Enterprise-related training and poaching externalities

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Abstract: *Labour poaching is a potential problem in work-linked training systems. Once trained, young people can be poached by rival firms, which threatened the training firm's investment. A distinction is made between two types of workforce poaching. It is shown that it may be rational for some firms to train young people, even if they then lose part of their workforce. However, this situation is not socially optimal: it does not exclude underinvestment or skilled labour shortages. This may justify government intervention. However, the introduction of subsidies can have perverse effects.*

JEL Classification: J24, J38, J42

1. Introduction

There is a broad consensus in Europe today on the advantages of work-linked training, a system that combines practical training in firms and formal training in educational establishments. Vocational, enterprise-related training is a means of developing not only employees' technical expertise but also the aptitudes and cognitive competences that enable them to work effectively in a rapidly changing environment (Berryman and Bailey, 1992). Indeed, training and experience are two complementary components of skill, and contemporary technical and organisational developments serve only to reinforce this complementarity (Lindbeck and Snower, 2000).

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However, can this type of training principle really be put into practice? It relies on firms taking on young people and equipping them with transferable competences. From a theoretical point of view, we are dealing here with one of the fundamental theorems of human capital theory, which states that companies cannot finance general training.

For a company which provides some training to its employees in the course of employment, the risk of poaching can be limited or controlled. The investments in general training are associated to investments in specific training; which allows the training firm to propose higher wages than its competitors (Feuer *et alii*, 1987). Furthermore, the exact nature of the training received by an employee is not easily observable for a potential external employer. The training is then valued below its market price on the market. This asymmetry of information confers some market power to the employer and allows him to invest in general training (Katz and Ziderman, 1990 ; Acemoglu and Pischke 1998).

On the other hand, in the initial training systems poaching is a major problem for the firms. In these systems, training leads to competences that are recognised in the labour market and may be validated by certificates or diplomas, thereby making the training both identifiable and transferable (Casey, 1991; Acemoglu and Pischke, 2000). For those companies providing work-linked training, poaching is not just a potential risk but a tangible reality. Some firms lose a proportion of the young people they train (Booth and Satchell, 1994). The end of the training period is often the time at which young people decide to change company[1]. Nevertheless, employers pay a significant part of the general training of the young people they take on without going bankrupt (Jones, 1986). The aim of this article is to

[1] Most of the young people leave the company which trained them at the end of an apprenticeship contract. In France, the rates of keeping of the training companies vary from 11% to 26% according to sectors. The end of a "qualification contract" is also frequently accompanied by a change of company. The rate of keeping was 28,7 % in 1998 (Charpail et Zilberman, 1998).

show that this situation is rational. *It seeks to explain how firms can be led to invest in the training of young people whom they will not necessarily retain.*

For that purpose, we reason in a market made up of heterogeneous firms and structured by an imperfect competition. Within this framework, we show that training is not only transferable in the sense of Steven (1994), the companies are threatened by a second kind of poaching which is based on the attraction power of the firms and on the possibility that have the competitors to transform the manpower which they takeover. In our analysis, it is thus less the nature of the training provided than the position of the various firms on the labour market which determines the labour flows.

The paper is organised as follows. We analyse the risks of staff poaching within a market assumed to be made up of heterogeneous companies and define two types of labour poaching (Part II). We will then go on to show that it may be in the interests of some companies to provide training, even if they then lose some of their trained staff to 'dominant' companies (Part III). However, this situation is not socially optimal. The labour market still suffers from localised skill shortages. This may be good reason for government intervention, particularly through the provision of training subsidies. However, this type of intervention is not without its own perverse effects (Part IV).

2. Two kinds of poaching externalities

2.1. Worker's value and rent sharing

Consider a labour market in which workers and firms are heterogeneous. The agent skills are symbolized by a multidimensional vector $[S_i] = (s_1, s_2, \ldots, s_n)$. The components of this vector are the agent's characteristics determining the ability to perform various tasks. Motor skills (physical strength, manual dexterity) may be components of this vector, but also other characteristics such as interpersonal, organizational and managerial skills, diagnostic and analytical skills, etc. (Wolff, 2000).

