Interpreting Europe and US labor markets differences : the specificity of human capital investments*

Etienne WASMER†

First version: February 27, 2002
This version: July 2002

Abstract: This paper suggests that in the US context, workers tend to invest in general human capital especially since they face little employment protection and low unemployment benefits, while the European model (generous benefits and higher duration of jobs) favors specific human capital investments. This conjecture provides, among other things, a rationale for differences in labor mobility and reallocation costs, which are typically ignored in American 'International Trade' textbooks while considered as extreme in the public debate in Europe.

The main argument is based on a fundamental property of human capital investments : they are not independent of the aggregate state of labor markets, and in particular, frictions and slackness of the labor market raises the returns to specific human capital investments relative to general capital investments. This is a property that Becker's seminal contributions could not envisage in the context of perfect labor markets.

Two sets of implications are then derived : on one hand, mobility costs are high in Europe and turbulence has especially strong adverse effects. Jobs endogenously last longer in Europe than in the US, but when they are destroyed, the welfare loss for workers is higher. On the other hand, in the steady-state, European workers, ceteris paribus, are more efficient. In terms of transaction costs, the US pay in average higher search/hiring costs in the labor market, and smaller training costs, so that the welfare implications of each type of economy are a priori ambiguous: no model dominates the other one, and each one has its own coherence, although the European one is more fragile when macroeconomic conditions change.

- Key Words: Training, Specific Human Capital, General Human Capital, Unemployment, Matching
- JEL classification: J63, J30

*I thank participants of seminars in Paris I-Eurequa, ECARES and of the conference Institutions et Marchés in Reims.

†Affiliations: ECARES, ULB, Université de Metz, CEPR and IZA. Address: ECARES, ULB, 50 Av. F. Roosevelt, CP 114, 1050 Brussels, Belgium. E-mail: ewasmer@ulb.ac.be

Differences in the labor markets of Continental Europe and the US, either in terms of institutions or in terms of performance, are very important. The dark side of Europe has been widely discussed. The rates of unemployment have diverged since the late 70's, and have been much larger and more persistent in countries such as Spain, France, Italy or Belgium. Unemployment benefits, in level and in duration, are typically larger except perhaps in Italy, encouraging low job search activity. The employment protection legislation is much larger in Europe than in the US, discouraging firms from taking risks in hiring workers.

What is sometimes less known is that, despite these differences, there are not many differences in the level of productivity per worker between Europe and the US. Further, productivity per hour worked is often larger in Europe, while, since the first oil shock, its growth has been significantly larger than in the US. The following table compiles summary statistics illustrating these points using OECD data and Layard and Nickell (2000). Further, according to these authors, there seems to be a positive link between labor productivity growth and employment protection legislation in a cross-section of OECD countries.

	Be	Fr	Ge_W	It	Jp	Ne	Sp	Sw	Us
Unemployment rate, 1997	9.6	12.5	7.7	8.2	3.2	5.7	21.4	10.9	4.9
GDP/capita, 1994	79	76	77	73	81	73	53	68	100
GDP/worker, 1994	103	92	85	98	74	89	84	72	100
GDP/hour worked ,1994	116	114	111	87	79	114	88	98	100
Labor Prod. Growth, 1976-92	1.03	1.43	1.38	2.15	3.09	0.77	1.42	0.80	1.17
Labor Prod. Growth (hours), 1976-92	2.21	2.14	2.04	2.51	3.51	1.60	2.12	0.92	1.08
Emp. Protection (1990)	17	14	15	20	8	9	19	13	1
Regional Mobility (% of pop. moving, 1980-97)	na	1.3	1.1	0.6	2.7	na	0.4	3.7	2.9

Another well known fact is the lack of occupational and regional mobility in several European countries, especially in Southern Europe, as compared to the US. The last row of the table indicates that 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. Several authors already discussed low mobility of workers as a perhaps important cause of diverging experience of US and Europe. For Bertola and Ichino (1996) notably, this is a key factor of lower unemployment and higher wage dispersion in the US. High mobility in the US has some influence on the way economic theory is exposed to students. Indeed, American textbooks of international trade theory usually discuss the gains and losses of free-trade with a long-run perspective. Short-term reallocation costs of trade-openness are at best briefly evoked, and more typically, totally ignored, and the conclusion focuses on discussing who are the long-run winners and losers. In a European context, the fact that (older) workers in traditional industries need to leave their origin sector/region, due to reallocation of activities induced by country-specialization, and accordingly that we can neglect the associated short-run mobility costs, may sound much more critical. European students typically react to these features of the model, while *a contrario*, such low mobility costs do not seem to disturb American students, judging by the lack of reference to them in the 5th International edition of International Economics, Theory and Policy (Krugman and Obstfelfd, 2000).

The goal of this paper is to propose an interpretation for Europe/US differences in a general framework that encompasses all these aspects of labor markets. The interpretation is the following : European workers invest more *at the margin* and for endogenous reasons described below, in specific human capital, while US workers invest more in general human capital. Accordingly, sectorial, occupational and geographical mobility costs are much higher in Europe than in the US. We then discuss the predictions of the model to offer an alternative view of the transatlantic comparisons between labor markets.

Why would there be such differences in the nature of human capital investments? A caricatural, or better, idealized explanation is that (older) European workers feel secure in their jobs. The average duration of typical employment is long and as such, they can afford investing a lot in the knowledge of their firm and job. Being productive in the job, they receive a high wage, even though the specificity of their investment makes their outside options in case of unemployment quite low, *ceteris paribus* i.e. controlling for unemployment benefits. As a result, and despite generous unemployment benefits allowing them to be choosy with respect to jobs, they are strongly hurt by unexpected layoffs. In such an event, they face significant wage discounts and possibly longer spells of unemployment.

In contrast, US workers live permanently with the idea of mobility. They invest smaller amounts in firm specific knowledge, and much more in recyclable skills, i.e. in general human capital. As a result, their outside options are high, although their efficiency on the job is low. Their mobility from job to job is high too, since there is little surplus to share with employers. Accordingly, workers do not really mind having low unemployment benefits, since they are trained to obtain new jobs at low investment costs.

To try a risky comparison with academics, European workers are like experimental physicists who work in and are attached to a University team, while the US workers resemble economists who permanently raise their outside option without much care about personal investment in the team.

This is an a priori plausible story, but there are few models allowing for a rigorous investigation of these issues. This paper is connected with the work of Ljunqvist and Sargent (1998, 2001) who also introduce human capital losses and labor market institutions to explain transatlantic comparisons. In their 2002 model, human capital is general, but at the separation time, workers loses some of this capital. They model the search margin, contrary to the present paper, but do not investigate the determinants of human capital investments which follow a random process in both employment and unemployment status. The latter characteristics allows them to introduce 'loss of skills during unemployment', a feature that we do not consider here since it would imply, in our model, unemployment duration dependence which is an empirical controversy. They also introduce age categories, whereas we rely on birth and retirement to obtain a non-trivial age/skill structure. Finally, we develop the labor demand side of the model, while they consider an exogenous distribution of wage offers. We come back later on the common implications of both approaches. The paper is also in the spirit of Acemoglu and Pischke (1999a) who focus on general human capital and institutions. A key difference is that our paper is centered on the decisions to investing in general and specific skills, the latter being not central in their paper.[1]

The task of this paper is to provide a simple, tractable model to organize thinking. The first section introduces the model with the most general set of assumptions and derive an important partial equilibrium property of the allocation of human capital investments in a frictional labor market. The key result here is that, the slacker the labor market, the more workers invest in specific human capital. The second section introduces simplifying assumptions, and studies the general equilibrium properties of the model. We identify two regimes, one in which workers invest in general human capital and one in which they invest in specific human capital. The latter is associated with large benefits, long duration of jobs and highly frictional labor markets. The former is associated with low duration of jobs, no human capital investments on-the-job except in the first job (an alternative interpretation is that this initial investment is schooling). Section 3 develops three extensions : employment protection, incentives provided by employers to induce specific

[1] There is page 559 of their paper a section devoted to specific human capital, including a choice by firms about the type of investments. Their focus is on the complementarity between general and specific investments. Here we mostly focus on workers' investments, except, very indirectly, in Sections 3.2 and 3.3, for we assume that workers have a fair amount of discretion in their unobservable learning efforts. We come back on Acemoglu-Pischke's insights later.

training, and technology choices. The last section exploits the insights of the model to reinterpret the experience of the last decades from both sides of the Atlantic along several dimensions.

1. The general model

1.1. The setup

Time is continuous; the discount rate of all agents is r. Workers die with a death rate of δ and are replaced by new-born workers with no human capital. These new born workers look for jobs and are randomly matched with employers looking for workers to fill vacant units of production. A productive unit is the association of one worker and one firm. As such, the productivity of a worker is the sum of a firm's component and the human capital of the workers. The firm's component is random and denoted by ε. As standard from human capital theory, investments in human capital are worker's decisions under a set of incentives provided by the firm. The human capital of the workers is denoted by h and is the sum of three components, $h = h^{g0} + i^g + i^s$, where h^{g0} is the general human capital inherited from the last job[2], i^g is the investment in general human capital made by the worker in his/her current job, while i^s is the investment in specific human capital made by the worker in the current job. By definition, the inherited stock of specific human capital from the last job is irrelevant here and does not show up in equation (1.1) below.

We denote by

$$y(\varepsilon) = \varepsilon + h \tag{1.1}$$

the marginal productivity of workers when the firm's component is ε. This component evolves according to a Poisson process with intensity λ and is drawn from a density function $f(\varepsilon)$ with c.d.f. $F(\varepsilon)$. The density has support $(\varepsilon^-, \varepsilon^u)$ and ε^u is also (until Section 3) the initial value of productivity at the time of match formation.

We further assume, to simplify, that investments in human capital are made instantaneously at the entry into the firm, at a cost $C(i^s, i^g)$ where C is increasing, convex in each variable.[3]

The value of the surplus for the worker of a job with idiosyncratic component ε is $E(\varepsilon) - U$ where U is the life-time expected income for unemployed workers and $E(\varepsilon)$ is the value of being employed in that job. Similarly, for the firm, the surplus is $J(\varepsilon) - V$, where $J(\varepsilon)$ is the discounted

[2] For new born workers, h^{g0} could be interepreted as schooling investments; hereafter we exclusively focus on on-the-job training.

