Final Exam - *Answers*
December 20, 2000

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

Be sure to look ahead and budget your time. Don't waste time on parts of questions that you can't answer. Leave space and come back to them if you have time.

1. Consider a small economy able to produce and consume vectors of goods X and C respectively, subject to vectors of prices, p: in autarky, $X^A=C^A$ at prices p^A; and in free trade, $X^F \neq C^F$ at prices $p^F \neq p^A$.

   a. Show that $p^F C^F > p^F C^A$, stating clearly any assumptions that you need to get this result.

   Letting $T = X - C$ be net exports, we have $p^F C^F = p^F(X^F - T^F) = p^F X^F - p^F T^F = p^F X^F$, since $p^F T^F = 0$ assuming that trade is balanced. Assuming perfect competition and the absence of any distortions, production maximizes the value of the economy's output at prevailing prices, and therefore, since X^A is feasible to produce under free trade, $p^F X^F > p^F X^A$. But since trade is zero in autarky, $X^A=C^A$. Therefore, combining these steps, $p^F C^F = p^F X^F > p^F X^A = p^F C^A$.

   b. Interpret the result in part (a) in terms of what it tells you about the gains from trade.

   If all consumers were alike in income and preferences, so that this same inequality would hold for each of them, this would say that free-trade consumption is revealed preferred to autarky consumption. Therefore, if consumers' welfare depends only on the goods that they consume, they are better off under free trade.

   With heterogeneous consumers, this conclusion does not follow, however. But the aggregate inequality still tells us that aggregate expenditure is large enough to pay for the autarky consumption bundle, and therefore that if income were reallocated among consumers, they could each be made better off. It therefore expresses the gains from trade in this potential sense.

   c. Suppose now that you learn that one of these goods is cigarettes, consumption of which generates a negative externality reducing the welfare of other nearby consumers. How, if at all, does that alter or undermine the proof in part (a) and the interpretation in part (b)?

*The externality means that consumer welfare does **not** depend only on a consumer's own consumption. Therefore having the budget to buy what you bought under autarky does not mean that you are better off. The inequality in (a) thus need not indicate gains from trade, even in the extreme case of identical consumer incomes. For example, if the price of cigarettes is lower under free trade than under autarky, so that consumers consume more of them, they will also suffer more from the externality and may be worse off.*

d. Narrowing your attention to just two goods, cigarettes and an aggregate of all others taken as numeraire so that p is now the relative price of cigarettes, how are the gains from free trade versus autarky affected if $p^F<p^A$? What if $p^F>p^A$?

As just described, if $p^F<p^A$ then consumption of cigarettes will expand with free trade and cause a greater negative externality. Welfare may or may not be reduced by trade, depending on the importance of the externality compared to the more standard sources of gain from trade. If on the other hand, if $p^F>p^A$ so that the price of cigarettes goes up with trade, then trade will reduce cigarette consumption and lessen the negative externality. In this case, trade is even more beneficial than normally, since it reduces the externality along with more conventional gains from trade.

e. Considering the externality caused by cigarette consumption, could an import tariff ever be beneficial? How about an import subsidy? Or an export tax or subsidy?

An import tariff raises the price of the imported good to both consumers and producers. If cigarettes are imported in free trade, as they will be if $p^F<p^A$, then a tariff will reduce consumption and provide a benefit by reducing the externality. However, the tariff also distorts production, which lowers the value of output, and this may or may not cause greater harm than the reduction in the externality. But it is definitely possible that the tariff in this case will be beneficial.

An import subsidy lowers the price of the imported good, which could likewise be helpful if the pattern of trade is the opposite; that is, if $p^F>p^A$ and cigarettes are exported. And by the symmetry between import and export taxes (and subsidies), an export tax could likewise be beneficial in the first case of cigarette imports, and an export subsidy could be beneficial in the second case of cigarette exports. (You might note that in all of these cases, the irony is that a trade policy raises prices to consumers only by also raising them to producers, so the possibly beneficial policies all increase production of cigarettes!)

f. Could a trade tax or subsidy ever be optimal in these circumstances?

No. As long as the only distortion is the consumption externality, then any trade policy, by changing prices to producers as well as consumers, causes an additional and unnecessary distortion and therefore welfare loss. The optimal

policy, regardless of the pattern of trade, is a tax on cigarette consumption that causes cigarette consumers to internalize the negative externality that they are causing to others.

