Economics 507a: International Trade
Third Homework Assignment
Due October 25, 2007

1. (due to Alan Deardorff) Consider the Helpman-Krugman two-sector model in which two factors, *K* and *L*, produce a labor-intensive homogeneous product, *Y*, and a capital-intensive differentiated product, *X*, under monopolistic competition with free entry. Assume Dixit-Stiglitz preferences, and low enough fixed costs for there to be a large number of firms. Start at an initial equilibrium with factor price equalization and with the home country a net exporter of capital and a net importer of labor in terms of the factor content of trade. Suppose then that the world endowments of capital and labor both increase by 25 percent.

   a) Assuming that preferences of all consumers are identical and homothetic, how will the new integrated world economy (IWE) compare to the old in terms of prices of goods and factors, outputs of goods, and number of firms in the *X* industry?

   Since industry *Y* has constant returns to scale, and since industry *X* also behaves as if it has constant returns to scale due to the fixed demand elasticity that keeps firms always of the same size, a 25% proportional expansion of both factors will simply expand all quantities in the integrated world economy also by 25%. Thus all prices will be the same as before, industry outputs will be expanded by 25%, and while firms in the *X* industry will continue to produce exactly as before, the number of firms will be expanded by 25%.

   b) If the new capital and labor are distributed to the two countries in proportion to their initial endowments, what will happen to the outputs of the two goods in each country, to their consumption, and to trade?

   All outputs, consumption, and trade in each country will rise by 25%.

   c) If the new capital and labor are located instead in the foreign country, what will happen to outputs, consumption, and trade in both countries? Which of these quantities will rise by the greatest percentage?

   In this case, the home country will experience no change in its income or levels of production, consumption, and trade. The foreign country will therefore experience a *more than* 25% increase in all of these. Its production of good *X* will rise by the greatest percentage, since it initially produced the smaller share of world output of that good.

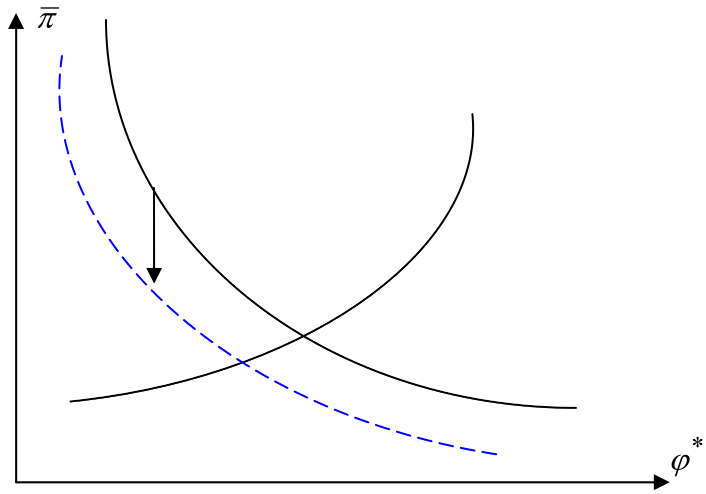
d) Defining the volume of intra-industry trade as the minimum of the home country's exports and imports of *X*, how will the volume of intra-industry trade change in cases (b) and (c)?

With 25% more varieties of *X* in the world, the home country will consume all of them, importing from abroad those it does not produce. In case (b), where all outputs rise by 25%, intra-industry trade (IIT) will therefore rise by 25% also. (As a share of total trade, IIT trade remains constant.) In case (c), country *A* produces no more varieties, and it must therefore import all of the new ones. In terms of number of varieties traded IIT therefore rises by more than 25%. But in terms of the share of total trade that is IIT, no change occurs.

2. Melitz (2001) develops a monopolistic competition model with entry costs, both for new firms and for firms entering new export markets. The model predicts that market shares will shift toward the more efficient producers when a country moves from autarky to free trade. Thus open economies are more productive.

a) Explain, as concisely as possible, how an increase in transport costs changes the gains from trade in Melitz's model.

