## Chapter 5: Unemployment and the AD-AS model

### Aims of the chapter

This chapter explores the short and long run determinants of unemployment, output and the price level. We begin exploring the characteristics of the labour market and the different components of unemployment in order to identify appropriate macroeconomic policies to reduce them. Next, we exploit the labour market to derive the Aggregate Supply relation. This is combined with the Aggregate Demand relation obtained from the IS-LM framework to form a completely new model, the AD-AS model, which is used to study how unemployment, output, prices, and the interest rate behave in the short and in the long run. The AD-AS model is then used to explain short-run fluctuations, and to assess to what extent macroeconomic policy can be employed to stabilise the economy over the business cycle.

### Learning objectives

On completing this Chapter and having completed the essential reading and activities, you should be able to:

- explain the mechanism underlying the determination of the equilibrium real wage and unemployment rate in the labour market.
- identify the main types and causes of unemployment, and the appropriate macroeconomic policies to reduce them.
- derive aggregate supply under imperfect competition in the labour and product market, and discuss the alternative interpretation of the slope AS curve.
- compute the aggregate demand from the IS-LM model, and clarify the determinants of its slope and position.
- employ the AD-AS model in order to assess the determinants of output, price level, and interest rate over the business cycle.
- study how monetary and fiscal policy can be used as stabilisation tools in response to demand and supply shocks.

## The labour market: main definitions

The labour market includes three categories of individuals: employed, unemployed, and inactive. The term **employed** refers to a person who is currently working. **Unemployed** refers a person who is not working and is seeking a job. **Inactive** denotes a person able to work but not seeking a job. The **labour force,** $L$, is the sum of employed, $N$, and unemployed, $U$, people, and it is defined analytically as:

$$L = N + U.$$

The sum of the labour force and the inactive, $I$, defines the population of working age $PW$:

$$PW = L + I = N + U + I.$$

The **unemployment rate** $u$ is the ratio between unemployed and the labour force:

$$u = \frac{U}{L}, \tag{5.1}$$

whereas the employment rate $e$ is defined as the ratio between employed and the population of working age:

$$e = \frac{N}{PW}. \tag{5.2}$$

Equations (5.1) and (5.2) show that there is not a one-for-one relationship between changes in the rates of unemployment and employment, as these two variables are connected by the so called **participation rate**, $PR$, defined as the ratio between the labour force and the total population of working age:

$$PR = \frac{L}{PW}. \tag{5.3}$$

These definitions imply that:

$$u = 1 - \frac{e}{PR},^{[20]}$$

which shows that an increase in employment reduces the unemployment rate to the extent that it is not offset by a fall in the participation rate. The empirical evidence shows that the participation rate is not constant over time, but it tends to increase during expansions and to fall during recessions. The latter occurs because when the unemployment rate is high, some unemployed people give up their job search and cannot be counted as unemployed any more.

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[20] This result is obtained by manipulating the unemployment rate as follows:

$$u = \frac{U}{L} = \frac{L-N}{L} = 1 - \frac{N}{L} = 1 - \frac{N}{PW}\frac{PW}{L} = 1 - e\frac{1}{PR}.$$

These people are known as **discouraged workers**, i.e. people who do not look for work, but who would take work if it was offered to them.

Because workers change their status over time, the labour market can be characterised in terms of worker flows between the three states of employed, unemployed, and inactive. A specific unemployment rate can be the outcome of a very active labour market with a high number of **separations** and **hires**, or of a stagnant (sclerotic) labour market with relatively few separations and hires. The labour market mobility is measured by the proportion of unemployed leaving unemployment in a specific period of time. The inverse of this measure defines the **average duration of unemployment**, i.e. the average length of time people spend in unemployment.

The empirical evidence suggests five basic stylised facts about unemployment. First, the unemployment rate varies across countries and over time. In the United States the unemployment rate rose until the mid 1980s, and fell afterwards. In Europe the unemployment rate was relatively low during the 1950s and the 1960s, but it increased over the 1970s and the 1980s, and has been above the United States rate over the last 20 years. Second, unemployment is negatively correlated with the business cycle: it sharply increases during recessions and it falls during expansions. Third, the duration in unemployment also varies across countries and over time, and it is correlated with the business cycle. In particular, unemployment duration rapidly increases during recessions, whereas it reduces during economic expansions. Fourth, the proportion of unemployed workers finding jobs is low during downturns when unemployment is high. Finally, the proportion of employed workers losing their jobs is high during expansions when the unemployment rate is high.

