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Life cycle training and equilibrium unemployment

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A B S T R A C T

This paper examines life cycle vocational training investments in the context of a model with search frictions that features skill obsolescence and heterogenous agents. We shed light on some age-dependent externalities. On the one hand, this implies that firms can increase too far from retirement the selection into training programs with respect to what it would be optimal to do. On the other hand, endogenous job creation leads unemployed job finding probabilities to be too low at equilibrium, and also decreasing at the end of the working life. In turn, the latter implies that training externalities are lower for the older workers. We calibrate the model on the french economy and assess the quantitative impact of externalities on employment.

1. Introduction

Macro-labour literature recently examined the interplay between matching frictions and educational choices. In particular, it is worth emphasizing contributions that show the impact of matching frictions and labor market institutions on the nature of human capital investments, either general (transferable skills) or specific. Generally speaking, matching frictions produce incentive to accumulate adaptable skills whereas job protection or unemployment benefits raise the relative return of specific human capital. Those points have been emphasized by Wasmer (2006) in the context of on-the-job training, while Decreuse and Granier (2013) dealt with these issues by considering educational choices before the labor market entry. In this paper, our focus is on vocational training in general human capital, where workers are subject to skill obsolescence during unemployment spells. Ljungqvist and Sargent (1998, 2007) indeed been pointed out that related economic turbulence can be the main driving force behind the persistent increase in european unemployment rates. Then, in such an environment, our contribution is rather on the age-dynamics of on-the-job training investments and related externalities.

While it is well known that, in a context of competitive markets, human capital investments are in general efficient (Becker, 1964), search frictions on the labor market give rise to some inefficiency issues, so that there is a room for an optimal policy to promote vocational training investments. More particularly, Acemoglu (1997, 1999) highlighted the impact of a poaching externality: as general human capital investments can benefit, with some probability, to some future employers, the current firm's private return of training investment is lower than its social return. Belan and Chéron (2014) also argued that due to a higher job finding rate of workers with a higher general human capital, the training of workers implies an additional unemployment externality: the social return of training indeed embodies the fact that unemployed worker with higher human capital will switch faster from home production to market production. We here extend this infinitely-lived agents approach by considering a finite horizon of workers in the labor market.

More precisely, this paper develops a life cycle approach to vocational training investments in the context of search frictions. Our main goal is actually to examine to what extent the impact of skill obsolescence and continuous vocational training externalities is age-dependent. This seems all the more important that life cycle issues for a labor market with search frictions have been pointed out by recent works. Chéron et al. (2011, 2013) for instance emphasized distance-to-retirement effects on workers' flows and showed that there exists an age-specific externality related to the job creation process. Menzio et al. (2015) provided a similar life cycle approach with human capital accumulation to predict US labor market flows and wage growth, but with an exogenous accumulation process. Lastly, Pierre-Jean and Rouland (2014) built on Chéron et al. (2011) to propose a model with search frictions and endogenous human capital accumulation, in order to examine how training investments are related to age-dependent employment protection. But, as the latter paper deals with specific human capital accumulation, it does not raise any age-dependent externality. In turn, in this paper we examine how search frictions and externalities related to training investments in general human capital can interact each other over the life cycle.

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On the one hand, this allows to emphasize that, with respect to what it would be optimal to do, firms typically reduce too far from retirement the entry of workers into training programs. Otherwise stated, some older workers that are not trained would have to be trained when poaching and unemployment externalities are internalized. But on the other hand, it comes that both private and social return of training investments converge to zero when retirement gets closer. The latter is furthermore reinforced in the context of endogenous matching. Indeed, as job matching probabilities decrease at the end of the working life (due to shorter distance-to-retirement), training externalities also collapse. Overall, there exists some opposite forces on externalities as worker is aging. However, our model simulation suggests that to offset the gap between equilibrium and optimal allocations we would primarily need to raise the job creation far from retirement. By doing so, this reduces workers' risk of skill obsolescence, hence lowers future social costs.

The remaining of the paper is organized as follows. The next section presents a partial equilibrium version of the model with exogenous job finding probabilities. We lay out the economic environment and characterize both equilibrium and optimal age-dynamics of training policy to identify related externalities over the life cycle. Then, we extend these results to the endogenous matching case. Additional theoretical results that exhibit the interaction between job creation and training are first provided, and we lastly implement an empirical investigation with a calibration of the model on the french economy. A final section concludes.

2. Search frictions and life cycle training

We aim to develop a life cycle model that features search frictions and general human capital depreciation during unemployment spell, which depends on a "turbulence" parameter in line with what have been pointed out by Ljungqvist and Sargent (1998). Human capital accumulation relates to firms' endogenous decision to train workers at the time of hiring, as in the paper by Belan and Chéron (2014) with infinite-lived agents. We here consider a finite horizon (retirement), and this leads to an age-dependent selection of workers by firms into training programs, that is due to a distance-to-retirement effect. Yet, in this section we first consider exogenous job finding probabilities in order to characterize the equilibrium and efficient properties of training, and point out the age-dynamics of poaching and unemployment externalities.

