

Delegation, Skills Acquisition and the Exit Risk

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In this paper we examine the optimal degree of delegation that the principal should offer to the agent, considering that delegation permits, on the one hand, to use fully the agent's ability and knowledge, but, on the other hand, allowing the agent to acquire general skills increases the risk of exit and, therefore, implies greater turnover costs for the organization. We focus on the relationship between delegation of tasks to the agent and his process of on-the-job learning, which, increasing the agent's outside option influences the probability of exit deriving from stochastic shocks hitting external opportunities. We show that these effects reduce the degree of delegation that the principal chooses to give to the agent. Moreover, it results that the optimal degree of delegation is decreasing in the principal's abilities and increasing in the agent's abilities and in the degree of specificity of acquired skills.

In questo lavoro si esamina il grado ottimale di delega che il principale concede agli agenti, considerando che la concessione di delega consente, da un lato, di sfruttare appieno il contributo lavorativo degli agenti ma, d'altra parte, può comportare un rischio di uscita di questi ultimi e, quindi, maggiori costi di turnover per l'organizzazione.

Nel lavoro viene delineato un legame tra grado di autonomia concessa al lavoratore e acquisizione di skill. La delega favorisce la formazione di capitale umano che può essere utilizzato dall'agente anche all'esterno dell'impresa. Ciò influenza l'outside option del lavoratore accrescendo il suo potere contrattuale nonché la probabilità di uscita in seguito a shock stocastici sulle opportunità esterne. Tali effetti riducono la convenienza del principale a concedere delega agli agenti. Nel paper si mostra, inoltre, come il grado di delega prescelto dal principale dipende dalle abilità del principale e da quelle dell'agente, dal grado di specificità dell'attività svolta dall'impresa e dalla varianza degli shock.

1. Introduction

A growing economic literature analysis how the allocation of decisional rights among agents influences the use of local information and the effort provided by agents in implementing new projects. According to Aghion and Tirole (1997), the delegation of authority to employees, allowing them to pursue, in some measure, their private interests, increases their effort in the activity of information searching about projects that might be successfully implemented by the firm. Aoki (1986) and Prendergast (2001) stress the fact that the delegation of decisional power to employees improves the use of local information, while, focusing on incentives, Zabojnik (2002), shows that the delegation of authority to employees can be profitable for the firm also when workers do not have any advantage in terms of available information.

Other papers show that the firm organizational structure is strictly related to the workforce skills. Soskice (1993) argues that with complex economic systems workers are able to undertake decisions only if sufficiently educated and able to understand and process all the relevant information. Caroli, Greenan and Guellec (2001) examine the efficiency of different organizational structures taking into account the effects of increased supply of skilled workers in the labour market.

In this paper we focus on the relationship between organizational structure and human capital accumulation, arguing that delegating discretion to employees leads to the acquisition of new skills and knowledge that they would not have acquired in absence of delegation.¹ In a similar thread of thought, Prendergast (1995) considers that on the job learning is related to the number of tasks assigned to the worker. We assume that the worker is endowed with a certain level of human capital that becomes productive only when he accumulates experience working and deciding autonomously, while when the decisional power is in the principal's hands, the agent does not accumulate new skills and his effort results in some way complementary to the principal's direction and coordination activity.

Since through delegation workers become able to self-organize their activity, they acquire skills which are useful also outside the firm. As suggested by Lazear (1998) "In the process of giving workers power, the firm also give workers the ability to extract a larger share of the pie". We argue that workers with higher discretionality increase their bargaining power, as they become able to acquire more general skills and develop ideas that can be implemented also in other firms. However, if compensation is established at the beginning of the employment relationship and is not renegotiable by parties when outside options are revealed, the principal in

¹ Delegation may foster employees' experimental learning. For example, an employee in the sale department may be delegated the right to make improvements on the sale material, change what is displayed in the firm's show room and thereby discover new sale concepts and methods.

deciding the organizational structure has to take into account the risk of exit, since a higher outside option increases the agent's probability of exit.

