3 as the size of the best economic condition effect. These coefficients have been estimated in regressions where only the current and minimum unemployment rate were considered and taking into account real wages.[26] As coefficients are negative, the stronger the effect, the smaller the coefficient. Therefore, we expect negative correlation with these indexes.

Table 7: Renegotiation Power

		Difficulty of Dismissal - DOD (1998)	Overall Strictness Protection against Dismissal (1998)	Union Density (1994)
Min. Unemployment Rate Coefficient	Covariance	-0.0023	-0.0022	-0.02
	Correlation	-7.73%	-8.42%	-8.62%

Correlations and covariances are reported in Table 7. Results illustrate that there is a positive association between the strength of downward wage rigidity and institutional backgrounds constraining the bargaining power of firms in ongoing matches. These results suggest that models should take into account that firms are less mobile than workers to renegotiate wages. Consequently, continuous Nash bargaining may not be the best alternative to describe the renegotiation process.

6 Conclusions

In this paper, I study the impact of downward wage rigidity over labor market dynamics. Three main contributions stood out.

Firstly, I propose a matching model with cyclical fluctuations in productivity, endogenous job-termination and on-the-job search where downward wage rigidity is imposed. Simulating the model, I demonstrate that it predicts procyclical quits, countercyclical layoffs and countercyclical unemployment rates. I also show that with some reasonable parameters, the model partially tackles the critique presented by Shimer (2005) of scarce variability of vacancies and unemployment of standard matching models.

Secondly, I provide evidence of downward wage rigidity for ten European Countries using the ECHP. Downward wage rigidity is detected by analyzing the relationship between wages and general economic conditions. Although this approach is less

[26]Taking into account coefficients estimated in regressions where nominal wages are in left hand side, estimated covariances are qualitatively similar.

straightforward than the standard strategy, that directly measures changes in wages, it is robust to measurement error in self-reported wages.

Thirdly, with microdata from the same set of countries, I analyze the cyclical patterns of job termination. The estimates of the separation model parameters imply a strong negative relationship between unemployment rates and quits at the European level. I find a significantly positive effect of the unemployment rate over the probability of layoff. These results suggest that in Europe quits are procyclical and layoffs are countercyclical, as predicted by the model.

I finally connect the evidence in favor downward wage rigidity with indexes of asymmetry between firms and workers in the renegotiation of wages. I find that in countries where dismissing a worker is harder or where unions are stronger, downward wage rigidity is more intense. Taking this evidence into account it would be interesting to explicitly model asymmetries in the renegotiation process. Future models should consider that the wage bargaining process when the worker is an *insider* may be different from the wage bargaining process when the worker is an *outsider*.

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A Appendix

A.1 Simulations of the model

Although the model is simple, it is not straightforward to obtain a closed form solution for the wage. The model is therefore simulated to have a better understanding of its predictions and to be able to compare them with some stylized facts concerning the cyclical behavior of wages and labor market dynamics.[27] I proceed as follow.

The value of a job for the firm and the value of being employed and of being unemployed are solved by value function iterations, for each possible state. The distribution of match heterogeneity in terms of σ_i is assumed to be discrete. There are 6 different elasticity levels evenly partitioning the interval [0,1]. The distribution of states of the economy is also discretized, with three possible states. The best economic condition is also a state variable. There are six (*ie* : factorial of the number of possible states of the economy) possible states for each kind of match in term of y_t and $y^*_{i,t}$, that makes a total of 36 possible states. The six possible states for a given value of σ are.

$$\begin{pmatrix} (y=y_1; y^*=y_1,\sigma) & (y=y_1; y^*=y_2,\sigma) & (y=y_1; y^*=y_3,\sigma) \\ - & (y=y_2; y^*=y_2,\sigma) & (y=y_2; y^*=y_3,\sigma) \\ - & - & (y=y_3; y^*=y_3,\sigma) \end{pmatrix}$$

Following Mortensen and Pissarides (1994), I calculate the value functions in steady state, without taking into account transition in employment ratios.

