Why Do Firms Sponsor Education? An analysis Based on Labour Market Competition

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Abstract

This paper develops a simple model of reputation to show how firms operating in concentrated sectors can use the sponsorship of (general) human capital investments to trained workers as a device of commitment with prospective employees. Employees of firms that operate in concentrated sectors learn skills that are valuable only for a limited number of alternative employers. This gives monopsonistic power to the training firm over the trained workers. Foreseeing it, potential employees will be reluctant to work for the firm unless the employer is able to commit herself not to take advantage of such situation. It is argued that human resources policies including the provision of (specific or general) human capital to workers reduces employers’ commitment costs. Evidence from the 1995 of the ECHP shows that, consistently with the predictions of the model, firms from more concentrated sectors are more likely to provide their workers with training, education and health insurance.

Keywords: Training, Human Capital, Labour Market Competition

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**Introduction**

This paper analyses the role of the sponsorship of education as a tool of firms' human resources policy, stressing its relevance in concentrated sectors.

Many firms sponsor the training of their employees. They do not only “teach” the workers the specific knowledge needed for their tasks but also pay for them to take courses usually considered as general-purpose education, as it is the case of Executives MBAs.

This work addresses two main reasons that explain why firms would make such large expenditures in education, both of them related to the specificity of the ”on the job” training previously done by workers. First, there may be some complementarities between the technical skills acquired on the job and the new ones obtained with further education; this would make such education more specific to the sponsoring firm that it could seem at first. Second, if the skills learned on the job by the workers are of low value outside the training firm, the employer has to commit herself to pay them above such outside value in order to attract prospective workers. A profitable way to do it could be to increase the employees’ outside opportunity by providing them with further education. Both arguments lead us to think that those firms requiring specific technical skills from their employees may be also more willing to provide them with education. Along this paper, specificity of skills is argued to stem from high concentration of the industry.

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1 Executive Education, for example, is a very illustrative case. Baron and Kreps (1998) estimated in $230,000 the actual total costs for a firm of sponsoring a one-year MSc degree in Stanford University, with tuition close to $47,000 in 1997. Given the general rise in such fees that nowadays are close to $60,000, total costs may be currently around $250,000. Nevertheless, figures depict a large increase of firm’s expenditures in executive education. Apart from large companies like GM, GE or ATT that send each year thousands of managers to this kind of programs, smaller firms also seem to follow such trend. The average US Company that spent $2 million in managerial education in 1992 was spending $10 million in 1998. Overall, the evolution of US firm's expenditure in corporate training seems to have doubled each four years in the last decades, as Table 1 shows.
There are many examples of skills that can be acquired in one firm and be specially valued by other potential employers in the same industry. Information about the preferences of clients and providers, knowledge of the industrial regulation and its tricky applications, expertise on the technology employed, or even the ability to perform some specific administrative tasks can be included within this category, for a wide range of different jobs. Therefore, those abilities acquired "by-doing" are usually quite specific to the firms working in the same industry and industrial structure may determine the best outside opportunity for the worker. High costs of switching the employer and bad fit of skills make such opportunity especially low in highly concentrated industries. Consequently, an employer in any of such sectors could take advantage of the lack of competition for the (specifically) skilled human capital and appropriate part of the returns generated by the worker's accumulation of such a specific knowledge. She could do it simply by paying him a wage lower to the (unenforceable) one agreed at the beginning of the employment relationship.

Take the example of a physicist shortly after his graduation. If he accepts an offer to work for, let us say, a nuclear power station, the set of skills acquired with experience after some years will probably have low value outside the power station, given the differences in technology that may exist with respect to other nuclear stations. Even in the case that such skills were almost fully applicable with any alternative employer, the relocation costs he would have to face could be huge. If the same physicist, instead, initially agrees to work for an electronics technology firm, the skills he may acquire there will be valuable for a large number of potential firms, and the employer will have to pay him a wage close to the added value of his productivity.

In the case of the electronics technology company, the worker may be attracted by the multitude of opportunities he may have once he becomes an expert technician in electronics; the market is the safeguard for the worker's investment. The owner of the nuclear station, on the contrary, must show that she is really offering to her employees a profitable career, safe from the hazards from becoming too specialised. Otherwise, she would develop a bad reputation that would prevent her from hiring new employees. In such
setting, the firm may find profitable to give such “safeguard” to the worker in the form of further education. Such new instruction may not be otherwise paid by the firm, since it is to some extent a general form of human capital, nor be it paid by the worker, given credit constrains and the risk of appropriation by the firm.

Alternative interpretations of labour relationships in concentrated sectors, based in large specific investments done by employers and quasi-rents appropriated by workers, lead to very different conclusions. Following such interpretations, senior workers of a firm in a concentrated sector have monopolistic power (in the market for skilled labour) that enable them to take part of the quasi-rents generated by the firm's assets (so, the firm has little need to commit with them). Moreover, the employer would not be willing to sponsor education to employees, since they can take most of the returns of the investment. Empirical studies, then, should assess under what circumstances each explanation fits better.

Although the previous literature on both human capital theories and the labour contractual approach is largely vast, I have no notice of any work that handled directly the relationship between market structure and the human resources policy of the firms.

In his seminal work, Becker (1964) already suggested the specific nature of the human capital of workers employed by a monopolist. He proposed a theory where workers pay the cost of their general human capital investments, and share with the firm the cost of the specific part of it. The evidence from the works of Mincer (1974) pointed out that direction. However, in the last ten years, many economists have provided evidence that casts doubts on this aspect of such standard theory. Cole (1992) and Acemoglu and Pischke (1998) suggested that some institutional factors and complementarities between general and specific skills could give the employer some monopsonistic power over their trained workers, and this would lead her to pay also general human capital investments. Acemoglu and Pischke (1996) and Barron (1999) stated that such monopsonistic power over workers with general skills can also arise from the informational advantage that the training firm
may have when the instruction is done in-house: the employer can learn about the ability of her workers during the training period.

On the other hand, economists concerned with the specificity of investments have systematically analysed the appropriatory actions that could take the worker, leaving often a marginal interest for those that could be taken by the firm. On the theoretical part, Malcomson (1997) analysed the incentives to invest under different contractual frameworks, stressing the point in the incentives for the firms. On the empirical part, Abowd and Allain (1996) obtained, from a data set of French workers and firms, a significant negative relationship between worker's bargaining power and firm's market share.

Closer to the focus of this paper, Stevens (1994) argued that most forms of human capital fare rather transferable, instead of completely general or totally specific to one firm. In a model with finite heterogeneous firms bidding for the transferable skills of the worker, she showed that as the number of potential bidders increases, also increases the expected outside value of the skills and decreases the probability of the worker staying at the firm. On the other hand, Neal (1995) used data from displaced workers to show that workers are compensated, to a large extent, for skills that are specific to the sector, rather than purely general or specific. In a sense, I join in this paper the messages of these last two works: workers are paid for skills specific to the sector and, with lower bidders for these skills, their outside opportunity is lower. This provides us a framework to analyse the human resources policy of firms in concentrated sectors.

Along the next section, I will introduce a simple game theoretical model to analyse the commitment problem faced by firms providing specific on-the-job skills to their workers. Given that firms achieving good reputation must credibly offer higher compensation packages to prospective workers, the main results arising from this section are: (i) sponsoring (general or specific) education may be profitable for firms that commit to wages above workers’ outside option if the educational investment is efficient and (ii) in such case, the proportion of workers sponsored by an employer with good reputation should be
higher when the transferability of skills learned on the job is lower. In the third section, the rationale and implications of such model are discussed, as well as other arguments supporting alternative hypotheses, with a special emphasis on the possibility of appropriation of quasi-rents by workers. The fourth section shows some evidence related to the relationship between labour market structure, compensation of the workers and sponsoring decisions. The evidence presented in that section is highly consistent with the results from the theoretical analysis, although it does not allow us to clearly reject alternative interpretations of the issue. The last section is devoted to summarise the conclusions and to point out future empirical research in this topic.

**The Model: Training and Commitment Decisions**

The proposed model is an infinitely repeated sequential game (close to that described in Kreps (1986)) that the firm “plays”, in principle, with a worker in each generation (later, the analysis will be done for a pool of workers in each generation). The extensive form of the sequential move stage game is represented in Figure 1.1.

There are two players in each stage game: the infinitely lived firm, and the worker of the t-th generation, so that the total number of players is infinite. The t-th stage game is developed in three sub-stages. First, the worker of the t-th generation decides either to start working and build a career in a given firm, learning some technical skills (action I), or to do it in any other company (action O); in the latter case, he will receive a payoff of $V'$ while the company obtains a payoff of 0. Secondly, if the worker signs up with the firm and gets the mentioned skills, the firm decides either to sponsor him further education or not, and to make him an offer as compensation for his work (action $W_{mba}$) if education is sponsored and action $W$ otherwise. Finally, the worker decides whether to accept the offer done by the firm (action A), or reject it (action R), pursuing his best ex post opportunity outside the firm. If the firm has not paid for the worker to get the instruction, the payoffs for the employee and the employer are, respectively, $W$ and $P(W)$ if the worker accepts the offer and $W_0$ and 0 if he rejects it. If the firm has sponsored the worker, the payoffs are $W_{mba}$ and

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2 The label of the actions will be identified with the exact offers made in each case.
$P_{mba}(W_{mba})$ if the worker accepts the offer and $W'_{mba}$ and $-c$ if he rejects it. Information is assumed to be complete and perfectly known by all agents. This means that each agent knows the payoffs to be obtained in every outcome, as well as the full history of the play of the game at each decision node.

The set of skills learnt by a worker signing up with the firm can be acquired at no explicit cost. They increase his productivity within the firm up to $V_I$, which is the net present value of technical skills from the moment he finishes the on-the-job training to the end of his career. If the worker does not agree to work for the firm, he obtains his best *ex ante* outside opportunity for his career (including the returns from on-the-job training anywhere else), which has a net present value $V'$. A rational worker, thus, will not be initially willing to “enrol” in the firm if he expects a payoff below that value.

Let $\alpha \in [0,1]$ denote the proportion of skills learned on the job that cannot be applied outside the training firm; $(1-\alpha)$ is, therefore, a measure of the “transferability” of such knowledge. Hence, once the worker has acquired these skills, his *ex post* outside opportunity $W^o = (1-\alpha)V_I$. In that moment, the employer can expect the worker to accept any offer above this value.

Within this framework, it can be characterised the problem of *ex post* opportunism to be analysed: Before the training, the employer may promise the prospective employee any compensation; but after the training period, the employer can retain the worker with an

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3 Actually, the cost for the worker of such “passive learning” is the opportunity cost, this is, the value of the skills he could be learning in other firm at that time.