A similar view is presented by Rajan and Zingales (2001), who define authority as the access to the key resource at the basis of the production process and examine the organizational structure in relationship to the risk of expropriating that resource, often consisting in ideas, knowledge and customers: "Managers may steal the idea, walk away with clients, or mimic the entrepreneur's management style, and start up a rival concern. The greater the access a manager has, the more he can appropriate, and the more effectively he can compete" (Rajan and Zingales, 2001, p. 805). Two different type of organisational structures are considered: in the first type, a horizontal hierarchical system, the entrepreneur directly interacts with all his employees, while in the second, a vertical hierarchical system, only a manager directly interacts with the entrepreneur and the others interact with this manager who have access to the critical resource. They show that in the vertical system, since workers have access to the critical resource and are also able to obtain the cooperation of their subordinates, the risk of expropriation is higher compared to the horizontal system. On the other hand, in the horizontal system workers may have weak incentives to invest in order to result productive in the firm.

In this paper, we consider a similar trade-off: allowing delegation to subordinates increases their contribution in the production process, but determines higher turnover costs. We assume that delegation is a continuous variable and involves different aspects, such as the workers' possibility to allocate their time and resources to search for new ideas, the possibility to have fully access to the information necessary to make appropriate judgments, the possibility to decide without the principal's supervision. We show that the optimal level of delegation is defined taking into account the negative effect (from the principal's point of view) on the worker's outside-option and, as a consequence, on his probability of exit. In fact, on the one hand, through delegation, the principal and the agent's productivities are appropriately combined, while, on the other hand, delegation, thanks to the acquisition of general skills, increases the agent's outside option, implying higher expected turnover costs for the organization. It results that the optimal level of delegation is influenced by the principal's and the agent's skills, by the specificity of the human capital acquired during the production process and by the variance of the stochastic variable affecting outside options and by the wage level paid to the agent.

The paper is organized in the following way. In the second Section we discuss the related literature. Section three defines the optimal level of delegation without turnover costs and Section four considers the influence of the risk of exit on the decisional power given to the agent. Section five concludes.

1. Related literature

The alternative between a decentralized organizational structure, with delegation of decisional power, and a centralized system has been considered in a number of papers as a trade-off between the optimal use of information available to subordinates directly involved in the production process and the opportunity of coordination and control allowed by the activity of superiors (Sah and Stiglitz, 1986; Radner, 1993; Van Zand, 1988; Bolton and Dewatripont, 1994; Garicano, 2001). This approach is usually based on convergent objectives among participants in the organization. However, more recently, these aspects have been analyzed considering that the agent may pursue private interests and that the allocation of decisional rights may affect the resolution of incentive problems (Aghion and Tirole 1997; Prendergast, 2002).

The first approach especially considers the role of communication and coordination problems, and examines the choice of the optimal organizational structure taking into account the costs of acquisition, processing and communication of information, delays and errors in decision making and advantages from specialization. For example, Aoki (1986) compares different organizational structures considering imperfect information and imperfect communication processes between the principal and the agent and shows that delegating decisional power to agents allows a better use of local information. Sah and Stiglitz focus on the trade-off between Type-I (refusing good projects) and Type-II (accepting bad projects) errors in decision making, pointing out that delegation has a comparative advantage in avoiding Type-I errors.

The second approach is based on agency problems and considers how the delegation of authority to the agent, allowing him to choose projects that maximize his private benefits, enhances his effort in the acquisition of information concerning projects to be implemented, determining, however, a cost in terms of loss of control, since the implemented projects do not maximize the principal's pay-off (Aghion and Tirole, 1997).

According to other authors the prevailing organizational structure is strictly related to the skill's of the labour force. Soskice (1993) and Ryan (1994) argue that only when workers are endowed with sufficiently high skills it is possible to give them decisional power, since only in this case they will be able to make adequate decisions. In a similar way, Caroli, Greenan and Guellec (2001) point out that an increase in the supply of skilled workers, determining a reduction of their wages, induces the firm to assign to skilled employees both manual and creative tasks leading to an horizontal organizational system.

Only few works consider, however, that the workers' skills may be influenced by the degree of autonomy they have in the production process. Workers who can autonomously decide and execute many tasks are also likely to learn new skills. Autonomy allows workers to use their knowledge and build new competencies, while executing supervisor's direction does not permit to develop new skills and abilities.

