

14.54—Fall 2024
Final Examination Solution

Question 1 — Multiple Choices (30 points)

1. A. What determines the patterns of trade in a Ricardian model are comparative advantages, which depend on relative labor requirements.
2. C. The two countries can produce at most one good in common, and due to its comparative advantage:

$$a_{XA}/a_{XB} > a_{YA}/a_{YB} > a_{ZA}/a_{ZB}$$

if A produces good X , it must also produce and export Z and Y ; if it exports good Y , it must also export good Z . Moreover, A never imports good Z .

3. C. From the FOC of producers, we must have that (T = Land, K =Capital, L = Labor)

$$\begin{aligned} p_F^* MPT(T, L_F) &= r_T \\ p_F^* MPL(T, L_F) &= w \\ p_M^* MPK(K, L_M) &= r_K \\ p_M^* MPL(K, L_M) &= w \end{aligned}$$

Therefore:

$$MPL(T, L_F) = \frac{p_M^*}{p_F^*} MPL(K, L_M)$$

if $\frac{p_M^*}{p_F^*}$ falls, L_M decreases and L_F increases. Therefore, $MPT(T, L_F)$ increases and $MPK(K, L_M)$ decreases. This implies that both r_T/p_F and r_T/p_M increase for land-owners, while both r_K/p_M and r_K/p_F decrease for capitalists.

4. A. Country A is relatively more abundant in capital than country B, so it will export the capital intensive good by the Heckscher-Ohlin theorem.
5. D. By the Heckscher-Ohlin Theorem, the relative price of the skill-intensive good must increase in Rich. By the Stolper-Samuelson theorem, the real wage for skilled workers in Rich must rise and the real wage for unskilled workers in Rich must fall. Since there are aggregate gains from trade, the income rise for skilled workers as a whole must exceed the income fall for unskilled workers as a whole.¹

¹In this problem, I granted full marks to those who chose A, because we did not specify whether “income” referred to the aggregate income of each group of workers as a whole (which was what we meant) or income per capita. The magnitude of changes in income per capita is ambiguous.

6. A. The country is more likely to benefit if it improves its terms of trade. Only a large country can manipulate its terms of trade and an export subsidy tends to worsen rather than improve terms of trade.
7. C. Tariffs and quotas are no longer equivalent when firms have market power. In this case, the tariff alleviates the monopoly distortion, whereas the quota does not.
8. B. A subsidy on exports of bicycles will increase domestic prices of bicycles, decreasing domestic consumption of bicycles.
9. B. Both countries try to improve its terms of trade, but their effort to improve the ToT will be offset by each other's effort. Overall, the welfare of each will be lower due to distortions introduced by the tariffs.
10. C. The negative externality implies that the economy would benefit from reducing domestic production of beef. However, a tax on consumption (option a) will not change the producer price (this is a small open economy) and, in turn, production from the pre-tax level. A subsidy on exports of production (option A) will increase domestic producer prices, which increases domestic production. Therefore, none of these instruments would be beneficial for the country.

Question 2 — True, False, Uncertain (20 points)

- (a) (3.33 points) False. In the Ricardian model, workers are freely mobile across sectors. So there should not be any systematic difference between workers employed in import-competing sectors and those employed in other sectors. In fact, since there are no losers, all workers gain from trade.
- (b) (3.33 points) True. Workers can move away from the sector whose price falls, while the specific factor is stuck in the sector. Hence, the welfare impact of import competition tends to be more severely felt by owners of specific factors than mobile factors.
- (c) (3.33 points) False. When countries are not completely specialized, factor prices are equalized.
- (d) (3.33 points) False. The European Common Agricultural Policy entails an export subsidy for agricultural production in Europe. The export subsidy increases the relative supply of agricultural goods on world markets and pushes down the relative world price of agricultural goods. This implies a terms-of-trade deterioration for any country specialized in the agricultural sector.
- (e) (3.33 points) False. For example, when factor price equalization holds, changes in factor supplies will not affect factor prices at all.
- (f) (3.33 points) False. Grossman and Rossi-Hansberg offer a scenario under which offshoring raises the real wage of the workers whose jobs is being offshored. This requires the productivity effect to dominate the terms-of-trade effect and labor-supply effect.

Question 3 — Theoretical Question (20 points + 5 bonus points)

- (a) (6 points) Given the Cobb-Douglas production functions, the marginal products of the three factors are given by

$$\begin{aligned} MPL_C &= \frac{1}{2} \sqrt{\frac{K}{L_C}}, & MPK &= \frac{1}{2} \sqrt{\frac{L_C}{K}} \\ MPL_W &= \frac{1}{2} \sqrt{\frac{T}{L_W}}, & MPT &= \frac{1}{2} \sqrt{\frac{L_W}{T}} \end{aligned}$$

In a competitive equilibrium, the value marginal product of labor must be equalized in the two sectors

$$(w =) p_C MPL_C = p_W MPL_W \quad (1)$$

which can be rearranged as

$$\sqrt{\frac{K}{L_C}} = \frac{1}{2} \sqrt{\frac{T}{L_W}} \iff L_C = \frac{4K}{T} L_W$$

Labor market clearing implies $L_C + L_W = 200$. Solving for L_C and L_W , we find

$$L_C = \frac{T}{T + 4K} 200, \quad L_T = \frac{4K}{T + 4K} 200, \quad (2)$$

Since $K = T = 10$, we get $L_W = 40$ and $L_C = 160$.

