CHAPTER 5

Constant Cost Production and Trade

Preview

Comparative advantage was discovered over 200 years ago by David Ricardo who sought the causes of trade. Ricardo developed a model of production with constant input per unit of output. Applications of this constant cost model remain useful in economics. This chapter covers:

- Constant cost production and trade
- Gains from trade with constant costs
- Labor productivity and international wages
- Applications of the constant cost model

INTRODUCTION

Mercantilism was a popular economic doctrine that wealth is the stockpile of gold and other assets. Mercantilists in the 1700s believe exports create wealth but imports squander it, and recommend policy to promote exports and restrict imports. Some have a similar view today.

Adam Smith argued against mercantilism pointing out that wealth is the capacity to produce goods and services. Smith advocated specialization based on cost advantage and trading for cheap products on international markets. Smith believed international competition would lead to wealth.

Ricardo realized there are gains from trade even for a country inefficient in producing every product. To enjoy gains from specialization and trade, relative efficiency is sufficient. Every country has comparative advantages in some activities.

Production lies at the heart of trade. In Ricardo's model, labor per unit of output is fixed implying constant opportunity cost. Countries gain through specialization according to comparative or relative efficiency advantage.

This chapter presents fundamental relationships among wages, labor productivity, and exchange rates. Applications and tests of constant cost theory support Ricardo's model. Comparative advantage and the gains from specialization and trade remain sound principles.

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A. CONSTANT OPPORTUNITY COSTS

Labor in the Constant Cost Model

Assume the only input is labor. With fixed the amount of labor required to produce a unit of output does not vary. Suppose the amount of labor it takes to produce a unit of services is 2 and the amount of labor it takes to produce a unit of manufactures is 3,

$$a_{LS} = 2 \quad \text{and} \quad a_{LM} = 3.$$

These labor inputs are the constant cost technology.

Let S be the output of services. Labor employed in services production is $2S$. If output of services is $S = 30$, labor input must be $60 = 2 \times 30$.

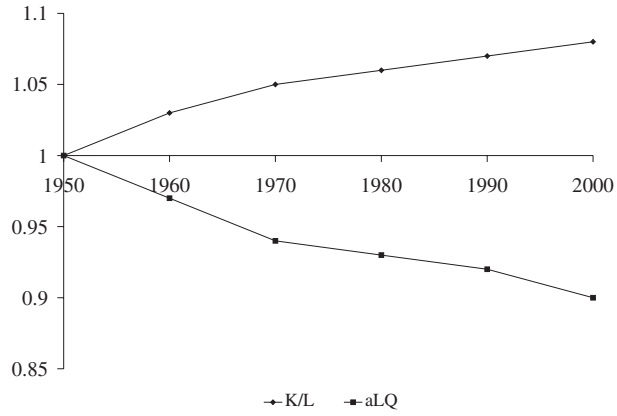
Labor is fully employed. The quantity of manufactures is M. If it takes 3 workers to produce a unit of output in manufactures, $3M$ workers are employed in manufacturing. If the total amount of labor L in the entire economy is 120 then

$$L = 120 = 2S + 3M$$

The economy is constrained in the outputs it can produce. With a given labor force and constant labor inputs, more of one output implies less of the other.

EXAMPLE 5.1 *Labor Productivity*

Capital raises labor productivity. As the ratio of capital to labor K/L in the US grew during the last half of the 20th century, labor input per unit of output fell. Investment is not a fast process but a sure one.



Constant Cost Production Frontier

In Figure 5.1 if the entire labor force worked in manufacturing, service output S would be zero and $120/3 = 40$ units of M could be produced. If no M were produced, $120/2 = 60$ units of S could be produced.

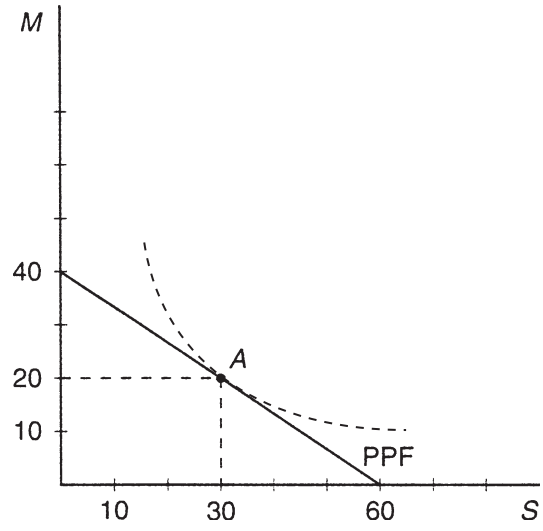


Figure 5.1
Constant Cost Production Frontier
Opportunity cost is constant along the linear PPF. The labor force is $L = 120$ and inputs are $a_{LS} = 2$ and $a_{LM} = 3$. At point A production is $(M,S) = (20,30)$.

Each unit of S costs the same amount of M along the linear PPF. The opportunity cost of one added unit of S in terms of M is constant.

The domestic relative price of services is the PPF slope, $|-40/60| = 2/3$. This much M must be given up to produce one additional unit of S. This constant cost PPF is much simpler than the increasing cost PPF.