Let v_{ij} be worker i's productivity in firm j. For a particular worker, the marginal product varies across firms. The worker's productive characteristics are not uniformly priced across firms (Heckman and Scheinkman, 1987); some of his skills are more valuable in one firm than in another. Suppose that there are N firms in the economy. Then the worker's potential value can be described by the vector:

$$(v_{i1}, v_{i2}, \ldots, v_{ik}, \ldots, v_{iN})$$

In the market equilibrium, a worker matches with the firm in which his productivity value is highest (McLaughlin, 1994). This match generates a differential rent M_{ij}. This differential rent is the difference between v_{ij} the worker's value in firm j and v_M his value in his second highest-valuing employer (Sattinger, 1979).

$$M_{ij} = v_{ij} - v_M \tag{1}$$

$$\text{with } v_M = \underset{k}{Max}\ \{v_{ik}\} \qquad \forall\ k \neq j,\ k \in \{1, \ldots, N\}$$

The wage contract is a simple rent-sharing agreement. Worker i and firm j sign a contract that pays the worker a wage equal to his opportunity wage plus a share of the rent to the match[2].

$$w_{ij} = \mu\ (v_{ij} - v_M) + v_M \tag{2}$$

Where $0 \leq \mu \leq 1$ is the rent-sharing parameter which reflects the determinants of bargaining strength.

[2] Numerous empirical studies have highlighted a rent-sharing mechanism (Hildreth and Oswald, 1997).

The wage is an outcome of bilateral bargaining[3]. The outside option of the employee, v_M, and the worker's productivity in the firm, v_{ij}, drive a wedge between the lowest wage for which the employee will work and the highest wage the employer will pay. Bargaining determines where within the wedge the wage will lie. Firms are able to obtain market power in the labour market that allows them to set wages below the productivity of workers:

$$a_{ij} = (1 - \mu)(v_{ij} - v_M) = v_{ij} - w_{ij} \qquad (3)$$

a_{ij} represents the part of the rent that the firm appropriates.

2.2. Job requirements and firms' training programmes

Firms are heterogeneous in their job requirements. Firms who use different combinations of specialised technology, or different patterns of work organisation, require workers with particular sets of skills. For simplicity, suppose that a firm is fully described by the type of worker it needs. Firm j's skill requirement is denoted by the vector $[R_j] = (r_{1j}, , ..., r_{kj}, ... , r_{nj})$. This is the *minimal* set of skills needed for the tasks involved in job j to be totally satisfied.

The school cannot provide a manpower perfectly adapted to every firm. There are unavoidable "skill gaps" between the young people leaving the school system and the jobs offered by the firms. Thus, if firm j hires a worker whose skill vector $[S_i]$ differs from $[R_j]$, the worker must be trained. The firm trains him in order to equip him with competences required for the job to be provided. The degree of mis-match determines the amount and the kind of job-related training needed to close the skills gap; and the cost of training to meet the firm's

[3] One may think of w_{ij} as the generalised Nash solution to the bargaining game that is played if the firm employs the worker: to maximise the Nash product $(w_{ij} - w_0)^{\mu} \cdot (v_{ij} - w_{ij} - \pi_0)^{1 - \mu}$ with respect to w_{ij}; where w_M and π_0 are the payoffs that the employee and the firm receive if the negotiations break down; and $\pi_0 = 0$ in the absence of other potential employees for the firm.

requirement is a function of the difference between the skill requirements and the worker's skill level (Eijs and Heijke, 2000). From this perspective, the labour market is an implicit market for learning opportunities that is dual to the market for jobs (Thurow, 1975). Firms purchase skills services and at the same time provide jobs offering learning possibilities.

2.3. A first kind of poaching

Companies compete with each other for the use of skilled labour. They are therefore all at risk of having workers poached by an external firm. The problem of poaching is traditionally analysed with the aid of the notions of *general training* and *specific training* defined by Becker (1975). Becker demonstrates that firms do not pay for investment in *general* human capital, while firms and workers share the cost of investment in *specific* human capital.

