Written Exam at the Department of Economics summer 2021

Incentives and Organizations

Final Exam
Solution Sketch

18 June 2021

(3-hour open/closed book exam)

Answers only in English.

This exam question consists of 5 pages in total

Falling ill during the exam
If you fall ill during an examination at Peter Bangsvej, you must:

- submit a blank exam paper.
- leave the examination.
- contact your GP and submit a medical report to the Faculty of Social Sciences no later than five (5) days from the date of the exam.

Be careful not to cheat at exams!
You cheat at an exam, if during the exam, you:

- Make use of exam aids that are not allowed
- Communicate with or otherwise receive help from other people
- Copy other people's texts without making use of quotation marks and source referencing, so that it may appear to be your own text
- Use the ideas or thoughts of others without making use of source referencing, so it may appear to be your own idea or your thoughts
- Or if you otherwise violate the rules that apply to the exam

The exam consists of four questions, which in turn consist of several parts. Please note that, because of differences in the workload needed to answer the different questions, different questions may have different weights in determining your overall exam result. Your answers can be short and concise, but your arguments must be explained sufficiently in your own words. Whenever relevant write the general formula and explain what you do in each step. The numerical answer alone is not sufficient.

Good Luck!

Question 1

Consider the following principal-agent model with one principal, P, and a risk-neutral agent, A. The output produced by the agent is determined by her effort devoted to two different task, e_1 and e_2, and the technology of production can be characterized by the following function:

$$y = e_1 + 2e_2 + \epsilon.$$

The principal cannot observe the output y, but only a performance measure x and it is therefore possible to base the agent's compensation only on x, but not on y. The technology of the performance measure is given by:

$$x = 2e_1 + e_2 + \vartheta.$$

ϵ and ϑ are exogenous noise terms drawn from two independent normal distributions with mean 0 and variance $\sigma_\epsilon > 0$, respectively $\sigma_\vartheta > 0$.

The agent is paid according to a linear incentive contract such that her income is $w = s + bx$. Exerting effort levels e_1 and e_2 cause effort costs $C(e_1, e_2) = \frac{1}{2}\, e_1^2 + \frac{1}{2}\, e_2^2$. The agent's utility is given by $u(w, e_1, e_2) = w - C(e_1, e_2)$. Suppose that her utility from an outside option is 0. The principal is risk neutral and maximizes her expected profit $E(\pi) = y - w(x)$.

a) What is A's optimal effort choice e_1^* and e_2^* for a given s and b?

Solution: Optimal effort level can be derived solving the agents maximization problem (see lecture notes, Section 4, slide 38). Optimal effort levels are given by: $e_1^* = 2b$ *and* $e_2^* = b$

b) Which condition needs to be fulfilled for the agent to be willing to accept a contract offer with salary s and commission rate b?

Solution: In order to make the agent accept the contract, the contract has to fulfil the agent's participation constraint (PC). The PC is given by:

$$u(w, e_1, e_2) = w - C(e_1, e_2) \geq 0$$
$$s + b(2e_1 + e_2) - \frac{1}{2}(e_1^2 + e_2^2) \geq 0$$

c) Derive the optimal commission rate b^* that P should offer to the agent to maximize P's profit.

Solution: Principal maximizes expected profits

$$\max_{s,b} E[\pi] = E[y - w(x)]$$
$$= e_1 + 2e_2 - s - b(2e_1 + e_2)$$

s.t. $e_1^* = 2b; \quad e_2^* = b$ *(IC)*

$s + b(2e_1 + e_2) - \frac{1}{2}(e_1^2 + e_2^2) \geq 0$ *(PC)*

Taking derivatives yields the optimal commission rate as $b^* = \frac{4}{5}$ *(see also lecture notes, Section 4, slide 40 with* $f_1 = 1, f_2 = 2, g_1 = 2$ *and* $g_2 = 1$*).*

d) Show whether the optimal incentive contract from part b) elicits the socially optimal (i.e., "first-best") level and distribution of effort.

