ECONOMICS
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Advanced International Trade
EC 378

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Fall 2006

Problem Set 4
Outline of Answers

1. a) Discuss the meaning and importance of the Leontief paradox.

Leontief found that US import substitutes were more capital-intensive than US exports even though the United States was the most capital-rich country. This, in his opinion, implied an empirical rejection of the Heckscher-Ohlin model.

b) How did Baldwin try to resolve the paradox? Was he successful?

Baldwin deleted natural resource sectors and added human capital to the definition of capital. After these adjustments, US exports were more capital-intensive than US import substitutes. This confirms a modified version of the Heckscher-Ohlin model and thus does not represent a complete resolution of the paradox, though it is not incorrect to argue that it did eliminate it.

c) Leamer's approach to resolving the paradox was to argue that one should compare the capital-labor ratio in production with that in consumption, rather than the ratios embodied in exports and imports. Show that the two approaches are equivalent only if trade is balanced. [Hint: think about how the capital-labor ratios are related.]

In thinking about how to aggregate capital-labor ratios across industries in the economy, one needs to think about the weights to be used in that aggregation. Intuitively, the weights should reflect the relative importance of an industry. Thus, its share of total output would be a natural weight. In the present case, it makes sense to divide economy-wide output into production for domestic consumption and production for exports. Domestic consumption consists of goods produced domestically and goods produced abroad (imports).

$$\left(\frac{K}{L}\right)^{\text{Production}} > \left(\frac{K}{L}\right)^{Consumption}$$

$$\Leftrightarrow \frac{V^{cons.prod.dom.}}{V}\left(\frac{K}{L}\right)^{cons.prod.dom..} + \frac{V^{\text{exports}}}{V}\left(\frac{K}{L}\right)^{\text{exports.}} >$$

Then, $$\frac{V^{cons.prod.dom.}}{V}\left(\frac{K}{L}\right)^{cons.prod.dom..} + \frac{V^{imports}}{V}\left(\frac{K}{L}\right)^{imports.}$$

$$\Leftrightarrow \frac{V^{\text{exports}}}{V}\left(\frac{K}{L}\right)^{\text{exports.}} > \frac{V^{imports}}{V}\left(\frac{K}{L}\right)^{imports.}$$

$$\Leftrightarrow \left(\frac{K}{L}\right)^{\text{exports.}} > \left(\frac{K}{L}\right)^{imports.} \quad iff \; V^{\text{exports}} = V^{imports}$$

where V's indicate the value of output and superscripts indicate the industry considered, where, e.g., "cons.prod.dom." is production for domestic consumption.
Note that the comparison of K-L ratios in production and consumption is more likely to give different answers than the comparison of K-L ratios in exports and imports, the larger a trade surplus exists. This was certainly true in the data that Leontief used.

2. Matthew Slaughter was looking for convergence in both goods prices and factor prices during the antebellum transportation revolution..

   a) Why is this time period a good choice to investigate the question of whether goods and factor prices indeed do converge, as predicted by the Heckscher-Ohlin model? Can you think of any other time period (and country/countries) that would be a good choice?

   The time period Slaughter considered is a good choice because the reduction in transportation costs was extremely large and thus we should be able to ascertain the effects from such a reduction in trade barriers.
   Other times of large reductions in trade barriers would be situations where a country was actually living in relative autarky, such as Japan before the 1850s.
   The difficulty with such historical studies is in the availability and quality of goods and factor price data.

   b) Slaughter estimates the following equation for goods prices:

$$\ln\left(\frac{P_B}{P_A}\right)_{it} = \alpha_i + \beta_i t + \varepsilon_{it}$$

ba) What does α_i stand for and why is it included in the equation?

In the level equation, this term indicates the original price level. Hence, α_i is the natural log of the original price level. It is included in the equation since different goods have different levels and thus controlling for it is crucial in estimating the speed of convergence. If one did not include it, the convergence coefficient would be incorrect.

bb) What is the expected sign for β_i if prices do converge? Is that the sign he finds?

