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# Compensation and Bargaining with Entrpreneurship as the Outside Option

CESifo Working Paper, No. 314

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*Suggested Citation:* Koskela, Erkki; Stenbacka, Rune (2000) : Compensation and Bargaining with Entrpreneurship as the Outside Option, CESifo Working Paper, No. 314, Center for Economic Studies and ifo Institute (CESifo), Munich

This Version is available at:
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CESifo *Working Paper Series*

# COMPENSATION AND BARGAINING WITH ENTREPRENEURSHIP AS THE OUTSIDE OPTION

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Working Paper No. 314

July 2000

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* The authors acknowledge financial support from The Academy of Finland. Stenbacka thanks Stockholm School of Economics for its hospitality.

CESifo *Working Paper No. 314*
*July 2000*

# COMPENSATION AND BARGAINING WITH ENTREPRENEURSHIP AS THE OUTSIDE OPTION

## Abstract

We analyze the impact of entrepreneurship as an outside option on compensation contracts between a principal and an agent with bargaining power. In the first stage the parties bargain over the base wage and the profit share. In the second stage the principal determines the capital investment and the agent decides on effort. It is shown that while negotiated base wage increases in the degree of the competitiveness in the market for outside equity funding, the profit share is invariant both to the imperfections prevailing in the equity market and to the relative bargaining power of the negotiating parties.

Keywords: Wage bargaining, outside option, entrepreneusrship

JEL Classification: J33, J41, J24

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## I. Introduction

Side to side with the strongest bull market ever in the stock markets throughout the western world, we have witnessed a hitherto unexperienced increase, both in an absolute and in a relative sense, in the compensations paid to top executives and key personnel. For example, for the U.S. the main American trades-union federation has estimated that, thanks largely to stock options, the average American chief executive earns 419 times the wage of the average factory worker in 1999. This ratio should be compared to the fact that such an executive made 42 times as much as the average factory worker in 1980. In particular, stock-option programs have grown at a breathtaking pace. The Economist (1999) reports, that the 200 largest American companies granted shares and share options to employees amounting to 2 % of their outstanding equity during the year to June 1998. When added to incentive programs made in previous years, it was estimated that the accumulated value of the incentive schemes alive at the end of 1998 amounted to as much as 13,2 % of corporate equity in these firms. While there has been an increase also in the value of stock options granted to lower-ranking employees, most of the value incorporated in these incentive schemes is concentrated to “mega-options” directed to a fairly small number of top executives.

Many firms, particularly those operating in the dynamic high-tech industries, face an increasingly demanding challenge in how to recruit the most promising human capital or how to keep their key personnel. Partly this might reflect an increasing relative importance of human capital compared with traditional capital investments, an aspect that might very well be exemplified by industries like those of IT-consulting, internet services and e-commerce. These industries also serve as examples of industries where key personnel is offered very lucrative compensation schemes. Partly the intensified battle for talent might also be significantly related to the structural changes, which have taken place in the financial markets. In particular, the development of the markets for outside equity, which could be exemplified by the dramatic growth from the mid-1970’s of the venture

capital industry[1], has opened new opportunities for entrepreneurship and start-ups for high-quality employees with new business ideas. Thus, for key personnel equipped with potentially profitable business ideas and with bargaining power relative to their employers the large mass of investors with preferences to invest, either directly or intermediated through funds, in start-ups represents an outside option which presumably will affect the negotiations regarding the compensation contracts. In other words, a well-performing market for outside equity might offer an instrument whereby the established firms have to defend themselves by designing very lucrative compensation contracts in order to avoid small start-ups to cream off talented employees. The overheated markets for productive workers in IT-consulting, internet services and e-commerce offer examples of industries where this might be a plausible mechanism for understanding the compensation contracts observed.

The analysis of efficient compensation contracts is typically carried out within the framework of the principal-agent approach. However, for the purposes of the present research we deviate from this approach in two important respects. Firstly, we focus on contract negotiations where not only the principal, but also the agent possesses bargaining power. Secondly, the agent's individual rationality constraint is not considered to be an exogenous feature as in standard models of wage bargaining. Instead it is determined by the payoff the agent would achieve as a self-employed entrepreneur. In other words, the outside option of the agent is to start up as an entrepreneur pursuing a business idea closely related to the project he performs within the employment relationship.

Issues related to bargaining, compensation structures and outside options are captured in at least three branches of the literature: (1) efficiency wages and profit sharing as incentive devices for the employees, (2) wage bargaining when both the contracting parties have bargaining power and (3) the determination of entrepreneurship. In what

[1] For an extensive characterization of the growth since the mid 1970's of the venture capital industry in the U.S. we refer to Gompers and Lerner (1999).

follows we briefly review the literature on these topics from the point of view of our research focus.

