BECC-106

# INTERMEDIATE MACROECONOMICS - I

School of Social Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068

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| **Block 1** | **Aggregate Demand and Supply** | |
| Unit 1 | Aggregate Demand | Ms. Archana Aggarwal, Assistant Professor, Hindu College, University of Delhi<br>(Edited by Prof. Kaustuva Barik, IGNOU) |
| Unit 2 | Aggregate Supply | |
| Unit 3 | Equilibrium Output and Prices | |
| **Block 2** | **Expectations, Inflation and Unemployment** | |
| Unit 4 | Adaptive Expectations | Units 4 and 5: Dr. Tarun Manjhi, Sri Ram College of Commerce, University of Delhi (Edited by Ms. Sonica Singhi, Lakshmibai College, University of Delhi) |
| Unit 5 | Rational Expectations | |
| Unit 6 | Inflation and Unemployment | Unit 6: Dr. Kaustuva Barik, IGNOU and Dr. Tarun Manjhi, SRCC, University of Delhi |
| **Block 3** | **Balance of Payments and Exchange Rate** | |
| Unit 7 | Financial Markets | Dr. Archi Bhatia, Associate Professor, Central University of Himachal Pradesh, Dharamshala<br>(Edited by Prof. Kaustuva Barik, IGNOU) |
| Unit 8 | Balance of Payments | |
| Unit 9 | Exchange Rate Determination | |
| **Block 4** | **Open Economy Models** | |
| Unit 10 | Mundell-Fleming Model | Dr. Archi Bhatia, Associate Professor, Central University of Himachal Pradesh, Dharamshala<br>(Edited by Prof. B S Prakash, IGNOU) |
| Unit 11 | Dornbusch's Overshooting Model | |
| Unit 12 | Macroeconomic Policy in an Open Economy | |

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# CONTENTS

# COURSE INTRODUCTION

In the course 'BECC 103: Introductory Macroeconomics' you were introduced to some important issues in macroeconomics. In the present course we further build upon those ideas and delve deeper into some of the topics in macroeconomics. This course introduces you to formal modeling of a macro-economy in terms of analytical tools. It discusses various alternative theories of output and employment determination in a closed economy in the short run as well as medium run, and the role of policy in this context. The course comprises four blocks.

Block 1, entitled **Aggregate Demand and Supply**, comprises three Units. This block, in fact, is an extension of the IS-LM model discussed in BECC 103. Unit 1 on Aggregate Demand begins with the derivation of the aggregate demand curve on the basis of the IS-LM model. We bring out the factors that influence the demand curve and the type of shift they result in. Unit 2 on Aggregate Supply discusses on the derivation of the supply curve from price setting and wage setting equations. Unit 3 brings together the aggregate demand and aggregate supply curves. The impact of supply shocks and demand shocks on equilibrium put and prices are also discussed in this Unit.

The title of Block 2 is **Expectations, Inflation and Unemployment**. It deals with the theoretical aspects of expectations and its role in macroeconomics. Unit 4 brings out the concept, features, scope and limitations of adaptive expectations. The subject matter of Unit 5 is rational expectations. It shows how economic agents take into account all available information in decision-making. It further delves into issues such as policy ineffectiveness proposition, and the role of expectations in IS-LM analysis. Unit 6 brings out the relationship between inflation and unemployment. It begins with the traditional downward-sloping Phillips curve. Subsequently it introduces expectations and explains why the Phillips curve is a vertical line in the long run.

Block 3, entitled **Balance of Payments and Exchange Rate**, consists of three Units. Unit 7, titled Financial Markets, begins with the role, types and features financial markets, financial derivatives and foreign exchange markets. Unit 8 deals with balance of payments, its accounting principles, determinants of exports and imports, and capital flows. Unit 9, titled, theories of exchange rate determination, discusses various exchange rate regimes, determinants of exchange rate, and purchasing power parity.

In Block 4 we discuss issues pertaining to **Open Economy Models**. There are three Units in this Block. Unit 10 deals with the Mundell-Flemming model, which brings out the effectiveness of fiscal policy and monetary policy under various exchange rate regimes. Unit 11 discusses Dornbusch's overshooting model, which discusses the impact of monetary shocks on asset markets. Unit 12 titled Macroeconomic Policy in an Open Economy explains how policies on money supply, interest rate and exchange rate are inter-linked.

# UNIT 1 AGGREGATE DEMAND *

**Structure**



## 1.0 OBJECTIVES

After going through this Unit, you should be in a position to

- provide an overview of IS-LM analysis;
- bring out the conditions under which fiscal policy is effective;
- bring out the conditions unde4r which monetary policy is effective;
- derive the aggregate demand (AD) curve from the IS-LM model;
- identify the factors that influence the position and slope of the AD curve;
- bring out the reasons for shift in the AD curve;
- explain the impact of fiscal policy and monetary policy on the AD curve; and
- explain how the impact of a demand shock depends upon the shape of the aggregate supply (AS) curve.

## 1.1 INTRODUCTION

In Block 5 of the course 'BECC 103: Introductory Macroeconomics', we covered three issues, viz., (i) derivation of the IS curve, (ii) derivation of the LM curve, and (iii) interaction of the IS-LM curves. We learnt that goods market


* Ms. Archana Aggarwal, Assistant Professor, Hindu College, University of Delhi

equilibrium is represented through the IS curve while money market equilibrium is given by the LM curve. If we consider only one curve (either IS or LM), then we cannot determine equilibrium levels of both output (Y) and interest rate (i). In other words, goods market equilibrium cannot be determined until the rate of interest (as investment spending is a function of rate of interest) is known. Similarly, money market equilibrium cannot be determined unless the income level is known (as money demand is a function of income level). In order to overcome this limitation, we brought together the IS and the LM curves to derive the equilibrium levels of output and interest rate simultaneously. In this Unit we begin with an overview of the IS-LM model. Subsequently, we derive the aggregate demand (AD) curve and discuss how AD is impacted by fiscal policy and monetary policy. Finally, we bring together the AD curve and the aggregate supply (AS) curve to determine the equilibrium levels of output and price.

## 1.2 OVERVIEW OF THE IS-LM MODEL

The IS curve shows the combination of interest rate ($i$) and output level (Y) at which the goods market is in equilibrium. You may recall from Unit 12 of BECC 103 that on each and every point of the IS curve the goods market is in equilibrium. The IS curve is downward sloping. It is given by the following equation:

$$Y = \alpha A - \alpha b i \quad \ldots(1.1)$$

where A is autonomous spending,

$\alpha$ = autonomous spending multiplier,

$b$ = sensitivity of investment function to interest rate, and

$i$ = rate of interest.

While plotting the IS curve (see Fig. 1.1 given below) we take output ($Y$) on the x-axis and $i$ on the y-axis. Thus, the slope of the IS curve ( $\frac{di}{dY}$ ), as we can observe from (1.1), will be $-\frac{1}{\alpha b}$ (you have to re-arrange equation (1.1) and specify i in terms Y, and then differentiate the equation). From equation (1.1), however, we find that a given change in the rate of interest leads to a larger change in the income level for larger value of $\alpha b$. It means that if the autonomous spending multiplier ($\alpha$) or the sensitivity of investment spending to rate of interest ($b$) or the product of both ($\alpha b$) is larger, then the change in interest rate would be larger. We have also seen that IS curve can shift due to a change in autonomous spending $A$ or due to change in the value of multiplier $\alpha$. Thus an expansionary fiscal policy, an investment subsidy, optimism of investors leading to higher investment at each rate of interest, an increase in autonomous consumption, etc. lead to a rightward shift of IS curve in a closed economy (see Fig. 1.1).

The LM curve (see Unit 13 of BECC 103) shows the combination of $i$ and Y at which the money market is in equilibrium. You may recall that the LM curve is upward sloping. It is given by the equation

$\overline{M} / P = kY - hi$ …(1.2)

As we observe from (1.2), the slope of the LM curve is $\frac{k}{h}$ (again, you have to re-arrange the equation, specify $i$ in terms of $Y$, and then differentiate it). A rightward shift of the LM curve (see Fig. 1.1 below) means that the money market equilibrium occurs at higher income level corresponding to each interest rate or a lower interest rate corresponding to each income level. A leftward or inward shift implies the converse. The LM curve shifts down (or to the right) in response to an increase in money supply (real) or a fall in money demand. However, a situation of liquidity trap makes money demand infinitely responsive to rate of interest and the corresponding LM curve becomes flat at that rate of interest. In this situation, an increase (change) in money supply fails to shift the LM curve.

### 1.2.1 Simultaneous Equilibrium in Goods and Money Markets

The intersection of the IS and LM curves gives the equilibrium levels of $i$ and $Y$. Let us bring the IS and LM curves together in order to derive the equilibrium income level and equilibrium rate of interest simultaneously.

Solving equations, (1.1) and (1.2) simultaneously gives us the following equation:

$$Y = \gamma A + \beta \frac{M}{P} \quad \text{... (1.3)}$$

Here, $\gamma = \frac{h\alpha}{h+\alpha bk}$ and $\beta = \gamma \frac{b}{h}$

The intersection of the IS and LM curves gives us equilibrium levels of output and interest rates. In Fig. 1.1, the equilibrium rate of interest is $i^*$ and equilibrium income level is $Y^*$

This equilibrium levels can change on account of shifts in (i) IS curve only, (ii) LM curve only, and (iii) both IS and LM curves. Let us look at the impact of shifts in these curves on equilibrium $i$ and equilibrium $Y$.

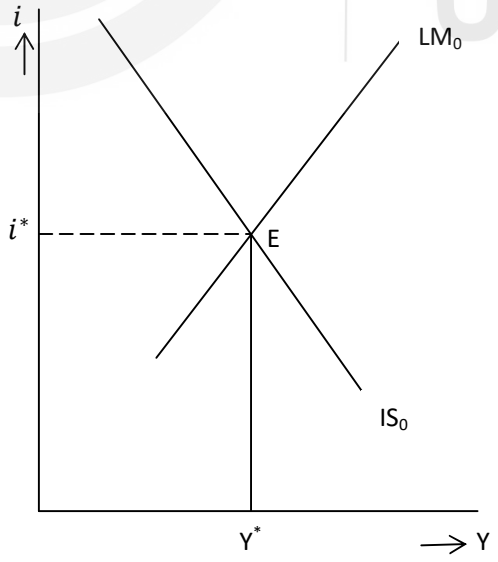


**Fig. 1.1: Equilibrium Output and Interest Rate**

### 1.2.2 Fiscal Policy and Crowding Out

We know that an expansionary fiscal policy (such as increase in government spending and reduction in tax rate) shifts the IS curve to the right. In contrast to the above, a contractionary fiscal policy shifts IS curve to the left. What happens to the equilibrium *i* and *Y*? Look at the Fig. 1.2. Suppose the initial curves are $IS_0$ and $LM_0$; with equilibrium at point E. An increase in government spending by $\Delta G$ shifts the IS curve from $IS_0$ to $IS_1$. The right-ward shift in IS curve is to the extent of $\alpha\Delta G$, i.e., by the distance EF in Fig. 1.2. *In the absence of money market*, the new equilibrium would be at point F. Output would increase from $Y_1$ to $Y_2$ and there would be no change in interest rate ($i_0$). However, this cannot happen as we have to include money market also. Point F represents excess demand for money in the financial markets. This leads to selling of bonds, a fall in bond prices and a rise in the rate of interest. The rise in interest restores equilibrium in the financial markets and the economy moves to point S where once again both the markets are in equilibrium. But this rise in interest rate leads to a fall in investment and thus a fall in output level (movement from F to S on the new IS curve, $IS_1$). Finally, equilibrium is at point S with interest rate $i_1$ and income level $Y_1$. It can be seen that the rate of interest is higher than original and output level, though higher than original, is lower than what would have happened in the absence of money market. The overall increase in output is equal to $\gamma\Delta G$ which is lower than $\alpha\Delta G$. This is on account of *crowding out* of investment.

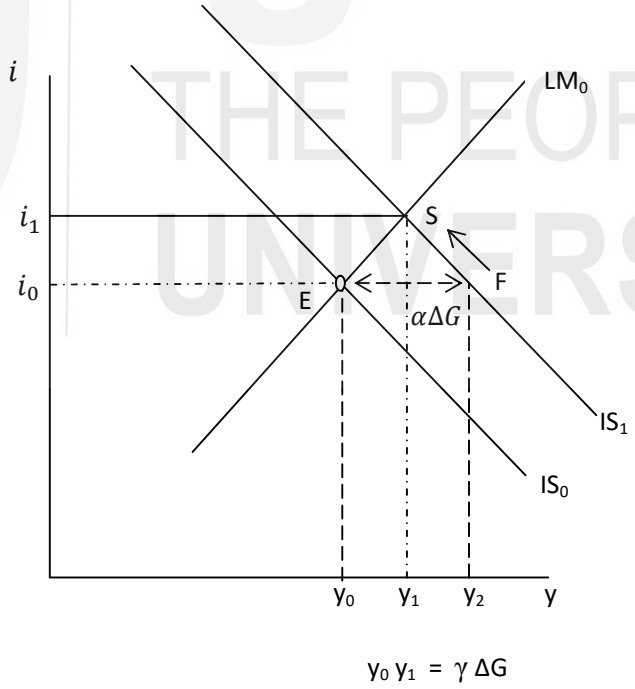


**Fig. 1.2: Crowing Out Effect**

Crowding out refers to the reduction in private spending (investment in this case) due to an increase in public spending (G). Crowding out happens because an increase in public spending leads to an increase in income and increase in money

demand, which leads to a rise in interest rate and a consequent fall in private spending such as investment. Larger the crowding out, larger the fall in private spending and lower the overall increase in income. Thus, the effectiveness of fiscal policy (in changing incomes) depends inversely on the extent of crowding out. In other words, effectiveness of fiscal policy depends on parameters *α, b, h* and *k.* Let us use the chain rule to understand the same.

$$\uparrow G \rightarrow (\alpha) \uparrow Y \rightarrow (k) \uparrow M_d \rightarrow (h) \uparrow i \rightarrow (b) \downarrow I \rightarrow (\alpha) \downarrow Y \quad \ldots (1.2)$$

The parameters in the brackets show the extent of change. For example, a higher value of $k$ makes fiscal policy less effective. Let us understand the process. A larger value of $k$ leads to a larger increase in money demand. Given the value of $h$, higher value of k leads to a greater rise in interest rate. The rise in interest rate reduces the demand for money and restores equilibrium in the money market. The higher rise in interest rate also leads to greater fall in investment (given the value of b). A greater fall in investment leads to a greater fall in income or output (given the value of α). Thus, the extent of crowding out is relatively higher and fiscal policy is less effective. You can take the value of other parameters (such as $h$, $b$ and α) and find out their effects on output level.

