



Problem Set #2: Due end of class September 28, 2017

You may discuss this problem set with your classmates, but everything you turn in must be your own work.
Please read the “problem set guidelines” on the course web page before beginning.

1. A firm’s productivity is difficult to measure, but its employment is much easier. In this question we will use what we can observe, employment, and a model to back out what we cannot observe, productivity.

Use the closed economy model (no exports or foreign affiliates) we developed in class to answer the following questions. Assume the parameters are: $\epsilon_1 = 3$, $w_1 = 1.2$, $f^p = 1$, $E_1 = 100$.

- a. Write out a formula for the amount of production labor (ℓ) a firm with productivity φ hires. Production labor means the labor needed to produce the good and does not include the labor used in fixed costs.
- b. Suppose an economy has 100 firms. 50 of the firms hire 4.29 units of labor, 20 firms hire 17.15 units of labor, 15 firms hire 38.58 units of labor, 10 firms hire 68.59 units of labor, and 5 firms hire 107.17 units of labor.

Plot the firm size distribution: on the x-axis are the 5 types of firm sizes. For each firm size, the y-axis plots the fraction of the total firms that have this size. For example, there are 50 firms with size 4.29, so we would plot $(x,y)=(4.29, 0.5)$. You can use whatever type of plot you think is reasonable, but I like a bar plot for this kind of data.

- c. Solve your formula from part a. for φ . This equation tells us what productivity the firm must have, if it hires ℓ production workers. For each firm size in part b. compute the implied productivity. [You may want to use a computer.] Report the 5 productivity values that correspond to the 5 firm sizes.
- d. Plot the implied productivity distribution: on the x-axis are the 5 values of firm productivities. For each productivity, the y-axis plots the fraction of the total firms that have this productivity.

- e. Download PS2.Data.xlsx from the course webpage. Sheet “Q1 Data” contains the firm size data for the United States in 2014. Plot the firm size distribution.¹

[The data are reported in intervals e.g., all firms between 5 and 9 employees. On the x-axis, plot the geometric mean of the interval, e.g., 6.7 for 5-9 employee interval. I have already computed the means for you.]

- f. Given what we have learned about firm size and productivity in our model, what can you say about the productivity distribution in the United States? How common are high productivity firms? Low productivity firms? You do not need to calculate anything for this question — describe your findings in words.

[Note: What we have done parts a.–d. is called *inference*. We used the model to help us learn about something we cannot observe — we inferred the productivity distribution. This is a powerful and common use of economic models in the “real world.”]

¹You can find a lot more detail on the firm size distribution at <https://www.sba.gov/advocacy/firm-size-data>.

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2. Use the model with heterogenous firms that we developed in class to answer the following questions. Assume that $E_2 = 1000$, $\epsilon_2 = 4$, $w_1 = 1.5$, $w_2 = 1.5$, $f^p = 6$, $f^e = 1.25$, and $\tau = 0.2$.
- What is the productivity level (φ) of the smallest firm in country one that exports to country two? Call this level of productivity $\underline{\varphi}^e$. [Hint: What firm type earns zero additional profits from exporting?]
 - Show that a country-one firm with $\underline{\varphi}^m = 0.815$ is indifferent between exporting to country two and operating a foreign affiliate in country two.
 - Explain why $\underline{\varphi}^e < \underline{\varphi}^m$.
3. Use the model with heterogenous firms that we developed in class to answer the following questions. Assume that $E_2 = 50$, $\epsilon_2 = 4$, $w_1 = 1.5$, $w_2 = 1.5$, $f^p = 100$, $f^e = 5$.
- Plot $\Delta\pi_1^m(\varphi) - \Delta\pi_1^e(\varphi)$ for a firm with $\varphi = 5$ as a function of τ . The x-axis is $\tau \in [0, 2]$ and the y-axis is the difference in profits.
 - For what value of τ is the firm indifferent between serving the foreign market by exporting or by building a foreign affiliate?
 - Given an example of a high τ good or industry. Give an example of a low τ good or industry.
 - Suppose you observed a firm in a high- τ industry exporting to a foreign country. What might explain this? Use the model to frame your answer.
4. Download PS2.Data.xlsx from the course webpage. Columns C-F of sheet “Q4 Data” hold the sales of U.S. multinational foreign affiliates, grouped by their host country.²
- Column C is the total sales of U.S. foreign affiliates located in that country.
 - Column D is the sales of those affiliates to parties in the United States.
 - Column E is the sales of those affiliates to parties in the affiliate’s own country.
 - Column F is the sales of those affiliates to parties in countries besides the United States or the affiliate’s host country — *third countries*.
- We have been studying horizontal FDI. For each country, compute the share of total sales that is “horizontal:” divide sales to the host country by total affiliate sales. Plot this variable against the logarithm of GDP. Put $\ln(\text{GDP})$ on the x-axis. [Do not take the log of the horizontal share variable.] Add the linear trend line and display the trend line equation on the chart.
 - What is the relationship between $\ln(\text{GDP})$ and the horizontal sales share? Interpret the slope coefficient of the trend line.
 - Is the relationship you found consistent with the proximity-concentration tradeoff? Explain your answer.

²Some data have been suppressed for disclosure reasons (D). In these cases, there are so few firms in that country, that it could be possible to figure out a particular firm’s sales from the aggregate data. When the (D) keep us from making a calculation, we have to drop that observation from our work.

- d. In the figure in part a., Ireland and Switzerland are both outliers relative to the line of best fit. For the countries' sizes, the affiliates in these markets sell too little in their host countries. In no more than two paragraphs, discuss reasons why affiliates in Ireland and Switzerland are more outward oriented than predicted.

[We have not discussed this in class (yet), so you will have to do some research. Try Google for things like "FDI in Switzerland."]