Job and Workers Flows in Europe and the US: Specific Skills or Employment Protection?*

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Abstract

There is more resistance to layoffs in continental Europe than in the U.S. At the same time, there is some evidence that employed European workers are more productive than their American counterparts. We reconcile these two facts by proposing that some institutions, such as Employment Protection Legislation (EPL), induce workers to invest in and develop job specific skills, making them more productive and leading to costly displacement as these types of skills are lost upon separation from the employer. It is also well established that mobility patterns - flows in and out of unemployment or even movements from job to job, are reduced in continental Europe relative to the U.S. The possibility to invest in skill improvement introduces a complementarity between EPL and the investment decision: more stable matches increase the incentive to accumulate specific skills; but also more productive matches are broken less frequently; hence there is a "multiplier" effect arising from this complementarity. To quantitatively assess all these propositions, we built a tractable asymmetric information matching model featuring all types of transitions out of employment: layoffs, quits to unemployment and job-to-job transitions. We find that EPL does induce workers to invest more in human capital and may help explain greater resistance to layoffs in Europe. We find that flows out of employment are indeed reduced by EPL. However, allowing for skill investment does not generate any strong multiplier due to the fact several new effects are at play keeping unemployment duration at a low level and thus putting downward pressure on the multiplier. The conclusion of all this may be that EPL matters for explaining specialization and low movements out of jobs, but that low movements out of unemployment may be better explained by other institutions such as unemployment benefits.

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1 Introduction

In Continental Europe, workers' displacement from traditional industries is the cause of social and political tensions. For instance, in Flanders, the most dynamic region of Belgium, the announcement of the Renault-Vilvorde plant closing in 1997 and the associated layoff of 3100 workers set huge demonstrations off and was one of the first Euro-strikes. In contrast, the U.K. or the U.S. have traditionally been more phlegmatic about massive job losses. The most recent example is the announcement of the closure of a Ryton's car plant with layoffs of 2300 workers by Peugeot in the U.K. in April 2006, not prompting any reaction from the British government.

The contrast between the two reactions is striking, even though in both cases the local unemployment rate was relatively low. An objective of this paper is to understand why there exists such a difference in the perception of mobility and displacement costs. The answer we propose is that continental European workers have been induced by labor market institutions such as employment protection legislation (EPL) to invest in and develop job and sector specific skills, leading to costly displacement as these types of skills are lost upon separation from the employer. In essence, the rent associated with holding a job increases with EPL. In contrast, institutions in the U.S. or the U.K. are much less specificity-friendly and thus lead to lower costs of occupational mobility.

It is also well established that mobility patterns - flows in and out of unemployment or even movements from job to job, are very different between continental Europe and the U.S./U.K. (Mortensen and Pissarides, 1999). Movements across regions is also limited in Europe. According to the OECD Employment Outlook and Layard and Nickell (1999), mobility rates in terms of the fraction of the population moving from one region to another is between twice and five times lower in France, Germany and Italy (between 0.6% and 1%) than in the U.S. (around 3%). As a result, rates of unemployment in Continental Europe are larger and more persistent in countries such as Spain, France, Italy or Belgium than in the U.S. The literature has focused on institutional differences to explain the patterns observed in Europe and the U.S. In particular, EPL has been argued to restrict the mobility of workers as numerous authors (Bertola and Bentolila, 1990; Blanchard and Portugal, 2001; Delacroix, 2003; Millard and Mortensen, 1997; Mortensen and Pissarides, 1999) have accounted for what is sometimes referred as "Eurosclerosis" by pointing out to more stringent firing restrictions. All such explanations are based on the fact that EPL renders layoffs more costly, thus reducing flows into unemployment. However, if firms anticipate that their expected lifetime surplus will be negatively affected by EPL, they will less actively look for workers, who hence will stay unemployed longer on average. Flows back into unemployment will thus be reduced as well. The two mechanisms have opposite effects on the unemployment rate. Blanchard and Portugal have developed such an argument to show how calibrated Portuguese and American economies can exhibit similar unemployment rates, but very different flows - much smaller in the case of Portugal. These authors have even shown that both quits and layoffs are reduced by EPL. As in the above literature, the reason is similar: EPL reduce market tightness and thus makes it relatively more costly not only to be laid off, but also to quit.

Since this approach has been successful in explaining reduced mobility, we proceed in that tradition. However, our contribution is to consider that more stable matches may also lead to a greater incentive to build up specific human capital, an issue that none of these authors are considering. Indeed, Layard and Nickell (1999) find that productivity per hours worked is higher in continental Europe than in the U.K./U.S. A vast empirical literature (Farber 1993, 1998, 2005; Jacobson et al., 1993; Ruhm, 2005 for the U.S.; Arranz et al., 2005; Bender et al., 2002; Lamo et al., 2005; Lefranc, 2003 for Europe) also quantifies earnings losses following displacement. We show that such costs, predominantly featured by specific skills, are a key ingredient in the analysis of unemployment and job reallocations. We will notably emphasize a complementarity between EPL and specific capital. The presence of costly firing regulations increases job tenure and thus raises the expected duration over which any (match specific) investment can be recouped. Thus, EPL create an additional incentive to invest to improve current productivity. In fact, considering specific human capital (SHC) when modeling EPL is important since there is “complementarity” between two mechanisms which reinforce each other: because of EPL, more stable matches will increase the incentive to accumulate SHC; but also more productive matches will be broken less frequently. hence there is a “multiplier” effect arising from this complementarity.

We thus introduce a mechanism through which firing restrictions affect employed workers' productivity. It is interesting to contrast it to the reallocation effect of EPL obtained in the Hopenhayn and Rogerson (1993) framework. There, firing costs hinder the reallocation of workers across production units subject to idiosyncratic shocks. These allocative inefficiencies have a negative effect of average productivity.[1] However, this is obtained in a setup without human capital and where productivity is determined solely by idiosyncratic shocks. We instead emphasize that EPL may magnify the incentive to invest in productivity improvements.

This mechanism is also important in understanding the reluctance to layoffs observed in continental Europe. If European workers are indeed more productive than their American counterparts, a traditional matching model with *exogenous* skills would predict that they should also be less opposed to layoffs, as their unemployment spells would be shorter (Delacroix, 2003; Millard and Mortensen, 1997). This, however, is assuming that individual productivity is independent of institutions. In a model where there is a complementarity between the two, a loss of a job implies a costly loss of specific human capital.

The channel was introduced in a layoff model in Wasmer (2006), but we need to generalize it in a calibrated model of both quits and layoffs: indeed, EPL and SHC are dual components of separation costs. EPL is an obstacle for firm-induced separations while SHC is an obstacle for worker's induced separations. Our first task is thus to build such a quit-layoff model as two distinct transitions. We also model job-to-job transitions as these movements are also made costlier by the loss of human capital. Thus the paper has a theoretical contribution as well since it builds a tractable matching model with layoffs, quits into unemployment and job-to-job transitions that

[1] Although average productivity may increase when small firms are exempted as in Europe, even in the Hopenhayn and Rogerson framework (Alessandria and Delacroix (2006)).

can be addressed to answer a number of questions. It is important as recent literature (Nagypál, 2006 among others) has shown the quantitative importance of job-to-job transitions, for example. Another theoretical contribution is that the model features inefficient destructions, a feature absent in the traditional Mortensen and Pissarides framework.

Numerically, we find that EPL does increase the incentive to specialize and invest in specific human capital in magnitudes similar to the productivity differences between the U.S. and continental European countries as found in Layard and Nickell (1999) who contrast GDP per hours across countries.[2] We also find that EPL causes relatively larger losses from displacement as the gap between the values of employment and unemployment is increased since human capital investment makes employed workers more productive and reduces the value of unemployment due to the cost of having to re-invest in the next job. Thus more stringent EPL implies greater rents from holding a job and more resistance to layoffs.

We do find that all flows out of jobs - quits, layoffs and job-to-job movements, are restricted by firing regulations. This in turn raises the return from SHC investment. However, when we quantify the associated multiplier effect, we find it to be relatively weak. This is because our setup brings three new channels through which general equilibrium effects of EPL are felt. First, EPL reduces inefficient surplus destruction. Second, EPL induces workers to invest more in specific capital and thus firms to post more vacancies. Third, the perspective of having to re-invest in the next job reduces the worker's bargaining position vis-à-vis the firm. All three effects tend to reduce unemployment duration and to restrict the quantitative multiplier. We consider a few avenues that would reverse these effects and increase the multiplier. One of them would be to re-evaluate the combined effects of EPL and unemployment insurance benefits on unemployment duration, by considering that these policies do not only affect the frequency of matching opportunities, but also the rate at which offers are accepted. This can be done easily within this framework.

The paper proceeds as follows. In Section 2, we provide the basic intuition of a static quit-layoff model. In Section 3, we develop it in a dynamic setup with EPL. In Section 4, we enrich the model by adding a human capital decision upon entry into the match. Sections 5.1 and 5.2 discusses further a few features of labor markets and then calibrates the model to U.S. and European economies. Section 5.3 simulates the two economies under different scenarios. In Section 6, we conclude and suggest alleys for future research.

[2] Other possibilities have been suggested to help explain why European workers are more productive, which are also based on institutions. One is that some institutions may leave the least skilled workers out of the labor force, thus raising the average productivity of the remaining workers actively engaged in the labor market. Another is that certain institutions may improve the quality of matches (Delacroix, 2002; Marimon and Zilibotti, 1999). We do not take the position that these channels are irrelevant. Instead, we suggest that EPL may also increases employed workers' incentive to invest in productive improvements.

2 A static quit-layoff model

We start by introducing the bargaining game in a static setup.[3] We can thus illustrate in a simple manner the trade-offs faced by the two parties when making offers. The game is extended to a dynamic setup in section 3, where we also introduce on-the-job search and firing costs.

Suppose a match is formed between a worker and a firm, generating output $h + \varepsilon$ where h is known to both agents and ε is a private value ε known only by the firm. The worker also has a private valuation ν from the match. Each party has an exogenous outside option $\mathcal{U}$ for the worker and $\mathcal{V}$ for the firm. Let w be the wage paid by the firm. Hence, the payoffs from agreement are $(w + \nu, h + \varepsilon - w)$ to the worker and the firm respectively. The inability to reach an agreement implies a separation and the set of payoffs $(\mathcal{U}, \mathcal{V})$.