The main idea behind the efficiency wage theories is that for various reasons the wage is not only a cost factor to the firm, but it also serves as an incentive device with effort-enhancing effects (Akerlof and Yellen (1986) survey a selection of some seminal articles in the field). Profit sharing as an incentive mechanism has been proposed and studied recently. Weitzman (1985) has argued that the profit-sharing system leads to better business cycle performance that a fixed wage system. He has also conjectured that introducing the profit-sharing system will have the effect of reducing equilibrium unemployment (Weitzman (1987)). Holmlund (1991) and Jerger and Michaelis (1999) have formally developed this idea further in different ways. Typically, the efficiency wage theories and profit sharing have been analyzed separately in the literature, but recently Koskela and Stenbacka (2000) have incorporated the performance-based profit sharing as a part of the factors affecting the incentives to provide effort within a bargaining framework of an imperfectly competitive labor market.

In the basic version of the wage bargaining model it is assumed that the supply of working hours and the effort of workers are exogenously given (see Oswald (1985) and Creedy and McDonald (1991) for complementary surveys of various bargaining approaches to model wage and employment determination). To the extent, however, that it is not possible to monitor the effort by workers, the wage bargaining outcome may be affected by effort provision of workers and vice versa. The interactions between wage bargaining and efficiency wage considerations have been analyzed in Lindbeck and Snower (1991), Sanfey (1991), Bulkley and Myles (1996), Altenburg and Straub (1998) and Koskela and Stenbacka (2000). These papers have made use of either the unemployment benefit (in a partial equilibrium context) or the weighted average of the unemployment benefit and the wage rate elsewhere in the economy (in a general equilibrium context) to delineate the outside option available to workers. But to the best of our knowledge the existing literature has not viewed entrepreneurship as an outside option of relevance for contract negotiations. Neither has the literature focused on the

relationship between the imperfections in the market for outside equity and the relative attractiveness of start-ups as the outside option affecting the negotiated compensation contracts.

Finally, there is a relatively recent literature dealing with both theoretical and empirical aspects of occupational choice with a particular reference to entrepreneurship. Kihlström and Laffont (1979) and Kanbur (1982) construct static models of populations with heterogenous risk attitudes and they show the existence of an equilibrium where the degree of risk aversion determines the occupational choice between risky entrepreneurship and safe employment.[2] Newman (1998), by allowing for endogenous risk-bearing, shows that when employment provides the workers with insurance the profits of entrepreneurs represent a rent for risk-bearing, and only those individuals with low risk aversion will become entrepreneurs. Further, Newman argues that risk-based explanations for entrepreneurship imply the empirically implausible result that workers are wealthier than entrepreneurs. Banerjee and Newman (1993) offer a dynamic analysis of the interplay between agents' occupational choice decisions on whether being a worker, self-employed or an entrepreneur and the distribution of wealth in the presence of capital market imperfections. Ghatak, Morelli and Sjöström (1997) use a general equilibrium, overlapping generations model to show how "career concerns" due to credit market imperfections will impact on the intertemporal equilibrium profile of effort offered by agents in the presence of moral hazard.

Empirical research has also demonstrated the importance of financial constraints and wealth as factors affecting the choice to become an entrepreneur. Empirical studies include Evans and Jovanovic (1989), Holtz-Eaken, Joulfaian and Rosen (1994), Blanchflower and Oswald (1998) and Xu (1998).[3] While many of the papers mentioned above have referred to capital market imperfections as a factor affecting

[2] Kanbur (1982) explores the relationship between inequality in society and the encouragement of risk-taking entrepreneurship and demonstrates that the 'conventional wisdom', according to which there is a policy conflict between these effects, could be at least misleading, if not wrong.

[3] Usually the positive correlation between assets and startups of firms has been explained by referring to credit market imperfections. Cressy (2000) provides an alternative explanation by arguing that greater wealth makes the individual more prone to take risks also in the presence of perfect capital markets.

entrepreneurship, the interaction between potential labor market imperfections due to, for example, the bargaining power of talented employees and the performance of outside equity markets has not, to our knowledge, been taken into account in the analysis of entrepreneurship.

We can conclude our literature review by observing that a large literature has focused either on performance-related incentives associated with contract determination in labor markets or factors affecting entrepreneurship in competitive labor markets. However, at the moment there is no unified framework to analyze performance-related incentives under circumstances where the agent has bargaining power in negotiating the compensation contract with entrepreneurship representing the outside option, the relative attractiveness of which depends on, for example, the imperfections in the outside equity markets. The purpose of this paper is to conduct such an analysis by focusing on the interrelationship between bargaining power, outside options and the compensation contracts. Hence, we are not interesting in modeling entrepreneurship determination, but rather in exploring the impact of entrepreneurship as an outside option on the compensation contracts.

We design an analytical framework making it possible to find structural explanations for why the compensation directed to top executives and key personnel with bargaining power relative to their employers have increased so dramatically during the past decade. We pose and provide answers to following questions: How will shifts in the technology towards production functions with higher emphasis on human capital affect negotiated compensation contracts? Can the dramatic increase in the compensation directed to top executives and key personnel be explained by reduced imperfections in the market for outside equity? And, if so, how precisely does the mechanism whereby the market for human capital is tied to the competitiveness of the capital market operate?