- (b) (4 points) Firm profit maximization implies

$$\begin{aligned} w &= p_C MPL_C = \sqrt{\frac{K}{L_C}} = \frac{1}{4} \\ r_K &= p_C MPK = \sqrt{\frac{L_C}{K}} = 4 \\ r_T &= p_W MPT = \frac{1}{2} \sqrt{\frac{L_W}{T}} = 1 \end{aligned}$$

- (c) (6 points) Now $K' = 60$. From (2), we get $L'_W = 8$ and $L'_C = 192$. Following the same steps as above,

$$\begin{aligned} w' &= p_C MPL_C = \sqrt{\frac{K}{L_C}} = \sqrt{\frac{10}{32}} = \frac{\sqrt{5}}{4} & \left(> \frac{1}{4} \right) \\ r'_K &= p_C MPK = \sqrt{\frac{L_C}{K}} = \sqrt{\frac{32}{10}} = \frac{4}{\sqrt{5}} & (< 4) \\ r'_T &= p_W MPT = \frac{1}{2} \sqrt{\frac{L_W}{T}} = \frac{1}{2} \sqrt{\frac{8}{10}} = \frac{1}{\sqrt{5}} & (< 1) \end{aligned}$$

- (d) (4 points) Prices in a small open economy are unchanged. So opposition to FDI only derives from changes in factor prices. Since $r'_K < r_K$ and $r'_T < r_T$, capitalists and landlords will oppose FDI. Conversely, $w > w'$ implies that workers will welcome it.
- (e) (+ 5 points) To answer this question, one needs to compute p_C/p_W both before and after FDI by setting the relative supply equal to relative demand. Throughout, I use wheat as the numeraire so $P_W = 1$. Starting from the supply side, equation (1) implies

$$P_C \frac{1}{2} \sqrt{\frac{K}{L_C}} = \frac{1}{2} \sqrt{\frac{T}{L_W}}.$$

Recalling $Q_C = \sqrt{K}\sqrt{L_C}$ and $Q_W = \sqrt{T}\sqrt{L_W}$, we can substitute out the endogenous variables L_C and L_W to obtain

$$P_C \frac{1}{2} \frac{K}{Q_C} = \frac{1}{2} \frac{T}{Q_W}.$$

Rearranging, we obtain the relative supply:

$$\text{RS: } \frac{Q_C}{Q_W} = \frac{K}{T} P_C$$

On the demand side, the Leontief preferences imply

$$\text{RD: } \frac{D_C}{D_W} = 2$$

Setting RD=RS, we get

$$P_C = 2 \frac{T}{K}$$

Now, we can proceed as before to solve for labor allocations L_C and L_W as well as factor prices. From equation (1), we have

$$\left(2 \frac{T}{K}\right) \frac{1}{2} \sqrt{\frac{K}{L_C}} = \frac{1}{2} \sqrt{\frac{T}{L_W}} \implies 2\sqrt{T}\sqrt{L_W} = \sqrt{K}\sqrt{L_C} \implies 4TL_W = KL_C$$

Imposing labor market clearing $L_C + L_W = 200$, we find

$$L_C = \frac{4T}{K + 4T} 200, \quad L_T = \frac{K}{K + 4T} 200.$$

Thus, we have $P_C = 2$, $L_C = 160$, and $L_W = 40$ before FDI (just as in part (a)), whereas $P'_C = 1/3$, $L'_C = 80$, and $L'_T = 120$ after FDI.

Factor prices before FDI are just as in part (b); after FDI, they are

$$\begin{aligned} w' &= p_C MPK = \frac{1}{3} \left(\frac{1}{2} \sqrt{\frac{K}{L_C}} \right) = \frac{1}{6} \sqrt{\frac{3}{4}} = \frac{1}{4\sqrt{3}} & \left(< \frac{1}{4} \right) \\ r'_K &= p_C MPL_C = \frac{1}{3} \left(\frac{1}{2} \sqrt{\frac{L_C}{K}} \right) = \frac{1}{6} \sqrt{\frac{4}{3}} = \frac{1}{3\sqrt{3}} & (< 4) \\ r'_T &= p_W MPT = \frac{1}{2} \sqrt{\frac{L_W}{T}} = \frac{1}{2} \sqrt{12} = \sqrt{3} & (> 1) \end{aligned}$$