**Activity 1**

Consider country A, in which there are 10 million unemployed people. Over a month 1 million unemployed people find a job and 4 million become inactive. Country B has 10 million unemployed people and over the same period of time, 4 million unemployed people find a job and none becomes inactive. Compute the size of total flows out of unemployment (as a percentage of unemployment) and the average duration of unemployment in both countries.
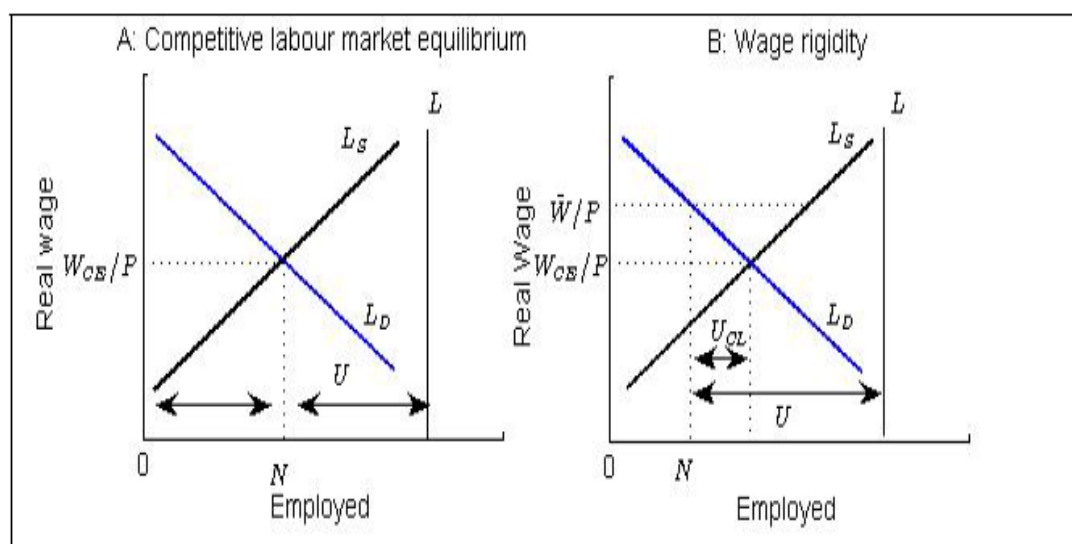
## Labour market and classical unemployment

In a competitive labour market the equilibrium real wage is determined by the equality between workers labour supply and firms labour demand. Panel A in Figure 5.1 describes the labour market in the employment-real wage space. The labour force is fixed and indicated by the vertical line $L$. Labour supply, $L_S$, is positively sloped because workers are ready to substitute leisure for labour as the real wage increases (substitution effect).[21] Labour demand, $L_D$, is negatively sloped because firms demand labour until the marginal product of labour equals the real wage. An increase in the employment level reduces the marginal product of labour, in turn reducing real wage and increasing demand for labour.

The competitive real wage, $W_{CE}/P$, determines the level of employment $N$, and, in turn, the level of unemployment $U = L - N$. In a competitive labour market, the real wage always adjusts to clear any excess of labour supply and/or demand. Wage rigidities are defined as the

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[21] Labour supply is positively sloped also because it is assumed absence of income effect, i.e. the tendency of high-income workers to reduce labour supply when their wage increases.

failure of the real wage to adjust to clear the labour market. More precisely, Panel B in Figure 5.1 shows that a **wage rigidity** forces the real wage above the competitive level, thus resulting in a level of unemployment higher than the competitive one. The unemployment caused by wage rigidities is called **classical or real wage unemployment**, and it is denoted in the figure with the symbol $U_{CL}$.

**Figure 5.1 Labour market and classical unemployment**



There are four main theories of wage rigidities and classical unemployment: minimum-wage, collective bargaining, insiders-outsiders, and efficiency wages.

**Minimum-wage** legislations set a legal minimum compensation that firms must pay to their employees. Minimum wage laws result in a real wage higher than the market clearing wage for those workers with low marginal productivity and equilibrium wage, such as low skilled and young workers, who tend to receive part of their compensation as job training and apprenticeships. There is an ongoing debate on whether or not minimum wage laws are beneficial for the labour market and the economy as a whole. Supporters argue that minimum wages increase the average living standards, create incentive to work, do not increase public spending, and stimulate consumption by increasing the purchasing power of low-income people who tend to spend their entire wage. Opponents of minimum wages believe that they ultimately increase unemployment among young or unskilled workers, and should be replaced by income tax credits. Low income households can deduct the tax credit from their tax payments and if the credit exceeds the tax bill, they can also receive a money refund. The tax credit does not raise firms cost and therefore does not distort the labour market equilibrium. However, it has the disadvantage of increasing government spending, especially during economic slowdowns.