Assumption 1. *(Asymmetric information)* The private value ε is drawn from a cdf F with support $[\varepsilon_{\min}, \varepsilon_{\max}]$. The private value ν is drawn from a cdf G, with support $[\nu_{\min}, \nu_{\max}]$. We make no restriction on $\varepsilon_{\max}$ and $\nu_{\max}$ which can be infinite, but exclude distributions for which the support has no lower bound.

Assumption 2 *(Take-it-or-leave-it offers).* One party makes a take-it-or-leave-it offer to the other party. Denote by w_f (w_w) an offer made by a firm (worker).

Assumption 2 implies that the party making the offer faces a trade-off between obtaining a more favorable wage when the offer is accepted and being turned down by the other party, which leaves the offering party with its outside option. Since the payoff from agreement is strictly monotonic in the offered wage, we have reservation strategies on both sides. Let us define a reservation productivity level $\varepsilon_r = \varepsilon_r(w_w)$ for the firm idiosyncratic component and a reservation utility level $\nu_r = \nu_r(w_f)$ for the worker's idiosyncratic component by $h + \varepsilon_r(w_w) - w_w = \mathcal{V}$ and $w_f + \nu_r(w_f) = \mathcal{U}$, or

$$\begin{cases} \varepsilon_r(w_w) = \mathcal{V} - h + w_w, \\ \nu_r(w_f) = \mathcal{U} - w_f. \end{cases}$$

Also denote by Σ_f (Σ_w) the surplus to the firm (worker), and by Σ the total surplus,

$$\begin{cases} \Sigma_w(w) = w + \nu - \mathcal{U} = \nu - \nu_r(w), \\ \Sigma_f(w) = h + \varepsilon - w - \mathcal{V} = \varepsilon - \varepsilon_r(w), \\ \Sigma = h + \varepsilon + \nu - (\mathcal{U} + \mathcal{V}). \end{cases}$$

A wage offer is accepted if and only if it makes the party receiving it better off than with its outside option. For reasons discussed below in the dynamic context, a rejection by the worker of

[3] This type of negotiating game is suggested in Shimer (2005), although to address other kinds of questions.

an offer made by the firm is denoted as a *quit* and a rejection by the firm of an offer made by the worker is denoted as a *layoff*.The wage offer is accepted if and only if it makes the party receiving the offer better off than with its outside option.

2.1 Firm's offers

We first solve here for the firm's offer. The nature of the trade-off mentioned above implies that the offer must maximize the firm's expected surplus.[4] Recognizing that there is no need to (i) offer a wage below one which would be refused for sure by all possible types of workers, or (ii) to offer a wage above one which would be accepted for sure by all types of workers, the firm offer $w_f(\varepsilon)$ solves

$$\max_{w} \quad (1 - G(\nu_r(w)).\Sigma_f(w), \quad s.t.\ \nu_{\min} \leq \nu_r(w) \leq \nu_{\max}.$$

The solution to this problem can be an interior or one of two corner solutions. The first one corresponds to the case where $\nu_r(w_f) = \nu_{\min}$, i.e. when the firm wants to retain the worker for sure. The second corner corresponds to the case where $\nu_r(w_f) = \nu_{\max}$, i.e. when the firm makes an offer that is acceptable to no worker. To rule out that possibility, we need to verify that ε is such that $\nu_r(w_f) < \nu_{\max}$.

Denote by $Q(w_f)$ the probability of a quit following an offer w_f. Solving the firm's problem leads to

$$\begin{cases} \text{Interior solution, } Q(w_f) = G(\nu_r(w_f)) \textit{ and } H_G(\nu_r(w_f)).\Sigma_f(w_f) = 1, \\ \text{Corner solution, } \ Q(w_f) = 0 \textit{ and } \nu_r(w_f) = \nu_{\min}, \end{cases} \tag{1}$$

where $H_G(\nu) = g(\nu)/(1 - G(\nu))$ is the hazard rate function associated with the distribution G. The expressions in (1) reflect the tensions faced by the firm. By increasing the wage offer, the firm decreases its surplus, but also reduces $\nu_r(w_f)$, thus the chance of a separation. The trade-off is quantified by the hazard rate: it states that at the optimal w_f, the marginal rejection probability $g(\nu_r(w_f))$ times the total surplus Σ_f has to equal the marginal gain in surplus (unity) times the continuation rate $1 - G(\nu_r(w_f))$. Of course when ε is high enough, the firm makes an offer that just ensures continuation and the wage becomes independent of ε.

Assumption 3. *$H_G(\nu)$ is non-decreasing over its support.*

Proposition 1 *Under Assumption 3, the interior solution is unique and w_f is increasing in ε.*

Proof. See Appendix.

[4] The firm offer maximizes $\Pr(\widetilde{\nu} < \nu_r(w)) \cdot \mathcal{V} + (1 - \Pr(\widetilde{\nu} < \nu_r(w))) \cdot (h + \varepsilon - w)$, which is equivalent to maximizing expected surplus.

Assumption 3 is only a sufficient condition, satisfied for a wide range of distributions. The first part of the proposition means that system (1) determines a well-defined interior solution. The second part confirms the intuition that the higher the firm idiosyncratic productivity, the more costly it is for the firm to incur a breakdown and thus w_f is increasing in ε.

Given the uniqueness of the interior solution, we have a simple partition of the support of the distribution F into two regions, separated by a unique $\widehat{\varepsilon}$ defined by the value of ε for which the interior solution and the first corner solution coincide. At this point, $\nu_r(w_f) = \nu_{\min}$ and $w_f = \mathcal{U} - \nu_{\min}$ so that using system (1), we have $\widehat{\varepsilon}$ such that[5]

$$\widehat{\varepsilon} = \mathcal{U} + \mathcal{V} + H_G^{-1}(\nu_{\min}) - h - \nu_{\min}.$$

The separation rule can also be derived simply. When $\varepsilon \geq \widehat{\varepsilon}$, there is no separation. When $\varepsilon < \widehat{\varepsilon}$, the worker refuses the offer if $\nu < \nu_r(w_f(\varepsilon))$. Considering only cases in which $\widehat{\varepsilon} \geq \varepsilon_{\min}$,[6] we have that conditional on a firm offer, the *ex-ante* probability of a quit is

$$Q = \int_{\varepsilon_{\min}}^{\widehat{\varepsilon}} G(\nu_r(w_f(\varepsilon)))dF(\varepsilon).$$

2.2 Worker's offers

The trade-off faced by the worker in making an offer is similar to the firm's one. We thus proceed similarly to obtain a simple partition of the support of the distribution G into two regions, separated by a unique $\widehat{\nu}$ defined by the value of ν for which the interior solution and the first corner solution precisely coincide. This threshold is given by[7]

$$\widehat{\nu} = \mathcal{U} + \mathcal{V} + H_F^{-1}(\varepsilon_{\min}) - h - \varepsilon_{\min}.$$

A worker characterized by $\nu \geq \widehat{\nu}$ makes an offer retaining the firm in the match for sure, while a worker with $\nu < \widehat{\nu}$ will make an offer with a risk of separation. Denoting by L the *ex-ante* probability of a layoff conditional on a worker offer, we obtain that

$$L = \int_{\nu_{\min}}^{\widehat{\nu}} F(\varepsilon_r(w_w(\nu)))dG(\nu).$$

2.3 The case of exponential distributions

A simple solution can be obtained when H_F and H_G are constant, as is the case for exponential distributions. In that case, $F(\varepsilon) = 1 - e^{-\phi(\varepsilon - \varepsilon_{\min})}$ over $[\varepsilon_{\min}, +\infty)$ and $G(\nu) = 1 - e^{-\gamma(\nu - \nu_{\min})}$

[5] We can also compute wage offers. For $\varepsilon < \widehat{\varepsilon}$, $w_f = h + \varepsilon - \mathcal{V} - H_G^{-1}(\nu_r(w_f))$. For $\varepsilon \geq \widehat{\varepsilon}$, $w_f = \mathcal{U} - \nu_{\min}$.

[6] Note also that there is a degenerate case, ruled out throughout the text, in which $\widehat{\varepsilon} < \varepsilon_{\min}$ so that there is no longer any quit. This case is reached when the value of h is large enough compared to outside options of agents. We choose parameters so as to always exclude this case but discuss it in appendix.

[7] We can also compute wage offers. For $\nu < \widehat{\nu}$, $w_w = \mathcal{U} - \nu + H_F^{-1}(\varepsilon_r(w_w))$. For $\nu \geq \widehat{\nu}$, $w_w = \varepsilon_{\min} + h - \mathcal{V}$.

over $[\nu_{\min}, +\infty)$ and we know that $H_F(\varepsilon) = \phi$ and $H_G(\nu) = \gamma$. We choose lower bounds which are not zero, but rather $\varepsilon_{\min}$ and $\nu_{\min}$ so that we dot not necessarily have equality of the mean and the standard deviation ($E(\varepsilon) = \varepsilon_{\min} + \phi^{-1}$ and $\sigma_F = \phi^{-1}$).

With constant hazard rates, the system can be solved analytically and the reservation levels are such that $\varepsilon_r(w_w(\nu)) + \nu = \widehat{\nu} + \varepsilon_{\min}$ and $\varepsilon + \nu_r(w_f(\varepsilon)) = \widehat{\varepsilon} + \nu_{\min}$, leading to the solution

$$\begin{cases} \widehat{\varepsilon} = \mathcal{U} + \mathcal{V} + \gamma^{-1} - h - \nu_{\min}, \\ \widehat{\nu} = \mathcal{U} + \mathcal{V} + \phi^{-1} - h - \varepsilon_{\min}, \\ L = \int_{\nu_{\min}}^{\widehat{\nu}} F(\widehat{\nu} - \nu + \varepsilon_{\min}) dG(\nu), \\ Q = \int_{\varepsilon_{\min}}^{\widehat{\varepsilon}} G(\widehat{\varepsilon} - \varepsilon + \nu_{\min}) dF(\varepsilon), \end{cases}$$

while wage profiles are described by

$$\begin{cases} w_f = \min(h + \varepsilon - \mathcal{V} - \gamma^{-1}, \mathcal{U} - \nu_{\min}), \\ w_w = \max(\nu - \mathcal{V} + \phi^{-1}, h + \varepsilon_{\min} - \mathcal{V}). \end{cases}$$

The surpluses also take simple forms reported in Appendix.

