Written Exam for the M.Sc. in Economics Winter 2015–16

Advanced International Trade

3–hour closed–book exam

December 15 2015

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 7 pages in total.

Problem 1:

Consider a small economy producing two tradable goods. Workers L produce a continuum of intermediate goods $i \in [0,1]$ that are combined with capital K into the final output in each industry using a CRS technology. Intermediates are normalized such that they all require the same amount of labor to produce. Let a_{fj} denote the required input of factor f to produce one unit of the final good $j = \{1,2\}$. Offshore production of intermediate good i costs $\beta(1+\frac{1}{2}i)$.

1. How would you interpret the cost of offshoring?

   Suggested answer:
   Following Grossman and Rossi-Hansberg (2008), the cost of offshoring has two components. First, an overall offshoring cost (β) reflecting things like transportation and communication technology. Second, an offshoring cost that varies across intermediates $(1+\frac{1}{2}i)$. Let intermediates i be ordered such that they are increasingly complex to produce. The more complex intermediates (higher i's) could be more costly to offshore, for instance, because one cannot write a manual for those goods and hence it takes many resources to instruct foreign workers to produce them.

2. Assume $\beta < \frac{w}{w^*} < \frac{3}{2}\beta$. What does this restriction imply for production of intermediates at home and offshore? Write down a condition for the cut-off intermediate good, I, for which domestic and offshore production costs are balanced.

   Suggested answer:
   The double inequality excludes the possibilities that all intermediates are produced offshore and that all intermediates are produced domestically. To see this note that for some offshoring to be profitable we have $w^* a_{Lj}\beta(1+0) < w a_{Lj}$, and to ensure that not all intermediates are cheaper to produce abroad we need $w a_{Lj} < w^* a_{Lj}\beta(1+\frac{1}{2})$:

$$w^*\beta(1+0) < w < w^*\beta(1+\frac{1}{2})$$
$$\implies \beta < \frac{w}{w^*} < \frac{3}{2}\beta$$

   The marginal offshore intermediate is given by:

$$w = w^*\beta(1+\frac{1}{2}I)$$

3. Show that the cost of producing one unit of output is $c_j = w a_{Lj}\Omega + r a_{Kj}$, where $\Omega \equiv 1 - \frac{I^2}{2(2+I)}$. How does offshoring affect unit costs?

   Suggested answer:

$$\begin{aligned}
c_j =& w a_{Lj}(1-I) + w^* a_{Lj}\beta \int_0^I 1 + \frac{1}{2}i \, di + r a_{Kj} \\
c_j =& w a_{Lj}(1-I) + w^* a_{Lj}\beta \left[i + \frac{1}{4}i^2 \right]_0^I + r a_{Kj} \\
c_j =& w a_{Lj}(1-I) + w a_{Lj}\frac{I+\frac{1}{4}I^2}{1+\frac{1}{2}I} + r a_{Kj} \\
c_j =& w a_{Lj}\left(1 - \frac{I^2}{2(2+I)}\right) + r a_{Kj}
\end{aligned}$$

$\Omega(I) = 1 - \frac{I^2}{2(2+I)} < 1$ for $I > 0$. Hence, offshoring reduces unit costs similar to labor-augmenting technological change that increases the productivity of labor.

4. Show that the cost-savings/productivity effect of easier offshoring tends to increase wages and leave capital owners unaffected. Hint: Use the zero-profit conditions and assume $\hat{p} = 0$ for the small economy.

   Suggested answer:
   Firms chose I and y. Using the expression for the marginal intermediate being offshored, we have

$$\max_{y_j} p_j y_j - c_j y_j \text{ s.t. } c_j = w a_{Lj} \Omega + s a_{Hj}$$

$$\Rightarrow p_j = w a_{Lj} \Omega + r a_{Kj}$$

   Totally differentiate these zero profit conditions (with respect to β) to get

$$\begin{aligned}
\mathrm{d}p_j &= \mathrm{d}w a_{Lj} \Omega + w a_{Lj} \Omega'(I) \mathrm{d}I + \mathrm{d}r a_{Kj} \\
\frac{\mathrm{d}p_j}{p_j} &= \frac{\mathrm{d}w}{w} \frac{w a_{Lj} \Omega}{c_j} + \frac{w a_{Lj} \Omega}{c_j} \frac{\Omega'(I) \mathrm{d}I}{\Omega} + \frac{\mathrm{d}r}{r} \frac{r a_{Kj}}{c_j} \\
0 &= \theta_{Lj}(\hat{w} + \hat{\Omega}) + \theta_{Kj} \hat{r}
\end{aligned}$$

   these two equations ($j = \{1, 2\}$) imply

$$\begin{aligned}
\hat{r} &= 0 \\
\hat{w} &= -\hat{\Omega} = -\frac{\Omega'(I) \mathrm{d}I}{\Omega(I)} \\
\hat{w} &= \frac{\frac{8I + 3I^2}{2(2+I)^2} \mathrm{d}I}{1 - \frac{I^2}{2(2+I)}} > 0
\end{aligned}$$