More precisely, we construct a model where a principal (a firm) and an agent (a talented employee) engage in bargaining with respect to the compensation contract, which consists not only of the base wage but also includes a performance-related component. Of

course, in practice incentive contracts can be made contingent on performance through the use of many different types of instruments, one example of such an instrument being stock options. In the present analysis we will make use of the simplest possible type of a performance-related instrument, namely profit shares. That way we will be able to disentangle the impact of the technology and of the imperfections in the equity market on the fixed component and on the performance-related component of the negotiated compensation contract.

The model has two stages. In the first stage there is contract negotiation between the principal and the agent regarding the base wage and the profit share given the production technology and the outside option of the agent. This outside option depends on the working of outside equity markets. In the second stage, when the parties are committed to the compensation structure reached through the bargaining process, the principal determines the capital investment and the agent decides on his effort provision.

It is shown that the profit of an entrepreneurial start-up is an increasing function of the degree of the competitiveness of the market for outside equity funding. This means that as the degree of competitiveness increases, the agent's outside option, and thereby his threat point valid for the contract negotiations, improves. In line with intuition we find that the negotiated base wage increases in the degree of the competitiveness of the market for outside equity funding in a way which is proportional to the generated increase in the profit of an entrepreneurial start-up. In contrast, the profit share is found to be invariant both to the magnitude of the market imperfections prevailing in the market for outside equity and to the relative bargaining power of the negotiating parties.

We proceed as follows. In Section 2 we introduce the basic structure of our model including the time sequence of decisions. The determination of effort by the agent and the capital investment decision by the principal are studied in Section 3. In Section 4 we characterize the agent's opportunity of entrepreneurship as the agent's outside option for the stage of bargaining regarding the compensation contract with the principal. In Section

5 we derive the Nash bargaining solution with respect to both the base wage and the profit share. Finally, some concluding comments are presented in section 6.

## II. Basic Structure of the Model

We consider a firm operating with a production function incorporating traditional capital, K, and human capital, H, of a key employee, the agent. This agent contributes to the output of the firm through effort provision, the magnitude of which lies outside the control of the principal. Following the traditional principal-agent approach, we assume that contracts cannot be made contingent on non-observable effort.

We assume the production technology to be of Cobb-Douglas type according to

**Assumption F:** *The technology is assumed to satisfy*

*(F1)* $$F(H,L) = H^{a} K^{1-a} .$$

The parameter $a$ is restricted to satisfy $0 < a < 1$ so that specification (F1) can be thought of as a measure of the importance of human capital relative to traditional capital investments. As is well known, this form of the production function also exhibits complementarity between the factors of production.

With r denoting the opportunity cost of capital for the principal, the combination (H,K) of the production factors will generate revenues

(1) $$p(H,K) = H^{a} K^{1-a} - rK .$$

Effort provision causes disutility for the agent. The principal faces the challenge of designing an incentive scheme so as to implement optimal effort provision while taking the ordinary restrictions imposed by incentive compatibility and individual rationality into account. The principal is assumed to have access to two instruments for its design of

an incentive scheme: a base wage, w, and a profit share, $t$. The profit share, $t$, determines what fraction of the firm's profits, in addition to the contractually determined base wage, is transferred to the agent. Thus, conditional on the negotiated contract consisting of a base wage as well as a bonus share the agent makes the effort decision in order to maximize the rent

$$(2) \qquad u(H) = w + t\,p(H,K) - g(H),$$

where the function g(H) is a monetary representation of the disutility of effort. For the disutility of employee effort we make

**Assumption G**: *The disutility of effort belongs to the class of functions*

*(G1)* $g(H) = g\,H^{1/g}$ *with* $0 < g < 1$.

Assumption G means that we consider a class of functions with the property that the distility of effort can be captured through an increasing and convex relationship with constant elasticity. The parameter $g^{-1}$ describes the inverse of the elasticity of disutility with respect to effort. One could make the interpretation of $g$ as a measure related to the complexity of the agent's working task.

The firm and the agent engage in wage bargaining within a framework where both parties possess bargaining power. The stage of wage bargaining represents a commitment not only to the base wage but also to the form of the wage contract by determining to what extent profit sharing will be utilized. In our analysis of the negotiations regarding the compensation scheme we deviate from the standard literature by modeling the outside option as entrepreneurship available to human capital. In fact, the limitation imposed by the market for outside equity through which a talented agent could make a start-up as an entrepreneur serves as the agent's outside option affecting the outcome of the bargaining determining the compensation contract offered to the agent. This also creates an

important mechanism whereby the imperfections in the market for human capital are linked to the imperfections in the outside equity markets.

Conditional on the negotiated compensation contract the principal (firm) and the agent (employee) both make optimizing decisions. The firm unilaterally determines the capital investment once the conditions of the wage negotiations have been settled. In line with the tradition of efficiency-wage models, the wage contracts cannot be made contingent on the effort provision of the employee, because effort is unobservable and cannot be verified by a third party. Thus, the agent decides on effort so as to maximize his objective function, which takes into account that effort provision causes disutility. At the stage of the wage negotiations the employer holds rational expectations regarding how the outcome of the bargaining will impact on the effort incentives of the agent. These incentives depend on the base wage as well as on the profit share. It is important to emphasize – and this is a novel feature of the model - that the effort incentives of the agent, while directly depending on the negotiated incentive contract, will be indirectly connected to the market for outside equity.