[3] One could alternatively model human capital investments made continuously during the job spells, without qualitative difference.

value of expected profits and V is the value of a job vacancy. We have (see Appendix 1):

$$(r+\delta+\lambda)[E(\varepsilon)-U] = w(\varepsilon)-(r+\delta)U+\lambda\int Max\left[U,E(\varepsilon')\right]dF(\varepsilon') \quad (1.2)$$

$$(r+\delta+\lambda)[J(\varepsilon)-V] = y(\varepsilon)-w(\varepsilon)-rV+\lambda\int Max\left[V,J(\varepsilon')\right]dF(\varepsilon') \quad (1.3)$$

All job creation opportunities are exhausted, which means that the value of a job vacancy is:

$$V=0 \quad (1.4)$$

The wage is assumed to be the solution of the Nash-maximand:

$$w(\varepsilon)=ArgMax(E(\varepsilon)-U)^{\beta}J(\varepsilon)^{1-\beta}$$

where $0\leq\beta\leq1$ is an index of the bargaining power of workers. As a result of the bargaining game, the wage writes

$$w=(1-\beta)(r+\delta)U+\beta y \quad (1.5)$$

The reservation strategy determining the job destruction margin is easy to derive, following Mortensen and Pissarides (1994). We have that $\frac{\partial J}{\partial\varepsilon}=\frac{1-\beta}{r+\delta+\lambda}$ and $\frac{\partial(E-U)}{\partial\varepsilon}=\frac{\beta}{r+\delta+\lambda}$, and it follows that the surplus of the firm and the surplus of the workers are a linear function of ε, with

$$E(\varepsilon)-U = \beta\frac{\varepsilon-\varepsilon^d}{r+\delta+\lambda} \quad (1.6)$$

$$J(\varepsilon) = (1-\beta)\frac{\varepsilon-\varepsilon^d}{r+\delta+\lambda}$$

where ε^d is the reservation productivity (below which the firm and the worker optimally separate). The job destruction rule is defined by $J(\varepsilon^d)=0$ implying

$$\varepsilon^d+\frac{\lambda}{r+\lambda+\delta}\int_{\varepsilon^d}^{\varepsilon^u}(1-F(\varepsilon'))d\varepsilon'=(r+\delta)U-h \quad (1.7)$$

The left hand side is increasing in ε^d and λ and decreasing in δ and r, and the right hand side is increasing in U and decreasing in h. This expression closely matches the job destruction margin in Mortensen and Pissarides (1994).

Lemma 1. *Investments in specific human capital increases the duration of jobs by increasing the productivity of the match, since:*

$$\frac{\partial\epsilon^d}{\partial i^s}=-\frac{1}{1-\frac{\lambda(1-F(\varepsilon^d)}{r+\lambda+\delta}}<0$$

Proof. The above equation is obtained by totally differentiating (1.7). Noticing that the expected duration of jobs is given by $1/(\delta+\lambda F(\varepsilon^d))$ where $\lambda F(\varepsilon^d)$ is the endogenous destruction rate, the duration of a jobs is negatively related to ε^d. ■

Lemma 2. *General human capital investments have a priori an ambiguous impact on the duration of jobs, because they raise the outside option, but the productivity effect always dominates.*

Proof. Again by totally differentiating (1.7), and noting that

$$\begin{aligned}\frac{\partial \epsilon^d}{\partial i^g} &= \frac{\partial \epsilon^d}{\partial i^s} + (r+\delta)\frac{\partial U}{\partial i^g}\frac{1}{1-\frac{\lambda(1-F(\varepsilon^d)}{r+\lambda+\delta}} \\ &= \frac{-1+(r+\delta)\frac{\partial U}{\partial i^g}}{1-\frac{\lambda(1-F(\varepsilon^d)}{r+\lambda+\delta}}\end{aligned} \tag{1.8}$$

and

$$\partial U/\partial i^g > 0$$

In fact, we expect $(r+\delta)\partial U/\partial i^g$ to be smaller than one, since only a part of the increase in marginal productivity beneficiates the workers given the future bargaining between the firm and the worker. This is proven in Appendix 1. For this reason, $\frac{\partial \epsilon^d}{\partial i^g} < 0$. ■

An intuition of these two lemmas is provided by the Figure 1.1. An increase in productivity raises both $E(\varepsilon) + J(\varepsilon)$, i.e. the discounted value of gross profits. This reduces ε^d. An increase in specific human capital leave U unchanged, an increase in general investment raises U, which contributes to raise ε^d, however by less than the initial reduction.

1.2. The optimal investment decisions

We are now in position to calculate the optimal human capital investment decisions of workers. Recall that the decision is being made at the entry level in the job. Let us consider workers with general human capital h^{g0} and a firm with productivity ε^u. Workers maximize over i^s, i^g the expected value of employment net of investment costs:

$$E(\varepsilon^u, i^s + i^g + h^{g0}) - C(i^s, i^g)$$

Using that $E(\varepsilon^u, h) = \beta\frac{\varepsilon^u - \varepsilon^d(h)}{r+\lambda+\delta} + U(h)$, where $h = i^s + i^g + h^{g0}$, the first order condition on i^s, i^g leads to

$$\begin{aligned}\frac{\partial E}{\partial i^s} &= \frac{\beta}{r+\lambda+\delta}\left(\frac{-\partial\varepsilon^d}{\partial i^s}\right) = \frac{\partial C(i^s,i^g)}{\partial i^s} \\ \frac{\partial E}{\partial i^g} &= \frac{\beta}{r+\lambda+\delta}\left(\frac{-\partial\varepsilon^d}{\partial i^g}\right) + \frac{\partial U}{\partial i^g} = \frac{\partial C(i^s,i^g)}{\partial i^g}.\end{aligned}$$

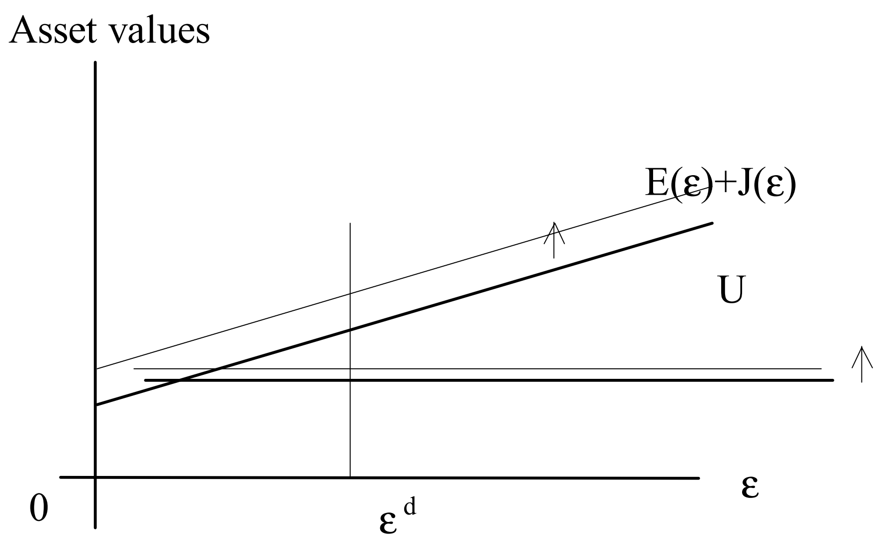

Figure 1.1: Impact of human capital investments on job duration

Denote by $\Phi = \frac{\partial U}{\partial i^g}$ the slope of the outside option of employed workers with respect to their general human capital investments. This slope Φ was already a crucial quantity in the two previous lemmas. We then have the following result. Using (1.8) ,we can further obtain:

$$\frac{\partial E}{\partial i^g} = \frac{\partial E}{\partial i^s} + A\Phi$$

where $A = \frac{(r+\delta)(1-\beta)+\lambda F(\varepsilon^d)}{r+\delta+\lambda F(\varepsilon^d)}$ is a function of parameters and ε^d that is always positive.

Theorem 1. *a) The marginal value of general investments is larger than the marginal value of specific investments; b) The difference is larger, the larger the quantity Φ, and among other things, a higher exit rate from unemployment for workers, denoted by p (i.e. a tighter labor market) leads to a higher value of Φ and in fact to a distortion of the structure of investments, towards more general human capital investments.*

Proof. The first point is simply due to the choice of normalization of human capital in production: since i^s and i^g have a marginal impact on productivity equal to unity, by definition, general human capital increases have an additional return, intertemporally, through raising the outside option of workers. To see the second point, simply use equation (6.1) and (6.2) in Appendix 1. ■

This last result is the corner stone of the paper: *when labor market prospects are better for workers, they tend to favor general human capital investments, while, when the labor market is slack, they invest preferentially in specific human capital.* This property of skills investment decisions is fairly general, which may justify the use of the word 'theorem' that should otherwise be used parsimoniously, and is also an important result that had not been anticipated by Becker (1964) when he introduced the fruitful distinction between general and specific human capital. The reason is simply that Becker was exclusively considering frictionless labor markets in which job finding processes are infinitely fast. In fact, the closest result to our paper was obtained by Acemoglu and Pischke (1999a and b) who considered the role of frictions and labor market institutions on the investments decisions in general human capital and showed, among other important results, that frictions lead to sharing the costs of those investments, contrary to Becker's implications that these costs were paid by workers through lower wages. We next exploit this property to build a general equilibrium model under simplifying assumptions about the nature of human capital investments.

2. The general equilibrium

2.1. Simplifying assumptions on the structure of investments in human capital

Now that the important link between the aggregate labor market and the skills investment decisions of workers has been established, we need to expose the general equilibrium logic of firm's job creation decisions. In the context of the model above, such a task is made difficult by the existence of a distribution of general human capital of workers in the cross-section.[4] Acknowledging this difficulty, that can be overcome at some computational costs but also at large expositional costs, one can instead simplify the model by making further assumptions on the structure of investment decisions undertaken by workers. In fact, I chose to discretize the structure of investments, by assuming that there are only four possible levels of human capital: a) Workers may not invest at all in which case their productivity is $y \equiv 0$; or b) workers have the possibility to increase the productivity in investing into a fixed amount of specific human capital by paying a cost C^s. Productivity per unit of time would thus be $y = \varepsilon + h^s$. This specific investment would be lost in case of job separation, and has thus no impact on the workers' valuation of unemployment ; c) Workers also have the possibility to increase the productivity in investing into a fixed amount of general human capital, in paying a cost C^g. Productivity per unit of time is thus $y = \varepsilon + h^g$. In contrast, this investment is permanent and raises the outside option of workers ; d) Finally, workers may invest in both skills,

[4] Indeed, the history of worker determines the number of jobs and of unemployment spells they experienced and these histories differ between individuals. Accordingly, it is difficult (but not impossible) to exactly calculate the distribution of human capital investments of workers. This distribution is indeed necessary to determine firms' job openings decisions, since the expected value of profits is determined by the expected value of general human capital of workers.

and would then reach a productivity $y = \varepsilon + h^{s+g}$, at a cost C^{s+g}. The latter is assumed to be very large, so that such a strategy is not chosen in equilibrium.

