Who should pay the bill for employee upskilling?

Radu Vranceanu, Angela Sutan

The pioneering spirit

WHO SHOULD PAY THE BILL FOR EMPLOYEE UPSKILLING?

Radu Vranceanu
Angela Sutan

ESSEC RESEARCH CENTER

WORKING PAPER 2008

OCTOBER 2020

October 21, 2020

Who should pay the bill for employee upskilling?

Radu Vranceanu* **and Angela Sutan†**

Abstract

Upskilling is an investment in human capital that allows a worker to successfully undertake a new task or new project within his/her existing job. It involves costly effort on behalf of the employee to acquire new skills and new knowledge. In this context, one essential question for managers is whether to invest in workers' upskilling or let them pay for the investment in human capital and compensate them accordingly. Using traditional contract theory analysis, we show that the latter choice is not cost-neutral since the most flexible workers benefit of an informational rent. A profit comparison shows that it might be in the interest of a company to invest in worker upskilling, rather than to rely on worker self-training.

Keywords: Contract theory, Upskilling, Screening, Training policy
JEL Classification: J33, J41, D86

*ESSEC Business School and THEMA, 1 Av. Bernard Hirsch, 95021 Cergy, France. E-mail: vranceanu@essec.edu

†University Bourgogne Franche-Comte, Burgundy School of Business - CEREN EA 7477, 29 rue Sambin, 21000 Dijon France. E-mail: angela.sutan@bsb-education.com

1 Introduction

The constant need for companies to set up processes to ensure that their workforce adapts to technological advances is a characteristic of modern industrial societies. The HR management literature refers to the processes set up by firms to improve the correlation between the capabilities of their employees and the broad requirements of new tasks as "upskilling" (Capelli and Rogovsky 1994, Leigh et al., 1999, Cohen, 2019). This skill transformation reached preeminence with the advent of the information technology revolution in the 1990s, driven by the massive deployment of computers and the Internet (Gordon, 2000; 2012). In the 2010s, the digital transformation shifted to the systematic generation and exploitation of big data via machine learning and AI. Automation is also displacing traditional tasks (Acemoglu and Restrepo, 2019), requiring new interactions between humans and machines that heavily draw on new skills, new knowledge, and new work-attitudes (Grand-Clement et al., 2017). Recently, the Covid-19 sanitary crisis rapidly imposed the massive deployment of distance work (Brynjolfsson et al., 2020) and a radical transformation of work organization in many sectors, including e-commerce, banking, health care, consulting, education (Agrawal et al., 2020). According to a recent survey of business executives (July 2020) by the consultancy firm McKinsey, changes in digital and technology adoption are taking place these days about 25 times faster than before the pandemic.[1]

Both the management and employees are concerned with the constant need to cope with these technological challenges. Before the recession caused by Covid-19, the shortage of skills was considered the main factor limiting the expansion of the US manufacturing sector, which planned to invest 26.2 billion dollars in upskilling programs.[2] In a survey of 22000 employees in 2019, consulatancy firm PwC revealed that 77% of employees would learn new skills or be completely retrained to improve their future employability.[3] Another survey by PwC revealed

[1] See McKinsey *Global Survey of Executives*, July 2020.

[2] CNBC, January 17, 2020. www.cnbc.com/2020/01/17/manufacturers-to-spend-26point2-billion-on-upskilling-workers-in-2020.html

[3] PwC's report *Upskilling Hopes and Fears* survey was conducted in July 2019.

that in January 2020, 74% of the managers of 1581 global companies were concerned about the availability of key skills within their workforce.[4] According to a survey of 300 US firms by the *TrainingJournal* in August 2020, 42% of companies stepped up their investment in upskilling and reskilling, while 42% of employees pursued training on their own after the coronavirus outbreak.

This paper addresses an important managerial question; Should a company or its employees bear the cost of upskilling? Another important question addressed by this paper is the design of the optimal compensation when firms have only imperfect information about workers' skills. Finally, the analysis allows to determine the equilibrium proportion of workers who choose to pay the learning cost (to upskill).