4 The analysis is done omitting the flow of payments along that first period. Incentives for ex-post opportunism appear only on the employer's side once the worker acquires the technical skills. In some two-period models commitment problems arising from investment in specific assets are solved through first period compensating higher wages. This is ruled out here by the assumption that payoffs only occur in the second period (or, alternatively, that all workers are paid exactly his productivity in the first period). Although this approach faces the risk of being too simplistic in the analysis of the problem, I consider it more realistic than assuming that legal and incentives issues do not strongly constraint employers’ ability to offer compensations in the first period.
offer below the amount agreed and, more importantly, below his *ex ante* best outside opportunity. The following definition states when such problem is present:

**Definition 1: Ex post opportunism by the firm.** There exists an problem of *ex post* opportunism by the firm if \((1-\alpha)V_I < V'\). The presence of this problem means that, whenever the worker's outside opportunity is lower after the on-the-job training period, the employer must credibly commit herself to pay him at least \(V'\) if she wants to attract any prospective employee.

Let us assume that exists an educational program of cost \(c\), where the senior worker may acquire new (managerial) skills that also allow him to make a better use of his (already acquired) technical skills. The net present value of the abilities obtained in such program would be, then: \(V_{mba} = S + \lambda V_I\), where \(S\) is the value of the new knowledge acquired and \(\lambda\) denotes the improvement in the use of technical skills achieved thanks to the complementarities with the managerial skills learned. The value added by such program is partly specific to the training firm, to the extent that it depends on specific skills previously obtained. More exactly, the firm can take \(\alpha \lambda V_I\) from the investment, retaining the employee the rest, since his outside opportunity after the program increases to \(W_{mba} = S + (1-\alpha)(1+\lambda)V_I\).

Credit constraints and other transaction costs can be assumed to prevent the worker from financing himself the course (this issue will be discussed in the next section). On the other hand, it seems that the firm would only be willing to pay the cost of the course if its returns are specific enough. However, as it will be shown, whenever the employer has to commit to pay a minimum compensation to the worker, she may want to sponsor the instruction even if it is apparently unprofitable for her to do so. The main reason is that providing education may be a cheaper way to fulfil the needed commitment.

**Definition 2:** The investment on further education of the worker is *apparently unprofitable* for the firm if the part of the value that can be directly taken by the employer does not compensate her for the cost (i.e., if \(\alpha \lambda V_I < c\)).
Definition 3: Sponsorship of education is valuable enough to attract prospective workers if a worker expecting to be paid the course will be willing to sign up with the firm, (i.e.: \[ S+(1-\alpha)(1+\lambda)V_i \geq V' \]).

Equilibria with a Single Worker in Each Generation

Suppose that it exists a problem of ex post opportunism by the firm and, on the other hand, sponsoring education is apparently unprofitable for the employer. Let us consider first the case when a single worker is hired in each recruiting round, so that the firm is unable to carry out a mixed strategy. Three sub-game-perfect Nash equilibria, then, could be observed (see Figure 1.2):

Equilibrium 1.1: Firm fulfils each worker's expectations by paying him \( V' \). In order to be able to attract prospective workers, the employer offers and pays to the senior worker of each generation his ex ante outside opportunity. The t-th worker's equilibrium strategy is:
(i) in the first sub-stage, action I (to sign up and train within the firm) if \( t = 1 \) or if the last worker employed by the firm obtained a compensation larger or equal to \( V' \), and action O otherwise; (ii) in the third sub-stage, action A (to accept the offer of the firm) if the offered compensation is not smaller than his ex post outside opportunity (\( W_{mba} \) if he has been provided with instruction and \( W^{o} \) otherwise), and action R (reject the offer) otherwise. The strategy of the firm is “fulfil with money”: always offer (and pay) \( W = V' \) to each senior worker. The resulting outcome, if this equilibrium exists, is that each worker agrees to work for the firm, he is offered \( V' \), and he accepts the offer.

Equilibrium 1.2: Firm fulfils each worker's expectations providing him with further education. In this case, the employer makes less costly the fulfilling of her commitment, thanks to the sponsorship of an educational program. The t-th worker's equilibrium strategy is the same as in Equilibrium 1.1. On the other hand, the equilibrium strategy of the firm is, in this case, “fulfil with education”: always sponsor education to each senior worker and
offer (and pay) him \( W_{mba} = \max\{V', W_0\} \). If \( V' > W_0 \), the employer has still to pay to the workers more than their ex post best outside opportunity to maintain her reputation. If \( W_0 > V' \), the course sponsored is valuable enough to attract prospective workers.

**Equilibrium 1.3: Firm is unable to hire any worker.** After the technical training, the employer would only be willing to pay the employee his ex post best outside opportunity; however, she is not given the opportunity to behave that way. The t-th worker's equilibrium strategy in this case is: (i) in the first sub-stage, action O in any case (he never agrees to start working for the firm), and (ii) if (by error) he signs up, he takes action A in the third sub stage (to accept the offer of the firm) if the offered compensation is greater or equal to his ex post outside opportunity \( W_{mba} \) if he has been provided with instruction and \( W_0 \) otherwise and action R otherwise. The strategy of the employer is “always cheat” the expectations of any worker she could hire, by offering him only his ex post best outside opportunity \( W = W_0 = (1-\alpha)V \) once he is technically trained.

As it can be noticed, Equilibria 1.1 and 1.2 represent the two different ways that the employer has to fulfil her commitment. In both cases, the strategy of the workers is to rely on the reputation of the firm. Then, the best response compatible with such strategy will lead to either Equilibrium 1.1 or 1.2 (or neither of them) depending on the value added by the course and the specificity of the technical training. Equilibrium 1.3, on the other hand, is always feasible: if the firm is going to pay the worker less than \( V' \), his best response is in any case not to sign up with the firm; and if the employer has no expectation of hiring any prospective worker, her best response is always to exploit at maximum any hired worker.

Why are Equilibria 1.1 to 1.3 the only sub-game perfect Nash equilibria that can be observed under pure strategies? First, any strategy by the employer that provides each employee with a payoff below \( V' \) leads the worker to follow action O (not to sign up); then,

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5 More specifically, the offer of the employer will be of \( V' \) when the course is not valuable enough to attract prospective workers, and \( W_{mba} \) otherwise.

6 Note that if the employer finds profitable to cheat to the first worker, she would also find profitable to do it in the t-th one, if given the chance to do it.
such strategy is dominated by the strategy “always cheat” that characterises Equilibrium 1.3. Second, consider any strategy of the employer that allows her to keep a good reputation by giving a payoff higher or equal to $V'$ to each senior worker; such strategy is always dominated by the strategy “fulfil with education” or “fulfil with money” (or by both), that lead to Equilibria 1.1 and 1.2 respectively. Third, given that worker's decision power is limited to accept or reject offers, the set of strategies available for him is very constrained. Prospective employees will sign up if they expect to be paid above $V'$; on the other hand, a senior employee will be willing to go on working within the firm for any compensation above his ex post best outside opportunity, since any strategy different from this one would be an incredible threat.

Moreover, within the framework of this section where no mixed strategies are allowed, any strategy of the firm alternating offers above and below $V'$ should follow a systematic pattern. In that case, however, workers anticipate the behaviour of the firm and respond by signing up only when they expect to be paid at least $V'$. Equilibria of this type always yield outcomes with payoffs that are, for all agents, lower or equal to those obtained from either Equilibrium 1.1, 1.2 or 1.3.

To be more specific, the following propositions develop the conditions for each of the possible outcomes of the game in pure-strategies equilibrium (see Figure 1.2).

**Proposition 1.1.** *Equilibrium 1.3 is the only sub-game-perfect Nash Equilibrium if and only if:*

(a) *The firm hires a single worker in each generation, and the provision of further education is not valuable enough to attract prospective workers (i.e., $V' \geq W_{mbu}^0$ and*

(b) *Neither of the two following inequalities holds:*

$$\left(\frac{1}{r}\right)(V_i - V') \geq \alpha V_i$$  \hspace{1cm} (1)
In such case, the outcome of the game is that each worker follows his best ex ante outside opportunity, not signing up with the firm.

Proof: See Appendix A.1

Being \( r \) the “inter-generations” rate of discount, conditions (1) and (2) basically determine whether it pays for the firm to maintain a good reputation or not. If condition (1) holds, then it is more profitable for the employer to pay a compensation of \( V' \) to her senior employee and be able to hire a prospective workers than to cheat his expectations and create a bad reputation. Similarly, if condition (2) holds, it is better for the firm to subsidise education to the worker and pay him \( V' \) than simply to pay him the ex post outside opportunity and be unable to hire any new worker. Firms that are growing, or have a stable position in the market, will be more concerned about the future and, therefore, they will apply a lower discount rate \( r \) to the long run benefits of having a good reputation. For such type of firms, conditions (1) and (2) are more likely to hold. On the other hand, a firm cheating the expectations of the employee would be disabled to hire any new worker to go on with its activity. Since in a long-term setting only firms keeping a good reputation are expected to survive, a greater interest will be paid to analyse the means used by the employers to do it.

**Proposition 1.2.** *Equilibrium 1.1 is a sub-game-perfect Nash Equilibrium of the game if and only if*

(a) The firm hires a single worker in each generation, and the provision of further education is not valuable enough to attract prospective workers (i.e., \( V' \geq W_{mba}^0 \))

and

(b) Condition (1) holds and the following inequality is not strictly satisfied:
\[(1+\lambda)V_I + S - c - V' \geq V_I - V' \iff \lambda V_I + S \geq c \] (3)

In this case, the outcome of the game is that each worker agrees to work for the firm, the employer makes him an offer of \(V'\), which is accepted by the senior employee.

Proof: See Appendix A.1

**Proposition 1.3.** Equilibrium 1.2 is a sub-game-perfect Nash Equilibrium of the game if and only if:

(a) The firm hires a single worker in each generation, and the provision of further education is not valuable enough to attract prospective workers (i.e., \(V' \geq W^0_{mba}\)) and

(b) Conditions (2) and (3) are satisfied.

In this case, the outcome of the game is that each worker agrees to work for the firm, the employer provides him with further education, and makes him an offer of \(V'\), which is accepted by the senior employee.

Proof: See Appendix A.1

Condition (3) states whether it is profitable for the firm to use the investment in education to fulfil the commitment done. If this is the case, given that the employee's *ex post* outside opportunity after the course is still below the payment committed by the firm (\(V' \geq W^0_{mba}\)), the employer can take all the returns to the investment. On the other hand, if the cost of sponsoring the course is high enough, the benefits from being able to take the mentioned returns do not pay for such cost in comparison with the cash option. Therefore, she will be willing to pay the education as long as it is an efficient investment (i.e., the returns are higher than the costs).
If the course improves the value of the productivity of the worker outside the firm above its *ex ante* value, the conditions for each outcome are different, given that the firm can not take all the returns to the investment:

**Proposition 2.1.** *Equilibrium 1.3 is a sub-game-perfect Nash Equilibrium of the game if and only if:*

(a) The firm hires a single worker in each generation, and the provision of further education is valuable enough to attract prospective workers (i.e., $W_{mba}^{0} \geq V'$) and

(b) Neither condition (1) nor the following inequality hold:

\[ \frac{1}{r}[(1+\lambda)\alpha V_{i} - c] \geq \alpha V_{i} \]  

(4)

In this case, the outcome of the game is that each worker follows his best *ex ante* outside opportunity, not signing up with the firm

Proof: see Appendix A.1.