Investments are however a priori reversible and, facing a new ε, workers with specific human capital may wish to invest in general human capital and vice-versa. However, for this not to be the case (which greatly simplifies the exposition of the model), a few restrictions, denoted by $\mathcal{R}$ and detailed hereafter, insure that workers do not find this optimal. These restrictions need to be checked ex-post but will appear to be quite natural in a steady-state. They also insure, consistent with assumption a), that we can exclude the zero-investment case, since this leads to the destruction of the match, as soon as the workers have a positive share of the surplus.

As a simple normalization, it is assumed that

$$h^s > h^g \tag{2.1}$$

$$C^s = C^g = C \tag{2.2}$$

If inequality (2.1) was not satisfied, given (2.2), workers would of course never invest in specific human capital: for a trade-off to appear between different investments, specific investments necessarily have to bring the highest productivity level. This is of course a matter of convention, purely due to the assumption of equal costs (2.2).

The remainder is identical to previous section. After the investment has been done, the wage is bargained over between the employer and the employee. Correctly anticipating the outcome of bargaining, the worker chose the appropriate investment to be made. It is important to remark that the timing of events is consistent with a pure hold-up story, i.e. the firms never compensate workers for sunk cost C. Anticipating this, workers cannot be manipulated by firms in order to chose the desired type of investment. Section 3 will however investigate the case in which firms can induce workers to invest in specific human capital by transferring a lump sum at the entry level. Also, as in the previous section, new values of ε are realized at random intervals with the same Poisson intensity λ and cumulated distribution function $F(\varepsilon)$.

2.2. Some value equations

We denote by U^0 the life-time value of a new-born worker, and by U^k, $k = s, g$ the life-time value of an unemployed workers having invested in specific (general) human capital. Of course, $U^0 \equiv U^s$ since by definition, specific capital cannot be recycled (the probability to obtain an offer in exactly the same firm is assumed to be zero).

We also denote by $E^k(\varepsilon)$, $k = s, g$ the life-time, discounted value of having a job with specific (general) human capital and productivity ε. For firms, the value of a filled position is $J^k(\varepsilon)$, $k = s, g$. The value of a vacant position is denoted by V. We have

$$(r+\delta+\lambda)E^k(\varepsilon) = w^k(\varepsilon) - (r+\delta)U^k + \lambda \int Max\left[U^k, E^k(\varepsilon')\right] dF(\varepsilon') \quad (2.3)$$

$$(r+\delta+\lambda)J^k(\varepsilon) = \varepsilon + h^k - w^k(\varepsilon) + \lambda \int Max\left[V, J^k(\varepsilon')\right] dF(\varepsilon') \text{ for } k = g, s \quad (2.4)$$

At the entry level, denoting by b the value of unemployment benefits, and by p the job finding rate of unemployed workers, we have

$$(r+\delta)U^s = b + p.Max\left[E^g(\varepsilon^u) - C - U^s, E^s(\varepsilon^u) - C - U^s\right] \quad (2.5)$$

and

$$(r+\delta)U^g = b + p.\left[E^g(\varepsilon^u) - U^g\right] \quad (2.6)$$

where ε^u is the initial value of technology, which is also the upper bound of the distribution $F(.)$. The second equation uses the fact that unemployed workers with general human capital do not invest in specific capital, again given the set of restrictions $\mathcal{R}$. It then clearly appears that

Lemma 3. *Unemployed workers are better off if they have some general human capital.*

Proof. Using the difference between (2.6) and (2.5), we obtain

$$(U^g - U^s)(r+\delta+p) = p.Max\left[C, E^g(\varepsilon^u) - E^s(\varepsilon^u)\right] \geq 0$$

■

All job creation opportunities are exhausted, which means that

$$V = 0 \quad (2.7)$$

We postpone to the end of the section the derivation of the forward value of V.

2.3. Bargaining

Bargaining take place immediately after the investment is done, and then at each occurrence of a productivity shock. Since we assume a discrete investment in human capital, we rule out the classical issue of under-investment in human capital arising from the hold-up problem. The solution of the bargaining game is the same as in the previous section, and yields a wage rule

$$w^k = (1-\beta)(r+\delta)U^k + \beta(\varepsilon + h^k),\ k = s, g \quad (2.8)$$

In other words, the workers with specific training have a higher wage, controlling for their outside option, but the workers with general training have a higher outside option, raising wages. Which type of worker has the highest wage is thus unclear.

2.4. The job destruction decision

We are now in position to determine the reservation strategy at the exit margin. As in the previous section, we have that

$$\begin{aligned} E^k - U^k &= \frac{\beta(\varepsilon - \varepsilon^{dk})}{r+\delta+\lambda} \\ J^k &= \frac{(1-\beta)(\varepsilon - \varepsilon^{dk})}{r+\delta+\lambda} \end{aligned} \quad (2.9)$$

where the job destruction rule is defined by $J^k(\varepsilon^{dk}) = 0$ implying

$$\varepsilon^{dk} + \frac{\lambda}{r+\lambda+\delta}\int_{\varepsilon^{dk}}^{\varepsilon^u}(1-F(\varepsilon'))d\varepsilon' = (r+\delta)U^k - h^k \quad (2.10)$$

Remarking that the second part of the left hand-side is increasing in ε^{dk} but with a slope strictly lower than one, one has immediately that, along (2.10),

$$\begin{aligned} \partial\varepsilon^{dk}/\partial h^k &< 0 \\ \partial\varepsilon^{dk}/\partial U^k &> 0 \end{aligned}$$

This implies straight away the following proposition.

Proposition 1. *Ceteris paribus, we have that $\varepsilon^{dg} > \varepsilon^{ds}$, i.e. jobs last longer when the worker has invested in specific human capital instead of general human capital.*

Proof. This arises for two reasons, because of $h^s > h^g$ and because $U^g > U^s$. ■

In words: at identical outside option, workers with specific training face lower job destruction than those with general training since they are more productive. Since in addition, they have a lower outside option than workers with general training, the total surplus, at equivalent productivity, is higher for them. Destructive shock thus arise less frequently. There is thus an unambiguous relation between the nature of the human capital investment and the turnover of workers.

2.5. Workers human capital investment decisions

Let us denote by α^g the fraction of unemployed workers without general human capital[5] who decide to invest in general human capital, and $\alpha^s = 1 - \alpha^g$ the complement. Defining $\Delta X = X^g - X^s$ for any variable X in the model, we have the following conditions:

[5] i.e. either the new born or the workers having previously invested in specific skills before losing the job

- Regime S: if $\Delta E < 0$ and $E^s - U^0 > C$, then $\alpha^g = 0$, $\alpha^s = 1$
- Regime G: if $\Delta E > 0$ and $E^g - U^0 > C$, then $\alpha^g = 1$, $\alpha^s = 0$
- Regime M (mixed strategy): if $\Delta E = 0$ and and $E^s - U^0 > C$ then workers are indifferent between the two investments and $0 \leq \alpha^g \leq 1$.
- Regime O: if $\underset{k=s,g}{Max}\ (E^k - U^0) \leq C$, then workers do not invest and reject the job offer.

We first focus on the first two (pure) regimes and study regime M later on.[6] Each regime, in partial equilibrium where we treat p as a parameter, is characterized by $E^k(\varepsilon^u)$, U^k and ε^d, solved by the Bellman equations (2.5) or (2.6), (2.9) and finally the destruction rule (2.10). We can thus calculate ΔE, at least implicitly, and show that it is a function of p, increasing, taking negative then positive values. Thus, there is a threshold value p^l such that $\Delta E = 0$ when $p = p^l$. Depending on the position of p with respect to p^l, we are in regime S or G defined above. Hereafter, superscript $k = s, g$, characterizes the value of utility of an individual worker making decision k, while index K, $K = S, G$ characterizes the regime in which she would make the decision.

Proposition 2. *Above a cutoff level of the hiring rate, denoted by* p^l*, workers chose to invest in general human capital at the entry into the firm. Below, they instead chose specific human capital. When* p *is exactly equal to* p^l*, they are indifferent between the two options.*

Proof. See Appendix 2 and Figure 2.1.

■

This result is the 'discrete investment' equivalent of Theorem 1. Although the proof of the result above is involving three different equations to be solved for simultaneously, the intuition is easy to get: a tight labor market (high p) implies that workers value more the increases in their outside options, and accordingly tend to prefer general human capital. On the contrary, when p is low, i.e. when the tightness of the labor market is low from workers' perspective, jobs become a bigger asset to them. Protecting them from adverse shocks has a higher relative value and specific human capital is better than general human capital at doing this. In addition, when tightness is low, the cost of re-investing into specific human capital is done less frequently.

Remark 1. As already argued in introduction, in the G-regime, the initial investment by workers in their first job can be interpreted as schooling, with no further on-the-job training; A

[6] Note that, in each case, we need to check that regime 0 is not reached. This explains the second inequality in the first three cases above. Note also that these workers do not have general human capital, this is why we consider in htat inequalities the outside option U^0.

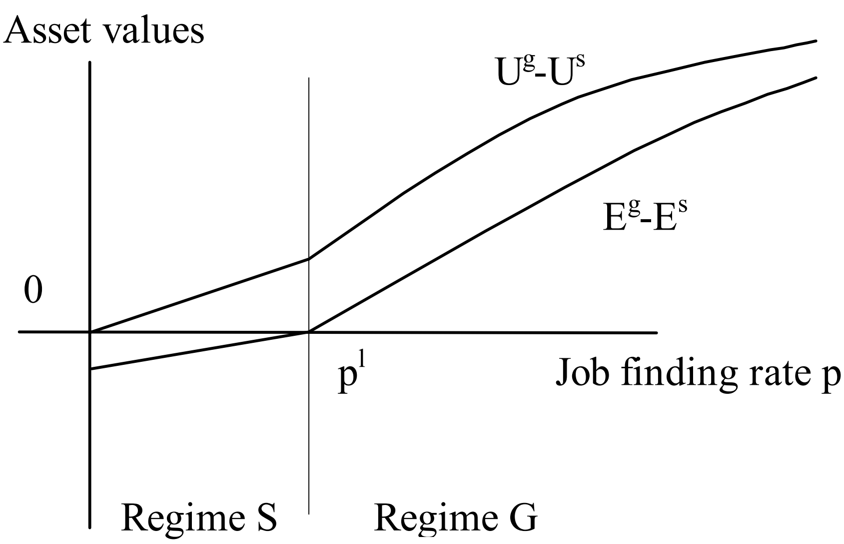

Figure 2.1: Workers' relative asset values

contrario, the S-regime is associated with no schooling and only on-the-job specific training.