The results can be summed up as follows:

- *Higher* $k \rightarrow$ *Fiscal Policy is less effective*
- *Higher* $h \rightarrow$ *Fiscal Policy is more effective*
- *Higher* $b \rightarrow$ *Fiscal Policy is less effective*
- *Higher* $\alpha \rightarrow$ *Fiscal Policy is more effective.*

You can check these results algebraically by looking at the fiscal policy parameter γ. We know from (1.1) that $\gamma = \frac{h\alpha}{h+\alpha}$. Equation (1.1) shows that given the level of real money supply, an increase in A leads to an increase in Y by an amount of $\gamma \Delta A$. Higher values of $h$ and α lead to an increase in the value of γ whereas higher values of $b$ and $k$ lead to a lower value of γ.

### 1.2.3 Monetary Policy and Transmission Mechanism

Let us repeat the above exercise for monetary policy. We know that an expansionary monetary policy shifts the LM curve downwards or to the right whereas a contractionary monetary policy shifts the LM curve to the left or upwards (see Unit 13 of BECC 103). What happens to the equilibrium $i$ and $Y$? Look at the Fig. 1.3. The initial equilibrium is at E, the intersection of $IS_0$ and $LM_0$. You should note that $LM_0$ shows the equilibrium in the money market when the nominal money stock is $M_0$ and price level is $P_0$.

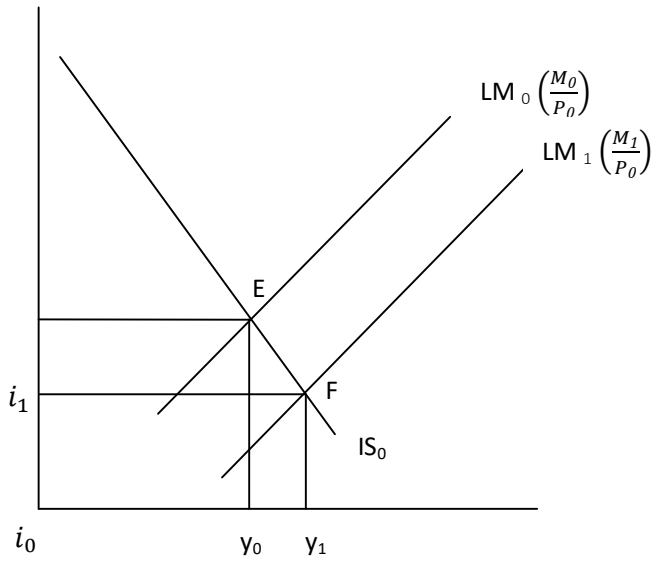


**Fig. 1.3: Transmission Mechanism**

Suppose, there is an increase in nominal money stock from $M_0$ to $M_1$. It increases the real money supply if the price level does not change (i.e., remains at $P_0$. Let $LM_1$ become the new LM curve. In Fig. 1.3 we find that the intersection between $IS_0$ and $LM_1$ takes place at point F. The rate of interest decreases from $i_0$ to $i_1$ and the output/income level rises from $Y_0$ to $Y_1$. Thus, an increase in money supply increases the equilibrium output level. It happens because an increase in money supply throws money market into disequilibrium and a decline in the rate of interest is required to restore equilibrium (by increasing demand for real balances). The decline in rate of interest, in turn, impacts the goods market so that investment spending and aggregate expenditure increase. The increase in aggregate expenditure results in an increase in equilibrium output level. This can be seen in a downward movement along the IS curve from point E to point F. This process is known as *transmission mechanism* whereby the money market 'transmits' its impact on income through the goods market.

The effectiveness of monetary policy depends on the strength of the transmission mechanism. The strength of the transmission mechanism depends on the parameters *α, b, h* and *k.* Let us look into the process through which it takes place.

$$\uparrow M_s \rightarrow \uparrow M/P \rightarrow (k \text{ and } h) \downarrow i \rightarrow (b) \uparrow I \rightarrow (\alpha) \uparrow Y \quad \text{... (1.3)}$$

The parameters in the brackets show the extent of change in output. How do these parameters impact the effectiveness of monetary policy? An increase in money supply ($M_s$) leads to a disequilibrium in the money market. People try to get rid of this excess money by buying bonds. Bond prices go up and rates of interest fall. The fall in the rate of interest increases money demand and thus the equilibrium in the money market is restored. Lower the value of $h$ (or, lesser sensitivity of money demand to rate of interest), larger is the required fall in rate of interest (so that money demand rises sufficiently to restore equilibrium in the

money market, given the value of $k$). Subsequently, it leads to a larger increase in investment (given the value of $b$) and larger income (given the value of $\alpha$). Thus, a lower value of $h$ implies that monetary policy is more effective. As far as $k$ or the sensitivity of money demand to income is concerned, lower $k$ means that the restoration of money market equilibrium relies much more on interest rate and hence a larger fall in interest rate is required.[1] This then, leads to a larger increase in investment and income (given $b$ and $\alpha$).

Let us look at the impact of $b$ and $\alpha$ on the effectiveness of monetary policy. A given fall in interest rate (as a result of increase in money supply) leads to larger increase in investment (larger the value of $b$) and thus a larger increase in income. Again a given fall in interest rate (as a result of increase in money supply) leads to an increase in investment (given $b$) and this increase in investment leads to a larger increase in income, if the value of $\alpha$ is higher. Thus we can say that higher value of $b$ and $\alpha$ make monetary policy more effective.

From equation (1.1), we know that $\beta$ shows the impact of changes in money supply on income level when A= 0, $\beta = \gamma \frac{b}{h}$ is nothing but the monetary policy multiplier.

Substituting $\gamma = \frac{h\alpha}{h+\alpha bk}$, we get $\beta = \frac{h\alpha}{h+\alpha bk}\frac{b}{h}$and the effectiveness of monetary policy can be seen to be dependent on the values of $\alpha$, $b$, $h$ and $k$.

- *Lower* $k \rightarrow$ *Monetary Policy is more effective*
- *Lower* $h \rightarrow$ *Monetary Policy is more effective*
- *Higher* $b \rightarrow$ *Monetary Policy is more effective*
- *Higher* $\alpha \rightarrow$ *Monetary Policy is more effective.*

**Check Your Progress 1**

1. Assume that investment is insensitive to rate of interest, as may be the case during recession. Suggest one policy action by the government in order to increase income. Explain the logic behind your answer.

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[1] With excess money supply, equilibrium in the money market is restored with an increase in money demand which results on account of both an increase in income and fall in rate of interest. If the value of $k$ is small, money demand is not very sensitive to income and hence the rate of interest plays a larger role in increasing the required money demand.

2. Can monetary policy raise income under conditions of liquidity trap? Explain your answer.

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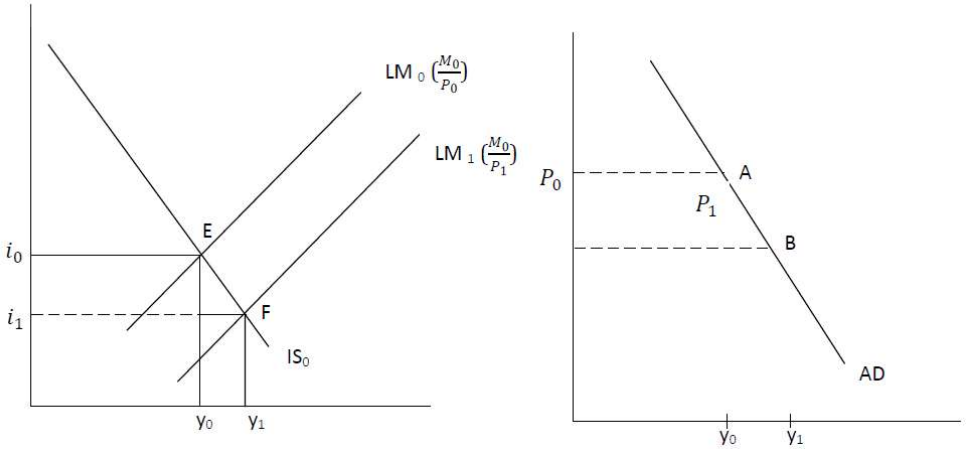
## 1.3 AGGREGATE DEMAND CURVE

The impact of fiscal and monetary changes, as discussed above, is based on the assumption of fixed price level. A change in the price level, changes the real money supply, shifts the LM curve (with a given stock of nominal money supply) and changes the equilibrium level of interest rate and output level. If we keep changing the price levels, we keep getting different levels of equilibrium output. The combination of 'Price' and 'output/income' at which goods and money markets are in simultaneous equilibrium gives the Aggregate Demand (AD) curve. The derivation of the AD curve from IS-LM curves is shown in Fig. 1.4 below.

Panel (a) of Fig. 1.4 shows $IS_0$ and $LM_0$ curves intersecting at point $E$ with an equilibrium income level of $Y_0$. The $LM_0$ curve is based on real money stock of $M_0/P_0$. Thus the combination of $P_0$ and $Y_0$ is the point $A$ on the $AD$ curve in panel (b) of Fig.1.4. With a falling Price level to $P_1$, the real money stock rises to $M_0/P_1$ (here the real money supply rises on account of fall in price level and not due to an increase in nominal money stock) and the $LM$ curve shifts to $LM_1$. Panel (a) of Fig. 1.4 shows that with the change in LM curve, the rate of interest falls to $i_1$ and income rises to $Y_1$ . Thus the combination of $P_1$ and $Y_1$ becomes point $B$ on the $AD$ curve.




**Panel (a)** **Panel (b)**

**Fig. 1.4: Derivation of AD Curve**

AD curve slopes downwards showing a negative relationship between price and output. This is because a fall in price level increases the real money supply, which throws the money market into disequilibrium. A reduction in the rate of interest restores the equilibrium in the money market. The fall in rate of interest, in turn, increases the level of investment spending and demand, thus raising the income level.

### 1.3.1 Slope of the AD Curve

The AD curve is flatter, if a given change in price leads to a larger change in income. On the other hand, the Ad curve is steeper if a given change in price leads to a smaller increase in income. The slope of the AD curve depends on parameters *α, b, h* and *k.*

$$\downarrow P \rightarrow \uparrow M/P \rightarrow (k \text{and } h) \downarrow i \rightarrow (b) \uparrow I \rightarrow (\alpha) \uparrow Y \quad \text{... (1.4)}$$

The argument is very similar to that given as above which explains the effectiveness of monetary policy (see sub-section 1.2.3). With a fall in price and hence an increase in real balances, money market is thrown out of equilibrium. Now, lower the value of *h* or less is the sensitivity of money demand to rate of interest, larger is the required fall in rate of interest in order to raise money demand sufficiently to restore equilibrium in the money market (given the value of *k*). Subsequently, it leads to a larger increase in investment (given *b*) and larger income (given *α*). Thus, lower *h* implies that same change in price leads to a larger change in income and thus AD curve is flatter. The impact of other parameters can also be argued along the lines of the previous section. The results can be summarised as follows:

- *Lower k→AD curve is flatter*
- *Lower h→ AD curve is flatter*
- *Higher b→ AD curve is flatter*
- *Higher α→ AD curve is flatter*

### 1.3.2 Shift of the AD curve

The AD curve shifts to the right or shifts upwards as a result of fiscal or monetary expansion whereas a fiscal or a monetary contraction shifts the AD curve to the left (or downwards). Any factor which shifts the IS curve or the LM curve to the right leads to a shift in the rightward shift of the AD. Thus an increase in any component of autonomous spending such as an increase in government spending leads to a rightward shift of the AD curve. Also an increase in the nominal money supply shifts AD upwards.

We elaborate on the factors that shift the AD curve and the nature of shifts they bring about.

i) **Investment:** If firms are optimistic about future they plan to increase their investment. Technological advancements in computer, for example, will lead to an increase in aggregate demand, which will shift the AD

curve to the right. Conversely, if firms become pessimistic about future business conditions, they would not undertake further investment. This will shift the AD curve towards the left.

ii) **Consumption:** Let us assume that there are certain changes in economic environment such that households save a higher amount at each level of income. This could arise because of certain incentives provided by the government, or an increase in the rate of interest on saving. An increase in saving will have the effect of reduction in consumption. Due to reduction in consumption, there will be a leftward shift of the AD curve. Let us consider another scenario. Suppose there is a stock market boom, which leads to windfall gains for households. It leads to unexpected increase in consumption. This is likely to increase consumption, thereby shifting AD curve to the right.

iii) **Government Expenditure**: Due to change in government purchases. If we drop our assumption of fixed government purchases and we let it to be flexible then it is the most direct way used by the policy makers which shift the aggregate demand curve. In case there is an increase in government purchase, then the AD curve shifts to the right, and vice versa.

iv) **Taxes**: Another factor that causes shift in the AD curve is change in the level of taxation. If there is increase in tax rates, there is decrease in the level of disposable income. A reduction in disposable income of households will lead to a reduction in aggregate consumption. On the other hand, if there is a decrease in tax rate, there is an increase in consumption of households. There are certain taxes that influence investment. If the investment tax credit increases (it is a tax rebate tied to a firm's investment spending) then it increases the investment and hence the AD curve shift rightwards.

v) **Net Exports**: Net exports are defined as exports minus imports (X – M). If there is an increase in exports (X) while imports are constant, the net exports (NX) will increase. Similarly, if there is a decrease in imports while exports remain unchanged, we witness an increase in NX. Let us discuss the impact of NX on the AD curve through an example. When Europe experiences a recession, for example, Europe buys fewer goods from the US. This reduces the US net exports at every price level. It shifts the AD curve for the US economy to the left (similar to panel (b) of Fig. 4.2). Thus we observe that a decrease in NX will shift the AD curve to the left. Similarly, an increase in the NX will shift the AD curve to the right.

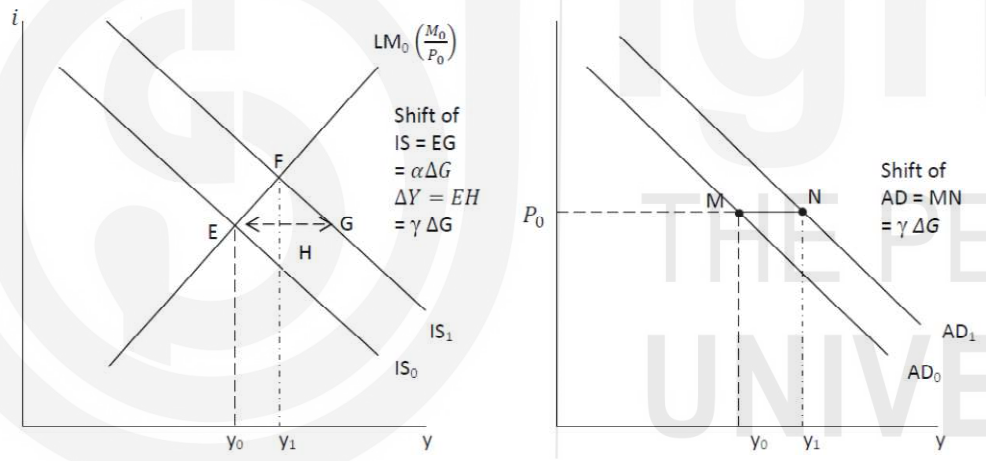
vi) **Money Supply**: An increase in money supply will lead to a reduction in the rate of interest. It is likely to increase the investment spending in the economy and finally the output level will increase. The AD curve will shift to the right. Similarly, a decrease in money supply will lead to an increase in interest rate. It will lead to a reduction in investment, which in

turn will decrease AD. Thus the AD curve will shift to the left, in the case of a decrease in money supply.