In an economy made up of heterogeneous firms where workers' value varies from one company to another, Becker's principles are invalidated. Stevens (1994) shows that in fact general training and specific training are polar cases. Training is often neither perfectly general nor completely specific. Most of the time, training cannot be regarded as the sum of two components, one completely general, and the other completely specific. Dissatisfaction with Becker's concepts has led Stevens to define the new concept of 'transferable training'. A training programme is *transferable* if it is of some value to at least one firm in addition to the training firm. Training raises the productivity of a worker in certain firms, but not in all, at least not equally. In an economy made up of heterogeneous firms, training in company j confers on individual i a value v_{ik}^{j} in each of N enterprises. The potential post-training productivity of the worker is described by the vector:

$$[v_{ik}^{j}] = (v_{ij}^{j}, v_{i1}^{j}, , \dots , v_{ik}^{j} , \dots , v_{iN'}^{j}) \qquad (4)$$

where v_{ik}^{j} is the productivity of worker i after training in firm j if he works in firm k.

A sum of general and specific training would be described by:

$$[\ v_{ik}^{j}\ ] = (g + s, g, g, \ldots , g) \tag{5}$$

Actually, there are many other possibilities which cannot be regarded as the sum of a general and specific component. In general, we will have:

$$[\ v_{ik}^{j}\ ] = (v_{ij}^{j}, \lambda_1 \cdot v_{ij}^{j}, \ \ldots , \lambda_N \cdot v_{ij}^{j}) \qquad \text{where } \lambda_1 \neq \lambda_2 \neq \ldots \neq \lambda_N$$

The transferable components of training vary across firms in accordance with their characteristics[4]. This translates as a *variable* increase in the individual's productivity in N other firms in the market. The risk of workers being poached can therefore be assessed on the basis of the differential rent M_{ij} at the end of the training period.

$$M_{ij} = v_{ij}^{j} - \underset{k}{Max}\ \{\ v_{ik}^{j}\ \} \qquad \forall\ k \neq j, k \in \{1, \ldots, N\} \tag{6}$$

The transferability of the set of competences can be analysed as a function of the sign of M_{ij}. If $M_{ij} > 0$, the risk of poaching is zero. If $M_{ij} \leq 0$, there is at least one competing company in which the productive value of the trained individual is at least equal to that of the individual in the company that provided the training. The company is thereby subject to the risk of having members of its workforce poached. This formula allows Becker's concepts of *general training* and *specific training*[5] to be applied more generally.

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[4] Many studies confirm the fact that the productivities for individuals with a given education are not identical, but vary systematically with the firm characteristics: the technology, the kind of sector in which the firm is operating, the size of the firm (Hartog and Jonker, 1998).

[5] With the formula that we are using, if training is *general* in the strict sense of the term given by Becker, then:

$$[\ v_{ik}^{j}\ ] = (g, g, \ldots, g)$$

We will then have: $M_{ij} = 0$. The company is indeed at risk of losing employees.

When training is *specific*: $[\ v_{ik}^{j}\ ] = (s_j, 0,0, \ldots , 0)$

We will have: $M_{ij} = v_{ij}^{j}$, and so $M_{ij} > 0$. The firm can finance specific training.

2.4. A second kind of poaching: poaching with training

The concept of transferability reflects the *immediate* potential use of individual’s skills in a set of rival firms. This approach assumes implicitly that it is the same vector of competences that is valued by the initial firm and the firms which poach the trained employees. The competing firms do not however content with poaching the employees of the other firms to employ them directly. They attract them and adapt them to their requirements. They transform their vector of competences because they are rarely perfectly in alignment with the skills required in the job concerned. To adapt the competences of poached workers requires time, additional investments and costs (transfer costs). This is confirmed by Shaw’s study (1987), which showed that individuals leave their jobs for more highly paid and skilled positions but that these ‘promotions’ result in additional ‘occupational investments’.

Even if the individual trained by a company j is not directly useful in a rival firm k, thanks to the competence which he acquired, he can more easily adapt to the characteristics of this firm. Those will be able to adapt quickly, and at lower cost, to the various opportunities of employment which are offered to them. This defines a second possible type of poaching.