2.6. Entry of firms and equilibrium labor market tightness

To close the model, we assume the existence of a constant return to scale matching function $x(u, \mathcal{V})$ between u unemployed workers and $\mathcal{V}$ recruiting firms, such that, posing $\theta = \mathcal{V}/u$ the labor market tightness,

$$
\begin{aligned}
q &= q(\theta) = \frac{x(u, \mathcal{V})}{\mathcal{V}} \text{ with } -1 < \theta q'/q < 0 \\
p &= p(\theta) = \theta q(\theta) = \frac{x(u, \mathcal{V})}{u} \text{ with } p' > 0
\end{aligned}
$$

Thus, once θ is known, p is uniquely determined.

At each contact generated through the matching process, firms face a relative fraction κ^s , κ^g of workers of making the investment s or g at the entry level (with $\kappa^s + \kappa^g = 1$). The fraction κ^g depends on α^g but is not identical to it (the exact relationship is determined later, see equation (6.24). The reason is simple. It is because among the unemployed, there are workers already endowed with general human capital, who will not find it profitable to invest in specific skills, since they don't need to repay investment costs C to reach the productivity level y^g ; investing in specific skills is a dominated strategy for them : $E^s - C < E^g = E^s$ in this regime.

With γ the flow recruitment costs, the value of a job vacancy is given by

$$rV = -\gamma + q \sum_{k=g,s} \kappa^k [J^k(\varepsilon^u) - V] = 0 \tag{2.11}$$

Equation (2.7) implies that the expected return to a job $\sum_{k=g,s} \kappa^k J^k(\varepsilon^u)$ is equal to the expected search costs γ/q.

Proposition 3. *When employers expect to be in regime K, $K = S, G$, they create in aggregate a number of jobs $\mathcal{V}^K$ such that $p_{K=G} < p_{K=S}$. In addition, in both regimes, tightness and p negatively depends on γ, β, r and δ.*

Proof. Equation (2.11), using (2.9) becomes

$$(1-\beta)\frac{\varepsilon^u - \kappa^g \varepsilon^{dg} - \kappa^s \varepsilon^{ds}}{r + \lambda + \delta} = \frac{\gamma}{q(\theta)} \tag{2.12}$$

Given that we know that matches between a firm and a worker with specific human capital close down less frequently ($\varepsilon^{dg} > \varepsilon^{ds}$), this means that the discounted value of profits is higher in regime S than in regime G. As a result, equilibrium labor market tightness is higher in regime S than in regime G. One way to represent the equilibrium is to map the right-hand side and the left hand-side of equation (2.12) as functions of tightness, in noting that the PDV of profits in both regimes are decreasing with θ: ε^{dk} is increasing with rU^k itself raised by higher θ. Rewriting θ as a function of p[7], the job finding rate, Figure 2.2 represents the equilibrium.

The second part is easy to prove in fully differentiating (2.12) and (2.10). ■

This result deserves some comments. First, employers prefer employees to invest in specific human capital, since they are more stable in jobs, have a higher productivity and a lower outside option in bargaining. This is why, in a S-regime, they create more jobs. However, this is not necessarily in the interest of workers for all values of labor market tightness, as the partial equilibrium analysis showed. Second, in the G-regime, there is obviously a conflict between employers and employees about the nature of human capital investments, the resolution of which is studied in Section 3.2 and 3.3 when employers are allowed to choose technologies or to compensate workers for their human capital investments.

[7] For instance, with a Cobb-Douglas matching function, we have $q = q_0\theta^{-\eta}$, $p = q_0\theta^{1-\eta}$ and $\gamma/q(\theta) = \gamma/q_0\theta^{\eta/(1-\eta)}$.

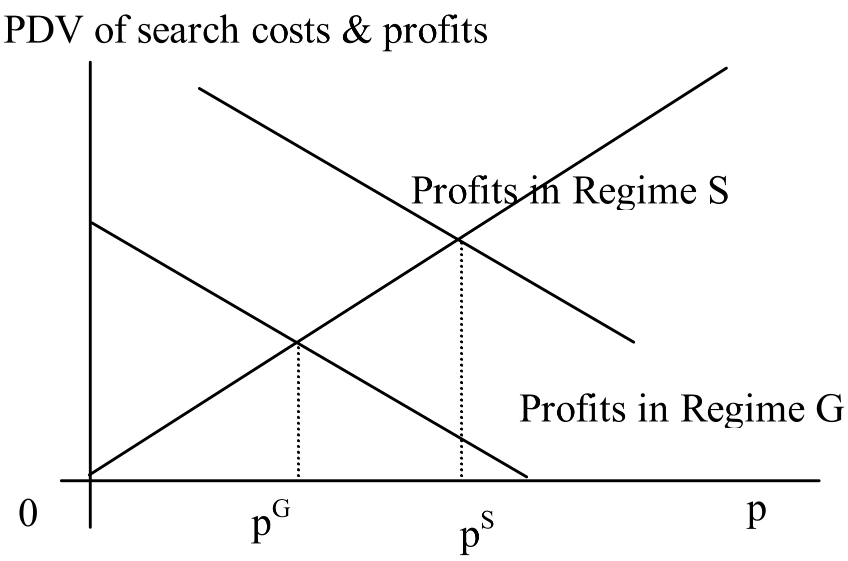

Figure 2.2: Profit curve in the pure strategy regimes

2.7. Equilibrium

2.7.1. Pure equilibria

We have the following cases :

- if parameters are such that $p_{K=G} < p_{K=S} < p^l$ then there is a unique, stable equilibrium under regime S
- if parameters are such that $p^l < p_{K=G} < p_{K=S}$ then there is a unique, stable equilibrium under regime G
- if parameters are such that $p_{K=G} < p^l < p_{K=S}$ then the economy may cycle between the two regimes but never reaches a pure steady-state equilibrium. It may however reach a 'mix' steady-state equilibrium.

2.7.2. Mixed equilibria

The latter case deserves some more comments, since it is not standard in matching models. What happens is that, if we start from a situation with high $p > p^l$ then workers decide to invest in general human capital. This firms reduce their number of job openings, anticipating that jobs will generate lower profits. Then θ and thus p decline towards $\theta_{K=G}$ (resp. $p_{K=G}$), and eventually reaches θ^l (resp. p^l). In this case, as soon as p goes below p^l, newly hired workers decide to invest

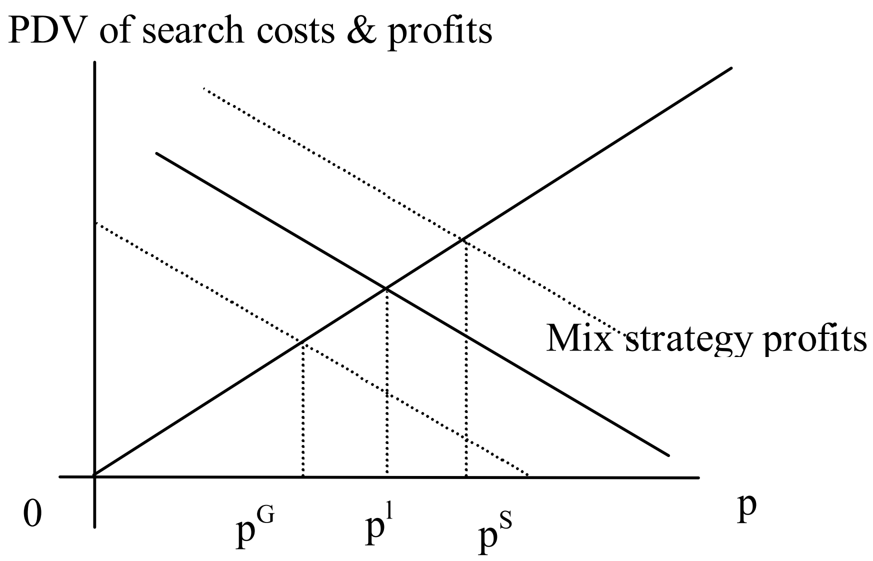

Figure 2.3: Profit curve in the mix strategy regime

in specific skills. Then, firms start to create more jobs again, and p rises again, etc... Since all this is anticipated by workers, their decision is more complex, since, despite $p < p^l$, they may invest in general skills since they anticipate that this would become more profitable soon. In other words, there is no 'pure strategy' in a steady-state.

To '*convexify*' the problem, workers indifferent between the two choices of human capital are allowed to play a mixed strategy. Firms anticipating the value κ^s, this leads to a value of θ and p determined by the job creation condition that in turn would be consistent with equality $E^s = E^g$. Figure 2.3 illustrates this situation: any convex combination of the extreme (pure equilibria) profit curves can be attained with a value of $0 < \kappa^g < 1$. We postpone to next sub-section the link between κ^g and α^g and the proof of existence of this steady-state equilibrium in pure strategy.[8]

2.7.3. Space parameter and the regimes

Consider now the following limit cases :

1. $\gamma \to 0$ implies $p_K \to \infty$ for $K = S, G$ while p^l is unchanged, implying regime G

[8] One may remark that this mix regime is unstable, along the lines of the previous paragraph. Actually, as long as agents spontaneously coordonate on the right 'mix strategy', this regime is attained, but divergence arises if there is a deviation. This notion of stability/instability is similar to saddle-paths in macro models.

