MACROECONOMICS

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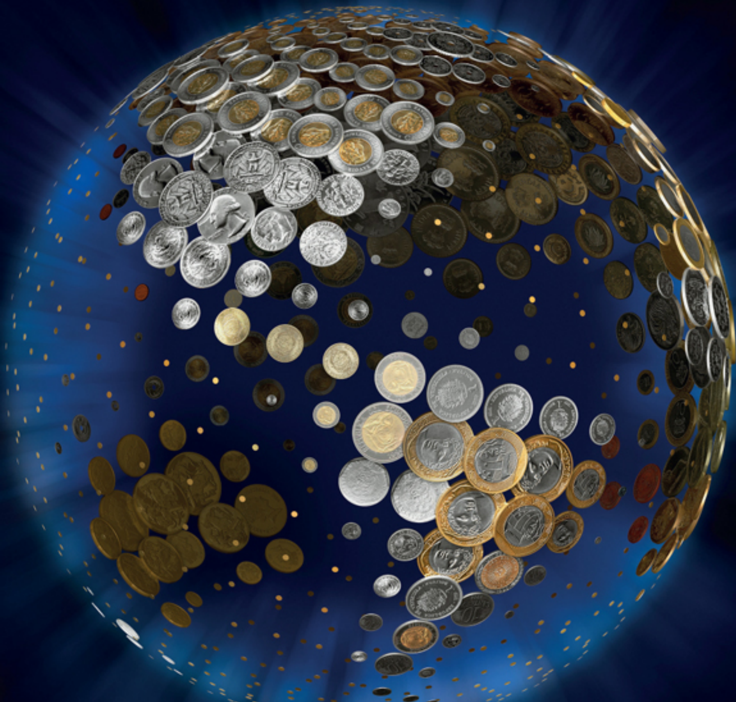
Fifth Edition



ALWAYS LEARNING

PEARSON

Macroeconomics

relative to the US money supply, the Deutschmark depreciates by about 1%. The next coefficient states that if German income grows 1% over US income, the Deutschmark appreciates by 0.72%. The last coefficient measures the influence of the difference in inflation expectations. This difference is used as a proxy for expected depreciation: if the real exchange rate is to remain constant, then depreciation must reflect the inflation differential: $\varepsilon = \pi - \pi^*$. Then expected depreciation should equal the difference in expected inflation rates. The positive coefficient of 28.65 states that the more depreciation the market expects, the more the exchange rate depreciates today. The equation explains 80% of the variance of this exchange rate during the sample period.

Note: Frankel's equation also includes the difference in interest rates. Its coefficient is not significant and is not shown here.

WORKED PROBLEM

In and out of the United States

Net exports as a building block of the Mundell–Fleming model have been specified in equation (4.2) (Chapter 4) as (after rearranging)

$$NX = (x_2 + m_2)R + x_1 Y^{\text{World}} - m_1 Y \tag{5.14}$$

This type of equation should explain all net exports, the current account, or certain categories of net exports. Table 5.3 gives data for US net travel and transportation receipts (TRAVEL), the effective exchange rate of the currencies of major trading partners versus the dollar (R), US GDP (Y^{USA}) and OECD GDP (Y^{OECD}). Attempting to estimate equation (5.4) from these data gives

$$\begin{aligned} \text{TRAVEL} = {} & -6{,}102.1 - 273.80R + 12.35Y^{USA} \\ & \quad (0.36) \qquad (2.68) \qquad (0.79) \\ & -205.71Y^{OECD} \\ & \quad (0.24) \end{aligned}$$

$R^2_{adj} = 0.56$; 22 annual observations 1973–94

The equation does not perform quite as expected. While the real exchange rate index has the expected negative sign (since this index is the reciprocal of the dollar exchange rate versus other currencies), and with a t-value of 2.68 is also significant, income levels in the United States and in the OECD countries do not seem to exert the expected influence on net travel receipts. And even if the coefficients were significant, they would have the wrong sign. What may have caused this is that net travel expenditures cannot adjust immediately to changes in income levels or the real exchange rate. One way to check this is to assume that the above equation only models desired net exports NX^*. Actual net exports NX only adjust by a fraction of the change in desired travel expenditures each period:

$$NX - NX_{-1} = \alpha(NX^* - NX_{-1}) \tag{5.15}$$

Substituting equation (5.14) for NX^* into equation (5.15) and solving for NX gives

$$\begin{aligned} NX = {} & (1 - \alpha)NX_{-1} + \alpha(x_2 + m_2)R \\ & + \alpha x_1 Y^{\text{World}} - \alpha m_1 Y \end{aligned} \tag{5.16}$$