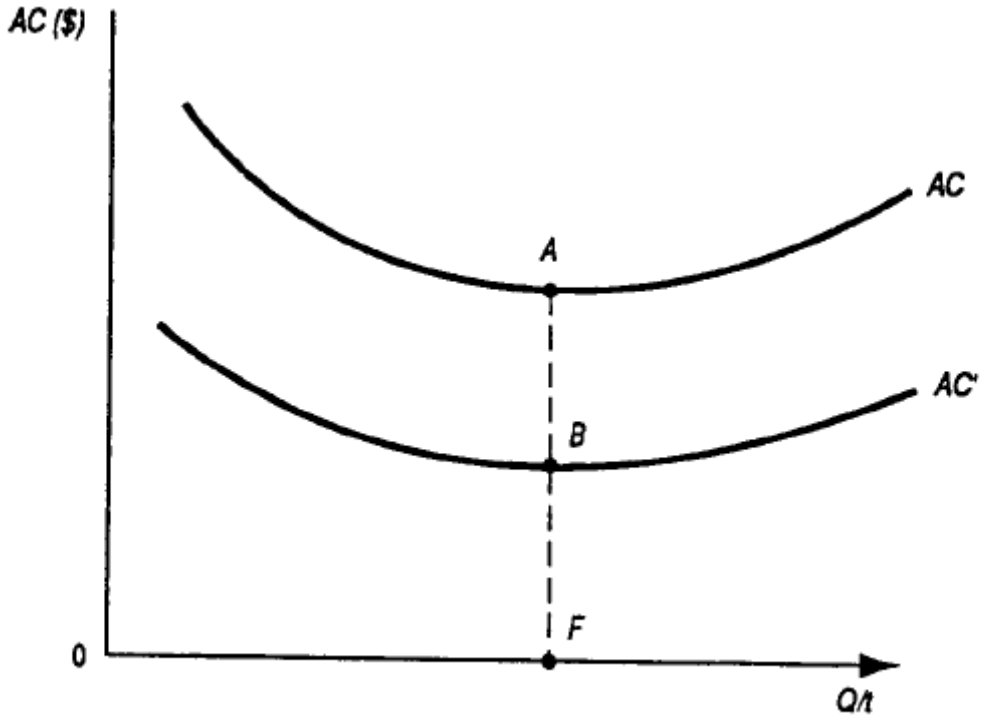
If there is indeed convergence, then one would find a negative sign for β_i, indicating that over time, the ratio of prices in regions A and B is decreasing. This is indeed the sign Slaughter finds for all 15 of the ratios he tracks in his study.

bc) What would the magnitude of β_i have to be if there was not just convergence, but prices actually equalized over the time period of his investigation?

Recall that β_i indicates the exponential rate of growth of a price ratio. If prices equalize over the 35-year period of his investigation, then by 1860, the price ratio would have to be 1. Hence, the necessary growth rate depends on the initial price ratio, which is different for each of the included ratios. Slaughter doesn't give us data for these initial ratios, except that they could approximately be read off Figure 1.
Here's a simple example: The NYC/CIN butter ratio is about 2 in 1825. For it to be 1 by 1860, the ratio would have to fall to 50% of its original level. Hence, the rate of convergence must be ln(0.50)/35 which is approximately -0.0198 or close to 2% convergence per year.

3. Draw a figure showing external economies of scale for a single firm.

The firm's AC = AF without and = BF with external economies. Thus, at a given level of output of the firm, the firm's AC are lower, i.e. the firm's AC curve shifts down as cumulative industry output expands.



4. Consider two economies that are identical in all respects. Assume that there exist scale economies in the production of both goods, rubber duckies and semiconductors.

   a) Explain why each country would specialize in the production of one good. How is it determined which good a country specializes in?

