**EC201 Intermediate Macroeconomics**

# Lecture 10: Aggregate Demand and Aggregate Supply I

Lecture Outline:
- how to derive the aggregate demand from the *IS-LM* model;
- a preliminary AD-AS model;

Essential reading:
Mankiw: Ch. 10.3 and Ch. 12.2, 12.3

## Introduction

The IS-LM model is a model used to describe the equilibrium in an economic system when prices are fixed and where aggregate demand components are the main determinants of equilibrium output. Indeed, in describing the equilibrium on the goods market we have considered the usual identity: $Y = C + I + G$.

That identity implies that what determines Y is the right hand side, something we called aggregate planned expenditure. In deriving the IS curve we specified how the planned expenditure is determined (consumption as a function of disposable income, investments as a function of the interest rate). In practice, we have implicitly assumed that is the demand side of the economy (demand for consumption, investments and public expenditure) that determines final output. Therefore, in the IS-LM model there is almost no role for the supply side of the economy in determining final output. To overcome this issue, another macro model, called the AD-AS model, has been developed, where the equilibrium output is now determined by the intersection of aggregate demand (AD) and aggregate supply (AS). Moreover the IS-LM model can be used for short-run analysis but not to understand what may happens in the economy in the long-run. The AD-AS model overcomes also this problem.

The idea that aggregate demand is the main determinant of final output is derived directly from the Keynes' general theory, and this explains why the IS-LM model did not take into account the supply-side of the economy. In particular, according to Keynes the **Say's Law**[1] was not true, especially in the short-run. The Say's law says, roughly speaking, that: "supply creates its own demand", meaning that the supply-side of the economy is what really matters for final output determination. According

[1] Jean Baptiste Say (1767-1832), a French economist.

to this law, prosperity can be increased by stimulating production and not by stimulating the demand side of the economy as Keynes suggested. The Say's law has been considered valid by classical and neoclassical economists before Keynes's general theory appeared.

In general, we may assume that the Say's law may hold in the long run, when prices are flexible and can adjust to insure that aggregate demand is always equal to aggregate supply. However, in the short-run, when prices are sticky, the Keynesian version is probably more appropriate as a description of an economic system.

Therefore, for a ***classical*** (or neoclassical) economist:

1) *Output is determined by the supply side*:
    - supplies of capital, labor
    - technology
2) *Changes in demand for goods and services* (***C***, ***I***, ***G*** ) *only affect prices, not quantities.*
3) *Assumes complete price flexibility.*
4) *Applies to the long run.*

For a ***Keynesian*** economists we have:

1) *Prices are sticky in the short-run.*
2) Because of 1) *output depend on demand in the short-run*, which is affected by
    - fiscal policy (***G*** and ***T*** )
    - monetary policy (***M*** )
    - other factors, like exogenous changes in ***C*** or ***I***.

**The model of aggregate demand and supply**

The AD-AS model is a paradigm most mainstream economists and policymakers use to think about economic fluctuations and policies to stabilize the economy.

It shows how the price level and aggregate output are determined and it shows how the economy's behaviour is different in the short run and long run.

**Aggregate Demand**

First we need to define the concept of aggregate demand. This concept is similar to the microeconomic version of a demand function for a given good in a given market.

*The aggregate demand curve shows the relationship between the price level and the quantity of output demanded.*

In order to derive this aggregate demand we need a theory that tells us how aggregate prices can affect aggregate output and *vice versa*.

We have seen at least two theories that can be useful for this purpose. One is the **quantity theory of money** and the other is the **IS-LM model**. The IS-LM model will give us a better idea of what an aggregate demand function should look like, but it may instructive for the moment to consider the derivation of the aggregate demand from the quantity theory of money.

**Aggregate Demand and the Quantity Theory of Money**

The quantity equation is given by:

$$MV = PY \qquad 1)$$

Or, written differently:

$$P = \frac{MV}{Y} \qquad 2)$$

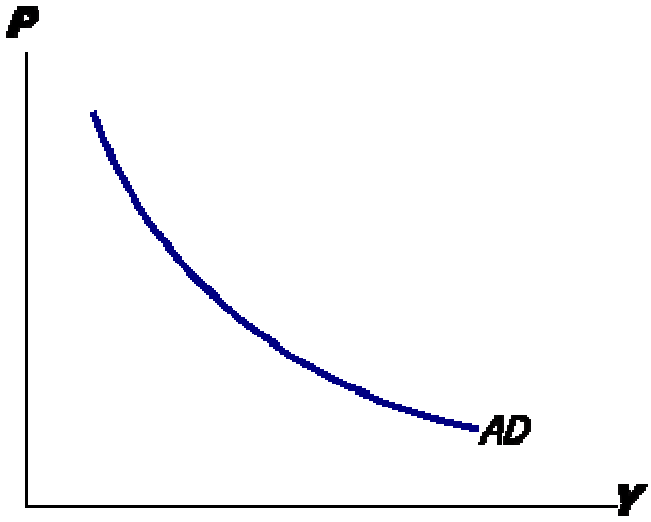
For given value of M and V, equation 2) gives us a negative relationship between P and Y (in particular equation 2) tells us that between P and Y there is a relationship given by a Rectangular Hyperbola). Equation 2) can be interpreted as an Aggregate Demand function. What is the economic intuition behind this negative relationship?

Suppose that P increases. Therefore real balances, defined by M/P must decrease. According to the quantity theory the demand for real money balances is given by:

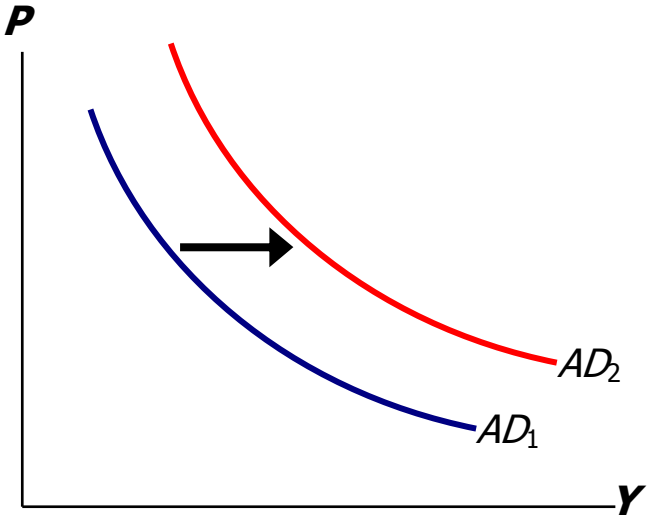
$$\frac{M}{P} = \frac{1}{V}Y$$

An increase in P, given the value of M, reduces real money balances. In order to buy the same amount of stuff, velocity would have to increase. Assume however, as in the original quantity theory that velocity is constant. With lower real money balances (or, equivalently, the same nominal balances but higher goods prices), people demand a smaller quantity of goods and services. This gives a simple explanation why the aggregate demand is downward sloping.

If we plot equation 2), the Aggregate Demand function will look like the following:




From equation 2) we can see how a change in the money supply affects the aggregate demand. In particular, if M increases, the AD curve will shift to the right.
This is shown in the following figure:




For a given value of P, an increase in M implies higher real money balances. In the simple money demand function associated with the Quantity Theory, the demand for real balances is proportional to the demand for output, so output must rise at each P in order for real money demand to rise and equal the new, higher supply of real balances M/P. With this preliminary version of the AD curve we can introduce a preliminary version of the aggregate supply (AS). We will introduce more formally the idea of an aggregate supply in next lectures.

## The IS-LM Model and the Aggregate Demand

The aggregate demand function derived from the quantity theory says that the main determinants of the aggregate demand are the money supply and the velocity of money. Those are the only variables that can affect the relationship between prices and income given by equation 2).

A better examination of the determinants of aggregate income can be found using the IS-LM model that we know is a model that explains the demand side of an economy.

We need to find a relationship (negative) between aggregate prices and real income from the IS-LM curves. Indeed we have aggregate prices in the IS-LM model, therefore we can work out that relationship. In particular prices enter in the LM curve through the real money balances. We need to allow prices to change in the IS-LM model to find this relationship.