Problem 2:

Consider the Dornbusch, Fischer and Samuelson (1977) model with two countries, Home and Foreign. We use * to denote parameters specific to Foreign. Each country produces a continuum of goods, indexed $z \in (0, 1)$. The only factor of production is labor which is paid the wage w in Home and w^* in Foreign. The countries' labor endowments are given by L and L^*. Consumers have identical Cobb–Douglas preferences such that they spend a fraction $b(z)$ of their income on good z. It is assumed that $b(z) > 0 \, \forall z$ and $\int_0^1 b(z) = 1$.

In the free trade equilibrium, countries produce and specialize in the goods in which they have a comparative advantage. Assume Home produces all goods in $(0, \widetilde{z})$, while Foreign produces all goods in $(\widetilde{z}, 1)$, where $\widetilde{z}$ is the good for which production costs are exactly the same in the two countries.

One of the equilibrium conditions in Dornbusch, Fischer and Samuelson (1977) is:

$$\theta(\widetilde{z}) w^* L^* = (1 - \theta(\widetilde{z})) \, wL \tag{1}$$

where $\theta(\widetilde{z}) = \int_0^{\widetilde{z}} b(z) dz$.

1. What is the interpretation of $\theta(\widetilde{z})$? What is the interpretation of equation (1)?

   Suggested answer:
   $\theta(\widetilde{z})$ is the fraction of income spent on goods produced in Home. Equation 1 is the balanced trade condition, dictating that Home's exports $(\theta(\widetilde{z})w^*L^*)$ are equal to Home's imports $((1-\theta(\widetilde{z}))\, wL)$.

2. Show that $\theta(\widetilde{z})$ is equal to the home country's share of world income:

$$\theta(\widetilde{z}) = \frac{Y}{Y^* + Y}$$

   where $Y = wL$ and $Y^* = w^*L^*$.

   Suggested answer:

$$\begin{aligned} \theta(\widetilde{z})w^*L^* &= (1-\theta(\widetilde{z}))\, wL \\ \theta(\widetilde{z})(w^*L^* + wL) &= wL \\ \implies \theta(\widetilde{z}) &= \frac{wL}{w^*L^* + wL} = \frac{Y}{Y^* + Y} \end{aligned}$$

3. Derive the Gravity Equation. That is, derive a relationship between bilateral trade and the two countries' incomes. Holding world income fixed, will two countries of unequal income levels trade more or less compared to two countries of similar income levels?

   Suggested answer:
   Let X denote the home country's exports to foreign:

$$X = \theta(\widetilde{z})w^*L^* = \frac{YY^*}{Y^* + Y}$$

   Similarly, let X^* denote the foreign country's exports to home:

$$X^* = (1-\theta(\widetilde{z}))\, wL = \frac{YY^*}{Y^* + Y}$$

   Bilateral trade is then:

$$T = X + X^* = \frac{2}{Y^* + Y} YY^*$$

   Countries with more similar incomes trade more. E.g., $T = 2$ when $Y = 2, Y^* = 2$ compared to $T = 1.5$ when $Y = 1, Y^* = 3$.

4. Eaton and Kortum (2002) present a multi-country Ricardian model with geographic barriers to international trade. What are the key differences between the 2002–article by Eaton and Kortum and the 1977–article by Dornbusch, Fischer and Samuelson? What determine absolute and comparative advantages in Eaton and Kortum (2002)? Note that you are not required to derived any statements formally in your answer.

Suggested answer:
In DFS (1977), unit labor requirements, the $a(z)$'s, are non-stochastic numbers for all goods. In a two-country setup, it is straightforward to use the ratio of the a's to determine the comparative advantages of each country. This is not the case when considering the general case of many countries. Eaton and Kortum think of the a's as realizations of random variables from a Frechet distribution. In order words, each country's technology is completely summarized by a statistical distribution which can be characterized by just a few parameters. Eaton and Kortum interpret the location parameter of the Frechet distribution as capturing a country's absolute advantage, while the scale parameter governs comparative advantage (that is, the dispersion in the productivity distribution). This is the main assumption Eaton and Kortum makes in order to have a multi-country setup — and what set them apart from DFS.

In most other dimensions, Eaton and Kortum have the same setup as DFS. That is, CRS-technology with labor as the only input. Perfectly competitive factor and goods markets. Iceberg trade costs. The only other minor difference is that DFS assume Cobb-Douglas perferences, whereas Eaton and Kortum consider more general CES preferences.

