Written Exam for the M.Sc. in Economics Winter 2016–17

Advanced International Trade

3–hour closed–book exam

February 21 2017

SUGGESTED ANSWERS

Please note that the language used in your exam paper must correspond to the language of the title for which you registered during exam registration. That is, if you registered for the English title of the course, you must write your exam paper in English. Likewise, if you registered for the Danish title of the course or if you registered for the English title which was followed by 'eksamen på dansk' in brackets, you must write your exam paper in Danish.

This document consists of 6 pages in total.

Problem 1:

Consider a world economy with C countries with one differentiated good industry in each country. Utility in country j is given by:

$$U^j = \sum_{i=1}^{C} N^i \left(c^{ij}\right)^{(\sigma-1)/\sigma}, \quad \sigma > 1 \tag{1}$$

where c^{ij} denotes the total consumption of a given variety produced in country i and consumed in country j, while N^i is the number of symmetric varieties produced in country i. The budget constraint of country j is:

$$Y^j = \sum_{i=1}^{C} N^i p^{ij} c^{ij} \tag{2}$$

where Y^j is country j's total income and p^{ij} is the price of a given variety produced in country i and consumed j.

Maximizing utility subject to the budget constraint leads to the following demand function:

$$c^{ij} = \left(\frac{p^{ij}}{P^j}\right)^{-\sigma} \frac{Y^j}{P^j} \tag{3}$$

where the price index is defined as:

$$P^j = \left(\sum_{i=1}^{C} N^i \left(p^{ij}\right)^{1-\sigma}\right)^{1/(1-\sigma)} \tag{4}$$

It is costly to ship varieties across international borders. Assume $p^{ij} = \tau^{ij} p^i$, where $\tau^{ii} = 1$ and $\tau^{ij} \geq 1$ for $i \neq j$. Following Krugman (1980) assume also that firm output is fixed. In this case, country i's GDP is equal to $Y^i = N^i p^i \bar{y}$, where $\bar{y}$ denotes the fixed output of firms.

1. Show that exports from country i to country j may be expressed as:

$$X^{ij} = \frac{Y^i Y^j}{p^i \bar{y}} \left(\frac{\tau^{ij} p^i}{P^j}\right)^{(1-\sigma)} \tag{5}$$

Suggested answer:
Exports from i to j are given by:

$$\begin{aligned} X^{ij} &= N^i p^{ij} c^{ij} \\ &= N^i Y^j \left(\frac{\tau^{ij} p^i}{P^j}\right)^{(1-\sigma)} \\ &= \frac{Y^i Y^j}{p^i \bar{y}} \left(\frac{\tau^{ij} p^i}{P^j}\right)^{(1-\sigma)} \end{aligned}$$

2. Suppose Europe signs a trade agreement with Canada that lowers the trade costs between the two. How are exports from the US to Canada affected by this trade agreement?

   Suggested answer:
   The Canadian price index, P^{Canada}, declines when its becomes cheaper to buy goods in Europe. All other variables are unchanged. From the gravity equation, it can be seen that $\frac{\partial X^{US,Canada}}{\partial P^{Canada}} > 0$ if $\sigma > 1$. With a reduced Canadian price index, US exports to Canada must necessarily fall. This is not surprising: US goods are relatively less attractive compared to European goods after the trade agreement has been signed.

3. Trade costs are very hard to quantity. Assuming uniform trade costs, τ, a student of international trade argues that the term $\mu = \tau^{\sigma-1}$ can be inferred from data on trade flows and domestic sales using the following expression:

$$\mu = \left(\frac{X^{ii}X^{jj}}{X^{ij}X^{ji}}\right)^{1/2}$$

   Is the student correct?