We therefore build a model that is largely inspired by the contract theory literature (Bolton and Dewatripont, 2005; Salanié, 2005; Laffont and Martimort, 2009). In the model, workers can perform a stepwise investment in human capital – for instance, learn a new software or a foreign language, or a new managerial method – that allows them to successfully carry out complex projects of high value added for their company. Employees are heterogenous with respect to the learning cost required to successfully upskill (Jackman, 2020). The proportion of employees who decide to invest in the new skills is endogenous. Information about the type of worker is either private or public, depending on who is investing in upskilling. A firm has a portfolio of projects of varying complexity. High-complexity projects have a high return, and low-complexity projects have a low return. The analysis reveals that when employees do upskill, it is in their interest to hide it from their manager. If their manager knows the distribution of types, but cannot identify the types, he must offer a menu of contracts that prompts employees to self-select for the projects where they are most efficient. This brings an informational rent to the most skilled workers following the logic of second-degree price discrimination. In an alternative setting, a firm offers vouchers for upskilling, which workers can use to cover their learning cost. However, the use of

www.pwc.com/gx/en/issues/upskilling/hopes-and-fears.html

[4] PwC's 23rd Annual Global CEO Survey, January 2020, *Navigating the rising tide of uncertainty.* See www.pwc.com/gx/en/ceo-survey/2020/trends/pwc-talent-trends-2020.pdf

the voucher reveals the type of worker, thus allowing the firm to offer "discriminating" contracts.

A comparison of the profits reveals that depending on the parameters of the model, profits associated with the two educational strategies (self-training and firm-financed upskilling) can be at best identical. If workers do not use the full amount of the education voucher, then firm-financed education brings higher profits than the self-training strategy. Self-trained education is therefore a weakly dominated strategy. On the other hand, employees with low learning costs would be better-off in the self-training scenario, which can nurture tensions between workers and the firm with respect to the training policy.

One important limitation of the analysis is its static nature; in our model, the manager does not consider the possibility of replacing obsolete-skill workers with more qualified workers. This is tantamount to assuming that the cost of upskilling is low compared to the cost of massive turnover, which is a plausible assumption for many sectors.[5] Modestino et al. (2019) explain that in recruitment, companies now require a higher level of competencies for the same jobs compared to the recent past, as they prefer upskilling to worker replacement. We do not consider the possibility that workers who benefit from a firm-financed upskilling program might leave for a better paying job elsewhere (Benson et al. 2004) or that upskilling could be an efficient worker retention policy (Manchester, 2010; 2012; Dietz and Zwick, 2020). In a dynamic setting, the fact that workers benefit from information rent when upkilling is self-financed might make self-financing a more interesting education strategy. Our static analysis is therefore better suited for sectors where human capital is highly specific.

The paper is organized as follows. After introducing the main assumptions, we determine the optimal compensation policies for each of the two education strategies, and compare the resulting profits. As an extension, we analyze the effect of public subsidies for upskilling. The last section presents our conclusion.

[5] The *World Economic Forum* argued that it costs roughly $4,425 to hire a new employee, and the *Association for Talent Development*'s discovery that upskilling an existing employee costs a company about $1,300.

2 Main assumptions

The problem is cast as a game between workers, who must choose whether to undertake the upskilling effort or not, and the firm, which must decide on a compensation policy. We study two distinct cases: when the worker and when the firm pays for the upskilling program. The frequency of employees who upskill is endogenous.

The firm, which seeks to maximize profits, can develop a portfolio of projects based either on the old technology (of complexity q^L) or on the new technology (of complexity q^H). The level of complexity is exogenously given. If properly implemented, a complex project brings more value to the firm, $v^H > v^L$.

There is a continuum of employees of mass one; at the outset of the game, they are all of the s type (standard type) with basic competencies. With an investment in human capital c, they can evolve toward the flexible type, denoted f. This is tantamount to acquiring a fixed amount of knowledge that is essential for the implementation of a complex project.[6] This *learning (upskilling) cost* is uniformly distributed in the interval $[0, \bar{c}]$ and this distribution is common knowledge.[7] To rule out corner solutions, we assume that the upper bound of the cost distribution is large enough, $\bar{c} > \left(v^H - v^L\right)$, a condition that will be explained later on.

A flexible-type worker (f) can efficiently implement any project q^H (or q^L) and deliver the value v^H (and v^L, respectively). A standard-type worker (s) can efficiently implement only a project q^L, and not a project q^H. If he/she takes a project H, the value of the project is v^L because he/she lacks the essential skills for the successful implementation of this project. Such an asymmetry is revealed by Jeremy and Postel-Vinay (2020) who argue that employing a worker who is under-qualified in either cognitive or manual skills is several orders of magnitude more costly than employing an over-qualified worker.

