Chapter 5
Resources and Trade: The Heckscher-Ohlin Model

◼ Chapter Organization

Model of a Two-Factor Economy

  Prices and Production

  Choosing the Mix of Inputs

  Factor Prices and Goods Prices

  Resources and Output

Effects of International Trade Between Two-Factor Economies

  Relative Prices and the Pattern of Trade

  Trade and the Distribution of Income

Case Study: North-South Trade and Income Inequality

  Factor Price Equalization

Empirical Evidence on the Heckscher-Ohlin Model

Trade in Goods as a Substitute for Trade in Factors

Tests on U.S. Data

Tests on Global Data

The Case of the Missing Trade

Patterns of Exports between Developed and Developing Countries

Implications of these Tests

Summary

Appendix: Factor Prices, Goods Prices, and Production Decisions  Choice of Technique

  Goods Prices and Factor Prices

More on Resources and Output

1. ◼ Chapter Overview

In Chapter 3, trade between nations was motivated by differences internationally in the relative productivity of workers when producing a range of products. In Chapter 4, the Specific Factors model considered additional factors of production, but only labor was mobile between sectors. In Chapter 5, this analysis goes a step further by introducing the *Heckscher-Ohlin theory*.

The *Heckscher-Ohlin theory* considers the pattern of production and trade which will arise when countries have different endowments of such factors of production as labor, capital, and land; where these factors are mobile between sectors in the long run. The basic point is that countries tend to export goods that are intensive in the factors with which they are abundantly supplied. Trade has strong effects on the relative earnings of resources, and according to theory, leads to equalization across countries of factor prices. These theoretical results and related empirical findings are presented in this chapter.

The chapter begins by developing a general equilibrium model of an economy with two goods which are each produced using two factors according to fixed coefficient production functions. The assumption of fixed coefficient production functions provides an unambiguous ranking of goods in terms of factor intensities. (A more realistic model allowing for substitution between factors of production is presented later in the chapter with the same conclusions.)) Two important results are derived using this model. The first is known as the *Rybczynski effect*. Increasing the relative supply of one factor, holding relative goods prices constant, leads to a biased expansion of production possibilities favoring the relative supply of the good which uses that factor intensively.

The second key result is known as the *Stolper-Samuelson effect*. Increasing the relative price of a good, holding factor supplies constant, increases the return to the factor used intensively in the production of
that good by more than the price increase, while lowering the return to the other factor. This result has important income distribution implications.

It can be quite instructive to think of the effects of demographic/labor force changes on the supply of different products. For example, how might the pattern of production during the productive years of the “Baby Boom” generation differ from the pattern of production for post Baby Boom generations? What does this imply for returns to factors and relative price behavior? What effect would a more restrictive immigration policy have on the pattern of production and trade for the U.S.?

The central message concerning trade patterns of the *Heckscher-Ohlin theory* is that countries tend to export goods whose production is intensive in factors with which they are relatively abundantly endowed. Comparing the U.S. and Mexico, for example, we observe a relative abundance of capital in the U.S. and a relative abundance of labor in Mexico. Thus, goods that intensively use capital in production should be cheaper to produce in the U.S. and those intensively using labor should be cheaper to produce in Mexico. With trade, the U.S. should export capital intensive goods like computers, while Mexico should export labor intensive goods like textiles. With integrated markets, international trade should lead to a convergence of goods prices. Thus, the prices of capital intensive goods in the U.S. and labor intensive goods in Mexico will rise. According to the *Stolper-Samuelson Effect*, owners of a country’s abundant factors (e.g. capital owners in the U.S., labor in Mexico) will gain from trade, while owners of the country’s scarce factors (labor in the U.S., capital in Mexico) will lose from trade. The extension of this result is the Factor Price Equalization Theorem, which states that trade in goods (and thus price equalization of goods) will lead to an equalization of factor prices. These income distribution effects are more or less permanent, given that factor abundances do not quickly change within a country. While theoretically, the gains from trade could be redistributed such that everyone is better off, such a plan is difficult to implement in practice. The political implications of factor price equalization should be interesting to students.

After presenting the basic theory behind the *Hecksher-Ohlin theory*, the rest of the chapter examines empirical tests of the model, beginning with a case study looking at income inequality in the U.S. Wages paid to skilled workers in the U.S. have been rising at a much faster rate than those paid to unskilled workers over the past few decades. At the same time, there has been a large increase in international trade. Given that the U.S. is relatively abundant in skilled labor, the *Hecksher-Ohlin theory* would predict that increased trade should lead to higher wages for skilled workers and lower wages for unskilled workers. On the surface, this appears to be an empirical confirmation of the theory. However, other studies argue that rising wage inequality can only partially be explained by increased trade. According to the Heckscher-Ohlin model, the increase in skilled wages should be driven by an increase in the price of skill intensive goods following trade. However, skill intensive goods prices have not increased by nearly the same proportion as skilled wages. If rising wage inequality in a rich country like the U.S. is driven by factor price equalization, then we should also observe a narrowing gap in developing countries that are exporting low-skill intensive goods. However, income inequality in these nations is actually larger than in rich countries. Finally, trade between rich and poor nations is simply not large enough to be entirely responsible for the size of the income gap. Rather, the increasing skill premium is most likely due to skill-biased technical innovations like computers that have increased the productivities of skilled workers more than unskilled workers.