Prendergast (1995) considers this process of human capital accumulation in relation to the number of tasks assigned to the workers. He shows that a too low number of tasks is attributed to the subordinates: assignment is decided by the manager, who tends to reserve to himself an inefficiently high number of tasks. Similarly, in this paper we consider the relationship between organizational structure and accumulation of human capital, but we focus on the risk of exit of the agent.

The relevance of this kind of problem has been considered by Rajan and Zingales (2001), who examine the choice of the organizational structure as the attempt of entrepreneur to protect the source of organizational rents against the risk of expropriation by the employees who have access to them. In their model, hierarchies are more prone to expropriation because the subordinates, who made investment specific to their superiors, tend to leave the firm, following the managers. In this way, more hierarchical structure prevail in physical-capital-intensive industries (where expropriation is more difficult), while horizontal systems predominate in industries based on human capital or ideas.

3. The optimal degree of delegation (no risk of exit)

We consider an economic relationship in which a principal (she) hires an agent (he) to exert effort in the production of a good or a service. Both the principal and the agent actively work in the firm.

The aim of this Section is to analyze the optimal delegation that the principal should give to the agent.

We suppose that the degree of delegation the principal concedes to her agent is a continuous variable, d , $0 \leq d \leq 1$, where $d = 0$ implies that the agent has no autonomy and all the relevant decisions are taken by the principal, while $d = 1$ means that the agent has full autonomy and the principal's contribution to production is irrelevant. The assumption of a continuous variable d is a simplification useful to apply optimization analysis.

A similar approach is adopted in Prendergast (1995), in which the degree of delegation is measured as the number of tasks (continuous variable) attributed to the agent.

We use the following simple production function:

$$[1] \quad y = [d^a q_A + (1-d)q_P] e$$

where y is the value of production obtained in the relationship, e is the effort provided by the agent, q_A and q_P represent respectively the (exogenous) productivities or abilities of the agent and the principal, a is a parameter ($a < 1$). The production function shows that the firm's productivity is determined by both the productivity of the principal and the agent according to the degree of delegation: the influence of the agent increases with d . A higher delegation allows to use more the agent's contribution, while the principal's influence is diminished.

However, since $\mathbf{a} < 1$, delegation is characterized by decreasing marginal returns: as the agent becomes overloaded with tasks, his relative productivity grows at a decreasing rate.

This is a general scheme that allows us to take into account different organizational structures. In fact, it considers a trade-off that usually emerges in the choice of the organizational form, in which more hierarchical systems have an advantage in terms of coordination and control, while more decentralized structures are characterized by a better use of the agent's information and skills. For example, a higher degree of delegation permits the agent to use fully his private knowledge but, on the other hand, implies that the principal's information is neglected or his coordination activity remains unexploited.

We suppose that the agent exerts effort, sustaining a cost given by the following function: $\frac{g^2}{2}$. For the sake of simplicity, the principal's effort is exogenously given and included in the parameter \mathbf{q}_p .

The total surplus created in the agency relationship is equal to:

$$[2] \quad S = [d^a \mathbf{q}_A + (1-d)\mathbf{q}_p]e - \frac{g^2}{2}$$

The optimal (first best) level of delegation is obtained by differentiating S with respect to d :

$$[3] \quad \frac{\partial S}{\partial d} = [\mathbf{a}d^{a-1}\mathbf{q}_A - \mathbf{q}_p]e = 0$$

from which:

$$[4] \quad d^* = \left[\frac{\mathbf{a}\mathbf{q}_A}{\mathbf{q}_p} \right]^{\frac{1}{1-a}}$$

It is possible to see that the optimal level of delegation depends positively on the agent's productivity \mathbf{q}_A and diminishes when the principal's productivity \mathbf{q}_p increases. Clearly if

$$\left[\frac{\mathbf{a}\mathbf{q}_A}{\mathbf{q}_p} \right]^{\frac{1}{1-a}} > 1, \text{ then full delegation is assigned to the agent and } d^* = 1.^2$$

In this context, the same decision would emerge if the optimal degree of delegation is decided by the firm in order to maximize its profits.