   Suggested answer:
   The student is correct:

$$\begin{aligned}
\mu &= \left(\frac{X^{ii}X^{jj}}{X^{ij}X^{ji}}\right)^{1/2} \\
&= \left(\frac{\frac{Y^iY^i}{p^i\bar{y}}\left(\frac{p^i}{P^i}\right)^{(1-\sigma)}\frac{Y^jY^j}{p^j\bar{y}}\left(\frac{p^j}{P^j}\right)^{(1-\sigma)}}{\frac{Y^iY^j}{p^i\bar{y}}\left(\frac{\tau^{ij}p^i}{P^j}\right)^{(1-\sigma)}\frac{Y^jY^i}{p^j\bar{y}}\left(\frac{\tau^{ji}p^j}{P^i}\right)^{(1-\sigma)}}\right)^{1/2} \\
&= \left(\left[\tau^{ij}\right]^{\sigma-1}\left[\tau^{ji}\right]^{\sigma-1}\right)^{1/2} \\
&= \tau^{\sigma-1}
\end{aligned}$$

Problem 2:

Consider a small open Heckscher-Ohlin economy producing two goods, x and y, using low-skilled and high-skilled workers, L and H. Let a_{fg} denote the optimal input choice of factor f when producing one unit of good g, and assume the x-good is relatively skill-intensive, i.e., $a_{Hx}/a_{Lx} > a_{Hy}/a_{Ly}$. Production involves a continuum of tasks, $i \in [0,1]$, that are performed by low-skilled workers. Firms can undertake tasks at home or abroad through offshoring. Assume domestic low-skilled wages are greater than foreign wages, $w_L > w_L^*$. Assume also that firms need to hire $\beta(1+i) \geq 1$ foreign workers to perform task i at the offshore location. Let I denote the marginal task which is defined as:

$$w_L = w_L^* \beta (1 + I)$$

1. Show that the cost of producing one unit is:

$$c_j = w_L a_{Lj} \Omega(I) + w_H a_{Hj}$$

Provide a definition and interpretation of $\Omega(I)$.

Suggested answer:
The unit-cost functions are defined as:

$$\begin{aligned}
c_j &= a_{Lj} w_L + a_{Hj} w_H \\
&= a_{Lj} \left[w_L (1 - I) + w_L^* \beta \int_0^I (1 + i)\, di \right] + a_{Hj} w_H \\
&= a_{Lj} \left[w_L (1 - I) + w_L \frac{\int_0^I (1 + i)\, di}{1 + I} \right] + a_{Hj} w_H \qquad \text{(use } I\text{-definition)} \\
&= a_{Lj} \left[w_L (1 - I) + w_L \frac{I + \frac{1}{2} I^2}{1 + I} \right] + a_{Hj} w_H \\
&= w_L a_{Lj} \Omega(I) + w_H a_{Hj}
\end{aligned}$$

where $\Omega(I) = 1 - I + \frac{I + \frac{1}{2} I^2}{1+I} = \frac{1 - I^2 + I + \frac{1}{2} I^2}{1+I} = \frac{1 + I - \frac{1}{2} I^2}{1+I} < 1$ for $I \in [0,1]$. In the above expression, offshoring acts as a low-skilled labor-saving technological improvement. This cost reduction is captured by Ω.

2. Suppose the technology for offshoring improves which leads to a decline in β. How are factor prices affected by this change in offshoring costs?

Suggested answer:
Differentiate the zero-profit conditions and note that product prices are fixed:

$$\begin{aligned}
0 &= a_{Lg} (dw_L + w_L d\Omega) + a_{Hg} dw_H \\
0 &= \theta_{Lg} (\widehat{w}_L + \widehat{\Omega}) + \theta_{Hg} \widehat{w}_H
\end{aligned}$$

where θ_{fg} is the cost share of factor f in producing one unit of good g. These expressions imply:

$$\widehat{w}_L = -\widehat{\Omega} \quad \text{and} \quad \widehat{w}_H = 0$$

It follows that $\widehat{w}_L = -\widehat{\Omega} > 0$ since a lower β implies a higher marginal task, I, and $\Omega'(I) = \frac{-I-\frac{3}{2}I^2}{1+I} < 0$. The wages of low-skilled workers increase when the costs of offshoring decline, while the wages of high-skilled workers are not affected. Grossman and Rossi-Hansberg call this the productivity effect of offshoring.