In many countries wages are the outcome **collective bargaining**, i.e. negotiations involving unions, firms' associations, and the government. The outcome of the negotiation is known as **wage accord**, which consists in setting a specific level of real wage, then leaving firms free to decide how many workers to hire at the negotiated wage. Collective bargaining results in wage rigidities since the power of unions can push up the negotiated real wage above the equilibrium wage.

**Efficiency wage** theories argue that labour productivity is related to worker compensations, and paying a wage above the market clearing level improves employee morale, thus

increasing production. For this reason, firms may be willing to pay a real wage that exceeds the equilibrium wage in order to boost profits. A high wage may also be beneficial for firms in that it reduces the incentive for workers to quit, and thereby, the cost of advertising, screening, hiring and training new workers.

The final source of wage rigidity arises from the potential conflict of interest between different groups of workers: insiders and outsiders. **Insiders** are those workers already employed by firms, who are interested in keeping real wages high. This clearly contrasts with the interest of those unemployed – **outsiders** – since a wage reduction would increase their chances of employment. If, within a union, the bargaining power of insiders is greater than that of outsiders, the real wage may remain relatively high for a very long period of time, and this may lead to prolonged periods of unemployment. This phenomenon of a high unemployment rate over long periods of time (persistent unemployment) is also known as **hysteresis**. An alternative explanation of **hysteresis** focuses on the role of long-term unemployed in the labour market. Long-term unemployment causes a progressive loss of skills and detachment from the working life (discouraged workers). As a result, long-term unemployed do not have high bargaining power and have a small impact on wage negotiations, which could lead to a prolonged period of high unemployment.

### Frictional and structural unemployment

The unemployment rate is affected by the degree of mobility in the labour market, which is characterised by people continuously finding and losing jobs. The effect of the labour force dynamic on the unemployment rate can be formalised by denoting with $l$ the fraction of employed people losing their jobs in a specific period of time, and with $f$ the share of unemployed people finding a job, over a specific period of time. If the unemployment and the participation rates are constant, over the same period of time, then it must be true that:

$$\Delta u = 0 \Leftrightarrow lN = fU \ ,$$

which shows that a constant unemployment rate over a specific period of time can only occur if over the same period of time the number of employed losing their jobs equals the number of unemployed finding a job. The definition of labour force, $L = N + U$, can be substituted into the above to obtain:

$$l(L - U) = fU \ .$$

After dividing both sides of this expression by $L$ and solving for $u$, the unemployment rate becomes:

u=1 – l/f
where u = U/L (unemployment rate)

which shows that the unemployment rate increases as the rate of job finding reduces, or the rate of job losses rises. Equation (5.4) implies that any policy aiming at reducing the rate of unemployment must either reduce the rate of job losses or increase the rate of job finding. In this contest, the unemployment rate can have two very different sources. **Frictional unemployment** is caused by the time it takes workers to search and find a job. **Structural unemployment** is instead the outcome of a mismatch between, on the one hand, workers'

needs and characteristics and, on the other hand, vacancy requirements. Factors that determine structural unemployment are job locations, since job vacancies and unemployed people may be located in different regions, and workers skills, since workers may by either over or under-qualified to undertake available jobs. Thus, the longer it takes workers to search and find a job, the higher frictional unemployment, whereas the higher the degree of mismatch, the higher is structural unemployment.

## Activity 2

Discuss which of the three types of unemployment – classical, frictional, and structural – each of the following policies can help to reduce: 1) increase number of job centres; 2) increase number retraining programmes; 3) reduce unemployment benefit; 4) reduce minimum wages and trade union power.

### The natural rate of unemployment

The **natural unemployment rate** is defined as the sum of the three components of voluntary unemployment: classical, frictional, and structural unemployment. It is a measure of the average or medium run unemployment rate, around which an economy fluctuates over the business cycle. In the short run, the actual unemployment rate may differ from the natural rate: during expansions the actual unemployment rate is lower than the natural rate, whereas during recession it is higher. The difference between the actual and the natural rate of unemployment is defined as **cyclical or Keynesian unemployment**, and it is a measure of involuntary unemployment.