The meaning of Proposition 2.1 is similar to that of 1.1, but the conditions affecting the profitability for the employer of providing education differ, for she can only take part of the returns generated. Specifically, condition (4) determines whether it pays to maintain a good reputation by sponsoring education to her workers, or it is better for her to “cheat” the expectations of one of them and hire no more in the future. Such condition is also more likely to hold for growing or stable firms that have a lower discount rate $r$.

**Proposition 2.2.** *Equilibrium 1.1 is a sub-game-perfect Nash Equilibrium of the game if and only if:*

(a) The firm hires a single worker in each generation, and the provision of further education is valuable enough to attract prospective workers (i.e., $W^0_{mba} \geq V'$) and

(b) Condition (1) holds and the following inequality is not strictly satisfied:

$$(1 + \lambda) \alpha V_I - c \geq V_I - V' \iff V' - (1 - \alpha) V_I + \alpha \lambda V_I \geq c \quad (5)$$

In this case, the outcome of the game is that each worker agrees to work for the firm, the employer makes him an offer of $V'$, which is accepted by the senior employee.

Proof: see Appendix A.1.

**Proposition 2.3.** Equilibrium 1.1 is a sub-game-perfect Nash Equilibrium of the game if and only if:

(a) The firm hires a single worker in each generation, and the provision of further education is valuable enough to attract prospective workers (i.e., $W^0_{mba} \geq V'$) and

(b) Condition (4) and (5) are satisfied

The outcome of the game, in this case, is that each worker agrees to work for the firm, the employer provides him with further education, and then makes him an offer of $W^0_{mba} = S + (1 - \alpha)(1 + \lambda)V_I$, which is accepted by the senior employee.

Proof: see Appendix A.1.

The role of condition (5) in propositions 2.2 and 2.3 is analogous to that of condition (3) in propositions 1.2 and 1.3, and is the key in the firm's election of the way to fulfil. Suppose that the employer commits herself to pay at least $V'$ to the senior worker. Then, if (5) holds,
it is more profitable for her to do it through the provision of additional education than simply through a payment of $V'$. Two reasons are important here. First, by increasing above $V'$, the value of the general-purpose skills of the worker, the firm can take all the rents generated by the specific part of his previous training without losing reputation as employer. Second, as long as there are complementarities between the previous training and the new education, such “specific rents” are higher. On the other hand, if the cost of sponsoring the course is high enough to keep condition (5) not holding, the benefits for the employer from being able to take her part of the returns do not pay for such cost in comparison with the cash option.

Suppose that $\alpha$, the (un)transferability of the skills learned with training, depends on the number of external bidders for such skills and, therefore, on the concentration of the market. Then, a higher concentration in the industry (that is, a higher $\alpha$) makes more likely that an employer uses the sponsorship of education to maintain her reputation. First, higher $\alpha$ means that the circumstances of Proposition 1 are more likely to hold, in that case, only efficiency of the investment is required for education to be a better way to keep reputation. Second, if the circumstances of Proposition 1 are not present, it comes directly from condition (5) that a higher specificity increases the profitability of fulfilling with education with respect to the money option. With higher $\alpha$, there are more “specific rents” to be obtained by maintaining reputation through the financing of the course; thus, it is more likely that the profits from doing so compensate its cost $c$.

**A Pool of Workers in Each Generation**

Let us consider now the case when a pool of many homogenous workers is hired in each generation. It enables the employer to adopt a combined behaviour by, for example, fulfilling the expectations of some of the workers, while cheating those of the rest. The introduction of several hires in each period let us consider the case that the employer follows mixed strategies observed by prospective employees. Let us then assume that risk-

\footnote{Note that, when specificity of skills is very large, it is less likely that further education rises the senior worker's best outside opportunity above its \textit{ex ante} value.}
neutral prospective employees can observe the payoffs received by all senior workers, and that their perceived probability of obtaining each of the payoffs is exactly the proportion of senior employees that are receiving it. Under the further assumption of homogenous workers, some combinations of strategies are clearly dominated by any of the pure strategies described before. In particular, the employer will not be willing to fulfil her commitment just with money with some of the employees and through education sponsorship with the rest of them: if using the instruction program to keep reputation is profitable, it will be so for all the workers, otherwise, none of them will be sponsored.

On the other hand, any strategy of the firm including the possibility of cheating some of the employees while fulfilling the commitment with the rest, has to offer prospective workers an expected payoff greater or equal than $V'$. Otherwise, such combination of strategies would be dominated by the pure strategy “always cheat” that leads to Equilibrium 1.39.

The only type of combination that we should consider, then, is when the firm cheats the expectations of some of the workers, while fulfilling (either just with money or also with education) those of the rest, so that prospective worker's expected payoff from signing up with the firm is greater or equal than $V'$.

Let us suppose that the employer decides to maintain a good reputation by paying high compensations to some of her workers and cheating the rest. Given that workers are assumed to be risk neutral, a firm carrying out such strategy should compensate the loss suffered by the employees cheated with payoffs proportionally higher than $V'$ for the rest of workers. Therefore, such combination of strategies would mean only a redistribution of payoffs among senior employees, resulting in (expected) payoffs for both firm and worker

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8 Note that, if the prospective employees can observe the randomization of the behaviour of an employee adopting mixed strategies, all the results from this section can be applied to the setting of one worked hired in each generation.

9 It seems quite obvious that, if the firm will not able to attract prospective workers anyway, the best strategy of the firm is to cheat all the workers, when given the opportunity.
equal to those obtained with the pure strategy “fulfil with money” described in the previous section.

Hence, the most interesting combined strategy to be considered by the firm is a policy where the employer “fulfils with education” the expectations of part of her workers, while “cheats” the rest, so that the expected payoff of a prospective worker is still $V'$. Again, we have to distinguish here between the cases in that education is valuable enough to attract prospective workers and when it is not.

If the investment is not valuable enough (i.e., $V' > W_{mba}^0$), any combination “fulfilling with education” and “cheating” should include payoffs higher than $V'$ for workers sponsored to compensate the lower payoffs obtained by those “cheated”. However, any equilibrium strategy of this kind must include education sponsorship for all the workers: if the employer wants to offer an expected payoff of $V'$ to prospective workers and can use the provision of education to do it cheaper, it will be optimal for her to sponsor all senior employees (and take the full returns to education from all the workers). Furthermore, every strategy including the sponsorship of education to all the workers a minimum pay of $W_{mba}^0$ and an average compensation offer of $V'$ would be equally good.

If the investment is valuable enough (i.e.: $V' \leq W_{mba}^0$), the situation differs. To the extent that the final payoff of an employee provided with the new education is higher than $V'$, the employer could sponsor only some senior workers in each generation. By doing it, she could pay below $V'$ to the rest of them without losing the needed level of reputation, as long as the payoff expected by prospective employees stays at $V'$. More specifically, the employer would choose to subsidise the proportion $p$ of employees that would make maximum her profits in each generation, subject to the restriction of maintaining the reputation, with respect individually rational future workers:

$$\operatorname{Max}_p p[(1+\lambda)\alpha V_f - c] + (1-p)\alpha V_f$$

subject to: $V' \leq p[S + (1 - \alpha)(1+\lambda)V_f] + (1-p)(1-\alpha)V_f$
From the assumption that the education is *apparently unprofitable for the firm*, it comes straightforwardly that the firm's profits increase as \( p \) decreases. On the other hand, the right hand side of the restriction is increasing in \( p \) (the higher the proportion of workers sponsored, the better the reputation of the firm). Therefore, the firm will choose the \( p \) that satisfies such constraint as equality. The resulting proportion \( p^* \) of workers sponsored in each generation will be:

\[
p^* = \frac{V' - (1-\alpha)V_t}{S + (1-\alpha)\lambda V_t}
\] (6)

Within the framework of this analysis, it is clear\(^{10}\) that \( p \in [0,1] \). This strategy of “fulfil with a proportion \( p^* \)” dominates any other combination of this kind. In particular, it dominates the strategy with \( p=1 \), “fulfil with education”, described in the previous section. Without considering reputation concerns, sponsoring the course is not itself profitable for the firm. Therefore, the employer would prefer to pay education to a proportion lower than 1 of senior employees as long as it does not prevent her from hiring prospective workers.

In summary, with a pool of workers in each generation, four possible sub-game-perfect Nash equilibria types can be observed:

**Equilibria Set 2.1: Firm offers an average payment \( V' \) to senior workers.** The employer can cheat the expectations of any proportion of workers without losing reputation if she pays proportionally more to other workers, so that the expected payoff of a prospective employee is \( V' \). The equilibrium strategy of each worker of the t-th generation is here analogous to that of Equilibrium 1.1\(^{11}\): (i) in the first sub-stage, action I (to sign up and train within the firm) if \( t = 1 \) or if the last group of workers employed by the firm obtained an average compensation larger or equal to \( V' \), and action O otherwise; (ii) in the third sub-stage, action A (to accept the offer of the firm) if the offered compensation is not smaller

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\(^{10}\) More specifically, the existence of an *ex post* opportunism problem by the firm guarantees that \( p^* > 0 \), while the fact that the investment in this case is valuable enough to attract prospective workers guarantees that \( p^* < 1 \).

\(^{11}\) In fact, Equilibrium 1.1 can be redefined as a particular case within the Set 2.1.
than his \textit{ex post} outside opportunity \((W^o_{mba}\text{ if he has been provided with instruction and } W^o\text{ otherwise}),\) and action \(R\) (reject the offer) otherwise.

\textbf{Equilibria Set 2.2a: Firm sponsors instruction to all the employees and keeps a good reputation.} Suppose that the employer can make less costly the compliance of her commitment through the sponsorship of instruction and that, even after the provision of further education, worker's \textit{ex post} best outside opportunity of the worker is below the \textit{ex ante} value. In such setting, it is optimal for the employer to pay for the instruction of all her employees and offer them any combination of high and low compensations, such that each offer is not lower than \(W^o_{mba}\) and the average offer made is \(V'\) for each generation of workers. The equilibrium strategy of each worker of the \(t\)-th generation is the one described for Equilibria Set 2.1.