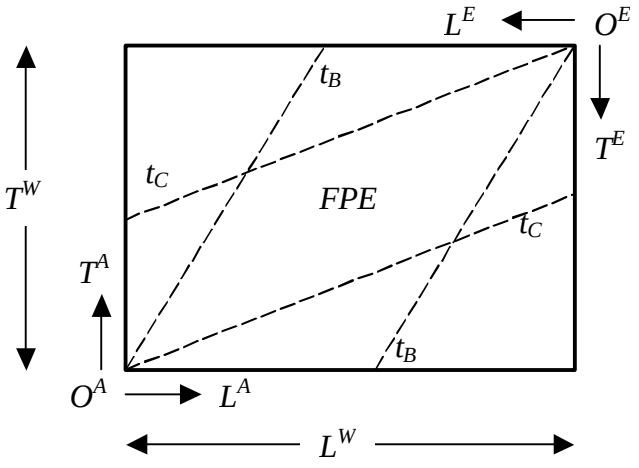
2. The world consists of two countries, America and Europe, who are able to produce and consume two goods, beef and clothes, using two factors, land and labor. America is relatively well endowed with land, compared to Europe. Production of beef is relatively intensive in the use of land, compared to production of clothes. All markets are perfectly competitive and there are no distortions. Trade between the countries is free and frictionless. All consumers demand strictly positive amounts of both goods, at all finite prices. Answer the following questions, using whatever tools are appropriate to explain your answers.

   a. What can you say for sure about the pattern of trade and the pattern of production, based on this information alone? That is, who exports and imports what? And who produces what?

      We can be sure that America exports beef and Europe exports clothes. America must produce beef, and it may or may not produce clothes. Europe must produce clothes and may or may not produce beef. All of this is straightforward implication of the standard 2×2×2 Heckscher-Ohlin Model.

   b. Explain, using the Integrated World Economy, how you would determine whether or not factor price equalization (FPE) occurs in this equilibrium.

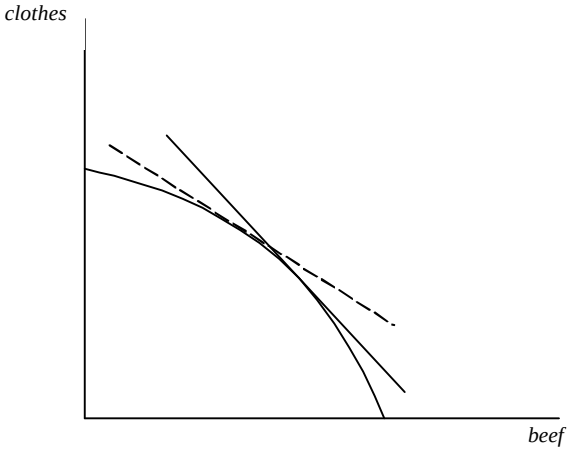
      The IWE is the world economy with factors as well as goods mobile across countries, so that the world is simply an autarky economy. In this IWE, interaction of supply and demand will determine an equilibrium relative price for the two goods. Letting clothes be numeraire, let this equilibrium price be p^0 and let $?^0$ be the ratio of the wage of labor to the rental on land that corresponds to p^0 in the IWE. (This is well-defined, even if there are factor intensity reversals, since only one set of factor prices will prevail in equilibrium, in the IWE.) Also, let t_B^0 and t_C^0 be the cost-minimizing land-labor ratios in producing beef and clothes at these factor prices. Then to determine whether or not there is FPE, we construct the box diagram below, in which the horizontal dimension is the world endowment of labor, the vertical dimension is the world endowment of land, and we measure the allocation of those endowments to America from the lower left corner and allocations to Europe from the upper right. Drawing factor rays from both of these



corners with slopes equal to t_B^0 and t_C^0, these form a parallelogram. If the actual endowments are within this parallelogram, then there is FPE. If not, not.

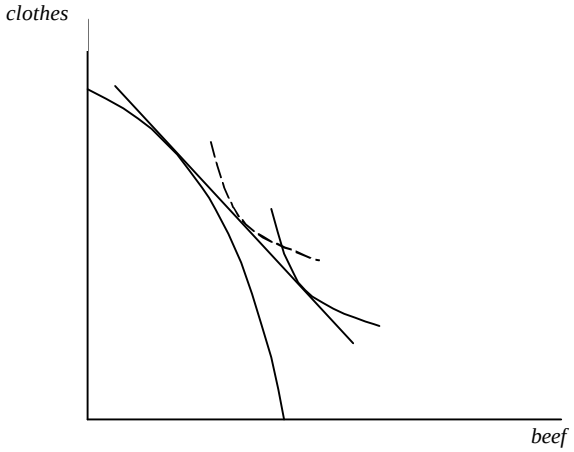
c. Suppose now that European consumers suddenly become afraid to eat beef. Explain why this will reduce the relative price of beef in both America and Europe if there initially was FPE. If there initially was *not* FPE, could the effects on relative prices be any different?