Figure 1 graphically summarizes the above results. The figure represents the outcome of the negotiating game following a firm offer (the case of worker offer is similar).

Insert figure 1 here [quit and continuation regions in (ε, ν)-space].

The graph illustrates a very important characteristic of the bargaining game. The probability of a separation following an offer by the firm is fully determined by the productivity threshold $\widehat{\varepsilon}$ (or $\widehat{\nu}$ for an offer by the worker). This property will greatly simplify equilibrium when we consider the dynamic case. However, notice that its interpretation is different from the reservation productivity in a traditional full information Mortensen and Pissarides (MP) framework. In MP, the reservation productivity is also sufficient to compute the ex-ante probability of a separation, since it defines the level below which all matches break down. In this setup too, all matches with $\varepsilon \geq \widehat{\varepsilon}$ do survive as firms want to make sure that the match remains in place by offering a surplus to the worker $\Sigma_w = \nu - \nu_{\min}$. Yet some matches characterized by $\varepsilon < \widehat{\varepsilon}$ may survive as long as ν is high enough (as long as $\varepsilon + \nu > \widehat{\varepsilon} + \nu_{\min}$). With an abuse of language, we refer to $\widehat{\varepsilon}$ as the *quit-point* (i.e. the point above which there can be no quit) and to $\widehat{\nu}$ as the *layoff-point* (i.e. the point above which there can be no layoff). Note that quits increase with $\widehat{\varepsilon}$ while layoffs increase with $\widehat{\nu}$. Since both cutoff points decrease with $h - (\mathcal{U} + \mathcal{V})$, this means that turnover is generally lower when the current match is more productive vis-à-vis the outside options.

Some intuition can be gained from rewriting the definitions of $\widehat{\varepsilon}$ as $h + \widehat{\varepsilon} + \nu_{\min} = \mathcal{U} + \mathcal{V} + \gamma^{-1}$

and of $\widehat{\nu}$ as $h + \varepsilon_{\min} + \widehat{\nu} = \mathcal{U} + \mathcal{V} + \phi^{-1}$ or

$$\begin{cases} \underline{\text{Firm offer:}} \quad \textit{Joint value of agreement at } (\widehat{\varepsilon}, \nu_{\min}) = \textit{Joint value of disagreement} + \gamma^{-1}, \\ \underline{\text{Worker offer:}} \ \textit{Joint value of agreement at } (\varepsilon_{\min}, \widehat{\nu}) = \textit{Joint value of disagreement} + \phi^{-1}. \end{cases} \tag{2}$$

Not surprisingly, asymmetric information leads to the possibility of inefficient separations. Consider an offer by the firm for example. A separation is inefficient if the total surplus $\Sigma = h + \varepsilon + \nu - (\mathcal{U} + \mathcal{V})$ is positive, while the worker surplus $\Sigma_w = \nu - \nu_r(w)$ is negative (the firm does not make an offer it would itself refuse). Given the expression for $\nu_r(w) = \widehat{\varepsilon} + \nu_{\min} - \varepsilon$, an inefficient separation takes place when

$$\mathcal{U} + \mathcal{V} - h \leq \varepsilon + \nu < \mathcal{U} + \mathcal{V} - h + \gamma^{-1}.$$

A similar calculation can be made for worker offers. Thus we refer to system (2) as "inefficient destruction conditions".

3 Dynamic framework with fixed human capital

We retain assumptions $1-3$ and the information structure of the game, but extend the game to a dynamic setting, endogenizing the outside options $\mathcal{U}$ and $\mathcal{V}$. We also enrich the model along three dimensions. First, we introduce EPL in the form of taxes to the firm due upon separation. Second we add a cost of separation to the worker, which we take as exogenous for now and interpret as the necessity to reinvest in human capital for the worker. The human capital decision is endogenized in the next section. Third, we add on-the-job search as job-to-job movements in addition to quits and layoffs are affected by both EPL and already incurred SHC investments.

Employment protection legislation:

The failure to reach an agreement between workers and firms involve explicit separation costs paid by firms, which are assumed to be pure taxes, rather than transfers. Whenever the firm rejects an offer by the worker and lays the worker off, it has to pay T_L. Whenever the worker rejects too low a wage by the firm, the firm has to pay T_Q. Since the worker rejects the offer, why don't we consider that $T_Q = 0$? This is done to prevent firms from separating at no cost by simply cutting the wage down so as to obtain a "voluntary" quit. We thus assume that both T_L and T_Q are positive. Following a job-to-job movement, the firm does no pay any tax.

Specific human capital costs:

We assume that at match formation, workers incur a fixed cost C akin to a specific human capital investment. This cost is endogenized in the next section, highlighting the complementarity between human capital acquisition and EPL.

On-the-job search:

We assume that on-the-job search (OTJS) can only take place after the refusal of an offer. If OTJS is successful, the worker can find a job without returning to unemployment. The implication that OTJS takes place around the time of separation with the firm is empirically supported by works of Nagypál (2006) and Pfann (2001). Nagypál finds that active search on-the-job is a good predictor not only of job-to-job transitions, but also of becoming unemployed. Pfann finds that mass layoffs are preceded by a spike in quits.

3.1 Derivation of equilibrium

All matches start with values ε_0 and ν_0 which are known to both sides. Thus upon entry, the wage w_0 is the outcome of Nash bargaining with bargaining powers α and $1-\alpha$ to the worker and the firm, respectively. After entry, the match is subject to a Poisson process with rate λ. Upon the Poisson event, each party receives a new, independent private draw. From that moment and for the duration of the match, all new idiosyncratic values are private. When the parties receive a new draw, they renegotiate and with probability β $(1-\beta)$, the firm (worker) makes a take-it-or-leave-it offer.

Since the new private draws are independent of previous values, all negotiations have the same ex-ante joint expected payoffs, which we denote as $E(P)$. As we have seen above, negotiations may lead to continuation of the match or to separation. Thus $E(P)$ incorporates both possibilities. Its value can be obtained in two different ways,

$$E(P) = E(P^{\text{firm}}) + E(P^{\text{worker}}) = \beta.E(P_f) + (1-\beta).E(P_w), \tag{3}$$

where superscripts represent the side receiving the payoffs and subscripts represent the side making the offer. The first part of the equality states that combined payoffs are the sum of ex-ante payoffs to the firm and to the worker, while the second part states that combined payoffs are a weighted average of total payoffs under firm offer and total payoffs under worker offer, with the weights reflecting the respective probabilities of making offers.

As is traditional in the literature, we assume the presence of frictions impeding the matching of workers and firms. This is formalized through a matching function which generates a rate p of matching for an unemployed worker and a rate q of matching for a vacant firm, both as functions of market tightness θ, defined as the ratio of vacant jobs to searching workers (see Pissarides (2000) for more details). We denote the value of a filled job as J (J_0 for entry matches) and the value of work as W (W_0 for entry matches). The value of a vacant job is J_v, while the value of unemployment is U.

The value functions are given by

$$rJ(\varepsilon; w) = h + \varepsilon - w + \lambda[E(P^{firm}) - J(\varepsilon; w)] - \delta J(\varepsilon; w), \tag{4}$$

$$rW(\nu; w) = w + \nu + \lambda[E(P^{worker}) - W(\nu; w)] - \delta W(\nu; w), \tag{5}$$

$$rJ_0 = h + \varepsilon_0 - w_0 + \lambda[E(P^{firm}) - J_0] - \delta J_0, \tag{6}$$

$$rW_0 = w_0 + \nu_0 + \lambda[E(P^{worker}) - W_0] - \delta W_0, \tag{7}$$

$$rJ_v = -\kappa + q(\theta)[J_0 - J_v] = 0, \tag{8}$$

$$rU = z + p(\theta)[W_0 - C - U] - \delta U, \tag{9}$$

$$\alpha J_0 = (1 - \alpha)(W_0 - U). \tag{10}$$

In flow terms with the future discounted at rate r, the value of a filled job is the sum of productivity net of wage plus the option value of renegotiating which generates a payoff for the firm equal to $E(P^{\text{firm}})$ minus the loss associated with an exogenous separation at rate δ. Such separations are assumed to be due to workers leaving the labor force altogether. The value of working is the sum of wage and utility from working plus the option value of renegotiating which generates a payoff for the worker equal to $E(P^{\text{worker}})$ minus the loss associated with an exogenous separation at rate δ. The same interpretation can be given for entry matches. The value of a vacant job reflects the payment of a vacancy cost κ per period and the option value of meeting an unemployed worker at rate $q(\theta)$. Free entry drives the value of a vacant job to zero. The value of unemployment is comprised of an income z while searching plus the option value of finding a firm at rate $p(\theta)$ which generates a value of $W_0 - C$, since human capital costs are incurred at the beginning of every new match. An unemployed worker can also leave the labor force. Finally, the last expression is the outcome of Nash bargaining at match formation when both productivity and utility are known.

We proceed to derive equilibrium. To fully characterize it, we need to derive job creation and destruction conditions, as well as to compute the ex-ante payoffs from the game $E(P)$. At this point, it is useful to contrast our equilibrium to the traditional full information MP framework. In MP, the equilibrium is comprised of only job condition and destruction conditions. This model differs in two ways from MP. First, the job destruction conditions reflect the possibility of inefficient separations which are ruled out in MP because of Nash bargaining. Second, the manner in which the surplus is allocated between firm and worker in the negotiations affects separations. This is not the case in MP because of privately efficient Nash bargaining. Thus ex-ante payoffs $E(P)$ are part of the equilibrium with the bargaining game assumed.

