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

Advanced International Trade

3–hour closed–book exam

December 15 2016

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.

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Problem 1:

Consider a small open economy that takes world prices as given. Let the initial domestic price vector facing consumers and producers be denoted by:

$$p = p^* + t \tag{1}$$

where p is a vector of domestic prices, p^* is a vector of world prices and t is a vector of trade tariffs and subsidies. For an imported good, $t_i > 0$ represents a tariff raising the domestic price above the world price, while $t_i < 0$ indicates an import subsidy. Conversely, $t_i > 0$ indicates a subsidy for an exported good, while $t_i < 0$ represents a tariff for exports.

The tax revenue collected by the government is:

$$R = t \cdot (c - y) = t \cdot m \tag{2}$$

where c is a vector of consumption, y is a vector of production, m is a vector of net imports and $a \cdot b = \sum_{i=1}^{N} a_i b_i$ is the usual dot product of two N-dimensional vectors.

There are H households in the economy and each household has a labor endowment of one unit that is inelastically supplied to the production sector. Households maximize their utility, $u^h(c^h)$, subject to the budget constraint:

$$p \cdot c^h \leq w + R^h = w + \frac{t \cdot m}{H} \tag{3}$$

where c^h is the consumption vector of household h, w is the wage income and R^h is a lump-sum transfer from the government.

Suppose the government implements a trade reform such that t' is the new vector of trade tariffs and subsidies. As part of the trade reform, the government is also changing its transfer system:

$$R'^h = (p' - p) \cdot c^h - (w' - w) + \frac{t \cdot m}{H} \tag{4}$$

where $'$ refers to post-reform variables.

1. Does the trade reform make households better off?

   Suggested answer:
   Households cannot be worse off since they can still afford their initial consumption bundle:

$$\begin{aligned} p' \cdot c^h &\leq w' + R'^h \\ p' \cdot c^h &\leq w' + (p' - p) \cdot c^h - (w' - w) + \frac{t \cdot m}{H} \\ p \cdot c^h &\leq w + \frac{t \cdot m}{H} \end{aligned}$$

2. The government's budget, i.e., tax revenue minus transfers, is given by:

$$B = t' \cdot m' - \sum_{h=1}^{H} R^h \tag{5}$$

$$= t' \cdot (m' - m) - (p' \cdot y - w'H) \tag{6}$$

Is the government's budget balanced, $B \geq 0$?

Suggested answer:
The budget is balanced if $t' \cdot (m' - m) \geq 0$:

$$\begin{aligned} B &= t' \cdot (m' - m) - (p' \cdot y - w'H) \\ &\geq t' \cdot (m' - m) \\ &\geq 0 \end{aligned}$$

since $p' \cdot y - w'H \leq 0$, i.e., profits are lower than the maximal profits of zero because the initial vector of production is suboptimal when producers face the new post-reform price vector, p'.

If changes in net imports evaluated at the post-reform vector of trade taxes and subsidies are non-negative then $t' \cdot (m' - m) \geq 0$. Assuming this is satisified, it can be concluded that the post-reform transfer system is feasible. The condition is met if imports increase for goods with $t'_i > 0$ and exports increase for goods with $t'_i < 0$. Notice that the government budget is always non-negative if the trade reform eliminates all trade taxes and subsidies, $t' = 0$.

3. The World Trade Organization (WTO) argues that restricted trade is better than no trade. What condition is needed for this statement to be true?

Suggested answer:
Starting in autarky ($m = 0$) and moving to trade with tariffs and subsidies, it is possible to construct a transfer system as before that leaves consumers no worse off. This transfer system is feasible if $t' \cdot m' \geq 0$, i.e., tariffs and subsidies must raise a non-negative revenue. In this case, restricted trade is better than no trade.

Problem 2:

Consider a small open Heckscher-Ohlin economy producing two products using low-skilled and high-skilled workers. The zero-profit conditions are given by:

$$p_1 = w_L a_{L1}\mu_{L1} + w_H a_{H1}\mu_{H1} \tag{7}$$

$$p_2 = w_L a_{L2}\mu_{L2} + w_H a_{H2}\mu_{H2} \tag{8}$$

where p_g is the price of product $g = 1, 2$, w_f is the wages of worker $f = L, H$, a_{fg} is the optimal input choice of factor f when producing one unit of product g, and $0 < \mu_{fg} \leq 1$ represents technological improvements that are specific to factors and products.