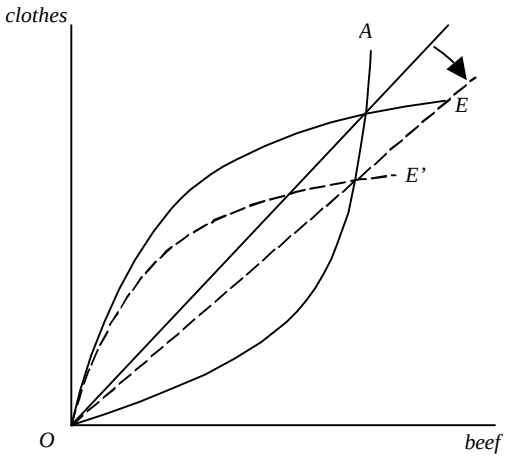
With initial FPE, prices in both countries are the same as in the world as a closed economy (the IWE). When part of the population of that closed economy (the residents of country E) shift their preferences away from beef and towards clothes, the world demand for beef falls and demand for clothes rises, causing movement around the world production possibility frontier and a lower relative price of beef:



This price must prevail in both countries if there continues to be FPE.

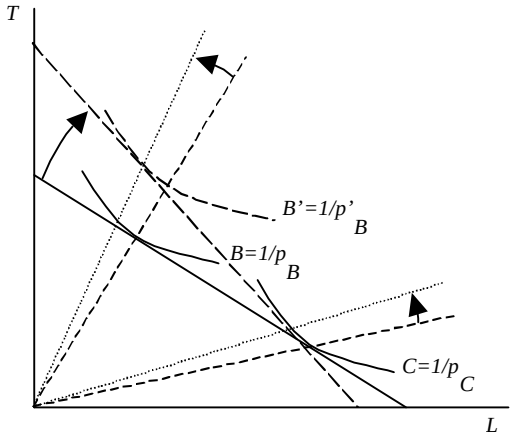
If there does not continue to be FPE, or if there was not FPE in the first place, then it will not be the IWE price that prevails in the world trading equilibrium. But there will still be a single price in both countries, due to free trade. And it will still be true that the price of beef falls with the change in preferences in Europe. We can see that by looking at country E's production and consumption at any arbitrary price, from which we see that the shift of preferences causes its offer curve, OE, to shift inward to OE' (importing less beef):





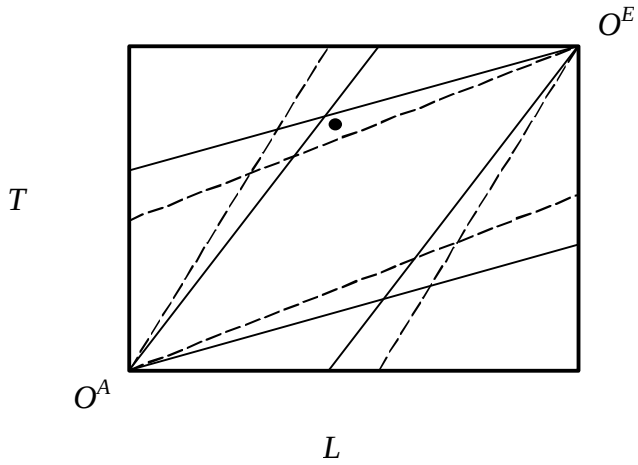
d. Assuming FPE both before and after the beef scare, what will be the effect on *real* factor prices of both land and labor in America?

This is just an application of the Stolper-Samuelson Theorem, which can be shown using the Lerner Diagram, as below, or by other means. The fall in the price of beef, since it is land intensive, will reduce the rental on land relative to both prices and increase the wage of labor relative to both prices. This is an unambiguous fall in the real rent and rise in the real wage, since nothing has changed the preferences of people in America.



e. If there was FPE before the beef scare, is it possible that the scare could move the world to an equilibrium without FPE? Show how this can happen, or why it can't. In the former case, say also whether and how your answer to part (d) would be changed.