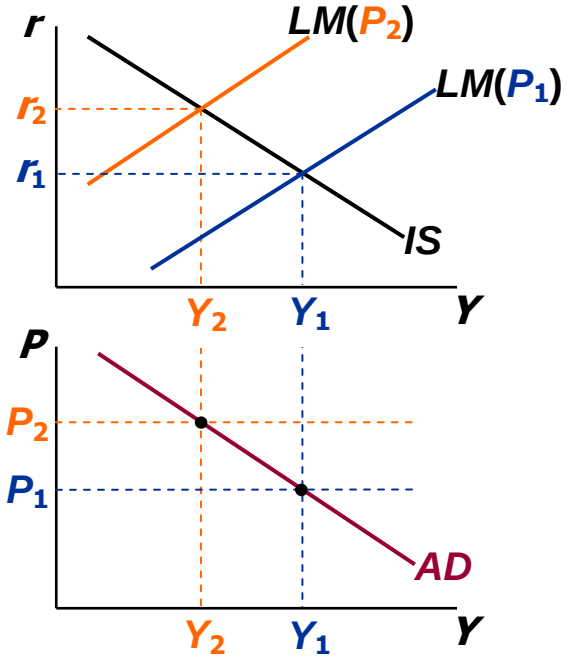
**Note:** *if prices can change in the IS-LM model, the equality between real interest rate and nominal interest rate should not hold in principle. From the Fisher equation:* $i = r + \pi^e$ *. However, for the moment we will do the analysis under the assumption that inflation expectations are constant, meaning that nominal and real interest rate move in the same direction (if r increases, i increases as well and so on). Therefore, we will maintain the equality between nominal and interest rate even if we allow prices to change.*

To derive the aggregate demand: if we change the price level what happens to real income according to the IS-LM model? Prices enter only the LM curve. Therefore a change in P will shift only the LM curve and not the IS curve.

Consider the linear LM curve derived in the previous lecture notes: $r = \frac{k}{h}Y - \frac{1}{h}\frac{M}{P}$

Suppose an increase in P:

$P \uparrow \Rightarrow \frac{M}{P} \downarrow \Rightarrow$ LM shifts to the left $\Rightarrow r \uparrow \Rightarrow I \downarrow \Rightarrow Y \downarrow$




In the top graph we have an LM curve for the initial price level $P_1$. Then we have the new LM curve when the price level increases at $P_2 > P_1$. On the bottom figure we draw the relationship between price level and equilibrium output implied by the movement in the LM curve. From a specific functional form IS-LM model we can compute analytically the aggregate demand function. Consider again the linear IS-LM model in previous lectures:

IS curve $r = \frac{1}{b}\left[C_0 + I_0 + G - cT - Y(1-c)\right]$

LM curve $r = \frac{k}{h}Y - \frac{1}{h}\frac{M}{P}$

We showed that the equilibrium level of output implied by this model was:

$$Y = \frac{h}{bk + (1-c)h}A + \frac{b}{bk + (1-c)h}\frac{M}{P} \qquad 3)$$

where $A = C_0 + I_0 + G - cT$

But equation 3) is exactly a relationship between Y and P. Furthermore, it is indeed a negative relationship since $\frac{b}{bk + (1-c)h} > 0$

Therefore equation 3) is an aggregate demand equation derived from the IS-LM model. Notice that equation 3) implies a non-linear relationship between Y and P.

Notice the difference between the demand function of a good in a microeconomic textbook and the one here. In a microeconomic context, an increase in the price of a

good reduces the demand (if the good is not a Giffen good) since there is a substitution effect and the purchasing power of the agent is reduced (income effect).

Here an increase in P reduces aggregate output through the increasing in the interest rate and therefore a reduction in Investments. This effect of prices on the interest rate and therefore on real income is called the "**Interest Rate Effect**" or "**Keynesian effect**". This effect explains why AD is negatively sloped. Note: the "Keynes effect" does not work if we are in the Liquidity Trap that is the closest case to Keynes's ideas about a macroeconomic system. In the liquidity trap even if prices decrease, the interest rate is too low to decrease more.

**Aggregate Demand and Wealth Effect**

However, there is another possible explanation for the negative relationship between Income and P implied by the AD curve.[2] This explanation is based on the idea of "**Wealth Effect**" or "**Pigou Effect**".

**Pigou effect**: *if money is part of households' wealth, then a decrease in P makes the households wealthier in real terms, this will increase consumption and therefore aggregate income:*

$P \downarrow \Rightarrow \frac{M}{P} \uparrow \Rightarrow C \uparrow \Rightarrow$ IS shifts to the right $Y \uparrow$

The Keynesian and the Pigou effects (and in general the fact that the AD is negatively sloped) imply that a ***deflation*** (a decrease in the general level of prices) can have stabilising effects on output. Consider a recession, where aggregate demand is particularly low. Given a low demand, the aggregate price level should fall and this will increase output, helping the economy to recover from the recession without any external intervention. Is the Pigou effect relevant? Well data seem to say that cash is a small proportion of household wealth; therefore we may say that this effect should not be particularly large. The idea that deflation can be good in terms of stabilising the equilibrium income level has been challenged by some economists. To see this, we need to remove the assumption that nominal and real interest rates are the same. In particular, we assume that the demand for money depends on the nominal interest rate while the investment depends on the real interest rate. Given that $i = r + \pi^e$, we can write the demand for money as $L(Y, i)$ and the investment function as $I(i - \pi^e)$.