The optimal level of effort is determined through the following FOC:

² The effect of \mathbf{a} on d is ambiguous: d increases in \mathbf{a} for low values of \mathbf{a} and viceversa:

$$\frac{\partial d}{\partial \mathbf{a}} = \left[\frac{\mathbf{a}\mathbf{q}_A}{\mathbf{q}_p} \right]^{\frac{1}{1-a}} \left\{ \frac{1}{(1-\mathbf{a})^2} \log \left[\frac{\mathbf{a}\mathbf{q}_A}{\mathbf{q}_p} \right] + \frac{1}{(1-\mathbf{a})\mathbf{a}} \right\}$$

$$[5] \quad \frac{\partial S}{\partial e} = [d^a \mathbf{q}_A + (1-d)\mathbf{q}_P] - \mathbf{g}e = 0$$

from which:

$$[6] \quad e^* = \frac{[d^a \mathbf{q}_A + (1-d)\mathbf{q}_P]}{\mathbf{g}}$$

The level of productivity of the firm (which in turn depends on the level of delegation) influences positively the agent's effort.

4. The degree of delegation in the presence of agent's exit risk

In this Section, we consider that delegation allows the agent to acquire, through on-the-job learning, new skills which allows him to autonomously undertake a productive activity, without the help of the principal. Our approach is similar to that followed by Rajan and Zingales (2001) and Prendergast (1995). Rajan and Zingales (2001) assume that the agent, by working in contact with the principal, obtains access to her unique idea, technology or organization, and consider the risk that he expropriates these resources by exiting from the firm and working on his own.³ Prendergast (1995) considers the degree of delegation as the (continuous) number of tasks carried out by the agent, which increases his future productivity.

In our framework, the worker's outside option strictly depends on the degree of delegation he obtains in the firm currently employing him. Specifically, we assume that the worker's outside option, s , is given by:

$$[7] \quad s = (x\mathbf{q}_A d^a + \mathbf{e})e$$

where x represents the degree of specificity of skills acquired inside the firm. With firm specific human capital $x < 1$, while if $x = 1$ implies that human capital is completely general.⁴ The degree of specificity is also related to the possibility of implementing a similar production process outside the firm, and therefore specificity results higher also if in the intensity of physical capital or if other resources available only in the firm are complementary to agent's activity. This means that even if the worker is able to produce autonomously outside the firm, it will obtain a result that is strictly related to the type of human capital acquired through learning-by-doing in the current firm. We assume that the worker's outside option is influenced by a stochastic variable \mathbf{e} which is distributed uniformly on the interval $[-k, +k]$.

³ "Bhide (2000) reports that 71% of the firms included in the Inc 500 were founded by people who replicated or modified an idea encountered in their previous employment"

⁴ It might also be the case of $s > 1$, when the acquired skills are more productively used in external firms.

The wage the principal pays to the agent is negotiated at the beginning of the relationship and no renegotiation can occur afterward. The wage is an increasing (linear) function of the production obtained in the relationship: $w = \mathbf{b}y$, where \mathbf{b} is fixed.

The agent decides to stay with the current firm whenever the remuneration he obtains is higher than his outside option. Since the wage cannot be renegotiated, the worker decides to leave the firms in case of a shock that increases his outside option to a level higher than the wage paid by his current firm.

Formally, the worker stays with the firm employing him when $\mathbf{b}y > s$, that is:

$$[8] \quad \mathbf{b}[d^a \mathbf{q}_A + (1-d)\mathbf{q}_P]e \geq (x d^a \mathbf{q}_A + \mathbf{e})e$$

From expression [8], it is possible to obtain the threshold value z of the variable \mathbf{e} which allows, whenever $\mathbf{e} < z$, the worker to stay with the current firm:

$$[9] \quad \mathbf{e} \leq \mathbf{b}[d^a \mathbf{q}_A + (1-d)\mathbf{q}_P] - x \mathbf{q}_A d^a = z$$

Otherwise, if shocks to external productivity are higher than z , then the agent will find convenient to leave the firm.

