Applied Microeconomics: Supervision 7

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Overall Grade: Good/Excellent

Overall Comments: You are in the stage of being more efficiency to answer the questions as you know pretty well all the material. Sometimes you lose focus and don't answer the question. Otherwise is a really good piece of work.

Short Questions Comments:

1) When selling insurance to groups of individuals, companies will set a premium that reflects average risks within those groups. If individuals select into these groups for reasons unrelated to their health risks, the resulting premium will be approximately equal to the average medical costs in the overall population.

2) Good answer.

3) Good answer.

4) Good answer.

Problem 1 Comments:

A) You were suppose to derive the optimal B given the functional forms. B=1/(1+ d var(x) L e^L-1)

B) Really good answer.

Problem 2 Comments:

A) Perfect answer.

B) Perfect answer.

C) While the new contract does reduce the incentive of making effort, it is not perfectly complied with the 100% cap regulations. Due to the randomness of the variable x, bankers are not able to anticipate whether their wages are in the fixed payment range.

Principal-Agent Model to explain CEO contracts

- Employer (firm) is risk neutral.
- Employees (CEO) are risk-averse.
- Efforts are unobservable and costly.
- One period model.

• <u>Contract Specification</u>

An employer is risk neutral with an expression

$$M = e - w(z, Y)$$

with $z = \underbrace{x}_{\text{noise}} + e$, $E(x) = 0$ and $E(Y) = 0$.

A linear contract between the employer (firm) and the employee (CEO)

$$w(z, Y) = \alpha + \beta (z + \gamma Y)$$

$$w(z, Y) = \underbrace{\alpha}_{\text{constant payment}} + \underbrace{\underset{\text{intensity of the incentives}}{\beta}(x + e + \gamma Y)}_{\text{bonus}}$$

We assume the risk-averse agent has a mean-variance utility function

$$U = E[w(z,Y)] - \frac{1}{2}\rho \operatorname{var}(w(z,Y)) - c(e)$$

Definition of risk premium r

$$u(E[w] - r) = E[u(z)]$$

Let $w^{CE} = E[w] - r$ be the certainty equivalent amount then

$$u(w^{CE}) = E[u(w)]$$

Take a general second-order Tayler Expansion of $U(w)$ around w_0

$$u(w) = u(w^0) + u'(w_0)(w - w_0) + \frac{1}{2}u''(w_0)(w - w_0)^2 \quad (1)$$

Take a first-order Tayler Expansion $U(w^{CE})$ around w_0

$$u(w^{CE}) = u(w_0) + u'(w_0)(w^{CE} - w_0) \quad (2)$$

Taking the expectation of (1)

$$E[u(w)] = E[u(w^0)] + E(u'(w^0)]\left(E[w] - E[w^0]\right) + \frac{1}{2}E[u''(w_0)]E[(w - w^0)^2]$$

Notice that $u(w^o)$ is a constant then $E[u(w^o)] = u(w^o)$

$u'(w^o)$ $\qquad E(u'(w^o)) = u'(w^o)$

$u''(w^o)$ $\qquad E(u''(w^o)) = u''(w^o)$

If $w^o = E(w)$ then

$$E[u(w)] = u(E[w]) + u'(E(w))\big(E(w) - E[E(w)]\big) + \frac{1}{2} u''(w^o) E[(w - E(w))^2]$$

$$E[u(w)] = u(E[w]) + \frac{1}{2} u''(E[w]) E[(w - E[w])^2] \qquad ③$$

For ② set $w^o = E[w]$

$$u(w^{CE}) = u(E[w]) + u'(E[w])(w^{CE} - E[w]) \qquad ④$$

Given the certainty equivolence definition

$$u(w^{CE}) = E[u(w)]$$

$$④ = ③$$

$$u(E(w)) + u'(E(w))(w^{CE} - E(w)) = u(E(w)) + \frac{1}{2} u''(E(w)) E[(w - E(w))^2]$$

$$w^{CE} = E(w) + \frac{1}{2} \frac{u''(E(w))}{u'(E(w))} E[(w - E(w))^2]$$

$$w^{CE} = E(w) - \frac{1}{2} \underbrace{\frac{-u''(E(w))}{u'(E(w))}}_{\rho} E[(w - E(w))^2]$$