We summarize the timing of the decisions made by the firm and the employee in Figure 1. In the subsequent sections we turn to a more detailed analysis of the decisions taking

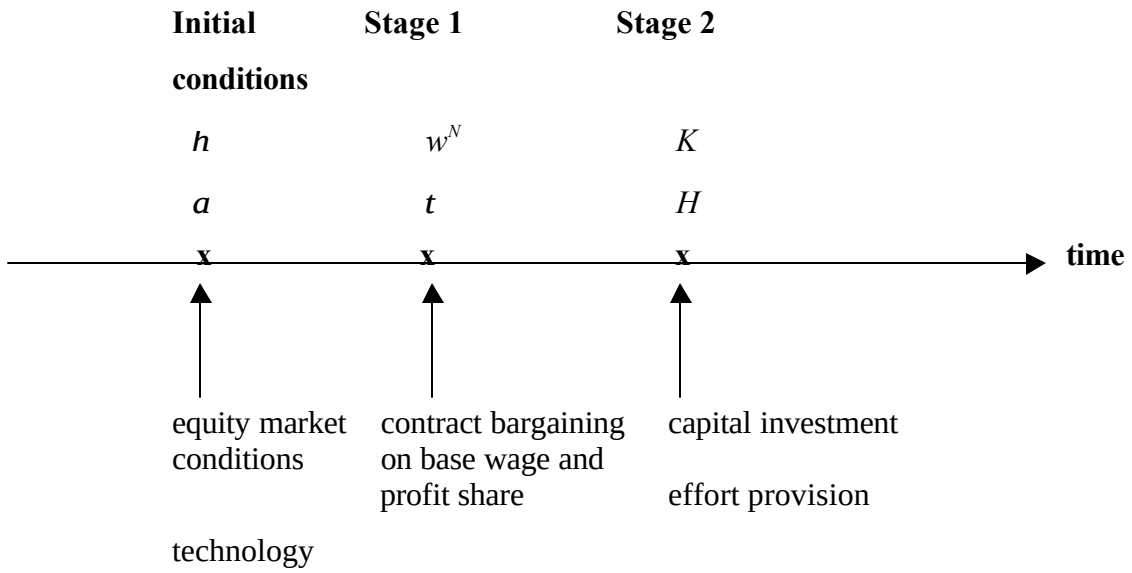


**Figure 1: Time sequence of events and decisions**

place at the different stages of the principal-agent interaction. We use backward induction and solve the game in reverse order by starting to investigate the determination of capital investment and effort in the next section. As a background for the analysis of contract negotiation between the principal and the agent, section 4 offers an analysis of entrepreneurship as an outside option to a talented agent and the dependence of this outside option on the nature of the outside equity market. In Section 5 we analyze the bargaining between the firm and the employee and, finally, there is a brief concluding section.

## III. Determination of Capital Investment and Effort

At this stage we assume that the principal and the agent have reached an irreversible bargaining outcome determining the base wage, w, as well as the profit share, $t$. Under such circumstances the optimal combination of capital investment and effort provision, $(H^*, K^*)$, is determined by the system of optimality conditions

$$H^* = \arg\max_H u(H) = w + t\left(H^a K^{1-a} - rK\right) - gH^{1/g} \tag{3}$$

$$K^* = \arg\max_K R(K) = (1-t)\left(H^a K^{1-a} - rK\right) - w. \tag{4}$$

According to (3) and (4) the base wage represents an instrument for the distribution of the surplus generated by the revenues of the project between the two factors of production, while the profit share affects the revenues by changing the intensity of both the effort and capital investment incentives.

From an investigation of the necessary first-order conditions we find that the optimal combination of $H^*$ and $K^*$ has to satisfy the relationship

$$(5) \qquad K^* = \left[\frac{1-\alpha}{r}\right]^{\frac{1}{\alpha}} H^*.$$

From (3) and (4) straightforward optimization yields the explicit solutions

$$(6) \qquad H^* = A(\alpha,\gamma)\, \tau^{\frac{\gamma}{1-\gamma}} \quad r^{-\frac{\gamma(1-\alpha)}{\alpha(1-\gamma)}}$$

and

$$(7) \qquad K^* = B(\alpha,\gamma)\, \tau^{\frac{\gamma}{1-\gamma}} \quad r^{-\frac{1-\alpha\gamma}{\alpha(1-\gamma)}},$$

where $A(\alpha,\gamma) = \alpha^{\frac{\gamma}{1-\gamma}} (1-\alpha)^{\frac{\gamma(1-\alpha)}{\alpha(1-\gamma)}}$ and $B(\alpha,\gamma) = \alpha^{\frac{\gamma}{1-\gamma}} (1-\alpha)^{\frac{1-\alpha\gamma}{\alpha(1-\gamma)}}$ depend only on the parameters determining the technology and the disutility of effort.