Let T_{jk} be the cost of transfer from the present firm j to firm k. T_{jk} is the training investment required to adjust the worker to firm k. For an individual to leave training firm j, he or she must have prospects of higher earnings. The individual’s earnings prospects depend on his potential productive value in the different firms in the market *after training*. Thus an individual’s earnings prospects in external firms are no longer apprehended by means of the vector (v_{i1}^j, v_{i2}^j, ... , v_{iN}^j), which reflects the immediate productivity of an individual trained by firm j, but rather by means of the vector (V_{i1}, V_{i2}, ... , V_{iN}), which reflects the individual’s productivity once he or she has been adapted to the different characteristics of the various firms[6]. Firm j is threatened by this second type of poaching if a firm k exists, such that:

$$V_{ij} < V_{ik} - T_{jk} \qquad (7)$$

Under these circumstances, we can say that firm k **dominates** firm j. In an economy made up of heterogeneous firms, we will find *dominated* firms, who are subject to their workforce being poached, and *dominant* firms, who not only avoid having their employees poached, but are also able to take advantage of their position to poach those of the firms they dominate. Many empirical studies support this labour market structure. In France, Cahuc *et alii* (1990) established the existence of two distinct groups of firms :

- a group of firms characterised by "non-constrained" internal labour markets. It includes large companies whose employees can with difficulty obtain higher wages by changing employer. These companies can retain their employees by offering them interesting perspectives in terms of incomes and careers;

- a group of firms characterised by external labour markets. It includes smaller enterprises. In these firms, the employees are much more sensitive to the outside opportunities: they can obtain higher wages by leaving the company and by finding a job in a bigger company.

We defend the idea that it is the second kind of poaching that is fundamental. There is rarely professional mobility without transformation of the manpower skills. Even if a worker is immediately productive, he does not avoid a phase of adaptation. Moreover, the first kind of poaching can always be interpreted as a second kind of poaching whose transfer cost is null ($V_{ik} = v_{ijk}$ and $T_{jk} = 0$). The traditional concept of poaching is only a particular case of the second kind of poaching. One thus can consider that any poaching is a poaching with training.

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[6] Otherwise expressed, $V_{ik} = v_{ik}^{k}$

That leads us to relativize the role of specific skills. A firm which endows its employees with specific skills does not avoid the risk of poaching insofar as this specific training does not abolish poaching with training. The firms which keep their employees are those that dominate their competitors; that is those that, considering their productive organization and their technology, value most the work of their employees. In the same way, if some firms finance training "which is useful in the other firms" (Loewenstein and Spletzer, 1998), if they keep their employees and if they appropriate a part of the returns on the "general" training (Bishop, 1991), it is because they are not dominated on their labour market.

3. A model of training with asymmetrical competition between firms

In the remainder of this paper, we develop a formal model to demonstrate some of the implications of these externalities for the training decisions made by firms. The purpose of this paper is to analyse a simple two firms model which incorporates some of the asymmetries that keep labour markets from functioning perfectly. This is accomplished by assuming that one firm dominates the other. This setting is not only realistic, as supported by empirical studies, but it defines a general framework of analysis in which perfect competition appears as a particular situation that could be explored.

3.1 Model assumptions

We assume that each firm's labour needs are determined exogenously: n_j represents the number of additional qualified staff workers sought by firm j.

$$n_j = N_j^* - N_j^{t-1} \qquad (8)$$

where N_j^* represents the firm's desired size of workforce in period t

and N_j^{t-1} represents the size of the firm's workforce in the preceding period.

Untrained individuals have constant productivity, initialised to zero, in all firms. The firms are characterised by constant returns to scale for skilled workers: each employee brings a_j to firm j up to point N_j*; once this staffing level has been reached, additional workers serve no function, their value is zero.

The net costs of training *m* trainees are given by a continuous twice differentiable function C = C(m), where C'(m) > 0, C"(m) > 0. The most appropriate form for the cost function is a quadratic function of the type:

$$C(m) = u\, m^2 + b \qquad \text{with } u > 0 \text{ and } b > 0 \qquad (9)$$

This assumption reflects diseconomies of scale in teaching. Firms run into constraints of capital equipment required for training as the number of trainees increase. Furthermore, increasing the number of trainees per trainer leads to a drop in the quality and the efficacy of the training process (Rosen, 1987).

3.2. The training firm and the poaching firm

Consider an economy in which there are two firms: firm A and firm B. Let us assume that firm A dominates firm B, expressed as: $V_{iB} < V_{iA} - T_{BA}$. Firm A is more attractive than firm B ($V_{iA} > V_{iB}$); staff there are more productive and receive better pay. What is more, training is profitable for firm A; the differential rent that the employer and employee share ($V_{iA} - V_{iB} = a_{iA}$) is greater than the cost of training T_{BA}.