\textbf{Equilibrium 2.2b: Firm sponsors instruction to a proportion \(p^*\) of employees and keeps a good reputation.} The equilibrium strategies of agents in this case are: on the one hand, the employer sponsors education to a proportion \(p^*\) of her employees (that are offered \(W^o_{mba}\)) while “cheats” the rest (by offering them only \(W^o=(1-\alpha)V_i\)); on the other hand, the equilibrium strategy of each worker is the one described in Equilibria Set 2.1. This equilibrium will exist whenever it is profitable for the employer to fulfil her commitment through the education of some workers and the best outside opportunity of the employee after the instruction is above its \textit{ex ante} value.

\textbf{Equilibrium 2.3: Firm is unable to hire any worker.} This equilibrium has been already described in the previous section. The employer would “exploit” all the workers she could hire, by paying them only their \textit{ex post} outside opportunity \(W^o=(1-\alpha)V_i\) after the “on the job” training period. Employees follow the strategy described in Equilibrium 2.1. No potential worker is then willing to sign up with the firm.

When the employer faces a group of workers to be hired in each recruiting round, there is one “new” equilibrium that may improve the equilibrium payoffs (per worker) for the firm with respect the outcomes of the previous section. Equilibria sets 2.1, 2.2a, and equilibrium
2.3 are just generalisations of equilibria 1.1 to 1.3 respectively. That is not the case of Equilibrium 2.2b, which, as long as \( V' \leq W_{mba}^0 \) and mixed strategies are allowed, leads a better outcome for the firm than that of Equilibrium 1.2.

The conditions for each of the possible outcomes can be stated in the following way:

**Proposition 3.** (Generalisation of Propositions 1.1, 1.2 and 1.3). Assume that an employer wants to hire a group of workers in each generation, and that \( V' \geq W_{mba}^0 \) (the provision of further education is not valuable enough to attract prospective workers). Then:

(i) If neither condition (1) nor condition (2) are satisfied, the only sub-game-perfect Nash equilibrium of the game is Equilibrium 1.3, and the outcome of the game is that each worker follows his best ex ante outside opportunity, not signing up with the firm.

(ii) If condition (1) holds and condition (3) is not strictly satisfied, any equilibrium from Equilibria Set 2.1 is a sub-game-perfect Nash equilibrium, and the outcome of the game is that all the workers of the generation agree to work for the firm, the employer makes an offer larger than \( W_{mba}^0 \) to each of them, such that the average offer is \( V' \) and all the offers are accepted by senior employees.

(iii) If condition (2) and (3) are satisfied, any equilibrium from Equilibria Set 2.2a is a sub-game-perfect Nash equilibrium and the outcome of the game is that all the workers of the generation agree to work for the firm, the employer provides all of them with further education and makes an offer larger than \( W_{mba}^0 \) to each of them, such that the average offer is \( V' \); all the offers are accepted by the senior employees.

Proof: see Appendix A.1
As it can be noticed, when $V' \geq W_{mba}^0$, the fact that the firm hires a group of workers in each recruiting round does not change the conditions for each outcome: if the long run profits from keeping reputation high (either just with money or also with education) are large enough (i.e., if condition (1) and/or (2) hold), the employer will offer them an average payment of $V'$. Furthermore, in that case the firm will subsidise the investment in education to all the workers if it is efficient to do so (i.e., if condition (3) holds).

**Proposition 4.1.** *Equilibrium 1.3 is the only sub-game-perfect Nash equilibrium of the game if and only if:

(a) The firm hires a group of workers in each generation, and the provision of further education is valuable enough to attract prospective workers (i.e., $V' \leq W_{mba}^0$) and 

(b) Neither condition (1) nor the following inequality hold:

$$\frac{1}{r} \{ p^* [(1+\lambda)\alpha V_I - c] + (1- p^*)\alpha V_I \} \geq \alpha V_I$$

(7)

Therefore, the outcome of the game in this case is that each worker follows his best ex ante outside opportunity, not agreeing to work for with the firm.

Proof: see Appendix A.1

**Proposition 4.2.** *Any equilibrium from the Equilibria Set 2.1 is a sub-game-perfect Nash equilibrium of the game if and only if:

(a) The firm hires a group of workers in each generation, and the provision of further education is valuable enough to attract prospective workers (i.e., $V' \leq W_{mba}^0$) and 

(b) Condition (1) holds and the following inequality is not strictly satisfied:
\[ p^* [(1+\lambda)\alpha V_I - c] + (1-p^*)\alpha V_I \geq \alpha V_I - V' \leftrightarrow \lambda V_I + S \geq c \quad (8) \]

In this case, the outcome of the game is that each prospective employee signs up with the firm, the employer makes an offer larger than \( W^0 \) to each of them, such that the average offer is \( V' \) and all the offers are accepted by the senior employees.

Proof: see Appendix A.1 and Appendix A.2

**Proposition 4.3.** Equilibrium 2.2b is a sub-game-perfect Nash equilibrium of the game if and only if:

(a) the firm hires a group of workers in each generation, and the provision of further education is valuable enough to attract prospective workers (i.e., \( V' \leq W^0_{mba} \)) and

(b) Conditions (7) and (8) are satisfied.

The outcome of the game, in this case, is that each worker agrees to work for the firm, the employer sponsors education to a proportion \( p^* \) of the workers and makes them an offer of \( W^0_{mba} \), while the rest are only offered \( W^0 \). All the offers are accepted by the senior workers.

Proof: see Appendix A.1

As stated above, Equilibrium 2.2b improves the outcome for the firm with respect the “fulfilling with education” strategy included in Equilibrium 1.2 for a single worker in each generation.\(^{12}\) Since the employer only sponsors courses to a proportion of workers high enough to maintain a good reputation, she obtains higher profits by cheating the rest of the

\(^{12}\) In order to verify such improvement, we just have to check that the firm’s stage payoff in Equilibrium 2.2b, which is represented in the left-hand side of condition (8), is higher than the firm's stage payoff in Equilibrium 1.2, which is represented in the left-hand side of condition (3).
employees. Such “superiority” is reflected in the fact that the conditions needed for Equilibrium 2.2b to exist are weaker than those for Equilibrium 1.2. Condition (7), which states whether it pays for the firm to keep a good reputation through the provision of education, is weaker (more likely to hold) than condition (4), its analogous in the previous section. Furthermore, if condition (8) holds, education sponsorship is a better strategy to keep reputation than just paying more. As it is shown in Appendix A.2, such condition (which is equivalent to condition (3)) is only a requirement of efficiency of the investment in education, and it is also weaker than condition (5), its analogous for the analysis of one worker hired in each generation.

Although in the last case analysed $\alpha$ does not affect here the election of the way to maintain reputation (which only depends on the profitable or unprofitable nature of the course), it has a crucial role in determining the proportion of workers sponsored by firms choosing to fulfil with education. It comes directly from equation (6) that $\frac{\partial \alpha}{\partial p^*} \geq 0$. Under efficiency of the investment, as $\alpha$ increases the employer has to sponsor a higher proportion of senior employees to maintain her reputation, since those not provided with further education suffer a greater loss. In the context of sector-specific skills learned on the job, the application of this result is intuitively clear: in concentrated industries, where there are less bidders for the technical skills of the worker, firms have to offer their prospective employees a higher probability of being sponsored education to compensate them for the low payoff obtained otherwise.

The overall effect of an increase in $\alpha$ is also an increase in the education subsidised by the employer, as long as the investment is efficient. The circumstances required for Proposition 3 (instead of those of Proposition 4) are more likely to hold for higher levels of $\alpha$ (the more specific the skills of the worker, the less likely is that education rises his best outside opportunity above the $ex \ ante$ value). The comparative static exercise done in the simulation of Figure 1.3 shows directly the consequences of this: $p^*$ is increasing in $\alpha$ until the point where education is no more valuable enough to attract prospective workers by itself, while it is $p^* = 1$ from then on.
The equilibrium analysis done above is based on two major assumptions: (i) it exists a problem of *ex post* opportunism by the firm and (ii) the investment in education is *apparently unprofitable for the employer*. Within the model, the possibility of *ex post* opportunism is the cause of the need of commitment that leads the employer to sponsor education. Potential for appropriation stems from the fact that “on the job training” done by the employee is to some extent specific to the training firm; therefore, a higher degree of specificity of his skills (i.e., higher $\alpha$) would lead to more room for *ex post* opportunism (i.e. $(1-\alpha)V_I \leq V'$ more likely to hold), arising then the need for commitment. In the example displayed of Figure 1.3, this is reflected by the fact that the employer is willing to subsidise the education to some of her employees only when $\alpha$ is above a minimum value.

As for the assumption of “apparent unprofitability” of the investment for the employer (i.e.: $\lambda \alpha V_I < c$), its rationale is straight forward: if the specific rents from education were higher than the total costs, all the employees would be provided with it, independently of reputation or commitment concerns of the employer. Note, however, that the latter situation is more likely to be present for higher values of $\alpha$, since the specific part of the productivity increase stemming from complementarities between previous training and further education is higher when such training is more specific. That general and specific human capital are complements is a reasonable assumption that, obviously, favours the sponsorship of education in environments where specific human capital is high. Nevertheless, such assumption is not needed for any of the displayed results: the described role of human capital provision in reducing employer’s commitment costs holds even when such new human capital does not involve any increase in specific skills. In terms of the model, all results hold for the particular case that $\lambda = 0$.

In summary, we have that, if the specificity of the technical training $\alpha$ is high enough (to create a problem of *ex post* opportunism), the employer has to commit herself to an average pay of at least $V'$ if she wants to maintain a good reputation. If an efficient educational program exists (condition (3) is satisfied), the firm will use the sponsorship of such program to reduce the cost of fulfilling the commitment. Moreover, as the example of Figure 1.3 shows, the proportion of workers sponsored will increase with $\alpha$ since those
workers not sponsored receive a worse payoff. Finally, if $\alpha$ is large enough, all the workers in each generation should be provided with the course. Therefore, to the extent that $\alpha$ is related to the number of external bidders for the worker's technical skills in the industry, higher market concentration should make firms operating in such markets more willing to sponsor further education to their senior employees.

Along this section, it has been stressed the role of education sponsorship in making cheaper firm’s upholding of good reputation as employer. The use of education as the *paradigm* of human capital provision has the advantages of being a largely studied topic and, probably, being easier to analyse empirically. Nonetheless, the results are applicable to many other forms of increasing workers human capital (either generally or not). This may include, for example, the provision of free health care or the improvement of working conditions. To the extent that these activities could represent an investment in the general productivity of employees, they would be more likely to be provided to senior workers in firms where the skills acquired on the job are rather specific.

**Discussion**

Several issues concerning to the relevance of the previous analysis will be discussed in this section, including the chances of the worker to finance himself the course and the possibility that senior employees had some bargaining power to take part of the returns to their specific skills.