[6] For instance, people who aim to make efficient use of large Internet databases might need to invest in learning programming language such as Python.

[7] Jackman (2020) documents that the ability to acquire new human capital quickly varies considerably among a large sample of Danish workers.

Let r^H and r^L be the compensation offered by a firm to a worker for undertaking a project of complexity H and L, respectively. In other words, the firm offers bundles of project complexity-compensation (q^H, r^H) and (q^L, r^L). Thus r^H and r^L are the key variables to be optimally determined by the firm.

The personal effort required by a project depends on the nature of the project, and the type (skills) of the worker. The flexible type of worker can easily switch from simple to complex projects. The s type of worker can also work on a complex project but at a higher personal cost (and without performing well). Let e_f^H and e_f^L be the "execution effort" required of $f-$workers to carry out one of the projects, with $e_f^H > e_f^L$. Let e_s^H and e_s^L be the execution effort required to type s workers to execute one of the projects, with $e_s^H > e_s^L$. We also assume that $e_s^H > e_f^H$, and $e_s^L > e_f^L$, for any project (H or L), and the effort of the $s - type$ is larger than the effort of the $f - type$ of worker.[8]

To keep the analysis as simple as possible, we assume that the effort structure is $e_f^L = e_0$, $e_s^L = e_f^H = e_1$ and $e_s^H = e_2$ with:

$$e_0 < e_1 < e_2, \tag{1}$$

Table 1 summarizes the execution effort (for the worker) and project value for the firm, by type of worker and type of project.

	project L	project H
Employee s	(e_1, v^L)	(e_2, v^L)
Employee f	(e_0, v^L)	(e_1, v^H)

Table 1: Execution effort and value, by type of employee and type of project

The utility of a worker of type i from executing a project of complexity q^j and receiving

[8] The effort to execute a project, e, depends on the type of worker, but is unrelated to the learning (upskilling) cost, c. The latter is a "personal characteristic" reflecting learning abilities, while the former is specific to the difficulty of the project, requiring given skills.

compensation r^j is simply his/her compensation minus his/her execution effort:

$$U_i(q^j, r^j) = r^j - e_i^j \text{ with } i = (f, s) \text{ and } j = (H, L). \tag{2}$$

If workers accept all contracts that provide them with positive utility, the participation constraints (PC) to any project of complexity j are:

$$U_s = r^j - e_s^j \geq 0 \tag{3}$$

$$U_f = r^j - e_f^j \geq 0. \tag{4}$$

3 The equilibrium

A Nash equilibrium of this game is a situation in which employees choose their best education strategy depending on the firm compensation scheme, and the firm chooses the optimal compensation scheme given the workers' education strategy.

Two polar cases can be considered, depending on who bears the cost of the upskilling program. If the worker pays for the upskilling, he/she can hide this information from the employer. We show that in an imperfect information context, flexible workers obtain positive information rent; thus, they have an incentive to hide this information. If the firm pays for the upskilling, the information about the type is common knowledge, and this involves a different (zero surplus) compensation policy.

3.1 Optimal contracts under firm-financed training

The firm may choose to pay for the upskilling program by offering, at the outset of the game, education vouchers of an amount b (to be decided optimally by the firm) to any employee who applies for the programme. Rather than enrolling all employees in one-size-fits-all classes, a voucher-based policy is highly recommended under the plausible assumption that the employee knows better than the firm what are his/her missing skills.

In this case, managers know who has applied for the program, so the information about the type of employee is no longer private to the employee. The company will be able to perfectly discriminate, i.e., to offer to upskilling voucher applicants the contract $(q^H, r^H = e_1)$ and to offer non-applicants the contract $(q^L, r^L = e_1)$. These compensations fulfill the participation constraints of employees (with no surplus for any of them).

Workers with a learning cost $c > b$ will not undertake the upskilling program.[9] Two variants can be considered: (1) the worker spends the minimum amount he/she needs to upskill, or (2) the worker uses the full amount of the voucher.

Variant 1.

If employees adopt a minimum effort strategy, then employees with a cost of upskilling $c < b$ will use no more than c (so c is the actual cost incurred by the firm for that employee).