3.2.1. Firm A's strategy: poach the maximum number of employees

Firm A can increase its workforce in two ways. First, it can poach workers from other firms. These workers have already received (transferable) training but need further training to be adjusted to the job requirements of the firm. Second, unskilled individuals entering the labour market can be added to the firm through training.

As the training provided by firm B is transferable, the transfer costs that firm A will have to meet for staff coming from firm B will be lower than the training costs associated with individuals leaving the education system. It is more economical to adapt experienced workers than to train inexperienced individuals leaving education. Firm A, which wants to minimise its training costs, will try to have the initial training needs met by the dominated firm by poaching its staff once training has finished. Firm A will provide initial training only when it cannot poach enough staff. We will eliminate this scenario from our argument by assuming that $n_A < N_B^{t-1}$: the poaching practised by firm A is not limited by the size of the workforce at firm B.

Firm A's profit is therefore equal to:

$$\pi_A = a_A N_A^* - T_{BA}(n_A) \tag{10}$$

Each employee brings a_A to firm A, with the firm meeting a transfer cost of $T_{BA}(n_A)$.

3.2.2. Firm B's situation: coping with systematic poaching of part of its workforce

Firm B's profit, depending on whether or not it trains young people, is equal to:

No Training: $$\pi_B^{NT} = a_B (N_B^{t-1} - n_A) \tag{11}$$

Training: $$\pi_B^{T} = a_B (N_B^{t-1} + m - n_A) - C_B(m) \tag{12}$$

- the 'No Training' strategy refers to no further training of new recruits by the firm B which has already trained in the previous periods. Firm B suffers poaching equal to n_A and employs a workforce of size $N_B^{t-1} - n_A$. The gains made by firm B using this strategy are given by (11).

- the 'Training' strategy: the firm trains a number *m* of young people and suffers a level of poaching n_A; the size of its workforce is then $N_B^{t-1} - n_A + m$. It also has to meet training costs. Its profit is given by equation (12).

Whether it provides training or not, part of firm B's workforce is poached by firm A. In view of this systematic poaching, equal to n_A, the question that needs to be answered is whether or not firm B should provide training and, if so, on what scale.

The first step in answering this question is to determine the value of m*, the optimal number of trainees for firm B, whilst remaining aware that part of its workforce will be systematically poached by firm A. The second step is to determine whether it is preferable to train these m* new entrants or to refrain from such an investment.

3.3. Determining the number of new entrants m* trained by firm B

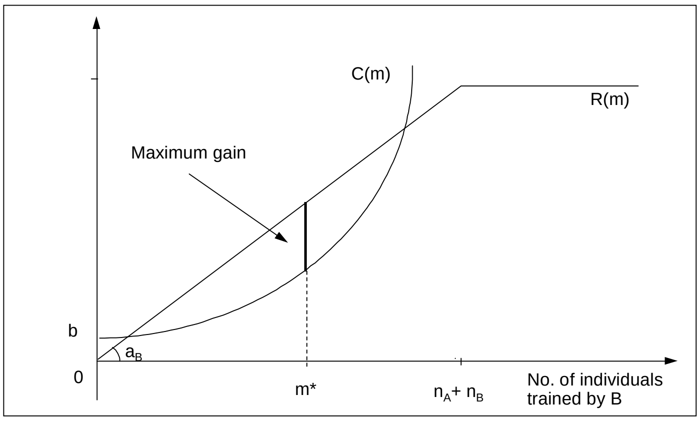
The optimal number m* of new entrants for firm B to train is the one that will allow it to maximise its profit (equation 12). The first order condition for maximisation with respect to *m* is:

$$a_B - C'(m) = 0 \qquad \text{where } m^* = \frac{a_B}{2u} \tag{13}$$

In appendix 1, we demonstrate that the number m* of trainees that maximises the profit for firm B is not necessarily equal to $n_A + n_B$:

We have : $m^* \leq n_A + n_B$

Fig. 1
Number of new entrants trained by firm B



Graphically, point m* is that at which the tangent to curve C(m) has a_B as its slope. So long as the marginal gain associated with training a new entrant is higher than its marginal cost, the firm will invest in training. It is therefore rational for firm B to train a number of young people lower than $n_A + n_B$. This means that firm B may decide to train new staff whilst still suffering a shortage of skilled labour. It actually has ($n_B + n_A$ - m*) employees fewer than it needs to reach the size of workforce it requires.