So if adjustment is slow, net exports not only depend on the current real exchange rate and domestic and foreign incomes, but also on last year's net exports. Estimating this equation with our travel data yields

$$\begin{aligned} \text{TRAVEL} = {} & -3053.1 + 0.88\ \text{TRAVEL}_{-1} - 117.36R \\ & \quad (0.57) \quad (12.71) \qquad\qquad (3.38) \\ & -12.11Y^{USA} + 782.32Y^{OECD} \\ & \quad (2.27) \qquad\quad (2.79) \end{aligned}$$

$R^2_{adj} = 0.96$; 22 annual observations 1973–94

Table 5.3

	TRAVEL in \$m	R (March 1973 = 100)	Y^{USA} in 1987 \$	Y^{OECD}*
1973	−3,158	98.9	3,268.6	69.4
1974	−3,184	99.4	3,248.1	69.1
1975	−2,812	94.0	3,221.7	63.6
1976	−2,558	97.6	3,380.8	68.8
1977	−3,565	93.4	3,533.3	72.0
1978	−3,573	84.4	3,703.5	74.9
1979	−2,935	83.2	3,796.8	78.5
1980	−997	84.9	3,776.3	78.9
1981	144	101.0	3,843.1	79.3
1982	−992	111.8	3,760.3	77.3
1983	−4,227	117.4	3,906.6	78.8
1984	−8,438	128.9	4,148.5	83.8
1985	−9,798	132.5	4,279.8	86.3
1986	−7,382	103.7	4,404.5	87.2
1987	−6,481	90.9	4,539.9	90.3
1988	−1,511	88.2	4,718.6	95.3
1989	5,071	94.4	4,838.0	98.4
1990	8,978	86.0	4,897.3	100.0
1991	17,957	86.5	4,867.6	99.7
1992	20,885	83.5	4,979.3	99.4
1993	20,840	90.0	5,134.5	99.1
1994	18,000	88.6	5,342.3	103.6

*Index of industrial production (1990 = 100)

All coefficients are now as expected and, except for the constant term, significantly different from zero. Since the estimate for the autoregressive coefficient (in front of TRAVEL_{-1}) is $1 - a = 0.88$, we have $a = 0.12$. This means that, within a year, travel expenditures only adjust by a fraction of 0.12 to a change in desired travel expenditures, which makes for a very slow adjustment.

YOUR TURN

Business cycle links under different exchange rate regimes

A very important result from this chapter is that domestic income is affected by income developments abroad depending on whether exchange rates are flexible or fixed. Under flexible exchange rates there is no link between domestic and foreign income. If the rest of the world falls into a recession, the exchange rate works as a buffer, making sure domestic exports and income are not affected. Under fixed exchange rates no such buffer exists and domestic income will be dragged down by falling world income.

The income data for Austria (A), Germany (D) and Norway (N) given in Table 5.4 provide an opportunity to explore this implication of the Mundell–Fleming model. For both Austria and Norway, Germany is an important trading partner. The difference between the two countries relevant for our purposes is that Austria had a more or less fixed exchange rate versus the German mark before both countries adopted the euro, while Norway's exchange rate was flexible. Hence, there should be a significant influence from German income on Austrian income, but not on Norwegian income. To test this, you may want to run a linear regression of the form $Y^A = c_0 + c_1 Y^D$ for Austria–Germany and a similar one for Norway–Germany.

As we noted in the your-turn section at the end of Chapter 2, regressing two heavily trended variables on each other may give a statistically significant result even though the two have nothing to do with each other. This problem can be alleviated by taking first differences or growth rates of the variables involved. So you may want to run a regression of the form $\Delta Y^A / Y^A = c_0 + c_1 \Delta Y^D / Y^D$ and see whether the effect is there still for Austria but not for Norway.

