International Trade – Fall 2019

Final Exam

Problem 1 (30 points)

Brexit - consequences for trade and income distribution

In June 2016, a majority of the British population voted to leave the EU. Three years later, negotiations are still ongoing. Discuss the consequences for UK production, international trade, welfare, and income distribution if the country chooses to exit the EU. Your discussion should be drawing on international trade theory, and you should elaborate on two scenarios:

a. A soft Brexit: a scenario in which the UK introduces immigration restrictions but keeps preferential access to the EU single market for goods i.e., tariffs are zero between the UK and the EU for goods and services.

b. A hard Brexit: a scenario in which UK leaves the EU without a new trade deal, and trades under World Trade Organization (WTO) rules, and does not get any preferential access to the EU countries (the EU imposes positive tariffs on UK exports, and UK imposes positive tariffs on imports from EU).

Answer: *[sketch] The answer is pretty open, but the students are expected first to state the thought experiments of soft and hard Brexit. Soft Brexit is the case that trade remains free, but labor supply in Home country (the UK in this case). Hard Brexit means that the UK faces a positive tariff on its exports and levy a positive tariff on its imports.*

Then, for each thought experiment, the students are expected to use a theory to discuss the change of UK production, trade, welfare (real wage for each group), and nominal wage for each group. The students also need to specify whether they assume the UK is a large or small open economy, which affects the analysis of

welfare. The precise answer depends on the specific model student choose for the analysis.

Where in the curriculum: Lecture 3 slides on the Ricardo-Viner model, Lecture 3-4 on two-by-two Heckscher-Ohlin model, with the assumption that the UK is a small open economy suite the best for the analysis. But students can choose other models as long as they make a correct analysis.

Problem 2 (20 points)

a. State the Stolper-Samuelson theorem.

Answer: *Stolper-Samuelson Theorem says that an increase in the relative price of a good will increase the real return to the factor used intensively in that good, and reduce the real return to the other factor.*

b. Explain the Stolper-Samuelson theorem using a graphical approach.

Answer: *[sketch] Use the graph showed in Lecture 4 slides, page 17 to explain*

Where in the curriculum: Lecture 3-4 slides on factor proportion model.

Krugman Model (40 points)

Consider a country H where each firm has monopoly power over a single variety x_j. A firm pays a fixed cost f and a variable cost b, so it hires labor according to

$$l_j = f + bx_j$$

Suppose the representative consumer has L_H units of labor for which he receives a wage w. The consumer has utility over N differentiated goods given by (note that $\sigma > 1$):

$$U = \left[\sum_{j=1}^{N} q_j^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

Solve the utility maximization problem yeilds the demand for each variety j:

$$q_j = \frac{p_j^{-\sigma}}{P^{1-\sigma}} wL_H.$$

a. Show that the aggregate price index P is given by $P^{1-\sigma} = \sum_{j=1}^{N} p_j^{1-\sigma}$. Use equations provided by the question.

Answer: *Multiply both sides of* $q_j = \frac{p_j^{-\sigma}}{P^{1-\sigma}} wL_H$ *by* p_j*:*

$$p_j q_j = \frac{p_j^{1-\sigma}}{P^{1-\sigma}} wL_H.$$

Then sum over $j = 1, ..., N$ *over both sides:*

$$\sum_{j=1}^{N} p_j q_j = \sum_{j=1}^{N} \frac{p_j^{1-\sigma}}{P^{1-\sigma}} wL_H.$$

As $\sum_{j=1}^{N} p_j q_j = wL_H$*, above equation simplifies to:*

$$1 = \sum_{j=1}^{N} \frac{p_j^{1-\sigma}}{P^{1-\sigma}}.$$

Note P *does not depends on* $\sum_{j=1}^{N}$*. Take it out and arrange terms:*

$$P^{1-\sigma} = \sum_{j=1}^{N} p_j^{1-\sigma}.$$

b. How does the price aggregator P change with an increase in N and p_j of a given variety j, respectively? What is the intuition for each of them?

Answer:

- *N increases, the number of varieties increase, the market gets more competitive hence P decreases.*

- *p_j increase, meaning the variety gets more expensive, hence the market gets less competitive and P increases.*

Each firm chooese the optimal price to maximize its profit. A firm's optimization problem is given by:

$$\max_{p_j} \pi_j = p_j q_j - b q_j w - wf, \tag{1}$$

where q_j satisfies the demand function we derived before. Solving the firm's optimization problem gives us the price for each variety: $p_j = \frac{\sigma b w}{\sigma - 1}$.

c. Show that the equilibrium number of varieties N equals $N = \frac{L_H}{\sigma f}$. (Hint: use $p_j = \frac{\sigma b w}{\sigma - 1}$, the labor market clearing condition, and the free entry condition)

Answer:

Because of free entry, each firm earns zero profit:

$$p_j q_j - b q_j w - wf = 0$$

Given a firm charges the optimal price $p_j = \frac{\sigma b w}{\sigma - 1}$,

$$\frac{\sigma b w}{\sigma - 1} q_j - b q_j w - wf = 0 \quad \rightarrow \quad q_j = \frac{(\sigma - 1) f}{b}.$$

Given the total production, the firm's total employment equals:

$$l_j = f + b q_j = \sigma f.$$

Note that all firms are 'identical (or, symmetric)' in this model. Hence total employment should be the same across firms. Hence the labor market clearing condition implies:

$$l_j N = L_H \quad \rightarrow \quad N = \frac{L_H}{\sigma f}.$$

d. Given $N = \frac{L_H}{\sigma f}$, how does the equilibrium number of varieties N change with an increase in L_H, σ and f, respectively? What is the intuition for each of them?