The analytical determination of the natural unemployment rate requires two modifications to the previous analysis of the labour market. First, the labour market has to be described in the unemployment – real wage space. Second, imperfect competition is introduced in both the labour and products market; to evaluate how this affects labour demand, labour supply, and the market clearing real wage. In this context, the natural unemployment rate is defined as the equilibrium unemployment rate in the labour market with imperfect competition.

The definition of the labour force implies that, in the unemployment-real wage space, the labour market is characterised by a decreasing labour supply and an increasing labour demand (Figure 5.2, panel A).

Under imperfect competition, the labour supply curve is replaced by the **Wage-Setting relation**, **WS**, which takes into account the bargaining of workers in wage negotiations. Analytically, the wage-setting relationship is written as:

$$W = \underset{+}{P^e} \, F\big(\underset{-}{u}, \underset{+}{z}\big),$$

where $W$ indicates the nominal wage, $P^e$ is the expected price level, $u$ is the unemployment rate, and $z$ measures structural and institutional factors that contribute to wage determination, such as the level of unemployment benefits, labour market protection, minimum wage legislations, etc. The expected price level $P^e$ is included in the WS relation because wage negotiations take into account the price level that they expect to prevail over the duration of the contract. The higher $P^e$ is, the higher the nominal wage demanded by wage setters. The unemployment rate summarises the labour market conditions, which affect wage bargaining:

the lower unemployment, the stronger the workers power of negotiating higher wages. Consequently, the *WS* curve is negatively sloped in the unemployment-real wage space because the higher the unemployment is, the weaker the bargaining power of wage setters, the lower the real wage. The variable $z$ determines the position of the *WS* curve: an increase in the level of unemployment benefit shifts the *WS* curve upwards, in that it increases real wages at any unemployment level. Under perfect competition, $z=0$, and the WS curve coincides with the competitive market labour supply curve.

If $F(z,u)$ is linear and equal to $1+z-\alpha u$, then the WS relation is linear and can be written as:

$$W = P^e(1+z-\alpha u), \tag{5.5}$$

where $\alpha$ is the response coefficient of nominal wage to an increase in unemployment.

Under imperfect competition firms can set the price level above the marginal cost. Therefore, the labour demand curve is replaced by the **price-setting relation, PS**, which analytically is written as:

$$P = (1 + \mu)W, \qquad\qquad (5.6)$$

where $W$ is the marginal cost of output and $\mu$ is the markup, which reflects the degree of firms' market power. Note that the standard assumptions about the production function imply that the marginal product of labour falls as employment rises. Consequently, the nominal wage increases as unemployment rises and the $PS$ curve is upward sloping in the unemployment-real wage space. The markup determines the position of the $PS$ curve: a reduction (increase) in the markup shifts the $PS$ upwards (downwards). Under perfect competition, $\mu = 0$ and the $PS$ curve coincides with the competitive market labour demand.
Panel B in Figure 5.2 plots the $WS$ and the $PS$ curves in the unemployment-real wage space. The WS curve is positioned above labour supply curve ($z \neq 0$) and the PS curve is positioned below the labour demand curve ($\mu \neq 0$). The natural unemployment rate is determined by the equality between the $WS$ and the $PS$ curves. Broadly speaking, the greater the degree of imperfect competition is, the higher the natural unemployment rate.

NB: W/P = 1/1+μ ; Marginal Cost of Labour = W, since Total Cost of Labour = W*L

## Activity 3

Consider an economy in which firms' markup over cost is 10 per cent and the WS relation is given by equation (5.5), with $z=0.01$ and $\alpha =1$. Assume that the marginal product of labour is constant.
a) Compute the real wage and the natural unemployment rate.
b) Calculate how the equilibrium real wage and the natural unemployment rate change if the markup increases to 15 per cent. Discuss your result.
c) Calculate how the equilibrium real wage and the natural unemployment rate change, if the bargaining power of unions increases so that $z=0.4$. Discuss your result.