Another empirical observation testing validity of the *Hecksher-Ohlin theory* is the *Leontif Paradox*. This is the observation that the capital intensity of U.S. exports is actually lower than that of U.S. imports, exactly the opposite of what the theory would predict for a capital abundant country. Further evidence of this paradox is found in global data, with a country’s factor abundance doing a relatively poor job of predicting its trade patterns. Finally, the theory predicts a much larger volume of trade (given observed differences in factor endowments) then we actually see in the data. A country like China, for example, has a significant abundance in labor. However, China’s net exports of labor intensive goods are lower than what the theory would predict. Similarly, U.S. net imports of labor intensive goods are lower than what would be expected given its relative labor scarcity. An explanation for this “missing trade” is that the assumption of identical technology across countries is flawed. Rather, there are significant differences in productivity across countries. That said, when the sample is restricted to trade between developed and developing countries (i.e. North-South trade), the *Hecksher-Ohlin theory* fits well (e.g., the United States imports more low-skill products from Bangladesh and more high-skill products from Germany). This observation has motivated many economists to consider motives for trade between nations that are not exclusively based on differences across countries. These concepts will be explored in later chapters. Despite these shortcomings, important and relevant results concerning income distribution are obtained from the *Heckscher-Ohlin theory*.

1. ◼ Answers to Textbook Problems

1. a. The first step is to compute the opportunity cost of both cloth and food. We are given the following resource constraints:

 aKC = 2, aLC = 2, aKF = 3, aLF = 1. L = 2,000; K = 3,000

Each unit of cloth is produced with 2 units of capital and 2 units of labor. Each unit of food is produced with 3 units of capital and 1 unit of labor. Furthermore, the economy is endowed with 2,000 units of labor and 3,000 units of capital. Given these values, we can define the following resource constraints:

 2QC + QF ≤ 2,000 🡪 Labor constraint

 2QC + 3QF ≤ 3,000 🡪 Capital constraint

Solve these two constraints for the quantity of food produced:

 QF ≤ 2,000 – 2QC

 QF ≤ 1,000 – 2/3Q­C

This gives us two budget constraints for food production that must *both* be met. The production possibilities frontier traces out these budget constraints for food and cloth production.

Looking at the diagram, we see that production of both food and cloth will take place when the relative price of cloth is between the two opportunity costs of cloth. The opportunity cost of cloth is given by the slopes of the two components of the production possibilities frontier above, 2/3 and 2. When cloth production is low, the economy will be using relatively more labor to produce cloth and the opportunity cost of cloth is 2/3 a unit of food. However, as cloth production rises, the economy runs scarce on labor and must take capital away from food production, raising the opportunity cost of cloth to 2 units of food.

As long as the relative price of cloth lies between 2/3 and 2 units of food, the economy will produce both goods. If the price of cloth falls below 2/3, then the economy should completely specialize in food production (too low a compensation for producing cloth). If the price of cloth rises above 2, complete specialization in cloth will occur (too low a compensation for producing food).

b. Note the input requirements for each good. One unit of cloth can be produced using 2 units of capital and 2 units of labor. One unit of food is produced using three units of capital and one unit of labor. In a competitive market, the unit cost of each good must be equal to the output price.

 QC = 2K + 2L 🡪 PC = 2r + 2w

 QF = 3K + L 🡪 PF = 3r + w

This gives us two equations and two unknowns (r and w). Solve for the factor prices:

 w = PF – 3r

 PC = 2r + 2\*(PF – 3r) = 2r + 2PF – 6r = 2PF – 4r

 \*\*\* r = (2PF – PC)/4

 \*\*\* w = (3PC – 2PF)/4

 c. Looking at the two expressions above, we see that an increase in the price of cloth will cause the rental rate of capital to fall and the wage rate to laborers to rise. This makes sense, as cloth is a labor intensive good. An increase in its price will lead to greater production of cloth and an increase in demand for the factor it uses intensively – labor.

 d. The capital stock increases to 4,000. The labor constraint will remain unchanged, keeping the maximum price of cloth at 2 units of food. The new capital constraint is given by:

2QC + 3QF ≤ 4,000

Solving for QF yields:

QF ≤ 1,333 – 2/3QC

Thus, the minimum price of cloth is also unchanged at 2/3 units of food. The only difference now is that the production possibilities frontier will have a larger horizontal intercept (if cloth is on the horizontal axis). Compared to Figure 5.1, the new production possibilities frontier will intercept the x-axis at 2,000 instead of 1,500.

e. The actual production point for cloth and food will depend on the relative prices of cloth and food. If we assume that the economy is producing at a point such that all resources are being utilized (point 3 in Figure 5.1), then we can compute the quantities of cloth and food by setting the resource constraints equal to one another:

QF = 1,333 – 2/3QC = 2000 – 2QC

2QC – 2/3QC = 2000 – 1,333

4/3QC = 667

QC = 500

QF = 1,333 – 2/3\*500 = 1000

f. Prior to the expansion of the capital stock, the economy was producing 750 units of cloth and 500 units of food. After the expansion, cloth production *fell* to 500 while food production *increased* to 1000. This is precisely what the *Rybczynski Effect* predicts will happen.

2. The definition of cattle growing as land intensive depends on the ratio of land to labor used in production, not on the ratio of land or labor to output. The ratio of land to labor in cattle exceeds the ratio in wheat in the United States, implying cattle is land intensive in the United States. Cattle is land intensive in other countries as well *if* the ratio of land to labor in cattle production exceeds the ratio in wheat production in *that* country. Comparisons between another country and the United States is less relevant for this purpose.

3. This question is similar to an issue discussed in Chapter 4. What matters is not the absolute abundance of factors, but their relative abundance. Poor countries have an abundance of labor relative to capital when compared to more developed countries. For example, consider a large, rich country like the U.S. and a small, poor country like Guatemala. Though the U.S. has more land, natural resources, capital, and labor than Guatemala, what matters for trade is the relative abundance of these factors. The ratio of labor to capital is likely to be much higher in Guatemala than in the U.S., reflecting a relative scarcity of capital in Guatemala and abundance in the U.S. This makes labor relatively cheaper and capital more expensive in Guatemala than in the U.S. Notice that this difference in factor prices is not driven by how much labor Guatemala has compared to the U.S., but by the proportion of labor to other factors.

4. In the Ricardian model, labor gains from trade through an increase in its purchasing power. This result does not support labor union demands for limits on imports from less affluent countries. The *Heckscher-Ohlin model* directly addresses distribution by considering the effects of trade on the owners of factors of production. In the context of this model, unskilled U.S. labor loses from
trade since this group represents the relatively scarce factors in this country. The results from the *Heckscher-Ohlin model* support labor union demands for import limits. On one hand this is a rational policy as labor unions representing unskilled workers are directly hurt by trade that favors the export of skill intensive goods (and import of low skill goods). However, the unions may be better served lobbying for resources to increase skill levels among its membership, given that the gains from trade overall will exceed the losses to a particular sector.

5. Specific programmers may face wage cuts due to the competition from India, but this is not inconsistent with skilled labor wages rising. By making programming more efficient in general, this development may have increased wages for others in the software industry or lowered the prices of the goods overall. In the short run, though, it has clearly hurt those with sector specific skills who will face transition costs. There are many reasons to not block the imports of computer programming services (or outsourcing of these jobs). First, by allowing programming to be done more cheaply, it expands the production possibilities frontier of the U.S., making the entire country better off on average. Necessary redistribution can be done, but we should not stop trade which is making the nation as a whole better off. In addition, no one trade policy action exists in a vacuum, and if the U.S. blocked the programming imports, it could lead to broader trade restrictions in other countries.

6. The factor proportions theory states that countries export those goods whose production is intensive in factors with which they are abundantly endowed. One would expect the United States, which
has a high capital/labor ratio relative to the rest of the world, to export capital-intensive goods if the *Heckscher-Ohlin theory* holds. Leontief found that the United States exported labor-intensive goods. Bowen, Leamer and Sveikauskas found for the world as a whole the correlation between factor endowment and trade patterns to be tenuous. The data do not support the predictions of the theory that countries’ exports and imports reflect the relative endowments of factors.

7. If the efficiency of the factors of production differs internationally, the lessons of the *Heckscher-Ohlin* *theory* would be applied to “effective factors” which adjust for the differences in technology
or worker skills or land quality (for example). The adjusted model has been found to be more successful than the unadjusted model at explaining the pattern of trade between countries. Factor-price equalization concepts would apply to the effective factors. A worker with more skills or in a country with better technology could be considered to be equal to two workers in another country. Thus, the single person would be two effective units of labor. Thus, the one high-skilled worker
could earn twice what lower-skilled workers do, and the price of one effective unit of labor would still be equalized.