$\hookrightarrow$ Absolute risk aversion coefficient

$$w^{CE} = E(w) - \frac{1}{2} \rho \operatorname{Var}(w)$$

The employer maximises the Certainty Equivalent Value

$$U^{CE} = E\left[w(z, Y)\right] - \frac{1}{2}\rho \; var\left(w(z, Y)\right) - c(e)$$

$$U^{CE} = E\left[\alpha + \beta(x + e + \gamma Y)\right] - \frac{1}{2}\rho \; var\left(\alpha + \beta(x + e + \gamma Y)\right) - c(e)$$

$$U^{CE} = E(\alpha) + \cancelto{0}{E(\beta x)} + E(\beta e) + \cancelto{0}{E(\gamma Y)} - \frac{1}{2}\rho\left[\cancelto{0}{var(\alpha)} + var(\beta x) + \cancelto{0}{var(\beta e)} + var(\gamma Y)\right] - c(e)$$

$$U^{CE} = \alpha + \beta e - \frac{1}{2}\rho\beta^2 \; var(X + \gamma Y) - c(e)$$

The principal problem (employer - firm) chooses the scheme of linear contract (α, β, γ) to maximise

$$\max_{\alpha, \beta, \gamma} \; e - w(z, Y) \quad s.t. \; U^{CE} \geq \underline{U}$$

The agent problem (employee - CEO) chooses the level of effort e to maximise

$$\max_{e} \; U^{CE}$$

$$\max_{e} \; \alpha + \beta e - \frac{1}{2}\rho\beta^2 \; var(X + \gamma Y) - c(e)$$

Step 1: Solve the agent problem

$$\max_{e} \quad \alpha + \beta e - \frac{1}{2} \rho \beta^2 var(x + \gamma Y) - c(e)$$

FOC

$$\beta = c'(e^*)$$

Step 2: Solve the principal problem (α, β, γ) given the optimal effort e^*

$$\max_{\alpha, \beta, \gamma} \quad e^* - [\alpha + \beta(x + e^* + \gamma Y)] \quad s.t. \quad U^{CE}(e^*) \geq \underline{U}$$

a) Solve for α

$$U^{CE}(e^*) = \underline{U} \Rightarrow \alpha + \beta e^* - \frac{1}{2} \rho \beta^2 var(x + \gamma Y) - c(e^*) = \underline{U}$$

$$\Rightarrow \alpha = \underline{U} - \beta e^* + \frac{1}{2} \rho \beta^2 var(x + \gamma Y) + c(e^*)$$

β) Solve for β

Replace α

$$\max_{e^*} \quad e^* - \frac{1}{2} \rho \beta^2 var(x + \gamma Y) - c(e^*) - \underline{U}$$

FOC

$$\frac{de^*}{d\beta^*} - \rho \beta^* var(x + \gamma Y) - c'(e^*) \frac{de^*}{d\beta^*} = 0$$

From the agents problem $\frac{d\beta}{de^*} = c''(e^*)$

$$\frac{de^*}{d\beta^*}\left(1 - c'(e^*)\right) = \rho \beta^* var(X + \gamma Y)$$

$$1 - c'(e^*) = \rho \beta^* var(X + \gamma Y)\, c''(e^*)$$

As $\beta = c'(e^*)$ $\quad 1 = \rho \beta^* var(X + \gamma Y)\, c''(e^*) + \beta^*$

$$\beta^* = \frac{1}{1 + \rho\, Var(X + \gamma Y)\, C''(e^*)}$$

c) Solve for γ

↳ $cov(X, Y) = 0 \Rightarrow \gamma = 0$

↳ $cov(X, Y) \neq 0 \Rightarrow \gamma^* = -\frac{cov(X, Y)}{Var(Y)}$

Summary Note for Contracts: Supervision 1

Sebastián Cortés-Corrales[1]