Denoting with α the share of the workers who decide to upskill, the profit for the firm is:

$$\begin{aligned}\pi &= \alpha(v^H - e_1) + (1-\alpha)(v^L - e_1) - \frac{1}{\bar{c}}\int_0^b cdc \\ &= (v^L - e_1) + \alpha(v^H - v^L) - \frac{1}{\bar{c}}\int_0^b cdc \qquad (5)\end{aligned}$$

However, $\alpha = \frac{b}{\bar{c}}$, and $\frac{1}{\bar{c}}\int_0^b cdc = \frac{1}{2\bar{c}}b^2$. The profit is:

$$\pi = (v^L - e_1) + \frac{b}{\bar{c}}(v^H - v^L) - \frac{1}{2\bar{c}}b^2 \qquad (6)$$

The first-order condition allows us to obtain the optimal amount of the voucher:

$$\hat{b} = (v^H - v^L) \qquad (7)$$

If $\bar{c} > (v^H - v^L)$ (the condition in the assumption section), the optimal proportion of f-types is:

$$\hat{\alpha} = \frac{(v^H - v^L)}{\bar{c}} < 1 \qquad (8)$$

Leading to maximum profit:

$$\hat{\pi} = (v^L - e_1) + \frac{1}{2\bar{c}}(v^H - v^L)^2. \qquad (9)$$

Variant 2.

[9] If they train themselves, they will receive a complex project that requires effort $e_2 > e_1$ (thus, they incur a loss).

As an alternative assumption, we consider that employees with $c < b$ will use the full amount of the voucher, b, on a principle that investment in human capital is always good; in this case, too, those with an learning (upskilling) cost $c > b$ do not train. The profit function is:

$$\begin{aligned} \tilde{\pi} &= (v^L - e_1) + \alpha(v^H - v^L) - \alpha b \\ &= (v^L - e_1) + \frac{b}{\bar{c}}(v^H - v^L) - \frac{1}{\bar{c}} b^2 \end{aligned} \tag{10}$$

The FOC allows us to determine the optimal amount of the voucher, $\tilde{b} = \frac{(v^H - v^L)}{2}$. The equilibrium profit is:

$$\tilde{\pi} = (v^L - e_1) + \frac{1}{4\bar{c}}(v^H - v^L)^2. \tag{11}$$

We can verify that $\tilde{\pi} < \hat{\pi}$.

We now turn to the polar education strategy in which the firm lets workers invest in upskilling.

3.2 Optimal contracts under employee self-financed training

In this context, the sequence of decisions is as follows. At the outset of the game, the firm posts a menu of contracts. Then, employees chose whether to pay the cost of upskilling or not. They then choose the preferred contract from the menu offered by the firm.

If employees undertake the upskilling program on their own, the information about their type is private information to them. Because the firm does not know which worker is of the flexible type, it must offer a menu of bundles (r^H, q^H) and (r^L, q^L) that prompts workers to self-select: all f workers choose complex projects q^H and are paid r^H, and all s workers choose simple projects q^L and are paid r^L. The research question (and a managerial one) is how to determine r^H and r^L to achieve this goal.

In the equilibrium with self-selection, the participation constraints (equations 3 and 4) become:

$$(PC_f) \qquad r^H \geq e_f^H = e_1 \tag{12}$$

$$(PC_s) \qquad r^L \geq e_s^L = e_1 \tag{13}$$

since the execution effort of the $f - type$ worker who takes the H project is e_1, and the effort of the $s - type$ worker who undertakes a L project is also e_1.

If the firm sets the compensation to the minimum levels that satisfy the PCs, $r^H = r^L = e_1$, $s - type$ workers would take the $L - project$, and obtain a zero surplus. They would never chose a q^H project, since $U_s = r^H - e_1 = (e_1 - e_2) < 0$. However, the $f - type$ workers have no incentive to take the H project, but they have an incentive to take the L project, as they obtain utility $U_f = r^L - e_0 = (e_1 - e_0) > 0$. Any contract tailored for them should provide them with at least this lowest rent.