As a consequence, since \mathbf{e} is uniformly distributed, with the density probability function given by $f(\mathbf{e}) = 1/2k$, the probability P that the worker remains with the current firm is equal to:

$$[10] \quad P\{\mathbf{e} \leq \mathbf{b}[d^a \mathbf{q}_A + (1-d)\mathbf{q}_P] - x \mathbf{q}_A d^a\} = \int_{-k}^z \frac{1}{2k} d\mathbf{e}$$

that is:

$$[11] \quad P\{\mathbf{e} \leq z\} = \left[\frac{\mathbf{e}}{2k} \right]_{-k}^z = \frac{z+k}{2k} = \frac{\mathbf{b}[d^a \mathbf{q}_A + (1-d)\mathbf{q}_P] - x \mathbf{q}_A d^a + k}{2k}$$

When deciding the degree of delegation to give to the agent, the principal has to take in account that, with probability $1 - P(\mathbf{e} \leq z)$, the agent will leave the firm.

It is important to establish under which conditions the agent's probability of exit is increasing with the degree of delegation. This probability increases as the threshold value z decreases with d :

$$[12] \quad \frac{\partial z}{\partial d} = \mathbf{b}[\mathbf{a} \mathbf{q}_A d^{a-1} - \mathbf{q}_P] - \mathbf{a} x \mathbf{q}_A d^{a-1} < 0$$

or:

$$[13] \quad \frac{\partial z}{\partial d} = (\mathbf{b} - x)\mathbf{a}q_A d^{a-1} - \mathbf{b}q_P < 0$$

A sufficient (but non necessary) condition to obtain that delegation increases the agent's risk of exit is that $\mathbf{b} \leq x$. This implies that the human capital accumulated through delegation in the firm is quite general, rather than specific, or that the proportion of production given as compensation to the agent is small. Moreover, a higher delegation determines a greater risk of exit since the principal's abilities are scarcely utilized, making the relationship less profitable.

Under these conditions, the principal has to reduce the degree of delegation in order to diminish the agent's risk of exit (since this is generally costly to the principal, in terms of turnover costs or in terms of opportunities costs due to resources expropriated by the agent).

Nevertheless, it is useful to notice that under some particular circumstances, $\frac{\partial z}{\partial d}$ could result positive (in case $\mathbf{b} > x$ and q_P small). In this case, since the principal has low abilities, the delegation to the agent could reduce the risk of exit. We neglect this case, since it seems to us less realistic.

The firm's profit function with turnover costs

In order to take into account the negative effects occurring in case the agent decides to leave the firm obtaining his outside option, we assume that whenever the agent chooses to exit (with probability $(1-P)$) the firm has to sustain a turnover costs C . Therefore, the firm's profit function is the following:

$$[14] \quad \Pi = [d^a q_A + (1-d)q_P]e(1-\mathbf{b}) - (1-P)C = [d^a q_A + (1-d)q_P]e(1-\mathbf{b}) - C + PC$$

Without loss of generality, we assume that the turnover costs occur in the next period and that the interest rate is equal to zero. The principal obtains $(1-\mathbf{b})y$ as a profit net of the wage costs.

Substituting in the firm's profit the probability P given by expression [11], we obtain:

$$[15] \quad \Pi = [d^a q_A + (1-d)q_P]e(1-\mathbf{b}) + C \frac{\{\mathbf{b}[d^a q_A + (1-d)q_P] - xq_A d^a\} + k}{2k} - C$$

In this case, the degree of delegation maximizing the firm's profit satisfies the following first order condition:

$$[16] \quad \frac{\partial \Pi}{\partial d} = [\mathbf{a}d^{a-1}q_A - q_P]e(1-\mathbf{b}) + C \frac{[(\mathbf{a}d^{a-1}q_A - q_P)\mathbf{b} - \mathbf{a}xq_A d^{a-1}]}{2k} = 0$$

from which we obtain:

$$[17] \quad d_{EX} = \left\{ \frac{\mathbf{a}q_A}{\mathbf{q}_P} \left[1 - \frac{Cx}{e(1-\mathbf{b})2k + C\mathbf{b}} \right] \right\}^{\frac{1}{1-\mathbf{a}}}$$