You should not forget that the price level is held constant in all the above cases. In the above discussion we have included certain important factors that influence the IS and LM curves. The price level also influences the LM curve. But it will not result in a shift in the AD curve; rather a change in P will lead to movement along the AD curve.

### 1.3.3 Fiscal Policy and AD Curve

An increase in government spending by $\Delta G$ shifts the IS curve to the right by $\alpha\Delta G$ along the output axis as shown in the previous chapter. However, on account of crowding out, the increase in equilibrium income is only by $\gamma\Delta G$ (as shown earlier). This implies that given constant prices, income rises by $\gamma\Delta G$ on account of increase in government spending. If we look at the AD curve, this means that at each price, AD curve shifts to the right, parallel to itself by $\gamma\Delta G$. This is shown in Fig. 1.5. Remember that the change in output is $\gamma\Delta G$. In both the pane (a) and panel (b) of Fig. 1.5, we represent this change by the distance $Y_0Y_1$.




**Panel (a)** **Panel (b)**

**Fig. 1.5: Fiscal Policy and Shift of the AD Curve**

### 1.3.4 Monetary Policy and AD Curve

An increase in nominal money supply shifts the LM curve to the right. It leads to a proportional shift of the AD curve to the right. The increase in nominal money supply results in an increase in income at each price level. However, the shift is proportional rather than parallel. In order to understand this, let us look at the shift of the AD curve as an upward shift rather than a rightward shift. In other words, we are looking at the increase in price at each income level on account of an increase in money supply. Quantity Theory of Money (QTM) tells us that prices rise in the same proportion as increase in money supply when income level is fixed and velocity of circulation is constant.

$$M\bar{V} = P\bar{Y} \quad \text{... (1.5)}$$

Thus a doubling of money supply leads to a doubling of prices at each income level, leading to a proportional shift of the AD curve. See Fig. 1.6

Thus expansionary policies, both fiscal and monetary, shift the AD curve to the right (or upward) and contractionary policies lead to a leftward (or downward) shift of the AD curve. The equation of the AD curve can be written as :

$$Y = \gamma A + \beta\, {}^{M}/_{P} \quad \text{... (1.6)}$$

Or $$P = \frac{\beta M}{\gamma A - Y} \quad \text{... (1.7)}$$

Here $A$ is the fiscal policy parameter; $\gamma$ is the *fiscal policy multiplier*; ${}^{M}/_{P}$ is the real money supply and $\beta$ is the *monetary policy multiplier*.

Apart from policy changes, AD curve can shift due to any change in the autonomous spending $A$. The shifts in AD curve due to a change in any component of aggregate demand is also referred to as *demand shocks*.

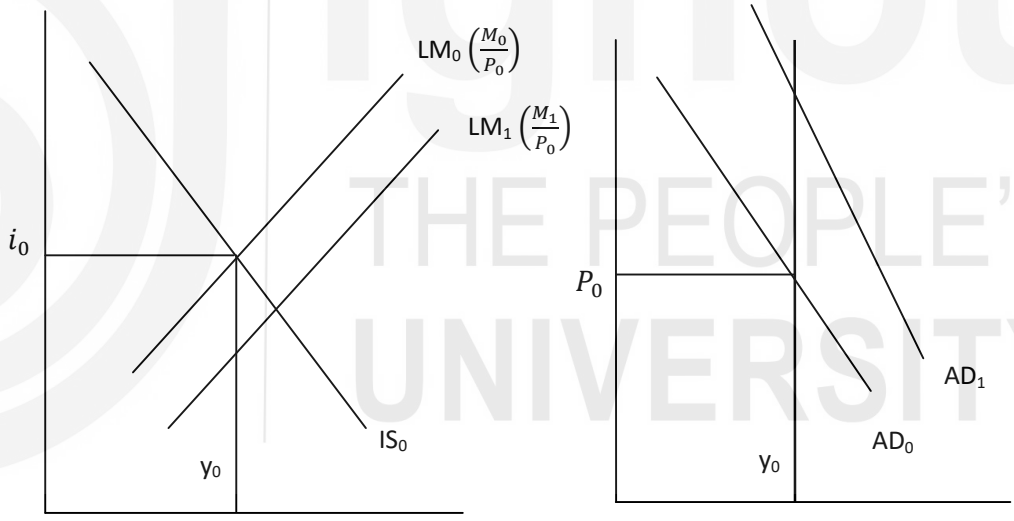



**Fig. 1.6: Monetary Policy and Shift of the AD Curve**

## 1.4 BRINGING TOGETHER AD AND AS

The equilibrium levels of income and price are determined by AD and AS. A change in aggregate demand, which shifts the AD curve, changes the equilibrium levels of output and price. The resulting quantity and price adjustment depends on the position and slope of the AS curve. Let us understand this in the context of (i) perfectly elastic AS curve, (ii) perfectly inelastic AS curve, and (iii) upward sloping AS curve. The particular shape of the AS curve depends on the conditions of the labour market.

### 1.4.1 Demand Shock and Perfectly Elastic AS Curve

Fig. 1.7 shows $AD_0$ intersecting the perfectly elastic *AS* at point *E* with output $Y_0$ and Price level $P_0$. This kind of AS curve is sometimes referred to as the *Keynesian* AS curve and is based on the assumption of completely rigid wages[2] in the labour market. An expansionary fiscal policy such as an increase in government spending by $\Delta G$ shifts the AD curve rightward by $\gamma\Delta G$ and the new *AD* curve is $AD_1$. As can be seen from the figure, the new equilibrium is given by *F* where prices remain constant whereas the income increases by $\gamma\Delta G$. In this case, fiscal expansion leads only to an increase in quantity and no change in prices.

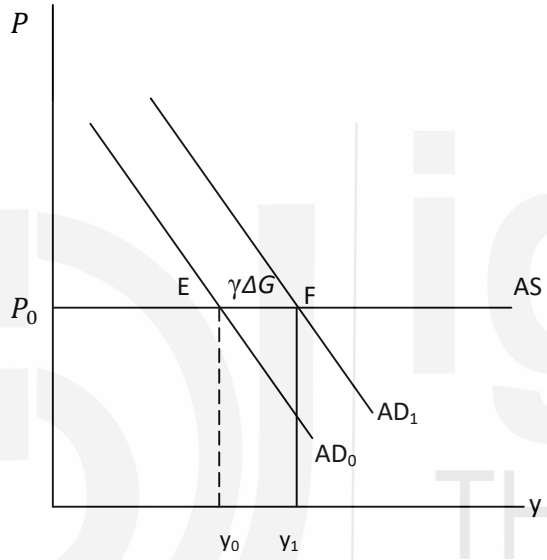



**Fig. 1.7: Effect of Demand Shock when AS Curve is Horizontal**

### 1.4.2 Demand Shock and Perfectly Inelastic AS

Fig. 1.8 shows $AD_0$ intersecting the perfectly elastic *AS* at point *E* with output $Y_0$ and Price level $P_0$.This kind of *AS* curve is also referred to as the *Classical* Supply Curve which is perfectly inelastic at full employment level of output. Let the *AD* curve shift up proportionately due to monetary expansion to $AD_1$. As is evident from the figure, there is no change in output but only a rise in the price level. This is on account of *supply side crowding out*. As demand increases, the producers want to increase production for which they need additional workers. However, since the labour market is already in full employment, the producers can only bid workers from each other, thus raising wages which in turn leads to increase in the price level. Here income and output is unable to increase due to supply conditions and hence it is called the supply side crowding out.

[2] The classical economists assumed that wage rate and price level to be flexible. Keynes put forth the view that there are rigidities in markets. See Unit 9 of BECC 103.

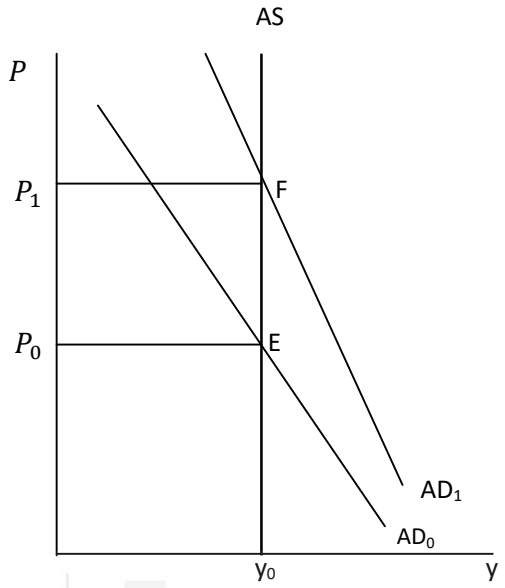



**Fig. 1.8: Effect of Demand Shock when AS Curve is Vertical**

### 1.4.3 Demand Shock and Upward Sloping AS

This kind of AS curve lies between the two extreme cases described above and is based on the assumption of less than full flexibility of wages in the labour market. A favourable demand shock leads to an increase in both output and prices whereas an adverse demand shock lowers the income and prices. This can be seen in Fig. 1.9. It is evident that the relative quantity and price adjustment depends on the slope of AS curve which in turn depends on the conditions of the labour market.

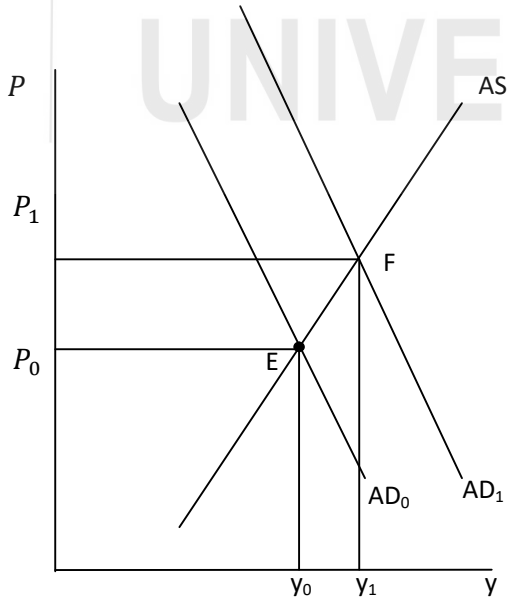



**Fig. 1.9: Effect of Demand Shock when AS Curve is Upward-sloping**

**Check Your Progress 2**

1. Draw the AD curve under the following conditions:

   a) $b = 0$

   b) $h = \infty$

   .....

   .....

   .....

   .....

   .....

   .....

   .....

   .....

2. Let there be a fall in demand for money at each level of income. Explain how this will affect the levels of output and prices under the following conditions:

   a) Keynesian AS

   b) Classical AS

   .....

   .....

   .....

   .....

   .....

   .....

   .....

   .....

## 1.5 LET US SUM UP

In this Unit we derived the AD curve from the IS and the LM curves. We explained how the simultaneous equilibrium in the goods and the money markets gives equilibrium output and interest rate for the economy. On the basis of the IS-LM curves we derived the aggregate demand curve for the economy.

We also discussed the position, slope and shifts of the AD curve. We found that AD and AS together give the equilibrium price and output in the economy. In the next Unit, we will derive the AS curve and understand the labour market conditions which underlies aggregate supply.

## 1.8 ANSWERS/ HINTS TO CHECK YOUR PROGRESS EXERCISES

**Check Your Progress 1**

1. An increase in G. There will be full expansionary impact on income. Income will rise by $\alpha\Delta G$. This is because there is no crowding out since b = 0.
2. Monetary policy becomes ineffective under conditions of liquidity trap. Here money demand is infinitely responsive to interest rate changes and LM curve is a flat curve. Any increase in money supply gets absorbed as money demand at the *prevailing* rate of interest. Thus rate of interest does not change and the transmission mechanism breaks down. The LM curve does not shift on account of changes in money supply.

**Check Your Progress 2**

1. In both cases the AD curve will be perfectly inelastic at a fixed level of income/output.
2. A reduction in money demand is tantamount to excess money supply in the money market. This leads to a proportional shift in the AD curve to the right.

   a) Output rises but prices remain the same

   b) Prices rise but output remains the same.

# APPENDIX TO UNIT 1: ALEGEBRAIC EXPRESION OF THE IS-LM MODEL

## A1.1 INTERACTION OF IS AND LM CURVES

As you know from Unit 14 of BECC 103, the equations for IS and LM are given as follows:

IS equation: $$Y = \alpha_G\left(\overline{A} - bi\right) \quad \ldots(A.1)$$

LM equation: $$i = \frac{1}{h}\left(kY - \frac{\overline{M}}{\overline{P}}\right) \quad \ldots(A.2)$$

As IS and LM intersect diagrammatically, there is a particular level of output and interest where IS and LM are equal. Thus we can equate (A.1) and (A.2) by substituting the interest rate given at (A.2) in the IS equation given at (A.1). This will give us the value of Y where both goods market and money market are in equilibrium.

We re-arrange terms as follows:

$$Y = \alpha_G\left[\overline{A} - \frac{b}{h}\left(kY - \frac{\overline{M}}{\overline{P}}\right)\right]$$

$$Y = \alpha_G\left[\overline{A} - \frac{bk}{h}.Y + \frac{b}{h}.\frac{\overline{M}}{\overline{P}}\right]$$

$$Y = \left[\alpha_G.\overline{A} - \alpha_G\frac{bk}{h}.Y + \alpha_G.\frac{b}{h}.\frac{\overline{M}}{\overline{P}}\right]$$

$$\left[Y + \alpha_G\frac{bk}{h}.Y\right] = \left[\alpha_G.\overline{A} + \alpha_G\frac{b}{h}.\frac{\overline{M}}{\overline{P}}\right]$$

$$Y\left[1 + \alpha_G\frac{bk}{h}\right] = \left[\alpha_G.\overline{A} + \alpha_G\frac{b}{h}.\frac{\overline{M}}{\overline{P}}\right]$$

$$Y = \left[\frac{\alpha_G}{1 + \alpha_G\frac{bk}{h}}\right]\overline{A} + \left[\frac{\alpha_G}{1 + \alpha_G\frac{bk}{h}}.\frac{b}{h}.\frac{\overline{M}}{\overline{P}}\right]$$

$$Y = \gamma.\overline{A} + \gamma\frac{b}{h}.\frac{\overline{M}}{\overline{P}} \quad \ldots(A.3)$$

where $\gamma = \left[\frac{\alpha_G}{1+\alpha_G \frac{bk}{h}}.\right]$

We can say that equilibrium level of income depends on autonomous spending $\left(\overline{A}\right)$ and real money stock $\left(\frac{\overline{M}}{\overline{P}}\right)$. Equilibrium income is higher if $\overline{A}$ and $\frac{\overline{M}}{\overline{P}}$ are higher.