**Figure 5.2: Labour market under imperfect competition and natural unemployment rate**
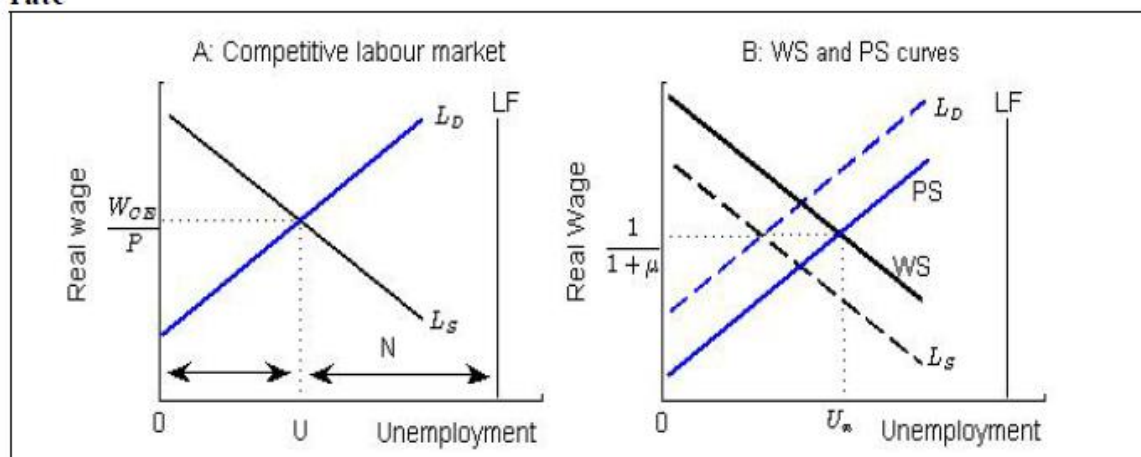
The WS and the PS relations can be employed to compute, analytically, the natural rate of unemployment $u_n$. To this end, note that the natural unemployment rate is a medium term concept, which holds when $P=P^e$. Under this assumption, the nominal wage in equation (5.6) can be replaced with the nominal wage in equation (5.5) to obtain:

$$1 = (1 + z - \alpha u_n)(1 + \mu).$$

Taking the natural logarithm of both sides of this expression and simplifying yields:

[Wage Setting: $W = Pe * (1+z-\alpha u)$ and Price Setting: $P = (1+\mu) * W$.
In equilibrium Output = potential output and thus P = Expected Price so that $P = Pe$. Hence, replace price Pe in the WS equation with $P = (1+\mu) * W$. Thus, $W = (1+\mu) * W * (1+z-\alpha u_n)$. Notice that $u$ was replaced with $u_n$ since $Y$ or the level of output (or GDP) equals potential GDP or the Full employment level of output (at which unemployment rate is equal its natural rate or $u_n$).

$W = (1+\mu) * W * (1+z-\alpha u_n)$ divide by $W$ and you get: $1 = (1+\mu) * (1+z-\alpha u_n)$

$$0 = z - \alpha u_n + \mu,[22]$$

so that the natural unemployment rate $u_n$ is given by:

$$u_n = \frac{z + \mu}{\alpha}, \tag{5.7}$$

which shows that increases in both $z$ and $\mu$ raises the natural unemployment rate.

The concept of natural unemployment rate implies that of natural levels of employment and output. Since, the number of unemployed people is such that the unemployment rate is at its natural level is consistent with $u_n = U_n / L$, the **natural level of employment** $N_n$ is given by:

$$N_n = L(1 - u_n).$$

If output is produced according to the production function:

$$Y = AN, \tag{5.8}$$

where $A$ indicates the level of technology, then substitution of the natural level of employment into the production function gives the **natural level of output**:

$$Y_n = AN_n = AL(1 - u_n). \tag{5.9}$$

## Activity 4

Explain why the phenomenon of hysteresis implies the existence of a relation between natural and cyclical unemployment, so that macroeconomic policies that aim at reducing cyclical unemployment can also indirectly affect the natural rate of unemployment.

## Aggregate Supply

In the IS-LM model firms respond to an increase in demand by increasing production without changing the price level, which is assumed to be fixed. The labour market under imperfect competition can be employed to derive the **Aggregate Supply (AS)** relation, which shows how the price level adjusts over time in response to changes in aggregate demand and income The analytical determination of the AS relation requires three equations: the WS relation in equation (5.5), the PS relation in (5.6), and the relation between output and unemployment rate in (5.9).

First, the nominal wage from the WS relation can be substituted into the PS relation to obtain the following expression for the price level:

$$P = (1 + \mu)P^e(1 + z - \alpha u),$$

Equation (5.9) shows that – in general – the unemployment rate can be written as:

(Recall that $P = (1+\mu) * W$ and $W = Pe * (1+z-\alpha u_n)$ so replace **W** with **Pe * (1+z-αu_n)** to get the

$$Y_n = AN_n = AL(1-u_n).$$ (5.9)

equation above and

$$u = 1 - \frac{Y}{AL}.$$

This result can be substituted in the price level equation to obtain the AS relationship as:

$$P = (1+\mu)P^e\left[1 + z - \alpha\left(1 - \frac{Y}{AL}\right)\right].$$ (5.10)

Equation (5.10) shows that the price level and output are positively related. The mechanism of price adjustment includes the following four steps. First, an increase in output leads to an increase in production which increases employment. Second, higher employment results in lower unemployment. Third, the reduction in unemployment leads to higher nominal wages through wage bargaining. Fourth, the increase in the cost of production, due to higher nominal wages, forces firms to raise prices by increasing the markup.