1) *The destabilizing effects of <u>expected</u> deflation*:

[2] There is a third explanation for the negative relationship between Y and P implied by the AD. This third explanation is called the Mundell Effect and it works through the link between P and the exchange rate.

The idea is: suppose you start with no inflation expectations, meaning $\pi^e = 0$, and so $i = r$. Now suppose that people start to expect a deflation and therefore $\pi^e \downarrow$ Given the level of *i*, this decrease in expected inflation will increase the real interest rate.[3] An increase in the real interest rate will depress investments and so real income will fall.

2) *The destabilizing effects of unexpected deflation:* ***debt-deflation theory***

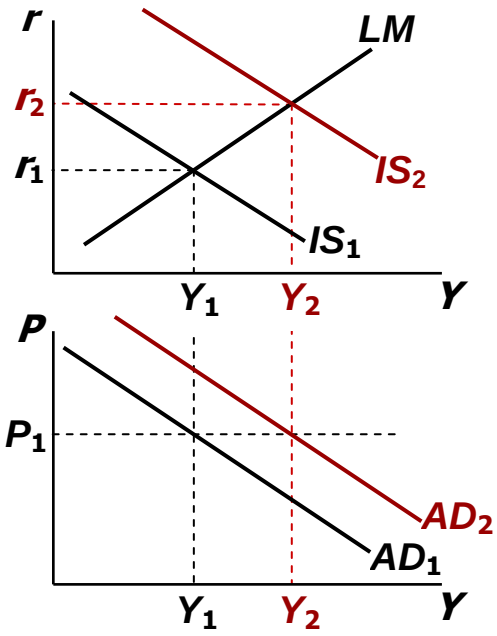
Suppose a decrease in P that is unexpected (this means that your inflation expectations can be wrong). From lecture note 4 we know that this transfers purchasing power from borrowers to lenders. Suppose borrowers lose (part of their real income is transferred to lenders because of unexpected inflation) compared to lenders. If borrowers' propensity to spend is larger than lenders', then aggregate spending may fall, the *IS* curve shifts left, and ***Y*** falls

**Fiscal/Monetary Policy and Aggregate Demand**

Now we can see the effect of various components on the aggregate demand, in particular, fiscal and monetary policy.

Fiscal Policy and Aggregate Demand:

*An increase in G or a decrease in T* will increase the term A in equation 3). This implies that at each value of P, Y must be larger. Therefore, the AD shifts to the right.



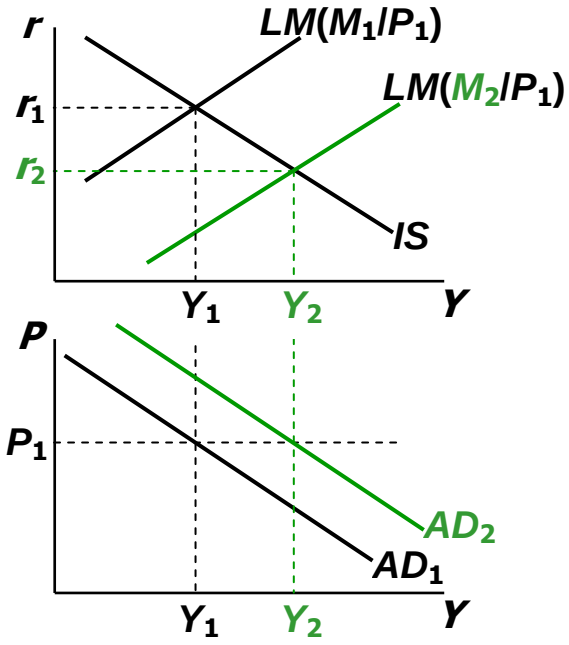

[3] Suppose you start with $i = r = 5\%$. Suppose people expect a deflation of 2%, meaning $\pi^e = -2\%$. Now the real interest rate becomes: $r = i - \pi^e = 5\% - (-2\%) = 7\%$.