If we substitute the value of Y obtained in equation (A.3) above in equation (A.2), we get the equilibrium rate of interest as

$$i = \frac{1}{h}\left(kY - \frac{\overline{M}}{\overline{P}}\right) \qquad \ldots(A.4)$$

Substituting $Y = \gamma\overline{A} + \gamma\frac{b}{h}.\frac{\overline{M}}{\overline{P}}$ (obtained in A.3) in the above equation (A.4), we get

$$i = \frac{1}{h}\left[k\left(\gamma.\overline{A} + \gamma\frac{b}{h}.\frac{\overline{M}}{\overline{P}}\right) - \frac{\overline{M}}{\overline{P}}\right] \qquad \ldots(A.5)$$

We re-arrange the terms in (A.5) as follows:

$$i = \frac{k}{h}\gamma.\overline{A} + \frac{1}{h}\left(\gamma.\frac{bk}{h}.\frac{\overline{M}}{\overline{P}} - \frac{\overline{M}}{\overline{P}}\right)$$

$$i = \frac{k}{h}\gamma.\overline{A} + \frac{1}{h}\left(\frac{\gamma bk}{h} - 1\right)\frac{\overline{M}}{\overline{P}}$$

$$i = k\gamma\overline{A} + \frac{1}{h}\left(\frac{bkh\alpha_G}{h(bkh\alpha_G)} - 1\right)\frac{\overline{M}}{\overline{P}}$$

as $\gamma = \frac{\alpha_G}{1+\frac{bk\alpha_G}{h}} = \frac{h\alpha_G}{(h+bk\alpha_G)}$

So, $i = k\gamma\overline{A} + \frac{1}{h}\left(\frac{bk\alpha_G - h - bk\alpha_G}{h+bk\alpha_G}\right)\frac{\overline{M}}{\overline{P}}$

$$i = \frac{k}{h}\gamma\overline{A} + \frac{1}{h}\left(\frac{-h}{h+bk\alpha_G}\right)\frac{\overline{M}}{\overline{P}}$$

$$i = \frac{k}{h}\gamma\overline{A} - \left(\frac{1}{h+bk\alpha_G}\right)\frac{\overline{M}}{\overline{P}} \qquad \ldots(A.6)$$

The equilibrium interest rate depends on $\alpha_G$ and the parameters of fiscal policy captured in the multiplier, $\overline{A}$ and the real money stock $\left(\frac{\overline{M}}{\overline{P}}\right)$. If the money stock rises, equilibrium interest rate will decline. If $\overline{A}$ (autonomous spending) rises, equilibrium interest rate will rise.

## A 1.2 FISCAL AND MONETARY POLICY MULTIPLIERS

Policy makers are interested in the outcome of a change in government spending in terms of change in equilibrium level of income while keeping the real money supply constant. This information is given by a fiscal policy multiplier. The equilibrium level of income obtained in the previous section is as follows:

$$Y = \gamma\overline{A} + \gamma\frac{b}{h}.\frac{\overline{M}}{\overline{P}}$$

An increase in government spending $(\Delta G)$ will change equilibrium income (Y).

$\Delta G$ is nothing but $(\overline{A})$ in this case. So,

$$\frac{\Delta Y}{\Delta \overline{G}} = \gamma$$

where $\gamma = \left[\frac{\alpha_G}{1+\alpha_G\frac{bk}{h}}.\right]$

Hence, γ is the fiscal multiplier or government spending multiplier. If we compare $\alpha_G$ (earlier multiplier) with γ (present multiplier), we realise that γ < $\alpha_G$ as γ is a fraction $\frac{1}{1+\alpha_G\frac{bk}{h}}$ . So, if we see a fiscal expansion in the IS-LM model, we would observe a dampening effect of increased interest rates.

Now, let us consider effect of *h* on γ. If *h* takes a very small value (nearly zero), then γ takes a value close to zero. On the other hand, if *h* is nearly infinity, then γ also approaches infinity.

When LM curve is near vertical, h assumes a small value and in that case fiscal policy multiplier (γ) will be nearly zero. Similarly, when LM curve is nearly horizontal, h assumes a high value and in that case the fiscal policy multiplier will approach to infinite. (Please note that the slope of LM curve is k/h). Similarly, a large value of b or k will reduce the value of fiscal policy multiplier.

Policy makers are also interested in knowing the outcome of a change in the real money supply in terms of change in the equilibrium level of income. This information will be given by monetary policy multiplier. Having the following knowledge,

$$Y = \gamma \bar{A} + \gamma \frac{b}{h} \frac{\bar{M}}{\bar{P}}$$

we can easily find out the expression of the 'monetary policy multiplier'

$$\frac{\Delta Y}{\Delta \frac{\bar{M}}{\bar{P}}} = \frac{b}{h} \gamma \qquad \ldots(A.7)$$

Larger $b$ and smaller $h$ will indicate more expansionary effect of a monetary policy on the equilibrium increase income. Larger $b$ means flatter IS curve. So, if the IS curve is steeper, then the effect of expansionary monetary policy will be somewhat low.

# UNIT 2 AGGREGATE SUPPLY*

**Structure**



## 2.0 OBJECTIVES

After going through this Unit you should be in a position to

- explain the concept of Aggregate Supply (AS) in Macroeconomics;
- identify the relationship between labour market and the AS curve;
- explain the shape of the AS curve;
- identify the factors that leads to a shift in the AS curve; and
- explain how the AS changes in the short run and in the medium run.

## 2.1 INTRODUCTION

We saw in the previous Unit that the equilibrium output and price level in the economy are determined with the help of both Aggregate Demand (AD) and Aggregate Supply (AS). In the case of a demand shock (autonomous or policy-induced), the shape of the AS curve plays a crucial role in the determination of relative change in output and prices. In this Unit, we will discuss the concept and the derivation of the AS curve. We will also see how the conditions in the labour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market determine the shape of the AS curve. Further, we will look at the concept of expectations about prices and the role played by expectations on the position of the AS curve. Finally, we will look at the relationship between the empirically observed Phillips Curve and the AS curve.

## 2.2 AGGREGATE SUPPLY CURVE AND THE LABOUR MARKET

The AS curve shows the relation between output produced and the corresponding prices at which the output is supplied by the firms. It is best to view the AS relation by asking the following question: what will be the price level corresponding to production of a certain level of output. This in turn depends on the cost of production corresponding to production of that level of output. If the cost of production is higher price of the product will be higher. Further, if the cost of production increases with an increase in output produced, prices charged should normally increase.

As you know from microeconomics, several inputs such as capital, labour and raw material are required in the production process. A major part of the cost of production is the wage cost. In fact, when we begin our production function analysis, in order to simplify issues, we assume that capital input is fixed and labour is the only variable input. Hence we need to understand how wages are determined before we can talk about prices corresponding to different levels of output. It can be shown that given the market structure in the labour market, wages depend on the level of employment (and also unemployment) in the economy. Also production of a certain level of output corresponds to a given level of employment (given the technology and the techniques of production). Thus we will first determine the relationship between unemployment (employment) and wages in the labour market and then proceed to show the relationship between the output produced and the price level (that is, the AS curve).

### 2.2.1 Perfectly Flexible Wages and the Classical AS Curve

In the perfectly competitive labour market (an assumption made by the Classical economists) the demand for and supply of labour are functions of real wages (you should refer to Unit 9 of BECC 103: Introductory Macroeconomics). Thus, we have

$$D_L = N(^W/_P) \quad \ldots (2.1)$$

$$S_L = F(^W/_P) \quad \ldots (2.2)$$

The demand curve for labour shows a negative relationship between real wages and demand for labour. As you know, in perfect completion the firms are price takers. Perfect competition in both labour market and product market leads firms to equate real wages with Marginal Product of Labour ($MP_L$) as they equate Value of Marginal Product of Labour ($VMP_L$) with a given nominal wage (W). Since the production function is assumed to be characterised by diminishing returns, ($MP_L$) declines as employment rises.

Thus the labour demand curve is downward sloping as firms take real wages as given and employ labour up to the point where marginal product equals the real wage (or value of marginal product equals the nominal wage).

The supply of labour is upward sloping. It is derived from the optimising behaviour of the labour supplying households who allocate their time between working/earning a wage and leisure. These households take the wages as given and decide the amount of labour to be supplied so as to maximise their utility.

Labour market is in equilibrium at that level of real wages and employment at which demand for labour equals the supply of labour. The assumption of *flexible wages* ensures that any temporary deviation from the equilibrium is immediately corrected by an immediate change in nominal wages. In other words, full flexibility of wages gives an employment level where everyone who chooses to work at the prevailing wages finds work or the only unemployment which exists is *voluntary unemployment* (it implies that there is no *involuntary unemployment*). The output level in the economy can be derived from the production function, given the equilibrium level of employment in the labour market or $y = f(L)$, where $L$ is the level of employment. It can be shown that the level of employment, and therefore the level of output remain the same at different price levels. An implication of the above is that there is no change in output level and we get a vertical AS curve. It means the AS curve is perfectly inelastic. Any change in price level which impacts the real wages and hence disturbs the equilibrium in the labour market is immediately corrected by a proportional change in nominal wages (see Unit 9, BECC 103). In this case the equilibrium output remains unchanged. This kind of AS curve based on the assumption of full flexibility of wages is sometimes called the *Classical Aggregate Supply Curve (*see Fig. 2.1).

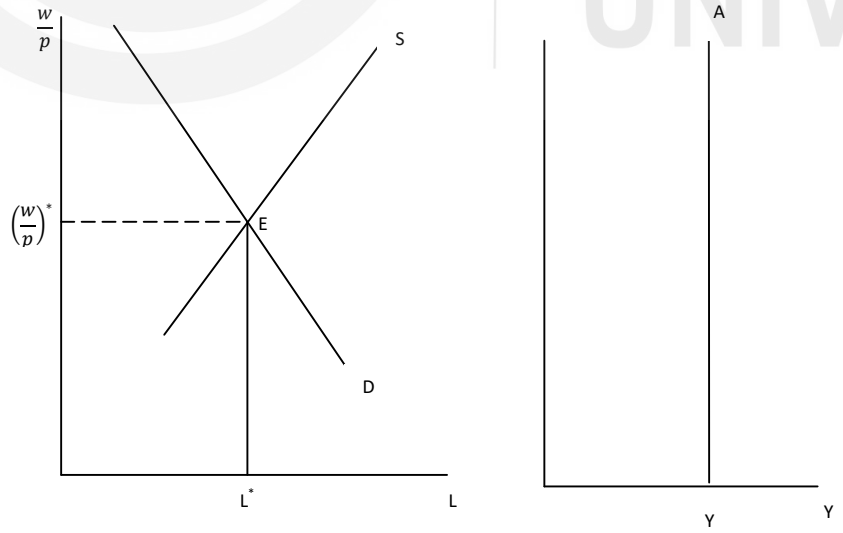


**Fig. 2.1: Labour Market Equilibrium and Classical AS Curve**

### 2.2.2 Perfectly Rigid Wages and the Keynesian AS Curve

Here we take a case which is diametrically opposite to the Classical view and wages are assumed to be perfectly rigid. Assumption of rigid nominal wages implies that we move away from the assumption of competitive markets and assume markets to be imperfect. Rigidity in wage rate could be because of two reasons: (i) Many times, as we know from our experience, wages are determined by a contract between the labour and the firms. In such cases wage rate will not change even if supply and demand conditions change. (ii) The product market is not competitive and the commodity producing firms are not price takers. The firms have some monopoly power to decide their output prices. They charge a price which is a certain 'mark-up' above the wages.

Given the imperfectly competitive labour and product markets, we need to understand how wages are determined and what are the prices charged by the firms, given the wages. One extreme example under such conditions is that of a perfectly rigid nominal wage. Here the wages remain the same irrespective of employment level. Let the firms charge a price *x%* above the wage. This would imply that prices would remain the same for all levels of employment and since each level of employment corresponds to a unique level of output, we get an AS curve which is infinitely elastic (horizontal line). In such cases, the firms charge the same price for all levels of output. This is sometimes referred to as the *Keynesian Aggregate Supply Curve* (see Fig. 2.2).

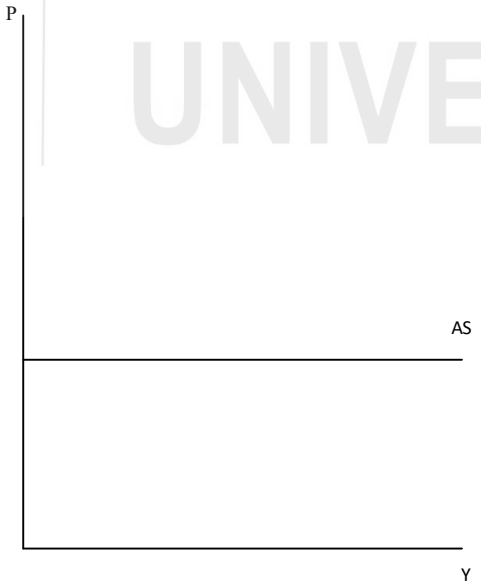


**Fig. 2.2: Wage Rigidity and AS Curve**

## 2.3 LABOUR MARKET UNDER IMPERFECT COMPETITION

Perfectly rigid wages discussed in the previous section is a special case of the less than perfectly competitive labour markets. Now we discuss the more general case where both the labour and the product markets are *not* perfectly competitive. It means that neither the labour nor the firms are price takers. In fact, wages are set either by employers or by union of workers or through the process of collective bargaining between the two. Once the wages are set, the firms set a price above the wages.

### 2.3.1 Wage Setting

The aggregate nominal wage W depends on three factors: (i) Negatively on unemployment rate, u (it implies that higher unemployment in society will negatively impact nominal wage rate); (ii) Positively on expected price level, $P^e$ (if labour expects that output price is likely to increase, they will demand higher nominal wage), and (iii) Positively on a catchall variable, z, that stands for all other variables which can affect wage setting. It can be expressed in the following way:

$$W = P^e F(u, z) \quad \ldots (2.3)$$

We look into each of these factors below.