Solution: First-best effort level is determined by social optimum, i.e. joint payoff of principal and agent (note that wage payments cancel out):

$$\max_{e_1, e_2} e_1 + 2e_2 - \frac{1}{2}(e_1^2 + e_2^2)$$

Considering FOC's with respect to e_1 *and* e_2 *yields:*

$$e_1^{FB} = 1$$
$$e_2^{FB} = 2$$

From part a) and c) it follows that the optimal incentive contract is characterized by effort levels:

$$e_1^* = \frac{8}{5}$$
$$e_2^* = \frac{4}{5}$$

e) Explain intuitively why or why not the equilibrium solution characterizes the social optimum. You can use your answers to parts a) – d) to illustrate your response (but you are also encouraged to respond if you have not answered all of the above questions).

Solution:

- *Performance measure x is not perfectly aligned with the principal's objective to maximize the output y.*
- *This is the case since the two tasks e_1 and e_2 contribute to x and y in a different way.*
- *Since e_2 is more important to produce y than e_1, P prefers higher levels of e_2. Effort costs are the same for both tasks. Therefore, it also optimal from the social perspective that e_2 is larger than e_1.*
- *However, e_1 is more important for performance measure x, which means that the agent prefers higher levels of e_1.*

Question 2

During the course, we discussed two phenomena, which are observationally equivalent in many situation: (i) reciprocity-based cooperation and (ii) relational contracting.

a) Explain both concepts. Describe the underlying assumptions for each concept as well as similarities and differences.

Solution:

- *A reciprocal worker is willing to reward kind behavior, respectively to punish unkind behavior even if it creates additional costs.*
- *If employers anticipate that workers have reciprocal preferences, employers have incentives to pay high wages (with strictly positive rents) as they expect that workers provide high effort levels in response.*
- *Reciprocal workers should indeed respond to fair wage by voluntarily providing high effort levels ("gift exchange").*

- *When principal and agent (expect to) interact repeatedly they may have incentives to form an implicit agreement (a relational contract) that ensures cooperation*
- *When expected future rents are sufficiently high, principal and agent have incentive to not exploit short-run shirking opportunities, even if current pay is not tied to performance*

- *Both concepts can imply voluntary cooperation even in the absence of direct incentives*

- *Relational contracting requires repeated interaction (infinite or with uncertainty about the end date), but no specific assumption about individual preferences are required.*
- *Reciprocity-based cooperation can emerge in one-shot interaction, but requires individuals to have social preferences.*

b) How can we disentangle the two phenomena empirically? *Note: for your discussion you can rely on the following figure taken from the paper "Relational Contracts and the Nature of Market Interactions" by M. Brown, A. Falk and E. Fehr (Econometrica, 2004).*

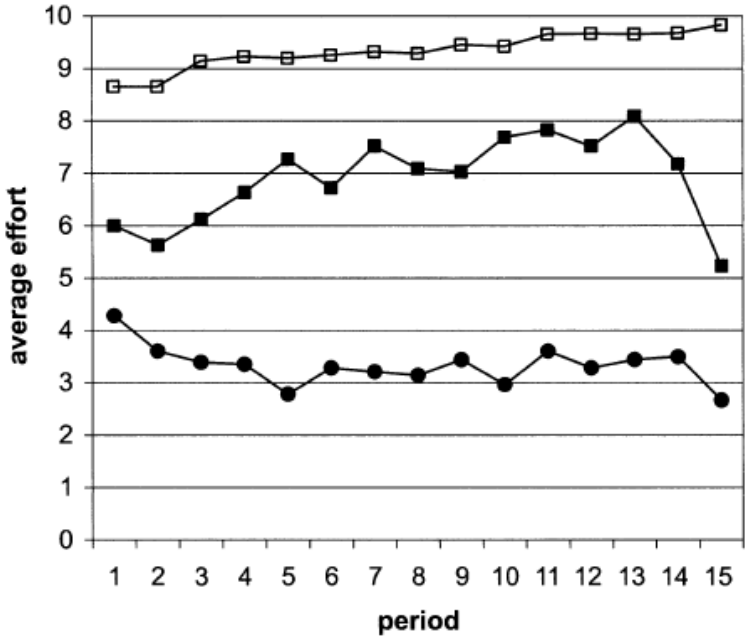


FIGURE 5.—Evolution of average effort over time (C; ICF; ICR).

