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**PROFESSOR — UNIVERSITY
RELATIONSHIPS: INCENTIVES
FOR INVESTMENT IN JOINT FUTURE**

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We present an incomplete contract model of relationship between University and Professor to analyze the impact of control rights distribution at University on faculty incentives to invest in human capital and University development. Secondary employment of teaching staff outside University may create positive externalities within University inducing Professors to invest in their human capital. We derive conditions under which an adverse selection problem is severe, and end up with conclusions regarding optimal employment and contract policy.

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Рассматривается модель неполного контракта между преподавателем и университетом. С ее помощью анализируется влияние распределения прав на принятие решений в университете на стимулы преподавателей инвестировать в собственный человеческий капитал, а также на стимулы университета к инвестициям в преподавательский состав. Показывается, что вторичная занятость преподавателей вне университета создает положительные стимулы к инвестициям в человеческий капитал. Выводятся условия, при которых возникает проблема неблагоприятного отбора среди преподавателей, а также делаются выводы относительно оптимальной политики найма и построения трудовых контрактов.

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Introduction

General Idea

Payment structure of academic contracts as a research topic is interesting for economists for at least three reasons. First, rewards for the work you do - that one you get and that one you believe you deserve - is an attractive topic to discuss among people of any profession and almost of any social status. Economists are no exception here. Second, academic activities have a number of specific features that make an economic analysis of this market very interesting as well as extremely complicated. Third, there exist a large variance of remuneration practices around the world that produce different effects.

Several features should be mentioned. First, as in the case of any intellectual activity, the outcome production is difficult and costly to measure as well as to elaborate explicit criteria for such a measurement. Second, this activity consists of several components (for professors at University there are at least three: teaching, research, and administrative services). Third, money motivation is not always the most effective one. Moreover, quite often external incentives may destroy an intrinsic motivation. These features as well as market structure itself not only create wide opportunities for opportunistic behavior but also create disincentives for investment both of professors and administration of University. Accordingly, there is a negative influence on faculty qualification and the quality of teaching services they provide; a situation on this sector of educational market becomes worse as such.

Motivation

Motivation problem in Russian Universities is deepened by the fact that salaries in State Universities are not competitive both comparing to new private Universities and other sectors of labor market. In the sector of economics, this problem is quite sharp as consulting, financial analysis etc are well-paid possible activities available for Professor of economics if he decides to quit academia.

So State Universities with sound reputation of high-quality teaching tradition offer low salaries while new private colleges and Universities are able to offer high competitive salaries but (in general) have low reputation at market and thus give low social status for their teaching staff. To build a reputation, these new Universities try to attract, at least on part-time basis, Professors from State Universities.

Consequently, a substantial part of professors considers their teaching at a University only as a mean to achieve a social status that might open them an opportunity for outside teaching (as of personal tutor for passing exams, teacher in less prestigious University or college etc).

As a result of such academic core erosion, all parties are worse off: University, students and professors themselves.

Relationships between university and its faculty cannot be described in the framework of complete contract: the frontiers of teaching activities are too uncertain, and it's too complicated to describe formally all responsibilities of parties. Also, there is often a necessity to make additional investment in "common future", while these investments could not be prescribed in basic

contract. If the contract is not complete, under the great uncertainty incentives of both parties to invest in specific assets are low. Professors tend to minimize investments in their own human capital, and University, in turn, follows the policy of "cream skimming".

The current situation in Russian economic education is characterized by relatively low level of investment in teaching quality. Facing large demand for economic education, many Universities rather prefer to follow an expansion policy, increasing the number of paying students. At the same time most lecturers chose to increase teaching efforts, while not investing in their own human capital. In this paper, we analyze this trade-off. What is the best contract and employment policy for university to create motivation for faculty to invest in teaching and research? Is common practice of lecturers' evaluation taking their efforts as a proxy efficient? Why universities do not prevent a widespread practice of secondary employment (private lessons etc) among faculty?

To address these questions, we consider relationships between lecturer and a university as an incomplete contract with relation-specific investments on both sides. The lecturer may invest in teaching and research quality while the university invests in its reputation and position in the market for education. We demonstrate how incentives are determined by distribution of decision rights to be realized in the case of exogenous shocks of demand for teaching services. We derive conditions, under which university is better off having lecturers who have second teaching job outside the university. The general underlying reason is that it creates strong incentives for lecturers to invest in their own human capital. We also show that when university considers the level of lecturer's investments as a signal of his teaching abilities, an adverse selection may arise with low-ability lecturers overinvesting.

Structure

The paper is organized as follows. After the brief literature overview we discuss the model setup and the results obtained. These results are discussed in detail and illustrated with cases from Russian academic practice. Open questions for further analysis conclude.

Literature Overview

Investments of a professor in his own human capital are usually considered in a broader context of faculty motivation for high-quality teaching and research. Its specifics in academic market is determined, among others, by the importance of an academic freedom for people who work in academia.