Due to the downward rigidity in wages, There are only three possible values of wages for each type of match defined in term of σ_i. As is has been assumed that when $y^*_{i,t} = y_t$ wages are described by a Nash negotiation, wages are implicitly defined by the following equation:

$$\beta J(y_t = y^*_{i,t}, y^*_{i,t}, \sigma_i) = (1-\beta)\left[W(y_t = y^*_{i,t}, y^*_{i,t}, \sigma_i) - U(y_t = y^*_{i,t})\right]$$

The dynamics of $y^*_{i,t}$ is totally described by the dynamics of the aggregate shock, y_t. The aggregate shock is modeled as a three state Markov Chain. I choose the following transition matrix:

$$\begin{pmatrix} 0.98 & 0.04 & 0.01 \\ 0.01 & 0.92 & 0.01 \\ 0.01 & 0.04 & 0.98 \end{pmatrix}$$

Which give an autocorrelation coefficient of 0.96 in the aggregate shock, which is the same autocorrelation coefficient used by Fonseca and Muñoz (2003) when calibrating a matching model for the Spanish economy.

There is no clear reference on how to choose δ, the exogenous rate of destruction. Mortensen (1993) calibrated his model with δ= 0.5 percent. But Christensen, Lentz, Mortensen, Neuman and Werwatz (2004) using Danish data estimates a matching model with on-the-job search and the resultant exogenous rate of destruction was 28.33 percent. I use a $\delta = 5\%$ consistent with Davis, Haltiwanger and Shub, (1996).

[27]For simplicity I have showed the model equations assuming that there is no exogenous rate of destruction, in simulations I assume an exogenous rate δ. The model equations including this parameter are presented in Section A.2.

The symmetric bargaining outcome, $\beta = 0.5$, is assumed following Mortensen (1993). This is the solution in the case of a symmetric bargaining game. It is also consistent with structural estimation of similar models with on-the-job search but without counteroffers by Flinn and Mabli (2011) with U.S. data and by Bartolucci (2011), with German data.

I assume a Cobb-Douglas matching function $m(v(y), u(y)) = u(y)^{\alpha} * v(y)^{(1-\alpha)}$. The advantage of this functional form is that if the free entry condition holds, the probability of finding a job and the probability of filling a vacancy do not depend directly on the tightness of the market, they only depend on the expected value of a job for the firm. [28] I impose $\alpha = 0.5$, this elasticity parameter of the matching function is equal to the bargaining power, hence the Hosios condition holds.[29]

The search intensity while employed is $\xi = 0.20$ like in Mortensen (1993). A summary of this parametrization is presented in Table 8.

Table 8: Parameter values for simulation

β (Worker share of Surplus)	0.50	ξ (On-the-job search efficiency)	0.20
c_2 (Searching Cost)	0.50	ρ (Productivity autocorrelation)	0.96
r (Interest rate)	0.05	α (Matching function parameter)	0.50
b (Unemployment benefits)	1.00	δ (Exogenous destruction rate)	0.05

A.2 Model equations with an exogenous rate of destruction

In the model presented in Section 2 there was no exogenous destruction. In order to calibrate the model I allow for exogenous destruction. Every period matches will be destroyed with probability δ.

The value of a vacancy and the value of the unemployment are the exactly the same than before:

The Value of a Job for the Worker has an extra term due to the probability of exogenously loose the job:

$$\begin{aligned} W(y_t, y^*_{i,t}, \sigma_i) &= w(y^*_{i,t}, \sigma_i) + \frac{\delta}{1+r}\int_{y_d}^{y_u} U(y_{t+1})dF(y_{t+1}|y_t) + \\ &\frac{(1-\delta)}{1+r}\max\left[\int_{y_d}^{y_u} U(y_{t+1})dF(y_{t+1}|y_t); \max\left[\Phi(y_t, y^*_{t,i,}, \sigma_i); \Omega(y_t, y^*_{t,i,}, \sigma_i)\right]\right] \end{aligned}$$

[28] This statement's proof is in the appendix.

[29] This condition says that in an economy like the present one, firm entry is socially efficient when the surplus sharing parameter, β, is equal to the elasticity parameter of the matching function, α. See Hosios (1990).

Where $\Phi(y_t, y^*_{t,i,}, \sigma_i)$ is the value of staying in the job but searching:

$$\begin{aligned}\Phi(y_t, y^*_{t,i,}, \sigma_i) &= \max\left\{\xi m(\frac{v(y_t)}{u(y_t)},1)\int_{y_d}^{y_u}\left[\int_{\sigma} W(y_{t+1}, y^*_{i,t+1} = y_{t+1}, \sigma)d\sigma\right] dF(y_{t+1}|y_t)\right.\\ &\left. + \left[1-\xi m(\frac{v(y_t)}{u(y_t)},1)\right]\rho(y_t, y^*_{t,i,}, \sigma_i) - c_2; \Omega(y_t, y^*_{t,i,}, \sigma_i)\right\},\end{aligned}$$