The zero profit condition, $\bar{\pi} = f \cdot k(\varphi^*) + p_x n f_x \cdot k(\varphi_x^*)$, shifts down when trade costs go up. That is, higher trade costs lead to lower average profits at each φ^*. Algebraically, the shift reflects the fact that the cut-off productivity level for exporters and the cut-off productivity level for production are related by $\varphi_x^* = \tau\varphi^*\left(\frac{f_x}{f}\right)^{1/(\sigma-1)}$, implying that higher trade costs lead to a higher φ_x^* at each φ^*. Hence, since $k(\varphi_x^*)$ and $p_x = \frac{1-G(\varphi_x^*)}{1-G(\varphi^*)}$ are both negative in φ_x^*, both fall with τ, given φ^*. The free entry condition, $G(\varphi^*)\cdot\left(\frac{\bar{\pi}}{\delta}\right) = f_e$, does not involve entry costs, so the effects of an increase in τ are as depicted below:



Clearly, the cutoff for continued operation decreases, and average profits among domestic firms decline. It is less obvious what happens to $\varphi_X^* = \tau\varphi^*\left(\frac{f_X}{f}\right)^{1/(\sigma-1)}$, since trade costs and the cut-off for survival move in opposite directions. However, a bit of grinding shows that the cut-off for exporting rises (see Melitz's appendix). Intuitively, higher trade costs insulate domestic producers from foreign competition, and allow less efficient firms to survive. But for the same reason, higher trade costs make it tougher to earn profits in foreign markets.

b) What is known empirically about the importance of export market entry costs and about the gains from trade due to intra-industry market share reallocations?

See lectures 16 and 17.

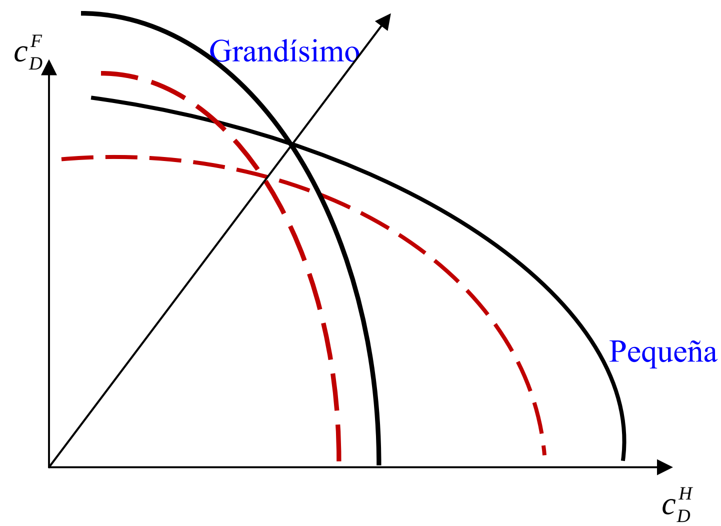
3. The island economies of Grandísimo and Pequeña maintain a common tariff rate, τ, on each other's exports, and prohibitive trade barriers *vis a vis* all other countries. They are considering forming a free trade area with each other—i.e., reducing τ toward 1 —while maintaining their trade barriers *vis a vis* the rest of the world. Adopting the assumptions of the Melitz/Ottaviano (2005) model, and assuming that Grandísimo is much larger than Pequeña, explain how this policy is likely to affect each of the following variables *in the short run, and in the long run*. Be sure to contrast responses in the two countries when they are qualitatively or quantitatively different.

a) Average mark-ups among goods sold in each country.

b) Average productivity levels among goods produced in each country

c) The number of product varieties sold in each country.

In the long run, the two free entry conditions that determine cut-offs can be expressed as: $\frac{L^H}{L^F}\left(c_D^H\right)^{k+2}+\left(c_D^F\right)^{k+2}\left(\tau^F\right)^{-k}=\frac{\gamma\phi}{L_F}$ (home) and $\frac{L^H}{L^F}\left(c_D^H\right)^{k+2}\left(\tau^H\right)^{-k}+\left(c_D^F\right)^{k+2}=\frac{\gamma\phi}{L_F}$ (foreign). Call Grandísimo the home country so that $L^H/L^F > 1$. The Pequeña curve is relatively flat because c_D^H gets a relatively small weight for this curve, and larger movements in c_D^H are necessary to offset a given movement in c_D^F:



Note also that the pre-liberalization equilibrium must occur at the point where $\left(\frac{L_H}{L_F}\right)^{1/(k+2)}\cdot c_D^H = c_D^F$ because the two equations are symmetric in these variables. Hence the initial equilibrium occurs at a point where the cut-off is lower in Grandísimo, and the ratio of cut-offs in the two countries is not dependent upon τ.