Solution:

- *It requires comparison of two scenarios (with and without the possibility to interact repeatedly)*
- *Brown et al. (2004): two types of incomplete contracts where effort is not enforceable → short-run incentives to shirk*
    1. *Incomplete contracts **with repeated interactions (ICF)** → workers and firms can engage in relational contracting*
    2. *Incomplete contracts **without repeated interactions (ICR)** (IDs are randomly reshuffled after every period) → workers and firms cannot engage in relational contracting*
- *ICF and ICR are equivalent, but ICF does allow the possibility to form relational contract (repeated interaction is possible), while ICR does not.*

- *ICR is benchmark, where effort level is only affected by reciprocity-based cooperation.*
- *ICF allows identifying the additional effect of relational contracting (note in last period, only reciprocal agents should provide high effort level)*
- *Additional comparison with complete contracts (C): effort is enforceable → no shirking possible*

c) The presence of future rents is important to establish relational contracts. Provide two examples of sources of such rents in employer-employee relationships in the real labor market.

Solution: See lecture notes 5, slide 18.
- *Avoiding the risk of being fired*
- *Future salary increase*
- *Having the prospect of being promoted to a better job*

d) Consider the following statement: *"The fact that many workers receive fixed hourly wages without explicit performance incentives shows that self-enforcing relational contracts are widespread and allow maintaining high levels of cooperation." Do you agree? Why / why not?*

Solution:
- *Relational contracts are only one possible reason why workers cooperate in the absence of explicit performance incentives*
- *Alternatively, workers may have fairness concerns or are intrinsically motivated.*
- *Explicit incentives can backfire, e.g. when they crowd out intrinsic motivation (Deci, 1971) or when workers choke under pressure (Ariely et al, 2009)*
- *Finally, there might be situations where it is not possible or too costly to measure a worker's performance (which is necessary to rely on explicit performance incentives)*

Question 3

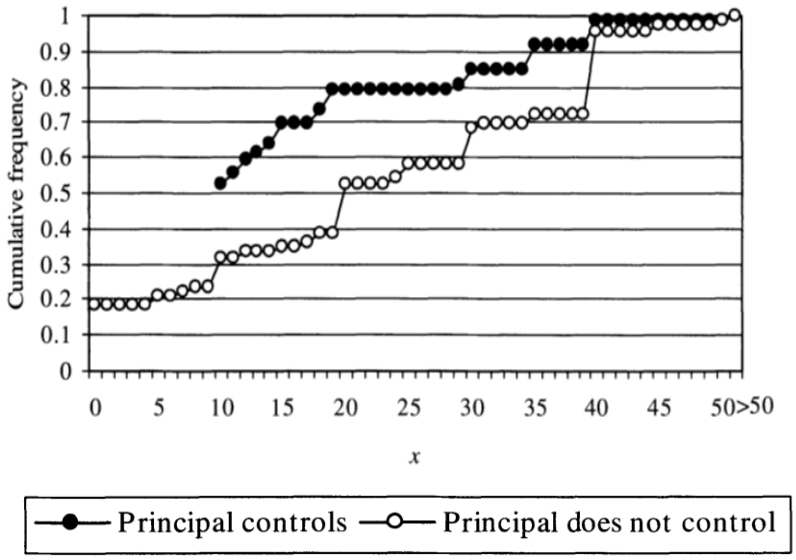
Consider the paper "The Hidden Costs of Control" by A. Falk and M. Koesfeld (AER, 2006).

a) Explain how the authors analyze the consequences of the principal's decision to control on the agent's motivation. *Note: focus on the key aspects of the basic experiment that are crucial for understanding the paper's main results.*

Solution:

- *Principal-agent game: one-shot anonymous interaction; participants are randomly assigned to be either principal or agent*
- *Agent chooses activity that is costly for herself and is beneficial for the principal*
- *Principal can restrict agent's choice set (enforces minimum level of production)*
- *Agent takes decision about production for both possible decisions of principal*
- *Both decide independently not knowing the others' decisions*
- *Alternative treatments with varying minimum levels of production*

b) What is depicted in the following figure that is taken from the paper? What conclusion can be drawn based on these findings?



