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Economics 507a (International Trade)
Spring 2007

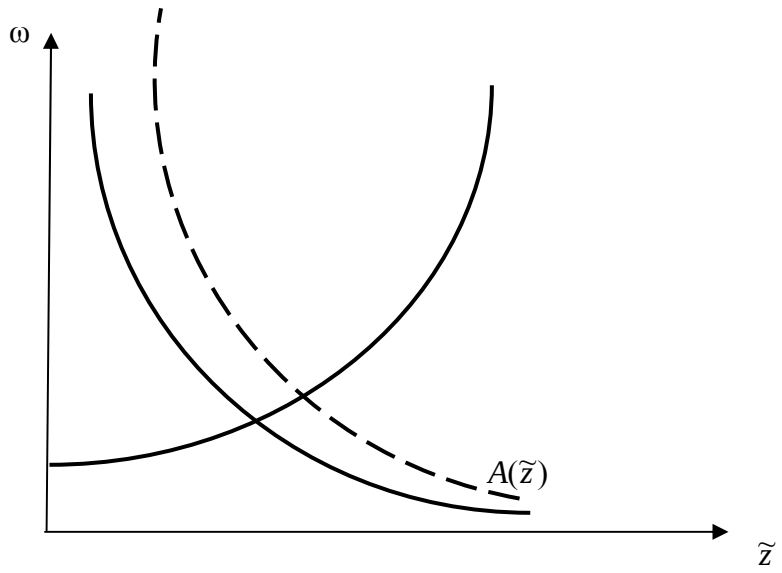
Suggested Answers to Midterm Exam

1a) The factor content (Heckscher-Ohlin) theorem states that, for country *i*, the net factor *j* content of trade is $T_j^i = V_j^i - s_i V_j^W$ where V_j^i is the country's endowment of factor *j*, V_j^W is the global endowment of factor *j*, and s_i is the country's share in global expenditures. Thus, in the present case, $T_j^i = 100 - \frac{2{,}500}{30{,}000} \cdot 6{,}000 = -400$. That is, the U.S. is a net importer of 400 units of labor.

1b) To be a net importer of 400 units of labor means that the country's consumption bundle required 400 more units of labor to produce than was available domestically (i.e., than was embodied in the country's output). Therefore, the country's imports must have required 400 more units of labor to produce than the country's exports.

1c) Trefler and Davis and Weinstein both find that there is far less implicit trade in factors than the simple HO theorem predicts. They attribute this mainly to differences in technology across countries, failure of factor prices to equalize, and (in the case of DW) aggregation bias. Thus one would expect to find actual net imports far less than 400.

2a) *True*. A general increase in home-country productivity of *x* percent (i.e., an *x* percent reduction in $a(z)$ at all z) will shift the relative productivity schedule $A(z) = a^*(z)/a(z)$ upward by *x* percent. Thus at any given cutoff, $\tilde{z}$, the relative wage that makes production costs the same in both countries, ω, will be *x* percent higher. The new equilibrium will be as diagrammed below:



Wages at home increase relative to the price of both home and foreign goods, which can be expressed as $w/a(z)w = 1/a(z)$ and $w/a(z)w^* = \omega/a(z)$, respectively. Wages abroad don't change in terms of foreign goods but they improve in terms of home goods because $w^*/wa(z) = 1/\omega a(z)$. The denominator of this expression must fall because when $a(z)$ rises *x* percent, ω rises *less* than 10 percent (refer to diagram above).

2b) *True* The key point is that gains from trade are larger when opening to trade changes one's equilibrium prices relatively dramatically. A small country has limited income, so if it moves from autarky to free trade, it doesn't affect prices in the rest of the world much, and global prices may remain very different from its autarky prices. Under these conditions it stands to gain a lot from trade. By the same token, a large country that begins trading with a small country will pull global prices toward its autarky prices because its domestic supply and demand will account for a large fraction of global supply and demand. Thus it will end up trading at prices not to far from its autarky prices, and the gains from trade it reaps will be limited.

One can demonstrate this result in the context of perfect competition using the excess demand schedules from lecture 2. Or, in a context with imperfect competition (where mark-ups and producer heterogeneity also play a role), one can use the Melitz-Ottaviano results to demonstrate that welfare responds more dramatically to trade policy among small countries.