3. Suppose the decline in offshoring costs leads the home country to specialize in the production of good x. Write down the factor-market clearing conditions. Are factor prices uniquely determined by product prices in this case?

   Suggested answer:
   The equilibrium conditions are:

$$\begin{aligned} p_x &= w_L a_{Lx}\Omega + w_H a_{Hx} \\ a_{Lx}x &= \frac{L}{1-I} \\ a_{Hx}x &= H \end{aligned}$$

   In a Heckscher-Ohlin model with more factors than products, factor prices are no longer uniquely determined by product prices. This is, for instance, the case in the Specific Factors model where factor prices depend on product prices as well as endowments.

4. Consider an additional improvement in the technology of offshoring. How are factor prices affected by an additional fall in β when the home country is only producing x? Hint: Differentiating the ratio of a_{Lx}/a_{Hx} implies:

$$\sigma_x(\widehat{w}_H - \widehat{w}_L - \widehat{\Omega}) = \frac{dI}{1-I}$$

   where σ_x is the elasticity of substitution between low and high-skilled workers in the production of good x.

   Suggested answer:
   Differentiate the zero-profit condition as before:

$$0 = \theta_{Lx}(\widehat{w}_L + \widehat{\Omega}) + (1-\theta_{Lx})\widehat{w}_H$$

   Use the hint to get:

$$\begin{aligned} \widehat{w}_L &= -\widehat{\Omega} - \frac{1-\theta_{Lx}}{\sigma_x}\frac{dI}{1-I} \\ \widehat{w}_H &= \frac{1-\theta_{Lx}}{\sigma_x}\frac{dI}{1-I} > 0 \end{aligned}$$

   Lower costs of offshoring increases the range of tasks performed abroad. A rise in offshoring has the same effects as an increase in the endowment of low-skilled workers — and factor prices respond to these changes in a setting with more factors than goods. The wages of high-skilled workers increase due to the labor-supply effect and it reflects the adjustment in wages necessary for all domestic low-skilled workers to remain employed. The low-skilled workers experience the same productivity effect as before but the labor-supply effect has a negative effect on their wages. Without further assumptions, it is not possible to determine the relative size of the productivity and labor-supply effects. The latter is, however, small when σ_x and θ_{Lx} are large.

Problem 3:

Answer True or False to each of the statements below. Briefly explain your answer.

1. An empirical study of Chinese firms concludes that exporters are less productive than non-exporters. This is consistent with the predictions of Melitz (2003).

   Suggested answer:
   False. Exporters have higher productivities than non-exporters in Melitz (2003). It is exactly this productivity advantage that allows them to profit from exporting — an activity that is associated with additional fixed and variable costs.

2. In Eaton and Kortum (2002), the gains from trade are higher if a country's productivity distribution is more dispersed.

   Suggested answer:
   True. Eaton and Kortum interpret the dispersion parameter as driving Ricardian comparative advantages. With a higher productivity dispersion, it is more likely that a country will be the lowest-cost supplier of a given product — this increases the gains from trade.

3. In a Specific Factors model with two goods and three factors, an increase in a factor endowment will increase the output of the industry using it intensively, and decrease the output of the other industry.

   Suggested answer:
   False. The Rybczynski theorem does not hold in a Heckscher-Ohlin model with more factors than products. A higher labor endowment will, e.g., increase the output of both industries in a Specific Factors model.

4. Krugman (1979) predicts that firms set the same price before and after opening up to international trade.

   Suggested answer:
   False. Firms set prices as a markup over marginal costs – and markups change when opening to international trade. Krugman assumes that the elasticity of demand depends on the consumption level. As a result, demand becomes more elastic as consumers spread their consumption over domestic as well as foreign varieties. This leads to lower markups and prices.