TOPICS IN INTERNATIONAL TRADE (ECONOMICS 507B)
Final Exam

December 19, 2006

Professor Tybout

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) Short answer (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.

False. It is true that the availability of skilled workers affects the tightness of the skilled labor market and thus affects the returns to creating a high-tech firm. It is also true that the number of high-skilled workers puts an upper bound on the number of high-tech firms. But this upper bound will not be binding because there is always some unemployment among high-tech firms due to exogenous job separations. Further, in some equilibria, high-skill workers accept jobs at low-tech firms. And regardless of the type of equilibrium, the returns to creating a low-tech firm are exactly the same as the returns to creating a high-tech firm.

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

False. Whether workers gain from the formation of international teams depends upon where they lie in the talent distribution, and where they are geographically located. In the high quality equilibrium with global matching, low-talent workers in the South benefit from globalization while low-talent workers in the North are made worse off. The former get matched with better managers by entering the global labor pool, where managers are of higher average quality than in the south under autarky. The latter lose managerial quality when globalization induces some of the best northern managers talent to form international teams, and induces some northern workers of modest talent to begin managing. Similarly, the highest quality managers in the north get worse workers after globalization because the best pre-globalization workers become managers themselves. But lower quality managers in the north benefit from an improvement in the quality of the workers they match with as some of the higher-talent southern managers become workers after globalization. Managers in the south who remain managers get matched with worse workers once northern managers start forming international teams. (Some southern managers switch to being 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).

Uncertain. There is strong evidence of learning by doing from the both the microchip industry (Irwin and Klenow) and the shipbuilding industry (Thorton and Thompson) Productivity clearly falls with production volume, both at the firm level and industry-wide. The microchip industry and the shipbuilding industry also show evidence of cross-firm spillovers, suggesting that there is a public component to knowledge creation, just as in Young's model. However, both industries also suggest that, controlling for industry-wide knowledge, there are positive within-firm effects of experience on productivity, so not surprisingly, and counter to Young's assumption, knowledge isn't a pure public good. Also, the evidence is mixed on cross-product knowledge spillovers, which are central to Young's model. These spillovers appear to be present in the shipbuilding industry, but only sporadically present in the microchip industry. So taking the findings of these empirical studies at face value, Young's specification is only partially supported.

d) Open economies generally grow faster.

Uncertain. Several problems complicate inference in the literature linking opennesss to growth: how to measure openness, the endogeneity of openness with respect to growth, and omitted variable bias. While many studies have found that openness is correlated with growth, Rodrik and Rodriguez note that most are subject to at least one of these problems (details would be appropriate here). Frankel and Romer (1999) used instrumental variables like land mass, access to sea ports, and proximity to foreign markets to deal with the endogeneity of openness. They find that "open" countries have higher per capita income, but they don't link openness to policy-related variables, they don't report results on growth rates, and the effect of their instruments on their results is counter to what theory predicts, so this study leaves a number of issues unaddressed.

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.

True in the short run. In Young's model, countries grow by producing goods with unexhausted learning potential. Advanced countries (call them "A" countries) have been doing this a long time, so for them, the goods with unexhausted learning potential are technologically very sophisticated. And because these countries are producing such sophisticated products their wages are high. This makes it optimal for them to purchase simple products from their trade partners. Poor countries (call them "P" countries) learn the same way—by producing goods with unexhausted learning potential. But they have not progressed as much in terms of learning, so the range of goods that are economically feasible for them to produce is less technologically sophisticated that the range found in advanced countries, and the goods that hold learning potential for them are less sophisticated than the goods that hold learning potential for A countries.

Assuming that A countries are far ahead of P countries, there won't be much overlap in the range of products these two types of countries produce, and trade between them may not cause P countries to abandon those goods with unexhausted learning potential. On the other hand, moderately-advanced countries (call them M countries) are likely to exhibit more overlap with P types in terms of the goods that they produce. Since M countries will have acquired more experience producing the P countries' learning goods, they may knock the P countries out of the market for these goods, eliminating the basis for productivity growth in P countries.(Compare figures C and D in Young's paper.) Specifics depend upon the relative size of the labor forces in the two country types, and gaps between countries generally change over time—see Young's paper. Of course, the P countries still benefit from productivity growth in the M countries or A countries because this growth translates into lower prices for the high-end goods they import.

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:

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

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. (Note: in the outsourcing equilibrium, the firm supplying y earns $\Pi^L = (1-\theta)[R(x,y) - xr_c - yr_a] + yr_a - ay$.) Your expression should involve only exogenous variables and parameters.

This problem is simply the outsourcing model discussed in lecture 16. In the outsourcing Nash equilibrium, each agent chooses the profit maximizing activity level, taking the activity level of the other agent as given. First order conditions are:

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

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

These conditions imply that $x = \mu\eta R / w_x$, $y = \mu(1-\eta)R / w_y$. Substituting into the revenue function yields $R = \left(\dfrac{\mu\eta R}{w_x}\right)^{\mu\eta}\left(\dfrac{\mu(1-\eta)R}{w_y}\right)^{\mu(1-\eta)}$, or solving for R,

$R_O = A\left[(w_x)^{\eta}(w_y)^{(1-\eta)}\right]^{\mu/(\mu-1)}$, where A is a constant that depends on η and μ.