where $\Omega(y_t, y^*_{t,i,}, \sigma_i)$ is the value of staying in the job but without searching:

$$\begin{aligned}\Omega(y_t, y^*_{t,i,}, \sigma_i) &= \int_{y_d}^{R_3(y^*,\sigma_i)} U(y_{t+1})dF(y_{t+1}|y_t) + \int_{R_3(y^*_t,\sigma_i)}^{y^*} W(y_{t+1}, y^*_{i,t+1} = y^*_{i,t}, \sigma_i)dF(y_{t+1}|y_t)\\ &\int_{y^*}^{y_u} W(y_{t+1}, y^*_{i,t+1} = y_{t+1}, \sigma_i)dF(y_{t+1}|y_t)\end{aligned}$$

The value of a job for the firm also has an extra term driven by the exogenous destruction rate:

$$J(y_t, y^*_{i,t}, \sigma_i) = p + \sigma_i y_t - w(y^*_{i,t}, \sigma_i) + \frac{1(NO\ QUIT)*(1-\delta)}{1+r}\left[\Psi(y_t, y^*_{t,i,}, \sigma_i) + \Theta(y_t, y^*_{t,i,}, \sigma_i)\right],$$

where

$$\begin{aligned}\Psi(y_t, y^*_{i,t}, \sigma_i) &= 1\left(\Omega(y_t, y^*_{i,t}, \sigma_i) < \Phi(y_t, y^*_{i,t}, \sigma_i)\right)\left[1-\xi m(\frac{v(y_t)}{u(y_t)},1)\right]\times\\ &\left[\int_{R_3(y^*_t,\sigma_i)}^{y^*_{i,t}} J(y_{t+1}, y^*_{i,t+1} = y^*_{i,t}, \sigma_i)dF(y_{t+1}|y_t) + \right.\\ &\left.\int_{y^*_{i,t}}^{y_u} J(y_{t+1}, y^*_{i,t+1} = y_{t+1}, \sigma_i)dF(y_{t+1}|y_t)\right],\end{aligned}$$

and

$$\begin{aligned}\Theta(y_t, y^*_{i,t}, \sigma_i) &= 1\left(\Omega(y_t, y^*_{i,t}, \sigma_i) > \Phi(y_t, y^*_{i,t}, \sigma_i)\right)\times\\ &\left[\int_{R_3(y^*_t,\sigma_i)}^{y^*_{i,t}} J(y_{t+1}, y^*_{i,t+1} = y^*_{i,t}, \sigma_i)dF(y_{t+1}|y_t) + \right.\\ &\left.\int_{y^*_{i,t}}^{y_u} J(y_{t+1}, y^*_{i,t+1} = y_{t+1}, \sigma_i)dF(y_{t+1}|y_t)\right].\end{aligned}$$

With similar interpretations than the original equations.

A.2.1 Proof that probabilities of filling a vacancy and finding a job only depend on the value functions

If the free entry condition holds, the probability of filling the vacancy is:

$$\frac{m(v(y),u(y)}{v(y)} = m(1, \frac{u(y)}{v(y)}) = \frac{c_1}{\int\limits_{\sigma} \left[\int\limits_{R(\sigma)}^{y_u} J(y_{t+1}, y_{t+1}, \sigma) dF(y_{t+1}|y_t) \right] d\sigma}$$

As I assumed a Cobb-Douglas matching function:

$$u(y) = \left[c_1 / \int\limits_{\sigma} \left[\int\limits_{R(\sigma)}^{y_u} J(y_{t+1}, y_{t+1}, \sigma) dF(y_{t+1}|y_t) \right] d\sigma \right]^{\frac{1}{\alpha}} v(y),$$

and the probability of finding a job is:

$$\frac{m(v(y),u(y)}{u(y)} = \left[\frac{v(y)}{u(y)} \right]^{(1-\alpha)} = \left[\frac{\int\limits_{\sigma} \left[\int\limits_{R(\sigma)}^{y_u} J(y_{t+1}, y_{t+1}, \sigma) dF(y_{t+1}|y_t) \right] d\sigma}{c_1} \right]^{\frac{(1-\alpha)}{\alpha}}.$$

This probability only depends on different values of jobs for the firm, the actual economic condition and the cost of posting a vacancy.