So from $u = 1 - Y/AL$ we can see that if **Y** rises, then **u** will fall and hence **W** will rise because $W = Pe * (1+z-\alpha\underline{u})$ and Price level will rise since the price setting Eqn. $P = (1+\mu) * W$ so that $P > Pe$ when $u < u_n$.

When $Y = Yn$, $P=Pe$ and hence divide Eqn. 5.10 by P to get $1 = (1+\mu) * (1+z-\alpha u_n)$.

Recall that Wn is the nominal wage at the natural unemployment rate. Rewrite PS Eqn. $P = (1+\mu) * W$ as $Wn/P = 1/1+\mu$ hence $P/Wn = 1+\mu$. Next, recall $1 = (1+\mu) * (1+z-\alpha u_n)$ or $1+\mu = 1/1+z-\alpha u_n$ and equals $P/Wn$. Next, rewrite $1+\mu = 1/1+z-\alpha(1 - Yn/AL)$. Recall that Wn is the nominal wage at the natural unemployment rate. And now we can replace $1+\mu$ in Equation 5.10 with $1/1+z-\alpha(1 - Yn/AL)$

The AS relation in equation (5.10) can be further simplified by observing that when the unemployment rate is at the natural level ($P = P^e \Leftrightarrow u = u_n$), the PS equation implies:

$$\frac{P}{W_n} = 1 + \mu = \frac{1}{1 + z - \alpha u_n} = \frac{1}{1 + z - \alpha\left(1 - \frac{Y_n}{AL}\right)},$$

where the term $W_n$ indicates the nominal wage evaluated at the natural unemployment rate. Therefore, equation (5.10) can be written as:

$$P = P^e \frac{\left[1 + z - \alpha\left(1 - \frac{Y}{AL}\right)\right]}{\left[1 + z - \alpha\left(1 - \frac{Y_n}{AL}\right)\right]}.$$

Subtracting $P^e$ from both sides in the above and rearranging gives:

$$P - P^e = P^e \frac{\left[\frac{\alpha}{AL}(Y - Y_n)\right]}{W_n / P},$$

which yields the standard form of the AS relation as:

$$P = P^e + \lambda[Y - Y_n], \tag{5.11}$$

where $\lambda = \frac{P^e}{W_n / P}\frac{\alpha}{AL} \geq 0$ and $Y - Y_n$ computes the so called output gap. Equation (5.11) states that the actual price level deviates from the expected price level to when output