Consumers maximize utility subject to the PPF. Consumers choose point A where $M = 20$ and $S = 30$. Consumers then spend half their income on each good. Half the labor force works in each sector.

EXAMPLE **5.2** *Labor Productivity and Technology*

Improved technology increases labour productivity. A startling example is long distance telephone calls per operator, rising in the US from 64 per day in 1970 to 1300 in 1994. The ten telecommunication firms in the US that cut the most jobs during the 1990s had an increase of 25% in labor productivity due to investment in improved technology.

EXAMPLE **5.3** *Labor Productivity and Human Capital*

Investment in human capital increases labor productivity. One success story is Japanese manufacturing where labor input per unit of output fell dramatically in the chart between 1955 and 1995.

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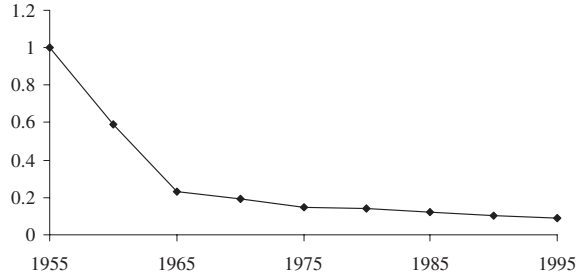

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International Differences in Production

The foreign country has unit labor inputs, $a^*_{LS} = 6$ and $a^*_{LM} = 4$. The foreign labor force is $L^* = 240$. The foreign production frontier PPF* is in Figure 5.2. Its endpoints are $60M^*$ and $40S^*$. The equation of the PPF* is

$$L^* = 240 = 6S^* + 4M^*$$

The foreign relative price of services is $M/S = |-60/40| = 1.5$.

Foreign labor input requirements are higher for both products, $a_{LS}{}^* > a_{LS}$ and $a_{LM}{}^* > a_{LM}$. The home country has an absolute advantage in both products but it pays to specialize and trade.

The relative autarky price of services is higher in the foreign country. The opportunity cost of service production is higher in the foreign country.

If foreign consumers also spend half their income on each good, the foreign labor force will split equally between sectors. Foreign consumption of services is 120/6 = 20 and consumption of manufactures 120/4 = 30.

Consumers in each country are constrained to be on their own PPF with no trade. Each economy values goods according to opportunity costs. If consumers were identical in the two countries, they would consume differently because of the different opportunity costs of production.

Figure 5.2 shows autarky production and consumption. The home produces and consumes at point A, the foreign country at A*. Consumers in both countries spend half of their income on each good. Autarky relative prices of services are 2/3 at home and 3/2 abroad.

EXAMPLE **5.4** *High Tech Comparative Advantage*

The relative price of high tech in terms of manufactured goods is M/H. Mordechai Kreinin (1985) compares these opportunity costs for the US, Japan, and Germany during the 1980s. The US had a slight comparative advantage relative to Japan. Both had a comparative advantage over Germany.

	US	Japan	Germany
M/H	0.90	0.95	1.08

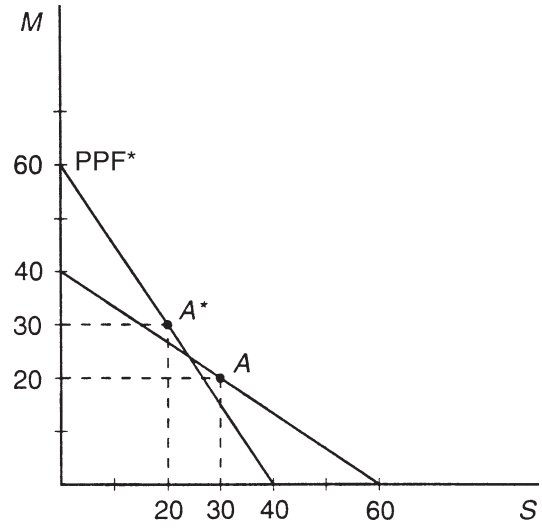
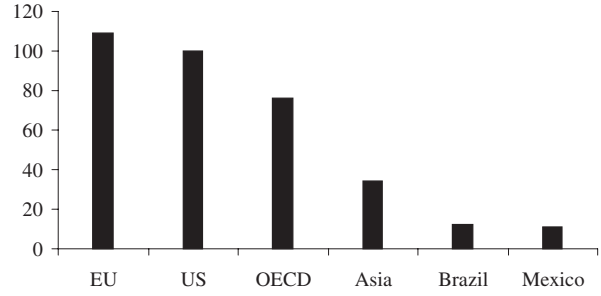


Figure 5.2
Production and Consumption without Trade
Foreign labor inputs are $a_{LS}^* = 6$ and $a_{LM}^* = 4$ with a labor force of 240. Production and consumption in autarky occur at point A in the home country and A^* in the foreign country. Services are cheap in the home country manufactures in the foreign country.

EXAMPLE 5.5 *International Wage Comparsion*

Countries with low labor costs specialize in labor intensive products with high labor inputs.