The most extensively discussed topic is a tenure. The underlying idea is that the perspective to be hired by the University on a permanent position stimulates non-tenured professor to achieve as much as possible to be offered a tenure. The tenure institution creates strong incentives for young faculty while, and that is extremely important, providing an academic freedom for senior staff (see, e.g. Machlup (1964) and McPherson and Shapiro (1999)). Tenure system in academia is a common practice in US higher education. However, opponents of this approach stress that

the strong opposite effect might arise: as soon as professor gets a tenure his incentives lower substantially (see Tullock (1996)).

A number of studies considers a bureaucratic control as a disciplining device. If detailed short-term contract is signed and revised then on a regular basis - that is if professor is tightly monitored, incentives for opportunistic behavior diminish. However, such control, even if providing additional incentives, destroys academic freedom and therefore destroys intrinsic motivation (see detailed discussion in Baker et al (1988), Kreps (1997)).

Comparative advantages of these two practices are compared in Bess (1998) and McPherson and Schapiro (1999). Referring to previous research and offering their own arguments, they argue that tenure has several comparative advantages. However, in Russian current conditions a tenure as an incentive mechanism cannot be implemented: tenure is not attractive.

In Russia, there exists an other mechanism that forces faculty to invest in their human capital: secondary employment in the market for teaching services. Sociologists discuss this phenomenon intensively, while in economic research it is almost neglected (but see Dzagourova, Smirnova (2003)).

A detailed employment contract that would describe completely all professor's activities, cannot be created. Incompleteness of contracts in academia is often discussed in literature though the analysis is typically descriptive (see, for example, McMeekin (1999), that discusses different types of contract - formal and informal - that exist at University).

For formal analysis, we modify the framework proposed by Grossman and Hart (1986). Their model considers the relationships of two firms that need to make specific investments under condition of the contract incompleteness. This framework allows to analyze the decision rights distribution on the incentives to invest and on efficiency of cooperation.

1 Model

1.1 Basic Idea

Thus, labor contracts, and contracts in academia in particular, are not complete. In the process of relationships both faculty and University make investments that are hard to measure for the other party as well as for outsiders. So the levels of these investments cannot be made verifiable. Even after investments are made it might be difficult to estimate them. Also, there could be some events in the future (that cannot be anticipated and predicted in advance), that may open some additional options for parties. However, to use them, they will have to revise the basic contract.

Contract revision may follow different procedures. These rules have a direct impact on incentives of both parties. Indeed, if one believes that after a contract is revised he gets enough opportunities to compensate for these investments, incentives to invest are higher then under condition of no control. Thus, incentives to invest depend on the decision rights distribution.

However, it is not the only factor that determines incentives of contract parties. An important one is that the level of secondary, or outside, employment of teaching staff. If outside, well-paid teaching opportunities are available only if a professor is affiliated with some prestigious University, incentive to get them forces him to invest in University activities even if employment conditions within the University do not look too attractive.

1.2 Setup

We consider relationships between University and teaching staff. We suppose that latter consists of one Professor, who possesses one unit of working time. At the initial period, University and Professor sign an employment contract. This contract specifies the salary Professor gets and the share k of working time, that he devotes to basic quality teaching within University. The rest of the working time Professor may teach outside. Such possibility arises only if he is employed at University. We consider profits obtained within such a contract as basic ones.

There exists probability γ that in recent future parties will get an opportunity to get non-zero additional profit from high quality teaching. This surplus is equal V for each unit of teaching. Such an opportunity may be caused by many reasons: for example, by an increase in demand at this sector of teaching. In this case willingness to pay for University program, for private lessons and such, rises.

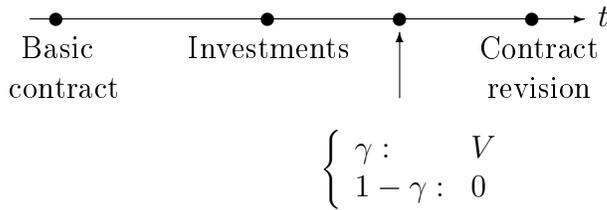
After the contract is signed parties may invest in these future opportunities. University investments may have a form of technical support of teaching process, new curricula development, or advertising of the market in whole and this University in particular. University investments X determine probability γ with which probability to get non-zero surplus from high quality teaching will be created: $\gamma = X^\alpha, \alpha < \frac{1}{2}$. However, even if University making investments paves the way for surplus, if Professor makes no investment in his own human capital by himself (that might have allowed him to provide high-quality teaching), this possibility cannot be used. Professor's investments I determine the amount of surplus: $V = aI^\alpha$, that could be obtained with additional cost C , $C = bI^\alpha$.