1. Show that product price changes are related to factor price changes and cost shares:

$$\widehat{p}_g = \theta_{Lg}(\widehat{w}_L + \widehat{\mu}_{Lg}) + \theta_{Hg}(\widehat{w}_H + \widehat{\mu}_{Hg}) \quad \text{for } g = 1, 2$$

where $\widehat{z} = dz/z$.

Provide definitions of θ_{Lg} and θ_{Hg}. Assuming $\theta_{L1} > \theta_{L2}$, how would you characterize products 1 and 2, respectively?

Suggested answer:
Totally differentiate zero-profit condition:

$$dp_g = a_{Lg}(\mu_{Lg}dw_L + w_L d\mu_{Lg}) + a_{Hg}(\mu_{Hg}dw_H + w_H d\mu_{Hg})$$

$$\widehat{p}_g = \frac{w_L a_{Lg}\mu_{Lg}}{c_g}(\widehat{w}_L + \widehat{\mu}_{Lg}) + \frac{w_H a_{Hg}\mu_{Hg}}{c_g}(\widehat{w}_H + \widehat{\mu}_{Hg})$$

$$\widehat{p}_g = \theta_{Lg}(\widehat{w}_L + \widehat{\mu}_{Lg}) + \theta_{Hg}(\widehat{w}_H + \widehat{\mu}_{Hg})$$

where $\theta_{Lg} = \frac{w_L a_{Lg}\mu_{Lg}}{c_g}$ and $\theta_{Hg} = \frac{w_H a_{Hg}\mu_{Hg}}{c_g}$ denote the cost shares of low-skilled and high-skilled workers for which it holds that $\theta_{Lg} + \theta_{Hg} = 1$. Good 1 is characterized as the low-skill labor-intensive good when $\theta_{L1} > \theta_{L2}$.

2. Suppose the production of good 1 experiences a uniform technological change, while product prices are fixed. That is, $\widehat{\mu}_{Lg} = \widehat{\mu}_{Hg} = \widehat{\mu}_g$ and $\widehat{\mu}_1 < 0 = \widehat{\mu}_2$. How are factor prices affected by this technological change?

Suggested answer:

$$0 = \theta_{L1}(\widehat{w}_L + \widehat{\mu}_1) + \theta_{H1}(\widehat{w}_H + \widehat{\mu}_1) \iff -\widehat{\mu}_1 = \theta_{L1}\widehat{w}_L + \theta_{H1}\widehat{w}_H$$
$$0 = \theta_{L2}\widehat{w}_L + \theta_{H2}\widehat{w}_H$$

By combining the two equations:

$$\begin{aligned} -\widehat{\mu}_1 &= \theta_{L1}\widehat{w}_L + \theta_{H1}\widehat{w}_H \\ &= \theta_{L1}\widehat{w}_L - \theta_{H1}\frac{\theta_{L2}}{\theta_{H2}}\widehat{w}_L \\ &= \frac{\theta_{L1}\theta_{H2} - \theta_{L2}\theta_{H1}}{\theta_{H2}}\widehat{w}_L \\ \implies \widehat{w}_L &= \frac{\theta_{H2}}{\theta_{L2}\theta_{H1} - \theta_{L1}\theta_{H2}}\widehat{\mu}_1 = -\frac{\theta_{H2}}{\theta}\widehat{\mu}_1 > 0 \\ \widehat{w}_H &= -\frac{\theta_{L2}}{\theta_{L2}\theta_{H1} - \theta_{L1}\theta_{H2}}\widehat{\mu}_1 = \frac{\theta_{L2}}{\theta}\widehat{\mu}_1 < 0 \end{aligned}$$

where θ is defined as:

$$\begin{aligned}\theta &= -(\theta_{L2}\theta_{H1} - \theta_{L1}\theta_{H2}) \\ &= -(\theta_{L2}(1-\theta_{L1}) - \theta_{L1}(1-\theta_{L2})) \\ &= \theta_{L1} - \theta_{L2} > 0\end{aligned}$$

Since technological change operates essentially like a change in the price of good 1, we know from the Stolper-Samuelson theorem that the wages of low-skiller workers increase as they are used intensively in the production of good 1, while the wages of high-skilled workers decline. This is exactly what the expressions above show.