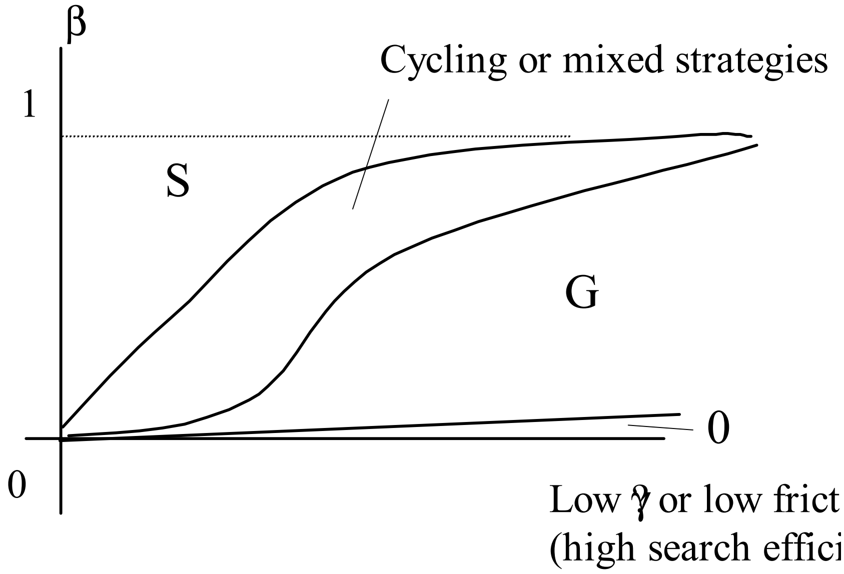

Figure 2.4: Different regimes in the space parameter

2. $\gamma \to \infty$ implies $p_K \to 0$ for $K = S, G$ while p^l is unchanged, implying regime S

3. β very close to zero implies regime 0

4. β is small but not too much, this implies from equation (6.4) $E^g > E^s$, implying regime G

5. $\beta \to 1$ implies from equation (2.12) that $p_K \to 0$, $K = G, S$ while p^l remains finite, implying regime S

In the space parameter (γ, β), we can thus illustrate the different regimes we obtain:

We notably see here that, giving a higher bargaining power to workers has here the traditional adverse effects (reducing the profits and thus job creations) but it also induces workers to raise their productivity, thus reducing job destruction, job turnover and reduces job search costs to both firms and workers.

2.8. Closing the model

The restrictions $\mathcal{R}$, the steady-state flows and some welfare analysis are all described in Appendix 4, 5 and 6 respectively.

3. Extensions

3.1. Employment protection legislation

The literature on the impact of employment protection is now rich and has brought some robust results: severance pay tend to be neutral to the extent that wages are downwards flexible and incorporate the expected extra costs for the firm. Pure taxes in case of separation affect the firm differently if these costs affect the outcome of bargaining or if they only affect the job destruction margin. Notably, Mortensen and Pissarides (1999) show that, when new entrants bargain the initial wage, this wage is made lower by the existence of future layoffs taxes, which reduces the adverse effects of employment protection legislation. Overall, they show that both job creations and job destructions are reduced, with ambiguous employment effects.

In the present paper, we may imagine that lower creation encourages the specificity of human capital investments, as a straight application of Theorem 1. Let us prove this formally. Introducing a firing tax T, the arbitrage equations are modified as follows:

$$(r+\delta+\lambda)E^k(\varepsilon) = w^k(\varepsilon) - (r+\delta)U^k + \lambda \int Max\left[U^k, E^k(\varepsilon')\right] dF(\varepsilon') \quad (3.1)$$

$$(r+\delta+\lambda)J^k(\varepsilon) = \varepsilon + h^k - w^k(\varepsilon) + \lambda \int Max\left[V - T, J^k(\varepsilon')\right] dF(\varepsilon') \text{ for } k = g, s \quad (3.2)$$

Using (2.7), we can write the bargaining problem, modified so that all wages (but the entry wage) are bargained according to

$$Max(E^k(\varepsilon) - U^k)^\beta (J^k(\varepsilon) + T)^{1-\beta}$$

The wage rule is then

$$w^k = (1-\beta)(r+\delta)U^k + \beta(\varepsilon + h^k + rT),\ k = s, g \quad (3.3)$$

while the entry wage w^{k0}, the bargaining of which is not affected by firing costs, is easily shown to be

$$w_0^k = (1-\beta)(r+\delta)U^k + \beta(\varepsilon^u + h^k - \lambda T),\ k = s, g \quad (3.4)$$

The job destruction rule is modified to take account of the firing costs T and is determined according to

$$J^k(\varepsilon^{dk}) = -T$$

which, using $J^k(\varepsilon) + T = \frac{(1-\beta)(\varepsilon-\varepsilon^{dk})}{r+\delta+\lambda}$, implies that

$$\varepsilon^{dk} + \frac{\lambda}{r+\lambda+\delta}\int_{\varepsilon^{dk}}^{\varepsilon^u}(1-F(\varepsilon'))d\varepsilon' = (r+\delta)U^k - h^k - rT \tag{3.5}$$

At constant U^k, this reduces the value of ε^{dk} exactly like an increase in y^k. Equations in Appendix 2, respectively (6.3) and (6.4) are still valid. So, the human capital decision by workers is not directly affected by T. Let us now consider the entry decision by firms. It is now given by

$$\kappa^g J_0^g(\varepsilon^u) + \kappa^s J_0^s(\varepsilon^u) = \frac{\gamma}{q(\theta)}$$

where $J_0^k(\varepsilon^u)$ is the entry value of a job, differing from $J^k(\varepsilon^u)$ since the wage rule is different. Remarking that $J_0^k(\varepsilon^u) = J^k(\varepsilon^u) + \frac{w^k(\varepsilon^u)-w_0^k(\varepsilon^u)}{r+\lambda+\delta}$, we have the entry decision represented by

$$(1-\beta)\frac{\varepsilon^u - \kappa^g\varepsilon^{dg} - \kappa^s\varepsilon^{ds} - \beta(r+\lambda)T}{r+\lambda+\delta} = \frac{\gamma}{q(\theta)}$$

Note that T is not paid in case of a demographic shock δ which explains that the discount factors in the numerator and the denominator differ. As explained in the introduction, job creation is now lower than in absence of employment protection. Thus, even though the frontier in Figure 2.4 is unchanged (p^l does not depend on T), the general equilibrium effect of employment protection is to make specific investments choices more likely.

3.2. Efficient compensation of workers

In the regime G, the firm could induce the worker to make the best investment from its perspective, i.e. the specific investment, by compensating the worker by a transfer $F = \Delta E > 0$, so that $F - \Delta E = 0$. We argued earlier on that, given the timing of events, this ex-post transfer to the workers was hardly credible and a hold-up problem arose. As a general statement, there are several situations in the labor markets in which a incontractiblity issue arises. In such cases, simple schemes such as commitments, issuing bonds or long-term contracts may solve this problem and restore efficiency, but are not observed in practice. This is why the modelling strategy of this paper has so far taken this contracting issue as given. We now relax this assumption and indeed allow firms to ex-post compensate workers if they invest in specific skills.

In partial equilibrium, this possibility is however limited by the fact that workers may find it too costly to invest in specific skills, so that the transfer, being necessarily limited to the firms gain in profits. In other words, if $F = \Delta E$, we need to insure that $F < -\Delta J$. Given equation (2.9), this implies the following constraint for such a compensation scheme to be possible:

$$\Delta\varepsilon^d > (r+\delta+\lambda)\Delta U \tag{3.6}$$

This inequality separates the space ($\Delta\varepsilon^d$,ΔU) in two parts. Let's call $\mathcal{F}$ the associated frontier (a straight line with intercept 0 and slope $r + \lambda + \delta$). Equation (6.3) defines another curve with higher slope and negative intercept. This implies that, in partial equilibrium, it is only when specific investments increase sufficiently the duration of jobs that the firms are able to compensate workers. To see what happens, assume for a moment that we start from the regime G and let's allow firms compensate for workers. Then, the job finding rate $p_{K=G}$ that is above p^l increases, since firms, despite the compensation of their workers, make more profits. The new job finding rate, denote it by $p_{K=S/comp}$ (meaning regime S through workers' compensation) is above $p_{K=G}$ but below $p_{K=S}$ due to the fact that the compensation by firms reduces profits. This means that workers, facing in general equilibrium a higher job finding rate, require further compensation from the firm. This reduces $p_{K=S/comp}$ since fewer firms enter, moderate the amount of compensation to workers, and so on...

In other words, in the space parameter, the subset of parameters leading to a pure regime G is smaller (but not empty since (3.6) has to be satisfied), the subset of parameters leading to a pure regime S is larger. The mix regime subset is affected ambiguously by these changes.

3.3. Technological choices by firms

The firms has another option to induce workers to chose a specific investments. It might for instance invest at costs j^s or j^g to raise the productivity of the workers h^s or h^g. Here again, the extreme parts in the parameter space are going to be unaffected by the firm's investment strategy: indeed, if workers find it extremely profitable to invest in general human capital, the firm is not going to spend any resource on raising the productivity of the specific technology. Instead, it is going to raise the productivity of the general technology. We have here a complementarity between firms' and workers' behavior that is going to take place, reinforcing the differences between economies in the two different regimes as well as the stability of each equilibrium to changes in the macroeconomic environment.

However, in the middle of the space parameter and more precisely, in the neighborhood of the mix-regime, firms are going to consider seriously the possibility of changing workers' investments decisions, and in the specific case, of turning workers's decisions into specific human capital to increase stability. This can be done by raising h^s so that workers obtain a higher bargained wage and face a longer duration of jobs. This situation characterizes well the regime S: ex-ante, workers may be relatively indifferent between investing in general or specific human capital. But employers manipulate workers' investments by increasing the productivity of specific technologies, which is in the joint interest of workers and firms.

Overall, this subsection and the previous one predict that, when both extensions described here are allowed, a part of the general regime surface in the space parameter disappears, while the 'mix strategy' area is moved to the left of Figure 2.4. The benchmark model and its qualitative conclusions however obviously survive these modifications.

3.4. Wage cuts of displaced workers and the conditionality of benefits

Assume now that the initial value of productivity at the time of match formation is no longer fix (equal to ε^u) but random, determined by a draw in $f(.)$, and that this productivity is revealed after worker's investment C is made. The key intermediate result is that the reservation productivity is exactly the same at the entry as at the exit margin, and accordingly, that the regime G or S is determined according to the same trade-off between higher productivity and higher outside option. Given that $\varepsilon^{dg} > \varepsilon^{ds}$, the rate at which workers reject job offers is given by $F(\varepsilon^{dk}), k = s, g$ and is larger in the G-economy, who are more choosy since they have better outside options. What is the average entry wage of workers in this economy? It is determined by the expected value of productivity. If we take as 'entry wage' the wage that is determined 'just before' the investment in human capital, it is given by

$$w_0^k = \beta\varepsilon^k + (1-\beta)(r+\delta)U^k$$

while the wage loss of displaced workers $\chi^k = Ew^k - Ew_0$. Given that entry wage have the same reservation strategy as continuing wage, the expected value of ε is the same and thus,

$$\chi^k = \beta h^k$$

Thus, this wage loss is higher in the $S-$economy, which is intuitive. This is reinforced by the likely existence of employment protection in S-economies, that leads to a larger difference between entry (unprotected) and continuing (protected) wage, as equations (3.3) and (3.4).