After investments of both parties are made, it is determined whether the non-zero surplus from teaching quality improvement could be realized, what size of this surplus is, what costs are associated with this improvement. Then, following the procedure that is specified in advance, a decision about whether contract should be revised is made, as well as how surplus and associate cost to be divided. According to this procedure, the contract is (or not) revised and gains are realized.

Further we focus on the case of $\alpha = \frac{1}{3}$, $1 < a - b < 3$. It allows to simplify calculations while does not change the results.

1.2.1 Timing

We consider a dynamic game between Professor and University. The sequence of actions is the following (see picture 1):



Pic. 1. Timing

1. Professor and University sign a basic employment contract. This contract specifies the ratio of the working time of Professor that he devotes to the teaching within University, and the salary he gets for these services;
2. Professor and University simultaneously and independently choose the level of investments;
3. The Nature determines the probability of potential additional profit from increase in teaching quality, the amount of this profit and cost;
4. The decision about contract revision is taken (whether the quality of teaching will be improved, who will bear the cost of this improvement and how the profit will be distributed);
5. Gains are realized.

1.3 Results

1.3.1 Efficiency Issues

Levels of investments, decisions to be made, profits created and cost imposed, depend on the procedure of contract revision and rule of surplus division. We will consider 3 possible alternatives:

1. Parties - Professor and University - behave cooperatively, maximizing total additional profit;
2. Professor and University are independent: each part seeks to maximize its own profit and has the right to block the contract revision;
3. University has an exclusive right to decide whether a contract conditions will be revised.

1.3.2 Social optimum: cooperative decision making

Lemma 1 *Socially optimal levels of investment are $\frac{(a-b)}{3}$ for both University and Professor, that create an additional surplus in the amount of $\frac{(a-b)^3}{27}$.*

Proof. *Total additional surplus is given by $E\pi = \gamma(X)(V(I)-C(I))-X-I = (a-b)X^{\frac{1}{3}}I^{\frac{1}{3}}-X-I$. First order condition gives:*

$$\frac{1}{3}(a-b)X^{-\frac{2}{3}}I^{\frac{1}{3}} = 1$$

$$\frac{1}{3}(a-b)X^{\frac{1}{3}}I^{-\frac{2}{3}} = 1$$

Solution for this system is

$$X = I = \frac{(a-b)^3}{27}. \quad (1)$$

Substituting optimal levels of investment just found we get the amount of additional surplus:

$$E\pi_{opt} = \frac{(a-b)^3}{27}. \quad (2)$$

■

1.3.3 Independent decision making

What does the independence of both parties - University and Professor - mean? It means that the contract revision will only take place if both parties agree upon new conditions. If such an agreement is not reached, the basic contract remains in force, and additional surplus definitely does not arise. Bargaining follows Nash procedure with bargaining powers of University and Professor equal respectfully ρ and $1 - \rho$, $0 < \rho < 1$. Here we would like to stress that parties bargain over that part of the surplus that emerges due to increase of quality teaching *within* University only. As for the additional employment and a quality of that services, it is the professor who decides and who gets the entire surplus. Such an assumption reflects the fact that it's quite costly (a). to monitor the amount of teaching outside the university and (b). to estimate the amount of earnings received there.

The value of parameter ρ is determined by the level of competition among the teaching staff: the greater such a competition is, the more professors value the place at the University they work at, the greater is the value of ρ .

Lemma 2 *Levels of Professor's and University's investment under independent decision making are:*

$$I_{ind} = \left(\frac{a-b}{3}\right)^3 (1-\rho k)^2 \rho k \quad (3)$$

$$X_{ind} = \left(\frac{a-b}{3}\right)^3 (1-\rho k) \rho^2 k^2 \quad (4)$$

Proof. University solves following maximization problem:

$$\max_X E\pi_{ind}^U = \rho\gamma k(V(I) - C(I)) - X = \rho k(a - b)X^{\frac{1}{3}}I^{\frac{1}{3}} - X$$

First-order condition gives:

$$\frac{1}{3}\rho k(a - b)X^{-\frac{2}{3}}I^{\frac{1}{3}} = 1$$

Professor chooses:

$$\begin{aligned} \max_I E\pi_{ind}^T &= (1 - \rho)\gamma k(V(I) - C(I)) + \gamma(1 - k)((V(I) - C(I)) - I) \\ &= \gamma(1 - \rho k)(V(I) - C(I)) - I = (1 - \rho k)(a - b)X^{\frac{1}{3}}I^{\frac{1}{3}} - I \end{aligned}$$

First-order condition gives:

$$\frac{1}{3}\rho k(a - b)I^{-\frac{2}{3}}X^{\frac{1}{3}} = 1$$

so we get

$$\begin{aligned} I_{ind} &= \left(\frac{1 - \rho k}{\rho k}\right) X_{ind}, \\ X_{ind}^{\frac{1}{3}} &= \left(\frac{a - b}{3}\right) (1 - \rho k)^{\frac{1}{3}} \rho^{\frac{2}{3}} k^{\frac{2}{3}}. \end{aligned}$$

■

Proposition 1 Investment levels of both parties as well as total additional profit under independent decision making are strictly less than socially optimal ones.