If the investment in education is efficient, non-sponsored workers could, in theory, be willing to pay for it or, at least, achieve a co-financing agreement with their firms. Transaction costs, however, can prevent them from doing it. Even if the worker had perfect information about the returns to investment and their allocation, liquidity and credit constraints would probably stop him from paying his part (specially when the course is

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13 If $\alpha$ is so large that either “education is not valuable enough to attract prospective workers” (that is to say, $S + (1-\alpha)\lambda V_i < V'$) or “the course is itself profitable for the firm” ( $\alpha\lambda V_i > c$) or both, all workers will be provided with it.
generally oriented). Moreover, other costs could be making more expensive for a worker to finance himself the instruction than what it is for the firm. First, firms seem to be in a better position than workers for a potential bargaining with, let us say, a graduate school. Second, part of the costs of the course (finding and hiring a temporary substitute, for example) is directly borne by the firm and cannot be cheaply transferred to the worker. In absence of the commitment concerns analysed in the previous section, the employer will not be prepared to bear the full cost of the course, unless the part of the returns that she can take pay for it.

An alternative to the analysis of the model has to be considered: The issue of specific investments done by the firm. Employers, especially in concentrated markets, may have done large investments (to take advantage of economies of scale, for example). The acquired assets are specific to the employees to the extent that they cannot be employed with different workers without incurring in a significant loss of value (specially in the case of employees with specific information). Under these circumstances, workers would gain monopolistic power with respect to the firm and, if they organise themselves properly, they could appropriate part of the returns generated by the employer's investment. In such case, the need of commitment by the firm would be lower, since employees' bargaining position could allow them to ask for compensations may be even higher than \( V' \) (in that case, prospective workers would already have incentives to sign up with the employer).

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14 There exist ways for the employer to increase her part of the returns of the investment. Contractual solutions are perhaps the most common; contracts including “golden handcuffs” that compel the workers to work for the firm at a fixed wage for a minimum of years after the training are often observed (the worker has usually to pay termination damages to the firm if he quits during that period). However, such contracts are usually costly and their enforceability is extremely constrained by legal issues.

15 The point of specific assets and appropriation, which stimulated a large literature, was firstly analysed by Williamson (1975) and Klein, Crawford and Alchian (1978).

16 The specificity may depend, for example, on the ability of the workers to prevent the firm from finding a substitute if they stop working. For a short discussion on the specificity in employment relationships, see Arruñada (1998); for a more general analysis of specific assets, see the fundamental paper of Klein and Leffer (1981).

17 Note that if employees can appropriate part of the returns to employer's assets, the firm would have incentives to invest less than what it would have been optimal.
Consequently, an employer that shares part of the quasi-rents of her physical assets with the employees would have low incentives to sponsor courses to their workers. Indeed, if such appropriation of quasi-rents increased worker's payoff over $V'$, the employer would be willing to pay the education only if it were itself profitable for her to do it. Moreover, if the bargaining power of the employees were high enough to allow them to take part of the specific returns of the course, the employer would have low incentives to sponsor even specifically oriented education.

Therefore, the effect of the specificity of worker's technical skills on the firm's sponsoring decision is predicted with different sign depending on the interpretation of such specificity. The previous section stressed the relationship between specificity of the initial training of a worker and his best outside opportunity: if it were completely general ($\alpha = 0$) worker's outside opportunity would probably be close to his productivity within the firm, making him more willing to sign up, regardless of the reputation of the employer. Furthermore, if such specificity depended on the concentration of the market, firms of competitive sectors would sponsor only courses with highly idiosyncratic components, while companies of concentrated industries could be willing to subsidise even highly general education to their workers (given that they are committed to increase their compensation in any case).

If programmers of an information technology firm learn the secrets of C++ with their experience in such firm, they can make equally good use of such skills in hundreds of other firms in the sector and, probably, next to their home. Therefore, the programmers will obtain compensation close to what they could have expected elsewhere before signing on, and the firm will not have to promise anything to potential employees. On the other hand, if a petrol refining company wants to hire, say, a chemical engineer for the support and analysis of its oil prospecting, and fails to credibly offer him a good career perspective, the potential worker will probably reject the offer. If he becomes an expert in oil prospecting it will not be easy for him to find an alternative job without incurring in high switching costs (and the employer will know it). Therefore, unless the firm offers him some real chances of improving the compensation for his skills in the future, he will prefer an alternative option in, for example, the textile industry. Following the main result obtained from the model, the
employer may find efficient the use the sponsorship of educational programs to reduce her cost of commitment.

The alternative interpretation of specificity, on the other hand, would lead to the opposite conclusion. Workers of firms in concentrated sectors may have bargaining power to appropriate part of the quasi-rents generated by the employer's investments. In such case, employees, especially senior ones, would be able to obtain high compensations, and little commitment would be needed by the firm to attract prospective workers. Only courses that offered very specific returns would be candidates to be sponsored by the employer. Furthermore, even this type of courses would be less likely to be provided by a firm in such situation, since the workers would also have power to appropriate a part of the specific component of the acquired human capital. Therefore, a clear conclusion can be obtained from this alternative interpretation: less training and education (of all kind) should be sponsored in the presence of specific assets, especially common in highly concentrated industries.

In order to test empirically the relevance of each of the arguments discussed, it would be ideal to have a survey of firms' human resources policy, including also data about the business environment of the firm, characteristics of the skills of the workers and the type of courses sponsored. It would probably provide us a clear idea of the role of the education sponsored by firms in maintaining their reputation as employers. Unfortunately, such ideal database does not seem to be available for us at the moment. In the next section, in turn, I will make use of the data available in the European Panel for Spain to make an analysis of the relationship between market concentration and firm's human resources policies. Although the data is provided at a rather aggregate level, it can help us to determine the factors may condition different human capital management policies.

**Some Evidence**

In this section, several pieces of evidence about the relationship between sector concentration, firms' educational policy and worker compensation structures are presented.
The analysis illustrates the differences in human capital investments and compensatory strategies of firms across sectors with different levels of concentration.

The Spanish section of the European Community Household Panel (ECPH) is a survey where a sample of more than 17,000 Spanish individuals were interviewed about many demographic and economic variables. From this sample, I selected the answers in 1995 to labour-related question of 3,338 not self-employed workers, non civil servant employees that provided information about their employment relationship and employer characteristics. The reasons for excluding from the sample civil servants are quite obvious, given the special characteristics of the employment in the public sector, especially in Spain, where the employer is basically not allowed to dismiss employees. I also excluded self-employed workers, since the interest of this study is to analyze the compensation of firms to their employers as different parties. Finally, it must be noticed that the number of observation vary across the different regression performed between 2,907 and 3,338, depending on the number of observations with valid values for all variables in each case.

The relevant variables used are described in Appendix B. The survey included several questions related to the training and education pursued by the worker. Among them, I chose the only one that asked the respondent employee whether “the employer provides (free or subsidised) education or training” to him/her. This question is asked among other similar references to the provision of several benefits, including health care, housing help, children care and leisure activities, which will be also analysed here. Some other questions in the survey directly asked the worker about the actual training or education pursued in the last year, and whether it was general or specific. These questions, however, fail to include any reference to who paid or provided such training (except in the case of vocational training) and will only be used later to analyse differences in returns to training and education across sectors.

The ECPH also included information about the industries where respondents’ employers were being employed, in a classification of 17 different sectors related to the 2-digits Spanish CNAE18. This information was matched to the concentration indexes obtained by

\[18 \text{“Código Nacional de Actividades Económicas”}\]
Bajo and Salas (1998) for the Spanish economy in 1993, using data from tax collection sources provided by the “Instituto de Estudios Fiscales” of the Spanish Ministry of Economy. The index of concentration used in this paper is the CR(4) measure of concentration in employment, which falls, by construction, between 0 and 1. I used concentration in employment instead of concentration in sales (typically used in industrial organisation literature), because it is expected to capture more closely labour market competition, in terms of the number of external bidders for workers’ skills. In any case, Bajo and Salas (1998), found very high correlation between both indexes (specifically, the correlation coefficient was 0.88). Index information from Bajo and Salas (1998) was supplied at a less aggregated level than information from the ECHP for some 13 of the 17 sectors considered. For those cases, I aggregated the indexes by weighting each sub-sector according to its economic importance, so that the matching between both sources of data could be done. This aggregation and the gap of two years between concentration index and employment data may induce some error in the measurement of industrial concentration in 1995. Nevertheless, this is probably the most accurate match that can be done between employment information and industrial concentration indexes, given the extreme scarcity of the latter and the fact that concentration rates do not change greatly from year to year. Furthermore, such lack of later information on industrial concentration prevents us from testing its effect on human capital provision using the panel dimension of the ECHP.

The main prediction drawn by the model of the previous section is that firms should be more willing to provide general human capital to their workers in more concentrated sectors. As Figure 1.4 shows graphically, average levels of education and training sponsorship are higher in sectors with higher concentration. Obviously, this positive correlation could be caused by other factors that, being positively related to sector

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19 Such information is included in the publication “Las empresas españolas en las fuentes tributarias”, Instituto de Estudios Fiscales.

20 The four concentration ratio, CR(4) measures the joint market share of the four firms with the highest shares of the sector. Technically: \( CR(4) = \sum_{i=1}^{4} S_i \), where \( S_i \) represents in this case the labour market share as buyer, for each of these four firms.
concentration, could affect to the costs and returns from the human capital investment. Firm size is probably the clearest example, since larger firms are more frequently found in concentrated industries and there may have scale advantages in the provision of training and education. Nonetheless, other variables including worker characteristics, type of employment relationship hold, and regional effects may have also an impact that has to be accounted for.

Table 2 shows the resulting marginal effects at the mean\textsuperscript{21} from a Logit regression that estimates the probability of enjoying different benefits as a function of the measure of concentration considered and a set of control variables within the categories mentioned above\textsuperscript{22}. Although the special interest of this paper relies on education sponsorship, the provision of health insurance, housing help, leisure activities and children care are also included, given of their potential relation to firm-specific investments done by the worker.

As it can be observed from the first column of Table 2, concentration has a significantly positive effect on the probability that a worker gets sponsored education from his/her employer. Either because they are able to take a part high enough of the returns generated or because they have already committed to workers’ compensations above market value, it seems that employers tend to pay more for the education and training of their employees in concentrated sectors.

\textsuperscript{21} Instead of presenting directly the coefficients obtained, I have chosen to present the estimated marginal effect that an increase of each relevant independent variable has on the probability of being awarded each of the event if the rest of the independent variable were took their mean value. For a further discussion on Logit technique, see Greene (1997) or Hamilton (1992).

