

**Final Exam - *Answers***  
**April 21, 2008**

Answer all questions. Write your answers in a blue book.

Be sure to look ahead and budget your time. You have two hours (120 minutes) to complete the exam. The questions are worth a total of 100 points, as indicated.

1. (50 points) Starting from an equilibrium in which a country (not necessarily a small one) trades freely with the rest of the world, what would be the effects on that country's trade and its welfare of it becoming larger? Specifically, suppose that the country's endowments of factor production, whatever these may be, *all* expand by the same proportion, while factor endowments in the rest of the world remain unchanged. Show your familiarity with the various models discussed in this course by writing an essay that describes and demonstrates (with diagrams and/or equations, as needed) the effects of this change on trade and welfare of the expanding country.

I expect that your answer will deal with Ricardian, Heckscher-Ohlin, and Specific Factors models, as well as models that include increasing returns and monopolistic competition. Before you start your answer, I suggest that you think about the models you will be using so that you don't waste time and effort on pieces of analysis that are not needed for the question or that can be done more simply for more than one model at a time. If it is helpful, you may limit yourself to models in which there are only two goods and in which preferences are identical and homothetic.

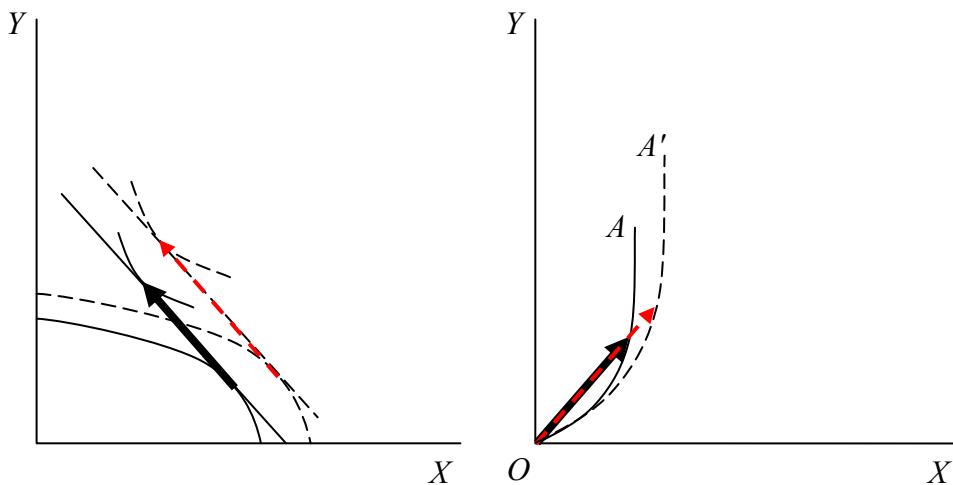
*Ans: This question can be addressed in several of our models, with somewhat different results in each. I will first look at it from the perspective of offer curves, which can be derived from the Ricardian Model, the Heckscher-Ohlin Model, and the Specific Factors Model. Next I will look at a model with external increasing returns to scale. And finally I will look at models of monopolistic competition a la Krugman.*

*Offer Curve Models*

*Consider first any of the models in which goods are homogeneous, returns to scale are constant, and competition is perfect. These include the Ricardian Model, the Heckscher-Ohlin Model, and the Specific Factors Model. In all of these cases, the trade equilibrium can be derived by first constructing offer curves from production possibility curves and community indifference curves, and then interacting the domestic and foreign offer curves to find a world price that clears the markets. An increase in the size of a country, expanding all of its factor endowments by the same proportion (just labor in the Ricardian Model, labor and land in the H-O Model, and labor plus both of the specific factors in the Specific Factors Model), will expand the production possibility curve proportionally outward. This causes, at any given*

*prices, output of all goods to expand in that same proportion, along with income and (given homothetic preferences) quantities consumed. Thus trade expands by that proportion as well. The offer curve therefore expands radially outward from the origin by the proportion that factors have increased, from OA to OA' as shown below.*

*This outward expansion of the offer curve, combined with the unchanged offer curve of the rest of world, determines what happens to equilibrium world prices and trade. Also, using trade indifference curves, we can tell something about what happens to the country's welfare. The expansion of production possibilities at given prices, shown in the first diagram, does move the country to a higher community indifference curve. But arguably the level of welfare there is the same as it was before, if we assume that the increased labor endowment means an increased population, so that consumption per capita has not changed. (If the labor endowment were expanded instead by an increase in the productivity of a given amount of labor, then the higher indifference curve would after all mean higher welfare.)*



