# Chapter 7

## **Economic Growth and International Trade**

"That part of annual produce, therefore, which, as soon as it comes either from the ground or from the hands of the productive laborers, is destined for replacing a capital, is not only much greater in rich than in poor countries, but bears a much greater proportion to that which is immediately destined for constituting a revenue either as rent or as profit." Adam Smith, Wealth of Nations, Book II, Chapter III.

## I. Chapter Outline

- 7.1 Introduction
- 7.2 Growth of Factors of Production
  - 7.2a Labor Growth and Capital Accumulation over Time
  - 7.2b The Rybczynski Theorem
- 7.3 Technical Progress
  - 7.3a Neutral, Labor-Saving, and Capital-Saving Technical Progress
  - 7.3b Technical Progress and the Nation's Production Frontier
- 7.4 Growth and Trade: The Small Country Case
  - 7.4a The Effect of Growth on Trade
  - 7.4b Illustration of Factor Growth, Trade, and Welfare
  - 7.4c Technical Progress, Trade, and Welfare
- 7.5 Growth and Trade: The Large Country Case
  - 7.5a Growth and the Nation's Terms of Trade and Welfare
  - 7.5b Immiserizing Growth
  - 7.5c Illustration of Beneficial Growth and Trade
- 7.6 Growth, Change in Tastes and Trade in Both Nations
  - 7.6a Growth and Trade in Both Nations
  - 7.6b Change in Tastes and Trade in Both Nations

### II. Chapter Summary and Review

The Heckscher-Ohlin model is an explanation of trade based on given supplies of factors, a given level of technology, and given tastes. As factor supplies change, technology advances, and tastes change, relative prices and comparative advantage may change. This chapter reviews the effects of changes in factor supplies, tastes, and technology on trade and welfare. For simplicity, the familiar H-O model with two homogeneous factors (capital and labor), two products, and two countries will be employed. There are many combinations of changes in

factor supplies, technology and preferences. Consequently, the analysis and examples, both in this Chapter Summary and Review and in the *International Economics* text are limited to a subset of all possible changes.

When there is growth in factor supplies, output will also grow, producing a shift of the production possibility to the right. With **balanced growth**, both K and L grow at identical rates. If there are constant returns to scale, whereby equiproportionate increases in capital and labor leads to the same proportionate increase in output and income, then production per laborer is unchanged and income per capita is unchanged (assuming that the labor-force participation rate is unchanged).

In the balanced growth case, the production possibility frontier shifts out uniformly, as shown in Fig. 7.1. The slope of the ppf's in Fig. 7.1, along any ray from the origin, such as 0a, will be identical because the production of goods Y and X increase at the same proportionate rate as the increase in K and L.



If one factor increases faster than the other, then both absolute and relative numbers change. If capital increases relative to labor, then the ppf will still shift out because both goods use capital, but if good Y is capital intensive, then the vertical intercept in Fig. 7.1 will shift up by more than will the horizontal intercept. (These non-proportionate shifts are not shown.) If capital grows at a higher rate than the labor force, then the productivity of labor will increase because each laborer, on average will have more capital with which to work. If productivity per worker increases, then production per worker and per capita income will increase. If, on the other hand, the labor force increases relative to the capital stock, then the ppf will shift out more for the labor-intensive good. If labor grows at a higher rate than capital, then labor productivity will fall as each laborer has less capital with which to work. (Diminishing returns occur when a variable input is applied to a fixed input. This is diminishing returns due to labor increasing faster than capital increases.) A decrease in labor productivity falls means a decrease in per capita income.

If only one factor of production grows, and the relative price of the two goods remains the same, then we have a somewhat curious result, called the **Rybczynski Theorem.** The Rybczynski Theorem states that the production of the good using the non-growing factor intensively actually decreases. One might expect that an increase in, say, just the labor force would, by expanding the entire ppf, lead to an increase in the production of both goods. Although the ppf does increase, making increased production of both goods possible, the assumption of constant relative prices means that the production of one good actually decreases.

The argument begins with the assumption that the relative price of goods does not change. If relative prices do not change, then relative *factor* prices do not change. See Fig. 5.3 of this study guide, which shows that for a given  $P_X/P_Y$ , there is a unique w/r. If the relative factor price (w/r) does not change, *then the relative amounts of capital and labor used will not change (capital-labor ratios remain unchanged in the production of both goods).* 

Now assume an increase in the labor force. In order for the capital-labor ratio to remain constant in the production of both goods, production of the capital-intensive good must fall in order to release enough capital to be combined with the new labor to produce the labor-intensive good. More of both goods cannot be produced, and the capital-labor ration to remain constant in the production of both goods, because there is no capital to combine with the new labor.