According to (6) the agent's effort increases with the profit share $\tau$, but decreases with the cost of the capital investment r. The former characteristic reminds of the positive relationship between the effort provision and the intensity of incentives in line with the traditional principal-agent literature. However, in the context of wage bargaining between unions possessing market power and firms this feature has not previously been analyzed in the literature.[4] The latter effect is due to the fact that a rise in r leads to a decrease in capital investment, which in turn has a negative effect on the marginal product of effort. Comparing (6) and (7) reveals that profit sharing affects effort provision and capital investment in an identical way. Because of the complementary relationship between H and K, the qualitative effects of the capital cost on the capital investment and on the agent's effort are similar, with the own effect on capital investment being stronger.

[4] There is a relatively recent literature, which studies the relationship between profit sharing, wage bargaining and unemployment under various bargaining structures (see e.g Holmlund (1990), and Jerger and Michaelis (1999)). Except for Koskela and Stenbacka (2000) this literature has not, however, considered the natural case where effort by an employee may be affected by a commitment to profit sharing.

We can summarize our characterization of the optimal combination of effort provision and capital investment in the following proposition.

**Proposition 1:** ***The equilibrium configuration of capital investment and effort provision is given by (6) and (7).***

After having characterized the capital investment by the principal and the effort provision by the agent we turn next to the analysis of the stage of bargaining determining the compensation contract. In the wage negotiations literature it is usually assumed that either the unemployment benefit (in a partial equilibrium context) or the weighted average of the unemployment benefit and the wage rate elsewhere in the economy (in a general equilibrium context) represent the outside option available to workers. For the talented agent, however, we assume entrepreneurship, and neither unemployment benefits nor other forms of exogenously given outside options, to be the relevant alternative to employment. Before turning to the detailed analysis of bargaining we characterize the value of entrepreneurship as the agent's outside option and its dependence on the performance of the outside equity markets.

## IV. Entrepreneurship as the Outside Option

We assume that the agent has the option to exploit the human capital incorporated in his idea, but because he lacks funds of his own he has to turn to outside financiers. We restrict ourselves to the market for outside equity.

We denote the share of project revenues required by outside investors in return for capital K by s(K). As the share s(K) serves as a measure of the price for outside equity funding it is natural to require this function to be an increasing and concave function of the capital raised from outside investors. In addition, the function s(K) should be required to satisfy the boundary conditions s(0) = 0 and $s(K) \to 1,\ as\ K \to \infty$.

In order to simplify our analysis so as to make it possible to highlight the economic mechanisms involved as transparently as possible, we make the following assumption regarding the functional form of the share describing the price of outside equity.

**Assumption S:** *The share of project revenues required by the outside equity market in return for K units of capital is given by*

*(S1)* $$s(K) = 1 - e^{-hK}.$$

This functional form satisfies all of the intuitively appealing properties mentioned above. In particular, while raising K units of capital the agent will be able to maintain the share $x(K) = 1 - s(K)$. We can characterize the parameter $h$ through the relationship[5]

(8) $$\frac{x'(K)}{x(K)} = -h.$$

As the relationship (8) makes clear, Assumption S implies that the share of the project revenues allocated to the human capital declines at a constant relative rate $h$ in response to a marginal increase in the capital investment. The parameter $h$ can be interpreted as a measure of the degree of market imperfections so that a more competitive market for outside equity is associated with a lower $h$.

When facing such a market for outside equity financing the self-employed agent decides on the project size (K) as well as the effort provision (H) in order to solve

(9) $$\max_{H,K} \; y(H,K) = (1 - s(K))F(H,K) - g(H).$$

[5] In what follows the derivatives are denoted by primes for functions with one argument and the partial derivatives by subscripts for functions with many arguments. Hence e.g. $x'(K) = \frac{\partial x(K)}{\partial K}$ for $x(K)$, while $A_y(y,z) = \frac{\partial A(y,z)}{\partial y}$ for $A(y,z)$ etc.

Making use of Assumptions F, G, and S we can express the necessary first-order conditions for optimal effort H and optimal project size K in the outside option of being an entrepreneur according to

$$y_H = a\, e^{-hK}\, H^{a-1} K^{1-a} - H^{\frac{1-g}{g}} = 0$$

and

$$y_K = -h\, e^{-hK} H^{a}\, K^{1-a} + (1-a)\, e^{-hK} H^{a}\, K^{-a} = 0\ ,$$

respectively. Solution of this system of equations yields the optimal entrepreneurial combination of effort and capital investment $(H^o, K^o)$ given by

(10) $$H^o = A(a,g)\ (e\,h)^{-\frac{(1-a)g}{1-ag}}$$

and

(11) $$K^o = (1-a)\, h^{-1}\ ,$$

where we have substituted equation (11) for $K^o$ in the expression (10) for $H^o$. From equations (10) and (11) we can observe that $H^o$ and $K^o$ increase, when the market for outside equity funds becomes more competitive, i.e. $\partial H^o / \partial h < 0$ and $\partial K^o / \partial h < 0$. Furthermore, effort provision as captured by (10) is qualitatively similar to that of (6). In contrast, the capital investment in the outside option exhibits a different structure than (7). In fact, from (11) we can see that the elasticity of the capital investment with respect to $h$ is equal to -1. Substituting (10) and (11) into the objective function (9) we find the indirect entrepreneurial profit function of the agent to be of the following form

(12) $$y^o(H^o, K^o) = C(a,g)\ h^{-\frac{1-a}{1-ag}}\ ,$$

where $C(a,g) = \frac{1-ag}{a} \quad a^{\frac{1}{1-ag}} \quad \left[\frac{1-a}{e}\right]^{\frac{1-a}{1-ag}}$.