Answer:

- *L_H increases, size of labor supply/market increases, the number of firms the market could support increases.*
- *σ increase, varieties become more substitutable to each other. Therefore each firm gets a lower profit margin for a unit of sells, hence equilibrium firm size increases. Given labor supply is fixed, the number of firms decreases.*
- *f increase, a firm need to sell more to cover fixed costs, hence equilibrium firm size increases. Given the labor supply is fixed, the number of firms decreases.*

e. Assume that country H can trade with country F without incurring any transportation costs. The two countries are identical. Trade is balanced. Compute the imports and exports of Home.

Answer:

The two countries are identical, and there is no cost of trade, so we can solve the equilibrium as if we have one single country, whose size equals $2L_H$. Normalize wage $w = 1$.

- *Demand for good j given by question a. remain unchanged.*
- *Optimal price of each variety remains unchanged*
- *Production of each firm remains unchanged*
- *The total number of firms is identical in Home and Foreign.*

The representative consumer consumes varieties from both countries due to the love of variety. They spend the same amount of money on each variety because all varieties are symmetric (provide the same marginal utility for given quantity), and the trade is free (same price). Hence total Home imports equal:

$$IM_H = wL_H \frac{1}{2} = \frac{L_H}{2}.$$

The balance of trade implies imports equal exports. Hence $EX_H = \frac{L_H}{2}$ *as well.*

Where in the curriculum: Lecture 8 and 9's slides on Krugman model.

Gravity Model (10 points)

Head and Ries (1999) analyse the effects of tariffs based on a model of trade and imperfect competition, using the so-called gravity equation. To the left, you find their results.

Focus on the effect of Canadian Tariff and U.S. Tariff on log output per Canadian plant with all observations (first column, row 1-2). The tariffs is measured in fractional terms. For instance, if the tariff is 50% on leather shoes, it is measured as 0.5 (not logged). The variable turnover has a greater value if a given industry has a higher entry and exit rate.

Table 3
Effects of tariffs on log output per plant (ln q)

	Sample:				
	All	Imp. Com.	IC + Free	IC + Fixed	All
Canadian Tariff	1.134[a]	1.247[a]	0.279	3.824[a]	4.928[a]
	(0.368)	(0.411)	(0.455)	(0.925)	(1.135)
U.S. Tariff	−1.638[a]	−2.227[a]	−0.937	−5.632[a]	−6.371[a]
	(0.596)	(0.716)	(0.828)	(1.403)	(2.078)
Cdn. Tariff					−17.952[a]
× Turnover					(5.489)
U.S. Tariff					20.131[c]
× Turnover					(10.289)
1994	0.179[a]	0.172[a]	0.117[a]	0.301[a]	0.186[a]
	(0.020)	(0.022)	(0.025)	(0.040)	(0.021)
R^2 (within)	0.175	0.173	0.129	0.338	0.191
Root MSE	0.149	0.152	0.149	0.154	0.149
No. of Obs.	1828	1628	1183	445	1693

Note: Fixed industry year effects are not reported except for 1994 which approximates the percent change from 1988. Standard errors in parentheses. [a], [b], [c] indicate significance in a two-tail test at the 1, 5 and 10 percent levels.

a. Write down the formula of gravity equation. What is the expected sign of each explanatory variable? Does the gravity equation explain well the real-world data?

Answer: *The exact formula can be found in Lecture 10 on Gravity Equation. Bilateral trade is a linear (after taking logs) function of origin and destination countries' size (usually proxied by GDP or GDPPC) and bilateral trade costs (often proxied by distance).*

b. Interpret the point estimates on the interaction terms; i.e., Canadian Tariff × Turnover (-17.952) and U.S. Tariff × Turnover (-20.131). Do the sign and magnitude make sense? Explain briefly.

Answer:

- *Interpretation: a one percentage point increase in Canadian Tariff increases the output per Canadian plant relatively less by -17.952% in an industry with 1 unit higher turnover. A1 percentage point increase in the U.S. Tariff decreases the output per Canadian plant by 20.131% less in an industry with 1 unit higher turnover.*
- *Sign makes sense. Industries with high turnover are more "flexible," and hence are more likely to react positively to offset the effects of trade shock.*

Where in the curriculum: Lecture 8 and 9's slides on Krugman model; Lecture 11's slides on trade and heterogeneity; Lecture 10 on Gravity Equation.