deviates from its natural level. The standard AS relation can also be solved for output to obtain the so called 'surprise-supply' relation:
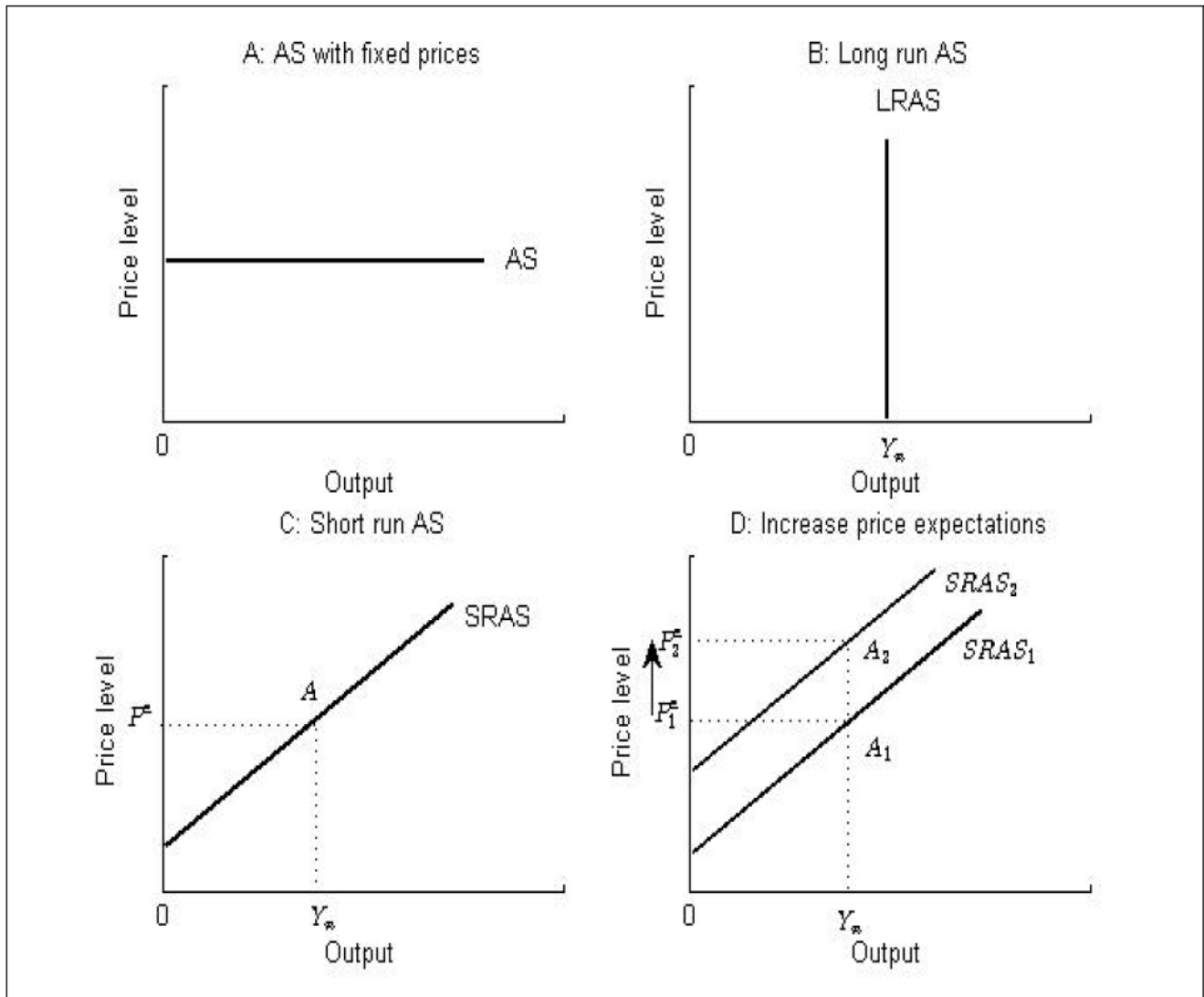
$$Y = Y_n + \mu(P - P^e),$$

where $\mu = 1/\gamma > 0$ and the term $P - P^e$ indicates surprise inflation. This relation shows that output exceeds the natural level to the extent that there is **surprise inflation** in the economy, i.e. the actual price level exceeds the expected one.

The definition of the natural level of unemployment implies that along the AS curve the price level equals its expected value, $P = P^e$, when output equals its natural level $Y = Y_n$. If the current level of output exceeds the natural level, $Y > Y_n$, then the current price level exceeds its expected level, $P > P^e$. The parameter $\lambda$ in equation (5.11) measures the slope of the AS curve, i.e. how quickly the price level changes in response to variations in the output gap.

There are three possible scenarios, as illustrated in the first three panels of Figure 5.3. Under the assumption of the IS-LM framework prices are fixed and the AS curve is horizontal (panel A). In the long run (more than 5-10 years) prices are fully flexible and the AS curve is vertical at the natural level of output (panel B). This is because the long run equilibrium, in the labour market, is defined in real terms and changes in the price level have no effect on the natural rate of unemployment, and thus the natural level of output. The long run AS curve is denoted in the guide as LRAS. In the short run, nominal rigidities, and/or imperfect information, make the AS curve positively sloped (panel C). The short run aggregate supply curve is denoted in the guide as SRAS.[23]

The position of the SRAS curve is determined by all the factors that contribute to the equilibrium in the labour market. An increase in the expected price level makes workers bargain for higher wages (for any given unemployment rate). The increase in the wage raises the price level through price setting. As a result, an increase in the expected price level causes the AS curve to shift upwards (Figure 5.3, panel D).

**Figure 5.3**

**A: AS with fixed prices**

Price level

AS

0    Output

**B: Long run AS**

Price level

LRAS

0    $Y_*$    Output

**C: Short run AS**

Price level

SRAS

$P^e$    A

0    $Y_*$    Output

**D: Increase price expectations**

Price level

$SRAS_2$

$P_2^e$    $A_2$    $SRAS_1$

$P_1^e$    $A_1$

0    $Y_*$    Output

## Activity 5

Is the following statement true or false: 'The aggregate supply curve is positively sloped because when the price level increases firms want to sell more goods?' Discuss your answer.