Starting from $IS_1$, an increase in G (or a decrease in T), shifts the IS curve to the right, say $IS_2$. Therefore Y increases. In the bottom figure, given the price level $P_1$ (P did not change), Y is now greater at each price level, meaning that AD shifts to the right.

Obviously *a decrease in G or an increase in T* will shift the aggregate demand to the left.

Monetary Policy and Aggregate Demand

The effect is similar to the one we have seen for equation 2). *An increase in M* will shift the aggregate demand to the right. Using the IS-LM model: an increase in M will shift LM to the right. Income will increase. In terms of the aggregate demand, given the price level, this increase in M will shift the AD curve to the right.




Obviously *a decrease in M* will shift the AD curve to the left.

## Preliminary AD-AS Model

### The Classical Case

Similarly to the concept of aggregate demand, an aggregate supply function is a relation between aggregate prices and aggregate output produced.

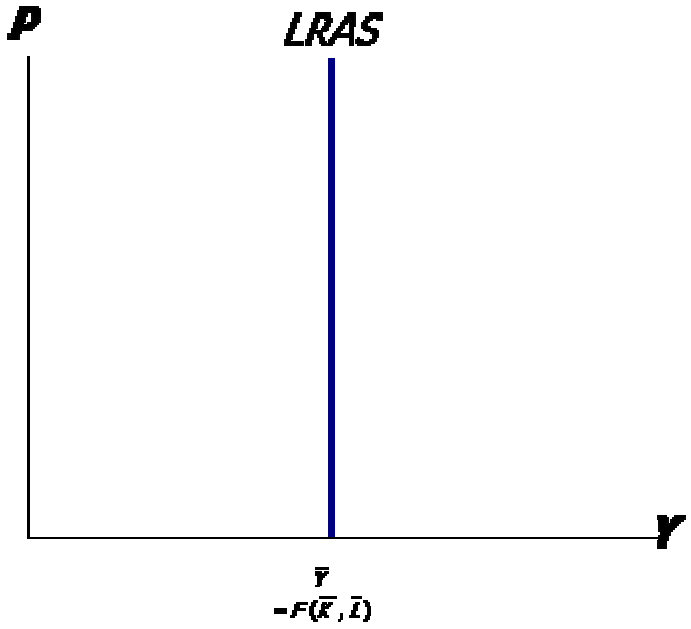
With the AD-AS model we are able to see the difference between short-run and long-run behaviour of an economy and also the adjustment of the equilibrium from the short-run to the long-run situation.

Aggregate supply in the long-run:

In the long run, output is determined by factor supplies and technology:

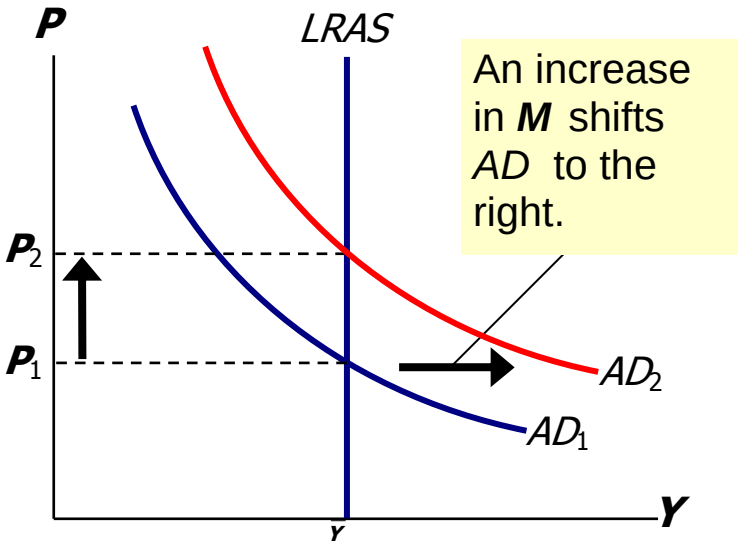
$$\overline{Y} = F(K, L)$$

Where $\overline{Y}$ is the **full-employment** or **natural** level of output, the level of output at which the economy's resources are fully employed. We expect that in the long-run, when all prices (so including the wages and the price of capital) are flexible, the economy is producing the natural level of output. So in the long-run, the level of output is independent from the level of prices and therefore the long-run aggregate supply (LRAS) is vertical at the level $\overline{Y}$ .