On the other hand, assuming that unemployment benefits are larger in a S-economy, this has no direct impact on the wage loss χ^k since the reservation strategy at the entry level is the same as later in the life-cycle of the job.

Finally, assume that unemployment benefits are lost after rejection of a job by the worker in a G-economy. In this case, the outside option of the worker is lower, and its reservation strategy leads him to accept lower wages (lower ε) at then entry than at the continuation stage. In that case, the entry wage of workers in a G-economy is lower, and the wage loss is higher.

To sum up, the basic model predicts higher wage losses for displaced workers in a S-economy, unless additional institutional differences, such as conditionality of unemployment benefits to job acceptance (in the G-economy). Such a feature indeed reduces the differences in χ^k, $k = s, g$ between the two economies. This may rationalize recent findings indicating that wage losses of displaced workers do not differ enormously between say, France and the US.

4. Some interpretations

4.1. Declining sectors in Europe

Massive layoffs by a continental European firm operating in traditional industries usually lead to large, passionate debates between the workers and the share holders, but also between the media and the policy makers, local or national. Among the numerous examples, one can just cite Renault Vilvoorde in the periphery of Brussels, of Moulinex in central France or Marks & Spencer in Paris.

At the time of announcements of the layoffs, workers collectively show the highest degree of distress and sometimes engage in illegal activities like threatening to pollute the surrounding rivers or to destroy the stocks. Politicians then come and attempt to rescue them with the (involuntary) help of the local or national tax payer. One can see the motivations of these different groups under an new light if one uses the perspective of the model of this paper. What seems typical of the situations described above is a 'misperception' by workers of the duration of the job they occupy. If someone invests in skills specific to a job in thinking that it will last forever, and forgets about investing in general human capital skills, its market productivity in and out of the firm will drastically differ, as well as the earnings.

All this is reinforced by the fact that the tightness of the local labor markets is typically very low, and thus the difference between the current value of employment (before the destructive shock) and the value of unemployment (in our model, $E^s - U^0$) is large. The state needs or feels obliged to intervene, since it is its role to take care of workers whose employability is low. The low employability, again, is due to a wrong choice of investments in human capital, reinforced by two factors : low levels of schooling for those workers due to national under-investment into higher education in the past ; and the choice of technologies by employer requiring specific rather than general skills. The failure of compulsory 'training' in countries like France is an additional factor of troubles in such cases. Finally, consistent with the alternative interpretation of the model expressed in Remark 1, laid-off workers have a very low schooling level, because they were recruited early by employers against the promise of being trained by the firms.

4.2. Turbulence vs. steady-state

A recent paper by Blanchard and Wolfers (2001) shows the strong complementarity between shocks and institutions in order to explain the European experience. Ljunqvist and Sargent similarly see increased turbulence to negatively interact with institutions. These views are similar to ours: in our terminology, a G-economy (resp. a S-economy) is the same as the LS (laissez-faire) (resp. WS, Welfare-State) economy in Ljunqvist and Sargent (2002).

What essentially comes out of our model is that the two regimes are perfectly natural and rational, in a steady-state. Each system has its own coherence. What happens when the coherence disappears due to some unexpected change in the macroeconomic environment, a huge rise in turbulence, a large unexpected wave of innovations, a large decline in international transportation costs and trade barriers, leading traditional industries to increased international competition. In our model, this would be equivalent to, either an increase in λ or in the variance of distribution $f(.)$. In the G-economy, the analysis of traditional models of job creation/job destruction models can be applied straight away (e.g. Mortensen and Pissarides 1999). An increase in λ raises unemployment, reduces tightness of the labor market and increases the duration of unemployment, while reducing further the incentives to invest in specific human capital.

In the S-economy, as long as it remains in the same regime, the same results apply, with an important asymmetry. The S-economy suffers from additional adverse consequences for workers who suffer larger human capital losses and welfare losses in case of unemployment. In addition, the S-economy may suffer from a regime change, i.e. an incentive for unemployed workers to invest in general human capital instead. This further reduces the number of job creation by firms and additionally depress the labor market.

To formalize the evolution of this economy, one would need to derive its dynamics, which is not done here due to space limitations. The main message is that a G-economy adapts quite flexibly to new conditions, since its workers have already paid the training costs and don't need to pay it after a shock (except new born workers of course), while in the S-economy, all newly fired workers need to repay the training costs. The short-run cost of adjustment to a new macroeconomic environment in this economy is thus much larger, and should not be disregarded in international trade theory.

Doers it mean that the G-regime is unambiguously the model to follow? The answer is no, because in a stable environment, represented by the steady-state in our model, jobs in the S-economy are more productive. As a result, as (unreported) numerical resolution of the model indicates, a shift from the regime G to the regime S is associated with a strong reduction in unemployment, a feature that may sound strange to the eyes of an observer of the last two decades, but perhaps much less so for those remembering that Europe had lower unemployment rates than the US in the 60's and early 70's.

4.3. Differences in institutions and some political economy

4.3.1. Unemployment benefits

So far, the only institution introduced is b (unemployment benefits); let us first discuss its effect in the model. We can make several observations. a) Since benefits enter in the same way into U^s and U^g and do not depend on the previous wage, they do not directly affect the training decisions. b) Such would not however be the case if they were proportional to the previous wage. Indeed, benefits would affect E^k indirectly by affecting the value of unemployment. Since we cannot sign the wage difference between the two investment choices, we cannot directly conclude on the effect of benefits. However, we can remark that dependence of benefits to the previous wage would affect bargaining, since workers internalize the future benefits of marginal wage increase through higher benefits. This would act as an increase in the effective bargaining power β and thus raise the occurrence of regime S. c) In addition, even if they are constant, benefits, by their direct effect on wages, reduce profits and thus job creations, thus reducing θ^K, $K = S, G$ and thus reinforces the likelihood of regime S.

4.3.2. Wage bargaining institutions

There is also in the model a huge scope for other types of institutions. As noticed in sub-section 3.2 notably, the timing of events is consistent with a pure hold-up story, i.e. the firms never compensate workers for sunk cost C. Anticipating this, workers cannot be manipulated by firms to chose the desired type of investment, i.e. specific human capital. However, if it is recognized that such investments are desirable, limiting the ex-post (post hiring) contractual freedom of agents is necessary, so that workers find that the dominance of specific human capital investment is credible. How can this be done? There are two ways for firms to be forced being credible in inducing specific investments. The first way is to give workers a higher share of the production, i.e. a larger β. Even though bargaining (and thus β) concerns individual, marginal workers, its outcome can be affected by unions, directly in the firm or indirectly through their effect on labor legislation or their application in courts. This is thus a rationale for the existence of both moderate union (which large employers sometimes themselves recognize) and of labor legislations. The second one, discussed in sub-section 3.1, is the existence of layoffs costs, which raise the expected horizon of jobs and favors specific human capital investments, at the social cost of maintaining inefficient firms in activity. There is however a positive aspect in this trade-off, as well known from contract theory and recent search papers by Acemoglu and Pischke (1999a and b discussed in 4.4.3).

4.3.3. Political economy of institutions

In line with the above discussion, employers themselves might find it profitable to protect workers from technological shocks, in order to induce the right type of investment. Indeed, once specific investments are made by workers, those are more 'fragile' in the sense that turbulence and reallocation of industrial activities would lead them to be displaced with low opportunities in the market. As discussed in 3.1, the implicit contract in traditional activities in the 70's may have been the acceptance by workers of specific skills in exchange of job protection and higher bargaining power. The arrival of reallocation shocks may have lead to the breakdown of this contract, explaining the social tensions surrounding the emblematic bankruptcies already described. Among other insights, the model suggests a complementarity between institutions and the specificity of human capital investments, leading to the persistence of such institutions. This is close to Saint-Paul's (2000) discussion of complementarities between institutions and labor market slackness generating persistence or multiplicity of equilibria.

4.4. In search of evidence

4.4.1. Returns to tenure

In an older paper, Hashimoto and Raisian(1985) had provocatively demonstrated that Japanese and American workers deeply diverged in terms of number of jobs occupied throughout their career. For instance, in the late 70's, they showed that in the US., 15% of male workers aged 40-49 had more than 20 years of tenure, while 31% of Japanese workers were in this case. At the age 65, US workers had had in average slightly more than 10 jobs, while the average Japanese workers had occupied only four jobs.

Perhaps as a cause, perhaps as a consequence, they found that, in large firms, returns to tenure were 7% a year (with a quadratic term of -0.03%) in Japan, and only 1.2% a year in the US (with an identical quadratic coefficient), controlling for total experience, schooling and all sorts of interaction terms. This has been a much controversial result, subsequent studies for the US oscillated between larger and significant returns to tenure (Topel 1991) and zero returns (Abraham and Farber 1987, Altonji and Shakotko 1987), while for Japan, Clark and Ogawa (1992) indicated that strong returns to tenure were less true in the mid 1980's, due to changes in the demographic structure of Japan.

Interpreting returns to tenure (net of total experience of the labor market) as the conventional human capital theory (returns to specific human capital), we have an indication of low investments in that sort of capital in the US., with a target of what we want to look at in Europe to motivate the story of the paper, namely returns to tenure. However, in absence of uncontroversial result about methodology even in the US., we cannot provide any decisive evidence here.

4.4.2. Mobility

In an older, very important paper, Bertola and Ichino (1995) had suggested that mobility costs were central to the developments of both US. and Europe, and interacted with wage institutions. Enough wage dispersion make it worthwhile for workers to pay mobility costs, while compressed distribution leads to lower incentives to mobility; additionally, they provide an interpretation of rising wage inequality in the US and raising unemployment in Europe. At a first glance, it seems that our model indicates the same direction, in the sense that labor mobility costs are higher in Europe, however due here to the different nature of human capital investment. At the same time, these mobility costs interact with the wage structure: lower β are associated with the regime G. Issues such as wage dispersion cannot really be addressed here, except by arbitrarily attributing differences across countries to differences across β, which makes sense anyhow since in the model the source of heterogeneity in wages is the difference in the idiosyncratic component of productivity ε which enters as $\beta\varepsilon$ in wages.