Job destruction:

We have seen in section 2 that the probability of separations Q and L only depend on a quit-point $\widehat{\varepsilon}$ and a layoff-point $\widehat{\nu}$, respectively. We thus need to obtain two destruction conditions. We can solve the game as in section 2 taking into account that (i) the setup is dynamic, (ii) there exists separation costs for both sides (EPL and SHC investment), and (iii) upon separation, workers have an opportunity to engage in OTJS to avoid returning to unemployment. In particular, we assume that upon disagreement between worker and firm on the terms of employment, a window of opportunity opens up for the worker to search for a new firm prior to returning to unemployment. To keep the setup stationary, we assume that this window of opportunity closes at a Poisson rate that we take to infinity. As this opportunity is very brief, workers devote infinite search intensity units to finding a partner. In the limit, searching with very high intensity over a very short period results in a *probability* $\Omega(\theta)$ of successful on-the-job search, which depends on market tightness θ. The details of the derivation of $\Omega(\theta)$ are relegated to the Appendix.

The properties of the game in the dynamic framework are the same as in the static one. Hence, the reservation productivity and utility levels $\varepsilon_r(w)$ and $\nu_r(w)$ just make the worker and firm indifferent between accepting or refusing the offer and are such that

$$\begin{cases} J(\varepsilon_r) = \Omega(\theta).J_v + (1-\Omega(\theta)).(J_v - T_L) = J_v - \overline{T_L}, \\ W(\nu_r) = \Omega(\theta).(W_0 - C) + (1-\Omega(\theta)).U = U + \Omega(\theta)[W_0 - C - U], \end{cases}$$

where $\overline{T_L} = (1-\Omega(\theta))T_L$ is the firing tax the firm can *expect* to pay upon laying the worker off. The two expressions take into account the fact that the refusal of an offer may be followed directly by a job-to-job movement. The second expression takes into account the fact that the worker who finds a new firm through on-the-job search negotiates with that firm and expects a payoff $W_0 - C$. Using equations (4)-(5), this leads to the reservation rules

$$\begin{cases} \varepsilon_r(w) = w - h - \lambda E(P^{firm}) - (r+\lambda+\delta).(\overline{T}_L - J_v), \\ \nu_r(w) = -w - \lambda E(P^{worker}) + (r+\lambda+\delta).(U + \Omega(\theta)[W_0 - C - U]). \end{cases}$$

The agents' problems are to maximize their respective expected surpluses,

$$\begin{cases} \textit{For the firm, } \max\limits_{w} \, [1 - G(\nu_r)].[J(\varepsilon, w) + \overline{T}_Q], \\ \textit{For the worker, } \max\limits_{w} \, [1 - F(\varepsilon_r)].[W(\nu, w) - (U + \Omega(\theta)[W_0 - C - U])], \end{cases}$$

where $\overline{T}_Q = (1-\Omega(\theta))T_Q$ is the firing tax the firm can *expect* to pay upon having an offer refused. Notice that T_Q affects the firm's offer through the surplus, while T_L affects the worker's offer through the reservation productivity ε_r.

The properties of the solution to the game are the same as in the static case. There exist a quit-point $\widehat{\varepsilon}$ and a layoff-point $\widehat{\nu}$ which determine the probabilities of separation. These points can be defined as in section 2 using two "inefficient destruction conditions":

$$\begin{cases} \underline{\text{Firm offer:}} \quad \textit{Joint value of agreement at } (\widehat{\varepsilon}, \nu_{\min}) = \textit{Joint value of disagreement} + \frac{\gamma^{-1}}{r+\lambda+\delta}, \\ \underline{\text{Worker offer:}} \; \textit{Joint value of agreement at } (\varepsilon_{\min}, \widehat{\nu}) = \textit{Joint value of disagreement} + \frac{\phi^{-1}}{r+\lambda+\delta}. \end{cases}$$

One can rewrite these two conditions as:[8]

$$\widehat{\varepsilon} = (r+\lambda+\delta)(U+\Omega(\theta)[W_0-C-U])-\overline{T}_Q)-\lambda E(P)+2\gamma^{-1}-h, \tag{11}$$
$$\widehat{\nu} = (r+\lambda+\delta)(U+\Omega(\theta)[W_0-C-U])-\overline{T}_L)-\lambda E(P)+2\phi^{-1}-h. \tag{12}$$

The separation probabilities Q and L following firm and worker offers are determined from the quit and layoff points as

$$Q = \int_{\varepsilon_{\min}}^{\widehat{\varepsilon}} G(\widehat{\varepsilon}-\varepsilon+\nu_{\min})dF(\varepsilon), \tag{13}$$
$$L = \int_{\nu_{\min}}^{\widehat{\nu}} F(\widehat{\nu}-\nu+\varepsilon_{\min})dG(\nu), \tag{14}$$

Ex-ante payoffs:

From (3), we can compute the joint ex-ante payoffs $E(P)$ by computing the payoffs conditional on a particular side offer, $E(P_f)$ and $E(P_w)$. By definition,

$$\begin{aligned} E(P_f) &= \int_{continuation} [J(\widetilde{\varepsilon})+W(\widetilde{\nu})]dF(\widetilde{\varepsilon})dG(\widetilde{\nu}) + \int_{\text{separation}} (U+\Omega(\theta)[W_0-C-U])-\overline{T}_Q)dF(\widetilde{\varepsilon})dG(\widetilde{\nu}), \\ &= (1-Q).E_f[\frac{h+\widetilde{\varepsilon}+\widetilde{\nu}+\lambda E(P)}{r+\lambda+\delta}|cont.] + \ Q.(U+\Omega(\theta)[W_0-C-U])-\overline{T}_Q). \end{aligned} \tag{15}$$

Following a firm offer, a separation may occur with probability Q in which case the joint payoff is fixed or the two partners may accept to continue with joint payoff $J+W$ which depends on the realization of shocks. Similarly the joint ex-ante payoffs conditional on a worker offer is equal to

$$E(P_w) = (1-L).E_w[\frac{h+\widetilde{\varepsilon}+\widetilde{\nu}+\lambda E(P)}{r+\lambda+\delta}|cont.] + \ L.(U+\Omega(\theta)[W_0-C-U])-\overline{T}_L). \tag{16}$$

Job creation:

Equations (6)-(7) can be used to obtain an expression for the total surplus at match formation, which combined with free entry of firms (8) give us that

$$\frac{\kappa}{q} = (1-\alpha)[\frac{h+\varepsilon_0+\nu_0+\lambda E(P)}{r+\lambda+\delta} - U]. \tag{17}$$

We can use equations (9) and (10) to obtain

$$\begin{aligned} U &= \tfrac{z-pC+\frac{\alpha}{1-\alpha}\kappa\theta}{r+\delta}, \\ W_0 - U &= \tfrac{\alpha}{1-\alpha}\tfrac{\kappa}{q}. \end{aligned}$$

Definition: An equilibrium is comprised of a quit-point $\widehat{\varepsilon}$, a layoff-point $\widehat{\nu}$, a market tightness θ and joint ex-ante payoffs from negotiating $E(P)$ satisfying two job destruction conditions (11)-(12), a job creation condition (17) and ex-ante payoffs given by (3), and (15)-(16).

[8] Calculations can be provided upon request by the authors.

3.2 Equilibrium stocks and flows

One can compute the unemployment rate as well as the durations of employment, unemployment and job tenure. For an employed worker, there are four possible transitions: (*i*) layoff to unemployment, (*ii*) quit to unemployment, (*iii*) direct transition to another job and (*iv*) transition out of the labor force. All these transitions are determined in equilibrium:

$$\left[\begin{array}{ll} \text{Layoff rate:} & \rho_L = \lambda.(1-\beta).L.(1-\Omega), \\ \text{Quit rate:} & \rho_Q = \lambda.\beta.Q.(1-\Omega), \\ \text{Job-to-job rate:} & \rho_{JJ} = \lambda.(\beta Q + (1-\beta)L).\Omega, \\ \text{OLF rate:} & \rho_{OLF} = \delta, \\ & \\ \text{Separation rate:} & \rho_S = \lambda.(\beta Q + (1-\beta)L). \end{array}\right.$$

A layoff takes place when a λ-shock hits, the worker gets to make the offer (probability β), the offer is not accepted (probability L) and the worker is not able to find a job before returning to unemployment (probability $1-\Omega$). A quit takes place when a λ-shock hits, the firm gets to make the offer (probability $1-\beta$), the offer is not accepted (probability Q) and the worker is not able to find a job before returning to unemployment. There is a job-to-job transition when an unsuccessful offer is followed directly by a new job (probability Ω). We also include transitions out of the labor force which are assumed exogenous, at rate δ. Finally, we define a separation rate which is the rate at which matches end up terminating due to unsuccessful negotiations, regardless of the worker's next destination (unemployment or another job). This allows to distinguish between job tenure and employment durations, which are two different concepts with OTJS.

To compute durations and tenure, it is useful to refer to the flow graph in Appendix. The average unemployment duration is the inverse of the sum of all rates inducing a movement out unemployment. A similar definition applies to average employment duration. Finally, job tenure differs from the latter, since movements out of a current job are more frequent than movements out of employment. Thus,

$$\left[\begin{array}{l} \text{Average unemployment duration: } \frac{1}{\delta+p}, \\ \text{Average employment duration: } \frac{1}{\delta+\rho_S(1-\Omega)}, \\ \text{Average job tenure: } \frac{1}{\delta+\rho_S}. \end{array}\right.$$

Finally, we compute the unemployment rate in Appendix and find that

$$u\% = \frac{\delta + \rho_S(1-\Omega)}{\delta + \rho_S(1-\Omega) + p}.$$

4 Acquisition of specific human capital

4.1 Optimal investment in specific skills

Specific human capital is an implicit separation cost incurred by workers, because they have to repay it upon starting a new job. So, it acts as the dual of conventional separation costs paid by firms. We now model such a human capital investment. Prior to the negotiation, workers invest in skills at a sunk cost $C(h-h_0)$ with $C'>0$ and $C''>0$. We assume that workers start with human capital h_0, hence $C(0)=0$. The optimal investment in skills is such that

$$C'(h-h_0)=\frac{dW_0}{dh}$$

where W_0 is the entry value of unemployment. Skills are purely specific so that $\partial U/\partial h=0$ as formalized in Wasmer (2006), so that the first order condition can be rewritten as

$$C'(h-h_0)=\frac{dW_0}{dh}=\alpha\frac{1+\lambda dE(P)/dh}{r+\lambda+\delta}. \tag{18}$$

Denote by h^* the optimal level of effort. Adding an investment decision only adds condition (18) to equilibrium. For all other conditions, the cost C is replaced by $C(h^*-h_0)$ where h^* satisfies (18).

