

UNIVERSITY OF TORONTO
Faculty of Arts and Science
AUGUST 2009 EXAMINATIONS
ECO381H1S – Personnel Economics
Duration 2 hours
(Instructor: J. Kantarevic)

Instructions

Non-programmable calculators are allowed. The test consists of seven questions, each worth 5 points. Show all your work. Good luck!

SOLUTIONS

1. Consider a one-period employment relationship with the following sequence of events. First, the employer pays w to the worker. Second, the worker supplies effort e . Third, the employer monitors the worker's effort. Fourth, the employer offers a retirement bonus b to workers who are not caught shirking during their period of employment. Effort e can take two values, 0 or 1, and imposes cost $0.25e$ on the worker. The monitoring technology allows the employer to detect shirking (when $e=0$) with probability $p=0.5$. Each unit of effort produces one unit of output. The worker's outside option R is 0.85 and the employer's outside option is 0. Explain what contract offer $[w, b]$ will induce the efficient outcome in this relationship.

- (ICC) The worker will provide $e=1$ rather than $e=0$ if $w+b-0.25 > w+(1-0.5)b$, or when $b \geq 0.5$. Therefore, to induce $e=1$, the employer has to offer at least $b=0.5$.
- (PC) To make the contract acceptable to the worker, the wage should satisfy the participation constraint $w+0.5-0.25 > 0.85$, or $w \geq 0.6$. Therefore, to induce the agent to participate, the employer has to offer at least $w=0.6$.
- (Choice of contract) The employer will choose w and b to maximize her profits. The profits are equal to $1-w-b-1-0.6-0.5=-0.1$ if the worker provides $e=1$ and $-0.6-(1-0.5)0.5=-0.85$ if the worker provides $e=0$. Therefore, it is efficient for the employer not to employ the worker and obtain the outside option of 0. Any w and b that do not satisfy the worker's participation constraint will do.

2. The probability that a military unit of N soldiers wins a battle is given by $Q=q_1+\dots+q_N$. The value of winning the battle, normalized to one, is shared equally by all soldiers. The contribution of each soldier is $q_i=e_i+u_i$, where e denotes soldier's effort and u is a random variable with a mean of zero. The cost of effort is identical for all soldiers and equals $0.5e_i^2$. Due to intensive military training, soldiers feel guilt if they don't give their best in the combat. Specifically, the guilt function is $k(1-e_i)/V$, where k is a parameter that the military can influence and V is a measure of social diversity. Suppose that the Military wants to increase the size of its unit. Show that k that will induce the efficient level of effort must be higher if the new soldiers come from a different social background than the old soldiers.

- The soldier maximizes $E[Q/N] - 0.5e_i^2 - k(1-e_i)/V = (e_1 + \dots + e_N)/N - 0.5e_i^2 - k(1-e_i)/V$. The first-order condition is $1/N - e_i + k/V = 0$.
- The efficient level of effort is given by the MB=MC condition, which yields $e^*=1$.
- Therefore, to induce $e^*=1$, $k=V(1-1/N)$. Differentiating k with respect to N gives V/N^2 , which is positive. Moreover, this function depends positively on V .

3. The aim of the Equal Opportunity Law is to prevent unfair tournaments between identical contestants (e.g. promotion in firms based on gender). Specifically, the aim of the law is to change the tournament rule where i wins over j if $q_i > q_j - k$ to the rule that i wins only if $q_i > q_j$, where $k > 0$. Using the tournament model, explain what impact this law will have on the effort and welfare of contestants. Use the appropriate optimality conditions and constraints to support your answer. Assume that the difference in random components of q_i and q_j is distributed uniformly on $[-1, 1]$.

- When $k=0$, both agents will choose the same effort level, given by $c'(e) = f(0)(W-w)$, and have the same probability of winning $p=0.5$. Therefore, their expected utility will be $w + 0.5(W-w) - c(e) = R$. Substituting for W from the optimality condition above, this gives $w + 0.5c'(e)/f(0) - c(e) = R$, or $w = R + c(e) - 0.5c'(e)/f(0)$.
- When $k > 0$, both agents will choose the same effort level, now given by $c'(e) = f(k)(W-w)$. Given the uniform distribution, $f(k) = f(0)$, so the effort level chosen by the agents will be exactly the same as with $k=0$.
- However, agent i now wins with probability $p = [1 - F(k)] = 1 - (k+1)/2 < 0.5$, while agent j wins with probability $1-p > 0.5$. Therefore, for agent i to participate in the tournament w must be higher: $w = R + c(e) - pc'(e)/f(k)$. Since the difference $W-w$ is the same as in the $k=0$ case, W will be larger as well. Therefore, when $k > 0$, agent i has a smaller expected utility than agent j .
- Therefore, the law will have the following impact: (1) it will not affect the effort level of either agent; (2) it will reduce the expected utility of advantaged agent, but it will not affect the expected utility of the disadvantaged agent.