Yes, it can happen. As shown in the Lerner Diagram above, the fall in the price of beef and consequent rise in the relative wage under FPE causes the land-labor ratios in both sectors to rise. This changes the shape and location of the FPE parallelogram in the box diagram, as shown below. Depending on the location of the initial allocation of factors, it is certainly possible for FPE to no longer hold, as at the dot shown in the figure below.



*However, it is **not** possible for country A to move outside its diversification cone, since A is the country relatively well endowed with land and the price change increases the land-labor ratio at the upper bound of the cone. Therefore, the results in part (d) still hold.*

f. What can you say about the welfare of America as a whole as a result of this beef scare?

*America as a whole loses, in the usual sense of gains and losses from trade. The reason is that its terms of trade has been reduced, and therefore the consumption possibilities of the country have deteriorated. Thus, while it is true that without any redistribution, the owners of labor are made better off (the rise in the real wage found above), they definitely do **not** gain enough to be able to compensate the land owners for their loss and still remain better off themselves.*

3. The government of a country, Mercantilia, persuaded of the desirability of trade, has decided to provide an export subsidy. It first identifies those sectors of the economy that are already exporting, then provides a 10% *ad valorem* export subsidy to each of them. It finances the subsidy using a nondistorting lump sum tax borne equally by every resident of the country. Without doing any formal analysis, describe what you would expect to be the effects of this subsidy on patterns and amounts of production and trade, and on the well-being of affected individuals in the country, using each of the following models:

a. The small-country, two-good, specific factors model

The export subsidy raises the domestic price of the exported good 10% above the world price, causing that sector to expand and the other to contract. Taking the unsubsidized import good as numeraire, the wage of mobile labor rises by less than 10%, while the returns to specific factors rise in real terms in the export sector and fall in the import competing sector. Owners of the former are likely better off, since the increase is likely to be larger than their share of lump sum taxes. Owners of the latter surely lose. Owners of labor are affected ambiguously, although the lump-sum tax makes them more likely to lose than if this was a simple price change. The country as a whole loses, due to the distortion of both production and consumption.

b. The continuum-of-goods Ricardian model

In this model, the country is the only producer of a whole range of goods, and sells them to both its own consumers and those abroad, initially at the same price. After the subsidy, the price to domestic consumers is above that to foreign consumers by 10%. To maintain balanced trade, these domestic prices will rise by some fraction of 10% compared to foreign goods, causing substitution in demand and an increase in imports of the foreign goods. At the same time, foreign prices of the home country's exports fall by the remaining fraction of 10%, causing substitution there toward these domestic goods and thus increased exports. Production remains unchanged, but there is greater trade in both direction due to these substitutions in demand. Domestic workers are made worse off by all of this, while foreign workers benefit, since in effect the country is subsidizing consumption by foreign workers.

c. The two-country, two-good Heckscher-Ohlin model

The export subsidy raises the domestic relative price of the export good above that abroad, and for a given foreign price causes the country to increase production and reduce consumption of its export good, thus expanding its trade and shifting its offer curve outward. As a result, the world equilibrium relative price of the export good falls, which is a worsening of the country's terms of trade. Assuming that the fall in world price is less than 10% (this is not quite certain, I think), the domestic price still rises, causing Stolper-Samuelson-like effects on factor prices: the factor used intensively in the export sector gains (except perhaps for the lump-sum tax) and the factor used intensively in the import-competing sector loses. The country as a whole necessarily loses.

d. The Krugman one-sector monopolistic competition model

The export subsidy prices domestic varieties to domestic consumers 10% above their price to foreign consumers. Similar to the continuum model, in order for trade to remain balanced, the domestic price of these domestic varieties must rise

by some fraction of 10%, while their price on the foreign market falls by the rest of that 10%. This causes a rise in domestic demand for foreign varieties and an corresponding rise in foreign demand for domestic varieties, and thus expansion of both exports and imports within the sector. Also as in the continuum model, the effect is basically to lower the wages of domestic labor compared to foreign labor, since they are subsidizing foreign consumption.

e. The Brander-Spencer export duopoly model

In this partial equilibrium model, the only good is exported by both countries to a third country's market, and the home country's export subsidy applies to the entire output of the country's single firm in that industry. The effect, under the Cournot competition assumed by Brander and Spencer, is to shift the home firm's reaction curve to the right yielding for it a larger share of the third country's market and a larger profit, even without including the subsidy payment. Therefore, the country's firm gains more in profit than it is paid in subsidy, and the country as a whole therefore gains as well.