Proof. Substituting values of Professor's and University's investments, found in Lemma 2, in total additional profit function, we get:

$$E\pi_{ind} = \gamma(V(I_{IND}) - C(I_{IND})) - X_{IND} - I_{IND} = 2\left(\frac{a - b}{3}\right)^3 (1 - \rho k)\rho k \quad (5)$$

Following the same logic, we can calculate profits for both parties:

$$E\pi_{ind}^U = \gamma\rho k(V(I_{ind}) - C(I_{ind})) - X_{ind} = 2\left(\frac{a - b}{3}\right)^3 (1 - \rho k)\rho^2 k^2 \quad (6)$$

$$E\pi_{ind}^T = \gamma(1 - \rho k)(V(I_{ind}) - C(I_{ind})) - I_{ind} = 2\left(\frac{a - b}{3}\right)^3 (1 - \rho k)^2 \rho k \quad (7)$$

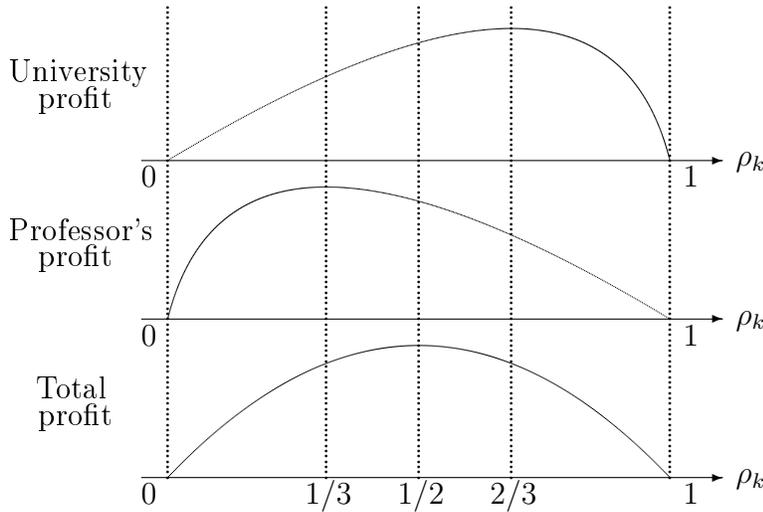
Due to condition $0 < \rho, k < 1$ the following inequalities hold: $\rho k(1 - \rho k) \leq \frac{1}{4}$, $\rho k(1 - \rho k)^2 \leq \frac{4}{27}$, $\rho^2 k^2(1 - \rho k) \leq \frac{4}{27}$, and, taking (5), (3), (4) into account, we get the result.

■

Proposition 2 *Too low values of University bargaining power are not profitable both for University and Professor.*

Proof.

Under independent decision making procedure, profit of the University reaches maximum at $\rho k = \frac{2}{3}$ (due to $\arg \max(1 - \rho k)\rho^2 k^2 = \frac{2}{3}$), profit of the Professor - at $\rho k = \frac{1}{3}$ (due to $\arg \max(1 - \rho k)^2 \rho k = \frac{1}{3}$), and their joint profit - at $\rho k = \frac{1}{2}$ (due to $\arg \max(1 - \rho k)\rho k = \frac{1}{2}$). Thus, the growth in ρk has the following influence on welfare (see picture 2):



Pic. 2. Dynamics of Additional Profits

at the interval $(0; \frac{1}{3})$ profits of both parties increase;

at the interval $(\frac{1}{3}; \frac{1}{2})$ profit of University increases, profit of Professor decreases, total profit increases;

at the interval $(\frac{1}{2}; \frac{2}{3})$ profit of University increases, profit of Professor decreases, total profit decreases;

at the interval $(\frac{2}{3}; 1)$ profits of both parties decrease;

If condition $\frac{1}{2} < \rho < \frac{2}{3}$ holds, then University, who determines parameter k , cannot reach the potential maximum of his profit. In this sense, the constraint on University bargaining power may have positive impact on social efficiency. However, if University bargaining power is critically low: $\rho < \frac{1}{3}$, it is not good for the Professor as well for the University. Indeed, in this case an optimal policy of University is to choose high value of k . In turn, Professor, who expects low level of outside employment and high "taxation" within University, will have low incentives for investments in teaching. Accordingly, University will also invest at low level.

Q.E.D.

■

These results allow us to make several important remarks:

1. As value k is chosen by University, a total additional profit is less than under independent decision making: University forces Professor to teach within University at the level higher than optimal. If decision about k were taken by Professor, profit would have been less than optimal too: Professor would have chosen too intensive outside teaching;
2. Leaving Professor the opportunity to work outside, University creates incentives for Professor to invest in human capital;
3. To be able to reach maximum of his potential profit, University has to have a bargaining power strong enough. The weaker University bargaining power is, the larger is the share of Professor's working time that University will force Professor to work. However, if it is too low, both parties are worse off as professor has no incentives to invest.