Solution:

- *Agent produces more when principal decides not to control*
- *When principal controls, more than 50% of agents choose minimum level of production (x=10), when principal does not control, only about 30% choose production of 10 or lower*
- *Average production level is also higher when principal does not control*
- *Majority of agents reward trust by principal with higher effort, respectively punish distrust. This implies that the decision to control the agent can entail a (hidden) cost on the principal.*
- *Some agents, however, choose effort level below the minimum when they are not controlled. For them, the decision to control will increase their production. This indicates that the effectiveness of the control device might be important.*

c) Consider the following statement: *"Given the findings of the paper it becomes evident that trusting your employees is always beneficial for employers as it increases workers' motivation".* Do you agree? Why / why not?

Solution:

- *Whether it is beneficial for employers to trust their employees depends on the parameters of the production process and preferences of the workers*
- *Further results show that the costs of control vanish when the control device becomes more effective (when the minimum level of production that is enforceable increases). Falk and Koesfeld test alternative treatments with x=5 and x=20*
- *Optimal level of control needs to balance trade-off:*
    - *Benefits of control: selfish agents are forced to choose higher effort level*
    - *Costs of control: agents with aversion against distrust choose lower effort level*

Question 4

Consider the study "Performance Pay and Productivity" by Lazear (AER, 2000).

He makes the following claim regarding the implications of his results: *"Some conclusions are unambiguous. Workers respond to prices just as economic theory predicts. Claims by sociologists [e.g. Deci (1971)] and others that monetizing incentives may actually reduce output are unambiguously refuted by the data. Not only do the effects back up economic predictions, but the effects are extremely large and precisely in line with theory."*

Discuss whether and why you do / do not agree with this statement. Base your discussion on Lazear's findings and at least three empirical examples discussed throughout the course.

Solution:

- *Lazear's findings confirm the statement to some degree: he finds an incentive and sorting effect of introducing pay-for-performance as predicted by the standard principal-agent model*
- *Workers' productivity increases by about 22% and the composition of the workforce changes towards more productive workers.*
- *It should be, however, acknowledged that the findings were obtained in a very specific environment: workers work independently (→ rules out peer effects), output was easy to measure and potential adverse effects on quality were easy to obtain (→ no multitasking issues)*

- *Throughout the course, we discussed various papers suggesting that the behavior of economic agents in response to monetary prizes is not always in line with standard economic theory.*

Three possible examples that could be discussed:

1) *Ariely et al. (2009): They argue that higher effort does not necessarily increase output due to arousal and chocking under pressure. In three lab experiments with varying, monetary incentives they find that performance tend to be lower with higher rewards. This contradicts Lazear's statement*

2) *Gneezy and Rustichini (2000): Experimental study that introduces a fine in Israeli day-care centers if parents pick-up their children late. In contrast to standard theory, the frequency of late arrivals increased when the fine was in place (and did not went down again after removing the fine again). One could interpret this as evidence that fine is perceived as a price that parents pay in order to not pick up their children on time, which crowds out their intrinsic motivation to arrive on time.*

3) *Fehr and Goette (2007): Experiment with bike messengers where the treatment group earns a 25% higher commission rate than the control group. While (in line with standard theory) workers increase the number of shifts, they seem to reduce the effort provided per shift. The latter is line with workers having reference-dependent preferences, i.e. they are loss averse around an income target per shift. With a higher commission rate they a more likely to reach to target for lower effort levels, which reduces their effort per shift. This also conflicts with Lazaer's statement ("monetizing incentives may actually reduce output are unambiguously refuted").*

Overall, there is of course empirical support that workers behave as predicted by standard economic theory in many situations. However, at the same time, the empirical literature also provide numerous examples where this is not the case. Overall, the claim appears to generalize the findings obtained in a very specific setting.