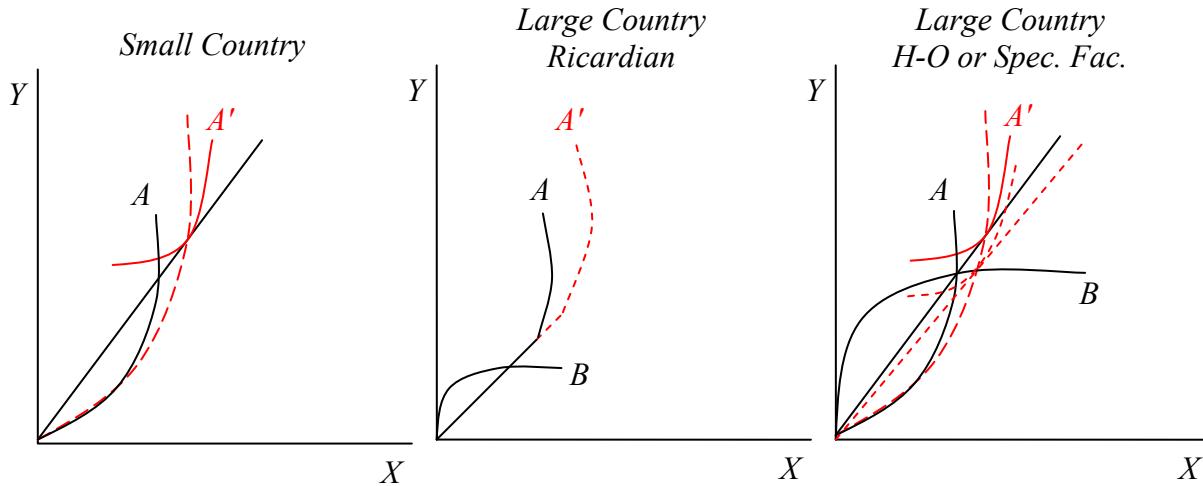
*To find the effect of the expansion on world prices, combine the home country's offer curve with that of the rest of the world. The result depends in part on the size of the country, and also on which model underlies the offer curve. Three cases are shown below.*

*If the country is small, then it faces fixed world prices that do not change when it grows, as shown in the figure on the left below. It therefore simply trades more (both exports and imports), and it reaches the trade indifference curve that corresponds to the expanded economy at those prices, which as said above can be argued to represent no change in welfare per capita.*

*If the expanding country is large, and if its production possibilities curve is concave to the origin as drawn above, then the expansion of its offer curve moves the equilibrium along the foreign offer curve to a lower price for the expanding country's*

export, as shown on the right below. In this case, its terms of trade are worsened by the expansion, and welfare per capita is reduced.

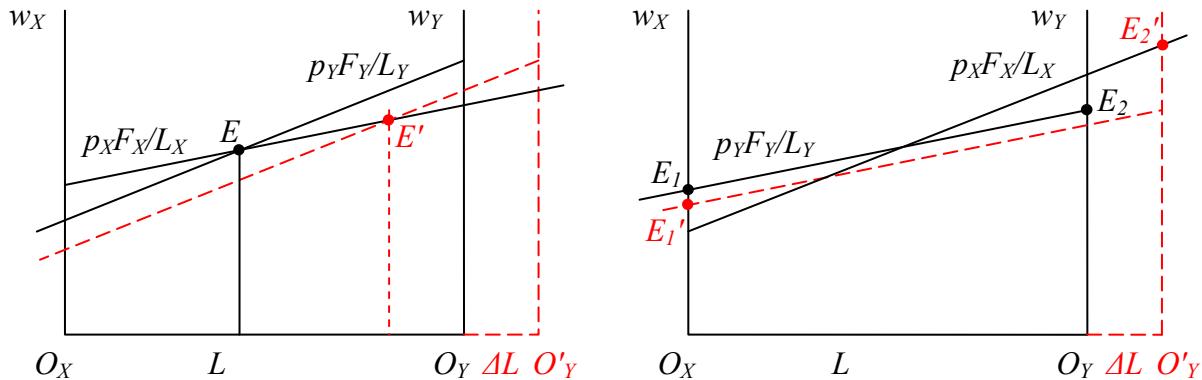
A final case is shown in the middle diagram, for a large Ricardian economy. Being Ricardian, both its production possibilities (not shown) and its offer curve are linear at its autarky prices, since it can produce various combinations of the two goods at



that price. Being large relative to the foreign economy, the equilibrium has it in this linear portion, and expansion does not change that. Thus, like the small country, expansion in this case leaves world prices unchanged. In fact, the country's welfare was at its autarky level before the change, and it remains there.

#### Increasing Returns to Scale

Consider next a model with increasing returns to scale, rendered manageable and meaningful by having them external to firms, which then engage in average-cost pricing. Such a model can have multiple equilibria, and the effects of expansion may depend on which of several equilibria the country is in. Two such cases are shown below. In both, a small open economy faces fixed prices of two goods that are produced from only labor. Good  $X$  displays increasing returns to scale, so that the value of labor's average product,  $p_X F_X / L_X$ , rises with  $L_X$  (left-to-right in the diagram),



while good Y displays decreasing returns to scale, its average product falling with rising  $L_Y$  (right-to-left).