1.3.4 University has decision rights

Some situations may arise when due to various reasons Professor has no opportunity to bargain with University. He is presented with a fait accompli that he has to incur additional cost to improve quality of teaching. In such situations one may say that University has an exclusive right for decision making over contract revision.

Lemma 3 *Levels of investment of Professor and University are, respectfully, $I_{uni} = \frac{ak}{27} ((a - b)k - 1)^2$ u $X_{uni} = \frac{a^2k^2}{27} ((a - b)k - 1)$.*

Proof. *If University has an exclusive right to revise the contract, and University decision is obligatory for Professor to implement, then University may extract all the additional surplus, that is created due to increased teaching quality. So University has the following maximization problem:*

$$\max_X E\pi_{uni}^U = \gamma kV - X$$

First-order condition gives:

$$\frac{1}{3}akX^{-\frac{2}{3}}I^{\frac{1}{3}} = 1$$

In turn, Professor bears all cost associated with high quality teaching. However, he may also increase the quality of outside teaching too and extract there all the surplus, created due to such a quality improvement. So Professor maximizes:

$$\max_I E\pi_{uni}^T = \gamma V(1 - k) - \gamma C - I = (a(1 - k) - b)X^{\frac{1}{3}}I^{\frac{1}{3}} - I$$

First-order condition gives:

$$\frac{1}{3}(a(1 - k) - b)X^{\frac{1}{3}}I^{-\frac{2}{3}} = 1$$

So we get

$$I_{uni} = \frac{a(1-k)-b}{ak} X_{uni}, (X_{uni})^{\frac{1}{3}} = \frac{1}{3}(a(1 - k) - b)^{\frac{1}{3}}a^{\frac{2}{3}}k^{\frac{2}{3}}$$

and

$$I_{uni} = \frac{ak}{27}(a(1-k) - b)^2 \quad (8)$$

$$X_{uni} = \frac{a^2k^2}{27}(a(1-k) - b). \quad (9)$$

■

Proposition 3 *Under sufficiently low values of parameter k University investment in the case of independent decision making are greater than in the case of authoritarian decision making by University.*

As University bargaining power grows, the minimal value of k , under which the University investments in the case of independent decision making are greater than in the case of University decision rights, decreases.

Proof.

Comparison of University investment in the cases of independent decision making and of decision by University alone is equivalent to comparison of expressions (4) and (9). So we get:

$$\begin{aligned} X > X_{uni} &\Leftrightarrow (a-b)^3(1-\rho k)\rho^2k^2 > a^2k^2(a(1-k) - b) \Leftrightarrow \\ &\Leftrightarrow a^2(a(1-k) - b) > (a-b)^3(1-\rho k)\rho^2 \Leftrightarrow \\ &\Leftrightarrow a^3 - a^2b - (a-b)^3\rho^2 > (a^3 - (a-b)^3\rho^3)k \Leftrightarrow \\ &k < 1 - \frac{a^2b}{a^3 - (a-b)^3\rho^3} \end{aligned} \quad (10)$$

As one may see from the condition (10), critical value of the parameter k decreases when University bargaining power grows.

Let us note, moreover, that this critical value of k is strictly less than $1 - \frac{b}{a}$ and, thus, condition (10) holds not always.

■

Remark 1 *Obtained result demonstrates that in the case on independent decision making it's reasonable for University to invest intensively iff Professor invests much too. Such investment will take place Professor teaches a lot outside University.*

Remark 2 *When University has decision rights over contract revision, the model of social status franchise is realized: while getting only tiny part of surplus that is created at University due to his high quality teaching, most of the time he teaches outside the University ($k < \frac{a-b}{a}$), so earning most part of his income at that outside job, using the reputation of University he is affiliated with.*

Proposition 4 *Joint additional surplus of both parties in the case of University decision making is lower than socially optimal, and reaches maximum at the level of 0.5 of socially optimal level.*

Proof.