This case is also called the "**Classical case**", since this is the way classical economists believed an economic system would work not only in the long-run but also in the short-run! Now, it is clear the difference with respect the Keynes' ideas. If the aggregate supply is vertical, changes in the demand will have effects only on prices and not on quantities, since market forces (= price flexibility) will always guarantee that the production level is at the natural level. Suppose an increase in M, we know that this will shift the AD to the right.

**Classical Case**

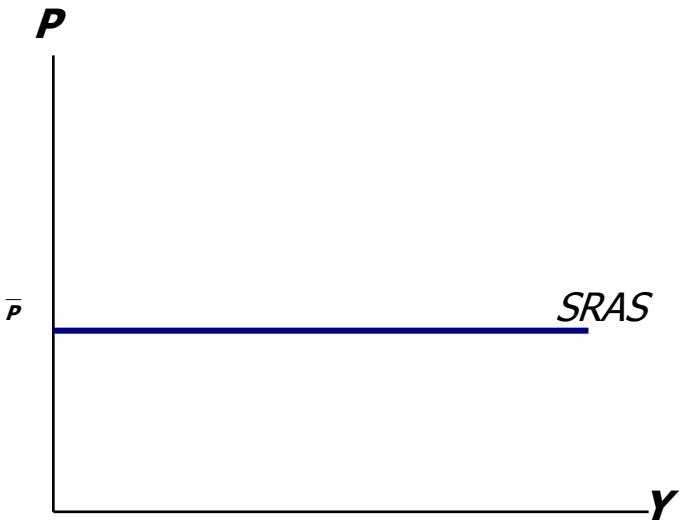



In the long run the effect of an increase M is to increase P without affecting Y (money is neutral). This is just a similar result as the one implied by the quantity theory of money.

**The Keynesian Case**

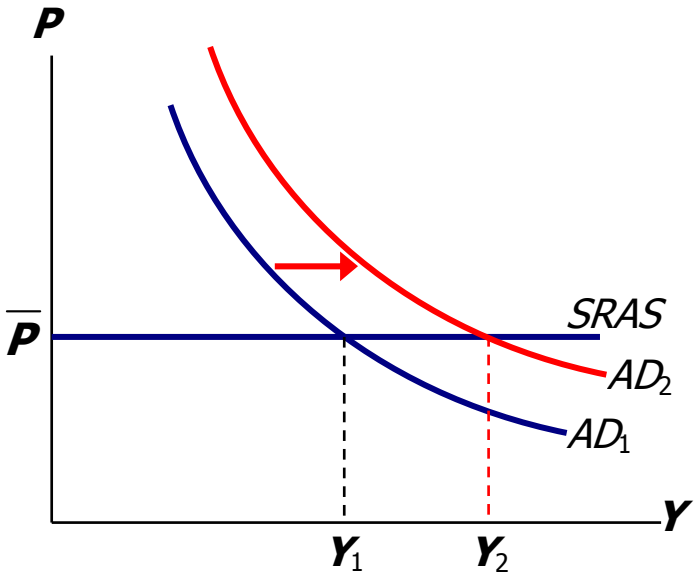
Aggregate supply in the short-run with fixed prices:

If prices are fixed then the short-run aggregate supply is an horizontal line.




Now an increase in M will have a completely different effect:

**Keynesian Case**




An increase in aggregate demand will increase output leaving unaffected prices. Thus, output is determined by aggregate demand. This is called the "Keynesian case".

**The Preliminary AD-AS Model: The Classical and Keynesian case together**

As a preliminary version of the AD-AS model we simply plot together the Classical and the Keynesian case. The Keynesian case will take care of the short-run while the Classical case will take case of the long run. Therefore we can see the adjustment process in the economy when moving from the short to the long run equilibrium.

**The Adjustment from Short-Run to Long-Run Equilibria**

In the short run prices are fixed however over time prices gradually become "unstuck". Movement in prices will drive the system towards the long-run equilibrium. The adjustment process depends upon where the short-run equilibrium lies compared to the long-run equilibrium.