The case on the left has sufficiently weak increasing returns that there is only a single equilibrium, E. When the labor endowment increases, making the diagram wider by  $\Delta L$ , equilibrium moves to E', output of X rises while output of Y falls, and the (real) wage rises. The effect on trade depends on which good was being exported, which could have been either one. But if the country was already exporting X, it will now export more of it; if it was exporting Y, it will export less of it. With only labor as a factor, welfare just depends on the wage, which has gone up.

The case on the right has stronger increasing returns in X (or weaker decreasing returns in Y). There are two stable equilibria, at E<sub>1</sub> and E<sub>2</sub> (plus an unstable equilibrium where the curves intersect). At E<sub>1</sub>, the country specializes in the decreasing returns good Y, which it must therefore export. Expansion of its labor force, again widening the diagram, causes it to produce and export more Y, but the decreasing returns means that the wage, and welfare, goes down. At the other equilibrium E<sub>2</sub>, again there is specialization this time in X, and output and exports rise when an expanded labor force produces more. But this time the labor becomes more productive due to the increasing returns, and the wage and welfare rise.

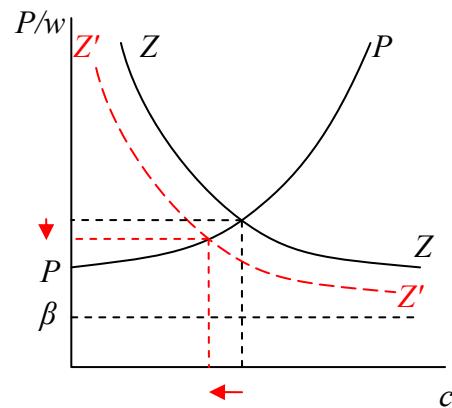
### Monopolistic Competition

Consider finally a one-sector model of monopolistic competition such as those in Krugman (1979) and Krugman (1980). In the first of these papers, Krugman found equilibrium as the intersection of two curves: PP representing optimal markup pricing and ZZ representing zero profits. The PP curve reflects the equation

$$\frac{P}{w} = \beta \frac{\varepsilon(c)}{\varepsilon(c)-1}$$

which is upward sloping from the assumption that elasticity of demand,  $\varepsilon$ , falls as consumption of a variety, c, increases. The ZZ curve reflects the equation

$$\frac{P}{w} = \beta + \frac{\alpha}{Lc}$$



which is a downward sloping rectangular hyperbola asymptotic to the horizontal line at  $\beta$ .

Let the initial intersection of these curves represent the equilibrium for a two country world before the labor force in one of them expands. That expansion shifts the ZZ

curve down and to the left, to  $Z'Z'$  as shown, causing the equilibrium price of the good, relative to the wage,  $P/w$ , to fall and thus the real wage to rise. Since labor is the only factor, this rise in the real wage is an increase in welfare.

However, the increase in the wage relative to this price of a single variety does not fully capture the increase in welfare. Since consumers buy a smaller quantity of each variety, they must be spending their higher income on a larger number of varieties. This increase in number of varieties also, by itself, raises utility in the Dixit-Stiglitz utility function. In fact, in Krugman's (1980) model he drops the assumption that demand elasticity varies with  $c$ , and the PP curve there would be a horizontal line at the constant optimal markup. Thus in that model, a rise in  $L$  leaves the price of each variety relative to the wage unchanged. But it still lowers  $c$  and therefore raises the number of varieties and thus raises welfare.

As for the effect on trade, the increase in one country's labor force increases the share of world income generated in that country and the share of the world's varieties produced in that country. The other country's imports will therefore be that larger share of their own income, which has either increased (in Krugman (1979)) or remained the same (in Krugman (1980)), so their imports, and the expanding country's exports, must have increased. With balanced trade, so must the expanding country's imports. (Trade as a share of the larger world income may rise or fall, depending on whether the expanding country was initially smaller or larger than its trading partner.)

2. (25 points) What is the Factor Content of Trade, what does the Heckscher-Ohlin Model predict about it, and to what extent is this prediction supported empirically?

Ans: The factor content of trade of a country,  $c$ , is defined as a vector  $F^c = AT^c$ , where  $A$  is a matrix of per unit factor requirements and  $T^c$  is the vector of country  $c$ 's net exports of goods. The Heckscher-Ohlin Model in its general form addressed by Deardorff (1982) predicts that, with balanced trade,

$$\tilde{w}^c F^c < 0$$

where  $\tilde{w}^c$  is the vector of country  $c$ 's factor prices in autarky. That is, at autarky factor prices, the factors that a country exports through trade are worth less than the factors that the country imports. This prediction has not been tested empirically.