4. Explain the following two puzzles:

(a) Promotion in some firms is based on seniority rather than on productivity.

(b) Rather than promote within the firm, firms sometimes hire outsiders, even though the firm is uncertain about the productivity of these outsiders.

- (a) There are at least two reasons. First, the firm may be using the deferred compensation scheme. Such a scheme rewards workers who stay with the firm by increasing their pay above their productivity, while recent hires are paid less than their productivity. Such a system may help alleviate incentive problems in firms. Second, the firm may try to avoid rent-seeking activities of workers who could spend time trying to influence the rating by their supervisor. A bureaucratic rule, such as promotion based on seniority alone, may reduce the influence activities of the workers.

- (b) Promotion within the firm may induce sabotage and collusion activities and may discourage co-operation. When these possibilities are significant, the firm may be better off hiring an outsider.

5. The Ministry of Health and Long-Term Care wishes to provide incentives to the Toronto General Hospital and the Princess Margaret Hospital to reduce waiting time for the cardiac surgeries. One option is to pay a bonus to each hospital for each cardiac surgery performed. The other option is to pay a large bonus for the hospital that performs more surgeries than the other hospital. Both hospitals have the same number of physicians and other resources to perform the surgeries. Discuss factors that the Ministry should consider when choosing which of the two options to implement. Briefly review evidence from the course readings on the effectiveness of each option.

- Factors to consider: risk aversion of physicians – importance of factors physicians cannot influence – possibility of gaming – multi-tasking – availability of other objective and subjective measures – monitoring costs – dangers of sabotage and collusion – frequency of technological changes.
- Evidence on piece rate comes from Shearer. In a randomized experiment involving tree planters in B.C., he demonstrated that piece rate workers are about twenty percent than salary workers. Evidence on tournaments comes from Becker and Huselid from NASCAR races. They use a fixed-effects model and demonstrate that racers' finish positions improve when the difference between winning and losing is larger.

6. Employee's output in Coca Cola is given by $q=e+u$, where e is effort and u is a random variable with a mean of zero. Each Coca Cola employee is paid individually according to $w=q$. Employees in Pepsi work in teams of 2. Each employee's output is $q=e+n+u$, where n is employee's ability. Pepsi employees get equal share of their total output $Q=q_1+q_2$. The cost of effort function is $0.5e^2$ for employees in both Coca Cola and Pepsi. All employees are risk neutral and don't exert peer pressure on each other. Each employee in the economy has the ability of either $n=0$ or $n=1$. What is the predicted observed difference in productivity per employee between Coca Cola and Pepsi?

- Employees in Coca Cola of any ability level will choose $e^*=1$. Their expected utility is then $1-0.5(1^2)=0.5$.
- An employee of ability n in Pepsi will choose $e=0.5$. The expected total output is then $Q=0.5+n+0.5+n=1+2n$. Therefore, if the worker is of ability $n=1$, his expected utility is $0.5(1+2)-0.5(0.5^2)=1.375$, which is greater than 0.5 that he can get in Coca Cola. On the other hand, if $n=0$, the employee's expected utility is $0.5(1+0)-0.5(0.5^2)=0.375$, which is less than 0.5 that they can get in Coca Cola.
- Therefore, employees with ability $n=0$ work for Coca Cola and employees with $n=1$ work for Pepsi. Productivity of Coca Cola employees is then 1 and the productivity of Pepsi employees is $0.5+1=1.5$.

7. Prior to 2000, all Canadian firms used a salary contract. In 2000, firms in Ontario switched to a piece rate contract, while firms in the rest of Canada (ROC) did not. To estimate the impact of this change, a researcher has estimated the following model:

$$\text{Productivity} = a + b \times \text{Ontario} + c \times \text{Post2000} + d \times \text{Ontario} \times \text{Post2000}$$

where Ontario is 1 if the firm is in Ontario and 0 otherwise and Post 2000 is 1 for the period after 2000 and 0 otherwise. The results were as follows.

Variable	Coefficient	Standard Error
Ontario	-1.05	0.90
Post2000	1.50	0.30
Ontario × Post2000	2.15	1.45

Interpret the reported coefficients and discuss the identification assumptions for this empirical strategy. Could these results be explained by the multi-tasking problem?

- There was no significant productivity difference between ROC and Ontario prior to 2000 ($b = -1.05$, but $t > -2$). Productivity increased significantly in ROC after 2000 ($b = 1.5$, with $t > 2$). However, the change in productivity between Ontario and ROC before and after 2000 was not significantly different ($d = 2.15$, but $t < 2$).
- This empirical strategy is known as the difference-in-difference strategy. The main assumption behind this strategy is the common trend assumption: in the absence of treatment, outcomes in the treatment and control groups would evolve similarly.
- The results indicate no significant impact of the piece rate on productivity. This could be explained by the multi-tasking problem as follows. This problem is likely to reduce the ability of firms to provide high-power incentives. As a result, low-power incentives can improve results by a small amount, which due to sample variation may not be picked in the data.