Section A Problems

A1. Draw the PPF for a country with unit labor inputs $a_{LS} = 4$ and $a_{LM} = 5$, and labor force $L = 220$. Find the relative price of S in terms of M.
A2. Draw the PPF with $a_{LS} = 3$, $a_{LM} = 1$, and $L = 60$. Find the relative price of S in terms of M.

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EXAMPLE 5.6 *GDP Shares*

Output in the US has trended toward specialization in services. Services is now the dominant share of the economy. The share of manufacturing in GDP was 20% during the 1980s.

GDP shares	
Agriculture, forestry, fishing, mining, utilities, construction	9%
Manufacturing	13%
Services	78%

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B. GAINS FROM TRADE WITH CONSTANT COSTS

Different prices are the stimulus to specialize and trade, leading to efficient global production.

Relative Prices and Specialization

Countries specialize in products with comparative advantage increasing global production. The concepts of lower opportunity cost, relative efficiency, and comparative advantage are equivalent.

With complete specialization in services, the home country moves along its PPF to produce only services. It enjoys gains from trade because services are traded at a price above the domestic relative price of 2/3.

The international price of services is the terms of trade line $tt = 1$ in Figure 5.3. For the home country, the relative price of services must be above 2/3. For the foreign country tt must be less than $M/S = 3/2$ for specialization in manufactures.

The limits to the terms of trade are these minimally acceptable relative prices,

$$3/2 > tt > 2/3.$$

In the late 1700s John Stuart Mill contributed to Ricardo's model by showing how the terms of trade are determined. Mill assumed consumers in both countries spend half their income on each product. The price will be the same in both countries with trade, and trade is balanced.

In Figure 5.3 exports of M from the foreign country are traded for S from the home country at $tt = 1$. The home economy exports 30 units of S and imports 30 units of M. Consumers maximize utility on the terms if trade line tt. The shaded trade triangle in Figure 5.3 shows 30 units of exported S and 30 units of imported M.

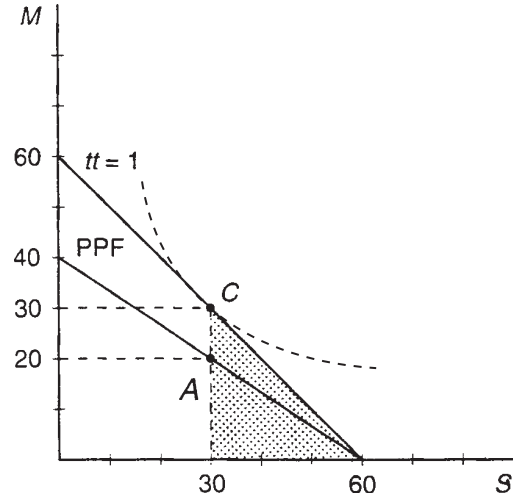

Figure 5.3
The Trade Triangle
Consumers maximize utility on the terms of trade *tt* at $(M,S) = (30,30)$. The shaded trade triangle starts at the point of complete specialization in *S*.

EXAMPLE 5.7 *Revealed Comparative Advantage*

The US mainly exports high tech manufactures, business services, and some agricultural products. High tech manufactures and business services use relatively high inputs of skilled labor. US import categories are low tech manufactures and some resource products. Input availability explains a good deal of production and trade. David Richardson and Chi Zhang (1999) document the US revealed comparative advantage in high tech products.

More highly valued exports on the world market imply greater gains from trade. Gains from trade are partly due to demand. If home consumers value foreign manufactures more than foreign consumers value home services, the terms of trade would favor the foreign country.

If a large country trades with a small one, trade is thought to benefit the large country. The terms of trade, however, cannot vary much from the large country autarky price. Demand for the small country exports jump substantially.

A small country gains more from trade with terms of trade farther from domestic prices.

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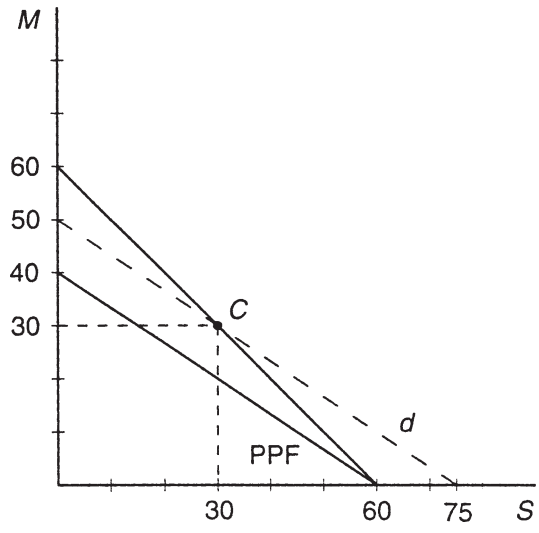

Figure 5.4
Real Gains from Trade
The consumption bundle at C is valued at domestic autarky prices. The domestic price line d is parallel to the PPF. The value of consumption is the endpoint of price line d. Trade creates a gain of 25%.

The Real Gains from Trade

The *real gains from trade* are consumption with trade measured with autarky prices. The real gains from consumption at point C in Figure 5.3 are measured with the domestic autarky price $M/S = 2/3$. This domestic price line d in Figure 5.4 is drawn through C parallel to the PPF.