2.1. Economic environment

Workers are characterized by their ability level, denoted by a, distributed over the interval $[\underline{a}, \bar{a}]$ according to p.d.f. $f(a)$, and by their age, denoted by t. The model is in discrete time and at each period the older worker generation retiring from the labor market is replaced by a younger generation of the same size (normalized to unity) so that the population on the labor market is constant. We assume that each worker of the new generation enters the labor market at age t=0 and retires at a deterministic age T.

We assume that workers enter the labor market with up-to-date knowledge, so they get the highest level of general human capital, hence related productivity $(1+\Delta)a$ with $\Delta > 0$. But then they can face skill obsolescence (human capital depreciation) over the life cycle: this occurs during unemployment spells with a per period probability π; if so, productivity is falling to a. Then, at the time of hiring, firms can choose to train workers whose human capital has been depreciated, in order to restore productivity $(1+\Delta)a$ instead of a. This leads firms to bear an instantaneous training cost γ_f. Obviously, this intertemporal decision shall depend on workers' ability, so that the training policy consists of determining an ability threshold that is age-dependent, denoted $\tilde{a}_t$.

Therefore, workers are heterogenous according to three dimensions: (i) ability a, (ii) age t, and (iii) status wrt. skill obsolescence. This implies in particular that we need to distinguish three types of agents at the time of hiring[1]:

- Type-0, with obsolete knowledge and unable for training ($a < \tilde{a}_t$), with productivity a;
- Type-1, able for training ($a \geq \tilde{a}_t$) but with obsolete knowledge, with productivity $(1+\Delta)a$ once the cost γ_f has been paid;
- Type-2, with up-to-date skills and instantaneous productivity $(1+\Delta)a$ without any additional cost.

Furthermore, at this stage we first consider a partial equilibrium framework where the frictional labor market is featured by exogenous job finding probabilities, constant across ages. We assume that worker's status with respect to skill obsolescence and ability a is perfectly observable by the employer. The probability for an unemployed worker of age t to be employed at age $t+1$ is assumed to be given by:

- p_0 for individuals with obsolete skills, unable for training if they are hired at the next period ($a < \tilde{a}_{t+1}$)
- p_1 for individuals with obsolete skills, able for training if they are hired at the next period ($a \geq \tilde{a}_{t+1}$)
- p_2 for individuals with up-to-date skills.

with $p_2 \geq p_1 \geq p_0$.

2.2. Value functions and Nash bargaining of wages

Let $w_{j,t}(a)$ be the wage, β the discount factor, δ the job destruction probability and b the home production. The expected values of income streams, denoted by $E_{j,t}(a)$ for a worker and $U_{j,t}(a)$ for an unemployed, are defined, $\forall\ t \leq T-1$, by:

Type 0:

$$E_{0,t}(a) = w_{0,t}(a) + \beta[(1-\delta)E_{0,t+1}(a) + \delta U_{0,t+1}(a)],\ \forall\ a < \tilde{a}_t$$
$$U_{0,t}(a) = b + \beta[p_0 E_{0,t+1}(a) + (1-p_0)U_{0,t+1}(a)],\ \forall\ a < \tilde{a}_t$$

Type 1:

$$E_{1,t}(a) = w_{1,t}(a) + \beta[(1-\delta)E_{1,t+1}(a) + \delta U_{2,t+1}(a)]\ ,\ \forall\ a \geq \tilde{a}_t$$
$$U_{1,t}(a) = b + \beta\begin{cases} p_1 E_{1,t+1}(a) + (1-p_1)U_{1,t+1}(a)\ ,\ \forall\ a \geq \tilde{a}_{t+1} \\ p_0 E_{0,t+1}(a) + (1-p_0)U_{0,t+1}(a)\ ,\ \forall\ a \in [\tilde{a}_t; \tilde{a}_{t+1}] \end{cases}$$

Type 2:

$$E_{2,t}(a) = w_{2,t}(a) + \beta[(1-\delta)E_{2,t+1}(a) + \delta U_{2,t+1}(a)],\ \forall\ a$$
$$U_{2,t}(a) = b + \beta\left[p_2 E_{2,t+1}(a) + (1-p_2)(1-\pi)U_{2,t+1}(a) + (1-p_2)\pi\begin{cases} U_{1,t+1}(a)\ ,\ \forall\ a \geq \tilde{a}_{t+1} \\ U_{0,t+1}(a)\ ,\ \forall\ a < \tilde{a}_{t+1} \end{cases}\right]$$

where we let $E_{j,T}(a) = U_{j,T}(a) \equiv R\ \forall\ a, j$. Value functions for unemployed of type 1 and 2 deserve further discussion. Indeed, it can be the case that the ability of workers is high enough at age t to be trained, but no longer at age $t+1$, so that they switch from type-1 to type-0 from t to $t+1$ (see the expression $U_{1,t}(a)$). Similarly, type-2 workers that remain unemployed and face human capital depreciation can directly switch to the 0-type, if $a < \tilde{a}_{t+1}$. We should also notice that

[1] The firm decide at time t to train a worker with obsolete skills recruited at time $t-1$ if his ability level a is superior or equal to the ability threshold $\tilde{a}_t$.