A.3 Model's calibration

In this first approximation to the model calibration, I used much of the parameter values commented in section 3. I have only reduced the variability of y_t from 0.84 to 0.35 and the exogenous destruction rate δ from 5% to 4%.

I then reach reasonable values for the unemployment rate for European Economies[30]. The mean unemployment rate conditioned to recession, 15.77 percent and conditioned to expansion 8.25 percent.

	mean	standard deviation	variation coeff.	autocorrelation
Cyclical component (y_t)	0.36	3.64	28.75	0.96
Mean productivity	10.37	1.60	0.15	0.95
Vacancies ($v(y_t)$)	0.02	0.01	0.49	0.60
Unemployment($u(y_t)$)	0.12	0.08	0.73	0.67
$v(y_t)/u(y_t)$	0.155	0.055	0.357	0.951

[30]See figure 3.

This calibration is tentative, the only dimensions that have been calibrated in equilibrium are productivity autocorrelation and the unemployment rate. As it was stated above, this calibration only wants to show that imposing downward wage rigidity may help to generate more variability in vacancies and unemployment with the same dispersion in productivity. In this model vacancy-unemployment ratio varies more than twice than productivity, that was the original critic made in Shimer (2005).

A.4 Additional Tables

Table 9: Wage Rigidity - Austria

Log(monthly nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.08	-0.05	0.09	-0.08	-0.02	0.06	levels
	(8.38)**	(3.54)**	(6.66)**	(7.87)**	(1.44)	(4.24)**	
(2)	-0.11	0.03		-0.1	0.04		levels
	(14.11)**	(5.99)**		(11.76)**	(5.90)**		
(3)	-0.02	-0.04		-0.04	0.01		job-fixed
	(3.80)**	(3.97)**		(6.62)**	-0.56)		effects

Log(monthly real wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(4)	-0.05	0.04	-0.02	-0.02	0.00	-0.02	levels
	(5.41)**	(3.27)**	(1.77)	(4.98)**	(1.45)	(0.24)	
(5)	-0.07	0.02		-0.06	0.02		levels
	(8.47)**	(2.86)**		(6.84)**	(2.58)**		
(6)	-0.02	-0.04		-0.02	-0.03		job-fixed
	(4.54)**	(3.24)**		(3.65)**	(3.11)**		effects

Note: Each row in the first three columns represents a wage equation where workers with every type of contracts are considered. Each row in the last three columns represents a wage equation where only workers with permanent contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included.

Table 10: Wage Rigidity - Belgium

Log(monthly nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.05	-0.02	0.00	-0.06	0.00	0.00	levels
	(13.85)**	(3.19)**	(0.98)	(17.21)**	(0.08)	(0.57)	
(2)	-0.05	-0.01		-0.05	0.00		levels
	(17.04)**	(2.54)*		(19.61)**	(0.42)		
(3)	-0.01	-0.01		-0.01	-0.01		job-fixed effects
	(2.37)*	(1.93)		(3.67)**	(1.51)		

Log(monthly real wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.02	0.00	-0.02	-0.027	0.003	-0.005	levels
	(4.98)**	(1.45)	(4.41)**	(8.38)**	(0.92)	(0.97)	
(2)	-0.02	-0.01		-0.03)	0.00		levels
	(6.77)**	(3.57)**		(9.31)**	(0.48)		
(3)	-0.00	-0.01		-0.00	-0.01		job-fixed effects
	(-0.49)	(-1.85)		(1.12)	(2.34)**		

Note: Each row in the first three columns represents a wage equation where workers with every type of contracts are considered. Each row in the last three columns represents a wage equation where only workers with permanent contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included.

Table 11: Wage Rigidity - Denmark

Log(monthly nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.04	-0.04	-0.01	-0.11	-0.01	0.00	levels
	(7.32)**	(4.79)**	(2.19)*	(14.90)**	(1.47)	(0.01)	
(2)	-0.05	-0.04		-0.11	-0.02		levels
	(10.53)**	(8.09)**		(19.83)**	(2.19)*		
(3)	0.02	-0.03		0.01	-0.02		job-fixed
	(4.02)**	(4.90)**		(1.27)	(3.00)**		effects

Log(real nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.00	-0.01	-0.03	-0.07	0.002	-0.01	levels
	(0.19)	(1.67)	(4.60)**	(9.18)**	(0.61)	(1.01)	
(2)	-0.01	-0.04		-0.07	-0.01		levels
	(1.82)	(7.17)**		(12.66)**	(0.89)		
(3)	0.02	-0.03		0.00	-0.02		job-fixed
	(2.81)**	(4.67)**		(0.45)	(3.87)**		effects

Note: Each row in the first three columns represents a wage equation where workers with every type of contracts are considered. Each row in the last three columns represents a wage equation where only workers with permanent contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included.