Further documentation of the limits to mobility within European countries has however to be undertaken. For instance, the replication of Blanchard and Katz (1992) to different European countries has shown that the high persistence of regional unemployment was due to a lack of population migrations between regions.

4.4.3. Direct evidence on human capital investments

Acemoglu and Pischke (1999b) having recently explored the link between labor market institutions and human capital investments. Their most recent empirical evidence, available on Steve Pischke's homepage, indicates no link between US state minimum wages and general training on the period 1987-92. A direct test of our model would be to test how such institutions affect specific training. A recent OECD study of the impact of post-schooling training (OECD 1999, 2001) indicates that returns to training are small or insignificant in France, Australia, the Netherlands and Germany, and higher in Italy and the UK. It is however impossible to decompose specific and general training, nor to infer from the survey whether these differences in returns arise from differences in the intensity of training or in measurement of the variable 'training'. Training is also usually provided to the individual with the highest unobserved skills and causal returns to training is thus difficult to measure.

5. Concluding comments

This paper has proposed an alternative way of describing Europe-Us differences in the labor market, that is linked to the nature of human capital decisions, and at the same time consistent with the interaction of shocks and institutions (Blanchard and Wolfers 2001, Ljunqvist and Sargent, 1998, 2002). The bottom line of our paper is as follows. The European model is often blamed for its rigidities along several dimensions. That it has several negative aspects is hardly questionable, but the question is perhaps to understand if one has not overlooked its benefits. The intuition here is that underprovision of specific human capital investments due to the hold-up problem is partly corrected by the existence of those so-often blamed institutions. One strong line is to even argue that the European model may be superior to the US one in steady-state situations, which is also an implication of Ljunqvist and Sargent's analysis. This may be a bit surprising for an observer of labor markets of the last 20 years. However, remembering that Europe had lower unemployment rates than the US in the 60's and early 70's, and that rapid changes occurred afterwards, the seemingly superior efficiency of the US in the past decades is seen as being associated with its impressive ability to cope with a changing economic environment. An admittedly controversial claim is that intrinsic inefficiencies may show up at some point or another once a steadier macroeconomic environment will take place.

To complement the previous claim, we can add that in several European countries as well as in Japan, there is a feeling by observer that labor markets have become closer from the US. in several directions, one of them being the flexibility at the margin, the other one being the higher turnover, perhaps as a consequence. Although this is seen here as an optimal institutional response to a more volatile environment, the 'irreversibility' character of these changes leads to be cautious when assessing the welfare gains of such reforms, since the optimal model choice, as argued above, is conditional on the stability of the macroeconomic environment, that may well return to an higher level in a few years. Finally, compared to previous approaches cited above, we point out new directions for empirical research in macroeconomics. We notably suggest to measure the differences in returns to tenure across countries or sector as a proxy for the intensity of specific human capital investments.

6. Appendix

6.1. Appendix 1.

The Bellman equations are:

$$\begin{aligned} rE(\varepsilon) &= w(\varepsilon) + \lambda \int Max(U - E(\varepsilon), E(\varepsilon') - E(\varepsilon)) dF(\varepsilon') + \delta(O - E(\varepsilon)) \\ rJ(\varepsilon) &= y(\varepsilon) - w(\varepsilon) + \lambda \int Max(V - J(\varepsilon), J(\varepsilon') - J(\varepsilon)) dF(\varepsilon') + \delta(V - J(\varepsilon)) \end{aligned}$$

which rewrites as in the text.

The derivative of the discounted value of future unemployment with respect to current investment in general capital i^g is also the derivative of that value with respect to h^{g0}. The value of unemployment writes (recalling that the initial value of ε is ε^u):

$$(r + \delta)U(h^{g0}) = b + p \underset{i^{s\prime}, i^{g\prime}}{Max} [E(\varepsilon^u, i^{s\prime}, h^{g0} + h^{g\prime}) - C(i^{s\prime}, i^{g\prime}) - U(h^{g0})] \tag{6.1}$$

where $i^{s\prime}, i^{g\prime}$ represent the human capital investments made by workers in the next job they will occupy and b is the income of the unemployed workers. We have thus, using

$$\frac{\partial U}{\partial h^{g0}} = \frac{p}{r + \delta + p} \frac{\partial E}{\partial h^{g0}}$$

Given that $\frac{\partial E}{\partial h^{g0}} = \frac{\beta}{r + \delta + \lambda}$, we obtain that

$$\frac{\partial U}{\partial i^g} = \frac{p}{r + \delta + p} \frac{\beta}{r + \delta} < \frac{1}{r + \delta} \tag{6.2}$$

QED.

6.2. Appendix 2 : the supply of human capital

Let us use the notation α^g to rewrite the arbitrage equation of the unemployed (2.5) and (2.6) which leads to:

$$(r + \delta + p)\Delta U = pC + p\alpha^s \Delta E \tag{6.3}$$

Going back to equation (2.9), we see that, for the same level of revealed ε,

$$\Delta E = \frac{-\beta \Delta \varepsilon^d}{r+\lambda+\delta} + \Delta U \tag{6.4}$$

The first term of the right hand side is negative, given Proposition 1. Due to lower turnover, workers with specific human capital enjoy the returns from their job for a longer time. However, the second term of the right hand side is positive, which indicates that the higher outside option of workers with general human capital contributes (intertemporally) to a higher relative life time value of being employed with general human capital, i.e. a higher E^g relative to E^s.

When the job finding rate is equal to zero, $\Delta U = 0$ since the common value of unemployment in both regimes is simply $b/(r+\delta)$. This implies that, if $p = 0$, $\Delta E = -\frac{r+\delta+p}{p}C < 0$. When instead p goes to infinity, we have ΔU converging to ΔE and thus $\Delta E > 0$. Having proved the sign of ΔE in $p = 0$ and $p \to \infty$, we need to sign $\partial \Delta E / \partial p$.

Combining both equations, we have that

$$\Delta E \left(1 - \frac{p\alpha^s}{r+\delta+p}\right) = pC - \frac{\beta \Delta \varepsilon^d}{r+\lambda+\delta}$$

To calculate $\partial \Delta E/\partial p$, we need first to differentiate $\Delta \varepsilon^d$. Using (2.10) and its difference across regimes

$$-\Delta \varepsilon^d + \frac{\lambda}{r+\lambda+\delta} \int_{\varepsilon^{ds}}^{\Delta \varepsilon^d + \varepsilon^{ds}} (1 - F(\varepsilon'))d\varepsilon' = -(r+\delta)\Delta U + \Delta h \tag{6.5}$$

we obtain in differentiating with respect to p:

$$\frac{\partial \Delta \varepsilon^d}{\partial p}(-1 + \frac{\lambda}{r+\lambda+\delta}(1 - F(\varepsilon^g)) + \frac{\lambda}{r+\lambda+\delta}\frac{\partial \varepsilon^s}{\partial p}(F(\varepsilon^{ds}) - F(\varepsilon^{dg})) = -(r+\delta)\frac{\partial \Delta U}{\partial p}$$

From (2.10), we have

$$\frac{\partial \varepsilon^{ds}}{\partial p}(1 - \frac{\lambda}{r+\lambda+\delta}(1 - F(\varepsilon^s)) = -(r+\delta)\frac{\partial U^s}{\partial p} \tag{6.6}$$

It follows that

$$\frac{\partial \Delta E}{\partial p} = \frac{\partial \Delta U}{\partial p}\left(1 - \frac{(r+\delta)(1-\beta)}{r+\delta+\lambda F(\varepsilon^{ds})}\right) - \frac{\lambda}{r+\lambda+\delta}(F(\varepsilon^{ds}) - F(\varepsilon^{dg}))\frac{\partial \varepsilon^{ds}}{\partial p}\frac{1-\beta}{r+\lambda+\delta} \tag{6.7}$$

Given that $\frac{\partial U}{\partial p} > 0$ (Appendix 1), we have from (6.6) that $\partial \varepsilon^{ds}/\partial p > 0$: the destruction rate is higher if tightness is higher, a property that is derived in Mortensen-Pissarides and denoted as the job destruction curve. The second part of (6.7) is thus positive. The first part is positive to the extent that $\partial \Delta U/\partial p$ is positive. Going back to (6.3) this is obvious in the regime G when $\alpha^s = 0$. In the regime S, this is also true, but more involving, since we need to solve for the full system ($\partial \Delta U/\partial p$,$\partial \Delta E/\partial p$). I don't report the calculations here, but they are available on request. What matters is that, in all regimes, those values are positive, and that we can represent the evolutions of the differences in asset values with respect to p, which characterizes the regime of the economy. The value p^l is determined by $\Delta E = 0$. If $\Delta E = 0$ this implies that $\Delta U = \frac{\beta}{r+\lambda+\delta}\Delta\varepsilon^d$ from (6.4) and $\Delta U = \frac{pC}{r+\lambda+\delta}$. In other words, p^l is the value of the job finding rate that insures

$$\Delta U(p^l) = \frac{p^l C}{r+\delta+p^l}$$

6.3. Appendix 3 : flows and stocks

In both regimes, there is a share ξ of new jobs, i.e. of jobs having not faced any transition. Let us denote by e^0 this number of jobs, e the total number of jobs and thus, $\xi = e^0/e$. We have notably that

$$de^0/dt = (1-e)p - (\delta+\lambda)e^0 \tag{6.8}$$

In regime G, denoting by u^g and u^0 the stocks of unemployed workers with general or no human capital, we have

$$du^0/dt = \delta - (p+\delta)u^0 \tag{6.9}$$

$$du^g/dt = (1-u^0-u^g)\lambda F(\varepsilon^{dg}) - (p+\delta)u^g \tag{6.10}$$

where the first line shows that changes in u^0 are the difference between the arrival of new born workers (the total active population is normalized to unity) and the successful job seekers in that pool (remembering that a fraction δ of them dies), and the second line states that changes in u^g are the difference between the arrival of laid-off workers and of successful job seekers in that pool (still taking care of deaths in the pool). In steady-state,

$$u^0 = \frac{\delta}{\delta+p} \tag{6.11}$$

$$u^g = \frac{p}{\delta+p}\frac{\lambda F(\varepsilon^{dg})}{\delta+p+\lambda F(\varepsilon^{dg})} \tag{6.12}$$

In the mixed regime, we need to calculate the steady-state stocks of workers in each state : u^0, u^g, e^s,

e^g with e^k is the number of 'employed' workers with human capital k, $k = s, g$. Now, we have

$$du^0/dt = \delta + e^s \lambda F(\varepsilon^{ds}) - (p+\delta)u^0 \quad (6.13)$$

$$du^g/dt = \lambda F(\varepsilon^{dg}) e^g - (p+\delta)u^g \quad (6.14)$$

$$de^g/dt = \alpha^g p u^0 + u^g p - (\delta + \lambda F(\varepsilon^{dg}))e^g \quad (6.15)$$

$$de^s/dt = (1-\alpha^g) p u^0 - (\delta + \lambda F(\varepsilon^{ds}))e^s \quad (6.16)$$

It follows that, in a steady-state, we have

$$u^0 = \frac{\delta + e^s \lambda F(\varepsilon^{ds})}{\delta + p} \quad (6.17)$$

$$u^g = \frac{\lambda F(\varepsilon^{dg})}{p+\delta} e^g \quad (6.18)$$

$$e^g = \alpha^g \frac{p}{\delta + p + \lambda F(\varepsilon^{dg})} \quad (6.19)$$

$$e^s = (1-\alpha^g) \frac{\delta}{\delta + \lambda F(\varepsilon^{ds})} \frac{p}{\delta + p} \quad (6.20)$$

and finally, using

$$\frac{\kappa^g}{\kappa^s} = \frac{\delta + \lambda F(\varepsilon^{ds})}{\delta + \lambda F(\varepsilon^{ds})} \frac{e^g}{e^s} \quad (6.21)$$

we obtain the expression (6.24).