(Is it possible for production of the labor-intensive good to fall and production of the capital-intensive good to increase when the labor force increases and capital-labor ratios remain the same? No, because the new labor available will not keep the capital-labor ratio constant in the production of the capital-intensive good.)

The previous discussion addresses the effect of changing factor supplies on the ppf. The ppf can also be shifted out by changes in technology. Although John Hicks defined a number of general forms of technical progress we will consider only **neutral technical progress**. Neutral technical progress in the production of a good occurs when the ratio of capital to labor, given relative factor prices (w/r), is unchanged by technical progress. If the capital-labor ratio is unchanged, then the productivities of capital and labor have increased by the same amount. (If the productivity of one factor increased more than the other, then, at given factor prices, firms would use more of the factor with the greater productivity gains.)

If the rate of neutral technical progress is the same in the production of both goods, then the productivity of both the total labor force and the total capital stock will increase by the same amount, and the ppf will shift out in the same manner as for balanced growth in factor supplies (see Fig. 7.1).

If there is neutral technical progress in the production of only good Y, then the intercept for good Y will increase, but the intercept for good X will be unchanged. The ppf intercept for a good represents the maximum amount of a good than can be produced if all resources are devoted to that good. If there is technical progress in the production of good Y, then the maximum amount of Y that can be produced will increase, but the maximum amount of good X that can be produced is unaffected. In general, technical progress increases the amount of production for given capital and labor and so will increase production per worker and per capita income.

Given that growth in factor supplies and technical change can affect the ppf, we now address the effect of the change in the ppf on trade. How growth affects trade can be divided into a production effect and a consumption effect.

The production and consumption effects of growth are how growth affects the production and consumption of exportables and importables, *given the terms of trade*. In Heckscher-Ohlin type trade with only two goods, goods are either exportable or importable. Exportables are goods that can be exported, or consumed domestically. Importables are goods that can be imported or provided domestically. As production of exportables increase, given demand, more exports can take place. As production of importable increase, given demand, imports will decline. As consumption of exportables increase, given production, exports fall. As consumption of importables increase, given production, increase.

If growth leads to an equal increase in the production of exportables and importables, then growth is **trade neutral**, favoring neither an increase in exports

nor a decrease in imports.

If growth leads to a greater increase in the production of exportables than in importables, then growth is protrade.

Finally, if growth leads to a greater increase in the production of importables than in exportables, then growth is **antitrade**.

Table 7.1 classifies the production effects of growth.

Table 7.1: Production Effects of Growth			
Increase in Production of	Increase in Production of	Production	
Exportables	Importables	Effect	
Larger	Smaller	Protrade	
Smaller	Larger	Antitrade	
Equal	Equal	Trade Neutral	

The consumption effects of growth are classified similarly. If growth leads to an equal increase in the consumption of both exportables and importables, then consumption, given production, is reducing exports and increasing imports by the same amount so consumption is trade neutral.

If growth increases the consumption of exportables more than the consumption of importables, then the reduction in exports will exceed the increase in imports and the consumption effect is antitrade.

If growth increases the consumption of importables more than the consumption of exportables, then imports will increase by more than exports fall so the consumption effect is protrade.

Table 7.2 classifies the consumption effects of growth.

Table 7.2: Consumption Effects of Growth			
Increase in Consumption of	Increase in Consumption of	Consumption	
Exportables	Importables	Effect	
Larger	Smaller	Antitrade	
Smaller	Larger	Protrade	
Equal	Equal	Trade Neutral	

Table 7.9. Consumption Effects of Crowth

Whether growth as a whole is protrade or not depends upon the production and consumption effects together. If, for example, either consumption or production is protrade, and the remaining effect is trade neutral or protrade, then growth will be protrade. If one effect is protrade and one is antitrade, then the net effect depends upon the size of the two effects.

Now consider the effect of growth on trade in a small country. A small country is defined as one that faces a given world terms of trade that are not affected by changes in the small country, although they can change due to a change in world conditions. Changes in what the country supplies to the rest of the world (exports), and/or demands from the rest of the world (imports) are too small to affect world prices (the terms of trade). (Essentially, a small country faces an offer curve of its trading partners that is linear, so that any change in the small country's offer curve leaves the terms of trade unchanged and equal to the slope of the foreign offer curve.)