#### *2.3.1.1 Wages and Unemployment*

The explanations of wage setting are broadly on the following two lines:

a) Bargaining by Workers

Bargaining power of the workers depends on the prevailing economic environment in the labour market. At low rates of unemployment, workers and unions enjoy a stronger bargaining position. Under these conditions, workers can obtain higher wages. However, the bargaining position is weak during high rate of unemployment and hence the workers have to accept a lower wage. In other words, according to this explanation, wages depend inversely on the rate of unemployment.

b) Efficiency Wage set by the Firms

This explanation focuses on how the firms set the wage rate they offer to labour. As unemployment falls in society, firms find it more difficult to retain old workers or recruit new workers. Firms do not want that existing workers should quit; because recruitment of new workers increase production cost. Further, new workers have to be trained which again involves cost. Therefore, the firm sets 'high wages' to attract the workers. The efficiency wage theories link the 'productivity' or 'efficiency' of the workers to the wages paid to the workers.

Both of the above explanations make the nominal wage inversely related to unemployment rate.

#### *2.3.1.2 Wages and Expected Price level* ($P^e$)

Workers are not interested in nominal wages *per se* but in the purchasing power of wages or the amount of goods which the nominal wages can buy. In other words, workers are interested in real wages, that is, $W/P$. At the time of entering into a contract for setting the wage, however, it is not possible to know the actual prices which would prevail during the period for which the contract is made. The future prices are not realised as yet; they can only be expected. If the expected prices are higher, workers would demand higher nominal wages. Thus nominal wage, W, is directly related to expected price $P^e$.

#### *2.3.1.3 Wages and Catch all Variable, z*

Apart from unemployment rate and expected price level, there are some other variables that influence wage rate. We use the letter *z* to take into account all other variables which can affect bargaining position of workers and therefore the nominal wage. As an illustration let us consider the passing of the minimum wage legislation. This improves the bargaining power of workers since workers know that they are legally entitled to the stipulated minimum wages. It makes the workers demand higher nominal wages at each unemployment rate and is indicated as an increase in z. Conversely, let us consider a situation where the trade unions become ineffective for some or the other reason. In such cases, the bargaining power of workers will decline and workers will settle for lower nominal wage at each unemployment rate. This is indicated by a decrease in *z*.

Thus nominal wage, W is directly (or, positively) related to the catch-all variable z.

### 2.3.2 Price Setting

In the previous sub-section we discussed about determination of wage rate. Now let us discuss how firms determine prices. The price of a product set by a firm depends on its cost of production. The costs, in turn, depend on the price of inputs and the production technology given by its production function. As a simplifying assumption, let us assume that one unit of labour produces one unit of output or *labour productivity* equals 1. Now the cost of producing one more unit of output or the *marginal cost* equals the cost of employing one more worker which is nothing but the wage rate. Had the product market been perfectly competitive, prices charged by the firms would have been equal to wage rate. However, the commodity market is not perfectly competitive which means that the firms (like the workers in the labour market) are not price takers but price setters. Normally, in such situations, prices charged are higher than wages or the price is some *mark-up* over the wage cost. If the mark-up is denoted by μ, then the price setting by the firm can be captured by

$$P = (1 + \mu)W \quad \ldots (2.4)$$

### 2.3.3 Equilibrium in the Labour Market

In cases where both the labour and commodity markets are not perfectly competitive, the equilibrium in the labour market is where the desires of the workers and the desires of the firms come together. For this, we will construct the Wage Setting (WS) and the Price Setting (PS) curves.

The WS curve is derived from equation (2.3) mentioned earlier. Let us assume that expected price equals the actual price (this happens in the medium run or the long run as will be explained in Unit 3). Now, the WS relation can be written as follows:

From equation (2.3) we know that $W = P^e F(u, z)$

$(-, +)$

Let $P = P^e$

Then, $W = P.F(u, z)$

Or, $\frac{W}{P} = F(u, z)$ … (2.5)

Equation (2.5) which shows the relationship between real wage rate and unemployment rate is called the wage setting equation.

The PS equation is derived from equation (2.4) given earlier. The PS equation is the same as equation (2.4) written in the form of real wages, which the firms are willing to give.

From (2.4) we know that $P = (1 + \mu)W$

Or, $\frac{P}{W} = (1 + \mu)$

Or, $\frac{W}{P} = \frac{1}{1+\mu}$ … (2.6)

We can depict the WS and PS equations through diagrams (see Fig. 2.3).

The *x* axis measures unemployment rate and the *y* axis measures real wages. The WS curve is a downward sloping curve whereas the PS curve is a horizontal line parallel to the *x* axis. The reasons are obvious. Since nominal wages, W, are an inverse function of unemployment *u*, the real wages, $\frac{W}{P}$, will vary inversely with unemployment, given the price level. For a given nominal wage (W), we get several real wage ($w = W/P$) curves, depending the value of P. If we look at equation (2.5), we observe that there could be several WS curves depending upon the value of expected price and the catch-all variable z. Let us consider a particular WS curve based on some expected price $P^e$ and catch-all variable *z*. An increase in $P^e$ and *z* will shift the WS to the right. Similarly, a decrease in $P^e$ and *z* will shift the WS to the left.

The PS curve is horizontal. Therefore, the real wage implied by the PS curve, $\frac{1}{1+\mu}$, is independent of the level of unemployment *u.*

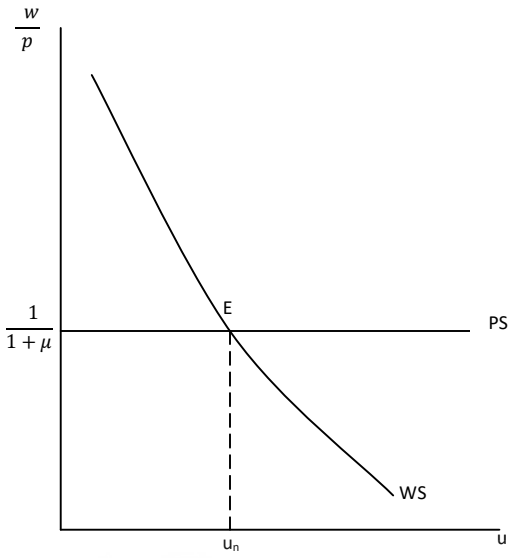


**Fig. 2.3: Labour Market Equilibrium**

Remember that the labour market is in equilibrium where the WS and the PS curves intersect. A little thought will make it clear that the WS curve is similar to the supply curve of labour in non-competitive markets. You may wonder that the WS curve in Fig. 2.3 is downward sloping while the supply curve is upward sloping. Notice that in Fig. 2.3 we measure the level of unemployment on the x-axis – as unemployment increases there is a decrease in the level of employment. With the decrease in employment, there will be a decrease in the level of output. Thus we get a downward sloping WS curve. Had we measured employment (the opposite of unemployment) on the x-axis, we would have got an upward sloping WS curve, which is similar to the supply curve of labour. Further, the PS curve is similar to demand curve of labour in non-competitive conditions. Equilibrium real wage is equal to $\frac{1}{1+\mu}$ which is the real wage implied by the PS curve. You should note that the intersection of the WS and PS curves in Fig. 2.3 gives us the equilibrium level of unemployment in the labour market. This equilibrium rate of unemployment $u_n$ is also known as the natural rate of unemployment. The natural rate of unemployment is the minimum unemployment rate which results due to various factors in an economy. These factors could be the structure of the labour force and ongoing economic environment. At any point of time there are some workers who are in a transition of job from one firm to another. There are some workers who have been replaced by technology and they are on the lookout for a new job. These workers are unemployed temporarily, which is reflected in the natural rate of unemployment.

**Check Your Progress 1**

1) Explain how the equilibrium real wage and unemployment get impacted in the following cases:

   i) Unemployment benefits being given by the state

   ii) Increasing number of people being self-employed or employed in informal jobs

   iii) Anti-monopoly legislation

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2) Bring out the factors that influence wage setting by a firm.

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3) In an imperfectly competitive market, how do firms set prices?

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4) Explain why the classical aggregate supply curve is vertical.

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## 2.4 DERIVATION OF THE AGGREGATE SUPPLY CURVE

The aggregate supply relation can be easily derived from the WS and PS relations. We learnt from equation (2.4) that $P = (1 + \mu)W$. Also, we learnt from equation (2.3) that $W = P^e F(u, z)$. Therefore, we can write the following equation:

$$P = (1 + \mu)W = (1 + \mu)P^e F(u, z) \quad \ldots (2.7)$$

In equation (2.7), you should note that the values of $P^e$, $\mu$ and $z$, are given. Thus price level *P* is inversely related to unemployment rate in the economy, *u*. This is because nominal wage W is an inverse function of *u*. If *P* is inversely related to *u*, it must be directly related to output level, *Y.* This can be seen by looking at the definition of unemployment rate and the production function.

Unemployment Rate $u = \frac{L-N}{L}$ where $L$ is the labour force and $N$ is total employment.

Also, the production function can be written as $Y = AN$, where $A$ denotes labour productivity and $N$ is employment. Recall that we assumed A = 1 (see Sub-Section 2.3.2). We continue with the same assumption. Thus the production function can be rewritten as $Y = N$.

Using the above results, $u = \frac{L-N}{L} = \left(1 - \frac{N}{L}\right)$ and $Y = N$, we can write the following relation:

$$P = P^e\,(1+\mu)F(1-\frac{Y}{L}, z) \qquad \ldots (2.8)$$

Equation (2.8) is the equation of the AS curve. Since price is inversely related to *u*, it is directly related to output level, *Y*. The parameters in the AS equation are based on the given levels of expected price $P^e$, mark-up $\mu$ and catch-all variable *z*. Price is directly related to each of these parameters and any increase in these parameters shifts the AS curve upwards. A shift in the AS curve indicates a higher price P corresponding to each level of output, Y.

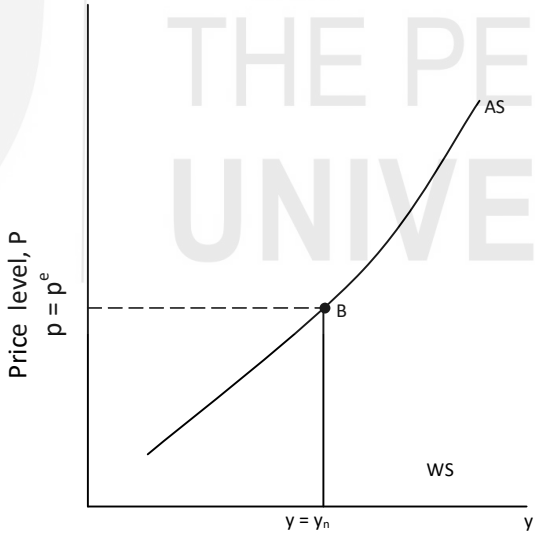



**Fig. 2.4: Aggregate Supply Curve**

Recall the definition of the supply curve – it describes the relationship between quantity supplied and the price level. The curve AS in Fig. 2.4 is the aggregate supply curve which is upward sloping. It shows that as the price level *P* rises, output level *Y* also rises. The figure also shows that the AS curve passes through point B where output level Y equals the natural level of output (also called

potential output of an economy) and the price level P equals the expected price level $P^e$. Let us explain the reasons for this.

An increase in output implies an increase in employment, N, and a fall in unemployment $u$. We know that as $u$ falls, nominal wage, W rises on account of wage setting in the less than competitive labour market. We also know that a higher wage leads the firms to set higher prices since price is a mark-up over the costs. It means that as output rises, prices also rise and we have an upward sloping AS curve.

From the equilibrium in the labour market, we know that when price equals the expected price, i.e., $P = P^e$, the equilibrium rate of unemployment is at the natural rate of unemployment, i.e., $u = u_n$. In accordance with the production function, there is a unique correspondence between employment level (and by implication unemployment) and output level. Hence the natural rate of unemployment $u_n$ corresponds to the natural level of output $Y_n$. It is that level of output which prevails if price equals expected price. Thus every AS curve passes through a point where $P = P^e$ and $Y = Y_n$. This has important implications as given below.

- When $Y = Y_n$ then $P = P^e$
- When $Y > Y_n$ then $P > P^e$
- When $Y < Y_n$ then $P < P^e$ … (2.9)

## 2.5 SHIFT OF THE AS CURVE

Let us look into equation (2.8), the aggregate supply curve.

$$P = P^e (1 + \mu)F(1 - \frac{Y}{L}, z)$$

As pointed out earlier, there is a positive relation between P and Y. Apart from P and Y, there are three factors that influence the AS curve, viz., (i) expected price $P^e$, (ii) mark-up $\mu$, and (ii) catch-all variable $z$. Any change in these factors lead to a shift of the AS curve. Let us see how a change in any of these factors affect the AS curve.

### 2.5.1 Change in Expected Price $P^e$

We have already shown that the AS curve passes through the expected price $P^e$ and the natural level of output $Y_n$. Suppose there an increase in the expected price to $P^{e\prime}$. It means that firms expect an increase in prices and they would supply a lower quantity at the existing price. This would shift the AS curve upward to the left as shown in Fig. 2.5. The new AS curve is shown as $AS'$ in the figure. Similarly, if the firms expect a fall in price (which means a decrease in expected price from $P^e$ to $P^{e"}$, they like to supply more in the present than in future. Thus there will be an outward shift in the AS curve to the right. Accordingly the AS curve will shift to $AS_2$.

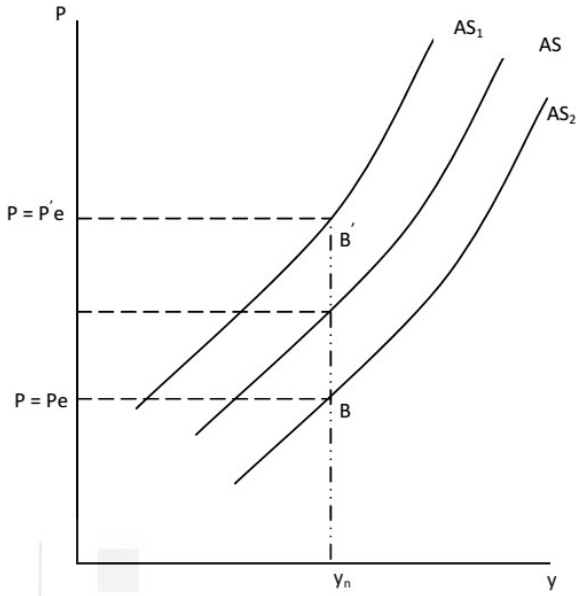



**Fig. 2.5: Shift in the AS curve**

This also helps us to see that if the aggregate demand (AD) and aggregate supply (AS) curves intersect at an output level which is lower or higher than $Y_n$ , this leads to shifts of AS curve till $Y_n$ is reached in the medium run. Let us consider an example. From the set of results given at (2.9) above, we know that if $Y > Y_n$ then $P > P^e$.