Table 12: Wage Rigidity - France

Log(monthly nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.04	0.02	-0.01	-0.06	0.03	-0.01	levels
	(10.16)**	(2.42)*	(1.70)	(14.76)**	(4.73)**	(1.74)	
(5)	-0.04	0.01		-0.05	0.02		levels
	(15.75)**	(2.74)**		(20.12)**	(5.34)**		
(6)	0.00	-0.03		-0.01	-0.03		job-fixed effects
	(1.36)	(8.36)**		(2.20)*	(6.91)**		

Log(real nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.02	-0.01	0.01	-0.04	-0.01	0.03	levels
	(5.38)**	(1.76)	(1.97)*	(10.53)**	(1.93)	(4.43)**	
(2)	-0.02	0.01		-0.04	0.02		levels
	(8.96)**	(1.65)		(13.93)**	(4.32)**		
(3)	-0.01	-0.03		-0.02	-0.03		job-fixed effects
	(2.48)*	(7.66)**		(4.32)**	(5.79)**		

Note: Each row in the first three columns represents a wage equation where workers with every type of contracts are considered. Each row in the last three columns represents a wage equation where only workers with permanent contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included.

Table 13: Wage Rigidity - Greece

Log(monthly nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	0.11	0.19	-0.08	0.10	0.18	-0.07	levels
	(22.55)**	(11.89)**	(6.36)**	(19.03)**	(9.88)**	(5.19)**	
(5)	0.13	0.08		0.12	0.07		levels
	(31.79)**	(18.37)**		(26.45)**	(14.84)**		
(6)	0.04	0.08		0.04	0.11		job-fixed effects
	(12.80)**	(7.97)**		(11.83)**	(8.56)**		

Log(real nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	0.06	-0.05	0.10	0.06	-0.04	0.11	levels
	(12.66)**	(3.87)**	(6.76)**	(11.36)**	(3.08)**	(5.90)**	
(2)	0.07	0.03		0.07	0.04		levels
	(18.61)**	(8.51)**		(16.10)**	(8.19)**		
(3)	0.03	0.01		0.02	0.08		job-fixed effects
	(9.07)**	(0.92)		(4.90)	(1.23)		

Note: Each row in the first three columns represents a wage equation where workers with every type of contracts are considered. Each row in the last three columns represents a wage equation where only workers with permanent contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included.

Table 14: Wage Rigidity - Ireland

Log(monthly nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	0.03	-0.08	-0.01	-0.01	-0.04	-0.02	levels
	(3.67)**	(8.92)**	(5.15)**	(0.87)	(2.44)*	(6.89)**	
(5)	-0.02	-0.04		-0.04	-0.03		levels
	(7.31)**	(13.32)**		(9.88)**	(6.76)**		
(6)	0.02	-0.02		0.01	-0.01		job-fixed effects
	(4.54)**	(5.72)**		(2.53)*	(2.75)**		

Log(real nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	0.04	-0.01	-0.08	-0.00	-0.01	-0.04	levels
	(5.47)**	(4.14)**	(8.95)**	(0.07)	(5.65)**	(2.33)*	
(2)	-0.01	-0.03		-0.02	-0.02		levels
	(1.86)	(12.94)**		(5.99)**	(6.25)**		
(3)	0.01	-0.02		0.02	-0.02		job-fixed effects
	(3.12)**	(4.50)**		(4.76)**	(4.22)**		

Note: Each row in the first three columns represents a wage equation where workers with every type of contracts are considered. Each row in the last three columns represents a wage equation where only workers with permanent contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included.

Table 15: Wage Rigidity - Italy

Log(monthly nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.11	0.04	-0.01	-0.10	0.04	-0.01	levels
	(29.27)**	(7.29)**	(1.28)	(25.99)**	(8.26)**	(1.22)	
(5)	-0.1	0.04		-0.09	0.05		levels
	(36.86)**	(14.67)**		(32.40)**	(17.20)**		
(6)	0.01	-0.01		0.01	-0.01		job-fixed
	(3.85)**	(3.13)**		(4.87)**	-1.15		effects

Log(real nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.05	-0.01	0.02	-0.05	-0.01	0.03	levels
	(15.46)**	(1.74)	(3.07)**	(13.41)**	(1.26)	(5.14)**	
(2)	-0.06	0.01		-0.05	0.03		levels
	(20.10)**	(4.83)**		(16.72)**	(10.26)**		
(3)	0.01	-0.01		0.01	-0.01		job-fixed
	(1.77)	(2.42)*		(0.43)	(2.56)**		effects

Note: Each row in the first three columns represents a wage equation where workers with every type of contracts are considered. Each row in the last three columns represents a wage equation where only workers with permanent contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included.