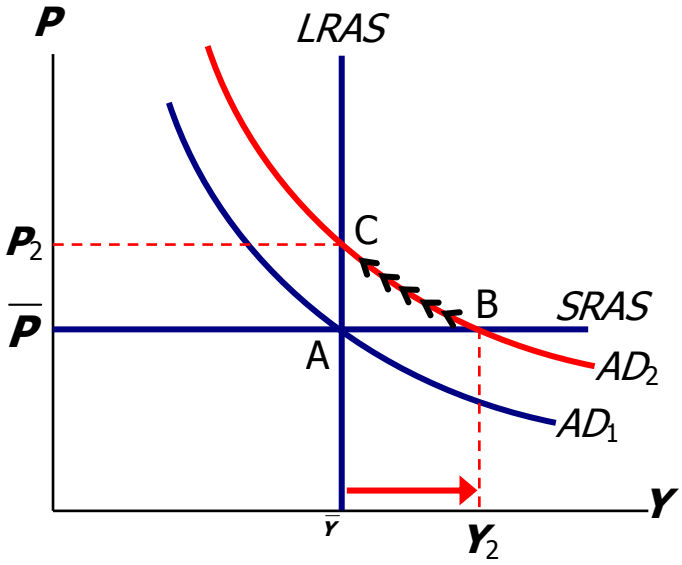
| In the short-run equilibrium, if | then over time, $P$ will… |
|---|---|
| $Y > \overline{Y}$ | *rise* |
| $Y < \overline{Y}$ | *fall* |
| $Y = \overline{Y}$ | *remain constant* |

Consider the adjustment process after an increase in money supply (M):

A = initial equilibrium

B = new short-run eq'm after ***M*** increases

C = long-run equilibrium




Suppose you start at the equilibrium A. At that point, short-run and long-run equilibrium coincide and therefore, without any external shock, prices do not need to move to adjust. They are already at their long-run equilibrium level even if we are in the short-run. However, suppose that M increases. Aggregate demand will shift to the right and equilibrium income in the short-run will be higher than the natural level.

The new short-run equilibrium is at point B in the graph.

The high level of demand for goods and services at point B puts upward pressure on prices. In order for firms to increase output, they hire more workers, so unemployment falls below the natural rate of unemployment, putting upward pressure on wages. Over time, as prices become "unstuck," they begin to rise in response to these pressures. This process stops when the economy gets to point C: output again equals the "natural rate of output".

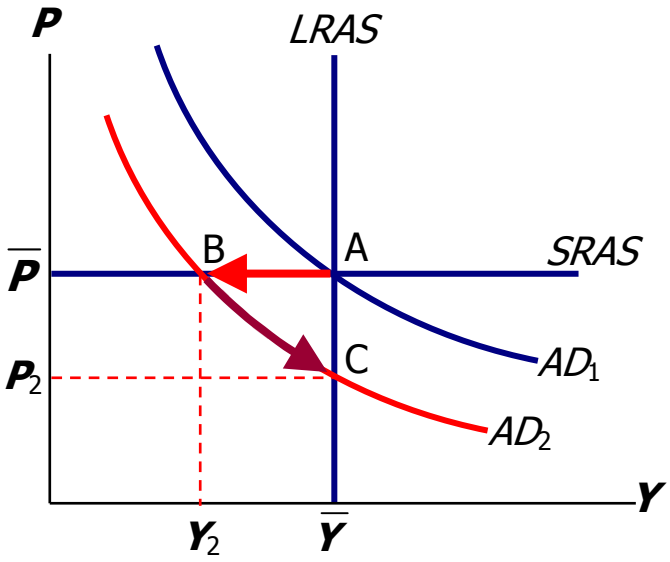
**Shocks in the Preliminary AD-AS Model**

We can use the AD-AS model to study short-run fluctuations. As in the IS-LM model, we need to introduce the ideas of shocks. Shocks temporarily push the economy away from full employment. Here we have two types of shocks:

1) Aggregate demand shocks: for example the shocks that can affect the IS or the LM curves. A negative demand shock tends to decrease aggregate demand, while a positive demand shock tends to increase AD.

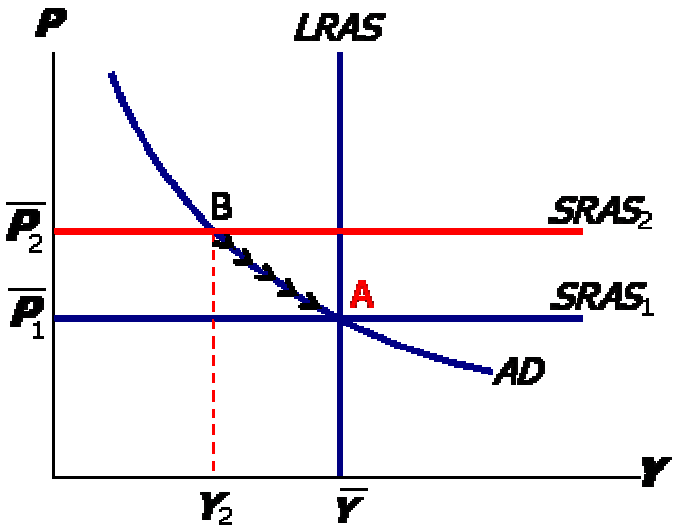
2) Aggregate supply shocks: alter production costs and affect the prices that firms charge. For example bad weather reduces crop yields, pushing up food prices. Workers unions negotiate wage increases. Those are examples of negative supply shocks, in the sense that they tend to increase the aggregate level of prices. Positive supply shocks instead reduce costs and prices. For example, the discovering of a new technology that reduces production costs.