Table 5.4

Year	Y^A	Y^D	Y^N
1975	54.3	52.6	44.6
1976	56.8	55.1	47.6
1977	59.4	56.8	49.4
1978	59.4	58.5	51.7
1979	62.3	61.0	53.9
1980	64.1	61.7	56.6
1981	64.0	61.8	57.2
1982	65.2	61.1	57.3
1983	67.1	62.1	59.3
1984	67.3	63.9	62.8
1985	68.8	65.3	66.0
1986	70.4	66.9	68.4
1987	71.6	67.8	69.8
1988	73.9	70.2	69.7
1989	77.0	72.8	70.4
1990	80.5	77.0	71.8
1991	83.3	85.3	74.4
1992	84.4	89.1	76.4
1993	84.8	88.1	78.5
1994	86.8	90.2	82.8
1995	88.3	91.8	86.0
1996	90.1	92.5	90.7
1997	91.3	93.8	93.8
1998	94.2	95.8	95.7
1999	96.9	97.0	96.6
2000	100.0	100.0	100.0

CHAPTER 6

Enter aggregate supply

What to expect

After working through this chapter, you will understand:

1. In more detail the meaning of **potential income** or output.
2. How wages and employment are determined in the **labour market**.
3. How regulations, trade unions, and other labour market characteristics, or demographic features, may give rise to **involuntary unemployment** which persists in the long run.
4. Why **aggregate output** produced by firms may temporarily exceed or fall short of the level of potential output produced in equilibrium (or the long run).
5. How **unemployment** may be decomposed into a temporary and a persistent component by means of the **Beveridge curve**.

Aggregate supply (or **aggregate output**) is the sum of goods and services currently produced.

The **aggregate supply curve** shows the total quantity of goods and services supplied by all firms in the economy at different price levels.

The **extreme Keynesian aggregate supply curve** is horizontal, stating that, at the current price, firms are ready to produce any output that is demanded. A refined Keynesian aggregate supply curve will be introduced later.

The **classical aggregate supply curve** is vertical, stating that firms produce only one output Y^*, no matter how high prices are.

By now we have a good understanding of aggregate demand: that is, of what happens on the economy's demand side. This contrasts with our understanding of **aggregate supply**, the treatment of which so far has been, well, rather simplistic. The only time we have explicitly touched upon the issue of firms' level of output was when we discussed money in the circular flow model in Chapter 1. There we considered two extreme cases of the **aggregate supply (AS) curve**, the line that indicates how much output firms produce at different price levels. For easy reference, Figure 6.1 replicates these two versions. The **horizontal aggregate supply curve** shown in panel (a) is the one we employed in Chapters 2–5 in the context of the Keynesian cross, the *IS-LM* model and the Mundell–Fleming model. It is usually referred to as the **extreme Keynesian aggregate supply curve**. It assumes there is slack and the presence of one or more production factors in abundance. Then how much firms produce depends only on demand. At the given price level, firms supply any level of output that is demanded. But then the price level never changes! How does this correspond with the real world where continuous price changes in the form of inflation are the rule rather than an exception? Quite obviously, a horizontal aggregate supply curve cannot be the whole story.

Panel (b) in Figure 6.1 shows a **vertical aggregate supply curve**. Firms supply potential output Y^* no matter what the price level is. This curve is generally referred to as the **classical aggregate supply curve**, for reasons that will become evident in a moment. The drawback here is that, unless we assume that the *AS* curve shifts backwards and forwards all the time, only prices change, but never income. This is clearly at odds with real-world observations