To ensure that each worker selects a contract tailored for his/ her type of employee, and rejects a contract tailored for the other type of employee, we need to take into account the incentive compatibility (IC) constraints (Bolton and Dewatripont, 2005; Salanié, 2005; Laffont and Martimort, 2009):

$$(IC_f) \qquad U_f(r^H, q^H) \quad > \quad U_f(r^L, q^L) \tag{14}$$

$$(IC_s) \qquad U_s(r^H, q^H) \quad < \quad U_s(r^L, q^L) \tag{15}$$

or:

$$(IC_f) \qquad r^H - e_f^H \quad \geq \quad r^L - e_f^L \Leftrightarrow r^H - r^L \geq e_1 - e_0 \tag{16}$$

$$(IC_s) \qquad r^L - e_s^L \quad \geq \quad r^H - e_s^H \Leftrightarrow r^H - r^L \leq e_2 - e_1 \tag{17}$$

The saturated PC for $s - type$ workers requires $r^L = e_1$. Thus, the two IC conditions can be written:

$$(IC_f) \qquad r^H \quad \geq \quad 2e_1 - e_0. \tag{18}$$

$$(IC_s) \qquad r^H \quad \leq \quad e_2 \tag{19}$$

The firm profit maximization problem with employee self-training has a solution if:

$$(2e_1 - e_0) \leq r^H \leq e_2 \tag{20}$$

which requires the necessary condition for the existence of the separating contracts:

$$2e_1 - e_0 < e_2 \Leftrightarrow (e_1 - e_0) < (e_2 - e_1). \quad (21)$$

We assume this condition to be fulfilled in the following. The optimal bundles are (q^L, r^L) and (q^H, r^H) with compensations defined as:

$$r^L = e_1 \quad (22)$$

$$r^H \in [(2e_1 - e_0); e_2] \quad (23)$$

This is an important result, *under self-training, upskilling brings a positive informational rent* $\left(r^H - e_1\right) \geq (e_1 - e_0) > 0$ *to employees who choose the upskilling strategy.*

Why would a firm pay an f-worker more than the compensation that saturates IC1, $r^H = (2e_1 - e_0)$? *By paying more than the minimum required for self-selection, it might prompt more workers to invest in upskilling* (workers with a higher learning cost would have an incentive to incur it) and then undertake the high-value project.

We have assumed that the cost of upskilling c is uniformly distributed on $[0, \bar{c}]$ and is paid by the worker. Obviously, all workers with a learning cost $c < \left(r^H - e_1\right)$ have an incentive to invest in learning.

We denoted with α the share of employees who choose to invest in upspkilling. Under the assumption of a uniformly distributed c, its explicit form is:

$$\alpha^* = \frac{1}{\bar{c}}\left(r^H - e_1\right). \quad (24)$$

The profit can be written as a function of r^H:

$$\begin{aligned} \pi(r^H) &= \alpha v^H + (1-\alpha)v^L - \alpha r^H - (1-\alpha)r^L \\ &= \left(v^L - e_1\right) + \alpha\left[\left(v^H - v^L\right) - \left(r^H - e_1\right)\right] \\ &= \left(v^L - e_1\right) + \frac{1}{\bar{c}}\left(r^H - e_1\right)\left[\left(v^H - v^L\right) - \left(r^H - e_1\right)\right]. \end{aligned} \quad (25)$$

If no worker follows the upskilling strategy, the profit is $\left(v^L - e_1\right)$. Obviously, an equilibrium with self-training in which the firm offers the (q^H, r^H) contract and $\alpha > 0$ workers pay the cost of upskilling is possible only if: $\left(r^H - e_1\right) < \left(v^H - v^L\right)$. But the highest compensation is $r^H = e_2$. This entails as a necessary condition for this equilibrium: $(e_2 - e_1) < \left(v^H - v^L\right)$.

The FOC indicates as the first-best optimal r^H:

$$r^H = e_1 + \frac{\left(v^H - v^L\right)}{2} \Leftrightarrow \left(r^H - e_1\right) = \frac{\left(v^H - v^L\right)}{2} \tag{26}$$

However, it must be verified that this first-best compensation fulfills the two ICs (equations 18 and 19), otherwise the effective compensation is a corner solution as indicated by the saturated constraint.

$$\begin{aligned} (IC_f) \qquad r^H - e_1 &= \frac{\left(v^H - v^L\right)}{2} \geq (e_1 - e_0) &(27)\\ (IC_s) \qquad r^H - e_1 &= \frac{\left(v^H - v^L\right)}{2} \leq (e_2 - e_1). &(28)\end{aligned}$$

Three cases can be taken into account, depending on the parameters of the problem. In the first case, IC_s is not binding, yet IC_f is binding (thus the f-employee receives the lowest compensation $r^H = 2e_1 - e_0$); in the second case, none of the two IC constraints is binding thus the first-best optimum prevails; the later case is the situation in which IC_s is binding, thus the employee receives the highest possible compensation in this problem $r^H = e_2$ (for a higher compensation, $s-$employees would accept the H project).