What has been tested, repeatedly, is a prediction that holds under much more restricted conditions, the Heckscher-Ohlin-Vanek (HOV) Theorem. Assuming that all countries have the same unit factor requirements (due to identical technologies and factor price equalization) and that they consume goods in the same proportions (due to identical homothetic preferences and free trade), then

$$F^c = V^c - s^c V^W$$

where  $V^c$  is the vector of country  $c$ 's factor endowments,  $s^c$  is its share of world income, and  $V^W$  is the vector of world factor endowments.

This prediction was tested by Leamer and others and found to fail, rather seriously. That is, in not much more than half the cases did even the sign of the HOV prediction, let alone the quantity, match that of the measured factor content of trade. Thus Leamer and his co-authors concluded that the Heckscher-Ohlin Model, in this particular form at least, does a poor job of explaining trade.

Trefler, in the first of two papers, showed that this discrepancy could be completely eliminated by assuming that countries differ in the productivity of their factors, and he found that adjustments needed in factor productivities accorded well with the factor prices, or at least the wages, of different countries. This suggests that the original H-O Model, with its assumption of identical technologies and thus factor productivities, is not descriptive of the world, but that it can perhaps be reconciled fairly simply with the data by allowing technologies to differ sufficiently.

In his second paper, though, Trefler looked more carefully at the prediction error of the HOV model and found them to be not only large, but essentially equal to the predicted factor content of trade. In other words, the actual factor content of trade is remarkably small, almost zero, compared to the predicted factor content of trade. He called this the "Case of the Missing Trade". That is, the HOV model predicts far more trade, in factor-content terms, than actually occurs.

The last word on this subject, so far, as been a paper by Davis and Weinstein. They worked through a series of modifications of the HOV model, allowing not only differences in technologies but also the failure of factor price equalization and differences in demands. With these changes they were able to get models that accorded increasingly well with the data. The message was that, while the extreme and precise predictions of the HOV model are not of much use, a more general Heckscher-Ohlin Model can be made to do pretty well.

3. (25 points) A current concern in the world economy, and in many countries, is that the prices of agricultural products are rising to record levels, making food increasingly expensive for poor people who were already on the verge of starvation. Suppose that you were advising the government of a food-exporting country whose poor people are blaming exports as the reason for their rising cost of living. The country's government is considering a tax on food exports (or, if you prefer for ease of analysis, simply banning these exports) as a policy to deal with this crisis. They want to know from you what the effects of such a policy will be, as well as whether there are alternative policies that they should use instead. Tell them.

Here I'm not looking for formal analysis, but rather a well reasoned verbal discussion of the effects of the policies (the export tax and any alternatives that you consider),

drawing on but not explicitly using the models of this course. In particular, your answer should take account of results in the course concerning the gains from trade, the effects of trade on real factor prices, and the theory of the second best.

*Ans: An export ban will indeed lower the price of food in a food exporting country, as we can confirm by just reversing the usual analysis of a move from autarky to free trade. As an exporter of food, the country must have had a comparative advantage in food and therefore a lower autarky price of food than prevails in the world. So that effect of the policy is exactly what the government apparently wants.*

*A better question, though, is whether it will help the poor. For that we'd like to know the effects on the incomes of the poor, as well as what they spend for food. If, for example, we use the Stolper-Samuelson Theorem in a context in which the country produces land-intensive food from labor and land, then the export ban will lower the real return to land and raise the real return to labor, which may well benefit many of the poor. Other models, such as the specific factors model with mobile labor, give more ambiguous results for the real wage, but given the apparent importance of food in the budgets of the poor, it seems likely that poor workers will benefit here as well.*

*Of course, an export ban will lower the welfare of the country as a whole, as we know from the analysis of gains from trade. Specifically, others in the economy will be hurt, through for example a fall in rents on land that they own, and the size of that loss will be larger, in value terms, than the gain to the poor. Thus, if one could manage to transfer income from the rich to the poor directly, the country could either benefit the poor more, or hurt the rich less, than would happen with a ban on exports. But such a direct transfer may not be possible or politically acceptable.*

*The theory of the second best, however, suggests that we should look for alternative policies that might achieve the objective, whatever that may be, at lower cost. Suppose, for example, that the objective is to permit the poor to consume more food. Then a preferable policy would be to subsidize their food consumption, while leaving trade unimpeded. The advantage would be that the country would still benefit as producers of food from the high price of their export on world markets. In economic terms, the incentive to produce food would not be distorted by a consumption subsidy, while an export ban that lowered the price of food to both domestic producers and consumers would distort the decisions of both groups. Of course, the disadvantage of a consumption subsidy is that it adversely affects the government budget. But given that the country as a whole must be doing well (as an exporter of food, whose price has risen), that drawback may be manageable.*