Joint additional profit of University and Professor is equal to

$$\begin{aligned} E\pi_{uni} &= \gamma(V(I_{uni}) - C(I_{uni}) - X_{uni} - C_{uni} = \\ &= (a - b)(X_{uni})^{\frac{1}{3}}(I_{uni})^{\frac{1}{3}} - X_{uni} - C_{uni} \\ &= \frac{a-b}{9}(a(1 - k) - b)ak - \frac{1}{27}(a(1 - k) - b)a^2k^2 \end{aligned}$$

so we get

$$E\pi_{uni} = \frac{2}{27}ak(a - b)(a(1 - k) - b). \quad (11)$$

Let us consider the comparative statics. What is this function behavior when k changes? We may find the value of k , that delivers a maximum:

$$\left(\frac{2}{27}ak(a - b)(a(1 - k) - b)\right)'_k = \frac{2}{27}a(a - b)(a - b - 2ak) = 0$$

$$\text{so arg max} \left(\frac{2}{27}ak(a - b)(a(1 - k) - b)\right) = \frac{a-b}{2a}.$$

$$\text{and } 0 < \frac{a-b}{2a} < \frac{a-b}{a}.$$

Thus, substituting the found value of k in the expression of additional profit and taking condition (2) into account, we get:

$$\max E\pi_{uni} = \frac{((a-b)^3)}{54} = \frac{1}{2} E\pi_{opt}.$$

■

Remark 3 *It's worth noting that the maximum of additional profit in this case is not lower than under independent decision making and also is not limited, as in that previous case, by the value of University bargaining power, as can be reached under any value of ρ .*

Proposition 5 *Under condition of low ($\rho < \frac{1}{3}$) University bargaining power, University has an incentive to buy out the decision rights from the Professor.*

Proof. *For University to have an incentive to buy out the decision rights the following condition should hold:*

$$E\pi_{uni}^U - E\pi_{ind}^U > E\pi_{ind}^T - E\pi_{uni}^T$$

or, the same, the total profit of parties under the case of University decision rights should be greater than under independent decision making:

$$E\pi_{uni}^U + E\pi_{uni}^T > E\pi_{ind}^T + E\pi_{ind}^U \quad (12)$$

Under the condition of University decision rights, University chooses the value of parameter k to make this profit maximal:

$$k_{uni} = \arg \max E\pi_{uni}^U,$$

So one may find University profit under the case when it's up to him to decide about contract revision:

$$E\pi_{uni}^U = \frac{ak^2}{9} (a-b)(a(1-k)-b)$$

$$\text{and, using (8), (9), we get: } k_{uni} = \frac{2(a-b)}{3a}.$$

Thus, condition (12) is rearranged to:

$$E\pi_{uni}^U|_{k_{uni}} > E\pi_{ind}$$

Taking into account the expressions of total profit (5) and (11), it can be expressed as $\frac{4}{243} (a-b)^3 > \frac{2}{27} (a-b)^3 \rho k(1-\rho k) \Leftrightarrow \rho k(1-\rho k) < \frac{2}{9}$.

And $\rho k \in (0; \frac{1}{3}) \cup (\frac{2}{3}; 1)$.

As University seeks to chose $\rho k = \frac{2}{3}$, then ρk may be located in indicated limits only in the case of $\rho < \frac{1}{3}$.

■

1.3.5 Independent decision making with consequent investments

It's quite often in real situations that University in the moment of decision making already possesses an information about human capital investments made by Professor. Accordingly, one may interpret it as if investments are made consequentially. University estimates a professional level of teaching staff and taking this information into account decides what policy would be optimal at the educational market and within University. Indeed, quite often University pays all his attention on the teaching effort but not the results of teaching. Partly it could be explained by the relative ease of such a measurement system. Also it may be due to Soviet tradition of tight organizational control.

The structure of relationship is modified in the following aspect: after the basic contract is signed, Professor decides about the level of investment that he makes in his human capital. The level of this investment is became known to University. University takes it into account, and makes investment by himself too. A surplus, if created, is divided under a condition of independence of parties.

Lemma 4 *Levels of investments of University and Professor under consequent decision making are*

$$I_{sq} = \frac{1}{12} \rho k (a-b)^3 (1-\rho k)^2, \quad X_{sq} = \frac{1}{18} \rho^2 k^2 (a-b)^3 (1-\rho k).$$

Proof. We solve this problem "from the end", applying the method of backward induction. So let us assume that Professor have already invested at the level I . At what level for University is optimal to invest? An answer for this question could be given by solving the University maximization problem with fixed I :

$$\max_X E\pi_{sq}^U = \rho\gamma k(V(I)) - C(I) - X = \rho k(a-b)X^{\frac{1}{3}}I^{\frac{1}{3}} - X$$

So, using first-order condition, we get the optimal investment of University X as a function of Professor's investment I :

$$X_{sq}(I) = \left(\frac{1}{3}\right)^{\frac{3}{2}}\rho^{\frac{3}{2}}k^{\frac{3}{2}}(a-b)^{\frac{3}{2}}I^{\frac{1}{2}}$$

Professor, when choosing the level of investment, can predict the reaction of University. So he solves his own maximization problem taking future decisions of the University into account, that is:

$$\begin{aligned} \max E\pi_{sq}^T &= \\ &= (1-\rho)\gamma k(X_{sq}(I))(V(I) - C(I)) + \gamma(X_{sq}(I))(1-k)(V(I) - C(I)) - I \\ &= \gamma(X_{sq}(I))(1-\rho k)(V(I) - C(I)) = \left(\frac{1}{3}\right)^{\frac{1}{2}}\rho^{\frac{1}{2}}k^{\frac{1}{2}}(1-\rho k)(a-b)^{\frac{3}{2}}I^{\frac{1}{2}} - I. \end{aligned}$$