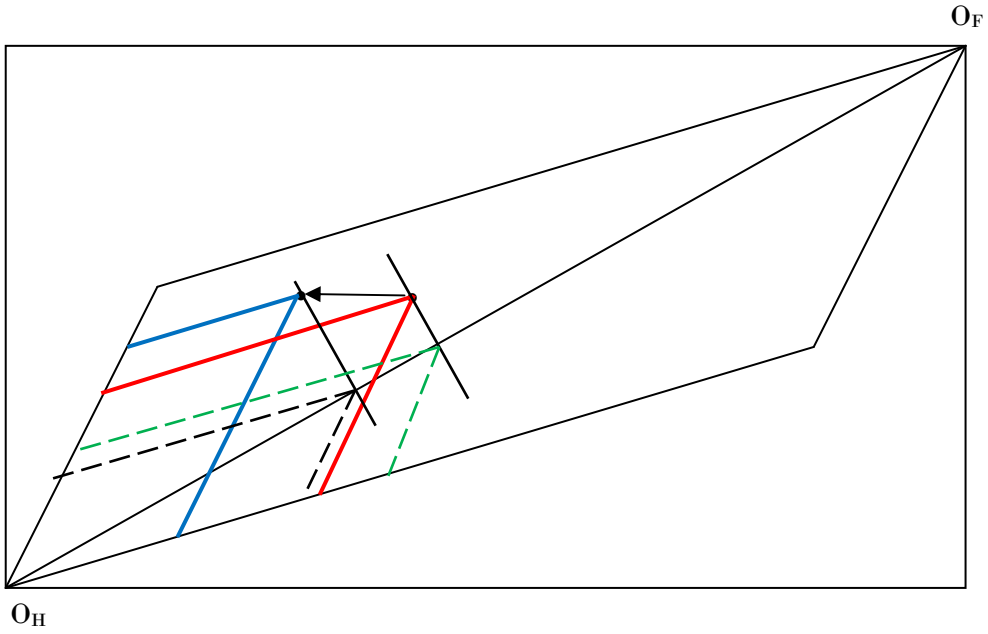
2c) *False* These three models have distinctive features that, in principle, allow one to differentiate among them using observable information:

- The HK model does not predict a role for distance—it is based on the assumption that trade is frictionless. This means that all countries face the same menu of prices for all product varieties, and all countries consume *all* goods in proportion to their share in global income.
- The HK model does not provide a role for cross-firm heterogeneity, which is key to the Helpman-Melitz-Rubenstein version of the Melitz (2003) model that is used to develop gravity relationships.
- Unlike the HMR model, the EK is done at the product level rather than the firm level. Hence, unlike HMR, the EK gravity equation doesn't involve the number of product varieties produced in each country.
- Only the HMR provides a rigorous interpretation for zero aggregate bilateral flows between two countries, although EK does predict zeros at the *product* level.

Clearly, tests concerning the role of distance and other trade frictions (as in EK and HMR) can be used to rule out the simple HK relationship, and the fact that zero trade is observed between many country pairs speaks in favor of HMR. Also, tests like HMR's for firm heterogeneity can be used to determine whether firm heterogeneity plays a role in determining trade flows.

3a) Suppose the differentiated manufactured good is capital-intensive and call it good Y. Then, since the home country exports Y, it must be capital-intensive. The issue is what

happens if labor migrates from the home to the foreign country. So long as the shift in factor endowments does not move the world out of the factor price equalization set, the same global output prices, factor prices, production mix and consumption mix will continue to prevail. Thus, by the Rybcznski theorem, production of the labor-intensive good (call it *Y*) will contract at home and expand abroad, while production of the capital-intensive good (call it *X*) will expand at home and contract abroad. Only the geographic location of production and trade flows between the home (*H*) and foreign (*F*) country will be affected. Such a shift is depicted below. (Refer to the notes or Krugman/Helpman for details concerning this type of diagram.)