Finally, we need to consider welfare. Note that the Leontief preferences imply that the cost of attaining one util is $2P_C + P_W = 2P_C + 1$. Thus, utility attained by owners of each type of factors is given by

$$\begin{aligned} \frac{w}{2P_C + 1} &= \frac{1}{20} \\ \frac{r_K}{2P_C + 1} &= \frac{4}{5} \\ \frac{r_T}{2P_C + 1} &= \frac{1}{5} \end{aligned}$$

before FDI, and (noting $2P'_C + 1 = 5/3$)

$$\begin{aligned} \frac{w'}{2P'_C + 1} &= \frac{3}{5} \cdot \frac{1}{4\sqrt{3}} = \frac{\sqrt{3}}{20} & \left(> \frac{1}{20} \right) \\ \frac{r'_K}{2P'_C + 1} &= \frac{3}{5} \cdot \frac{1}{3\sqrt{3}} = \frac{1}{5\sqrt{3}} & \left(< \frac{4}{5} \right) \\ \frac{r'_T}{2P'_C + 1} &= \frac{3}{5} \cdot \sqrt{3} = \frac{3\sqrt{3}}{5} & \left(> \frac{1}{5} \right) \end{aligned}$$

after FDI. Thus, capitalists will oppose FDI, while workers and land-owners will welcome it.

Intuitively, the large increase in capital in a closed-economy induces a sharp fall in the relative price of computers P_C/P_W , which adversely impacts capitalists. Workers gain despite w going down, as the fall in P_C is quite large.

Question 4 — Theoretical Question (20 points)

- (a) (4 points) The isoquants are L-shaped. There is no substitution between skilled and unskilled labor. The skilled/unskilled labor ration does not respond to changes in the relative wage. In computer industry, $\frac{a_{SC}}{a_{LC}} = 2$. In Tee-shirts industry, $\frac{a_{ST}}{a_{LT}} = \frac{1}{2}$. The computer industry is skill intensive since $\frac{a_{ST}}{a_{LT}} < \frac{a_{SC}}{a_{LC}}$.

- (b) (3 points) In a competitive equilibrium, zero profits imply

$$\begin{aligned}1000 &= 200w_S + 100w_L \\8 &= w_S + 2w_L\end{aligned}$$

Solution is: $w_L = 2, w_S = 4$.

- (c) (3 points) Factor market equilibrium requires

$$\begin{aligned}100Q_C + 2Q_T &= 10000 \\200Q_C + Q_T &= 10000\end{aligned}$$

Solution is: $Q_C = \frac{100}{3}, Q_T = \frac{10,000}{3}$

- (d) (4 points) Zero profits now implies

$$\begin{aligned}1000 &= 200w_S + 100w_L \\6 &= w_S + 2w_L\end{aligned}$$

Solution is: $w_L = \frac{2}{3}, w_S = \frac{14}{3}$. There is a decrease in the relative wage of unskilled workers. It is predicted by the Stolper-Samuelson theorem

- (e) (2 points) Given Leontief technology and the same endowment, under free trade they will produce the same amount.
- (f) (2 points) Yes there will be trade. Since the relative price of tee-shirts is lower under free trade than under autarky, home will import tee-Shirts and export Computers at the new world price.
- (g) (2 points) An import quota on tee-shirts would increase the relative price of tee-shirt. By the Stolper-Samuelson theorem, it would hurt skilled workers, so you should therefore oppose to such a restriction.

Question 5 — Theoretical Question (10 points)

- (a) Under free trade: Supply: $10 = 5 + q_s \Rightarrow q^s = 5$. Demand: $25 - q_d = 10 \Rightarrow q^d = 15$. Imports $M = q^d - q^s = 10$.

- (b) Trade Policy

- (i) Note that the US faces a perfectly elastic foreign export supply curve for EVs. Thus, with an import tariff t , the domestic price rises to $p_T = 10 + t$. To double domestic production and attain $q^s = 10$, t must satisfy $10 + t = 5 + 10$, which yields $t = 5$. This implies $p_T = 15$ and $q^d = 25 - p_T = 10$. Thus, imports fall to zero. Recall the dead weight loss from an import tariffs is given by two triangles (areas 2 and 4 in Lecture 20 Slide 16). Thus, $DWL = \frac{1}{2}5 \cdot 5 + \frac{1}{2}5 \cdot 5 = 25$ with an import tariff.

- (ii) A production subsidy s creates a wedge between the seller price and buyer price. The seller price rises to $p^W + s = 10 + s$. To double production and attain $q^s = 10$, the subsidy s must satisfy $10 + s = 5 + 10$, which yields $s = 5$ as above. However, with a production subsidy, the buyer price remains $p^W = 10$, so the quantity consumed is $q^d = 15$ as in the free trade case. This implies that, unlike with an export subsidy, the dead weight loss from a production subsidy is given by only one triangle (area 2 in Lecture 20 Slide 16).² Thus, $DWL = \frac{1}{2}5 \cdot 5 = 12.5$ with a production subsidy.
- (iii) An import tariff distorts both consumption and production margins, while a production subsidy distorts only the production margin. Thus, the production subsidy is less distortionary; the import tariff is a second-best policy for achieving the goal of doubling the domestic production.

²The production subsidy will increase the producer surplus, whose change is given by areas 1; however, the production subsidy costs the government $1+2$, so the dead-weight loss will equal area 1. Note the consumer surplus is unchanged because the consumer price remains at p_W .