**The effects of a negative demand shock**




Starting from equilibrium A, the negative shock shifts the AD to the left. In the short-run the effect is a reduction of equilibrium income and the new equilibrium is point B. Over time, prices fall and the economy moves down its demand curve toward full-employment. When in a recession, the economy, left to its own devices, “fixes” itself: the gradual adjustment of prices helps the economy recover from the shock and return to full employment. Of course, before the economy has finished self-correcting, a period of low output and high unemployment is endured.

**The effects of a negative supply shock**




A negative supply shocks shift up the SRAS. The new equilibrium in the short-run will be point B where prices are now higher and output is lower than before the shock. A point like B describes a situation known as **Stagflation** because it combines stagnation in output (low output) with high inflation. In absence of any other shock, price will fall over time and the economy moves back toward full employment.

The typical example of a negative supply shock is the Oil Shock in the 70s.

Obviously the period of time that output may take to move back to the natural level may be very long and so this self-adjustment can be very costly for the economy. Therefore, economic policy can be used to reduce the timing of the adjustment and so its costs.

**<u>A note on fluctuations in the AD-AS model</u>**

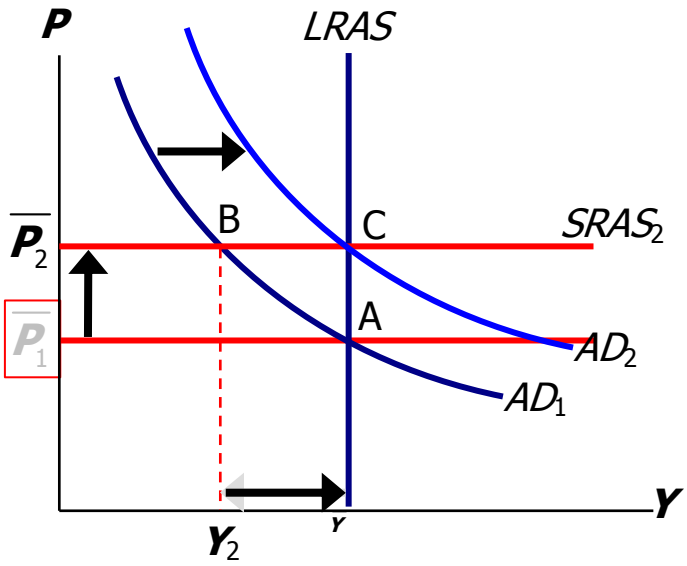
Fluctuations in output are due to shifts (because of exogenous shocks or because changes in economic policy) in the AD curve or in the short run AS curve. However, all those fluctuations must have a **temporary** effect on output. Indeed, output must always return after a while to the natural level. In particular you should notice that shocks on the AD (or changes in economic policy that shift the AD curve) have always a temporary effect on output. This is because the AD does not affect the natural level of output that is determined by the long-run aggregate supply.

We can have shocks that have **permanent** effects (meaning that the natural level changes), but those shocks must be shocks that shift the long-run aggregate supply.

This dichotomy will become important when we will discuss the Real Business Cycle theory of output fluctuation.

**Stabilization policy in the preliminary AD-AS Model**

Stabilization policy refers to policy actions aimed at reducing the severity of short-run economic fluctuations. For example: using monetary policy to combat the effects of adverse supply shocks:




Suppose you start at point A. A negative supply shock shifts up the SRAS. The central bank can accommodate the shock by raising the money supply and shifting the AD curve to the right. In this way the real income will be back to the natural level but P is now higher than in point A. This means that monetary policy can stabilise the effect of a negative shock but the price of doing that is to increase permanently the price level. If inflation is considered to be bad, this may not be a good policy.