Each country's comparative advantage is intensified by this migration pattern, so each country moves further toward specialization in one type of good. This increases total trade, and reduces the ratio of intra-industry to inter-industry trade. To see the former, refer to the graph above. For the home country, the loss of labor shifts consumption rays from green to black, and production rays from red to blue. The difference between consumption and production of each good rises (green to red versus black to blue), so trade must rise. To see the latter, denote the home country's share in global income by *s*. Then the ratio of intra-industry (*X* * for *X*) trade to total trade is imports of *X* by *H* divided by imports of *X* by *F* (which must match exports of *Y* by *F*):

$IIT = \frac{spX^*}{s^* pX} = \frac{sX^*}{s^* X}$. As home production of capital-intensive *X* goods grows and foreign production of *X* goods falls, this ratio must fall.

3b) Output *per firm* won't change. The reason is that the elasticity of demand is fixed in the HK model, and this pins down the ratio of price to marginal costs. Free entry ensures that price matches average cost, so the ratio of average cost to marginal cost is also pinned down, and doesn't respond to the labor migration. Finally, factor prices are unchanged

(because we remain in the FPE set), so firms marginal and average cost curves don't change. Thus since the ratio of average to marginal cost is a monotonic negative function of output, the output level is uniquely determined. Algebraically, this result is implied by the equilibrium condition for the representative firm: $\left[1-\frac{1}{\sigma}\right]C(w,x)=\frac{\partial C(w,x)}{\partial x}$, where C is total production cost and σ is the elasticity of demand.

3c) Since X production goes up at home and falls abroad while output per producer remains constant in each country, the number of producers (i.e., the number of product varieties) must move in proportion to X in each country. That is, it goes up at home and falls abroad.

4a) In the Eaton-Kortum model the exact price index for country n is $p_n=\gamma\Phi_n^{-1/\theta}$, where $\Phi_n\equiv\sum_{i=1}^{N}\phi_i d_{ni}^{-\theta}=\sum_{i=1}^{N}T_i\left(c_i d_{ni}\right)^{-\theta}$ is a CES-like index of the delivered cost of goods from all of n's trading partners. Think of country n as Examistan. Then the d_{ni} terms are the unit shipping costs for producers located in country i who are sending goods to Examistan, and a reduction in shipping costs works to the advantage of consumers in Examistan by reducing their price index. Since wages are pinned down by trade in a homogeneous good, this increases the welfare of Examistanis at given c's. The c's will adjust too in general equilibrium, but this should not undo the benefit to country n. To the contrary, the reduction in costs in country n should create feedback effects that reduce production costs in the other countries (because they use n's goods as intermediate inputs).

4b) Free entry conditions in the Melitz-Ottaviano model implies that in long run equilibrium, expected profits for firms in both countries must match the costs of creating a firm:

$$L^H\left(c_D^H\right)^{k+2}+L^F\left(c_D^F\right)^{k+2}\left(\tau^F\right)^{-k}=\gamma\phi \qquad \text{(home firms)}$$

$$L^F\left(c_D^F\right)^{k+2}+L^H\left(c_D^H\right)^{k+2}\left(\tau^H\right)^{-k}=\gamma\phi \qquad \text{(foreign firms)}$$

These conditions imply equilibrium unit-cost cutoffs in each country:

$$c_D^{\ell}=\left(\frac{\gamma\phi}{L^{\ell}}\cdot\frac{1-\left(\tau^h\right)^{-k}}{1-\left(\tau^{\ell}\tau^h\right)^{-k}}\right)^{\frac{1}{k+2}}$$

Let $\ell=H, h=F$. This expression then implies that if the costs of shipping to the home market fall (i.e., τ^H falls), the cut-off in the home market rises. And since welfare in each country is a monotonic negative function of the country's domestic market cut-off, this reduces welfare at home. Intuitively, reductions in transport costs make it more attractive

to locate outside Examistan, thus avoiding the costs of selling in the non-Examistan market and incurring relatively low shipping costs on sales in Examistan. This shift in the location of production reduces competitive pressures among Examistan-based producers and works to the disadvantage of Examistan's consumers.

In the *short run* these results do not come through because free entry conditions are irrelevant. Instead, existing firms continue to operate so long as their fixed costs are covered. When some firms in each country are inactive, the short-run cut-offs (above which operating profits are zero) are determined by:

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

Thus reductions in the cost of shipping to the home market reduce c_D^H and cause more of the domestic firms to become inactive, and cause the non-exiting firms to reduce their mark-ups and shrink. Intuitively, the reduction in trade barriers does not cause Examistan-based producers to shift their operations abroad here, it simply increases competitive pressures in the Examistan market, to the benefit of consumers.