As an example of growth, consider the case of growth in only one factor, say labor. With constant terms of trade, the Rybczynski Theorem states that the production of the capital-intensive good will fall.

If the labor-intensive good is the exportable good, and the capital-intensive good is the importable good, then the production effect of growth is protrade. If consumption is protrade, trade neutral or has small antitrade effects, then growth will be protrade. In this case of an increasing labor force and a labor-intensive exportable good, the Rybczynski Theorem tells us that the production effect must be protrade. The consumption effect can be protrade, antitrade or neutral.

In a large country, growth will change the production of exportable and importable goods and thus exports and imports. A change in exports relative to imports will change the terms of trade.

If the volume of trade is reduced at the old terms of trade (fewer exports offered relative to imports at the old terms of trade), then the terms of trade will move in favor of a country (the price of exports will increase relative to the price of imports).

If the volume of trade is increased at the old terms of trade (more exports offered relative to imports at the old terms of trade), then the terms of trade will move against a country (the price of exports will decrease relative to the price of imports).

An increased volume of trade for a large country (Nation 1) is shown in

Fig. 7.2 by the shift of the offer curve labeled "Nation 1" to the offer curve labeled "Nation 1\*". Note that the increased volume of trade changes the terms of trade from  $(P_X/P_Y)_1$  to  $(P_X/P_Y)_2$ . Good X is Nation 1's export good so there is a decrease in the terms of trade for Nation 1. For a decreased volume of trade, assume the initial offer curve is that labeled "Nation 1\*", and shift it to the offer curve labeled "Nation 1".



Whether growth improves a country's welfare depends upon the combined result of the **terms of trade effect** and the effect of growth on per-capita incomes. The effect of growth on per-capita incomes is called the **wealth effect**. *Again, there are many sources of growth so there are many examples that could be considered. A few of those examples are considered here.* 

Suppose Nation 2, exporting Good Y, experiences neutral technical progress of the same amount in both goods. The production effect of this growth will be trade neutral because production of both goods (exportables and importables) increases by the same amount. If it is assumed that the consumption effect of the growth is trade neutral, then the net effect will be trade neutral.

The effect of neutral technical progress of the same amount in both factors will be to shift out the ppf by a uniform proportionate amount, as shown in Fig. 7.3. Both production points P and P' are on the ray 0b.



If the consumption effect is trade neutral, then consumption of both goods will increase by the same proportionate amount. The consumption points C and C' will lie along the same ray 0a.

The wealth effect will be positive because there is increased output for the given level of labor. For a small country, this will unequivocally increase welfare.

For a large country, however, the terms of trade effect must be considered. Both the consumption and production effects of the growth are trade neutral, so exports and imports expand at the same rate as output. For a given terms of trade, more exports of Y are offered for more imports of X. The increased supply of Y and increased demand for X will lower the price of Y relative to X. The terms of trade will move from P<sub>1</sub> in Fig. 7.3 to P<sub>2</sub>. (The slope of the price line is  $P_x/P_Y$ , so if  $P_Y$  decreases,  $(P_x/P_y)$  increases or the slope becomes steeper.)

The result is a lower relative price for exports, which will offset to some degree the wealth effect gains from the neutral technical progress. Along  $P_{2,}$  indifference curve III cannot be reached. The nation is better off than before growth, but not as well off as if three were no terms of trade effect.

Note that although the production and consumption effects in Fig. 7.3 are trade neutral, there is an increased volume of trade – more exports are offered for more imports after growth at the given terms of trade. Thus Nation 2's offer curve shifts to the left as shown in Fig. 7.4, producing a deterioration of the terms of trade for Nation 2 (exporting Y) from  $P_1$  to  $P_2$ .



Now consider a case in which growth unambiguously improves welfare in a large country - both the wealth effect and the terms of trade effect enhance welfare. If Nation 2 exports a labor-intensive good and experiences an increase in the supply of capital, then the wealth effect will be welfare enhancing because more output is available with a given supply of labor. In addition, the Rybczynski Theorem says that if prices are unchanged, then production of the labor-intensive good, which is the exportable good in this case, must fall and production of the capital-intensive good must increase, which is the importable good. Production is antitrade because the change in the production of the importable good exceeds the change in production of the exportable good (which is actually negative). With a smaller volume of trade, the relative price of the exportable good will increase — a terms of trade effect that is also welfare enhancing.