4.2 The complementarity between layoff cost and specific human capital investments

We are now better able to understand the role of employment protection on flows in the labor market. We want to illustrate the complementarity between EPL and SHC. We do so analytically in a simpler case where $T_L=T_Q=T$ and $\gamma=\phi$ and where on-the-job search is shut down. The numerical work in section 5 generalizes the result.

We first take the equilibrium conditions and look at partial equilibrium by taking market tightness θ and investment costs C as fixed. Differentiating the system, we obtain that separations are negatively affected both by an increase in layoff costs T and by an increase in h. The differentiation detailed in Appendix yields the following relation:

$$dQ=-B(rdT+dh), \tag{19}$$

where $B^{-1}=\frac{-1}{\widehat{\varepsilon}f'(\widehat{\varepsilon})}+\frac{\lambda\phi^{-1}}{r+\lambda}(2-\frac{f(\widehat{\varepsilon})}{\widehat{\varepsilon}f'(\widehat{\varepsilon})})>0$.

We can now quantify the multiplier effect of human capital by differentiating equation (18), governing optimal skill investment. Human capital investment declines with a higher quit rate, as the expected duration of employment goes down, the marginal return on specific skills declines, a mechanism discussed in Wasmer (2006). Formally,

$$dh=-AdQ, \tag{20}$$

where $A = B^{-2} \frac{\lambda}{r+\lambda} \frac{1}{\phi \widehat{\varepsilon}} \frac{1}{C''(h-h_0)} > 0$. We can now combine equations (19)-(20)to obtain

$$dQ = -\frac{B}{1-AB} r dT.$$

In the absence of variations in h, a unit increase in rT leads to a reduction in turnover of B units. This effect is augmented by $(1-AB)^{-1} > 1$ when specific skills react to the increase in T. The intuition is easy to grasp: a higher T reduces turnover and raises h as indicated by equation (20). This is all the more important that A is large, i.e. when h is more elastic to Q (notably when investment costs are not too convex). Instead, an inelastic h, reflected by convex costs and hence low A, does not amplify the partial equilibrium response of Q to the firing tax.

5 Quantitative analysis

5.1 Labor market transitions

We first want to obtain summary statistics of labor market transitions, focusing on a sample of the 25-54 year old population for the period 1994-2001. The U.S. flows are reported from Garibaldi and Wasmer (2005). The flows for European countries are based on authors' calculation from the European Community Household Panel (ECHP). We consider that workers can be in one of three states: employed, unemployed or out of the labor force and look at the data in two different ways in order to guide our calibration. First, we quantify the rate at which workers flow between these three states. Thus we reproduce average durations in any state. Second, the theoretical model makes a clear distinction between layoffs to unemployment, quits into unemployment and job-to-job transitions. So conditional on a separation from a firm, we classify the transitions according to the category in which it falls. Thus, we also precisely match the different types of separation from the firm.

We report the six transitions between states e, u and n (employment, unemployment and inactivity) where xy, $x, y \in \{e, u, n\}$ represents the monthly transition rate between states x and y. The average duration in state x is thus $1/(xy + xz)$ where y and z are two distinct states from x. Such numbers are reported in table 1. We average out the Continental European countries (Germany, France, Spain and Italy) in the 5^{th} column, while column 6 reports U.K. statistics and the last column reports U.S. statistics (note that the latter comes from another source).

Insert table 1 here [transitions between states].

The second set of statistics is obtained for the countries in the ECHP dataset only. We know, for all persons in the survey at time t who left a previous job within two years, the reason for having left that job.[9] This information is available regardless of current status (employed, unemployed

[9] The exact universe is the 25-54 population having been previously employed and, according to the survey documentation, "person stopped working in last job at the earliest 2 years before it joined the survey."

or inactive). The survey allowed for twelve possible reasons for leaving a job. In table 2, we show how we grouped the survey answers either by type of decision - layoffs, quits, job-to-job transitions or family/demographic transitions, or by destination - unemployment, out of the labor force or directly to another job. In family/demographic transitions, we regroup family and personal reasons such as health reasons, unrelated to the current job. This will correspond to the exogenous δ-transitions out of the labor force in the theoretical model. We report in table 3 the data for the different European countries.[10]

Insert table 2 here [defining the different types of separation from firm].
Insert table 3 here [reporting that data].

5.2 Numerical strategy and calibration

The methodology is to consider separately an economy where there is no possibility to invest in specific human capital ("exogenous human capital") and another economy where workers can invest in human capital at the beginning of a match ("endogenous human capital"). In both cases, we calibrate on the U.S. economy to determine the structural parameters (using U.S. policy parameters) and then experiment with that same economy only changing policy parameters to reflect European type regulations. We are mostly interested in three types of predictions: (i) flows between the labor market states, (ii) the degree of investment in human capital, and (iii) losses associated with separation from a firm. Proceeding as we do enables us: to evaluate how much of the difference in flows between the U.S. and Europe are due to firing restrictions; to determine how much more can be explained when incentives to specialize (i.e. invest in human capital) are enhanced by such restrictions; to quantify the investment in human capital; and to determine losses from separations with and without specialization.

We first calibrate a US economy with no firing costs in a world where human capital investment is not allowed and refer to it as the exogenous HC case. We take the human capital investment cost function to be quadratic, i.e. $C(h-h_0) = c_0.(h-h_0)^2/2$. In the exogenous case, we set $c_0 = 0$ and $h_0 = 1$ as a normalization. The time period is 1 month. The discount rate is chosen so that the annual interest rate is 4%. Frictions in this model come from shocks that lead to renegotiations and to informational frictions which impede on the matching of workers with firms. We assume as is traditional in the matching literature that the arrival rate λ corresponds to shocks hitting a match approximately every other year on average.[11] The difficulty in finding partners for unemployed workers and vacant firms is modeled through a Cobb-Douglas meeting function and the elasticity of meeting with respect to vacancies is $\eta = 0.5$ as estimated by Petrongolo and

[10] We do not have strictly comparable data for the U.S. Consequently, we retain the same proportion of layoffs, quits, family/demographic and job-to-job transitions conditional on separation from the firm, as estimated for the U.K. Nonetheless, as we have that data, we calibrate the US economy to match US unemployment and employment durations.

[11] We actually choose $\lambda = 1/20$ to help with replicating a relatively low employment duration.

Pissarides (2001). Finally, we choose the initial shocks $\varepsilon_0 = \nu_0 = 0$ equal to the mean of the distributions of private values. The policy parameters, unemployment insurance z and the firing costs T_Q and T_L, are determined by U.S. regulations, $z = 0.25$ and $T_Q = T_L = 0$.

We close out the calibration by matching labor market transitions and the different types of separations from a current job. Thus we choose parameters to replicate an average duration of employment of 3.2 years and an average duration of unemployment of 2.4 months. Notice that due to the possibility to carry out on-the-job search, the theoretical model makes a distinction between employment duration and job tenure, as opposed to the traditional Mortensen and Pissarides framework. However, since we use transition data out of the various labor market states, we match employment duration. We also match a ratio of layoffs to total separations of 22.5%, quits to separations of 11.1%, family/demographic transitions to total separations of 27.1% and job-to-job movements to total separations of 39.3%. Finally, model parameters were set to obtain a market tightness equal to 1 and average vacancy posting costs of 4 months. The calibrated values are reproduced in table 4.

Insert table 4 here [U.S. exogenous calibration].

Next, we recalibrate a US economy now allowing for investment in human capital and refer to it as the endogenous HC case. We proceed in essentially the same manner, but for the fact that we have to calibrate two new parameters, the cost parameter c_0 and the increment in productivity $h - h_0$. We set the pre-investment productivity $h_0 = 0.75$ to be in line with earnings losses from separation of 25% as in Jacobson, LaLonde and Sullivan (1993) and calibrate c_0 so that total investment is again equal to $h = 1$. All the other parameters have to also be recalibrated. The calibrated values are reproduced in table 5.

Insert table 5 here [U.S. endogenous calibration].

5.3 Simulations

Labor market flows:

Let us first look at the effect of firing costs on labor market flows in the exogenous case. We take the US structural parameters and choose for Europe a value of $z = 2/3$. We choose $T = T_Q = T_L$ throughout and let T vary from 0 to 9 months of output. The results are consistent with what has been previously found both in the empirical and theoretical literatures. Employment and unemployment durations increase (combining to cause a small decrease of the unemployment rate in that case.) We also find that the quit rate, the layoff rate and the job-to-job transition rates decrease. Thus all types of flows are also reduced by employment protection legislation.[12] The results of our simulations in the exogenous case are reported in table 6.

[12] Notice that the ratio of the quit to layoff rates decreases with T, yet not sufficiently to match the ratios observed in Europe [see our data from ECHP or Blanchard and Portugal (2001)].

Insert figure 2 and table 6 here [T and flows, exogenous case].

While qualitatively the model performs well by indeed reducing *all* types of flows out of jobs as well as flows into jobs, it does not perform as well quantitatively. The levels of employment and unemployment durations are too low (3.5 years and 4 months respectively) and these durations are too insensitive to rather large changes in employment protection legislation (employment duration only increases by a year and unemployment duration increases by less than a month when firing costs are increased to 9 months of output). Notice that by proceeding the way we did, changing z while keeping the other structural parameters unchanged, we necessarily started with a lower employment duration than that calibrated for the U.S. This is because increasing z reduces the gap between the value of unemployment and that of employment and leads to more separations. So, this explains in part why predicted European employment durations are too low. However, that does not provide a rationale for the lack of variability of employment duration with respect to T. It is however conceivable that looking at the endogenous case, we may find more variability due to the multiplier effect coming from the interactions of firing costs with the incentive to invest in specific human capital. This is what we do next.