The value of consumption at C in terms of good M is

$$30M + (2/3 \times 30S) = 30M + 20M = 50M$$

The 30 units of S consumed are worth 20 units of M. Added to the 30 units of M consumed with trade, the real value of consumption is $50M$. The value of autarky consumption in terms of M the endpoint 40 of the M axis on the PPF. The real gain from trade is the difference, $10M$ equal to a 25% increase.

In the foreign country there are also real gains from trade. Specialization pushes it into the production of manufactures. There are only two countries in the world and home imports equal foreign exports.

EXAMPLE 5.8 *The Capital, Labor, and Land of Ricardo*

Andrea Maneschi (1992) points out that Ricardo relied on models with land and capital along with labor to develop economic concepts. Tariff disputes between workers, landowners, and manufacturing capitalists were a major topic in political economy during the late 1700s when Ricardo wrote economics. Not much has changed since then.

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EXAMPLE 5.9 *Iron and Steel Labor Inputs*

During the 1970s Japan switched from a large importer of iron and steel to a large exporter while the US and the UK became net importers. Investment in Japan led to a decrease in unit labor inputs and lower production costs. Mordechai Kreinin (1984) reports these decreases in unit labor inputs between 1964 and 1984 as the US and UK lost their comparative advantages to Japan.

	US	UK	France	Germany	Japan
a_{Li}	−16%	−16%	−55%	−56%	−72%

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Section B Problems

B1. Diagram the foreign country in the example of real gains from trade. Show production point P*, the terms of trade line *tt*, consumption C*, and the trade triangle. Find the gains from trade in terms of its export *S*.
B2. Suppose the home country is characterized by $a_{LM} = 4$ and $a_{LS} = 5$ and the foreign country by $a_{LM}^* = 5$ and $a_{LS}^* = 6$. Which country has the comparative advantage in *S*? Find autarky relative prices of *S* in both countries and the limits to the terms of trade.

EXAMPLE 5.10 *Wages and Labor Costs around the Pacific Rim*

Wages and labor inputs determine the labor cost of manufacturing. Susan Hickock and James Orr (1989) report a comparison of manufacturing labor costs around the Pacific Rim. US labor inputs are lower but the US has a difficult time competing due to high wages.

	wages	a_{LM}	unit labor cost
Thailand	$0.86	8.3	$7.14
Taiwan	$2.71	3.8	$10.30
South Korea	$2.65	4.3	$10.84
US	$13.90	1	$13.90

C. EXTENDING CONSTANT COST TRADE THEORY

For trade to occur, wages and the exchange rate are constrained to limits set by productivities of trading partners. Constant cost trade theory extends to many products and many countries.

Labor Productivity and Wages

Trade changes product prices that influence factor prices. Economic profit in a competitive industry is zero due to free entry and exit of firms. Accounting profit may be positive but there is no excess profit. The price of a good in competition is its average cost, $P = AC$.

With specialization, the price of services is its average cost in the home country,

$$P_S = AC_S = wa_{LS}$$

The dollar price of manufactures produced in the foreign country depends on the foreign wage, foreign unit labor input, and the exchange rate e = $/peso,

$$P_M = ew^* a_{LM}^*$$

The terms of trade *tt* is the ratio of the two dollar prices from the countries of origin,

$$tt = P_S/P_M = \mathrm{wa_{LS}}/ew^* a_{LM}^*.$$

The relative home wage can be increased through labor productivity or the terms of trade, $w/ew^* = (a_{LM}^*/a_{LS})tt$.

Changing productivity affects relative wages. Suppose home labor becomes more productive with a_{LS} falling. Less home labor is required per unit of service output. For given *tt* the home relative wage rises. The quality and quantity of other inputs directly affect labor productivity. With better machines and training, labor will be more productive. Investment in physical capital and human capital is required to increase labor productivity. The home wage then increases relative to the foreign wage.

If the terms of trade improve for the home country, services become more valuable and the home relative wage rises. The terms of trade depend partly on demand in the two countries. A country that increases its demand for foreign products will suffer a lower wage. When demand for Japanese manufactures rose in the US during the 1970s and 80s the terms of trade worsened for the US and wages fell.

Higher productivity and better terms of trade increase relative wages.

EXAMPLE 5.11 *Wages, Productivity, and Trade*

Lower relative costs are associated with exports. Countries with low wages also have low labor productivity. Steve Golub (1995) tests the relationship between relative labor costs and bilateral trade flows across pairs of countries. As an example in 1990 wages and labor productivity in Malaysia were both 15% of US levels implying similar labor costs.

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Exchange Rates and Wages

For the home economy to export services, the price of services must be lower at home than abroad. The price of services produced at home depends on the home wage and labor productivity, $P_S = wa_{LS}$. The dollar price of foreign labor is ew^*. The dollar price of services produced in the foreign country is $ePs = ew^*a_{LS}^*$.