From (12) we can see that the profit to the start-up is determined by a combination of three parameters: $a$, $g$ *and* $h$. In other words, the entrepreneurial profit is determined by the technology, by the costs of providing effort as well as by the competitiveness of the market for external equity funding. In particular, from (12) we can conclude that $\partial y^o(H^o, K^o)/\partial h < 0$. This means that the profit of a start-up in entrepreneurial activity increases as the imperfections of the market for outside equity decrease, an intuitive outcome.

We summarize our characterization of the profit opportunities open to the agent through an entrepreneurial start-up in

**Proposition 2:** ***The optimal combination of effort provision and capital investment, characterized by (10) and (11), generates the entrepreneurial indirect profit function (12). The profit of an entrepreneurial start-up is an increasing function of the degree of the competitiveness of the market for outside equity funding.***

With this as the characterization of the agent's outside option relevant for the stage of bargaining regarding compensation, we now turn to a detailed analysis of the negotiations between the employer and the employee.

## V. Nash Bargaining and Compensation Structure

We apply the Nash bargaining solution and make use of the 'right-to-manage' approach. In the context of our model it means that the capital investment is unilaterally determined by the firm conditional on the binding contract negotiation concerning the basic wage $w$ and the profit share $t$. Effort provision takes place at the discretion of the agent. Finally, and importantly, the negotiations regarding the incentive scheme are assumed to take

place conditional on the parties having full knowledge of the conditions prevailing in the market for outside equity financing.

We denote the relative bargaining power of the agent by $b$, and, consequently, that of the principal by $(1-b)$, and assume that the outside option with an entrepreneurial start-up represents the threat point of the agent. As derived in detail in the previous section, this threat point is given by $y^0(H^o, K^o)$ (see equation (12)). With operation involving a capital investment K* the threat point of the firm can be described by $p^o(K^*) = -rK^*$. Applying the traditional Nash bargaining solution with respect to both the base wage and the profit share as objects of the bargaining process the negotiating parties decide on w and $t$ in order to maximize[6]

$$(13) \qquad \Omega(w,t) = \left[u - y^o\right]^b \left[R - p^o\right]^{1-b}$$

subject to the equilibrium characterizations (6) and (7), where $u(H^*) = w + tp(H^*, K^*) - g(H^*)$ and $R(K^*) = (1-t)p(H^*, K^*) - w$, respectively. In the Nash maximand (13) $p(H^*, K^*)$ denotes the profit of the firm when evaluated at the equilibrium combination of effort and capital investment to capture that the bargaining takes place in anticipation of optimal behavior with respect to these variables.

Denoting $\tilde{U} = u - y^0$ and $\tilde{R} = R - p^o$ the first-order conditions for the Nash bargaining solution $(w^N, t^N)$ can be written as follows:

$$(14) \qquad \Omega_w = b\,\frac{\tilde{U}_w}{\tilde{U}} + (1-b)\,\frac{\tilde{R}_w}{\tilde{R}} = 0$$

and

$$(15) \qquad \Omega_t = b\,\frac{\tilde{U}_t}{\tilde{U}} + (1-b)\,\frac{\tilde{R}_t}{\tilde{R}} = 0\,.$$

[6] In general, the Nash bargaining approach can be justified either axiomatically (see Nash (1950)) or strategically (see Binmore, Rubinstein and Wolinsky (1986)).

We proceed by solving this system of equations so that we first characterize the Nash bargaining solution with respect to the base wage and, subsequently, we turn to the negotiated profit share. As is shown in the Appendix, from (14) we find that the Nash bargaining solution with respect to the base wage can be expressed as

$$(16) \qquad w^N = (\beta - \tau)\, p(H^*, K^*) + \beta\, r K^* + (1-\beta)\left(g(H^*) + \gamma^0(H^o, K^o)\right).$$

In particular, from (16) we can infer that

$$(17) \qquad \frac{\partial w^N}{\partial \eta} = (1-\beta)\,\frac{\partial \gamma^o(H^o, K^o)}{\partial \eta}\ .$$

Thus, by taking Proposition 2 into account we can conclude that the negotiated base wage increases in the degree of the competitiveness of the market for outside equity funding in a way which is proportional to the generated increase in the profit of an entrepreneurial start-up as long as all the bargaining is not concentrated to the agent ($\beta < 1$). As (17) makes clear, the factor of proportionality is equal to the relative bargaining power of the employer. For the special case with the agent possessing all the bargaining power ($\beta = 1$) changes in $\eta$ will have no impact on the negotiated base wage, because in that case the agent can capture all the project surplus independently of the outside option. Moreover, from (16) we obtain the usual result that an increase in the agent's relative bargaining power will raise his base wage, i.e. $\partial w^N / \partial \beta = F(H^*, K^*) - g(H^*) - \gamma^o(H^o, K^o) > 0$.