3.4. Firm B's dilemma: to train or not to train?

With the value of *m** determined, the question that arises for firm B is whether or not it is preferable to train m* new entrants and to meet the costs of this training (while also possibly finding itself under-staffed), or not to train and suffer an even greater labour shortage. Firm B will decide its strategy by comparing its potential gains from each of these different strategies. Firm B will prefer to train if:

$$\pi_B^{T}(m^*) > \pi_B^{NT}$$

that is, taking into account (11) and (12), if $m^* \cdot a_B > C_B(m^*)$ (14)

If $m^* \cdot a_B < C_B(m^*)$, firm B would do best not to train and to allow all of the workers needed by firm A to leave. Firm B would therefore have to deal with a labour shortage equal to $n_A + n_B$. Even though it would have to take on more staff, it would be preferable for it to suffer the labour shortage than to meet the costs of training. Not only does the dominated firm have to be capable of meeting the costs of training all of its new staff, it also has to be preferable for it to train these individuals than to suffer labour shortages. So when $\pi_B^{NT} > \pi_B^{T}(m^*) > 0$, firm B has the means to train staff because the gains are higher than the costs of training ($\pi_B^{T}(m^*) > 0$), but it is rational for it to refrain from training and to remain understaffed.

However, if $m^* \cdot a_B > C_B(m^*)$, the best option for the dominated firm is to train m* new entrants. It should be noted that if $m^* < (n_B + n_A)$, it does not profit fully from its training investment and is understaffed. *The dominated firm supplies the labour market with trained staff whilst at the same time suffering labour shortages of its own*. A paradoxical equilibrium is arrived at: the dominated firm trains young people, it provides trained workers for the labour market but nevertheless suffers labour shortages.

It is quite possible to extend these findings to cases involving more than two firms. On the labour market, dominated firms are encountered that train inexperienced staff and so provide other firms with qualified, experienced staff. This has been found to be the case in most of the apprenticeship systems, with small firms supplying larger firms with experienced staff (Smits and Stromback, 2001). Small companies have to take on trainees in excess of their future staffing requirements, in the expectation that a certain number will leave at the end of their training period. Those entering the labour market therefore acquire experience that they can exploit in ascending career paths (Marsden and Germe, 1991).

Until now, we reasoned within the framework of an economy where all the firms are differentiated. When one makes grow the number of firms, the differentiation tends to disappear between certain firms and the probability to find identical firms increases. When two companies are identical and value similarly the skills of their employees, the differential rent a_{ij} disappears, and the situation of symmetry reappears. Nevertheless, the condition (14) remains valid. It suffices to replace a_B by the value 0. One finds then Becker's proposition according to which the employer can not finance general training. Identical firms can train workers only if their cost of training is null. Symmetrical competition appears as a specific case of imperfect competition.

4. Skill shortages and policy implications

4.1. Fewer trainees than is socially optimal

We can show that *the number of trainees actually trained is always lower than the number of young people that it would be socially optimal to train*. In fact, the number of young people trained m^* does not maximise S, the social returns from training.

S is the sum of the value of the training firm's output from its retained workforce, plus the value of output produced by trained workers in the poaching firm, less the costs to society of training (the training firm's expenditure on training $C_B(m)$ and the poaching firm's expenditure on training $T_{BA}(n_A)$). Thus S can be written as:

$$S = (N_B^{t-1} - n_A + m)\cdot V_B + (N_A^{t-1} + n_A)\cdot V_A - C_B(m) - T_{BA}(n_A) \qquad (15)$$

Consider a policy maker who wishes to raise the welfare of firms and workers. The social planner would choose the number of trainees m in order to maximise S (Booth and

Chatterji, 1998). The first order condition for maximisation (15) with respect to *m* is:

$$V_B - C'(m) = 0 \qquad \text{where } m^S = \frac{V_B}{2u} \tag{16}$$

m^S being the socially optimal number of trainees.