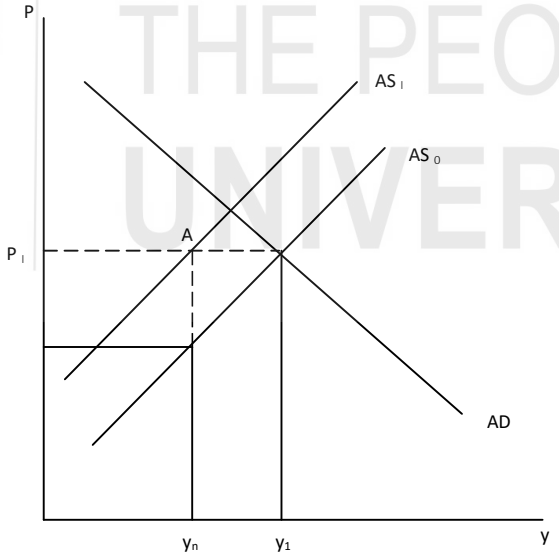



**Fig. 2.6: Expected Prices and the AS Curve**

We consider such a case in Fig. 2.6. Here $AS_0$ curve was drawn on the basis of $P^e = P_0$ and hence it passes through $P_0$ and $Y_n$. The economy starts in a short run equilibrium where $AS_0$ and AD intersect at $Y_1$ and $P_1$. It means that the actual price P is higher than the expected price $P^e$. Sooner or later, workers will realise that they are at a loss since they had considered a lower $P^e$ equal to $P_0$ while setting the wages.

With this realisation, workers will now revise their expectations about prices (The timing and the method of revision depends on the nature of wage contract and the method of forming expectations). Let us assume that workers form expectations about prices such that expected price equals the previous period's price or $P_t$=$P_{t-1}$. Coming back to Fig. 2.6, when the workers realise that the actual price $P_1$ exceeds the expected price $P_0$, they revise their expectations upward and the new expected price becomes $P_1$. With higher expected prices, they ask for higher wages and subsequently, firms charge a mark-up over revised wages. We thus have a new AS which shows higher prices at each level of output. The new AS curve $AS_1$ passes through new expected price $P_1$and the natural level of output $Y_n$, shown by point A in the figure. $AS_1$ curve lies above the $AS_0$ curve. (It should be noted that the economy is still not in medium run equilibrium but this will be discussed at length in the next Unit).

### 2.5.2 Change in Mark-Up μ and Catch-All Variable z

An increase in z leads the workers to demand higher wages for each level of unemployment/employment and thus the firms charge a mark-up over higher wages. An increase in z shows as a upward shift in the AS curve.

An increase in μ means that firms charge a higher mark-up above the costs and thus prices are higher corresponding to each level of output. Once again, the AS curve shifts upwards due to an increase in the mark-up μ.

## 2.6 SHORT-RUN AND LONG-RUN AGGREGATE SUPPLY

The short run aggregate supply curve (SRAS) is thus an upward sloping curve showing a direct relationship between output and prices. Each SRAS is drawn on the assumption of given expected prices. In the medium and the long run, however, price expectations can change resulting in the shifts of SRAS. With a change in expected prices, there is a new SRAS which passes through new expected price and natural level of output.

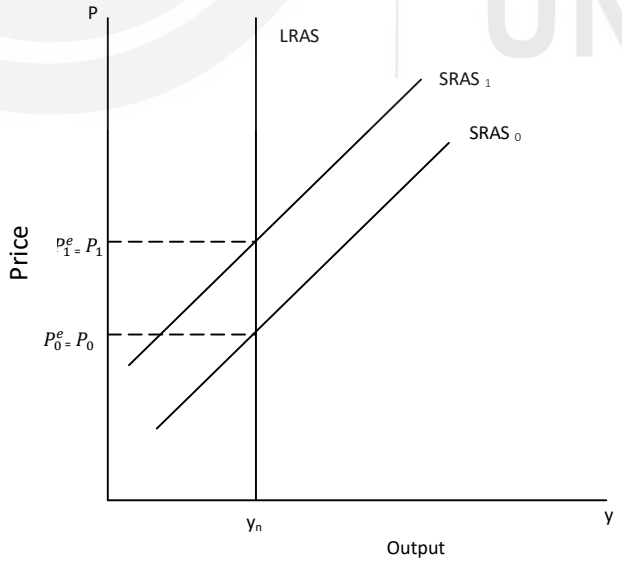



**Fig. 2.7: Long-Run AS Curve**

The points where different SRAS pass through $Y_n$ can be joined to derive the long-run aggregate supply (LRAS). In the long run, input prices change at exactly the same rate as output prices. Hence the aggregate supply curve becomes vertical. Actual output in the long is equal to the natural or potential output. It can be seen from Fig. 2.7 that the LRAS is a vertical line where output is fixed at $Y_n$ for different prices where each price equals expected price or $P = P^e$.

The level of potential output changes over time. Let us find out the reasons for such changes in potential output. You should note that potential output will change if there are changes in the quantity of labour, stock of capital, amount of natural resources, or the state of technology. Thus there are two sources of growth: (i) growth of inputs, and (ii) technological progress. The potential GDP increases over time as the economy accumulates resources. There are more machinery, more buildings, more raw materials, etc. These inputs lead to an increase in the production capacity of the economy. The other source, i.e., technological progress takes place over time in many fields. You would have noticed how more and more powerful computers and mobile phones have been invented over the years. Such improvement in technology is taking place in most fields. Technological progress leads to increase in productivity or efficiency. It implies we can produce more output from the same level of inputs.

Thus, the position of the LRAS curve moves to the right over a period of time. You should note that the changes in the level of potential output do not depend on the price level.

## 2.7 AS CURVE IN THE MEDIUM RUN

Medium run is a period of time during which the economy adjusts its fixed inputs (say, capital) to its long run level. In macroeconomics we can assume a period of about 5 to 10 years to fall under the category of medium rum. We learnt above that the AS curve is vertical in the long run (Classical) and horizontal in the short run (Keynesian).

Let us understand the medium run dynamics. In case the firms face high demand for their goods and services, they respond by producing more in short run. As the aggregate output continues to increase, firms and economy move closer to their full capacity. It is not likely that the whole economy suddenly reaches the full employment level of output. As the AD increases, the firms' response would be to increase output in the beginning. As AD keeps on increasing further, firms' will start increasing prices. The firms also begin to reach their full capacity constraints; they cannot increase their production capacity in the short run.

As you know from microeconomics, certain inputs such as capital and top management are fixed in the short run. Some firms and industries will reach their maximum production capacity before others; so there will be no kink in the AS curve. Simultaneously, there will be a decline in the unemployment rate as the economy is moving towards the full capacity level. At some level of output (Y*), it is virtually impossible for the firms to expand any further because all factors of

production are fully utilized. At that level of output, whatever be the price level, output cannot increase further.

In Fig. 2.8, we depict the upward sloping AS curve. The segment A to B shows the flatter portion (Keynesian zone), while the segment C to D shows the steeper portion (Classical zone) of the AS curve. We notice that all the three time periods (short-run, medium-run and long-run) are summarised in the above figure. The characteristic described in the AS curve are as follows: till about point B, it is the short run. Medium run is from point B to about point C (intermediate zone). Point C onwards, it is the long run (output Y*). During recession the economy is operating on the flat part of the AS curve (Keynesian view). The maximum an economy can produce is Y*, i.e., full employment output (classical view).

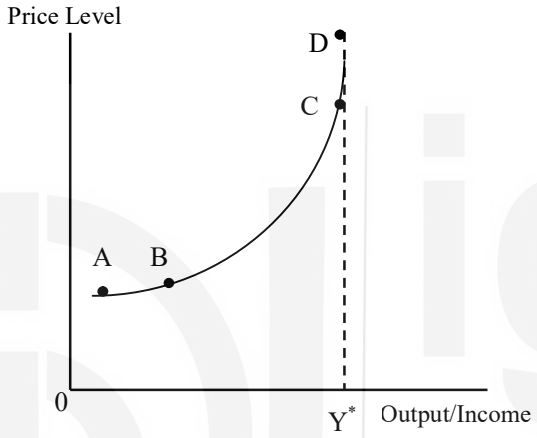



**Fig. 2.8: Medium Run Aggregate Supply Curve**

The Keynesian position of horizontal AS curve and the classical position of the vertical AS curve are exceptions. In normal circumstances, the AS curve is upward sloping. Therefore, we consider the medium-run AS curve for further analysis.

### 2.7.1 Slope of the Medium Run AS Curve

Response of input prices to changes in overall price level is the basis of difference between classical and Keynesian views. According to the Classical economists, price changes are fully anticipated. It means the expectations of producers and households are realised. For example, if producers expect that prices will increase by 10 per cent in the coming year, prices actually increase exactly by 10 per cent (neither more than 10 per cent, nor less than 10 per cent).

The Keynesian view, however, holds that an increase in price level is not fully anticipated every time. There is some time lag between the changes in input prices and the changes in output prices. In other words, the wage rate is sticky.

There are several reasons for this: (i) Nominal wages are slow to adjust to changing economic conditions. This could be attributed to 'long term contracts' between workers and firms. Usually wage rate is decided in advance, as part of the contract. (ii) Firms have to incur costs for adjusting prices.

Let us take an example of a restaurant. Vegetable prices in the market change so frequently; but restaurants maintain the same prices of food items on the menu card. If restaurants wish to change prices of food items according to vegetable prices, they have to print menu card so frequently. The printing and distribution cost of menu cards will eat away major part of their profits! A similar situation applies to other firms and they keep their prices unchanged, unless price trend in the economy is clear and significant.

Keynesian economists term this reason as 'menu cost'. (iii) Customers are accustomed to certain prices of the goods and services they purchase. They expect prices to be maintained at the same level and resist increase in prices. In order to retain their market share and customer goodwill, firms do not increase prices frequently. Thus, prices change only slowly over time. Hence, the aggregate supply curve slopes upward (See Fig. 2.9).

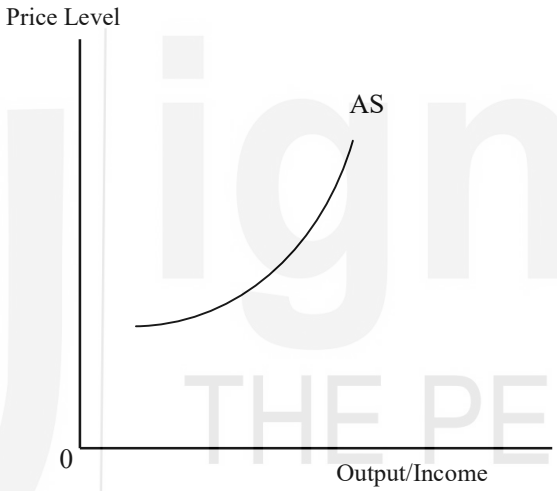



**Fig. 2.9: Medium Run Aggregate Supply Curve**

### 2.7.2 Shifts in Medium Run AS Curve

By now, you know that the AS curve describes the relation between output produced in the economy and price level. Thus any change in prices will result in a movement along the AS curve. There are several factors, apart from prices, that influence aggregate output. When we draw an AS curve, we assume these other factors to remain constant. Thus, any change in these factors results in a shift in the AS curve. Let us identify these factors.

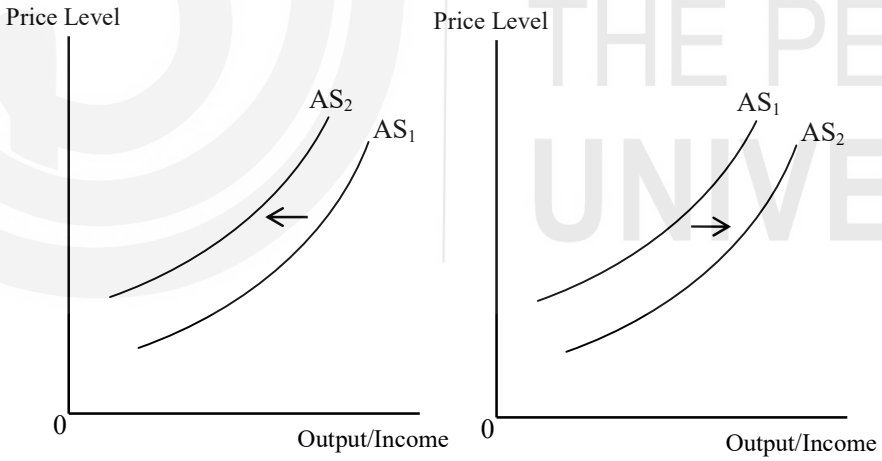
Anything that affects (apart from the price of the good) the individual firm's decision on output and prices can shift the aggregate supply curve in the short run. Thus there are several factors the shift the AS curve: supply shocks, economic growth, stagnation, public policy, and natural disasters. We discuss about these factors below.

(i) Input Prices: If the input prices fall, the cost of production also falls. It means that the firms can produce more in the given budget. Thus there is a shift in the AS curve to the right. Such a shift is depicted in panel

(b) of Fig. 2.10. Similarly, if there is an increase in input prices, production cost will increase. The AS curve will shift to the left, as shown in panel (a) of Fig. 2.10. Fluctuation in input prices is a common phenomenon. You might have observed periodical increases in crude oil prices which severely affects the Indian economy.

(ii) Technological Progress: We have discussed about the impact of technological progress on the AS curve in Section 2.6. Advancement in technology increases productivity of firms. You should note that the AS curve shifts to the right (see panel (b) of Fig. 2.10) as a result of technological progress.

(iii) Public Policy: The government provides incentives to firms so that economic growth accelerates. These incentives could be in the form of tax cuts for firms or higher government expenditure on infrastructure creation (such as roads, power supply, communication, etc.). Such incentives reduce the cost of production of firms, as a result of which the AS curve shifts to the right. Conversely, if the government policies are such that it increase the cost of production (such as stricter environmental norms, increase in tax rate, reduction in public expenditure on infrastructure), there is a left-ward shift in the AS curve. You should note that changes in tax rate on household income influences the AD curve, not the AS curve.




**Panel (a)** **Panel (b)**

**Fig. 2.10: Shifts in Medium Run Aggregate Supply Curve**

(i) Recession: Business cycles affect the AS curve. During recession there is accumulation of inventories and firms are pessimistic about the future. There is not much demand for goods and services also. In such circumstances, the AS curve shifts to the left (as shown in panel (a) of Fig. 2.10). Conversely, during the expansion phase of a business

cycle, firms are optimistic in their business operations. The AS curve will shift to the right (as shown in panel (b) of Fig. 2.10) during the expansion phase.

(ii) Natural Disasters: An economy is often struck by natural disasters such as flood, drought, earthquake, etc. Such disasters affect production adversely and the AS curve shifts to the left.

**Check Your Progress 2**

1) Explain why there is a shift in the AS curve due to change in $P^e$.

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2) State the reasons for the upward slope of the medium run aggregate supply curve.

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3) Explain the factors that will result in a rightward shift in the aggregate supply curve (use appropriate diagram).