First order condition gives:

$$\frac{1}{2}\left(\frac{1}{3}\right)^{\frac{1}{2}}\rho^{\frac{1}{2}}k^{\frac{1}{2}}(1-\rho k)(a-b)^{\frac{3}{2}} = I^{\frac{1}{2}}$$

So we get

$$I_{sq} = \frac{1}{12}\rho k(1-\rho k)^2(a-b)^3 \quad (13)$$

$$X_{sq} = \frac{1}{18}\rho^2 k^2(1-\rho k)(a-b)^3. \quad (14)$$

■

Proposition 6 In the case of consequent decision making the following facts hold:

1. Levels of investments of both parties are greater than in the case of simultaneous decision making;
2. Total profit is greater than in the case of simultaneous decision making;
3. University and Professor profits are greater than in the case of simultaneous decision making;

Proof. Fact 1 follows from the direct comparison of (4) and (14), (3) and (13).

Let us find total joint profit under consequent decision making:

$$E\pi_{sq} = (a-b)\left[\frac{1}{216}\rho^3k^3(a-b)^6(1-\rho k)^3\right]^{\frac{1}{3}} - \frac{1}{12}\rho k(a-b)^3(1-\rho k)^2 - \frac{1}{18}\rho^2k^2(a-b)^3(1-\rho k) = \frac{(a-b)^3}{6}\rho k(1-\rho k)^{\frac{3+\rho k}{6}}.$$

Using expression (5) for the total additional profit in the case of independent decision making and taking into account that $\frac{3+\rho k}{36} > \frac{2}{27}$, we proof fact 2.

Taking (13) and (14) into account, one may find that University profit is equal to $E\pi_{sq} = \frac{1}{9}k^2\rho^2(1-\rho k)(a-b)^3$. For any values of ρ, k this profit is higher, than the profit under independent decision making, that is determined by (6).

■

Remark 4 So both Professor and University are better off under consequent decision making. Is everything OK with that?

1.4 Adverse selection

1.4.1 Source of Problem

Let us suppose that University faces Professor that belongs to one of two possible types: $a \in \{a_1; a_2\}$, $a_1 > a_2$. Professor's type determines the value of additional surplus that may arise if he improves his teaching quality. In other words, the higher the value of a is, the higher his qualification is. Under real conditions to determine the type of Professor is quite complicated. However, if investment decisions are made consequently, University may consider the level of Professor's investments as a signal about his type. Accordingly, constructing beliefs about Professor's type on the basis of such a signal, University might choose the level of investments.

What problem might arise with such a schema? Professor is interested in University investing at the high level. So if he belongs to low-ability type, he may pretend to be of high-quality type. He can try to do so by making large investment and inducing University to invest a lot too, at the level higher than optimal for University having low-ability Professor. As a result, an adverse selection arises.

Under what conditions it might happen?

1.4.2 Results

Proposition 7 Suppose University has the following beliefs about Professor's type:

$$\text{Prob}(I = I_i | a = a_i) = 1, i = 1, 2 \tag{15}$$

Then, such defined beliefs lead to adverse selection if the following condition holds:

$$a_2 - b > \frac{-1 + \sqrt{5}}{2}(a_1 - b) \tag{16}$$

Proof.

Under asymmetry of information high ability Professor has no incentives to pretend to be a low ability type. His investment level will be same as in the case of informational symmetry (see (4)).

Low ability Professor chooses between two strategies: *Honest* - to invest in the amount of I_2 and *Cheating* - to invest at the amount of I_1 . If strategy *Honest* is chosen, University, according to his beliefs, considers Professor as low-ability one and invest at the level of X_2 . Otherwise University believes Professor to be of high ability type and invest X_1 .

Denote by $E\pi_{sq}^T(a_i|a_j)$ - Professor of type a_i profit, who sends signal about type a_j . Then additional profit of low-ability Professor in the case of *Honest* strategy is:

$$E\pi_{sq}^T(a_2|a_2) = (1 - \rho k)(a_2 - b)I_2^{\frac{1}{3}}X_2^{\frac{1}{3}} - I_2,$$

and in the case of *Cheating* strategy

$$E\pi_{sq}^T(a_1|a_2) = (1 - \rho k)(a_2 - b)I_1^{\frac{1}{3}}X_1^{\frac{1}{3}} - I_1$$

Using expressions (4), (3), we find:

Additional profit under the *Honest* strategy:

$$E\pi_{sq}^T(a_2|a_2) = \frac{(1-\rho k)^2(a_2-b)^3\rho k}{12}$$

Additional profit under the *Cheating* strategy:

$$E\pi_{sq}^T(a_1|a_2) = \frac{(1-\rho k)^2(a_1-b)^2}{12} (2(a_2 - b) - (a_1 - b))$$