We summarize our findings regarding the negotiated base wage in

**Proposition 3:** ***The Nash bargaining solution with respect to the base wage is given by (16). The negotiated base wage increases with the bargaining power of the agent and with the degree of the competitiveness of the market for outside equity as long as the agent does not possess all the bargaining power.***

We now turn to the determination of the performance-related profit share as part of the bargaining between the principal and the agent. By imposing (16) we find that the first-order condition for the profit share, expressed by (A2) in the Appendix, can be written as

$$(18)\qquad \begin{aligned} & p(H^*,K^*) + t\,\frac{\partial p(H^*,K^*)}{\partial t} - g'(H^*)\frac{\partial H^*}{\partial t} = \\ & -p(H^*,K^*) + (1-t)\frac{\partial p(H^*,K^*)}{\partial t} + r\,\frac{\partial K^*}{\partial t}\,. \end{aligned}$$

At this stage we can conclude that the Nash bargaining solution with respect to the profit share is independent of the relative bargaining powers of the negotiating parties. We can further elaborate (18) by observing that

$$(19)\qquad \frac{\partial K^*}{\partial t} = \frac{g\,K^*}{(1-g)\,t}\,,\quad \frac{\partial H^*}{\partial t} = \frac{g\,H^*}{(1-g)\,t}\quad \textit{and}\quad \frac{\partial p(H^*,K^*)}{\partial t} = \frac{g\,p(H^*,K^*)}{(1-g)\,t}\,.$$

Substituting these properties into (18) the condition determining the negotiated profit share can be simplified into

$$(20)\qquad (2t-g)\,p(H^*,K^*) \;=\; g\left[(H^*)^{\frac{1}{g}} + r\,K^*\right]\,.$$

By making use of (1) as well as the equilibrium relationship (5) we can further simplify (20) so as to explicitly express the Nash bargaining solution with respect to the profit share according to

$$(21)\qquad t^N \;=\; \frac{g\,(2-a)}{2+g\,a}\,.$$

The Nash bargaining solution is clearly feasible as the parameter restrictions imposed by Assumptions F and G imply that $0 < t^N < 1$. From (21) we can extract a number of important features and interpretations.

Firstly, the negotiated profit share is invariant to the magnitude of the market imperfections prevailing in the market for outside equity. In other words, changes in the value of the outside option represented by entrepreneurship are reflected in the negotiated base wage, but not in the profit share.

Secondly, the negotiated profit share is also invariant to the relative bargaining powers of the principal and the agent so that changes in the relative bargaining powers generate changes in the base wage, but the Nash bargaining solution with respect to the profit share remains unaffected.

Thirdly, the Nash bargaining solution with respect to the profit share is determined by two sources: the technology ($a$) and the disutility caused by effort provision ($g^{-1}$). A straightforward comparative statics analysis establishes that

(22) $$\frac{\partial t^N}{\partial g^{-1}} < 0 \quad \textit{and} \quad \frac{\partial t^N}{\partial (1-a)} > 0 \ .$$

Thus, when the elasticity of disutility of effort increases, the sensitivity of the agent to the profit sharing instrument decreases and, consequently, the negotiated profit share falls. If, as, for example, the literature on education as a signal of ability suggests (see Spence (1974)), the effort disutility decreases with education this feature means higher profit shares directed towards agents with a higher education. A higher relative weight on capital investments in the technology generates a higher weight of the performance-related profit share in the Nash bargaining solution. The latter property can be explained by observing that an increase in the productivity of capital will translate into an increase in the profit-enhancing effects of investments. The Nash bargaining solution is adjusted to this by decreasing the profit share allocated to the agent.

We summarize our findings regarding the performance-related Nash bargaining solution in

**Proposition 4:** ***The Nash bargaining solution with respect to the profit share is invariant both to the magnitude of the market imperfections prevailing in the market for outside equity and to the relative bargaining power of the negotiating parties. Further, it is decreasing in the elasticity of effort disutility, while increasing in the relative importance of capital in the production function.***

An increase in the relative attractiveness of the outside option represented by entrepreneurship and in the relative bargaining power of the agent are both features improving the bargaining terms from the agent's point of view. The invariance of the negotiated profit share to such improvements in the bargaining terms could be viewed as reflecting an incentive on behalf of both the negotiating parties to transmit a stronger bargaining position into the base wage rather than into the profit share. This feature, in turn, can be explained by a combination of the features whereby the capital investment takes place at the discretion of the principal and effort provision at the discretion of the agent, while simultaneously the production function postulates that there prevails complementarity between capital investment and effort provision.

The invariance of the negotiated profit share to the relative bargaining power of the agent stands in sharp contrast with the results obtained in the literature on wage bargaining. For example, Jerger and Michaelis (1999) and Holmlund (1991) have analyzed profit sharing within a framework capturing traditional union-firm negotiations including profit shares in addition to base wages. According to their results the profit share obtained as an outcome of Nash bargaining depends on the relative bargaining power of the trade union in a very precise way: the negotiated profit share is equal to the relative bargaining power (see also Pohjola (1987)).[7] Thus, these contributions seem to predict that the relative

[7] However, in all these contributions the bargaining takes place in the absence of incentive effects (efficiency wage considerations).

importance of performance-related compensation would increase with the bargaining power of unions – a feature which does not seem to lie in conformity neither with intuition nor with casual observations. In contrast to this literature, our invariance result implies that the relative importance of profit sharing decreases with an increase in bargaining power of the agent.