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## 2.8 LET US SUM UP

In this Unit, we saw how the shape of AS curve depends on the conditions of the labour market. Under conditions of less than competitive labour and commodity markets, the AS curve slopes upwards showing a positive relation between the output and the price level. A change in expectation about prices shifts the AS curve which yields a vertical AS curve in the long run. We also discussed the impact of certain variables on the AS curve.

## 2.9 ANSWERS/ HINTS TO CHECK YOUR PROGRESS EXERCISES

**Check Your Progress 1**

1) (i) This increases z and WS shifts to the right. Real wage remains the same whereas unemployment rises. Real wage is implied by PS curve. Now workers will accept the same real wages, only at a higher rate of unemployment.

(ii) WS shifts to the left as z falls. Real wage remains the same but unemployment falls.

(iii) Mark-up falls leading to an upward shift of PS curve. Real wage rises and unemployment falls.

**Check Your Progress 2**

1. Go through Sub-Section 2.5.1 and answer.
2. The reasons for upward sloping AS curve are: (i) Nominal wages are slow to adjust to changing economic conditions; (ii) Firms have to incur cost for adjusting prices which are called menu costs; and (iii) Social norms and notions of fairness expect that firms do not change prices frequently.
3. There are several factors that affect aggregate supply and result in a shift in the AS curve. These could be supply shocks, public policy, business cycle, and natural disasters. Identify the situations that will shift the AS curve to the right. Go through Sub-Section 2.7.2 for details.

# UNIT 3 EQUILIBRIUM OUTPUT AND PRICES*

**Structure**



## 3.0 OBJECTIVES

The objective of this chapter is to use the AS-AD curves and see how output and prices get impacted due to the shifts in these curves. The chapter will also help us to understand that the government policy cannot impact output in the medium run.

## 3.1 INTRODUCTION

We derived the AD and AS curves in the last few chapters. In this chapter, we will bring them together and look at the impact of demand and supply shocks on the equilibrium output and the prices, both in the short run and in the medium run. We will also go behind the scenes and understand what happens to rate of interest and investment spending. Also, through the labour market, we will look at the impact on real wages.

## 3.2 EQUILIBRIUM OUTPUT AND PRICES: SHORT RUN AND MEDIUM RUN

Let us recall the equation of AD as $Y = \gamma A + \beta \frac{M}{P}$ or $P = \frac{\beta M}{\gamma A - Y}$ … (3.1)

where $\gamma = \frac{h\alpha}{h + \alpha b k}$ and $\beta = \gamma \frac{b}{h}$

Here $A$ is the fiscal policy parameter; $\gamma$ is the fiscal policy multiplier; $^{M}/_{P}$ is the real money supply and $\beta$ is the monetary policy multiplier. Let us recall that expansionary policies, both fiscal and monetary, shift the AD curve to the right


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(or upward) and contractionary policies lead to a leftward (or downward) shift of the AD curve. Apart from policy changes, AD curve can shift due to any change in the autonomous spending *A*. The shift in AD curve due to a change in any component of aggregate demand is also referred to as *demand shocks*.

The AS curve can be expressed as $P = P^e\,(1+\mu)F(1-\frac{Y}{L}, z)$ … (3.2)

Each AS curve is drawn based on the given levels of expected price $P^e$ (we will discuss further about expectations in Units 4 and 5), mark-up $\mu$ and catch-all variable $z$. Change in any of these parameters result in a shift of the AS curve. The shift of the AS curve due to a change in $\mu$ or $z$, are referred to as *supply shocks*. We have also seen that each AS curve passes through a point where $P = P^e$ and $Y = Y_n$. From the above, we can draw the following inferences:

- When $Y = Y_n$ then $P = P^e$
- When $Y > Y_n$ then $P > P^e$
- When $Y < Y_n$ then $P < P^e$

### 3.2.1 Equilibrium in the Short Run

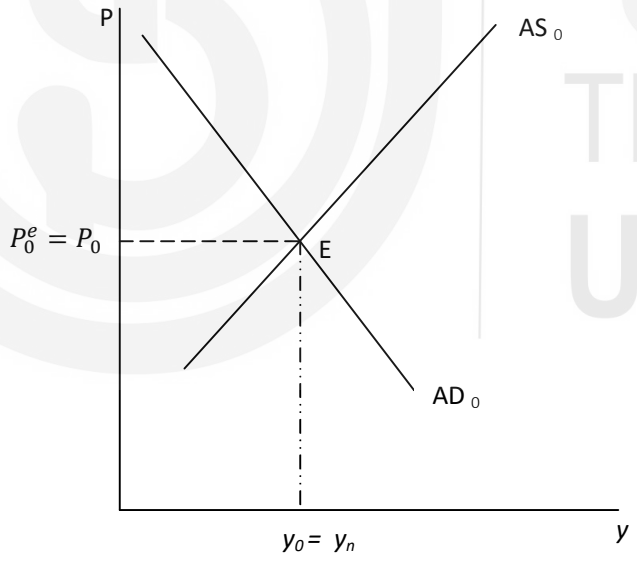



**Fig. 3.1: Equilibrium in the Short Run**

In Fig. 3.1 the aggregate demand curve is $AD_0$ and aggregate supply curve is $AS_0$. The AD and AS curves intersect at point E giving an equilibrium output $Y_0$ and equilibrium price level $P_0$. Let the output $Y_0$ be equal to the natural rate of output $Y_n$. Recall that if $Y = Y_n$, then $P = P^e$. It means that $P_0$ is also the expected price or is equal to $P_0^e$. Here the AD curve has been drawn for given values of fiscal policy parameter *A* and money supply *M*.

At point *E*, the goods market, financial market and the labour market are all in equilibrium. This is because point *E* lies on both the AD and the AS curves.

However, in the *short run*, there is no reason for the intersection of the AD and the AS curves to result in an equilibrium output which is equal to the natural rate of output. Equilibrium output could be less than or more than the natural rate of output. Equilibrium output depends on the position of AD and AS curves which in turn depends on the monetary and fiscal policies as well as mark-up $\mu$ and catch-all variable *z*.

### 3.2.2 Short Run to Medium Run

Let us now focus on the dynamics of moving from the short run to the medium run (see Fig. 3.2). We start with aggregate supply curve $AS_0$ and aggregate demand curve $AD_0$. Price level is at $P_0$, which is the expected price ($P^e$) also. Equilibrium output is $Y_1$, which is above the natural rate of output.

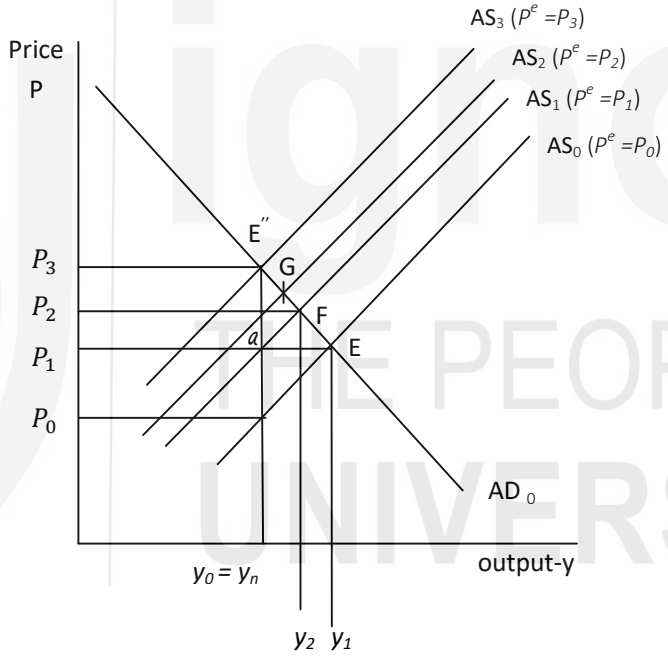



**Fig. 3.2: Equilibrium in the Medium Run**

This is the short run equilibrium we discussed in the previous sub-section. However, we know that when $Y > Y_n$ then $P > P^e$. In Fig. 3.2, $AS_0$ curve was drawn on the basis of $P^e = P_0$ and hence it passes through $P_0$ and $Y_n$ (notice that it is not the equilibrium price). The economy starts in a short run equilibrium where $AS_0$ and AD intersect at $Y_1$ and $P_1$. It means that the actual price $P_1$ is higher than the expected price $P^e = P_0$. Sooner or later, workers will realise that their actual real wage is lower than the expected real wage since they had considered a lower $P^e$ equal to $P_0$ while setting the wages. With this realisation, they will now revise their expectations about prices (The timing and the method of revision depends on the nature of wage contract and the method of forming expectations).

Let us assume that workers form expectations about prices such that expected price equals the previous period's price or $P_t$=$P_{t-1}$. Coming back to Fig. 3.2, when the workers realise that the actual price $P_1$ is higher than the expected price $P_0$, they revise their expectations upward and the new expected price becomes $P_1$. With higher expected prices, workers bargain for higher wages. Higher wage rate leads to an increase in the cost of production and firms charge a mark-up over revised wages while setting prices. We thus have a new AS curve which shows higher prices at each level of output. Thus there is a shift in the AS curve from $AS_0$ to $AS_1$. The new AS curve $AS_1$ passes through new expected price $P_1$and the natural level of output $Y_n$, (point $a$) and lies above the $AS_0$ curve. The new equilibrium is given by point *F* where the AD curve intersects the mew AS curve, with prices equal to $P_2$ and output equal to $Y_2$. (Please note that point *F* is different from the point *a* which gives the position of $AS_1$curve). The economy is still not in medium run equilibrium at point *F* as the equilibrium output $Y_2$ is greater than the natural rate of output $Y_n$. Once again, we know that when $Y > Y_n$ then $P > P^e$. Sooner or later, workers will again realise that the real wage paid to them is lower than the expected real wage since they had considered a lower $P^e$ equal to $P_1$while setting the wages. With this realisation, they will once again revise their expectations about prices and the new expected price will be equal to $P_2$ . The AS curve will shift upward to $AS_2$ which passes through expected price ($P_2$) and natural rate of output ($Y_n$) at point *b*. The equilibrium is now given by the intersection of *AD* and $AS_2$ at point *G*. Once again we do not reach natural output level ($Y_n$). The same process as described above takes place and comes to an end only when the *AS* curve has shifted sufficiently to intersect the *AD* curve at $E^{"}$ where the equilibrium output equals the natural rate of output $Y_n$ and now the equilibrium price is the expected price level. Point $E^{"}$ gives the medium run equilibrium. At this point, the wage setters have no reason to change their expectations about prices any further and therefore, there is no further shift of the *AS* curve. To sum it up:

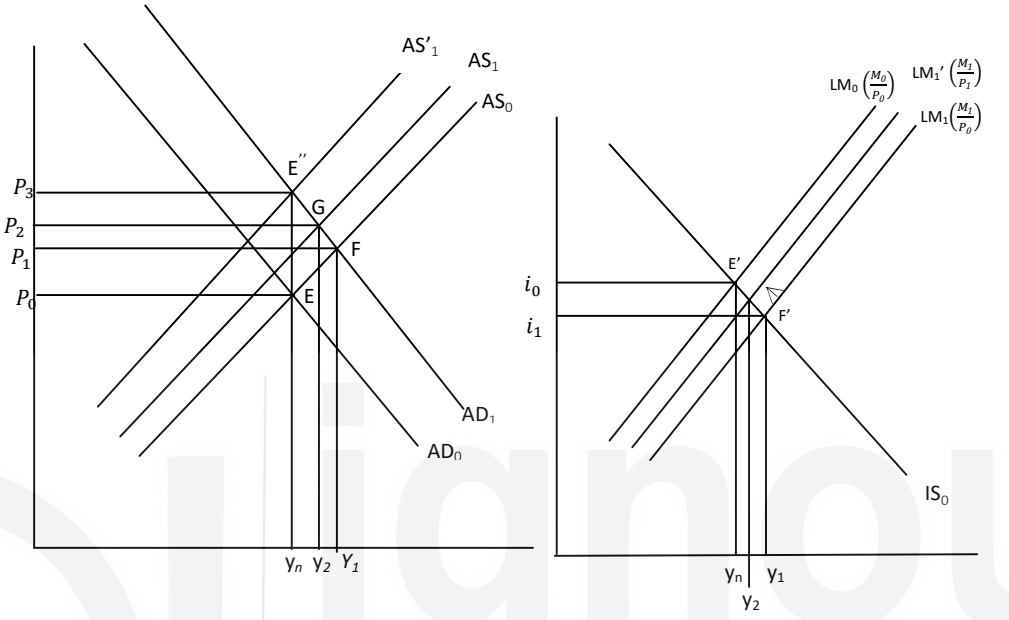
- In the short run (SR), output can be equal to, below or above the natural rate of output.
- In the medium run (MR), the output comes back to the natural rate of output. If the economy had started in a short-run equilibrium with $Y > Y_n$, the eventual rise in price level decreases the demand and the level of output. The adjustment from the SR to the MR works through the changes in price level.

In the following sections, we will look at the dynamics of adjustment on account of disturbances due to the demand shocks and supply shocks.

## 3.3 DEMAND SHOCKS

Recall that the shifts in AD curve due to a change in any component of aggregate demand is also referred to as *demand shocks*.

### 3.3.1 Expansionary Monetary Policy




**Panel (a)** **Panel (b)**

**Fig. 3.3: Effect of Monetary Expansion**

Let us consider Fig. 3.3. In panel (a) of Fig. 3.3 we present equilibrium in the economy with the help of AD and AS curves. In panel (b) we present the corresponding equilibrium with the help of IS and LM curves. Panel (a) shows that the economy operates with $AD_0$ and $AS_0$ and there is medium run equilibrium in the economy. The equilibrium is at point *E* with output equal to $Y_n$ and price level equal to $P_0$. Here, $P_0$ is also the expected price level.

Panel (b) of Fig. 3.3 shows that output level $Y_n$ corresponds to an interest rate of $i_0$ since the *IS* and *LM* curves intersect at $i_0$ and $Y_n$. Let us assume that there is a monetary expansion (i.e., money supply increases from $M_0$ to $M_1$). It will lead a decrease in interest rate, which will increase investment expenditure. Thus, the *AD* curve will shift proportionately from $AD_0$ to $AD_1$ (see Panel(a)). Point E′ in panel (b) corresponds to point E in panel (a) of Fig. 3.3.

In the short run, equilibrium shifts from point *E* to point *F* where output is equal to $Y_1$ and prices rise to $P_1$. This corresponds to point $F'$ in panel (b) of Fig.3.3. Note that a monetary expansion, initially shifts the LM curve to $LM_1$which is drawn on the basis of higher money stock $M_1$and the old price level $P_0$. However, since the price level rises to $P_1$ in the short run (see Panel (a) of Fig. 3.3), real money balances decrease to some extent and the relevant *LM* curve becomes $LM_1'$ which is based on money supply $M_1$ and higher price level $P_1$.