When we consider the endogenous case (table 7), we can see that all flows out of jobs are reduced regardless of their type, as evidenced by increasing employment durations and reduced quit, layoff and job-to-job rates as with the exogenous case. However, we also observe a slight decrease in unemployment duration. This is due to the fact that with higher human capital investment, matches are more profitable and firms post more vacancies. In equilibrium, this tends to keep employment duration lower. As a result, the "multiplier" we find by comparing the exogenous and endogenous cases is relatively weak: by increasing T from 0 to 9 months of output, employment duration increases by approximately 30% in the exogenous case, and by approximately 35% in the endogenous case. In a way, our success in finding that employment protection legislation does enhance the incentive to invest in human capital comes at the cost of a lower multiplier.

It is worth commenting on that lack of a really strong multiplier effect. First, we tried different parametric specifications and assumptions on the nature of the distribution of private values F and G and although one can find higher values for the multiplier, these values are still too low to help match European employment durations. The issue is always that more human capital investment tends to reduce unemployment duration and thus puts downward pressure on durations as well in equilibrium. To better understand this issue, it is worth taking a look at the different effects at play. With no investment in human capital, we have the usual effect that increasing T makes it more costly to separate and reduces matches surplus, thus causing job creation and job destruction to fall. In this model however, there is also another mechanism at play even without HC investment. Since we may have inefficient destructions, increasing separation costs would cause employment duration to increase and unemployment duration to decrease because of fewer inefficient destructions of surplus.

When we let workers choose their specific HC, we add two new effects. First, specialized workers are more productive, increasing surplus and reducing unemployment duration. Second, since re-investment represents a cost to workers in case of separation, it reduces their value of unemployment and thus their bargaining position, further encouraging vacancy posting and reducing unemployment duration.

Thus, if we compare this model to the traditional Mortensen and Pissarides framework, we add three effects that each tend to reduce unemployment duration. More employment protection legislation reduces inefficient surplus destructions, it encourages worker to increase their productivity and it adversely affect their bargaining position. We leave it for future research to determine which effect is the most important quantitatively.

In conclusion, the endogenous model delivers the right qualitative predictions on flows out of jobs, but due to the fact that more productive workers implies a shorter duration of unemployment, the multiplier effect is relatively weak. As we have seen, this model introduces new mechanisms that tend to keep unemployment duration low. To remedy that, there are a few avenues to consider. First, one could put investment costs either on the firm side or have them shared between the two parties. This would reverse one of the new effects highlighted. Second, one could consider that longer unemployment durations in Europe are due more to the fact that more jobs are refused before finally leaving unemployment, rather than because of large differences in market tightness between the U.S. and Europe. This would be akin to adding an acceptance margin for jobs. As opposed to the traditional Mortensen and Pissarides model, this can be done easily within this framework, by considering that the same asymmetric bargaining applies for all, new and continuing, jobs. This way we avoid the fact that with Nash bargaining for entry jobs, all first offers are necessarily accepted.

Insert table 7 here [T and flows, endogenous case].

Incentive to specialize and losses from displacement:

We can verify that employment protection legislation provides an incentive to specialize by looking at how human capital investment varies with T. Table 8 shows that as employment protection legislation increases from 0 to 9 months of output, additional specific investment has made the worker 7% more productive. Even though nothing in the calibration was chosen from that perspective, it is of the same order of magnitude as the figures reported in Layard and Nickell (1999) who find that based on six continental European countries (Belgium, France, Germany, Italy, the Netherlands and Spain) in 1994, productivity measured as GDP per hour worked was 4% higher in continental European countries than in the U.S.

Can the specialization of European workers also account for the resistance to mass layoffs as alluded to in the introduction? We tackle that question by looking as lifetime losses from displacement and measure it as the loss in value for employed workers net of their unemployment value, $E[W|match] - U$. We also compute this loss *relative* to U, i.e. $(E[W|match] - U)/U$. We find that as T varies from 0 to 9 months of output, the relative losses due to displacement increase from 3.56% when $T = 0$ to 6.57% when $T = 9$. Thus specialization is consistent with larger losses as it increases the gap between current employment at high productivity and unemployment with re-investment costs. This is even despite the fact that unemployment insurance is higher in Europe and that market tightness increases with T in the simulations for the endogenous case. We can also compare the same relative lifetime losses for a European worker (with $T = 9$) and an American worker (with $T = 0$ and lower UI benefits). We find that while the loss is 6.57% for the European worker, it is only 5.28% for the American worker. The model predicts that there is more resistance to layoffs in Europe because European workers have relatively more to lose in lifetime value from displacement.

Insert table 8 here [T and HC investment].

6 Conclusion

We developed a matching model characterized by all types of labor market transitions and featuring separation costs both on the firm and the worker sides to study how firing restrictions affect European labor markets. When workers can invest in specific human capital, firing restrictions induces specialization which makes separation more costly. Quantitatively, our model showed that indeed workers who are protected by more stringent regulations invest more in specific capital and as a result have more to lose from separation. This is consistent with European experience where employed workers are more productive and yet oppose layoffs more. A model lacking the investment motive would not deliver these combined predictions.

Our model also finds that firing restrictions reduce all the different types of separations from the firm (layoffs, quits into unemployment and job-to-job transitions), consistent with less mobility in European labor markets. The complementarity that exists between job stability and human capital investment is however quantitatively determined to be relatively weak. We found it to be because our model introduces three new channels through which EPL affects unemployment duration - inefficient separations are fewer, more productive workers induce more vacancy posting, and re-investment costs in the next job adversely affect the worker bargaining position in the current job. We suggested several ways to undo these effects.

One interpretation of our model is that EPL may be central to understand the restricted flows out of jobs and from jobs to jobs, as well as the incentive to specialize and the associated resistance to layoffs, but that unemployment insurance may be central in understanding flows out of unemployment. In future research, we intend to adjust this framework to add a job acceptance margin at entry. This can be done relatively easily within this setup by letting all negotiations be determined by the same asymmetric information bargaining game.

Another alley of research is to empirically assess the importance of specific capital investment in Europe versus the U.S., a task made difficult first by the lack of available direct evidence across countries, and second by the fact that wage compression in Europe may interfere with inferences one can make from evidence on earning losses.

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Appendix

A Optimal wage offers

A.1 Proof of uniqueness of offer

The interior solution is conveniently rewritten as a function of $\nu_r(w_f)$. In using $\Sigma_f = \nu_r(w_f) - \nu + \Sigma(\varepsilon, \nu)$ where by linearity, $-\nu + \Sigma(\varepsilon, \nu)$ is independent of ν (unknown to the firm anyway), we have $H_G(\nu_r(w_f))^{-1} = \nu_r(w_f) - \nu + \Sigma(\varepsilon, \nu)$. The right hand side is linear in $\nu_r(w_f)$ and the left hand side is decreasing or constant, so that there is at most one intersection $\nu_r(w_f)$ and thus one wage. Further, since Σ increases in ε, the intersection $\nu_r(w_f)$ decreases in ε and the wage w_f increases in ε.

A.2 Surpluses in the static case

When the firm makes the offer, it is also informative to compute the surpluses to the firm Σ_f and to the worker Σ_w:

$$\begin{cases} \textit{firm surplus} = & \begin{cases} \gamma^{-1}, & \text{if } \varepsilon < \widehat{\varepsilon}, \\ \gamma^{-1} + \varepsilon - \widehat{\varepsilon}, & \text{if } \varepsilon \geq \widehat{\varepsilon}, \end{cases} \\ \textit{worker surplus} = & \begin{cases} \nu - \nu_{\min} + \varepsilon - \widehat{\varepsilon}, & \text{if } \varepsilon < \widehat{\varepsilon}, \\ \nu - \nu_{\min}, & \text{if } \varepsilon \geq \widehat{\varepsilon}. \end{cases} \end{cases}$$

In other terms, when the firm makes an offer, it obtains for itself at least a surplus equal to γ^{-1}, conditional on reaching an agreement. When the solution is a corner, then acceptance of the offer by the worker is guaranteed and γ^{-1} becomes a lower bound for the firm surplus. Clearly, the firm is not going to make an offer that would not at least match its outside option and there cannot be a layoff following a firm offer.

A quit occurs when the worker's surplus is negative. When the solution is interior, the worker may quit when the total surplus is less than γ^{-1}. Separations that take place when the total surplus is between 0 and γ^{-1} are thus inefficient, a natural feature with asymmetric information and take-it-or-leave-it offers.

A similar formula can be given for the surplus of each party when the worker makes the offer:

$$\begin{cases} \textit{firm surplus} = & \begin{cases} \varepsilon - \varepsilon_{\min} + \nu - \widehat{\nu}, & \text{if } \nu < \widehat{\nu}, \\ \varepsilon - \varepsilon_{\min}, & \text{if } \nu \geq \widehat{\nu}, \end{cases} \\ \textit{worker surplus} = & \begin{cases} \phi^{-1}, & \text{if } \nu < \widehat{\nu}, \\ \phi^{-1} + \nu - \widehat{\nu}, & \text{if } \nu \geq \widehat{\nu}. \end{cases} \end{cases}$$

B Dynamic case

B.1 Calculation of the probability $\Omega(\theta)$ of job-to-job movement

We represent all the possible movements of workers in the following graph.

Insert figure 3 here [flow chart].

In steady state,

$$\begin{cases} L = U_n + E_s + E_{-s}, \\ \delta L + \mu E_s = (\delta + p(\theta))U_n, \\ p(\theta)U_n + p_e(\theta)E_s = (\rho_S + \delta)E_{-s}, \\ \rho_S E_{-s} = (\delta + p_e(\theta) + \mu)E_s, \end{cases}$$

where L is the size of the labor force, U_n the number of unemployed workers, E_s the number of employed workers searching on-the-job, E_{-s} the number of employed workers not searching. Denote by μ the rate at which the option to search on-the-job before having to return to unemployment terminates. The rate at which on-the-job searchers do find a new firm is $p_e(\theta)$. As $\mu \to +\infty$ (the OTJS window just opens up for an instant), it must be that $p_e \to +\infty$ as well. Denote $\Psi = \lim \mu/p_e$ that we assume finite. We are looking for $\Omega(\theta)$ the fraction of workers who just got a "bad" λ-shock and who "instantaneously" found a new job. By definition,

$$\Omega(\theta) = \frac{p_e(\theta)E_s}{\rho_S E_{-s}} = \frac{p_e(\theta)}{\delta + p_e(\theta) + \mu} = \frac{1}{1+\Psi},$$

in the limit.