\textsuperscript{22} Specifically, individual characteristics include sex, years of job market experience and 2 dummies of highest educational degree achieved. Employment relationship characteristics include 2 dummies accounting for the type of contract hold, a set of 18 dummies of workers’ occupational status, 3 dummies capturing the tenure of the worker with him/her employer, a dummy variable registering whether the employee works part-time only, a dummy registering whether the worker needs to use several languages at the job and another one registering whether the worker considers himself/herself overqualified for the type of work done.
Similarly, the provision of health care insurance by employers also appears positively related to industrial concentration in Table 2. As it is stated below, health care insurance may be considered a long-run compensation mechanism, more likely to be provided by employers in presence of specific human capital. Nevertheless, to the extent that it is also a way to provide workers with general human capital (health), results from the second column of Table 2 also give support to the implication from the model that more general human capital is provided by employers in concentrated sectors.

Non-wage benefits like housing help, leisure activities or health and children care are usually provided (instead of higher wages) when they involve a tax reduction or when they can be more efficiently contracted by the firm than by each worker individually (because of economies of scale or reduced adverse selection problems for example). In any case, all four fringe benefits share the feature of being especially valuable for workers that expect to maintain a long-term relationship with their employers. If workers’ human capital is more firm-specific in concentrated sectors, longer term employment relationships are expected, and the mentioned compensation forms should result more attractive in such settings. Congruently with this prediction, results displayed in the last three columns of Table 2 show positive effects of concentration on the likelihood of provision of all four benefits, although the estimated coefficient is only significant for the case of leisure activities.

The results presented in Table 2 do not support the idea that larger firms at concentrated sectors are “hold up” by employee-specific investments. On the one hand, all benefits are more likely to be provided by large employers. This could be due to the existence of economies of scale in their provision but it is, at least, consistent with the thesis that workers can extract higher quasi-rents in larger firms. On the other hand, it must be noticed that tenure and other individual worker characteristics do not seem to affect so much to the probability of benefit provision as firm characteristics do, so that it cannot be said that tenured workers are especially likely to obtain it. Moreover, the fact that larger firms seem to be also more willing to sponsor worker's investments in education undermines an

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explanation of labour relationships based on worker's appropriatory power that predicts a lower ability of the firms to capture the returns to such education.

A more indirect way to check the reality of the model developed in this paper is to analyse how wage returns to tenure and training interact with the concentration of the industry. If higher concentration leads to higher investment in the training of tenured workers by their employers, wages and returns to tenure should be equal or higher in concentrated industries than in the rest of the economy (unless employers do not maintain a commitment with workers with respect to compensations). On the other hand, if there are more pre-existent commitments to wages above employees’ outside opportunities in these industries, general education and training (either firm-sponsored or not) should provide workers from such industries with lower wage increases than the rest.

Table 3 shows the results from a regression of log-wages on industrial concentration, worker’s tenure cumulated in their firm, vocational training and general education pursued last year and the same set of control variables included in the analysis of training sponsorship. Results reveal that workers from higher tenure groups earn higher wages, all else equal. Consistently with the predictions stated above, workers from concentrated sectors earn higher wages (as well as non-wage compensations) and the interactions between higher tenure dummy variables and concentration are either non-significant or significantly positive.

Unfortunately, the lack of panel dimension of the data in this analysis prevents us from estimating wage increases upon vocational training or general education course. Last column of Table 2 shows that, in concentrated sectors, workers who followed a vocational training in the year previous to the survey earn especially higher wages than those who didn’t do it. The same positive interaction is found for general education, although in this case the moderating effect is only significant at the 10% level. This could mean that workers obtain larger wage returns from training and education in concentrated industries (contrary to the predictions of the model developed in the previous section). Nonetheless, it may be simply reflecting that employers from this industries perform better at selecting the
most suitable employees for training and education, since longer-term employment relationships give them more time to learn about workers’ abilities\(^{24}\).

In sum, the complementary evidence presented in Table 3 gives a weaker support to the predictions of the model developed in this paper than that of Table 2. Compensation seems to be overall higher at concentrated sectors and concentration does not affect negatively to workers’ returns to firm tenure. On the other hand, although wage increases upon training and education cannot be estimated in our analysis, the positive interactions between concentration and “last year training and education attainment” suggest that wage increases upon education might not be lower in concentrated industries.

All in all, the results from this section show that firms from more concentrated sectors tend to care more about the human capital of their employees, either through training and education sponsorship, or through health care provision. This gives support to the main prediction of the analysis done in the second section. Also consistently with that analysis, wages and wage returns to tenure are higher or similar at concentrated sectors than in the rest of the economy. Finally, it is much less clear whether training or educational courses cause smaller wage increases in concentrated sectors, as predicted by the model. Nonetheless, a correct answer to this last question can only be obtained with the information on wage increases that a panel data structure would provide.

An alternative theory based on employee appropriation of firm’s quasi-rents seems difficult to be argued on grounds of this evidence. Indeed, tenured workers seem to obtain higher wages in concentrated industries, especially those employees with more than 15 years of service. Nevertheless, tenure does not appear as an important characteristic to explain the benefits analysed in Table 2, which are mostly more likely to be provided in larger and concentrated industries. Furthermore, large employers at concentrated sectors would not be more willing than other firms to provide human capital to their employees, as results show, unless they had the power to obtain profit from it.

\(^{24}\) Note that industrial concentration, as measured by CR(4), is significantly correlated with worker’s firm tenure.
Summary and Conclusions

Many firms pay for the training and education of their workers, even for the generally applicable part of such instruction, as many economists have found in the last years. The model developed in this paper explains why, even when it seems unprofitable for them to finance these investments, employers that have to maintain a good reputation are likely to do it. Since the hazards for employees of becoming too specialised make the need of such reputation especially important in concentrated sectors, more sponsoring should be observed there.

Workers of firms operating in concentrated industries acquire skills that fit worse outside the training firm. This provides them with lower valued alternative employment options, giving monopsonistic power to the firm. Under these circumstances, prospective employees will be reluctant to sign up with an employer, unless she can credibly commit herself to compensate them. I have argued that an employer in such circumstances may be more willing to sponsor further education, even of a general kind, to her workers as a profitable way of carrying out such commitment. In general, there are transaction costs that stop workers from financing themselves such human capital investments. Firms, on the other hand, may be reluctant to sponsor them if, in principle, they cannot take the returns to such investment. If the employers have to commit in any case to pay wages above workers’ outside options, they will be able to capture at least part of the returns generated.

The evidence presented in the previous section shows that firms in concentrated sectors pay similar or higher wage returns to tenure and are more willing to sponsor their human capital acquisition of their employees (in the form of training, education and health). These

25 Moreover, if the number of firms in the market is low, an implicit agreement between them to avoid “raiding” each other is easier to be achieved and maintained. An example of this “co-operative” behaviour can be found in the elite Japanese firms in the 70s and 80s.

26 Under imperfect information, sponsoring education may be also a more effective way to signal the firm's commitment with the worker's career. It could be easier for potential employees to observe whether the employer is sponsoring education to her present workers than to investigate the compensation paths obtained by senior workers.
findings are consistent with the predictions of the model, although not conclusive in ruling out alternative explanations, especially those that assume high bargaining power of workers with strong specific knowledge.

From a practical point of view, the main implication of the analysis done along the paper is that less competition for skilled labour may result in (efficiently) increased investment in human capital. This is because shifting most of the bargaining power towards one of the parties (the monopsonistic firm) helps to avoid transaction costs that lead to underinvestment in human capital.

On the theoretical part, further research on the determinants of education sponsorship should pay attention to the problem of signalling in absence of perfect information about the workers' abilities. If the employer is able to learn about the workers' ability and their fit to the firm during the on-the-job training period, she may want to sponsor education only to her best employees; first, it allows her to take advantage of the complementarity between natural ability and acquired skills and, second, it could be used as a screening device designed to attract better employees. In such setting, the bad consequence for the employer is that she would signal to the rest of the employers who are the best workers or, more exactly, who are the ablest workers using the skills needed to become eligible for the further training. In that case, the employer, who could have gained an informative advantage about the ability of the worker, can lose it through the sponsorship of the course. Such problem is expected to be less important in the case of less competitive industries, given that there are less alternative employers interested in the ability of the worker using the acquired skills.

As for the empirical part, it remains to find out the extent to which employers of concentrated sectors are able to capture the returns to human capital investments. In this sense, an accurate evaluation on how individual wage increases after training and education

27 If employees differ in ability, and the employer can find out such ability during the period of on-the-job training, she will be able to hire the best talents, as long as higher ability workers perceive a higher probability of being sponsored.
vary across industries is needed. On the other hand, firm-level evidence describing more in
detail firms’ policies with respect to human capital would also be useful to analyse the
effects of market concentration. Although it would lack the ability to account for worker
characteristics that surveys as the ECHP have, it would allow a higher precision to measure
organisational attitudes towards human capital provision and their relationship with labour
market circumstances.
References


Tables

Table 1: Evolution of Expenditure of US firms in Corporate training (1987-1999)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Estimated Expenditure of US firms in Corporate Training (millions of US$)</td>
<td>2,000</td>
<td>4,000</td>
<td>8,000</td>
<td>16,000</td>
</tr>
</tbody>
</table>