1 CEO Compensation: "Rent extraction" vs "Shareholder value"

This note discusses the main academic debate concerning executive compensation. This debate revolves around the issue that traditional principal-agent models are not consistent with the data. This led to a rise in theories suggesting that CEO compensation results from "rent extraction" by CEOs. However, more recent contributions propose "shareholder value" theories, which are specific to the CEO setting and deliver empirically robust predictions. The conclusion from the current debate is that shareholder practices for setting executive compensation need not be inefficient as they are consistent with both models with multiplicative production functions and dynamic considerations.

1.1 Traditional Agency Models

Traditional agency models derive predictions for the optimal CEO contract based upon the *i)* Informativeness Principle, *ii)* Incentive Intensity Principle and *iii)* Participation Constraints. The issue of these traditional models is that they are derived from off the shelf principal-agent models, without reference to the empirical features of CEO salary setting and incentive structures.

1.2 Rent Extraction

Rent extraction theories purport that contracts are not decided by firms to maximise shareholder value, but by CEOs to maximise their own return (Bebchuk and Fried, 2004). This has led to significant policy changes, including:

- US disclosure of compensation (2006)
- US say on pay legislation in Dodd-Franck Act (2010)
- US disclosure of ratio of CEO pay to median worker (2013)
- EU caps on bankers' bonuses (2013)

[1] I would like to thank Oliver Exton and Toke Aidt for starting and sharing this note. This note summarises some of the main concepts covered in the supervision, but do NOT constitute answers to any of the problems. If you spot any mistakes or have any suggestions, please contact me at sc2198@cam.ac.uk.

1.3 Shareholder Value

Shareholder value models extend the standard principal-agent models to include the specifics of the CEO-firm relationship. In particular, they account for the relationship between the CEO and firm performance, where CEOs can have much larger effects on firm performance than average employees. The pay of CEOs can be considered with two dimensions: the level of pay and the use of incentives.

1.3.1 Level of Pay

An empirical regularity is that CEO pay increases in firm size. Whilst neo-classical models incorporate the CEO talent in a standard production function, more recent theories incorporate assignment models. Gabaix and Landier (2008) incorporate a multiplicative function of firm value V with CEO talent $T(m)$ and firm size $S(n)$ of CEO with rank m at firm with rank n.

$$V = S(n) + C\,S(n)^{\gamma}\,T(m)$$

where C parameterises productivity of talent and γ the elasticity of talent with respect to firm size. This model also generates predictions for the relationship between CEO pay and firm size, that better match the empirical predictions. The key mechanism in the model follows the Sattinger (1993) result that the largest, most productive firms hire the most able CEOs.

1.3.2 Incentive Structures

Shareholder value models extend the traditional principal-agent models which consider a static moral hazard model with a CEO taking an action that potentially benefits the firm and where the CEO is risk-averse. It is the specific modelling assumptions that CEO actions are multiplicative for firm value that generates the significantly improved empirical predictions of the models, in particular that the correct elasticity to consider is the "% - %" elasticity of the percentage change in pay to a percentage change in firm value, rather than the standard "$- $" relationship (which should have a weak relationship in an optimal contract for high value firms).

2 Additional Reading

Abowd, J. M., Kramarz, F., Margolis, D. N. (1999). High wage workers and high wage firms. Econometrica, 67(2), 251-333, Chicago.

Edmans, A., Gabaix, X. (2016). Executive compensation: A modern primer. Journal of Economic literature, 54(4), 1232-87, Chicago.

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Piketty, T., Saez, E. (2003). Income inequality in the United States, 19131998. The Quarterly journal of economics, 118(1), 1-41.

Sattinger, M. (1993). Assignment models of the distribution of earnings. Journal of economic literature, 31(2), 831-880.

Song, J., Price, D. J., Guvenen, F., Bloom, N., Von Wachter, T. (2015). Firming up inequality (No. w21199). National Bureau of Economic Research, Chicago.