

Final exam Key
ARE 201, Fall 2005

Answer all questions. Write your answer question 1 and 2 on the exam (rather than on a separate sheet).

Question 1. (20 points) Fill in the blanks. The following table gives the number of units of labor required to produce one ipod or one milkshake in three countries, in a Ricardian (two commodity) world

commodity\country	Vietnam	Paraguay	Chad
ipod	1	0.5	1
milkshake	1	2	4

units of labor required to produce commodity

Assume that in equilibrium both commodities are consumed. There is free trade.

a) (Fill in the blank with the commodity name) Vietnam has a comparative advantage in milkshake, compared to Paraguay. Vietnam has a comparative advantage in milkshake compared to Chad.

Paraguay has a comparative advantage in ipod compared to Vietnam. Paraguay has a comparative advantage in neither good compared to Chad.

b) For what (if any) pattern(s) of production are the wages in Vietnam and Paraguay possibly equal? [Vietnam specialized in milkshake, Paraguay and Chad both specialized in ipods.]

c) For the pattern(s) of production in part (b), are the wages necessarily equal? [Yes/No] [NO]

d) For what (if any) pattern(s) of production are the wages in Vietnam and Chad possibly equal? [Wages in the two countries can be equal iff

the equilibrium relative price of milkshakes, $\frac{p_M}{p_I} = 1$. In this case, Chad is specialized in ipod and Vietnam is either incompletely specialized, or in the "knife-edge case" completely specialized in milkshakes. If you gave me the answer "both countries completely specialized in the good for which they have comparative advantage, you got 50% credit (2 points).]

e) For what (if any) pattern(s) of production are the wages in Paraguay and Chad possibly equal? [No pattern of production.]

Question 2. (15 points) There are two commodities, food and cloth. Food is the numeraire. The relative world price of cloth is p . Home, a small country, imports food.

a) Home uses (only) an ad valorem import tariff of τ . The relative price of cloth for domestic consumers is $\frac{p}{1+\tau}$ and the relative price for producers is $\frac{p}{1+\tau}$.

b) Home uses an ad valorem export subsidy of s . The relative price of cloth for domestic consumers is $p(1+s)$ and the relative price of cloth for domestic producers is $p(1+s)$.

c) Home uses (only) an ad valorem production tax of t on cloth. The relative price of cloth for consumers is p and the relative price of cloth for producers is $p(1-t)$.

d) How would your answer to part (a) have changed if Home is a large country rather than a small country? [The price would have been greater than $\frac{p}{1+\tau}$. The use of the tariff improves the term of trade, i.e. it increases p .]

[Some students apparently do not know the difference between an ad valorem and a unit tax. You should learn what the difference is.]

Question 3. (20 points) Production of food and cloth require mobile factors capital and labor using production functions $F(L, K)$ and $C(L, K)$. The fixed supplies of the factors are \bar{L} and \bar{K} , and the world relative price of cloth is p . (Food is the numeraire good.) Define $y(p, \bar{L}, \bar{K})$ as national revenue (the maximized value of production, given the output price and the available supplies of factors). Assume that both goods are produced. Show that in the absence of market failures, the competitive wage, w , equals the shadow value of labor, $\frac{\partial y}{\partial \bar{L}}$.

Answer: This question is based on the material in section 2.1.3 of the notes. I directed your attention to this material at least three times during lecture, and at least twice I discussed the result that I ask you to show here.

The Lagrangian for the social planner's problem is

$$y(p, \bar{L}, \bar{K}) = \max (pC(L_c, K_c) + F(L_f, K_f) + \omega (\bar{L} - L_c - L_f) + \rho (\bar{K} - K_c - K_f))$$

where ω and ρ are the constraint multipliers. The first order conditions include

$$\begin{aligned} pC_L &= F_L = \omega \\ pC_K &= F_K = \rho. \end{aligned}$$

The profit maximizing conditions for competitive firms require

$$\begin{aligned} pC_L &= F_L = w \\ pC_K &= F_K = r. \end{aligned}$$

From these two sets of equations, you conclude that $\omega = w$ and $\rho = r$.

The envelope theorem (applied to the Lagrangian) implies

$$\begin{aligned} \frac{\partial y}{\partial \bar{L}} &= \omega \\ \frac{\partial y}{\partial \bar{K}} &= \rho \end{aligned}$$

Using these results we have

$$w = \omega = \frac{\partial y}{\partial \bar{L}}.$$

Question 4.(45 points) Provide a brief verbal answer to the following question, including explanations. It is not necessary to present derivations.

Consider a two-sector, two-factor H-O-S model with no factor intensity reversals. Sector 1 is relatively capital intensive. Production of Commodity 1 creates one unit of pollution per unit of output. (Pollution is local, so damages in the country depend only on the level of production within the country. There are no abatement possibilities with this technology.) Social damages from pollution are *increasing and strictly convex* in the amount of pollution and are independent of income. A small, incompletely specialized country exports Commodity 2. International trade in *factors* is prohibited. There are no other distortions.

a) Consider three types of policies: a production tax/subsidy, a trade policy and a consumption tax/subsidy. Rank these three policies in terms of *welfare*; briefly explain.

b) Now consider three scenarios (i) the country can use only a production policy, (ii) it can use only a trade policy, (iii) it can use only a consumption policy. Rank the *magnitudes* of the interventions in the three scenarios. (That is, which policy level is largest and which is smallest in absolute value?)

c) Suppose that the country uses a production tax, and it begins with the level that is optimal in the absence of factor trade. In this situation, suppose that the domestic return on capital exceeds the return on capital in the Rest of World. The country holds the production tax fixed and removes the prohibition against capital imports. What happens to production and welfare in this country?

d) Suppose that the country simultaneously removes the prohibition against capital imports and adjusts the Sector 1 tax optimally. What is the direction of change of the tax? What is the net effect on welfare of the two policy changes?

Answer:

a) By the Principle of Targeting, the first best policy is a production tax/subsidy, since (by assumption) the externality arises as a consequence of production, not of trade or consumption. A trade policy can increase welfare by reducing pollution, but it creates a consumption distortion. A consumption policy is completely ineffective in reducing pollution. Therefore the optimal production policy gives the highest level of welfare and the optimal consumption policy (a zero tax/subsidy) gives the lowest level.

b) The optimal consumption tax/policy is 0 so it is the smallest in mag-

nitide. The optimal production tax is greater than the optimal trade policy for exactly the reasons explained in problem set 3.

c) Since the domestic return on capital exceeds the ROW return, capital flows into the county. By the Rybczynski theorem, output of sector 1 increases and output of sector 2 decreases. Allowing trade in capital increases the value of national production by more than the cost of capital imports, since initially the value of marginal product of capital exceeds the world price of capital. However, the increased production of sector 1 increases the marginal damages (because damages are strictly convex) so the initial tax is no longer optimal. Thus, the policy change eliminates one distortion (the difference between the value of marginal product of capital and the cost of capital in the world market) and increases another distortion (the difference between the actual and the optimal pollution tax). By the Theory of the Second Best, the welfare effect of liberalizing capital imports is ambiguous.

d) Absent a change in the tax, marginal damages increase (part c). Therefore, it must be optimal to increase the tax when capital imports are liberalized. When pollution taxes are adjusted optimally, there is no environmental distortion before of after liberalization of capital imports. Liberalization increases welfare.