For the home country to export services, the dollar price of services produced at home must less than the foreign country, $wa_{LS} < ew^*/a_{LS}^*$. Solving for the exhange rate e,

$$e > wa_{LS}/w^*a_{LS}^*$$

For the foreign country to export manufactures, the dollar price of manufactures produced in the foreign country $ew^*a_{LM}^*$ must be less than the domestic price wa_{LM}, implying

$$wa_{LM}/w^*a_{LM}^* > e$$

The exchange rate is then bounded according to

$$wa_{LM}/w^*a_{LM}^* > e > wa_{LS}/w^*a_{LS}^*.$$

Figure 5.5 illustrates these limits to the exchange rate. For a given exchange rate, the wage can be only so high for the economy to export. If the wage rises too far, the economy loses its cost advantage. The home wage is also limited by labor productivity relative to the foreign country. Given the gains from trade there is little reason to worry about the exchange rate that will find the level where trade is possible.

The wage is constrained by the foreign wage, the exchange rate, and labor productivity.

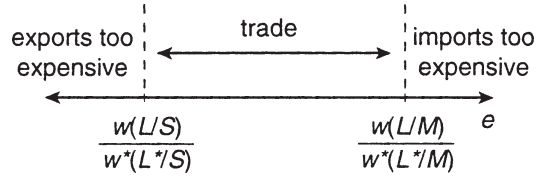

Figure 5.5
Limits to the Exchange Rate
If the exchange rates is too low, exports will cost too much abroad. If e is too high imports will cost too much. This limited range of e is required for trade.

EXAMPLE 5.12 *Wages and the Exchange Rate*

Dollar appreciation makes US exports more expensive abroad, lowers US exports, and could lower wages as a result. Baekin Cha and Daniel Himarios (1995) find dollar appreciation during the mid-1980s reduced wage growth but the subsequent depreciation had little effect. Between 1971 and 1988, the exchange rate affected wages even for construction and domestic services industries.

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Trade with Many Products

The three major categories of output are services *S*, manufactures *M*, and agriculture *A*. Consider the unit labor inputs in Table 5.1. The opportunity cost of one unit of *M* in the home country is either 3/2 *S* or 3/4 *A*.

Home services input relative to foreign input is $a_{LS}/a_{LS}^* = 2/3$. It takes 2/3 of a worker at home to produce as much service output as 1 foreign worker. In manufacturing, it takes 3/4 of a home worker to match 1 foreign worker, and in agriculture it takes 2.

The home economy has a comparative advantage in services since home labor is relatively efficient in that activity. The foreign country has a comparative advantage in agriculture. Manufactures are between services and agriculture, and could be exported by either country.

Figure 5.6 illustrates the home PPF with labor endowment of 120. In autarky, domestic consumers determine production and consumption at point *A*. Note 22 units of S and 10 units of *A* are produced, requiring $2 \times 22 = 44$ workers in and $4 \times 10 = 40$ workers in *A*. This leaves $120 - 84 = 36$ workers for *M* to produce $36/3 = 12$ units.

With specialization the home country drops agriculture and moves to point P. Suppose manufactures are not traded and output remains at 12. Service output rises to $84/2 = 42$ with the added 40 workers from agriculture. If the terms of trade are 1 unit of *A* for each exported unit of *S*, the economy could trade 15 units of *S* and consume $(M,S,A) = (12,27,15)$.

With many products, each country exports near the end of its labor productivity ranking.

Table 5.1 Unit Labor Inputs with Three Products

	a_{LS}	a_{LM}	a_{LA}
Home	2	3	4
Foreign	3	4	2

S = services; *M* = manufactures; *A* = agriculture.

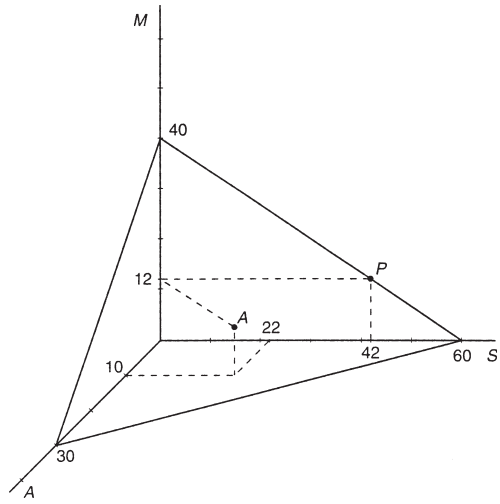

Figure 5.6
The PPF with Three Goods
Labor inputs are in Table 5.1 and L = 120. With three goods, the production frontier is a triangle. Autarky production and consumption occur at point A where (M,S,A) = (12,22,10). With complete specialization the economy moves to point P where (M,S,A) = (12,42,0). Trading services for agriculture moves consumption beyond the PPF.

EXAMPLE 5.13 *US Services Trade*

Major categories of US trade in services are below. Travel is a largest single category. The US spends more than the rest of the world on freight. Royalties are important in WTO negotiations. Affiliated services are transactions between MNF branch firms. Education of foreign students in US universities is growing as are financial services exports.