3. Suppose now that technological change is biased towards low-skilled workers. That is, $\widehat{\mu}_{L1} = \widehat{\mu}_{L2} = \widehat{\mu}_L < 0 = \widehat{\mu}_{H1} = \widehat{\mu}_{H2} = \widehat{p}_1 = \widehat{p}_2$. How are factor prices affected by this technological change?

   Suggested answer:

$$\begin{aligned}0 &= \theta_{L1}(\widehat{w}_L + \widehat{\mu}_L) + \theta_{H1}\widehat{w}_H \\ 0 &= \theta_{L2}(\widehat{w}_L + \widehat{\mu}_L) + \theta_{H2}\widehat{w}_H\end{aligned}$$

   Combining the two:

$$\begin{aligned}0 &= \theta_{L1}(\widehat{w}_L + \widehat{\mu}_L) + \theta_{H1}\widehat{w}_H \\ 0 &= \theta_{L1}(\widehat{w}_L + \widehat{\mu}_L) - \theta_{H1}\frac{\theta_{L2}}{\theta_{H2}}(\widehat{w}_L + \widehat{\mu}_L) \\ 0 &= \frac{\theta_{L1}\theta_{H2} - \theta_{L2}\theta_{H1}}{\theta_{H2}}(\widehat{w}_L + \widehat{\mu}_L)\end{aligned}$$

   The only solution is:

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

   With factor-biased technological change, the wages of low-skilled workers rise due to their higher marginal productivity, while wages of high-skilled workers are unchanged. This result is identical to the productivity effect due to offshoring in Grossman and Rossi-Hansberg (2008).

4. Summarize how offshoring affects factor prices according to the theory of Grossman and Rossi-Hansberg (2008). Briefly discuss if offshoring and technological improvements have similar effects on factor prices.

   Suggested answer:
   Grossman and Rossi-Hansberg (2008) consider a general Heckscher-Ohlin model with large countries and more factors than goods. They identify three effects of offshoring: the productivity effect, the relative-price effect and the labor-supply effect. In their baseline model, tasks of low-skilled workers are moved overseas if it becomes cheaper to have them performed there. This leads to costs savings that boost the wages of low-skilled workers — Grossman and Rossi-Hansberg label this effect as the productivity effect of offshoring. The productivity effect acts exactly like technological change biased towards low-skilled workers, as analyzed in question

2.3. The labor-supply effect leads to higher wages for high-skilled workers (and lower wages for low-skilled wages) as industries may substitute towards high-skilled workers which will increase their wages. With lower costs of offshoring, the price of the low-skilled good declines as its relative world supply increases. This leads to additional wage gains for high-skilled workers as well as wage losses for low-skilled workers, cf. the Stolper-Samuelson theorem. This is the so-called relative-price effect. Neither type of technological changes considered in questions 2.2 and 2.3 lead to increases in high-skilled wage. That said, the productivity effect of offshoring and low-skill labor-augmented technological change have a similar effect on wages.

Problem 3:

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

1. In Melitz (2003), exporting firms set higher prices than non-exporting firms.

   Suggested answer:
   False. Exporters set lower prices because they have lower marginal costs (higher productivity) and the same markups as non-exporters.

2. Global uniform technological improvements increase welfare everywhere according to Dornbusch, Fischer and Samuelson (1977).

   Suggested answer:
   True. Uniform technological improvements reduce the unit labor requirements in the same way in both countries. Relative productivities, relative wages and the range of goods that countries specialize in are therefore unchanged. Welfare increases because of higher real wages.

3. The Gravity Equation predicts that larger countries have higher bilateral trade because they export and import a wider range of products from each other.

   Suggested answer:
   False. The Gravity Equation predicts that larger countries have higher bilateral trade. However, it has no predictions in terms of how the two countries trade more.

4. In a monopolistic competition model with CES demand and increasing returns to scale technology, the only source of gains from trade comes from being able to consume foreign varieties.

   Suggested answer:
   True. This is the setup in Krugman (1980) that shows that the output of firms and the number of domestic varieties are fixed and invariant to international trade. Assuming more general preferences, Krugman (1979) finds that trade leads to additional pro-competitive/efficiency effects. This mechanism is, however, not present in a model with CES demand. In Krugman (1980), international trade increases the number of varieties available for consumption. This is the only source of gains.