As $m^* = \dfrac{a_B}{2u}$ and $V_B = a_B + w_{iB}$, we necessarily have: $m^* \leq m^S$

We can also show that m^S cannot be greater than $n_A + n_B$. Beyond $n_A + n_B$, the return from training is negative. We therefore arrive at:

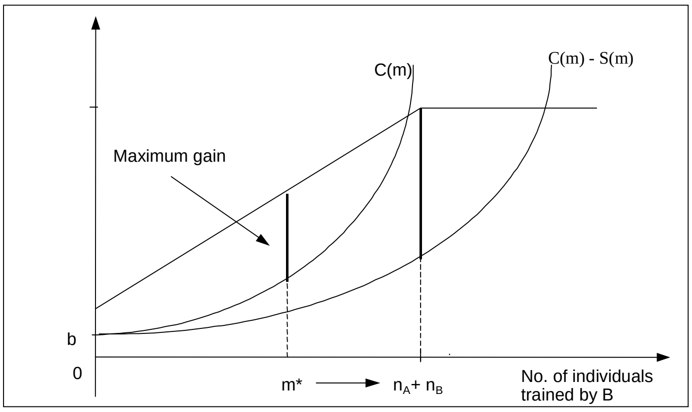
$$m^* \leq m^S \leq n_A + n_B. \tag{17}$$

Levels of output and profit over the economy are therefore lower than they could be. What is more, a certain number of individuals will not be recruited and trained, even though firms would be prepared to do this. Thus an increase in the number of young people being trained (up to m^S) would be reflected in welfare improvements and an increase in the social returns to training.

4.2. Subsidies for the training of young people?

Subsidy is one of the tools that government can employ to correct the behaviour of firms in this area (Stevens, 2001). Let us assume that the state subsidises a firm by providing it with a lump sum *s* for each new trainee. The optimal level of subsidy for each firm can be determined. The optimal level of subsidy s_B^* is that which allows firm B to undertake the training of m^S trainees.

Fig. 2
Training subsidy and number of trainees taken on by firm B



Let us assume that $m^S = n_A + n_B$. The subsidy must modify the cost structure of firm B in order that the optimal number of staff for it to train is equal to $n_A + n_B$. With the hypotheses that we have adopted, we can demonstrate (appendix 2) that:

$$s_B^* = \max.\ \{u\,(n_A + n_B) + \frac{b}{(n_A + n_B)} - a_B\ ;\ 2\,u\,(n_A + n_B) - a_B\} \qquad (18)$$

Clearly, the level of subsidy that enables the firm to produce the optimal number of trainees varies in accordance with the firm's characteristics. Firms operate heterogeneously in the market: labour needs n_j, differential rent a_j, and training cost parameters u_j and b_j vary from one firm to another. This means that the optimal subsidy level s_j^* varies from one firm to another.

Ideally, the subsidy amount should perfectly match the firm's characteristics. In reality, this is not practicable. The lack of flexibility in the system is a basic given of government intervention: subsidies come in a standardised form that cannot take into account the variations and diversity of situations found in the labour market. The government is unlikely to have sufficient information to determine the precise characteristics of each firm. We can say, therefore, that in practice the state sets a uniform rate of subsidy *s* that is applied to all firms. The level of subsidy s will still divide firms according to their optimal subsidy level s_j*:

$$s_1^* < s_2^* < \ldots s_j^* < s < s_{j+1}^* \ \ldots < s_N^*$$

In an economy made up of heterogeneous firms, some companies will gain more from state intervention than others. Those firms whose subsidy level s_j* is less than amount s (the j first firms) gain a *unitary rent* linked to the hiring and training of young people equal to $s - s_j$*. This deadweight spending –also called windfall gains- refers to the gains that firms benefit unduly from the subsidies[7].

Dominated firms may even be tempted to take on more trainees than the market can absorb. If the subsidy amount s is too high, firm B may be led to train a number of young people m* greater than $n_A + n_B$. In these circumstances, firm B will be training a number of young people that exceeds the recruitment capacities of firms in the local market. This phenomenon sustains the institutionalization of " young secondary markets " (Léné, 2002).