Table 2: Logit Regression of the Probability of Obtaining each Benefit. Marginal Effects at the Mean.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>EDUCATION</th>
<th>HEALTH</th>
<th>HOUSING</th>
<th>CHILDREN</th>
<th>LEISURE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SPONSORHIP</td>
<td>INSURANCE</td>
<td>HELP</td>
<td>CARE</td>
<td>ACTIVITIES</td>
</tr>
<tr>
<td>CR(4) Index</td>
<td>0.201** (0.062)</td>
<td>0.297** (0.101)</td>
<td>0.014 (0.016)</td>
<td>0.018 (0.014)</td>
<td>0.051** (0.020)</td>
</tr>
<tr>
<td>Size 5 to 19</td>
<td>0.084** (0.028)</td>
<td>0.190** (0.030)</td>
<td>-0.001 (0.006)</td>
<td>0.011 (0.011)</td>
<td>0.023 (0.018)</td>
</tr>
<tr>
<td>Size 20 to 49</td>
<td>0.152** (0.038)</td>
<td>0.278** (0.031)</td>
<td>-0.004 (0.006)</td>
<td>0.024* (0.018)</td>
<td>0.050* (0.030)</td>
</tr>
<tr>
<td>Size 50 to 99</td>
<td>0.195** (0.046)</td>
<td>0.347** (0.031)</td>
<td>0.004 (0.009)</td>
<td>0.031** (0.023)</td>
<td>0.087* (0.044)</td>
</tr>
<tr>
<td>Size 100 to 500</td>
<td>0.364** (0.046)</td>
<td>0.419** (0.027)</td>
<td>-0.002 (0.007)</td>
<td>0.061** (0.003)</td>
<td>0.158** (0.057)</td>
</tr>
<tr>
<td>Size &gt;500</td>
<td>0.446** (0.042)</td>
<td>0.435** (0.026)</td>
<td>0.036** (0.016)</td>
<td>0.064** (0.003)</td>
<td>0.268** (0.071)</td>
</tr>
<tr>
<td>Public</td>
<td>0.001 (0.033)</td>
<td>0.082 (0.056)</td>
<td>0.045** (0.026)</td>
<td>0.034** (0.020)</td>
<td>0.010 (0.016)</td>
</tr>
<tr>
<td>Sex</td>
<td>-0.013 (0.015)</td>
<td>-0.009 (0.025)</td>
<td>-0.011** (0.005)</td>
<td>0.004 (0.003)</td>
<td>-0.010* (0.006)</td>
</tr>
<tr>
<td>Secondary</td>
<td>0.069** (0.020)</td>
<td>-0.056** (0.028)</td>
<td>-0.004 (0.004)</td>
<td>0.002 (0.003)</td>
<td>0.002 (0.012)</td>
</tr>
<tr>
<td>Third level</td>
<td>0.073** (0.024)</td>
<td>-0.007 (0.035)</td>
<td>0.005 (0.007)</td>
<td>0.005 (0.006)</td>
<td>0.016* (0.010)</td>
</tr>
<tr>
<td>Tenure 2 to 5</td>
<td>-0.016 (0.019)</td>
<td>0.049 (0.031)</td>
<td>-0.002 (0.006)</td>
<td>0.003 (0.007)</td>
<td>0.004 (0.010)</td>
</tr>
<tr>
<td>Tenure 6 to 14</td>
<td>-0.010 (0.021)</td>
<td>0.113** (0.034)</td>
<td>0.000 (0.007)</td>
<td>0.007 (0.008)</td>
<td>-0.004 (0.009)</td>
</tr>
<tr>
<td>Tenure &gt; 14</td>
<td>-0.031 (0.021)</td>
<td>0.038 (0.036)</td>
<td>0.007 (0.008)</td>
<td>0.005 (0.007)</td>
<td>0.002 (0.010)</td>
</tr>
<tr>
<td>Part time</td>
<td>-0.024 (0.026)</td>
<td>-0.066 (0.044)</td>
<td>-0.013** (0.005)</td>
<td>-0.004 (0.006)</td>
<td>-0.004 (0.012)</td>
</tr>
<tr>
<td>Permanent</td>
<td>0.026 (0.036)</td>
<td>0.340** (0.051)</td>
<td>0.003 (0.009)</td>
<td>0.009 (0.010)</td>
<td>-0.025 (0.016)</td>
</tr>
<tr>
<td>Fixed-term</td>
<td>-0.018 (0.035)</td>
<td>0.246** (0.037)</td>
<td>-0.002 (0.009)</td>
<td>-0.003 (0.010)</td>
<td>-0.028** (0.010)</td>
</tr>
<tr>
<td>2nd Language at job</td>
<td>0.034* (0.018)</td>
<td>0.024 (0.028)</td>
<td>-0.003 (0.004)</td>
<td>0.004 (0.004)</td>
<td>0.009 (0.007)</td>
</tr>
<tr>
<td>Over- qualified</td>
<td>0.003 (0.014)</td>
<td>0.023 (0.021)</td>
<td>-0.000 (0.004)</td>
<td>0.005 (0.003)</td>
<td>0.004 (0.005)</td>
</tr>
<tr>
<td>Regional Dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Occupat. Dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Num. of obs.</td>
<td>3273</td>
<td>3273</td>
<td>3273</td>
<td>3070</td>
<td>2907</td>
</tr>
<tr>
<td>L-R test $\chi^2$</td>
<td>854.09**</td>
<td>812.86**</td>
<td>101.08**</td>
<td>141.89**</td>
<td>281.43**</td>
</tr>
</tbody>
</table>

*Significant at 10%. **Significant at 5%.
Table 3: OLS Log-Wage Regression. Dependent variable: Log (hourly wage). Regression coefficients

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>Model I</th>
<th>Model II</th>
<th>Model III</th>
<th>Model IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CR(4) index</strong></td>
<td>0.369**</td>
<td>0.367**</td>
<td>0.138</td>
<td>0.033</td>
</tr>
<tr>
<td></td>
<td>(0.065)</td>
<td>(0.065)</td>
<td>(0.107)</td>
<td>(0.111)</td>
</tr>
<tr>
<td><strong>Tenure 2 to 5</strong></td>
<td>0.035*</td>
<td>0.038*</td>
<td>-0.004</td>
<td>-0.012</td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.019)</td>
<td>(0.031)</td>
<td>(0.032)</td>
</tr>
<tr>
<td><strong>Tenure 6 to 14</strong></td>
<td>0.101**</td>
<td>0.104**</td>
<td>0.092**</td>
<td>0.089**</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.022)</td>
<td>(0.032)</td>
<td>(0.032)</td>
</tr>
<tr>
<td><strong>Tenure &gt; 14</strong></td>
<td>0.242**</td>
<td>0.246**</td>
<td>0.171**</td>
<td>0.493**</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.024)</td>
<td>(0.032)</td>
<td>(0.032)</td>
</tr>
<tr>
<td><strong>CR(4) × (Tenure 2 to 5)</strong></td>
<td>0.311*</td>
<td></td>
<td>0.332**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.177)</td>
<td></td>
<td>(0.176)</td>
<td></td>
</tr>
<tr>
<td><strong>CR(4) × (Tenure 6 to 14)</strong></td>
<td>0.121</td>
<td></td>
<td>0.118</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.161)</td>
<td></td>
<td>(0.160)</td>
<td></td>
</tr>
<tr>
<td><strong>CR(4) × (Tenure &gt; 14)</strong></td>
<td></td>
<td>0.486**</td>
<td>0.493**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.146)</td>
<td>(0.147)</td>
<td></td>
</tr>
<tr>
<td><strong>Vocational Training</strong></td>
<td>0.029</td>
<td>0.026</td>
<td>-0.098**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.021)</td>
<td>(0.040)</td>
<td></td>
</tr>
<tr>
<td><strong>CR(4) × Vocational</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.696**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.192)</td>
</tr>
<tr>
<td><strong>General Education</strong></td>
<td>0.021</td>
<td>0.023</td>
<td>-0.038</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.021)</td>
<td>(0.039)</td>
<td></td>
</tr>
<tr>
<td><strong>CR(4) × General</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.366*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.203)</td>
</tr>
<tr>
<td><strong>Number of observations</strong></td>
<td>3338</td>
<td>3338</td>
<td>3338</td>
<td>3213</td>
</tr>
<tr>
<td><strong>R^2</strong></td>
<td>0.51</td>
<td>0.51</td>
<td>0.51</td>
<td>0.51</td>
</tr>
</tbody>
</table>

In addition to the variables showed here, all models include the same control variables included in Table 2.

*Effect is significant at 10%. ** Effect is significant at 5%.
Figures

Figure 1: Extensive Form of the Stage Game

Figure 1 illustrates the extensive form of the stage game with the following elements:

- **Firm**
  - **Accept** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Accept** [W_{mba}, P_{mba}(W_{mba})]
  - **Reject** [W_{mba}', -c]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]

- **t-th Worker**
  - **Make an Offer** [W, P(W)]
  - **Reject** [W', 0]
Figure 2: Summary of Equilibrium Outcomes

- **Firm**
  - Fulfil with money
  - "Cheat" \( W = (1 - \alpha)V_i \)
  - Sponsor education and make an offer

- **t-th Worker**
  - Outside opportunity career
  - Accept
    - \( [V', (1/r)(V_i - V')] \)
  - Sign with the and acquire skills (specific due to concentration)

- **t-th Worker**
  - Accept
    - \( [\alpha V_i, (1 - \alpha) V_i] \)

- **t-th Worker**
  - Accept
    - \( \left[ \max\{V'; (1 - \alpha)(1 - \lambda)V_i + S\}, \min\{(1 + \lambda)V_i + S - c - V'; \alpha(1 - \lambda)V_i - c\} \right] \),
Figure 3: Simulation of the Proportion of Workers Sponsored as a Function of $\alpha$

Value of exogenous variables:

\[
\begin{align*}
V' &= 4 \\
V_f &= 4.5 \\
\lambda &= 0.25 \\
S &= 3 \\
c &= 3.5
\end{align*}
\]

Notes:

1) The investment in education is an efficient investment ($S + \lambda V_f > c$) but apparently unprofitable for the firm ($\lambda \alpha V_f < c$).
2) There is a problem of ex post opportunism as long as $\alpha > 0.12$; otherwise no worker will be sponsored.
3) If $\alpha > 0.82$, sponsorship of the course is not enough to attract prospective workers, and all the workers are sponsored.
Figure 4: Labour Market Concentration and Average Education Sponsorship.
Appendix A

A.1.-Proof of Propositions 1.1, 1.2 and 1.3:

Let us start from the arguments exposed before the statement of Proposition 1 that lead us to the conclusion that the only possible equilibria are Equilibrium 1.1 to Equilibrium 1.3. Then, the process to prove Proposition 1 can be organised in four steps:

(a) Show that Equilibrium 1.3 (firm is unable to hire any worker) is always a sub-game-perfect Nash equilibrium:

Here, we have to show that each of the strategy of the players is an optimal response to the other agent's one in every feasible sub-game that could be faced.

Let us begin with the t-th worker; first, the part of his strategy corresponding to the third movement “accept the offer if it is not smaller than his outside opportunity and reject it otherwise” is clearly a best response to any strategy of the firm, since it guarantees him the best payoff from those available at that point. Second, the part of his strategy corresponding to the first movement, “not agree to work for the firm and follow his best outside opportunity” is the best response to the employer's equilibrium strategy in the second movement, “cheat the expectations of the employee”, since $V' > (1 - \alpha) V_t$ by assumption.

As for the employer, the strategy “cheat the expectations of any worker se could hire” in the t-th period is the best response to the (t+1)-th worker equilibrium strategy of “not agree to work”.

(b) Show that Equilibrium 1.1. (firm fulfils with money) is a sub-game-perfect Nash equilibrium if and only if condition (1) holds and condition (3) is not strictly satisfied:
In this case, it is quite obvious that the strategy of the t-th worker is a best response to the strategy of the firm. As it has been above, his strategy in the third movement (the same of Equilibria 1.2 and 1.3) allows him to take the best payoff available in that moment; moreover, his strategy in the first movement is optimal given that the firm fulfils, since he takes $V'$, his best possible payoff.

