EC476 Part IV
Class 3

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This problem set covers the appendix in the lecture notes based on Klaus Schmidt's 1997 paper "Managerial Incentives and Product Market Competition".

Owen owns of a widget firm. He is the only producer of widgets in town and enjoys monopoly rents, but he has taken a risk and committed to produce widgets with a new technology that he hopes will lower his costs. He has employed a manager called Mary to oversee the firm's transition to the new technology. If it is successful (S), his costs will be low and his profits will be π. If it is unsuccessful (F) his costs will be so high that he will close up shop.

The likelihood that the transition succeeds hinges on Mary's effort, which we identify directly with its probability, $e = \mathbb{P}[\mathrm{S} \mid e]$. All would be well except Mary is lazy and would prefer not to exert effort—she bears the cost $e^2/2$ for it—so Owen offers her incentive pay. He pays her b if the project succeeds and lets her go without pay if he liquidates the business; he knows, however, that Mary has few outside opportunities (we assume that her participation constraint is slack throughout) and that she will suffer a loss equal (in utility

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terms) to L she is out of work, and hopes he won't have to pay Mary a big bonus to make her work hard.

Suppose throughout that parameters are such that the first-order approach is valid.

1. (a) Explain why Owen thinks that L will help him. Would he prefer to charge Mary a fine in the bad state? L is a deadweight loss. Does it make sense that it could improve efficiency?

   (b) Given her wage schedule b, Mary's problem is to maximize

$$\mathbb{E}\left[u_{\mathrm{M}}(b)|e\right] = \mathbb{P}\left[\mathrm{S}|e\right] b - \mathbb{P}\left[\mathrm{F}|e\right] L - \frac{e^2}{2} \tag{1}$$

   Show that her (subgame perfect) equilibrium effort level is

$$e_{\mathrm{M}} = b + L. \tag{2}$$

   (c) Owen's problem is thus to maximize

$$\mathbb{E}\left[u_{\mathrm{O}}(b)|e\right] = \mathbb{P}\left[S|e\right](\pi - b) \tag{3}$$

   subject to $e = e_{\mathrm{M}}$. Show that at equilibrium

$$b_{\mathrm{O}} = \frac{\pi - L}{2} \tag{4}$$

   and thus

$$e_{\mathrm{M}} = \frac{\pi + L}{2}. \tag{5}$$

   (d) i. Note that effort increases as L increases. Provide an example of L increasing and interpret.

   ii. Write down Owen's and Mary's equilibrium (indirect) utilities and differentiate to find the effects of varying L. Comment on who might gain and benefit from a slow labour market.

2. Suppose that Rupert, another entrepreneur, has seen Owen's investment and enters the market to compete with him. Rupert's firm is identical to Owen's; he also has a single employee who exerts effort e_{R}. Model the duopoly with the reduced form assumption that if with O or R is successful in implementing the new technology while the other is not then the successful one gets profit π and the unsuccessful one liquidates his business, leaving his employee out of work; if both are successful or both unsuccessful then they compete à la Bertrand and make no profits, but hang on to their employees.

   Managers are paid based on their performance but again suffer L if firms are liquidated.

   Owen and Rupert simultaneously set their wages, then their managers exert effort, and then payoffs realize.

   The success probabilities are independent.

		Owen	
		success	failure
Rupert	success	$0\ ,\ 0$	$\pi - b_{\mathrm{O}}\ ,\ 0$
	failure	$0\ ,\ \pi - b_{\mathrm{R}}$	$0\ ,\ 0$

RIVAL FIRMS

Figure 1: A firm profits only when it succeeds and its rival fails, otherwise it gets zero.

   (a) How might the role of L in the managers' payoffs be called "market discipline"?

   (b) Explain why Owen's wage-setting problem depends on the effort exerted by Rupert's manager. In particular, since Mary's problem

		Mary	
		success	failure
Rupert's Manager	success	b_O , b_R	b_O , $-L$
	failure	$-L$, b_R	0 , 0

RIVAL MANAGERS

Figure 2: Managers get paid whenever they succeed and suffer when their rivals succeed and they fail.

is now to maximize

$$\mathbb{E}\left[u_\mathrm{M}(b_\mathrm{O}) \,\middle|\, e, e_\mathrm{R}\right] = eb_\mathrm{O} - (1-e)e_\mathrm{R}L - \frac{e^2}{2} \tag{6}$$

show that

$$e_\mathrm{M} = b_\mathrm{O} + e_\mathrm{R}L. \tag{7}$$

(c) Explain why Owen's problem is to maximize

$$\mathbb{E}\left[u(b) \,\middle|\, e_\mathrm{M}, e_\mathrm{R}\right] = e_\mathrm{M}(1-e_\mathrm{R})(\pi - b) \tag{8}$$

subject to $e_\mathrm{M} = b_\mathrm{O} + e_\mathrm{R}$ and show that at equilibrium

$$b_\mathrm{O} = \frac{\pi - e_\mathrm{R}L}{2} \tag{9}$$

and hence

$$e_\mathrm{M} = \frac{\pi + e_\mathrm{R}L}{2}. \tag{10}$$

(d) Argue that the wage-setting best response functions can be seen as effort best-response functions so that at equilibrium

$$e_{\mathrm{M}}\big(e_{\mathrm{R}}(e)\big) = e \tag{11}$$

and

$$e_{\mathrm{M}}\big(e_{\mathrm{R}}(e)\big) = e. \tag{12}$$

Since the game is symmetric the best-response functions will coincide. Show that at equilibrium

$$e_{\mathrm{M}} = e_{\mathrm{R}} = \frac{\pi}{2-L}. \tag{13}$$

(e) Comment on when market discipline is effective(increases effort) from the inequality

$$\frac{\pi}{2-L} > \frac{\pi + L}{2}. \tag{14}$$