5. Conclusion

In an economy made up of heterogeneous firms, those firms providing training are threatened by two different types of poaching. The first type is based on the transferability of competences and their immediate use in a rival firm. The second type of poaching is based on the opportunity external firms have to adapt the workers they poach. Competing firms do not simply poach staff workers from other firms; they also transform the skills that have been acquired by the workers they poach, which requires further training investments. The analysis provided in this paper supplies the information required for an understanding of phenomena

[7] Deadweight spending represents a large part of the inefficiencies of employment subsidy policies. The relative size of deadweight spending has been highlighted in some empirical studies in Europe. It is estimated for 40 to 90% or total cost of subsidies (Picard, 2001).

that do not seem, *a priori*, to conform to theoretical predictions. The main results are as follows:

- It may be rational for some firms to train staff that they will not keep. These firms are led to train not only their own workers but also workers who will be used by other firms. They therefore supply the market with experienced labour.

- Those firms that supply the market with skilled labour may, *paradoxically*, find themselves with their own labour shortages. Although they agree to train more workers than they need, they may still suffer labour shortages.

- This leads to situations that are not socially optimal and that may justify government intervention. However, we have shown that in practice it is difficult to set up an optimal subsidy mechanism for in-company training. Government intervention in this area runs up against problems of flexibility and transparency. If the level of subsidy is too high, dominated firms may be tempted to take on a higher number of trainees than the market is able to absorb.

Numerous studies have described the conditions under which British, German and French apprenticeship schemes have functioned (Casey, 1991; Soskice, 1994). These studies focus on the historical and institutional aspects of these training schemes and highlight their various dysfunctions. The theoretical analysis provided in this article could be seen as complementing these studies by clarifying the rationale underlying these dysfunctions. It shows why it is difficult to regulate the training provided by employer-based youth training schemes. A possible extension would be to assume that trainees differ in their abilities to learn. Some of them will learn more quickly, and at lower cost, than others. It would be interesting to examine how the selection and training behaviour of companies changes when different categories of trainees are introduced. This would form the basis for an analysis of the changes to workplace training systems in a context marked by an increase of the general level of education.

<u>Appendix 1</u>: the optimal number of trainees m*

• $C(m)$ is a quadratic function : $C(m) = u\, m^2 + b$
• The gain function $G(m)$ is defined by:

$\pi_B(m) = (N_B^{t-1} - n_A + m)\, a_B - C(m)$ over the interval $]0\,;\, n_A + n_B[$

$\pi_B(m) = (N_B^{t-1} + n_B)\, a_B - C(m)$ over the interval $[n_A + n_B, +\infty[$

Let us show that function $\pi_B(m)$ allows a maximum.

$C(m)$ is increasing, $\pi_B(m)$ is therefore decreasing over the second interval. It will only allow a maximum if it is increasing over the first interval.

$\pi_B(m)$ may be increasing if its derivative $G'(m)$ is positive over $]0\,;\, n_A + n_B]$.

$G'(m)$ cancels out when $a_B - 2\, u\, m = 0$

i.e. $m = \dfrac{a_B}{2u}$

$G'(m) > 0$ if $m < a_B/2u$ and $G'(m) < 0$ if $m > a_B/2u$

So, $\pi_B(m)$ is increasing up to the point $m^* = \dfrac{a_B}{2u}$ and decreasing thereafter.

This point is part of the interval $]0; n_A + n_B[$ if $0 < \dfrac{a_B}{2u} < n_A + n_B$

If $a_B > 2\, u\, (n_A + n_B)$, then $m^* = n_A + n_B$

<u>Appendix 2</u>: the optimal subsidy level s_B*

The gain for firm B must be maximal for a number of trainees equal to $n_A + n_B$:

$$\begin{cases} G'(m^*) + S'(m^*) = 0 \\ and \\ m^* = n_A + n_B \end{cases} \Leftrightarrow \begin{cases} a_B - 2u\, m^* + s_B^* = 0 \\ and \\ m^* = n_A + n_B \end{cases}$$

hence $s_B^* = 2\, u\, (n_A + n_B) - a_B$

It is also necessary that the gains of the strategy 'Train ($n_A + n_B$) trainees' are higher than the gains for the 'No training' strategy :

$$a_B\, (n_A + n_B) + s_B^*\, (n_A + n_B) - u\, (n_A + n_B)^2 - b > 0$$

i.e. $s_B^* > u\, (n_A + n_B) + \dfrac{b}{(n_A + n_B)} - a_B$

Therefore: $s_B^* = \max.\left\{u\, (n_A + n_B) + \dfrac{b}{(n_A + n_B)} - a_B;\ 2\, u\, (n_A + n_B) - a_B\right\}$

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