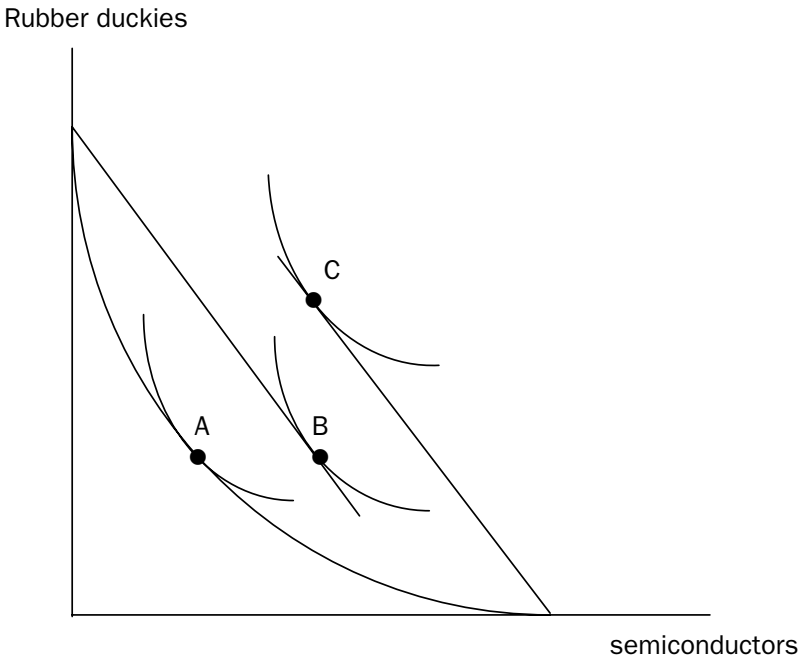
   An increase in production of one good reduces the opportunity cost of producing it, providing an incentive to produce as much as possible of it, which means putting all resources into the production of one good. This is unlike the increasing opportunity cost that exist when there are constant returns to scale.
   It is generally indeterminate which good a country specializes in. In practice, history or government policy will determine this. E.g., the U.S. specializes in airplanes because the size of the country resulted in great demand for airplane rides early on.

   b) Illustrate in a diagram how both countries can benefit from trade. Assume that both countries value the two goods equally.

   This is illustrated in Figure 6.1 in Salvatore (page 169).

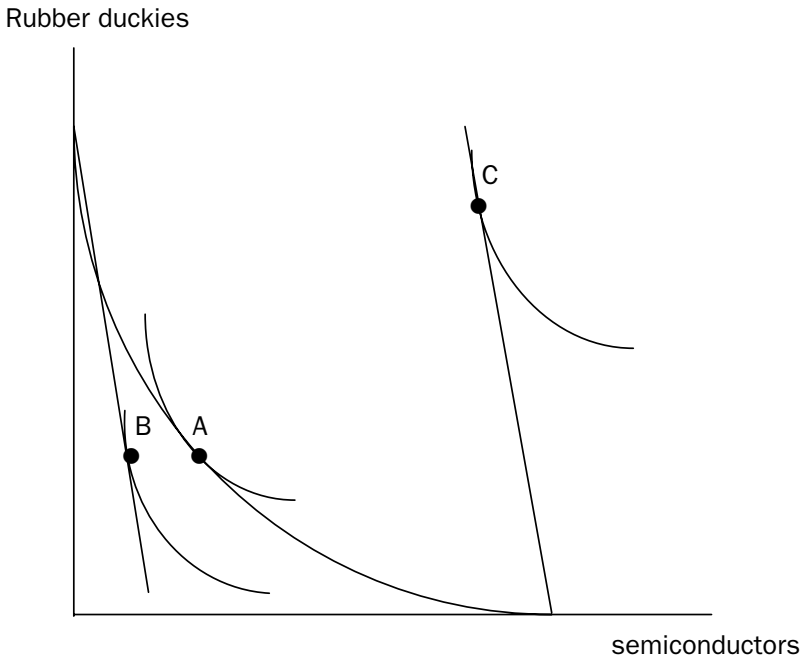
c) Now assume that <u>both</u> countries' tastes are biased towards semiconductors. Illustrate in a diagram how both countries can benefit from trade.

The bias in tastes towards semiconductors implies that the relative price of them rises, putting the country that produces semiconductors on a higher indifference curve (consuming at point C) than the country that produces rubber duckies (which consumes at point B):



d) Continue to assume that <u>both</u> countries' tastes are biased towards semiconductors. Illustrate in a diagram that the country that specializes in rubber duckies may not benefit from trade. How is that possible?

The bias must be so extreme that the relative price of semiconductors rises so much that the relative price of rubber duckies becomes sufficiently low that the country that specializes in that good ends up on an indifference curve below the one that goes through point A, the autarky point.



5. a) For the industries listed in Table 4 of Handout 1, compute the degree of intra-industry trade (IIT). Is there a correlation between the degree of IIT and how a sector ranks in terms of exports or imports or the trade balance?