	Exports	Imports
Travel	29%	34%
Passenger fares	8%	12%
Freight	4%	12%
Royalties	15%	7%
Affiliated services	11%	12%
Education	4%	1%
Financial services	6%	2%
Insurance	1%	4%
Telecommunications	2%	5%
Construction, engineering	2%	1%

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Trade with Many Countries

The constant cost trade model can be applied to many countries. The opportunity cost of a good can be found from labor inputs. Countries with a low opportunity cost export that product.

To illustrate, suppose there are three countries with the labor inputs for M and S in Table 5.2. The relative price of services is $2/3M$ in country 1, $3/4M$ in country 2, and $4/3M$ in country 3.

Country 1 has the lowest opportunity cost and will export services. Country 3 has the lowest opportunity cost and will export M. Country 2 has an intermediate position and the terms of trade will determine trade in country 2. If $tt > 3/4$ country 2 will export services. The limits to the terms of trade come from the extreme countries,

$$4/3 > tt > 2/3.$$

With many goods and many countries, unit labor input rankings can indicate which goods are exported. Table 5.3 illustrates three goods and three countries. The labor input ranking between countries 1 and 2 in each of the goods is

$$(4/2)_A > (3/4)_M > (2/3)_S$$

Country 1 will export S to country 2 in exchange for A. Between countries 2 and 3,

$$(4/2)_M > (3/4)_S > (2/3)_A$$

Country 2 will export A to country 3 in exchange for M. Finally, comparing inputs between countries 1 and 3,

$$(3/2)_M > (4/3)_A > (2/4)_S$$

Table 5.2 Unit Labor Inputs with Three Countries

	a_{LS}	a_{LM}
Country 1	2	3
Country 2	3	4
Country 3	4	3

Table 5.3 Unit Labor Inputs, 3 Countries and 3 Goods

	a_{LS}	a_{LM}	a_{LA}
Country 1	2	3	4
Country 2	3	4	2
Country 3	4	2	3

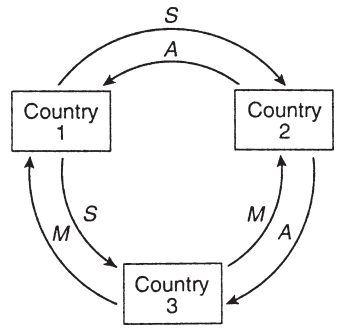

Figure 5.7
Trade with Three Countries and Three Goods
Country 1 has a comparative advantage in *S* relative to the other countries, country 2 in *A,* and country 3 in *M*.

Country 1 will export *S* to country 3 in exchange for M. Country 1 specializes in *S,* country 2 specializes in *A*, and country 3 specializes in *M as* illustrated in Figure 5.7.

There will always be products in which every country has comparative advantage.

EXAMPLE 5.14 *Labor Productivity and R&D*

Research and development R&D can lower unit labor inputs and raise wage. Countries that spend more on R&D enjoy increased labor productivity and higher wages. Almost all R&D takes place in the DCs. Japan's share of world R&D spending has increased while the EU share has remained about constant and the US share has decreased during recent decades.

Section C Problems

C1. Suppose labor inputs are $a_{LM}^* = 5$, $a_{LA}^* = 3$, $a_{LM} = 2$, and $a_{LA} = 3$. Find the international specialization. Find the relative wage w/ew^* if the terms of trade are 1.
C2. Find the limits to the exchange rate with the labor inputs in the previous problem when $w = \$10$ and $w^* = 1000$ pesos.
C3. If $w = \$16$, $e = \$/£ = 1.2$ and $w^* = £10$ find dollar prices of the three goods using the labor inputs in Table 5.1. Predict the pattern of trade.
C4. Diagram PPF* with the labor inputs in Table 5.1 and $L^* = 228$.

EXAMPLE 5.15 *International Wage Differences*

Assembly line wages vary across countries. Firms considering where to locate production also consider transport costs, local taxes, local work habits,

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and infrastructure but wage differences can be overwhelming. The three highest and three lowest wage countries during 2000 are listed below.

Norway	$18.90
Switzerland	$18.10
Germany	$18.00
Hungary	$1.20
India	$0.40
Turkey	$0.40

D. APPLIED CONSTANT COST TRADE THEORY

This section reviews applications and tests of the constant cost model of production and trade.

Improved Technology and Labor Growth

Improved technology is illustrated by decreasing unit labor inputs. When a_{LS} decreases from 2 to 1.5, the PPF in Figure 5.1 expands to PPF′ in Figure 5.8,

$$L = 120 = 1.5S + 3M$$

Total potential output in services is 120/1.5 = 80. More of both goods can be produced with the improved technology in one sector. The domestic relative price of services falls to |–40/80| = ½.