Table 16: Wage Rigidity - The Netherlands

Log(monthly nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.01	-0.09	0.02	-0.07	-0.03	0.01	levels
	(2.32)*	(12.50)**	(6.83)**	(10.74)**	(3.38)**	(3.32)**	
(2)	-0.06	-0.03		-0.08	-0.01		levels
	(16.06)**	(7.08)**		(20.41)**	(2.14)*		
(3)	0.00	-0.02		0.02	-0.01		job-fixed effects
	(0.07)	(5.02)**		(3.39)**	(2.27)*		

Log(real nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	0.01	0.02	-0.09	-0.04	0.009	-0.02	levels
	(2.50)*	(7.02)**	(11.88)**	(6.58)**	(3.52)**	(2.41)*	
(2)	-0.03	-0.03		-0.05	0.00		levels
	(8.19)**	(6.15)**		(13.04)**	(0.88)		
(3)	-0.02	-0.01		-0.03	-0.02		job-fixed effects
	(3.50)**	(3.22)**		(4.12)**	(4.01)**		

Note: Each row in the first three columns represents a wage equation where workers with every type of contracts are considered. Each row in the last three columns represents a wage equation where only workers with permanent contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included.

Table 17: Wage Rigidity - Portugal

Log(monthly nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.11	0.01	-0.01	-0.10	0.00	-0.01	levels
	(50.54)**	(2.52)*	(3.28)**	(40.78)**	(0.55)	(3.67)**	
(2)	-0.10	0.00		-0.09	-0.01		levels
	(53.77)**	(0.32)		(44.54)**	(2.44)*		
(3)	0.01	-0.01		0.02	-0.01		job-fixed effects
	(5.27)**	(4.17)**		(7.32)**	(4.20)**		

Log(real nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.06	-0.004	0.003	-0.06	-0.01	-0.004	levels
	(30.81)**	(1.93)	(0.90)	(24.63)**	(2.79)**	(0.97)	
(2)	-0.06	0.00		-0.06	-0.01		levels
	(32.81)**	(0.30)		(27.03)**	(2.23)*		
(3)	0.01	-0.01		0.01	-0.02		job-fixed effects
	(2.43)*	(3.79)**		(1.99)*	(4.74)**		

Note: Each row in the first three columns represents a wage equation where workers with every type of contracts are considered. Each row in the last three columns represents a wage equation where only workers with permanent contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included.

Table 18: Wage Rigidity - Spain

Log(monthly nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.03	-0.01	0.00	-0.04	-0.01	0	levels
	(19.69)**	(4.85)**	(0.06)	(18.94)**	(1.66)	(2.00)*	
(2)	-0.03	-0.01		-0.04	-0.01		levels
	(30.60)**	(9.33)**		(30.17)**	(4.60)**		
(3)	0.00	-0.02		0.00	-0.01		job-fixed effects
	(0.20)	(7.81)**		(0.64)	(5.73)**		

Log(real nominal wages)

	All Types of Contracts			Permanent Contracts			
	Actual rate	Minimum rate	Initial rate	Actual rate	Minimum rate	Initial rate	
(1)	-0.01	0.00	-0.02	-0.02	-0.004	-0.01	levels
	(8.45)**	(0.28)	(5.42)**	(10.67)**	(2.01)*	(1.34)	
(2)	-0.02	-0.01		-0.02	-0.01		levels
	(14.40)**	(9.72)**		(16.37)**	(4.27)**		
(3)	-0.01	-0.01		-0.01	-0.01		job-fixed effects
	(2.93)**	(7.04)**		(2.65)**	(6.12)**		

Note: Each row in the first three columns represents a wage equation where workers with every type of contracts are considered. Each row in the last three columns represents a wage equation where only workers with permanent contracts are considered. Absolute value of t-statistics in parentheses.** significant at 1%; * significant at 5%. Controls for age, tenure, education and dummies for country, sex, type of contract, marital status and immigration status are included.