The number of meetings is given by $m(s_u U_n + s_e E_s, V)$, where s_u, s_e are the respective search intensity units. Thus the individual meeting probabilities are given by $\frac{s_i}{s_u U_n + s_e E_s} m(s_u U_n + s_e E_s, V)$, $i = u, e$. Define market tightness $\theta = \frac{V}{s_u U_n + s_e E_s}$. Then,

$$\begin{cases} p(\theta) = s_u.m(1,\theta), \\ p_e(\theta) = s_e.m(1,\theta). \end{cases}$$

That implies that $s_e \to +\infty$. Define $\Psi_0 = \lim \mu/s_e$. Thus $\Psi_0 = \Psi.m(1,\theta)$. Let us normalize $s_u = 1$. Consequently, $\Psi_0 = \Psi.p(\theta)$ and

$$\Omega(\theta) = \frac{1}{1 + \Psi_0.p(\theta)^{-1}} = \frac{p(\theta)}{p(\theta) + \Psi_0}.$$

We can use Ψ_0 as a search intensity parameter for the employed to help us match job-to-job flows.

B.2 Calculation of the unemployment rate

We can rewrite the system of flow equations taking into account that $\mu \to +\infty$ and $p_e \to +\infty$. Also remember that $\mu/p_e \to \Psi = \Psi_0.p(\theta)^{-1}$. Since $\delta L + \mu E_s = (\delta + p(\theta))U_n$, it must be that $E_s \to 0$ and $E_{-s} \to E$ (total employment). Thus, the above system of flow equations can be rewritten as

$$\begin{cases} L = U_n + E, \\ \delta L + (\mu E_s) = (\delta + p(\theta))U_n, \\ p(\theta)U_n + \Psi^{-1}(\mu E_s) = (\rho_S + \delta)E, \\ \rho_S E = (1 + \Psi^{-1})(\mu E_s). \end{cases}$$

This is a system in U_n, E and (μE_s) to solve. Using the fact that $\Omega(\theta) = 1/(1+\Psi)$, one can compute the unemployment rate $u\% = U_n/L$ as

$$u\% = \frac{\delta + (1 - \Omega(\theta))\rho_S}{\delta + (1 - \Omega(\theta))\rho_S + p(\theta)}.$$

B.3 Multiplier effects of specific skills

We have, differentiating the equations for Q, $\widehat{\varepsilon}$ $E(P)$ that

$$\begin{aligned} &dQ = -\widehat{\varepsilon} f'(\widehat{\varepsilon}) d\widehat{\varepsilon}, \\ &d\widehat{\varepsilon} = -(r+\lambda)dT - \lambda dE(P) - dh, \\ &(r+\lambda)(dE(P) + dT) = -2\phi^{-1}dQ - \phi^{-1} f(\widehat{\varepsilon}) d\widehat{\varepsilon}. \end{aligned}$$

So, eliminating first $d\widehat{\varepsilon}$ and then $dE(P)$ from these equations, we obtain

$$\begin{aligned} &-\tfrac{dQ}{\widehat{\varepsilon} f'(\widehat{\varepsilon})} = -(r+\lambda)dT - \lambda dE(P) - dh, \\ &(r+\lambda)(dE(P) + dT) = -\phi^{-1} dQ \left(2 - \tfrac{f(\widehat{\varepsilon})}{\widehat{\varepsilon} f'(\widehat{\varepsilon})}\right), \\ &\textit{thus } dQ = \frac{-rdT - dh}{-\frac{1}{\widehat{\varepsilon} f'(\widehat{\varepsilon})} + \frac{\lambda}{r+\lambda}\phi^{-1}\left(2 - \frac{f(\widehat{\varepsilon})}{\widehat{\varepsilon} f'(\widehat{\varepsilon})}\right)} = -B(rdT + dh). \end{aligned}$$

The first equation states that a higher firing tax or a higher turnover rate reduce the expected payoff. The second equation determines the impact of layoff costs and specific human capital on turnover: both reduce turnover; further, a marginal unit of specific skills dh has the same impact as the interest payment of a unit of firing tax rdT.

We also have, differentiating the equation for $E(P)$ that

$$\begin{aligned} \tfrac{dE(P)}{dh} &= \tfrac{\partial E(P)}{\partial Q}\tfrac{\partial Q}{\partial h} = \tfrac{1}{r+\lambda}\left(+2\phi^{-1}+\phi^{-1}\tfrac{f(\widehat{\varepsilon})}{-\widehat{\varepsilon}f'(\widehat{\varepsilon})}\right)(-\partial Q/\partial h)\,, \\ &= \tfrac{1}{r+\lambda}\left(+2\phi^{-1}+\phi^{-1}\tfrac{f(\widehat{\varepsilon})}{-\widehat{\varepsilon}f'(\widehat{\varepsilon})}\right)B. \end{aligned}$$

Thus after differentiation,

$$\begin{aligned} C''(h-h_0)dh &= \tfrac{\lambda}{r+\lambda}d\left(\tfrac{dE(\mathcal{P})}{dh}\right) = \tfrac{d}{d\widehat{\varepsilon}}\left(\left(+2\phi^{-1}+\phi^{-1}\tfrac{f(\widehat{\varepsilon})}{-\widehat{\varepsilon}f'(\widehat{\varepsilon})}\right)B\right)d\widehat{\varepsilon}, \\ &= \tfrac{\lambda}{r+\lambda}\tfrac{d}{d\widehat{\varepsilon}}\left(\left(+2\phi^{-1}+\phi^{-1}\tfrac{f(\widehat{\varepsilon})}{-\widehat{\varepsilon}f'(\widehat{\varepsilon})}\right)B\right)\tfrac{dQ}{-\widehat{\varepsilon}f'(\widehat{\varepsilon})}, \\ &= \tfrac{\lambda}{r+\lambda}\tfrac{1}{-\widehat{\varepsilon}f'(\widehat{\varepsilon})}\tfrac{d}{d\widehat{\varepsilon}}\left(\left(2\phi^{-1}+\phi^{-1}\tfrac{f(\widehat{\varepsilon})}{-\widehat{\varepsilon}f'(\widehat{\varepsilon})}\right)B\right)dQ, \end{aligned}$$

using the fact that $f'(\varepsilon)/f(\varepsilon) = f''(\varepsilon)/f'(\varepsilon) = -\phi$ and showing that a higher turnover rate discourages specific investments. Then defining

$$A = B^{-2}\frac{\lambda}{r+\lambda}\frac{+(\phi\widehat{\varepsilon})^{-2}+\frac{1}{\widehat{\varepsilon}}(1+\widehat{\varepsilon}f''(\widehat{\varepsilon})/f'(\widehat{\varepsilon}))\left(+2\phi^{-1}-\phi^{-1}\frac{f(\widehat{\varepsilon})}{\widehat{\varepsilon}f'(\widehat{\varepsilon})}\right)}{C''(h-h_0)},$$

we obtain the relationship in Section 4.2.