Then opportunistic, cheating strategy is preferable when

$$E\pi_{sq}^T(a_2|a_2) < E\pi_{sq}^T(a_1|a_2) \tag{17}$$

Let us find conditions under which the inequality (17) takes place. So we have:

$$E\pi_{sq}^T(a_2|a_2) < E\pi_{sq}^T(a_1|a_2) \Leftrightarrow$$

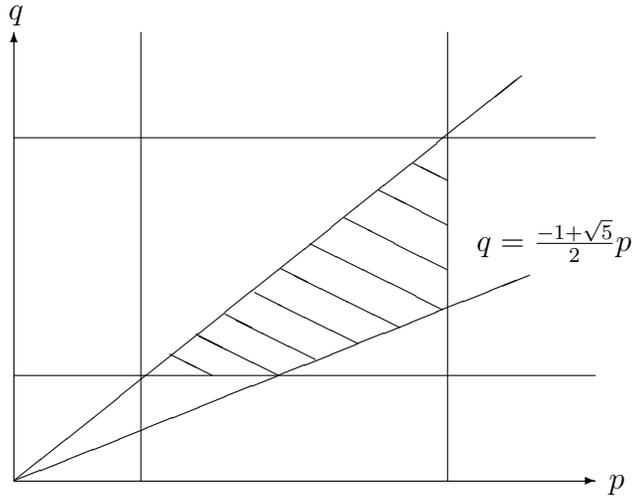
$$\frac{(1-\rho k)^2(a_2-b)^3\rho k}{12} < \frac{(1-\rho k)^2(a_1-b)^2}{12} (2(a_2 - b) - (a_1 - b)) \Leftrightarrow$$

$$(a_2 - b)^3 < (a_1 - b)^2(2(a_2 - b) - (a_1 - b)) \Leftrightarrow$$

$$(a_1 - a_2)((a_2 - b)(a_1 + a_2 - 2b) - (a_1 - b)^2) > 0$$

Let us denote $(a_1 - b) = p$, $(a_2 - b) = q$. then the last condition is equivalent to the condition $q^2 + pq - p^2 > 0$. Solving quadratic equation with respect to q , we rearrange it to $(q - p\frac{-1+\sqrt{5}}{2})(q - p\frac{-1-\sqrt{5}}{2}) > 0$, and get the result (see picture 3).

■



Pic. 3. Adverse selection problem

Thus, if the University considers the level of professor's investment as a signal of professor's teaching abilities, and condition (16) is fulfilled, then an adverse selection exists: low-ability professor makes large investments, disorientating University and forcing him to consider him as a high-ability one.

Incentives for opportunistic behavior as could be seen from condition (16), are determined by the difference in abilities of high and low-ability types. If this difference is large, an opportunistic behavior does not arise: signal about high ability is too costly to send for low-ability type.

It is worth mentioning that incentives for opportunistic behavior do not depend on the values of parameters k, ρ . It means that University, by choosing level of Professor employment or attributing him a larger share of surplus, cannot solve an adverse selection problem.

2 Discussion

Russian Evidence

Evolution of market for economic teaching in Russia in early 1990-s was influenced by an extremely high uncertainty in the economy and sharp opening of frontiers for western standards of teaching and economic research. Dispersion in abilities and qualifications among teachers as well as teaching programs is high. The situation is aggravated by the low density of expert community. Even the university culture itself is often focused on efforts not the results of teaching.

A substantial part of teaching staff is involved in secondary employment. According to Russian Education Monitoring Survey, in year 2003 only 56 percent of University teachers in Moscow were employed at one University only, 15 percent of respondents had at least two permanent jobs while 13 percent mentioned occasional teaching outside University. In regions the situation is even more dramatic.

Respondents mention two major sources of secondary income: private lessons within university (in general, the younger teacher is the higher is the share of private lessons income) and teaching at other universities on part-time basis. Obviously, this secondary employment has a negative impact on incentives and time teacher spend at their home university.

Conclusions

On the basis of theoretical results obtained in our paper several conclusions could be made:

Under a condition of contract incompleteness, incentives for investments depend on the distribution of decision rights for contract revision.

University may be interested in teachers to have secondary employment. It allows him to pay teachers a relatively low salary providing them with an opportunity to use a University reputation at the market for teaching services. Society is better off if some level of competition among universities as well as among teachers exists.

Evaluating of teachers by their efforts is appropriate only if the dispersion in teaching qualifications is high enough or if the University can solve an adverse selection problem that may arise under conditions of low dispersion.

To overcome an adverse selection problem, University should follow a screening policy, offering contracts with different conditions and different level of teaching responsibilities. An analysis of such contracts as well as a search for other mechanisms to prevent an adverse selection are the objectives for further analysis.

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