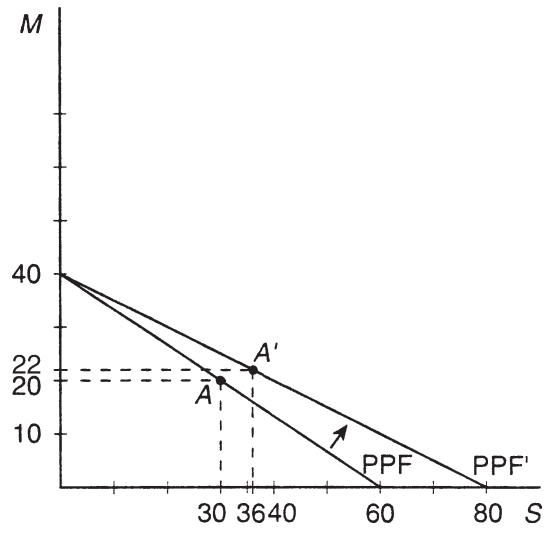

Figure 5.8
Improved Technology in Service Production
If a_{LS} falls from 2 to 1.5 the maximum point along the S axis shifts to 120/1.5 = 80. The economy is able to produce higher combinations of both goods. Production could jump from point A where $(M,S) = (20,30)$ to point A′ where $(M,S) = (22,36)$.

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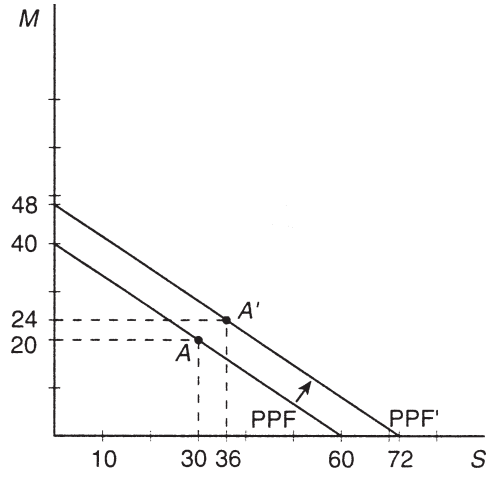

Figure 5.9
Labor Growth
If the labor force grows from $L = 120$ to 144, the economy expands to a higher production frontier. The economy's output could rise from point A where $(M,S) = (20,30)$ to point A′ where $(M,S) = (24,36)$.

Improved technology in one sector expands the PPF in that direction, lowers the relative price of that good, and raises production potential.

Labor growth is pictured by a parallel outward shift of the PPF. In Figure 5.9, the labor force expands from 120 to 144. Input requirements are the original $a_{LS} = 2$ and $a_{LM} = 3$. The equation for PPF′ is

$$L = 144 = 2S + 3M$$

Total 144/2 = 72 units of S or 144/3 = 48 units of M can could be produced. The relative price of S in terms of M remains 2/3. With growth, the economy can produce more of both goods.

Labor growth creates is an outward parallel shift of the PPF.

EXAMPLE 5.16 *Industrial Labor Inputs*

Matthew Shapiro (1987) reports changes in unit labor inputs in US industries between 1974 and 1985. When unit labor inputs decline, the production frontier expands in the direction of those outputs. Where they rise as in mining and construction, the production frontier shrinks.

	$\%\Delta a_{LQ}$
Communications	−2.3%
Agriculture	−1.4%
Manufacturing	−1.4%
Construction	1.1%
Mining	4.3%

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Table 5.4 Unit Labor Inputs in High Tech Products

	1963	1984
EU	1.25	1.46
US	1.00	1.06
Japan	1.76	0.92

Testing Constant Cost Trade Theory

G.D.A. MacDougall (1951) compared exports from the US and the UK in 1937. Higher labor productivity in an industry implied higher export market share, the prediction of constant cost theory. Other studies confirm the MacDougall test for many countries and products.

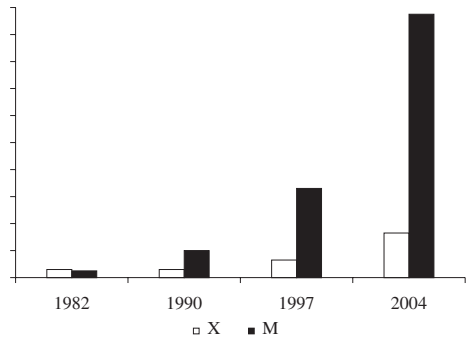
Hebert Glesjer, K. Goosens, and Eede Vanden (1982) compare countries in Europe before and after they joined the EU. Countries with lower opportunity costs of goods exported those goods to other member countries.

High tech products have high inputs of R&D. High tech manufactures include electronics, chemicals, aircrafts, computers, and specialized machinery. The unit labor inputs in high tech goods in Table 5.4 explain Japan's export growth. The EU declined in productivity as the US held its position. Japan's improved technology was due to its human capital (education) and physical capital. The Japanese PPF expanded along its high tech product axis.

The 1970s was a decade of decline for the US auto industry. Imports of Japanese cars rose from less than half a million in 1970 to almost 2.5 million by 1980. Japanese autos went from less than 5% to more than 20% of the US market. Labor productivity in Japan increased tremendously. The unit labor input was 1 in the US in 1970 when the Japanese unit input was 1.5. Over the 1970s the US unit labor input rose to 1.15 while the Japanese fell to 0.75. The Japanese automobile industry invested heavily, the stock of capital rising 225%.

EXAMPLE 5.17 *China/US Trade*

Trade between China and the US has increased dramatically. Major US export categories are aircraft, fertilizer, telecommunications equipment, and cotton. US exports are based on high tech production and agriculture. Import categories were toys & sporting goods, apparel, footwear, and other manufactured goods. US imports are labor intensive manufactured goods.