The optimal compensations (in their implicit form $r^H - e_1$) are:

$$r^H - e_1 = \begin{cases} (e_1 - e_0) & \text{if } \frac{\left(v^H - v^L\right)}{2} < (e_1 - e_0) & IC_f \text{ saturated, } IC_s \text{ non-saturated} \\ \frac{\left(v^H - v^L\right)}{2} & \text{if } (e_1 - e_0) \leq \frac{\left(v^H - v^L\right)}{2} \leq (e_2 - e_1) & IC_f \text{ and } IC_s \text{ non-saturated} \\ (e_2 - e_1) & \text{if } \frac{\left(v^H - v^L\right)}{2} > (e_2 - e_1) & IC_s \text{ saturated, } \ IC_f \text{ non-saturated} \end{cases} \tag{29}$$

Leading to the case-specific optimal profits:

$$\begin{aligned} &\pi^*_{ICf} = \left(v^L - e_1\right) + \tfrac{1}{\bar{c}}\left(e_1 - e_0\right)\left[\left(v^H - v^L\right) - \left(e_1 - e_0\right)\right] && \text{if } \tfrac{\left(v^H - v^L\right)}{2} < (e_1 - e_0) \\ &\pi^*_{FB} = \left(v^L - e_1\right) + \tfrac{1}{4\bar{c}}\left(v^H - v^L\right)^2 && \text{if } (e_1 - e_0) \leq \tfrac{\left(v^H - v^L\right)}{2} \leq (e_2 - e_1) \\ &\pi^*_{ICs} = \left(v^L - e_1\right) + \tfrac{1}{\bar{c}}\left(e_2 - e_1\right)\left[\left(v^H - v^L\right) - \left(e_2 - e_1\right)\right] && \text{if } \tfrac{\left(v^H - v^L\right)}{2} > (e_2 - e_1) \end{aligned} \tag{30}$$

It can be easily verified that the first-best optimal profit, as obtained when the two incentive compatibility constraints do not bind, corresponds to the highest profit in the self-training scenario:

$$\pi^*_{FB} > \max\{\pi^*_{ICf}, \pi^*_{ICs}\}$$

We can check that $\pi^*_{ICs} > \pi^*_{ICf}$ if $\left(v^H - v^L\right) > (e_2 - e_0)$ and vice-versa.

3.3 Best upskilling strategy

We have determined the profits of the firm in four configurations: two for the scenario in which the firm pays the bill for upskilling by offering an education voucher and two for the scenario in which workers pay the bill.

In the former scenario, we have shown that the highest profit is obtained when employees use only the minimum required amount to cover the learning cost c. A lowest profit obtains if they use the full amount of the education voucher, b.

If the employees are allowed to self-train, the highest profit is obtained in the specific configuration $(e_1 - e_0) \leq \frac{\left(v^H - v^L\right)}{2} \leq (e_2 - e_1)$ in which the two incentive compatibility constraints are not binding. If the ICs are binding, the profits are necessarily lower.

Proposition 1 *The profit when the firm offers training through a voucher and workers use the full amount of the voucher is identical to the profit when the firm lets workers self-train and the incentive compatibility constraints do not bind.*

Proof. Compare profit $\tilde{\pi}$ (Eq. 11) to profit π^*_{FB} (Eq. 30). ∎

Corollary 2 *The firm obtains the highest profit if it delivers a voucher for upskilling and employees spend only the minimum required to cover the learning (upskilling) cost*

Proof. Compare profit $\tilde{\pi}$ (Eq. 11) to profit $\hat{\pi}$ (Eq. 9) ∎

In practice there is likely significant uncertainty about the parameters of the problem $(v^H, v^L, e_0, e_1, e_2)$ and the way employees use vouchers. Because the strategy of self-training is weakly dominated, it is in the interest of the firm to opt for the strategy of directly investing in upskilling.

However, workers with a relatively low learning cost c, would obtain a positive net benefit $(r^H - e_1 - c)$ in the scenario where they pay for upskilling from their own pocket.

3.4 An extension: public subsidies for upskilling

In many countries, governments providing support for employee upskilling. Let us assume that the government provides a subsidy z for each worker undertaking an upskilling program. We consider the two cases: when the firm pays and when the employees pay the learning cost.

In the first scenario, as before, the firm delivers a voucher b for workers to upskill, but now also receives a subsidy $z < b$ for each worker trained.