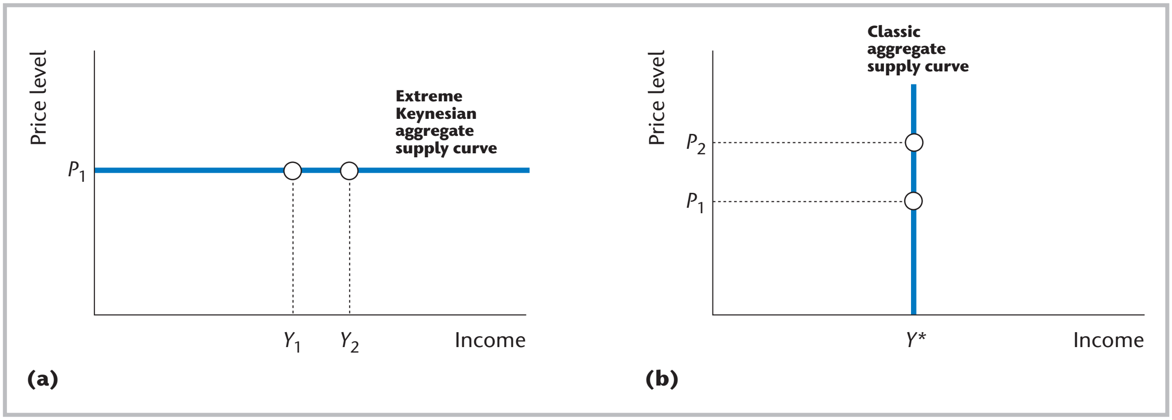


Figure 6.1 The panels repeat two extreme views of an aggregate supply curve employed so far. In panel (a), firms supply any volume of goods which the market demands at the given price level. In panel (b), firms supply one specific volume of output only, no matter what the price level is.

of business cycles, evidence of which was presented in Chapter 2. Again, a vertical aggregate supply curve cannot be the whole story either.

It is time to take a closer look at the economy's supply side. This chapter will do so by addressing three questions:

1 What exactly is potential output? How is this mysterious variable Y^* really determined?
2 How is it possible that in macroeconomic equilibrium, when income and output are at the potential level Y^*, involuntary unemployment exists and persists?
3 What can induce firms to supply output levels that deviate from potential output?

6.1 Potential income and the labour market

Potential output or equilibrium output is what an economy produces if it leaves no available factors of production idle. What are these factors? It is easy to draw up a long list of what contributes to the production potential of a country: the number of factories, the number of workers, their qualifications, the area and quality of land, the climate, natural resources, property rights, the political and legal system, and so on. These factors can be grouped into two main categories: capital K and labour L. So output Y at any point in time is a function F of these two factors:

$$Y = F(K, L) \qquad \textbf{Production function} \qquad (6.1)$$

Maths note. Formally, we assume for first and second derivatives $F_K, F_L > 0$ and $F_{KK}, F_{LL} < 0$.

The **production function** is the key to the economy's supply side. Figure 6.2 illustrates a production function and highlights two assumptions which economists usually make about its shape:

- Output increases as either factor increases.
- If one factor remains fixed, increases of the other factor yield smaller and smaller output gains.

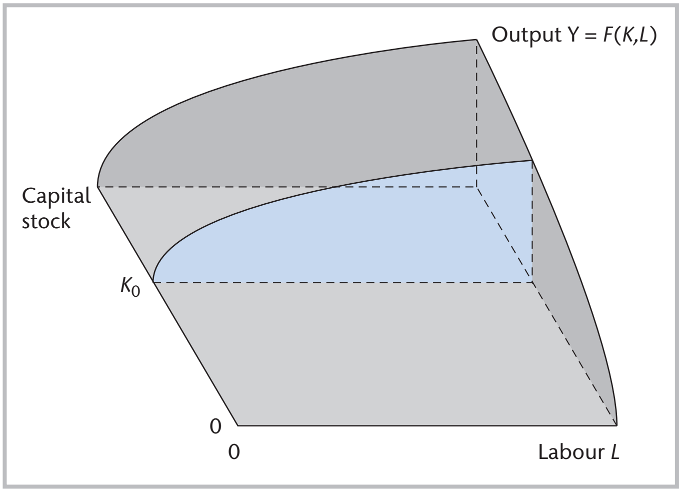


Figure 6.2 The full-scale **3D production function** shows how, for a given production technology, output rises as greater and greater quantities of capital and/or labour are being employed.

This second assumption refers to partial production functions, obtained by placing a vertical cut through the production function parallel to the axis measuring the factor that varies. Figure 6.3 shows such a partial production function, obtained in this case by fixing the capital stock at K_0.

Note. Strictly, the marginal product of labour is output gained by an infinitesimally small increase in labour. Our text and graph magnifies this by looking at a one-unit increase in labour.