In the internalized equilibrium, the solution takes a the same form, but the multinational chooses both x and y to maximize $R(x,y)-cx-a\alpha y$. Once again substituting the x and y expressions from the first-order conditions back into the revenue function and solving for R yields $R_I = A\left[(c)^{\eta}(a\alpha)^{(1-\eta)}\right]^{\mu/(\mu-1)}$. The ratio of revenues with outsourcing to revenues in the internalized equilibrium is thus: $\frac{R_O}{R_I} = \left[\left(\frac{w_x}{c}\right)^{\eta}\left(\frac{w_y}{a\alpha}\right)^{(1-\eta)}\right]^{\mu/(\mu-1)}$. Note that $w_x > c$, so this ratio of must be less than unity for η sufficiently close to 1. (Recall that $\mu < 1$.)

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

Using $\theta w_x = c-(1-\theta)r_c$ from equation (i) above, the pay-off to the multinational in the outsourcing equilibrium can be written as $\Pi^O = \theta[R_O - xr_c - yr_a] + xr_c - cx$ = $\Pi^O = \theta[R_O - xw_x - yr_a]$. Further, using $xw_x = \mu\eta R_O$ and $yr_a = \frac{r_a}{w_y}\mu(1-\eta)\theta R_O$ from equations (i) and (ii) yields $\Pi^O = \theta R_O\left[1-\mu\left(\eta+(1-\eta)\frac{r_a}{w_y}\right)\right]$. Similarly, using $xc = \mu\eta R_I$ and $ya\alpha = \mu(1-\eta)R_I$, profits for the internalized multinational can be written as $\Pi^I = R_I - cx - a\alpha y$ = $R_I[1-\mu]$. So the ratio of profits with outsourcing to profits in the internalized equilibrium is: $\frac{\Pi^O}{\Pi^I} = \frac{\theta R_O}{(1-\mu)\cdot R_I}\left[1-\mu\left(\eta+(1-\eta)\frac{r_a}{w_y}\right)\right]$.

We have already seen that $R_O / R_I < 1$ for η close to unity. Note further that the term in square brackets approaches 1-μ as $\eta \rightarrow 1$. So for η sufficiently large, $\Pi_O / \Pi_I < 1$, and the multinational is relatively likely to want to avoid outsourcing. The intuition is that, when most of the value is coming from the x activity, there is little penalty associated with high-cost y production (i.e., the fact that $\alpha > 1$ is unimportant), and the firm can avoid exposing itself to the hold-up problem by doing everything itself.

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

$g(x_i) = \dfrac{\kappa x_i}{1+\kappa x_i}$.

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?

   Production costs are already determined for period 1, so innovative effort only affects profits in period 2. Ignoring discounting, the payoff to a successful innovation is $\pi\left(c_i^1-\delta\right)-\pi\left(c_i^1\right)$, which amounts to: $\Delta\pi\left(\delta, c_i^1\right) = \frac{L}{4\gamma}\left[2\delta\left(c_D - c_i^1\right)+\delta^2\right]$. This pay-off is reaped with probability $g\left(x_i\right)$, so the net expected pay-off from innovative activity is $g(x_i)\Delta\pi\left(\delta, c_i^1\right) - x_i$. (Firms assume that *c* distribution doesn't change, so they expect no change in profits in the event of no innovation.) The first-order condition is thus $\Delta\pi\left(\delta, c_i^1\right) = 1/g'(x_i)$, and since $1/g'(x_i) = (1+\kappa x)^2/\kappa$, the closed-form solution for *x* is:

$$x_i = \frac{\sqrt{\kappa L\left[2\delta\left(c_D - c_i^1\right)+\delta^2\right]/4\gamma}-1}{\kappa}$$

   Clearly, the optimal level of innovative effort is a negative function of c_i^1. The second period distribution of costs will not be Pareto because the innovative effort is highest at the low end of the cost distribution, and outcomes are stochastic, so the period 2 distribution is a mixture.

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 $p_i = c_D(N) - \frac{\gamma}{L}q_i$.)

   The increase in *N* will reduce the pay-off to innovation because it shifts everyone's demand schedule inward. However, it will not affect all firms equally because c_D does not enter the expression for the optimal *x* additively:

$\frac{\partial x}{\partial c_D} = \frac{\delta}{\sqrt{\kappa\left[2\delta(c_D - c) + \delta^2\right]}}$. The effect on investment is largest among high cost firms. The effect of the reduction in market size on investment is Schumpeterian. Incentives to distance one's firm from competitors depend upon the elasticity of demand—the bigger the elasticity, the bigger the pay-off to a given marginal cost reduction. Since the firm-specific elasticity of demand is $-\frac{dq_i}{dp_i}\frac{p_i}{q_i} = \frac{L}{\gamma}\frac{p_i}{q_i} = \frac{L}{\gamma}\frac{(c_D + c_i)/2}{(c_D - c_i)L/2\gamma} = \frac{(c_D + c_i)}{(c_D - c_i)}$, a reduction in c_D increases demand elasticities, and thus increases the incentives for firms to distance themselves from competitors. Since the elasticity of demand is larger for firms with smaller market shares, they have the most elasticity-induced incentive to improve their productivity.

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

The main problem with embedding this representation of innovation in a growth model is that it implies a cross-firm cost distribution that cannot be parameterized. Thus, even if a steady state exists, each period the cut-off c_D depends on a non-parametric density, not just N and a few parameters. Solving for this density is probably possible numerically, but it would not lend itself to closed-form expressions. To deal with steady state growth, it would also be necessary to incorporate zero profit entry conditions based on the expected value of the net earnings stream, and to model innovation in the homogeneous good sector. (Otherwise, this sector disappears asymptotically.)