How does our model shed light on the increase in compensations paid to top executives and key personnel? Firstly, if we take for granted that the imperfections in the markets for outside equity have gradually decreased, our model is perfectly consistent with these observations as far as the base wage is concerned. Similarly, the intensified battle for human capital means that the relative bargaining power of the agent in the sense of our model has increased and our model predicts that such a change should show up in the form of a higher negotiated base wage. But, are not the invariance results reported in Proposition 4 inconsistent with the observed increased relative importance of incentive programs whereby executives and key personnel are granted stocks and stock options? Not necessarily. From our analysis we can, at least, conclude that reductions in the imperfections of outside equity markets or increased relative bargaining power of talented agents need not imply a shift towards increased performance-related compensation in the sense of profit shares. Our analysis instead suggests that changes in the relative importance of performance-related compensation reflect shifts in technology and/or shifts in the elasticity of effort disutility. The latter feature, which tends to exhibit a negative relationship with education, suggests higher negotiated profit shares towards more educated agents. Also, with respect to the extensive use of stock options we would like to point to the frequently used practice of deflated exercise prices whereby the stocks can be bought at a predetermined price, which often turns out to be less than the market price of the stock (see, chapters 12 and 13 in Milgrom & Roberts (1992) for some evidence and further discussion of these issues). Thus, it is by no means selfevident that stock option plans represent performance-related incentives rather than compensation of the base wage type.

## VI. Concluding Comments

In this paper we have constructed a model to deal with performance-related incentives under circumstances, where the agent has bargaining power in negotiating the compensation contract and where his outside option is that of entrepreneurship. The relative attractiveness of entrepreneurship as an outside option depends on the degree of competitiveness of the market for outside equity. The purpose of this paper has been to focus on the interrelationship between bargaining power, entrepreneurship as an outside option and the compensation contracts.

To analyze these issues we have designed an analytical framework with two stages. In the first stage there is a contract negotiation between the principal and the agent regarding the base wage and the profit share given the production technology and the outside option of the agent which depends on the performance of outside equity markets. In the second stage, conditional on the compensation contract negotiated, the principal unilaterally determines the capital investments, while the agent has discretion in deciding on effort provision.

We have shown that the profit of an entrepreneurial start-up is an increasing function of the degree of the competitiveness of the market for outside equity funding. Thus, as the competitiveness of this market increases, the agent's outside option and thereby his threat point in the contract negotiations improves. As for the performance-related compensation contracts we have found that the negotiated base wage increases in the degree of the competitiveness of the market for outside equity funding in a way which is proportional to the generated increase in the profit of an entrepreneurial start-up. In contrast, our analysis has demonstrated that the negotiated profit share is invariant both to the magnitude of the market imperfections prevailing in the market for outside equity and to the relative bargaining power of the negotiating parties. Our analysis instead suggests that changes in negotiated profit shares reflect shifts in technology and/or shifts in the elasticity of effort disutility.

## Appendix: Nash bargaining solution for $w$ and $t$ :

The Nash bargaining solution $\left(w^N, t^N\right)$ has to satisfy the system of first-order conditions (14) and (15), which can be rewritten in explicit form according to (A1) and (A2) defined by

$$(A1) \qquad \frac{b}{w + tp(H^*, K^*) - g(H^*) - y^o(H^o, K^o)} = \frac{(1-b)}{(1-t)p(H^*, K^*) - w + rK^*}$$

and

$$(A2) \qquad b\,\frac{p(H^*, K^*) + t\dfrac{\partial p(H^*, K^*)}{\partial t} - g'(H^*)\dfrac{\partial H^*}{\partial t}}{w + tp(H^*, K^*) - g(H^*) - y^o(H^o, K^o)} =$$

$$(1-b)\,\frac{-p(H^*, K^*) + (1-t)\dfrac{\partial p(H^*, K^*)}{\partial t} + r\dfrac{\partial K^*}{\partial t}}{(1-t)p(H^*, K^*) - w + rK^*} \quad ,$$

where we have used the definitions for $\tilde{U}$ and $\tilde{R}$. For the derivation of (A1) and (A2) we have, in addition, utilized the fact that $H^* \, and \, K^*$ are both independent of the base wage, w, while $H^* \, and \, K^*$ exhibit structural dependence on the profit share, $t$. Thus, the effort-enhancing efficiency wage mechanism operates exclusively through the profit share, while the base wage simply represents an instrument for distribution of the surplus generated by the revenues of the project between the two production factors. As $H^o \, and \, K^o$ are determined by the market for outside equity facing the entrepreneurial start-up, these are both independent of the negotiated incentive contract, i.e. independent of both the base wage and the profit share. Equation (16) of the text can be obtained from (A1) by rearranging the terms. **QED**

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