We consider only the case where employees use the full amount of the voucher. The profit function is:

$$\begin{aligned} \tilde{\pi} &= (v^L - e_1) + \alpha(v^H - v^L) - \\ &= (v^L - e_1) + \frac{b}{\bar{c}}(v^H - v^L) - \frac{1}{\bar{c}}b(b-z) \end{aligned} \tag{31}$$

The FOC allows us to determine the optimal amount of the voucher $\tilde{b} = \frac{(v^H - v^L + z)}{2}$ and the number of workers who upskill $\tilde{\alpha} = \frac{1}{2\bar{c}}(v^H - v^L + z)$.

The equilibrium profit is now:

$$\begin{aligned} \tilde{\pi} &= (v^L - e_1) + \frac{(v^H - v^L + z)}{2\bar{c}}(v^H - v^L) - \frac{(v^H - v^L + z)}{2c}\left[\frac{(v^H - v^L + z)}{2} - z\right] \\ &= (v^L - e_1) + \frac{(v^H - v^L + z)^2}{4\bar{c}} \end{aligned} \tag{32}$$

In the second scenario, employees pay for upskilling. The government provides them with a subsidy z when they pay for an upskilling program. Those with a learning cost $c < \left(r^H - e_1 + z\right)$ will upskill; thus $\alpha = \frac{1}{\bar{c}}\left(r^H + z - e_1\right)$.

The firm profit is

$$\pi = \left(v^L - e_1\right) + \frac{1}{\bar{c}}\left(r^H + z - e_1\right)\left[\left(v^H - v^L\right) - \left(r^H - e_1\right)\right] \tag{33}$$

The FOC allows us to determine the optimal compensation:

$$\left(r^H - e_1\right) = \frac{v^H - v^L - z}{2} \tag{34}$$

The optimal compensation decreases with the subsidy z. We assume that IC2 is not binding, i.e., $\frac{v^H - v^L - z}{2} < (e_2 - e_1)$ (this is the case in which the profit is the highest). The profit is:

$$\pi^* = \left(v^L - e_1\right) + \frac{1}{\bar{c}}\left(\frac{v^H - v^L - z}{2} + z\right)\left[\left(v^H - v^L\right) - \frac{v^H - v^L - z}{2}\right] \tag{35}$$

$$= \left(v^L - e_1\right) + \frac{1}{4\bar{c}}\left(v^H - v^L + z\right)^2 \tag{36}$$

It turns out that the subsidy is policy neutral in that it does not provide an advantage to any of the two education policies (firm-financed upskilling or employee financed upskilling). Indeed, the two profits are equal.

However, if IC2 is binding, self-financed upskilling is not an option (the profit would be lower). We can remark that a large subsidy z can help desaturate IC2, thus rasing profits in the self-financed scheme, to the point where the firm is indifferent between self- training and financing the upskilling program.

4 Conclusion

Many surveys, as presented in the Introduction, have revealed that a shortage of skills is one essential factor limiting firm development all over the world. In the nineties, the Internet revolution tremendously changed the nature of work, placing substantial value on computer literacy. In the wake of the Covid-19 crisis, the massive and unexpected need for reducing direct work contacts and increasing physical and social distance brought about important changes in the organization of work. Distance work and distance learning draw heavily on new competencies, both technical and psychological, from online endurance to online communication talent. In the waves of massive adaptation of competencies to the new needs of firms, employees appear to be heterogeneous, with substantial variability in their ability to learn and adapt to the new work requirements. The process through which workers raise their human capital to align their skills to new needs has been referred to as upskilling.

Traditionally the learning cost of upskilling is paid by both firms, which set up specific programs, and employees, who train themselves in their free time. Currently, the development of online education is giving new momentum to the self-improvement strategy. This paper has addressed one important managerial question: Should employee or companies bear the cost of upskilling?

To address this question, this paper has developed a theoretical framework inspired by traditional contract theory. The analysis has revealed the complex compensation structure a firm must use to achieve worker self-selection when their skills are private information to them. As an original element of this analysis, the frequency of employees who decide to incur the upskilling cost is endogenous.

We have shown that in an uncertain environment it is in the interest of a firm to pay for employee upskilling. Specifically, if employees use the full amount of the education voucher provided by the firm, then the profit would be equal to the highest profit that the firm could achieve by letting employees self-train. If employees use only the amount needed to improve their skills, the firm will make a higher profit. On the other hand, we have shown that it is in the interest of the most flexible employees to pay for upskilling and keep this information private.

