ECO 745: Theory of International Economics Jack Rossbach

Fall 2015: Problem Set 3

Problem 1. Pricing under the Frechet Distribution

Suppose there is a continuum of goods, $j \in [0,1]$, and $i, n = 1, \dots, N$ countries. The cost of producing one unit of good j in country i and delivering it to consumers in country n is equal to

$$c_{ni}(j) = \frac{w_i}{z_i(j)} d_{ni}$$

where $z_i(j)$ is country i's productivity for producing good j. Assume the $z_i(j)$'s are drawn randomly from a Frechet distribution with distribution function

$$F_i(z) = \exp\left[-T_i z^{-\theta}\right]$$

Where $T_i > 0$ governs the average draw and $\theta > 0$ governs the variability of across draws.

1.i) Suppose that there is perfect competition and consumers in each country are served by the lowest cost producer. Derive the distribution function for $p_n = \min_i\{p_{ni}\}$. □

Now suppose consumers have CES preferences over goods

$$U_i = \left[\int_0^1 \left(Q_n(j)\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

Where $Q_n(j)$ is consumption of good j by consumers in country j and $\sigma > 1$ is the elasticity of substitution.

1.ii) Show that the CES price index in country n can be expressed as $p_n = \gamma \Phi_n^{-\frac{1}{\theta}}$ where γ depends only on θ and σ, and $\Phi_n = \sum_{i=1}^N T_i (w_i d_{ni})^{-\theta}$. □

Now suppose that instead of each country getting one productivity draw per good, for each good there are k producers within each country that all receive independent productivity draws. Additionally, instead of perfect competition, assume that all producers engage in Bertrand competition, so that the lowest cost producer captures the market while charging a price equal to the cost of the second lowest cost producer.

1.iii) Show that the lowest cost producer will not want to charge a markup over $\bar{m} = \sigma/(\sigma - 1)$.

1.iv) Derive the distribution of markups $M_n(j) = p_n(j)/c_n^1(j)$ in country n, where $c_n^k(j)$ is the cost of the kth lowest producer for country n and $p_n(j) = \min\{c_n^2(j), \bar{m} c_n^1(j)\}$ is the price charged by the lowest cost producer in country n. Note it can be useful to consider the joint distribution of Z_n^1 and Z_n^2:

$$F_n(z^1, z^2) = \Pr[Z_n^1 \le z^1, Z_n^2 \le z^2] = \left(1 + T_i\left((z^2)^{-\theta} - (z^1)^{-\theta}\right)\right) \exp\left[-T_i (z^2)^{-\theta}\right]$$

1.v) Show that the CES price index in country n can still be expressed as $p_n = \gamma \Phi_n^{-\frac{1}{\theta}}$ where γ depends only on θ and σ (this γ will differ from the γ in 1.ii), and $\Phi_n = \sum_{i=1}^N T_i (w_i d_{ni})^{-\theta}$.

Problem 2. Eaton-Kortum with Three Countries

Consider an Eaton-Kortum (2002) environment with a continuum of goods, $j \in [0,1]$ and three countries (country 1, country 2, and country 3). Suppose goods are produced using labor alone, and the preferences and costs are as in problem (1.i)–(1.ii). In the base case, suppose that $\sigma = 2$, $\theta = 8$, $T_1 = 2$, and $T_2 = T_3 = 1$, and each country has a labor supply equal to one, $L_j = 1; j = 1,2,3$.

2.i) What equations are required to solve the model (you do not need to re-derive the equations)?

2.ii) Suppose that there is frictionless trade, so that $d_{ni} = 1 \; \forall i, n = 1,2,3$. Normalize $w_1 = 1$. Compute the equilibrium wage vector and trade share matrix by hand.

2.iii) Now suppose that country 1 and country 2 are close to each other, $d_{12} = d_{21} = 1.2$, while country 3 is far away, $d_{3i} = d_{i3} = 1.5; \; i = 1,2$. Write a program to solve for the new equilibrium wage vector and trade share matrix numerically. Either email or attach to this problem set the code for your program.

2.iv) Suppose country 3 is able to eliminate its trade costs with country 1, so that $d_{13} = d_{31} = 1$, while all other trade costs remain the same $d_{12} = d_{21} = 1.2$. Compute the change in welfare $\left(\widehat{W}_i = \left(\frac{w_i'}{p_i'}\right) / \left(\frac{w_i}{p_i}\right)\right)$ for each country in this economy versus the one in 2.iii.

2.v) Suppose instead that $\theta = 4$. Redo part 2.iv, how does this affect the welfare impact of the fall in trade costs between countries 1 and 3 for each country? Discuss your finding as it relates to the results of Arkolakis, Costinot, Rodriguez-Clare (2012).

Problem 3. Revealed Comparative Advantage

Download the CEPII RCA dataset at: http://www.cepii.fr/cepii/en/bdd_modele/presentation.asp?id=26

This dataset reports a revealed comparative advantage index based off the results of the regression

$$\log X_{ij}^k = \delta_{ij} + \delta_j^k + \delta_i^k + \epsilon_{ij}^k$$

Where X_{ij}^k is gross exports from country i to country j in product k, δ_{ij} is an export-importer fixed effect, δ_i^k is an exporter-product fixed effect, and δ_j^k is an importer-product fixed effect (they implement a slightly different regression to limit the number of fixed effects for computational reasons).

From δ_i^k you can compute the implied productivity parameter in a multiproduct (multisector) Eaton-Kortum framework according to $z_i^k = e^{\delta_i^k/\theta}$ (note $T_i^k := \left(z_i^k\right)^\theta$ in EK 2002 notation), and normalize a RCA index according to

$$RCA_i(k) = \left(z_i^k / \overline{z_i}\right) / \left(\overline{z^k} / \overline{z}\right)$$

Where $\overline{z_i}$ is average productivity parameter across all products in country i, $\overline{z^k}$ is the average productivity parameter in product k across all countries, and $\bar{z}$ is the average across all sectors and products.

3.i) Choose a country and two years at least 5 years apart. Ensure that RCA indices exist in the CEPII dataset for at least some products at your initial date. Download data on the country's gross exports for each product, and merge the data with the CEPII RCA database.

3.ii) Re-compute the Balassa RCA index for each product (see Problem Set 1, problem 4) for the initial period. What is the correlation between the two RCA measures? How many products have RCA≥1 for each index?

3.iii) Compute the growth in exports for each product, and run a regression with the $\text{Dummy}_{RCA} = 1$ if $RCA \geq 1$ in the initial period for this new RCA index. Did products for which the country had a revealed comparative advantage grow more or less than other products?

3.iv) Suppose the United States has a high amount of expenditures on car parts while Mexico has a high productivity for producing car parts. Suppose there is a fall in trade costs (uniform across products) between the United States and Mexico. How should this fall affect Mexico's revealed comparative advantage in car parts as measured by the RCA index in this problem and by the Balassa RCA index?

Problem 4. Least Traded Products

Use the same country and end-points as you used in previous problem.

4.i) Sort the products by the amount of exports in the base periods. Group the products into 10 bins, so that each bin accounts for 10 percent of total exports, where the products with the least exports are in the first bin and the products with the most trade are in the last bin (allow products to split among bins so each bin contains exactly 10 percent of total exports).

How many products are there with positive trade in the base period in each bin?

4.ii) Recompute the share of trade accounted for by products in each bin in the final period (put products with zero trade in the initial period into the first bin). Which bins experience the most growth in trade? How do your results change if you ignore growth from products that have zero trade in the initial period?