6.4. Appendix 4. Restrictions $\mathcal{R}$

In the steady-state regimes, we have assumed so far that

- in regime G, in which $E^g > E^s$, we have that both employed workers with general human capital, or newly hired workers with general human capital, never invest in specific human capital, i.e. in both cases, $E^g > E^s - C$. This is always verified in regime G.
- in regime S, in which $E^g > E^s$, employed workers with specific human capital never invest in general human capital, i.e. $E^s > E^g - C$ which is always verified in regime S
- in both pure regimes, it is better to invest than not to invest, which writes formally as $E^k(\varepsilon^u + h^k) - C > U^0$. For any strictly positive β (bargaining power of workers), this is satisfied as long as C is small enough or h^k is large enough which we assume. However, in the neighborhood of $\beta = 0$, this is not verified, and there exists a zero-investment area, the size of which is reduced by low p, low C and by high ε^u and h^k.

- it is not profitable to invest in both skills, i.e. either h^{s+g} is close enough to h^s or C^{s+g} is large enough compared to C. We assume that these 'convexity' assumptions hold.

Under the assumptions of the latter two items, we have proved here that, in the 'steady-areas' of the equilibrium, the problem was well defined and the Bellman equations properly constructed.

6.5. Appendix 5. Unemployment

6.5.1. Regime S

In regime S in which every one invests in specific skills, the derivation of steady-state unemployment is straightforward and we obtain the usual value for the unemployment rate

$$u^S = u^0 = \frac{\delta + \lambda F(\varepsilon^{ds})}{p + \delta + \lambda F(\varepsilon^{ds})} \tag{6.22}$$

6.5.2. Regime G

In regime G, one needs to keep track of the stock of unemployed workers with different skills, notably those with general human capital. We have (see Appendix 3) the total unemployment rate in this regime is

$$u^G = \frac{\delta}{\delta + p} + \frac{p}{\delta + p} \frac{\lambda F(\varepsilon^{dg})}{p + \delta + \lambda F(\varepsilon^{dg})} \tag{6.23}$$

With $\delta = 0$, one is back to the standard value $\lambda F(\varepsilon^{dg})/(p + \lambda F(\varepsilon^{dg}))$ since everyone, in steady-state, becomes skilled with general human capital. Having $\delta > 0$ allows for demographic turnover and so for a positive fraction of unskilled in this economy.

6.5.3. Mixed Strategy Regime

In this regime, given that $E^s = E^g$, workers endowed with general human capital will all chose not to invest in specific human capital: indeed, why pay C to get the same level of utility as without making any new investment? So, the only workers investing in specific human capital are the new born workers. We need to link α^g to κ^s and κ^g to obtain a full description of that equilibrium. We obtain (see Appendix 3):

$$\frac{\kappa^g}{1 - \kappa^g} = \frac{\alpha^g}{1 - \alpha^g} \left(\frac{\delta + \lambda F(\varepsilon^{dg})}{p + \delta + \lambda F(\varepsilon^{dg})} \frac{p + \delta}{\delta} \right) \tag{6.24}$$

where the difference between α^g and κ^g is due to a corrective term accounting for the fact that there are inflows into unemployment of workers with general human capital, who later on systematically chose not to invest in specific human capital. Notably, $\delta = 0$ implies that $\kappa^g = 1$ whatever α^g (i.e. all the labor force would become skilled with general human capital in steady-state). Nevertheless, in spite of the corrective terms, it is possible to describe the full set of κ^g in $]0,1[$ with any mixed strategy $0<\alpha^g<1$ of new-born workers. Notably, it is possible to find the value of α^g corresponding to the equilibrium value $p=p^l$, as represented on Figure 2.3. This proves the existence of a steady-state mixed strategy equilibrium. Further, we have in this case that total unemployment is

$$u^M = \frac{\delta}{\delta+p}\left(1+(1-\alpha^g)\frac{p}{\delta+p}\frac{\lambda F(\varepsilon^{ds})}{\delta+\lambda F(\varepsilon^{ds})}\right)+\alpha^g\frac{p}{p+\delta}\frac{\lambda F(\varepsilon^{dg})}{\delta+p+\lambda F(\varepsilon^{dg})}$$

and it is easy to check that $\alpha^g=0$ and $\alpha^g=1$ brings back to the pure regimes (u^S and u^G above).

6.6. Appendix 6. Welfare implications

Since we don't have multiple equilibria, we cannot strictly speaking pareto-rank the regimes. However, it is possible to discuss the costs and benefits of each regime. Regime S has higher productive efficiency, since workers are more efficient in their job, and the economy pays fewer job search costs since job destruction occur less frequently. However, it has to pay (through the workers) human capital investments more frequently, since both new born workers and older workers have to pay C at the hiring level. A contrario, the economy in the regime G is less productive, has higher turnover and thus pays more frequently the search costs, but has only the new born workers paying the human capital investments. To illustrate the difference, we can derive the gross domestic product of each economy, which is

$$\begin{aligned} GDP^S &= u^S b+(1-u^S)\left[h^S+\varepsilon^u\xi^S+(1-\xi)\int_{\varepsilon^{ds}}^{\varepsilon^u}\varepsilon dF(\varepsilon)\right]-\gamma\theta u^S-pu^S C \\ GDP^G &= u^G b+(1-u^G)\left[h^G+\varepsilon^u\xi^G+(1-\xi)\int_{\varepsilon^{dg}}^{\varepsilon^u}\varepsilon dF(\varepsilon)\right]-\gamma\theta u^G-pu^0 C \end{aligned}$$

where ξ^K is the fraction of existing jobs that have not faced yet a transition to a new λ, and u^0 is the number of unemployed in the regime G that are still without general human capital. We showed in Appendix 3 that $\xi^K=\frac{p}{\lambda+\delta}\frac{u^K}{1-u^K}, K=S,G$.

References

[1] Abowd, J. and Kramarz, F. (1998). "Hiring Costs and Firing Costs", mimeo, revised version of Crest DP 1995-43

[2] Abraham, K. G. and Farber H.S. (1987). "Job Duration, Seniority, and Earnings", *American Economic Review* 77(3), pp278-97.

[3] Acemoglu, D. and Pischke, J.S. (1999a). 'The Structure of Wages and Investment in General Training', Journal of Political Economy, Vol. 107, Issue 3 (June), pp. 539-572

[4] Acemoglu, D. and Pischke, J.S. (1999b). "Beyond Becker: Training in Imperfect Labor Markets" Economic Journal Features 109, February 1999, F112-F142.

[5] Altonjji, J.G. and Shakotko R. A. (1987). "Do Wages Rise with Job Seniority", *Review of Economic Studies*, LIV, pp437-459.

[6] Becker G. (1964). *Human Capital*, The University of Chicago Press, Third Edition

[7] Bertola G., Ichino, A. (1995), "Wage Inequality and Unemployment: United States vs. Europe", NBER Macroannuals, pp13-66

[8] Blanchard, O. and L. Katz (1992), "Regional evolutions", Brookings Papers on Economic Activity, 1, 1-61.

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

[10] Clark, R. L. and N. Ogawa. (1992). "Reconsidering Tenure and Earnings Profile of Japanese Men", *American Economic Review*, March, 82, 336-45.

[11] Hashimoto, M. and Raisian, J. (1985). "Employment Tenure and Earnings Profiles in Japan and the United States", *The American Economic Review*, Vol. 75, Issue 4 (Sep.), pp. 721-735

[12] Hashimoto, M. and Raisian, J. (1985). "Employment Tenure and Earnings Profiles in Japan and the United States: A Reply", *The American Economic Review*, Vol. 82, Issue 1, pp. 346–354

[13] Krugman P.R. and Obstfelfd M. (2000). *International Economics, Theory and Policy*, 5$^{\text{th}}$ international edition, Addison-Wesley, ed.

[14] Malcomson, J.M. (2000). "Individual Employment Contracts", *Handbook of Labor Economics, Vol. 3*, D. Card and O. Ashenfelter, eds.

[15] Mortensen, D.T. and Pissarides, C.A. (1999). "Job reallocation, Employment Fluctuations and Unemployment", *Handbook of Macroeconomics*

[16] Ljunqvist L. and Sargent, T.J. (1998). "The European Unemployment Dilemna", *Journal of Political Economy*, 106, 514-550.

[17] Ljunqvist L. and Sargent, T.J. (2002). "The European Employment Experience", paper presented at the Center for Economic Performance Conference 'The Macroeconomics of Labor Markets', may.

[18] OECD (1999). Employment Outlook, Paris

[19] OECD (2001). "Investments in Human Capital through Post-Compulsory Education and Training", 26-Sep-2001, Working Party 1, ECO/CPE/WP1(2001)12

[20] Saint-Paul, G. (2000). *The political economy of labour market institutions*, Oxford University Press

[21] Topel, R. (1991). "Specific Capital, Mobility, and Wages: Wages Rise with Job Seniority", *The Journal of Political Economy*, Vol. 99, No. 1. (Feb., 1991), pp. 145-176