Eliminating bilateral tariffs between the two countries will shift the zero profit loci of both countries inward, and the new equilibrium will be at proportionally lower cut-offs for both. (Since Penqueña started at a larger cutoff, it will drop more in absolute terms.)

Once the cut-offs are determined, everything follows. If a country's domestic cut-off falls, average costs fall (i.e., productivity rises), mark-ups fall, and the number of varieties sold in the country increases

In the short run, zero profit conditions continue to hold so long as some firms are idle in each country: $N^\ell=\frac{2(k+1)\gamma}{\eta}\cdot\frac{\alpha-c_D^\ell}{c_D^\ell}$ and $N^h=\frac{2(k+1)\gamma}{\eta}\cdot\frac{\alpha-\tau^h c_X^\ell}{\tau^h c_X^\ell}$.

Also, the number of suppliers to each market is determined by the number of established firms, and the cutoffs: $N^{\ell} = \overline{N}_D^{\ell}\overline{G}^{\ell}(c_D^{\ell}) + \overline{N}_D^{h}\overline{G}^{h}(c_X^{h})$ and $N^{h} = \overline{N}_D^{h}\overline{G}^{h}(c_D^{h}) + \overline{N}_D^{\ell}\overline{G}^{\ell}(c_X^{\ell})$. Solving these equations together yields the cut-offs in each country (see lecture 14). For example, in Grandisimo:

$$\frac{\alpha - c_D^{\ell}}{\left(c_D^{\ell}\right)^{k+1}} = \frac{\eta}{2\gamma(k+1)}\left[\frac{\overline{N}_D^{\ell}}{\left(\overline{c}_M^{\ell}\right)^{k}} + \left(\tau^{\ell}\right)^{-k}\frac{\overline{N}_D^{h}}{\left(\overline{c}_M^{h}\right)^{k}}\right]$$

Thus in the short run cutoffs fall in both countries, and substituting back into the zero profit conditions, the number of varieties available rises in both countries. Note that the effect of trade costs at home is directly proportional to the number of established firms abroad, so as trade costs fall, the biggest effect on the left-hand side is in Pequeña. Also, the left-hand side is less sensitive to changes in the cut-off when the cut-off is large, $\frac{\partial(\alpha - c_D)}{\partial c_D{}^{k+1}} = \left(\frac{k+2}{c_d^{k+1}}\right)\left(\frac{-\alpha}{c_D} + \frac{k+1}{k+2}\right)$, so the cut-off drops relatively more in Pequeña. Thus the response to bilateral liberalization is qualitatively similar in the short run and the long run.

4. In Melitz and Ottaviano (2005), the parameter k determines the shape of the cost distribution $G(c)$. Suppose k falls for some exogenous reason—e.g., the advent of the computer age.

   a) How will this affect the autarky equilibrium for a representative country? In your answer, discuss the effects on average productivity levels, average mark-ups, the firm size distribution, and welfare. In addition to backing up your claims with algebra, provide economic intuition for the responses wherever possible.

   In autarky, the maximum cost cut-off depends positively on k. With some grinding, this follows from equation 15 and the condition that ensures $c_M > c_D$: $c_M > \sqrt{2(k+1)(k+2)\gamma f_E / L}$ (see Melitz/Ottaviano). More precisely, one can show that $\frac{d\ln c_D}{dk} > \left(\frac{1}{k+2}\right)^2\left(\frac{2k+3}{k+1}\right)$.