5. The Gravity Equation derived in Eaton and Kortum (2002) is:

$$X_{ni} = \frac{\left(\frac{d_{ni}}{p_n}\right)^{-\theta} X_n}{\sum_{m=1}^{N} \left(\frac{d_{mi}}{p_m}\right)^{-\theta} X_m} Q_i \tag{2}$$

where X_{ni} is total spending in country n on goods produced in country i. $d_{ni} > 1$ describes how many units of a good must be shipped from n for one unit to arrive in i. Country n's price index is p_n and its total spending is X_n. Q_i is exporter i's total sales. The parameter $\theta > 1$ governs the dispersion in technology.

Explain what happens to country i's export to n, X_{ni}, if trade costs decrease such that $d'_{mi} < d_{mi}\, \forall m \neq n$ and $d'_{ni} = d_{ni}$. Do exports adjust at the extensive margin or the intensive margin?

Suggested answer:
Because country i's iceberg trade costs decrease for all destinations except n, it holds that $(d'_{mi}/p_m)^{-\theta} X_m > (d_{mi}/p_m)^{-\theta} X_m\, \forall m \neq n$. Therefore, the denominator on the RHS of (2) increases, implying that exports from i to n decreases. The intuition is straightforward: As trade costs decline for all other destinations than n, these markets become more attractive relative to n. Therefore, country i decreases its exports to n and increases its exports to all other destinations. In Eaton and Kortum (2002), all the adjustment is at the extensive margin: Countries that are more distant, have higher costs, or lower T's, simply sell a smaller range of goods, but the average price charged is the same.

Problem 3:

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

1. If exporting involves lower fixed costs while FDI involves lower variable costs, only the most productive firms engage in FDI.

   Suggested answer: True. Helpman, Melitz and Yeaple (2004) assume that firms trade-off different relative costs when they choose to export or set up a local subsidiary abroad (the so-called proximity-concentration trade-off). In their model, only the most productive firms engage in FDI. This prediction is supported by empirical evidence.

2. Consider a $2 \times 2 \times 2$ Heckscher–Ohlin model where the two factors are low-skilled and high-skilled workers. According to the Rybczynski theorem, an increase in the factor endowment of low-skilled workers due to immigration leads to a decrease in low-skilled wages.

   Suggested answer: False. A greater endowment of low-skilled workers expand the output of the industry using low-skilled workers intensively. Wages are unaffected.

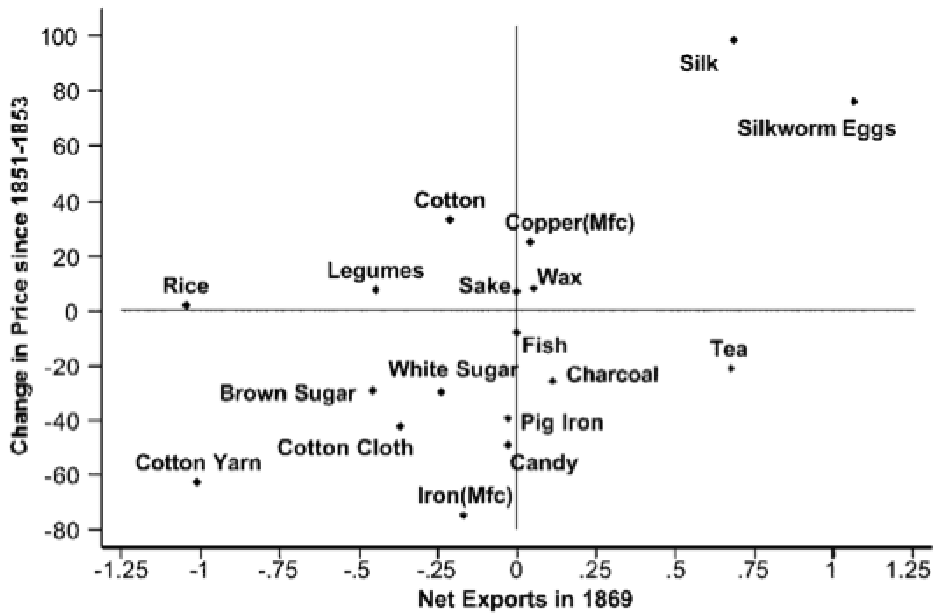
3. Between two trading partners, tariffs reduce international trade relative to internal trade more for the larger country.

   Suggested answer: False. The border effect is largest for the smallest country (Feenstra pp 151).

4. In the $2 \times 2 \times 2$ Heckscher–Ohlin model, the abundant factor gains from international trade, while the scarce factor loses.

   Suggested answer: True. This follows from the Heckscher-Ohlin theorem and the Stolper-Samuelson theorem.

5. Based on the figure below, Bernhofen and Brown (2004) reject the Law of Comparative Advantage in the context of Japan's transition from autarky to free trade in the mid-19th century.



Suggested answer: False. The figure shows a positive relationship between price changes and net exports. This is in accordance with the Law of Comparative Advantage.