With respect to the employer, the optimality of the strategy “fulfil with money” in each sub-game faced is subject to the condition that the payoff obtained from doing so is higher than any other strategy. Nevertheless, there are only two alternative strategies to be compared with (since the rest have been shown to be “dominated strategies”): cheating and fulfilling with education. First, would it better for the employer to cheat the expectations of the worker by paying him only is ex post outside opportunity? The answer to this question depends on whether condition (1) holds or not; given that the strategy of the (t+1)-th worker leads him not to trust in the employer if she has cheated anyone before, the benefits from cheating are $\alpha V_i$ in the t-th period, while those from “fulfilling with education” are $V_i - V'$ in all the remaining generations. Therefore, with an inter-generations rate of discount $r$, the condition for fulfilling with cash to be at least as good as the cheating option is (equivalent to condition (1)):

$$\alpha V_i \leq \sum_{t=1}^{\infty} (V_i - V') / (1 + r)^t$$

The second alternative strategy that has to be ruled out is that the employer fulfilled the commitment providing education to the senior employee. In that case, the payoff for the firm in each generation would be the full productivity of the worker minus the compensation paid to the worker and the cost of education, $S + (1 + \lambda)V_i - c - V'$ so that the condition for “fulfilling with money” to be at least as profitable as “fulfilling with education” is:

$$S + (1 + \lambda)V_i - c - V' \leq V_i - V'$$

Note that this condition is equivalent to condition (3) not being strictly satisfied. If the cost of the course is at least as high as its full return, then just paying cash is an optimal way of fulfilling.
(c) Show that Equilibrium 1.2. (Firm fulfils with education) is a sub-game perfect Nash equilibrium if and only if conditions (2) and (3) are satisfied

As in Equilibrium 1.1, it is straightforward that the worker strategy here is optimal given the firm's strategy, since it allows him to achieve the best payoff available in each moment. On the employer's side, the optimality of a “fulfil with education” as response to the worker's strategy has to be shown in comparison with the “cheating” and “fulfil with money” strategies by checking the resultant payoffs in each case, as it has been done in part (b). Thus, taking the above described one-period payoffs for each of the strategies, and taking into account that only fulfilling enables the worker to obtain payoffs in the following generations, the conditions for “fulfil with education” to be at least as good strategy as “cheat” and “fulfil with education” are, respectively:

\[ \alpha V_I \leq \sum_{t=1}^{\infty} \left[ S + (1 + \lambda)V_I - c - V' \right]/(1 + r)^t \]

\[ V_I - V' \leq S + (1 + \lambda)V_I - c - V' \]

Note that both conditions are equivalent to conditions (2) and (3) respectively.

(d) Show that either Equilibrium 1.1. or Equilibrium 1.2. exists (as sub-game-perfect Nash Equilibrium) it will prevail over Equilibrium 1.3.

Let us suppose that conditions for Equilibrium 1.1 or 1.2 hold; then the firm can credibly promise to the worker \( V' + \varepsilon \), with \( \varepsilon \geq 0 \). If the employer has incentives to maintain her promise for \( V' \) (this is, if either (1) or (2) or both holds), she will be willing also to honour it for \( V' + \varepsilon \); then (using backwards induction as refinement), the employer will agree to work for the firm, leading to either Equilibrium 1.1 or 1.2, which corresponding outcomes are the ones described in Figure 1.2 and in the statement of the proposition.

Note that:
• Propositions 2.1, 2.2 and 2.3 can be shown in a similar fashion, substituting conditions (2) and (3) by (4) and (5) respectively.

• The proof of Proposition 3 can be also done in an analogous way to Proposition 1, since it is only its generalisation. In this case Equilibria Sets 2.1 and 2.2a should substitute Equilibria 1.2 and 1.3 respectively.

• As for Proposition 4, the same method can be used for its proof: first, show that Equilibrium 1.3 is always a sub-game-perfect Nash equilibrium; second, show that any equilibrium from Equilibria Set 2.3 is a sub-game-perfect Nash equilibrium if and only if condition (1) holds and condition (7) are not strictly satisfied; third, show that Equilibrium 2.2b is a sub-game perfect Nash equilibrium if and only if conditions (7) and (8) hold; and fourth, show that if either Equilibrium 2.2b or any equilibrium from 2.3 is sub-game perfect, it will prevail over Equilibrium 1.3.

A.2.- Derivation of Condition (8)

The condition “fulfil with the education of a proportion $p^*$ of workers” to be a better strategy for the firm than “fulfil with money” is:

$$p^* [(1+\lambda)\alpha V_I - c] + (1-p^*)\alpha V_I \geq V_I - V' \leftrightarrow \alpha V_I + p^* (\lambda\alpha V_I - c) \geq V_I - V'$$

Substituting in the latter expression the $p^*$ optimal described in (6), simplifying and rearranging terms, we have the following inequality:

$$(c - \lambda\alpha V_I)/[\lambda(1-\alpha)V_I + S] \leq 1$$

From where we obtain:

$$c \leq \lambda V_I + S$$

Note that Condition (8) is weaker than condition (5) as long as the investment in education is valuable enough to attract prospective workers $(S+(1+\lambda)(1-\alpha)V_I \geq V')$
\[ V' - (1 - \alpha) V_I + \alpha \lambda V_I \geq c \quad \rightarrow \quad \lambda V_I + S \geq c \]

Since:

\[ S + (1 + \lambda)(1 - \alpha) V_I \geq V' \quad \leftrightarrow \quad S + \lambda V_I - \lambda \alpha V_I + (1 - \alpha) V_I \geq V' \quad \leftrightarrow \quad \lambda V_I + S \geq V' - (1 - \alpha) V_I + \alpha \lambda V_I \]
Appendix B: Description of the data

The ECHP variables used for the empirical section is described in the following table:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Measurement</th>
<th>Sample Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hourly Wage*</td>
<td>Stated Monthly Wage</td>
<td>Spanish Pesetas</td>
<td>821</td>
<td>502.13</td>
</tr>
<tr>
<td></td>
<td>(Weekly Working Hours × (4.286)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education Sponsorship</td>
<td>Whether the firm provides it or not</td>
<td>No = 0</td>
<td>0.266</td>
<td>0.442</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Insurance</td>
<td>Whether the firm provides it or not</td>
<td>No = 0</td>
<td>0.472</td>
<td>0.499</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housing Help</td>
<td>Whether the firm provides it or not</td>
<td>No = 0</td>
<td>0.032</td>
<td>0.176</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children Care</td>
<td>Whether the firm provides it or not</td>
<td>No = 0</td>
<td>0.043</td>
<td>0.202</td>
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<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leisure Activities</td>
<td>Whether the firm provides it or not</td>
<td>No = 0</td>
<td>0.076</td>
<td>0.264</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>Sex of respondent</td>
<td>Male = 0</td>
<td>0.346</td>
<td>0.476</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female = 1</td>
<td></td>
<td></td>
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<tr>
<td>Tenure &lt; 2</td>
<td>Whether working with current employer is less</td>
<td>No = 0</td>
<td>0.307</td>
<td>0.461</td>
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<tr>
<td></td>
<td>than 2 years</td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tenure 2 to 5</td>
<td>Whether working with current employer is between</td>
<td>No = 0</td>
<td>0.173</td>
<td>0.378</td>
</tr>
<tr>
<td></td>
<td>2 and 5 years</td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tenure 6 to 14</td>
<td>Whether working with current employer is between</td>
<td>No = 0</td>
<td>0.204</td>
<td>0.403</td>
</tr>
<tr>
<td></td>
<td>6 and 15 years</td>
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<td></td>
</tr>
<tr>
<td>Tenure &gt;14</td>
<td>Whether working with current employer is more</td>
<td>No = 0</td>
<td>0.287</td>
<td>0.452</td>
</tr>
<tr>
<td></td>
<td>than 14 years</td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>Maximum educational degree achieved is primary</td>
<td>No = 0</td>
<td>0.544</td>
<td>0.498</td>
</tr>
<tr>
<td></td>
<td>or below</td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>Maximum educational degree achieved is secondary</td>
<td>No = 0</td>
<td>0.200</td>
<td>0.400</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third level</td>
<td>Maximum educational degree achieved is third</td>
<td>No = 0</td>
<td>0.256</td>
<td>0.436</td>
</tr>
<tr>
<td></td>
<td>level</td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
<td>Measurement</td>
<td>Sample Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------------------------------------------------</td>
<td>------------------------</td>
<td>-------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>CR(4)**</td>
<td>CR(4) Index for the labour market</td>
<td>Values in the range [0,1]</td>
<td>0.166</td>
<td>0.117</td>
</tr>
<tr>
<td>Size &lt; 5</td>
<td>Number of employees in workplace is lower than five</td>
<td>No = 0</td>
<td>0.226</td>
<td>0.418</td>
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<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size 5 to 19</td>
<td>Number of employees in workplace is between 5 and 19</td>
<td>No = 0</td>
<td>0.285</td>
<td>0.451</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size 20 to 49</td>
<td>Number of employees in workplace is between 20 and 49</td>
<td>No = 0</td>
<td>0.151</td>
<td>0.358</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size 50 to 99</td>
<td>Number of employees in workplace is between 1 and 4</td>
<td>No = 0</td>
<td>0.093</td>
<td>0.290</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size 100 to 500</td>
<td>Number of employees in workplace is between 100 and 500</td>
<td>No = 0</td>
<td>0.110</td>
<td>0.313</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size &gt;500</td>
<td>Number of employees in workplace is higher than 500</td>
<td>No = 0</td>
<td>0.135</td>
<td>0.341</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>Whether the respondent works for the public sector (civil servants excluded)</td>
<td>No = 0</td>
<td>0.192</td>
<td>0.394</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part time</td>
<td>Whether the respondent works part time</td>
<td>No = 0</td>
<td>0.071</td>
<td>0.257</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent</td>
<td>Whether the respondent holds a permanent contract with the employer</td>
<td>No = 0</td>
<td>0.592</td>
<td>0.492</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd Language at job</td>
<td>Whether the respondent’s job involve the use of a foreign language</td>
<td>No = 0</td>
<td>0.216</td>
<td>0.412</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overqualified</td>
<td>Whether the respondent considers that he/she is overqualified for his/her job</td>
<td>No = 0</td>
<td>0.216</td>
<td>0.412</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed term</td>
<td>Whether the respondent holds a fixed-term contract with the employer</td>
<td>No = 0</td>
<td>0.331</td>
<td>0.471</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Casual</td>
<td>Whether the respondent is employed in a casual work with no contract</td>
<td>No = 0</td>
<td>0.077</td>
<td>0.267</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vocational Training</td>
<td>Whether respondent pursued any vocational training course last year</td>
<td>No = 0</td>
<td>0.125</td>
<td>0.328</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Education</td>
<td>Whether respondent pursued any general education course last year</td>
<td>No = 0</td>
<td>0.122</td>
<td>0.331</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes = 1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The value 4.286 corresponds to the exact number of weeks contained in a 30-days month.
** The CR(4) Index of concentration is the result from matching ECHP information on employment sector to industrial concentration data available in Bajo and Salas (1998) through own computations.