The conflict of interest between a firm and its flexible employees can create tensions with respect to this important policy. Companies that can overcome these tensions and rapidly move toward an ambitious upskilling policy might benefit from an important competitive advantage.

References

Acemoglu, Daron, and Pascual Restrepo. 2019. Automation and new tasks: how technology displaces and reinstates labor, *Journal of Economic Perspectives* 33.2: 3-30.

Agrawal, Sapana, Aaron De Smet, Sébastien Lacroix, and Angelika Reich, 2020. To emerge stronger from the COVID-19 crisis, companies should start reskilling their workforces now. *Mackinsey article*, Online, May 7.

Benson, George S., David Finegold, and Susan Albers Mohrman, 2004. You paid for the skills, now keep them: Tuition reimbursement and voluntary turnover, *Academy of Management Journal* 47.3: 315-331.

Bolton, Patrick, and Mathias Dewatripont, 2005. *Contract Theory.* MIT Press.

Brynjolfsson, E., Horton, J. J., Ozimek, A., Rock, D., Sharma, G., & TuYe, H. Y., 2020. COVID-19 and remote work: an early look at US data. NBER WP27344. *National Bureau of Economic Research.*

Cappelli, P. & Rogovsky, N. 1994. New work systems and skill requirements, *International Labour Review*, 133, 2: 205-220

Cohen, Mark A., 2019. Upskilling: Why it might be the most important word in the legal lexicon, *Forbes*, Sept 3.

Dietz, Daniel, and Thomas Zwick, 2020. The retention effect of training: Portability, visibility, and credibility, *The International Journal of Human Resource Management*: 1-32.

Gordon, Robert J. 2000. Does the "new economy" measure up to the great inventions of the past?. *Journal of Economic Perspectives* 14.4: 49-74.

Gordon, Robert J. 2012. Is US economic growth over? Faltering innovation confronts the six headwinds, NBER WP18315, *National Bureau of Economic Research.*

Grand-Clement, S., Devaux, A., Belanger, J., & Manville, C. 2017. *Digital Learning.* Santa Monica, CA: RAND corporation and Corsham institute.

Jackman, Robert, 2020. *Learning Speeds and Labor Market Adjustments*, ProQuest Dissertations Publishing Nr. 27958728, University of Chicago.

Jeremy, Lise and Fabien Postel-Vinay, 2020. Multidimensional skills, sorting, and human capital accumulation, *American Economic Review*, 110, 8.

Laffont, Jean-Jacques, and David Martimort, 2009. *The Theory of Incentives: The Principal-Agent Model.* Princeton University Press.

Leigh, Duane E., and Kirk D. Gifford, 1999. Workplace transformation and worker upskilling: the perspective of individual workers. *Industrial Relations*, 38, 2: 174-191.

Manchester, Colleen F., 2010. Investment in general human capital and turnover intention, *American Economic Review* 100.2: 209-13.

Manchester, Colleen F., 2012. General human capital and employee mobility: How tuition reimbursement increases retention through sorting and participation. *Intranational Labor Relations Review,* 65(4), 951-974.

Modestino, Alicia Sasser, Daniel Shoag, and Joshua Ballance, 2019. Upskilling: do employers demand greater skill when workers are plentiful? *Review of Economics and Statistics*: 1-46.

Salanié, Bernard, 2005. *The Economics of Contracts: A Primer.* MIT Press.

ESSEC Business School
3 avenue Bernard-Hirsch
CS 50105 Cergy
95021 Cergy-Pontoise Cedex
France
Tel. +33 (0)1 34 43 30 00
www.essec.edu

ESSEC Executive Education
CNIT BP 230
92053 Paris-La Défense
France
Tel. +33 (0)1 46 92 49 00
www.executive-education.essec.edu

ESSEC Asia-Pacific
5 Nepal Park
Singapore 139408
Tel. +65 6884 9780
www.essec.edu/asia

ESSEC | CPE Registration number 200511927D
Period of registration: 30 June 2017 - 29 June 2023
Committee of Private Education (CPE) is part of SkillsFuture Singapore (SSG)

ESSEC Africa
Plage des Nations - Golf City
Route de Kénitra - Sidi Bouknadel (Rabat-Salé)
Morocco
Tel. +212 (0)5 37 82 40 00
www.essec.edu

CONTACT:

RESEARCH CENTER

research@essec.edu