Economics 354 **Spring 2008**
Homework Assignment **Due: noon, Friday, March 28**

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1. Consider the model whose game tree is depicted in Scotchmer's Figure 5.4. This model assumes that Firm 1 chooses to invest in the basic research that is needed for the application to be discovered and that Firm 2's investment in the application is contingent of being able to earn positive profits from the project. Innovation pairs are characterized by the parameters (x, y, c_1, c_2). Other variables in the model are the profit share under patent protection π, the discounted patent length T, and the deadweight loss share ℓ.

Suppose that $T = 10$, $\pi = 0.5$, $\ell = 0.25$, and $r = 0.05$. Consider the four innovation pairs I, II, III, and IV with parameters shown in the table below:

Innovation pair	x	y	c_1	c_2
I	500	1000	2000	2000
II	0	1000	2000	2000
III	0	1000	2000	2700
IV	0	1000	2500	2700

For each of these pairs, calculate:

i. the total net social benefit from the innovation pair if both innovations are put in the public domain,
ii. the total benefit to users if the two innovations are undertaken under patent protection,
iii. the total net benefit to a combined firm undertaking both innovations under patent protection,
iv. the threat points of each firm under (1) ex-post licensing and (2) ex-ante licensing,
v. the total gains to the two firms from (1) ex-post licensing and (2) ex-ante licensing,
vi. the payoffs to each firm under ex-post licensing assuming Nash bargaining: that the total gains from licensing are divided equally,
vii. the payoffs to each firm under ex-ante licensing assuming Nash bargaining.

Based on these calculations,

a. Would this innovation pair be socially beneficial if a government performed both innovations (using tax money raised through lump-sum taxes) and offered the resulting products free?
b. Would this innovation pair be profitable under the current patent regime if both innovations were done jointly by the same firm?
c. Would it be feasible for this innovation pair to emerge through ex-post licensing between two firms?
d. Would it be feasible for this pair to emerge through ex-ante licensing between two firms?

What outcome do you predict in each case? Who gains and loses the most in each case relative to the ideal outcome?

2. As noted in the previous problem, Scotchmer's Figure 5.4 model assumes that the basic research has already been done by Firm 1. The difference between ex-ante and ex-post licensing is whether it is done before or after Firm 2 invests. What would be the outcome of before-basic-research licensing if the two firms were to bargain before either had invested? Is there ever a case where this outcome would be better than either after-basic-research bargaining scheme can achieve? Explain.

3. Explain why in the model of Scotchmer's Figure 4.1, intellectual property (even with infinite patent length) can never achieve the socially optimal level of innovation. Would this answer be different if innovators could be perfect price discriminators in the market for their innovated products? Would you advocate such a policy? Why or why not?

4. Suppose that in the model of Scotchmer's Figure 4.2 there is a project in which each firm that does R&D has a 5% chance of success per year of R&D at a cost of $200,000 per year. Discounted patent length is 18 years, the profit rate π is 0.50, deadweight loss percentage ℓ is 0.25, and the interest rate is 5%. The social value of the innovation is $500,000 per year.

For all values of n between zero and 15, calculate the total expected social benefit and total social cost, net expected social benefit (total expected social benefit minus total social cost), and expected net gain for the marginal entrant. (You may find it convenient to use Excel formulas to do this.) What would be the socially optimal number of firms doing R&D? How many would enter? Is discounted patent length too short or too long in this case? What would be the optimal discounted patent length? How much additional social benefit is gained by having the optimal length rather than 18 years?