The **partial production function** is drawn for given technology and stock of capital. The function itself tells us how much output is produced with a given labour input. For example, according to the partial production function drawn for a capital stock of K_0 in Figure 6.3, L_1 units of labour produce Y_1 units of output. The slope of the production function indicates (as an approximation) by how much output increases if we add one unit of labour. The output gain accomplished relative to a small increase in L – which is called the **marginal product of labour** – is measured by the slope of the production function. As the given capital stock is being combined with more and more labour,

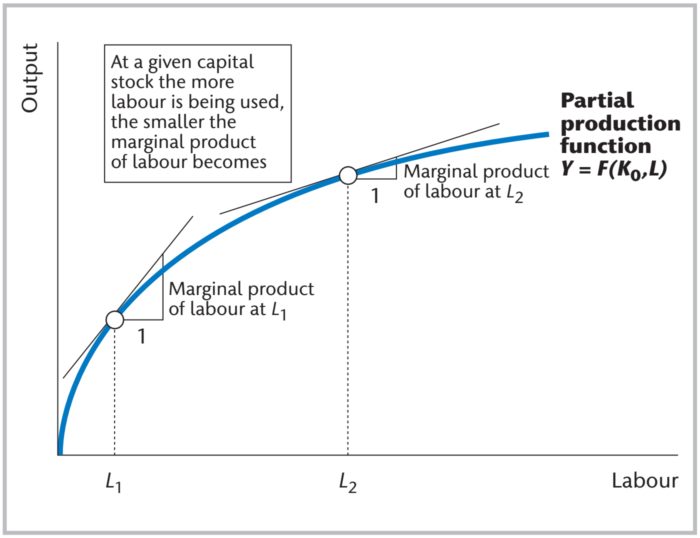


Figure 6.3 This partial production function shows how output increases as more labour is employed, while the capital stock remains fixed at K_0. The slope of $F(K_0, L)$ measures how much output is gained by a small increase of labour. The two tangent lines measure this marginal product of labour at L_1 and L_2 and indicate that it decreases as L rises.

each additional unit of labour has to make do with less and less capital. Therefore, one-unit increases of L yield smaller and smaller output increases. The two tangent lines measure this diminishing marginal product of labour. By similar reasoning, the marginal product of capital is also decreasing. It can be dealt with in the same kind of diagram, and we shall do this when discussing economic growth in Chapter 9.

So, knowing what income levels firms will generate with a particular amount of labour, **how much labour are firms going to employ?** As we shall see straightaway, this is just as much a matter of how much labour firms *want to employ* as it is of how much labour workers *want to offer*. The market where the supply of and the demand for labour interact is known as the labour market.

The classical labour market

In the classical view the **labour market** is seen as being just like any other market. The good being traded on this particular market is labour (measured in work-hours). It is supplied by (potential) workers, and demanded by firms. The price for one unit of this good, the hourly wage, adjusts so as to balance supply and demand.

Labour demand

Let us look at the demand for labour first. Firms demand another unit of labour whenever they think it will raise more revenue than it costs. We know that how much (real) revenue another unit of labour produces (or how much more output it produces) can be directly read off the partial production function. This point is repeated in the top panel of Figure 6.4.

If we measure the slope of the partial production function at all labour input levels and transfer all these marginal products onto a separate graph in the centre panel, the result is the downward-sloping **marginal product of labour schedule**. The nice thing about this schedule is that at the same time it is a **labour-demand curve**.

The **marginal product of labour schedule** indicates the additional output produced by one more unit of labour that obtains at various levels of employment.

The (aggregate) **labour-demand curve** shows the (aggregate) quantity of labour that firms demand at different real wage rates.

To see this, let the real wage, $w \equiv (W/P)$, which can be measured along the ordinate in units of real output, be w_1. Then as long as employment falls short of L_1 the marginal product of labour always exceeds w_1, the marginal cost of labour, and it raises profits to increase employment. At employment levels above L_1 the marginal cost of labour exceeds its marginal product. Hence, given w_1, firms maximize profits by demanding exactly L_1 units of labour. This result is re-emphasized in the bottom panel of Figure 6.4 by showcasing the relationship between firms' (real) profits and the level of employment explicitly, as given by the equation

$$\begin{aligned} \Pi &= Y(K_0, L) - w \times L \\ \text{Profits} &= \text{Output} - \text{Wage costs} \end{aligned} \qquad (6.2)$$

Equation (6.2) defines profits as the difference between output (which equals the firm's revenue) and wage costs. Note that the **profit curve** shown is drawn for a given wage rate w_1. Hence, employment L_1 maximizes profits only for this wage rate. However, the exercise may be repeated for other real wage rates, with different results for profit-maximizing employment, of course. It turns out that the marginal product of labour curve indicates profit-maximizing