Item	Exports (Rank)	Imports (Rank)	IIT
ADP equipment, office machines	29,800	98,584	0.46
Airplane parts	17,538	5,592	0.48
Airplanes	30,291	10,734	0.52
Chemicals - medicinal	25,012	39,176	0.78
Chemicals - n.e.s.	15,846	8,939	0.72
Chemicals - organic	26,765	38,009	0.83
Chemicals - plastics	28,861	17,385	0.75
Clothing	4,129	76,383	0.10
Corn	5,062	125	0.05
Cotton, raw and linters	3,929	20	0.01
Crude oil	595	182,944	0.01
Electrical machinery	74,286	99,121	0.86

Footwear	508	17,932	0.06
Furniture and bedding	4,415	30,633	0.25
General industrial machines	38,902	52,333	0.85
Iron and steel mill products	10,430	24,632	0.59
Metal ores and scrap	11,057	5,335	0.65
Natural gas	3,094	34,911	0.16
Petroleum preparations	14,782	59,698	0.40
Power generating machinery	41,296	41,263	1.00
Scientific instruments	34,544	30,242	0.93
Soybeans	6,282	63	0.02
Specialized industrial machines	33,144	31,076	0.97
Toys, games, & sporting goods	3,756	25,069	0.26
TV's, VCR's, etc.	20,974	104,079	0.34
Vehicles	71,747	195,926	0.54
Wheat	4,410	174	0.08

There is no clear correlation between the ranking in terms of exports or imports and the degree of intra-industry trade. However, there is a correlation with the trade balance. A larger absolute balance implies a greater difference between exports and imports and thus a smaller degree of IIT.

b) Pick a sector with a high degree of IIT and explain how your finding is sensible given the nature of that industry.

Electrical machinery and specialized industrial machines are sectors with high degrees of IIT. This finding makes sense since such machines consist of many different parts which may differ in their sophistication. Some may be simple enough that they can be produced using relatively unskilled labor, others may be so technically advanced that they require relatively skilled labor. The location of production chosen would then be consistent with skill abundance. Also, these industries probably consist of various final products (different types of machines) that are aggregated into one industry, but similarly vary in their degree of sophistication.

6. Consider an intra-industry trade model with monopolistic competition.

a) Explain the relationship between the number of firms in an industry and the price charged for a variety of a good.

There is a negative relationship between price and the number of firms. Intuitively, more firms imply a greater degree of competition and thus a lower price.

b) Explain the relationship between the number of firms in an industry and average cost of an individual firm.

Average cost of an individual firm will rise the more firms there are because market share of one firm will be lower.

c) What are the gains from trade liberalization in such a model? How are they different from or similar to the gains in a neoclassical trade model such as the HO model?

There are two sources of gains from trade. One is the familiar one, a decrease in price. The other is new, an increase in the number of varieties a consumer can choose from. This implies that consumer utility depends positively on the number of varieties, i.e. the more choice, the better.

d) If there are additional gains, how could one go about measuring these in practice?

Once could look at imports at a very disaggregated levels and count the change in the number of imported varieties of a good. This was done in a recent paper by Christian Broda and David Weinstein (Federal Reserve Bank of New York Staff Reports, no. 180, March 2004). They estimate that over the last 30 years, the number of imported product varieties has increased by a factor of four.
They also attempt to gauge the welfare effect of this increase and find that the welfare gains from variety growth alone are 2.8 percent of GDP.

7. Using an input-output table for the United States, calculate the share of intermediate inputs in gross output for all sectors in the table and for the economy as a whole. Also calculate the share of intermediate imports in total imports and the measure of vertical specialization from Chen et al. Describe in detail how you calculated these numbers. Compare your results to those of Chen et al. (for the appropriate year).
An Excel file containing the input-output table to be used can be found on the class homepage (problem set section). Source: U.S. Bureau of Economic Analysis

An Excel file with the data is available along with these answers on the class homepage – problem set section.

Since this input-output table is from 1997, the results for the share of imported intermediates in total imports and the measure of vertical specialization can directly be compared to Chen et al. I find that the share of imported intermediates is 51.9 percent, which is identical to what Chen et al. find. However, VS exports as a share of total manufacturing exports is 9.4 percent, rather than the 12.3 percent that Chen et al. find. This difference is a bit puzzling, although I have calculated VS/X only for manufacturing, not merchandise exports as Chen et al.