## The SRAS curve

The AS relation, in equation (5.11), shows that the extent to which output deviates from its natural level depends upon the steepness of the SRAS, as determined by the magnitude of the coefficient $\lambda$. There are four theories that explain why output may deviate from its natural level in the short run: sticky-wages model, workers misperception model, sticky-prices model, and imperfect information or Lucas 'islands' model.

The ***sticky-wage model*** is grounded upon two assumptions. First, nominal wages are sticky in the sense that cannot adjust quickly when the economic condition changes, since they are fixed over long periods of time. Second, collective bargaining determines only the level of nominal wage, whereas employment is determined by firms' labour demand. This implies that, once the real wage has been set at the expected price level, then an increase in the price level above the expected value leads to a fall in real wage and it increases labour demand. In turn, the increase in employment raises output, at least until the next wage negotiation. Analytically, the sticky-wage model is described by three equations:

Actual real wage: $\dfrac{W}{P} = \dfrac{W}{P^e} \times \dfrac{P^e}{P}$ ;

Labour demand: $N - N_n = -\left( \dfrac{W}{P} - \dfrac{W}{P^e} \right)$ ;

Output: $Y - Y_n = A(N - N_n)$.

The first equation shows that the actual real wage $W/P$ deviates (above or below) from the predetermined real wage $W/P^e$ to the extent that the expected price level differs (lower or higher) from the actual price level, $P/P^e$. The second equation shows that labour demand is inversely related to the real wage, and an increase in the price level above the expected level increases employment as it reduces real wages. The final equation shows that output is above the natural level to the extent that firms can hire a number of workers higher than the natural employment level.

The model shows that if after the negotiation the actual price level equals the expected price level, $P = P^e$, then employment equals its natural level, $N = N_n$, and consequently output equals its natural level, $Y = Y_n$. If, however, after the wage negotiation the price level is higher than the expected one, $P - P^e > 0$, then it must be true that output exceeds its natural level, $Y - Y_n > 0$, since firms can employ a number of workers in excess of the natural employment level, $N - N_n > 0$, at least until the next wage negotiation. Vice versa, an unexpected fall in the price level raises the real wage, making labour more expensive. The higher real wage induces firms to reduce employment, and the reduced employment leads to a fall in output. When contracts are renegotiated, workers accept lower nominal wages to restore the original real wage, so employment rises. Therefore, the sticky-wages model predicts that the longer the period is over which wages are negotiated, the flatter the SRAS.

The **worker misperception model** assumes that wages are fully flexible, unlike the sticky-wage model, but workers have imperfect information, in that they suffer from money illusion so they temporarily mistake nominal wage increases for real wage increases. Firms have perfect information and if the price level increases unexpectedly, they offer higher nominal wages which workers mistake for higher real wages. This causes an increase in labour supply and allows firms to temporarily raise output above the equilibrium level, at least until workers realise that the real wage has not risen, so they revise their expectations and reduce labour supply. Under this model, the higher the degree of workers misperception is, the flatter the SRAS.

The **Lucas 'islands' or the imperfect information model** considers an economy including many self-employed individuals, each producing a single product, but consuming many goods. Producers have imperfect information, in that they are only aware of the price of the product that they produce. The model distinguishes absolute changes in the price level, which occur when all prices of produced goods increase by the same proportion, from relative changes in the price level, which occurs when the price of some goods increase more than others.

A relative change in the price level makes better off the producers of the goods the price of which are increasing relative to the overall price level. This is because the price of their output increases to a greater extent than the overall price level. Both the real wage and the nominal wage earned by these producers increase. When an absolute change in the price level occurs, all producers are affected equally and the nominal wage increases while the real wage remains constant.

Imperfect information means that producers are likely to mistake changes in the price of the product that they produce (relative changes in the price level) with changes in the overall price level (absolute changes in the price level). Thus, when a producer sees a change in the price level, he/she is likely to believe that it is a relative change in the price level, even if it is an absolute change in the price level. As a result, the producer works more and this increases the level of output when the price level rises. Thus, the Lucas islands model predicts that the higher the degree of imperfect information is, the flatter the SRAS.

**Activity 6**

The empirical evidence in the United States suggests that real wages are mildly pro-cyclical, i.e. they tend to increase when the economy expands. Discuss whether or not the predictions of the sticky-wage model and the sticky-price model, about the correlation between real wages and output, are consistent with this evidence.