The final example considered is called **immiserizing growth**, first provided by Professor Jagdish Bhagwati in a short 1958 article. In this case, there is a clear deterioration in living standards for the representative member of the population. If there is technical progress in production of the exportable good, then the wealth effect will enhance welfare because there is more production with the same labor force. However, because the volume of trade increases, the terms of trade will deteriorate. If the terms of trade deteriorate enough, there will be a decrease in the total income of society as represented by a move to a community indifference curve lower than the one attainable before growth. (This case is shown in Fig. 7.6 of the *International Economics* text.) Because total income of society has fallen, the representative member of the population clearly loses. Immiserizing growth, although unlikely, would occur for a developing nation that exports labor-intensive goods if there were a sharp increase in its labor force.

If growth occurs simultaneously in both countries, then the terms of trade effect for large countries can be best analyzed with offer curves. The wealth effect can be determined from the nature of the growth as has already been described. For example, suppose that both nations experience neutral technical progress in production of their exportable goods. The welfare effect, as usual, will be welfare enhancing. If consumption is trade neutral, then the production effect in each country will be protrade, shifting the offer curves from 1 to 1\* and from 2 to 2\* in Fig. 7.5. If the effect on the offer curves is identical, then the terms of trade will not change. By considering whether the production and consumption effects are net, protrade, antitrade, or trade neutral, the effect of growth on the terms of trade can be determined with offer curves.



### **III. Questions**

**1.** Match the graphs in Fig. 7.6 with the changes described below. Assume that X is the capital-intensive good so Y is the labor-intensive good.



- a) A 10% increase in supply of capital
- b A 10% increase in the supply of labor
- c) A 10% increase in both the supply of capital and labor
- d) Technical progress in the production of Good X, but not Good Y

e) Technical progress at the same rate in the production of both Goods X and Y

**2.** For the changes described in question 1, explain the effect on total income and per capita incomes, assuming that the terms of trade do not change.

**3.** "If the ppf shifts out and the terms of trade are unaffected, then a country is unambiguously better off because a higher community indifference curve can be reached." Explain why this statement is not true. (Hint: Consider various sources of growth and the effect on per capita incomes as well as on total income of society.)

**4.** Suppose overall production increases by 10%, with 10% growth in the importable sector and 10% growth in the exportable sector. Consumption also increases by 10%, with 10% more consumption of exportables and 10% more consumption of importables. Is growth protrade, antitrade, or trade neutral?

**5.** Suppose overall production increases by 5%, with all of the growth in the exportable sector (which would have to be more than 5% in order for total growth

to increase by 5%). Consumption of the exportable good does not change, but consumption of the importable good increases by 5%. Is growth protrade, antitrade, or trade neutral?

**6.** Determine whether the effect of the following cases is on balance, protrade, antitrade, or trade neutral. Assume a small country.

a) Balanced neutral technical progress and trade neutral consumption

b) Neutral technical progress in the exportable commodity and protrade consumption

c) Neutral technical progress in the exportable commodity and neutral consumption

d) Neutral technical progress in the importable commodity and antitrade consumption

e) A developing country, exporting labor-intensive goods, experiences a significant increase in its labor force due to population growth, but no change in its capital stock. Consumption is trade neutral

**7.** a) Explain why the growth shown in Fig. 7.7 is an example of the Rybczynski Theorem.



b) Good Y is the exportable good and good X is the importable good. Is the

production effect protrade in this case? Make the small country assumption throughout this question.

c) Suppose the demand for good Y is unchanged in absolute terms as a result of the shift in the ppf in Fig. 7.7, so that any new demand is demand for good X. Is consumption protrade in this case?

d) Using Fig. 7.7, show the trade equilibrium before growth and the trade equilibrium after growth, as a result of the shift of the ppf shown in Fig. 7.7 and the change in consumption described above.

e) Show the same equilibria as in question d using offer curves.

**8.** A large nation produces an exportable **normal good** and an importable **inferior good**. Suppose there is equal neutral technical progress in each good.

a) What will happen to the nation's welfare due to the wealth effect?

b) What will happen to the nation's welfare due to the terms of trade effect?

**9.** What happens to the welfare of a large nation as a result of the following forms of technical progress if consumption is trade neutral?

a) Neutral technical progress in production of the exportable good

b) Neutral technical progress in production of the importable good