As we saw earlier, point F can only be the short run equilibrium because at *F*, the output is greater than natural rate of output and the actual price $P_1$ is higher than the expected price $P_0$. Sooner or later, workers will revise their expectations about prices and the new expected price becomes $P_1$. With higher expected Prices, there is a new AS curve $AS_1$ which passes through the new expected price $P_1$and the natural level of output $Y_n$. The new equilibrium is at point G with price rising to $P_2$ and the output becoming $Y_2$. The rise in prices further reduces the money balances and shifts the LM curve, further upwards in Panel (b) of Fig. 3.3. The process of upward shifting of the AS curve and also the LM curve continues till the economy reaches a new medium run equilibrium at point $E''$ where the output comes back to $Y_n$ and price becomes $P_3$. At this point, the wage setters have no reason to change their expectations about prices any further and therefore, there is no further shift of the *AS* curve. In panel (b) of Fig. 3.3, we observe that the LM curve shifts back completely till it coincides with the original *LM* curve $LM_0$ but the final LM curve is based on higher money stock $M_1$ and higher prices $P_3$. The real money balances $M_1/P_3$ is equal to the original real balances $M_0/P_0$. The interest rate comes back to the original rate of interest $i_0$. Thus a monetary expansion has no impact on any real variables in the medium run. Thus we can say that money is *neutral* in the medium run.

The results of a monetary expansion is summarised in Table 3.1.

**Table 3.1: Effects of Monetary Expansion**

| | **Output** | **Prices** | **Rate of Interest** |
|---|---|---|---|
| **Short Run** | Rises | Rises | Falls |
| **Medium Run** | Comes back to $Y_n$ | Rises | Comes back to original |

### 3.3.2 Expansionary Monetary Policy and Rational Expectations

If the expectations about prices are rational (see Unit 5), an expansionary monetary policy will have no impact on output and real balances even in the short run. This is because, workers with perfect foresight and a fully credible monetary policy, revise their expectations about prices in such a manner that in the short run itself, the expected prices become equal to the final prices. The *AS* curve shifts upwards in the short run itself so as to intersect the new *AD* curve at natural rate of output $Y_n$ and higher prices ($P_3$ in Fig. 3.3(a)). Monetary policy does not impact output in the short run also.

### 3.3.3 Expansionary Fiscal Policy

Let us look into the effect of fiscal policy on output and prices. We explain the impact of fiscal policy on output and prices in the short and the medium run with the help of Fig. 3.4.

In panel (a) of Fig. 3.4 we present the effect of an increase in government expenditure through AD and AS while in panel (b) we show it through IS and LM curves. Once again, we begin with $AD_0$ and $AS_0$. Panel (a) of Fig. 3.4 shows that the economy is in medium run equilibrium at point *E* with output equal to $Y_n$ and Price level equal to $P_0$. We also find that $P_0$ is the expected price level. Panel (b) of Fig. 3.4 shows that equilibrium is at point $E'$. Equilibrium output level $Y_n$ corresponds to an interest rate of $i_0$ since the *IS* and *LM* curves intersect at $i_0$ and $Y_n$.

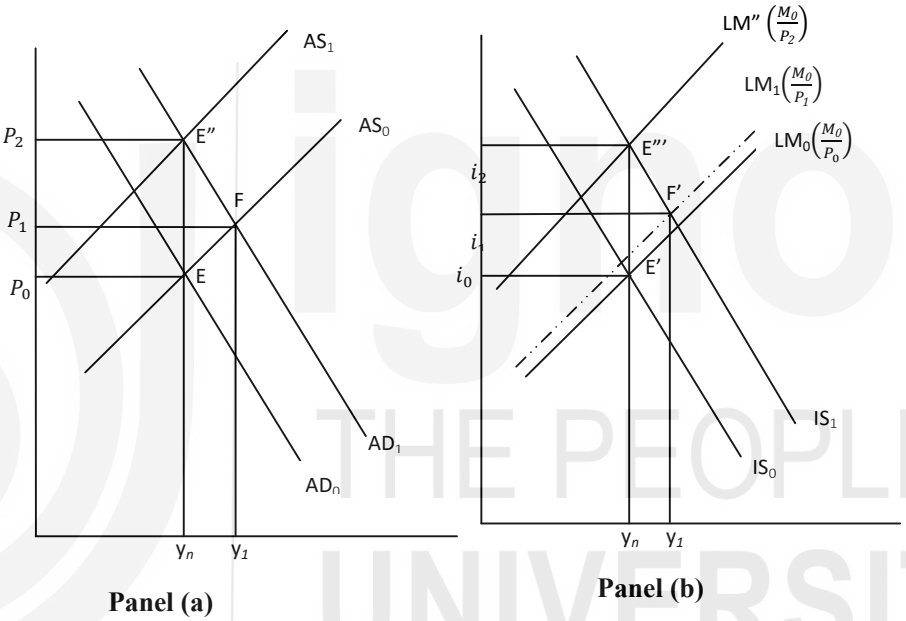



**Fig. 3.4: Effect of Fiscal Expansion**

Let us assume that there is an increase in government expenditure (G) so that the AD curve shifts to the right from $AD_0$ to $AD_1$. As a result, the short run equilibrium occurs at point *F* with output equal to $Y_1$ and prices equal to $P_1$.

In Fig. 3.4(b) we depict the impact of an increase in G through a right-ward shift in the IS curve, from $IS_0$ to $IS_1$. The *LM* curve shifts upwards to some extent (see the dotted line) due to rise in prices. The short-run equilibrium is at point $F'$ with output equal to $Y_1$ and rate of interest equal to $i_1$. In the short run, the effect on investment is ambiguous since there is an increase in both the income level and the rate of interest.

In panel (a) of Fig. 3.4, point *F* is the short run equilibrium since output is greater than the natural rate of output. Similarly, actual price $P_1$ is higher than the expected price $P_0$ . Sooner or later the workers will realise that their real wage has

declined, and they will revise their expectations about prices. This will cause an upward shift in the AS curve. Correspondingly, the LM curve will shift up. The process will continue till equilibrium reaches the point $E''$ where output is back at the natural rate of output. Notice that output level increased in the short-run but came back to its natural level in the medium run. The prices however are permanently at a higher level. The corresponding point of equilibrium in panel (b) of Fig. 3.4 is $E'''$. The equilibrium with output is equal to $Y_n$ with a higher rate of interest $i_2$.

As in the case of expansionary monetary policy, output comes back to the natural rate of output in the medium run and prices are permanently higher. However, there is an important difference compared to the impact of expansionary monetary policy. In the case of expansionary fiscal policy, the composition of output also changes. Although the output level is at the natural rate, because of the rise in government spending there is a fall in private investment spending. The fall in private investment is the result of a rise in the rate of interest. In other words, there is full crowding out.

**Table 3.2: Effect of Fiscal Expansion**

| | **Output** | **Prices** | **Rate of interest** |
|---|---|---|---|
| Short Run | Rises | Rises | Rises |
| Medium Run | Comes back to $Y_n$<br>Composition of output changes :↑ $G$ =↓ $I$ | Rises | Rises |

**Check Your Progress 1**

1. Expansionary monetary policy as well as expansionary fiscal policy result in output coming back to its natural level in the medium run. We say that the monetary policy is neutral but the same term is not used for fiscal policy. Explain why that is so.

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2. Assume that the economy starts at medium run equilibrium. Now let the government increase taxes. Using AS and AD curves, show the impact on output and prices in the short run and the medium run.

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## 3.4 SUPPLY SHOCKS

We will now look at the impact on output and prices as a result of the shift in the AS curve. As you know from Unit 2, the AS curve can shift either due to a shift in the wage setting (WS) curve or due to a shift in the (PS) curve [the AS curve also shifts due to change in the expectations about prices but that takes place as a transition from the short-run to the medium-run]. Here, we are concerned with the shift of the AS curve in the short-run itself or a supply shock. Recall that a change in the catch-all parameter z such as fall in z will shift WS curve down and an increase in mark-up μ will shift the PS curve downwards.

### 3.4.1 Shift in PS Curve

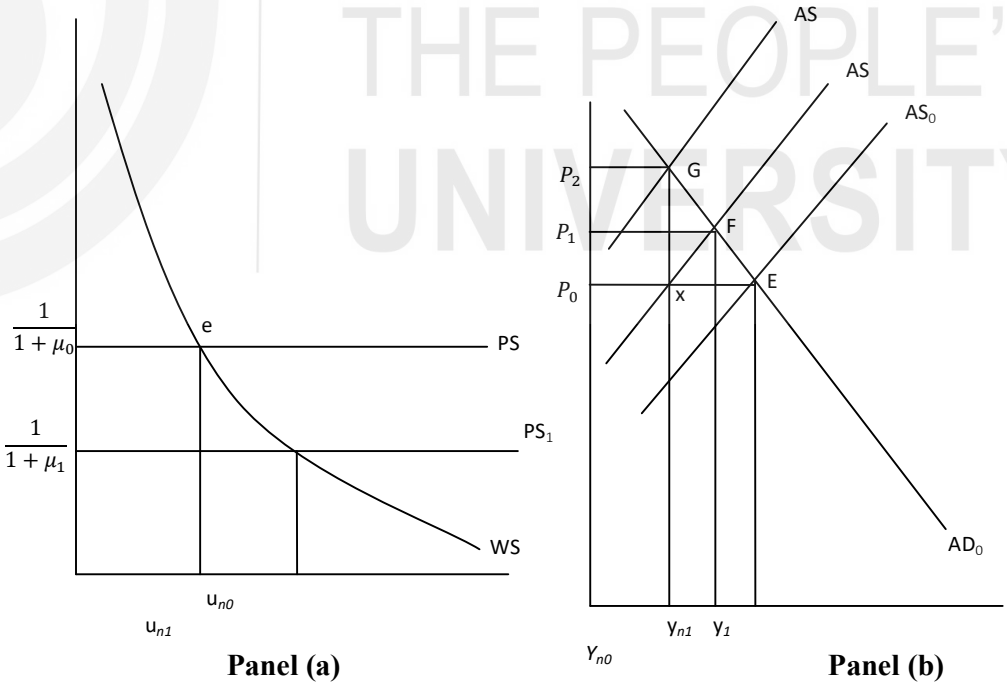


**Fig. 3.5: Effect of a Shift in WS Curve**

Look at Fig. 3.5. Panel (a) of Fig. 3.5 shows the *WS* and $PS_0$ curves intersecting at point e which gives the natural rate of unemployment as $u_{n0}$.

This corresponds to the natural rate of output equal to $Y_{n0}$ shown by the intersection of $AD_0$ curve and $AS_0$ curves (see panel (b)). The initial price which is also the expected price is equal to $P_0$. Now, let there be an increase in the global oil prices. This raises the raw material costs and the mark-up for the firms from $\mu_0$ to $\mu_1$. This leads to a downward shift of the *PS* curve from $PS_0$ to $PS_1$. Now the labour market (see panel (a) of Fig. 3.5) shows equilibrium at higher rate of unemployment $u_{n1}$ and lower real wage rate $\frac{1}{1+\mu_1}$.

A higher rate of unemployment corresponds to a lower natural rate of output $Y_{n1}$. In the short run itself, the AS curve shifts back to a new AS curve $AS_1$ which passes through the expected price $P_0$ and the new natural rate of output $Y_{n1}$ ($AS_1$ passes through point *x* in the lower part of figure 3.5). The short run equilibrium now happens at point *F* where the *AD* curve intersects the new AS curve. At *F*, the price level is higher ($P_1$) and the output level is lower ($Y_1$) than the original prices and output given by point *E*. In order to move to the *MR*, we need to compare the *SR* output $Y_1$ with the new natural rate of output $Y_{n1}$. Here, $Y_1 > Y_{n1}$ and $P_1 > P_0$. Since output $Y_1$ is greater than the natural rate of output $Y_{n1}$ and price level $P_1$ is higher than expected price $P_0$, the workers will revise their price expectations upwards and AS curve will shift up (passing through $Y_{n1}$ and new expected price $P_1$). This process continues till *AS* and *AD* curves intersect at $Y_{n1}$ and $P_2$, which is also the expected price now. The medium run equilibrium is given by intersection of $AD_0$ curve and $AS_2$ curve at point *G* (see panel (b) of Fig. 3.5. There will be no further change.

The impact of an adverse supply shock is summarised in Table 3.3.

**Table 3.3: Effect of a Shift in the WS Curve**

| | **Output** | **Prices** |
|---|---|---|
| Short Run | Falls | Rise |
| Medium Run | Falls to new natural rate | Rises |

### 3.4.2 Shift of WS Curve

The results are similar to those described above. Suppose there is an increase in contractualisation of labour resulting in a fall in the bargaining power of workers. This shows up as a fall in the catch-all parameter z and results in a leftward shift of the WS curve in the labour market.

In the labour market, the natural rate of unemployment *falls* and therefore the AS curve shifts to the right passing through *higher* natural rate of output and same expected prices. In the short run output will rise and prices would fall.

Since the actual prices are lower than expected prices, there would be a revision of price expectations downwards and the new medium run equilibrium would be at higher (natural) rate of output and lower prices which are also the expected prices.

**Check Your Progress 2**

1. Use WS-PS curves and AS-AD curves to trace out the impact of a rise in unemployment benefits on output and prices in the short and the medium run.

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2. Assume an economy starts in medium run equilibrium. The economy suffers an increase in global oil prices. However, the government increases the money supply in order to prevent recession in the short run. Show the impact on output and prices in the short run and the medium run.

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## 3.5 LET US SUM UP

The economy is continuously hit by shocks to the aggregate demand or aggregate supply or both. We have seen that in the medium run, economy always comes back to the natural rate of output. However, the natural rate of output, itself changes in case of supply shocks. However, in the short run, output can differ from natural rate of output and prices can be different from expected prices.

## 3.6 ANSWERS/ HINTS TO CHECK YOUR PROGRESS EXERCISES

**Check Your Progress 1**

1. Composition of output changes with fiscal policy and hence there is a real impact.
2. This is the case of contractionary fiscal policy. In the SR, output falls and prices rise. Rate of interest also falls in the SR. In the medium run, interest rate declines further and output returns to the natural rate of output. The prices are lower and are the equal to the expected prices.

**Check Your Progress 2**

1. WS curve shifts to right and there is a fall in the natural rate of output (a rise in the natural rate of unemployment). This is the case of an adverse supply shock. In the short run, prices rises and output falls. In the MR, output falls further and becomes equal to the new natural rate of output. Prices rise and equal the expected prices.
2. AD curve is shifted to the right through government policy at the time of an adverse supply shock. In the SR, output remains the same and prices rise. In the medium run, output falls to the new natural rate of output and prices rise further and equal the expected prices.