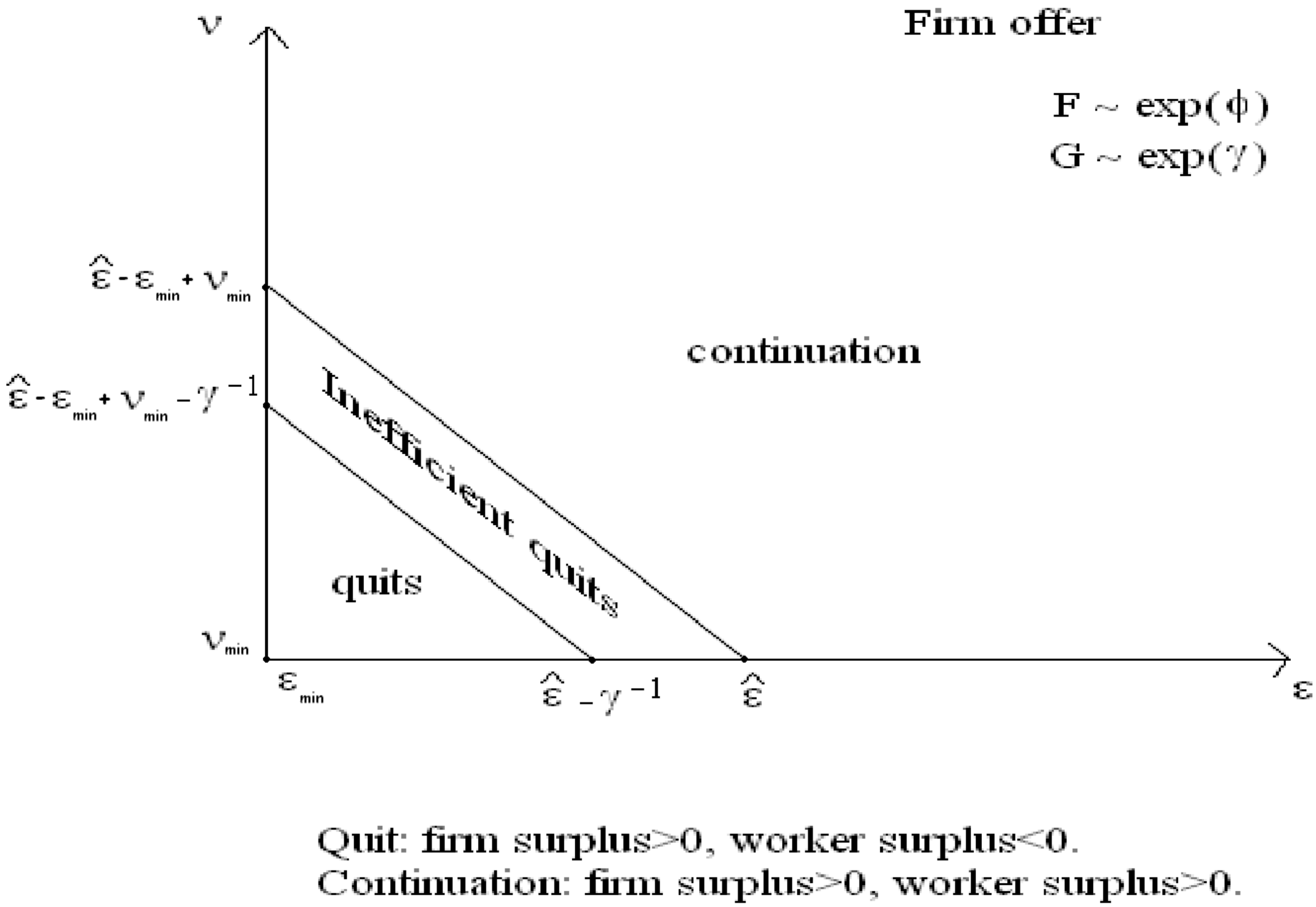

Figure 1: **Static negotiating game**

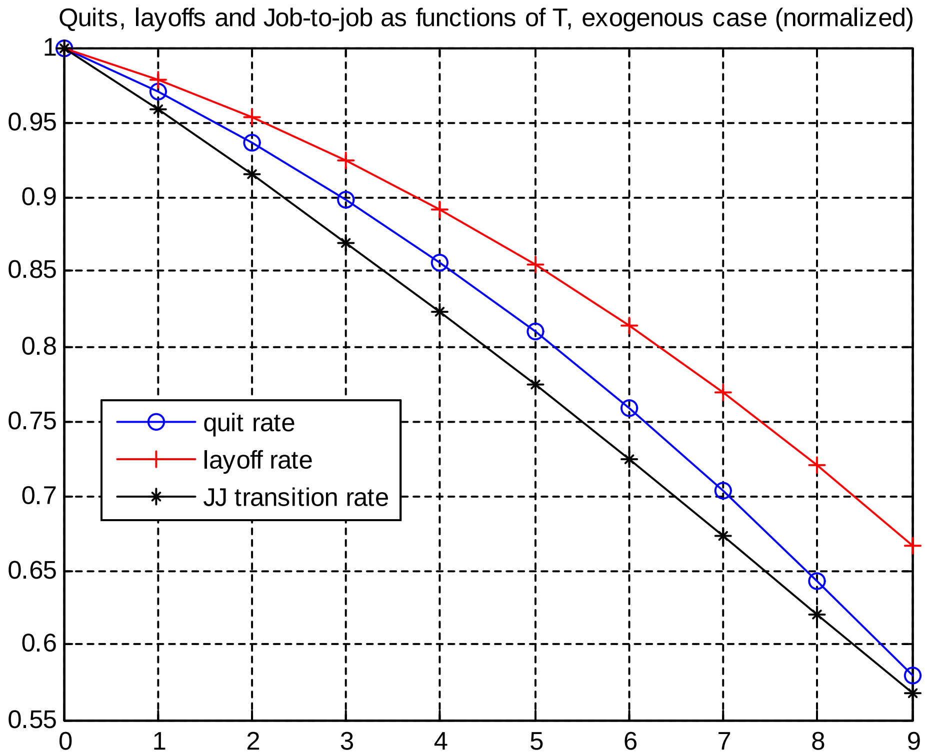

Figure 2: **Transitions out of jobs**

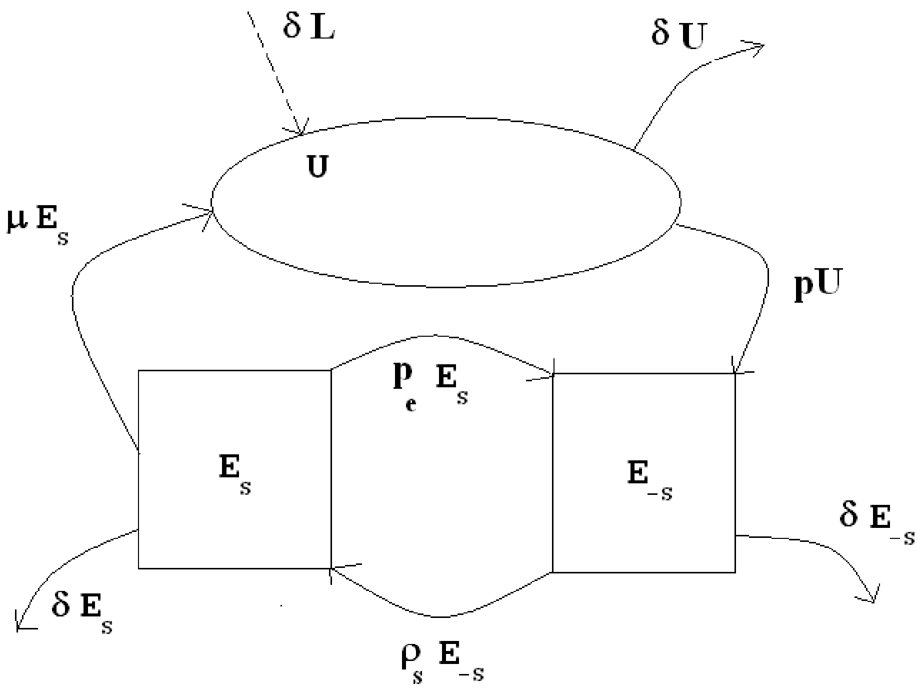

Figure 3: **Flow chart**

Table 1:

Summary statistics, transitions							
country	Germany	France	Italy	Spain	Cont. Europe	U.K.	U.S.
monthly flows (%)							
eu	0.507	0.613	0.462	1.572	0.789	0.366	1.02
en	0.188	0.182	0.186	0.220	0.194	0.355	1.62
ue	5.773	6.983	3.090	6.082	5.482	6.590	25.90
un	0.943	1.769	0.142	0.295	0.787	1.970	16.59
ne	1.038	1.280	0.297	0.458	0.768	1.449	3.46
nu	0.287	0.953	0.102	0.181	0.381	0.503	4.43
duration E (yrs)	12.0	10.5	12.9	4.7	9.9	11.5	3.2
duration U (mths)	14.9	11.4	30.9	15.7	18.2	11.7	2.4
duration N (yrs)	6.3	3.7	20.9	13.0	11.0	4.3	1.1
Ergodic stock/population							
Unemployment	7.77	7.95	13.75	20.62	12.52	5.38	5.50

Table 2:

Reason for leaving previous job among total population 25-54 y.o.	**Grouped by decision**	**Grouped by destination**
obliged to stop by employer	Layoff	Unemployment
end contract / temporary job	Layoff	Unemployment
sale / closure of own family business	Layoff	Unemployment
marriage	Family/demographic	Out of labor force
child birth / look after children	Family/demographic	Out of labor force
looking after old, sick, disabled persons	Family/demographic	Out of labor force
partner's job required move to another place	Family/demographic	Out of labor force
study / national service	Family/demographic	Out of labor force
own illness or disability	Family/demographic	Out of labor force
wanted to retire or leave off private means	Family/demographic	Out of labor force
obtained better job	Job-to-job	Employment
other	Quit	Unemployment

Table 3:

Reason for leaving the previous job						
Country	France	Germany	Italy	Spain	Continental Europe	U.K./U.S.
Layoff	49.1%	39.9%	41.5%	58.3%	47.1%	22.5%
Family/demographic	20.1%	40.4%	24.9%	16.1%	25.4%	27.1%
Quit	4.8%	10.1%	2.9%	4.9%	5.7%	11.1%
Job-to-job	26.0%	9.6%	30.7%	20.7%	21.8%	39.3%

Table 4:

U.S. exogenous calibration:	
Normalization:	
deterministic productivity h	1
Rates:	
discount rate r	0.0033
exogenous family transitions δ	0.0118
Shock process:	
arrival rate λ	0.05
parameter of F-distribution, ϕ	2.66
parameter of G-distribution, γ	3.46
Negotiating parameters:	
initial bargaining power workers α	0.29
firm's offer probability β	0.36
Entry matches:	
initial firm productivity ε_0	0
initial worker utility ν_0	0
Matching frictions:	
matching function scale parameter A	0.40
elasticity matching function η	0.5
vacancy posting costs κ	1.62
OTJS efficiency parameter Ψ_0	0.34
Policy parameters:	
U.I. replacement rate z	0.25
firing costs, layoff T_L	0
firing costs, quit T_Q	0

Table 5:

U.S. endogenous calibration:	
Normalization:	
deterministic productivities h_0, h	$0.75, 1$
Rates:	
discount rate r	0.0033
exogenous family transitions δ	0.0118
Shock process:	
arrival rate λ	0.05
parameter of F-distribution, ϕ	2.51
parameter of G-distribution, γ	2.03
Negotiating parameters:	
initial bargaining power workers α	0.40
firm's offer probability β	0.32
Entry matches:	
initial firm productivity ε_0	0
initial worker utility ν_0	0
Matching frictions:	
matching function scale parameter A	0.40
elasticity matching function η	0.5
vacancy posting costs κ	1.62
OTJS efficiency parameter Ψ_0	0.34
Policy parameters:	
U.I. replacement rate z	0.25
firing costs, layoff T_L	0
firing costs, quit T_Q	0
HC investment:	
cost parameter c_0	34.87

Table 6:

T (months) - exogenous case	0	3	6	9
Employment duration (years)	2.7y	2.8y	3.1y	3.5y
Unemployment duration (months)	3.5m	3.7m	3.8m	3.9m
Unemployment rate (%)	10.2%	10.2%	9.8%	9.0%
Monthly quit rate	0.0065	0.0059	0.0049	0.0038
Monthly layoff rate	0.0127	0.0117	0.0103	0.0085
Monthly JJ rate	0.0153	0.0133	0.0111	0.0087

Table 7:

T (months) - endogenous case	0	3	6	9
Employment duration (years)	2.8y	3.0y	3.2y	3.7y
Unemployment duration (months)	3.2m	3.2m	3.1m	3.0m
Unemployment rate (%)	9.1%	8.7%	7.8%	6.5%
Monthly quit rate	0.0060	0.0055	0.0048	0.0039
Monthly layoff rate	0.0121	0.0109	0.0093	0.0072
Monthly JJ rate	0.0156	0.0142	0.0126	0.0108

Table 8:

T (months) - endogenous case	0	3	6	9
h_{total} (normalized)	1	+1.63%	+3.97%	+7.62%