This result can be compared to the optimal degree of delegation without risks of exit. It can be shown that the same degree of delegation, $d_{EX} = d^*$, is obtained only when $x = 0$ or $C = 0$, that is, when the skills acquired on-the-job through delegation of tasks are completely specific or when the costs of turnover are null. On the contrary, with $x > 0$ and with positive turnover costs, the risk of exit is relevant and the principal tends to attenuate it by reducing the degree of delegation:⁵

$$d_{EX} < d^*$$

From [17], the degree of delegation is null, $d_{EX} = 0$, in the case of $\left[1 - \frac{Cx}{e(1-\mathbf{b})2k + C\mathbf{b}} \right] < 0$ that is, when $e(1-\mathbf{b})2k < C(x-\mathbf{b})$. This result tends to emerge with high turnover costs C or when the human capital tends to be general ($x \rightarrow 1$).

Similarly to the case in which the agent cannot leave the firm, the degree of delegation is increasing in the agent's ability $\partial d_{EX} / \partial q_A > 0$ and decreasing in the principal's ability $\partial d_{EX} / \partial q_P < 0$. Moreover, the optimal degree of delegation is:

- decreasing as x increases, that is, when the skills are less specific and the risk of exit is greater: $\partial d_{EX} / \partial x < 0$
- decreasing in the turnover costs C : $\frac{\partial d_{EX}}{\partial C} < 0$. In order to reduce an expensive turnover, the principal tends to diminish the decisional power conferred to the agent.
- increasing in the variance of the shock,

$$\frac{\partial d_{EX}}{\partial k} = \frac{1}{1-\mathbf{a}} \left\{ \frac{\mathbf{a}q_A}{\mathbf{q}_P} \left[1 - \frac{Cx}{e(1-\mathbf{b})2k + C\mathbf{b}} \right] \right\}^{\frac{\mathbf{a}}{1-\mathbf{a}}} \frac{\mathbf{a}q_A}{\mathbf{q}_P} \left[\frac{Cxe(1-\mathbf{b})2}{[e(1-\mathbf{b})2k + C\mathbf{b}]^2} \right] > 0$$

- increasing with the level of effort: $\frac{\partial d}{\partial e} > 0$

⁵ Since in this case $\left[\frac{Cx}{e(1-\mathbf{b})2k + C\mathbf{b}} \right] > 0$.

$$\square \quad \frac{\partial d_{EX}}{\partial b} = \frac{1}{1-a} \left\{ \frac{aq_A}{q_P} \left[1 - \frac{Cx}{e(1-b)2k + Cb} \right] \right\}^{1-a} \frac{aq_A}{q_P} \left[\frac{Cx[C - e2k]}{[e(1-b)2k + Cb]^2} \right]. \quad \text{If the}$$

cost of turnover is high, the derivative is positive, implying a higher delegation: since an increase in b reduces the risk of exit, the principal is able to concede more delegation to the agent.

5. Concluding remarks

In this paper we show that the risk of the agent's exit may be strictly related to the degree of delegation allowed to the agent. In fact, a higher delegation, implying for the agent the possibility to acquire new skills which are valuable on the labor market, has a positive effect on the worker's outside option. Under the assumption that no wage renegotiation can occur between principal and agent after the beginning of the relationship (in particular, wage is not adapted to face changing agent's outside option), this implies that delegation may increase the risk of exit and the expected related turnover costs for the organization. We have shown that in this case the degree of delegation allowed to the worker is less than that maximizing the social welfare.

Moreover, from the analysis emerges that, in general, the degree of delegation is an increasing function of the worker's productivity and a decreasing function of the principal's ability. Higher turnover costs reduces delegation, while a high degree of specificity (or complementarity with firm's resources) of human capital increases delegation to the agent.

In a future extension, we consider that delegation increases the agent's bargaining power, leading through a process of wage renegotiation, to a higher wage, without implying risks of exit of the agent when exit is inefficient. In this case, the principal tends to reduce the degree of delegation given to the agent to reduce the future wage she would have to pay him.

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