<u>Details</u>: Let $\lambda = 2\gamma \cdot f_E / L$. Then $\ln c_D = \frac{1}{k+2}\left[\ln\lambda + \ln[(k+1)(k+2)] + k\ln c_M\right]$,

and .

$$\frac{d\ln c_D}{dk} = \left(\frac{1}{k+2}\right)\left[\frac{1}{k+1} + \frac{1}{k+2} + \ln c_m\right] - \left(\frac{1}{k+2}\right)^2\left(\ln\lambda + \ln[(k+1)(k+2)] + k\ln c_M\right)$$

$$= \left(\frac{1}{k+2}\right)^2\left[\frac{k+2}{k+1} + 1 + 2c_M - \ln\lambda - \ln\left[(k+1)(k+2)\right]\right]$$

But $\ln c_M \geq .5(\ln[(k+1)(k+2)] + \ln\lambda)$, so $\frac{d\ln c_D}{dk} \geq \left(\frac{1}{k+2}\right)^2 \left[\frac{k+2}{k+1}+1\right] > 0$

Intuitively, with large *k*, efficient firms are relatively scarce and competitive pressures are less, so a more heterogeneous pool of firms survives.

A reduction in *k* thus reduces c_D, and increases average productivity level (i.e., increases average cost), which follows directly from $\bar{c} = \frac{k}{k+1} c_D$. Prices also fall, as implied by $\bar{p} = \frac{2k+1}{2k+2} c_D$. With prices and costs both falling, it is not possible to sign average mark-ups $\bar{\mu} = \frac{c_D}{k+1}$ or the average output levels, $\bar{q} = \frac{L}{2\gamma} \frac{1}{k+1} c_D$. (To see why, use the finding from earlier that $\frac{d\ln c_D}{dk} > \left(\frac{1}{k+2}\right)^2 \left[\frac{k+2}{k+1}+1\right] > 0$, with equality when $c_M = c_D$.) Finally, welfare, which can be expressed as $U = 1 + \frac{1}{2\eta}(\alpha - c_D)\left(\alpha - \frac{k+1}{k+2} c_D\right)$, clearly must rise.

b) How, if at all, will this decrease in *k* change the effects of *unilateral* trade liberalization? As in part (a) above, consider responses in terms of average productivity levels, average mark-ups, the firm size distribution, and welfare.

The open economy combination of cut-offs is defined by equation (29): $c_D^\ell = \left[\left(\frac{\gamma\phi}{L}\right)\left(\frac{1-\rho^h}{1-\rho^h\rho^\ell}\right)\right]^{1/(k+2)}$, where $\rho^\ell = \left(\tau^\ell\right)^{-k}$. This expression implies that the effects of *k* on responsiveness to liberalization (reductions in τ^ℓ) are ambiguous. Differentiating the log of this expression with respect to tariffs in country ℓ yields: $\frac{d\ln c_D^\ell}{d\rho^\ell} \cdot \frac{d\rho^\ell}{d\tau^\ell} = \left(\frac{-k}{k+2}\right)\left[\frac{\rho^h\rho^\ell}{1-\rho^h\rho^\ell}\right]\left(\tau^\ell\right)^{-k-1} < 0$. The first expression in brackets is larger in absolute value when *k* is large, but the second bracketed expression is smaller at large *k*, particularly when tariffs are high. (The term $\phi = 2(k+1)(k+2)(c_M)^k f_E$ also depends positively on *k*, and its importance varies with f_E and c_M.) So depending upon initial tariff rates the effects of *k* on trade liberalization can go either way. The effects on productivity, mark-ups, firm size and welfare follow from the changes in c_D, as usual.

c) Rather than k falling, suppose technological progress takes the form of a shift in the support of G(c) from (0, c_M] to (0, c_M'], where , $c_M' < c_M$. How will this type of shift affect the trading equilibrium?

Since $\phi = 2(k+1)(k+2)(c_M)^k f_E$, a decrease in c_M decreases cut-offs in both countries $c_D^{\ell} = \left[\left(\frac{\gamma\phi}{L} \right) \left(\frac{1-\rho^h}{1-\rho^h \rho^{\ell}} \right) \right]^{1/(k+2)}$. This translates into the usual effects on the trading equilibrium: lower average costs, lower prices, lower mark-ups, and smaller firms.