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TOPICS IN INTERNATIONAL TRADE (ECONOMICS 507B)
Final Exam

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Please write your student ID number at the top of each page you turn in and number all pages (For example, if you use 6 pages, label them 1 of 6, 2 of 6, and so on.) Do not write your name anywhere on the exam.

You must answer all questions on this exam. Good luck, and have a great winter break!

1) <u>Short answer</u> (60 minutes) Indicate whether each of the following statements is true, false or uncertain and explain why. Your grade will be based mostly on your explanation. For maximum credit, be as precise and complete possible.

a) In the search model of an export-oriented industry developed by Davidson et al (2006), it is always preferable to create a high-tech firm, but the number of these firms is limited by the number of high-skilled workers.

b) In the model developed by Antras et al (2006), allowing international teams to form is generally good for managers and bad for workers.

c) The learning by doing mechanism described by Young (1991) is consistent with econometric evidence on cross-generation spillovers from Irwin and Klenow (1994) and Thorton and Thompson (2001).

d) Open economies generally grow faster.

e) In Young's (1991) model of trade with learning by doing, a technologically backward country will grow faster if its trading partner is very advanced than if its trading partner is moderately advanced.

2) (25 minutes) Suppose the combination of activity x and activity y generates revenue according to $R(x,y) = x^{\mu\eta} y^{\mu(1-\eta)}$, where $0 < \mu < 1$, $0 < \eta < 1$. If both activities are pursued within a multinational firm, the firm earns profits:

$$\Pi^I = R(x,y) - cx - a\alpha y\,.$$

Here $c>0$ and $a\alpha > 0$ are the multinational's (exogenous) unit costs of x and y production, respectively, and $\alpha>1$. On the other hand, if the multinational outsources activity y to a local firm, and its bargaining power is such that it gets some share θ of the rents, the multinational's payoff is:

$$\Pi^O = \theta\left[R(x,y) - xr_c - yr_a\right] + xr_c - cx$$

Here $r_a < a$ and $r_c < c$ are the exogenous reservation prices for y and x, respectively.

a) Assume that when the multinational outsources the y activity to a supplier, the resulting x and y choices are the profit-maximizing Nash equilibrium. Derive an expression for the ratio of $R(x,y)$ in the outsourcing equilibrium to $R(x,y)$ in the internalized equilibrium. (<u>Note</u>: in the outsourcing equilibrium, the firm supplying y earns $\Pi^L = (1-\theta)\left[R(x,y) - xr_c - yr_a\right] + yr_a - ay$.) Your expression should involve only exogenous variables and parameters.

In the outsourcing equilibrium, each agent chooses the profit maximizing activity level, taking the activity level of the other agent as given. First order conditions are:

(i) $\theta \frac{\partial R}{\partial x} + r_c(1-\theta) = c \Rightarrow \mu\eta \frac{R}{x} = \frac{c - r_c}{\theta} + r_c \equiv w_x$

(ii) $(1-\theta)\frac{\partial R}{\partial y} - r_a(1-\theta) + r_a = a \Rightarrow \mu(1-\eta)\frac{R}{y} = \frac{a - r_a}{1-\theta} + r_a \equiv w_y$

These conditions imply that $x = \mu\eta R / w_x$, $y = \mu(1-\eta)R / w_y$. Substituting into the revenue function yields $R = \left(\frac{\mu\eta R}{w_x}\right)^{\mu\eta}\left(\frac{\mu(1-\eta)R}{w_y}\right)^{\mu(1-\eta)}$, or solving for *R*, $R = A\left[(w_x)^{\eta}(w_y)^{(1-\eta)}\right]^{\mu/(\mu-1)}$, where *A* is a constant that depends on η and μ and w_x, w_y are as defined above.

In the internalized equilibrium, the solution takes the same form, but the multinational sets both *x* and *y* and gets the entire revenue stream. It pays $\alpha a > a$ for each unit of *y* activity and *c* for each unit of *x* activity. So setting $\theta = 1$, $w_x = c$, $w_y = a\alpha$, the first-order conditions above yields $R = A\left[(c)^{\eta}(a\alpha)^{(1-\eta)}\right]^{\mu/(\mu-1)}$. The ratio of revenues with outsourcing to revenues in the internalized equilibrium is thus:
$R = \left[\left(\frac{w_x}{c}\right)^{\eta}\left(\frac{w_y}{a\alpha}\right)^{(1-\eta)}\right]^{\mu/(\mu-1)}$. Note for use in part b below that $w_x > c$ and $w_y < a\alpha$.

b) Demonstrate that when η is close to 1, the multinational is likely to avoid outsourcing. What is the intuition behind this result?

3) (25 minutes) Consider a two-period, two-country model with Melitz-Ottaviano preferences. Let technologies in period 1 be distributed across firms according to a Pareto distribution, so that if *N* products compete in the domestic market, operating profits at firm *i* in period 1 are: $\pi(c_i^1) = \begin{cases} \frac{L}{4\gamma}(c_D(N) - c_i^1)^2 & c_i^1 < c_D(N) \\ 0 & c_i^1 \geq c_D(N) \end{cases}$, where $c_D'(N) < 0$.

(Here γ is a utility function parameter, *L* is the labor force, and *N* is the number of firms active in the home market.) Further, assume that if firm *i* devotes x_i units of labor to innovation, its period 2 marginal costs will be $c_i^2 = \begin{cases} c_i^1 \text{ with prob. } 1 - g(x_i) \\ c_i^1 - \delta \text{ with prob. } g(x_i) \end{cases}$ where $g(x_i) = 1 - e^{-\kappa x_i}$.

a) Assume that the number of firms in the market is fixed at *N*, and that firms believe the distribution of firm types (*c*'s) will remain the same in period 2. Treating the wage rate as the numeraire, derive a closed-form expression for the amount of innovative effort by firm i, x_i. (Treat the wage rate as the numeraire.) How, if at all, do innovation efforts vary across firms with different marginal costs? Will the period 2 distribution of firm types really remain Pareto? Why or why not?

b) Continue to assume that firms believe the distribution of firm types (c's) will remain the same in period 2. But now suppose the home country unilaterally liberalizes at the end of period 1, so that the number of firms N competing in the domestic market will be larger in period 2. (This is correctly understood by all agents.) How does this trade liberalization affect the rate of domestic innovation? Does it affect firms with different marginal costs differently? Do your findings reflect Schumpeterian forces, incentives to distance one's firm from competitors, or some combination of these two effects? (To refresh your memory, recall that the inverse demand function faced by firm i is $p_i = c_D(N) - \frac{\gamma}{L} q_i$.)

c) Comment on whether the representation of endogenous innovation described above might serve as the basis for a characterization of steady state growth.