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Section D Problems

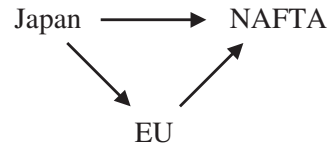
D1. High tech manufactures require skilled labor. Why might the US be able to produce relatively cheap high tech goods?
D2. Investment spending in the US automobile industry lagged far behind its competitors in the 1970s. How does this account for the high cost of producing autos in the US during the 1980s?
D3. Suppose $a_{LS} = 4$, $a_{LM} = 5$, and $L = 220$ but technology changes in manufacturing from $a_{LM} = 5$ to $a_{LM} = 4.4$. Draw the revised PPF. Explain whether technology improved.
D4. Suppose the economy in Problem D3 grows to labor force $L = 260$. Draw the new PPF.

CONCLUSION

The constant cost theory of international trade makes production simple. While the theory is useful, questions arise. Why does one country have lower labor inputs? What causes labor inputs to change? Do other inputs alter fundamental predictions? Theories in the next two chapters answer these questions with increasing costs of production, various inputs, and different industrial structures.

EXAMPLE 5.18 *3-Way Trade*

Japan has trade surpluses with NAFTA and the EU while NAFTA has deficits with the other two. The EU has a deficit with NAFTA but a surplus with Japan. This diagram summarizes the net trade flows. Japan exports manufactures, NAFTA foodstuffs and raw materials. Japan and the EU ship more manufactures to NAFTA than to each other.



Terms

Absolute advantage
Comparative advantage
Complete specialization
Constant costs
Unit labor inputs
Limits to the exchange rate
Limits to the terms of trade
Mercantilism
Opportunity cost
Relative prices

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MAIN POINTS

- A constant cost PPF with constant factor inputs has a slope equal to the relative product price.
- Trade with constant costs involves complete specialization according to comparative advantage.
- The gains from trade are higher utility or the increased value of consumption.
- Constant cost trade theory uncovers the fundamental international links between wages, productivity, and exchange rates.
- Unit labor inputs and comparative advantage contribute to explaining and predicting trade patterns.

REVIEW PROBLEMS

1. In Figures 5.2, which country has a lower opportunity cost of manufactures?

2. Suppose Delta is characterized by $a_{LM} = 4$ and $a_{LS} = 5$. Compare Delta with the home country in Figure 5.1 and predict the pattern of trade. Make a similar prediction for Delta and the foreign economy in Figure 5.2.

3. The workforce of the US totals about 150 million, while the workforce of Japan is 60 million. Find the amounts of high tech goods these economies could produce over the years in Table 5.4 if a quarter of each labor force worked in high tech products.

4. Suppose the H country is characterized by $a_{LM} = 4$, $a_{LS} = 5$, and $L = 260$, and F by $a_{LM}^* = 6$, $a_{LS}^* = 5$, and $L^* = 300$. Find comparative advantage. Suppose each country exports half its production to the other. Find the terms of trade. Diagram both trade triangles.

5. Evaluate the gains from trade for both countries in the previous problem in terms of S. Evaluate the gains from trade for both countries in percentage terms. Explain which country enjoys the largest gains from trade.

6. Find the percentage gains from trade in this same example if the terms of trade are $M/S = 1$ and 30 units of S are exported by F. Explain the difference in the gains from trade compared to the previous problem.

7. If the terms of trade are $tt = M/S = 1.4$ between the home and foreign countries in Figure 5.2, find the relative wages w/ew^* implied by free trade. Find the relative wage if $tt = 0.7$ and explain the effect of trade on the relative wage.

8. Using the information in the previous problem with each terms of trade, find w if $w^* = 1100$ ¥ and $e = \$/¥ = 0.008$. Compare and explain the limits to the exchange rate under the two terms of trade.

9. In the home country, unit labor inputs are $a_{LM} = 2$ for manufactures and $a_{LA} = 3$ for agriculture. In the foreign country, unit labor inputs are $a_{LM}^* = 4$ and $a_{LA}^* = 5$. The terms of trade are $tt = A/M = 3/4$. Find relative wages implied by trade.

10. Find the limits to the exchange rate for the two countries in the previous problem.

11. Find the home wage w if the foreign wage $w^* = 10{,}000$ pesos and $e = 0.001$ in the previous problem. Show what happens to w if
(a) tt worsens for the home country falling to 7/10
(b) The home labor input a_{LM} subsequently improves to 1.5.

12. Suppose unit labor inputs for three goods are

	Good 1	Good 2	Good 3
Home	3	5	3
Foreign	2	1	3

Predict the pattern of trade.

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13. If the foreign wage is 2250 ¥ and the exchange rate $e = 0.008$ in the previous problem, find the home wage w that makes the price of the middle good the same in both economies. Using this wage, find the prices of the two traded goods in each country. Explain the direction of trade.

14. Find the limits to the exchange rate in the previous problem.

15. Consumer goods such as appliances and apparel require low levels of investment and high levels of unskilled labor. Why does the US have little cost advantage in consumer goods?

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