

## The AS-AD model

The economy in the medium run

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## Preliminary remarks

- In the medium run both aggregate supply and aggregate demand movements will affect output.
- Output is produced using employed labour. The production function captures the production process which transforms inputs into output.
- In the medium run the economy returns to the natural level of output.

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## Aggregate supply

- The aggregate supply relation captures all the possible combinations of the aggregate price level and output such that the supply side of the economy is in equilibrium.
- Output is produced using labour:

$$Y = N$$

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## Aggregate supply

- The wage setting equation and the price setting equation determine labour market equilibrium, which in turn determines aggregate supply in the economy.

$$W = P^e F(u, z) = \frac{1}{1 + \mu} P = W$$

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## Aggregate supply

- Unemployment is given by

$$u = 1 - \frac{N}{L} = 1 - \frac{Y}{L}$$

- Hence, the aggregate supply relation is

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

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## Aggregate supply

- The price level depends positively on the expected price level. A higher expected price level leads to demands for wage compensation. Higher wages raise firms' costs, so these must raise prices.
- The price level depends positively on output. A greater output induces higher employment, hence lower unemployment and thus higher nominal wages, pushing up prices again.

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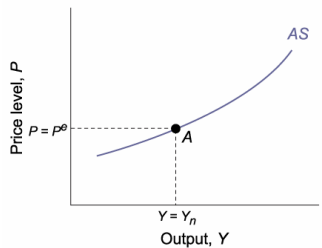
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## Aggregate supply



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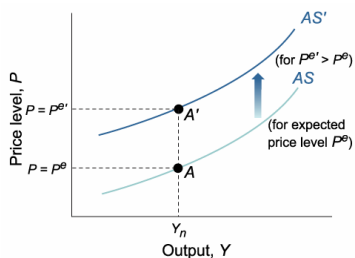
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## Aggregate supply



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## Aggregate demand

- The aggregate demand relation captures all the possible combinations of the aggregate price level and output such that the demand side of the economy is in equilibrium.
- The demand side of the economy is derived from the IS-LM model.

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## Aggregate demand

- Goods market equilibrium

$$Y = C(Y - T) + I(i) + G$$

- Money market equilibrium

$$\frac{M}{P} = L(Y, i)$$

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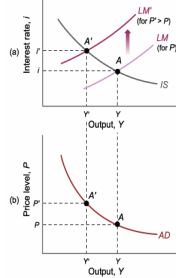
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## Aggregate demand



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## Aggregate demand

- The position of the aggregate demand curve depends on the values of the exogenous variables on the demand side of the economy: government spending, taxes, nominal money supply.
- A shift in exogenous variables shifts the AD curve. How?

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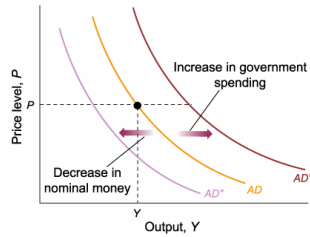
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## Aggregate demand curve



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## Equilibrium in the short run

- The general equilibrium requires the aggregate supply side and the aggregate demand side of the economy to be simultaneously in equilibrium.
- The only such point in the  $(Y,P)$  space is the intersection point between the aggregate supply curve and the aggregate demand curve.

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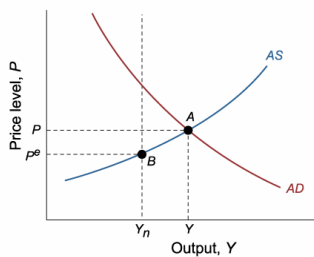
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## Equilibrium in the short run



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## Equilibrium in the short run

- In the short run there is no reason why output should equal its natural level.
- The aggregate supply curve is drawn for a given expected price level.
- The economy is continuously hit by economic shocks such as changes in government spending, taxes, the nominal supply of money or oil shocks.

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## Equilibrium in the medium run

- In the medium run the actual price level must be equal to the expected price level.
- Suppose that actual output lies above its natural level. In this case, the actual price level lies above the expected price level.
- Workers will revise their expectations, ask for wage compensation and nominal wages will go up. As firms' costs increase, they will raise their prices (the markup is constant) and the price level goes up. The process of adjustment continues until the actual price level equals its expected level.

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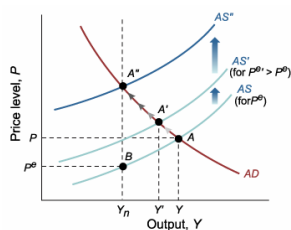
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## Equilibrium in the medium run



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## Equilibrium in the medium run

- A higher expected price level shifts the AS curve upwards. A higher price level implies a lower real money supply, so output decreases. The process of adjustment continues until there is no reason anymore for workers to ask for wage compensation.
- Typical scenario: start at the "natural" equilibrium, shock the economy, look at the short-run impact, and then look at the process of adjustment whereby the economy returns its natural level in the medium run.

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## Monetary policy

- Start from a position where (i) output is at its natural level, and (ii) the expected price level is equal to the actual price level.
- What are the short-run and medium-run effects of monetary policy? Suppose that the central bank increase the nominal supply of money. The AD curve shifts to the right. In the short run an expansionary monetary policy induces a higher level of output and a higher actual price level.

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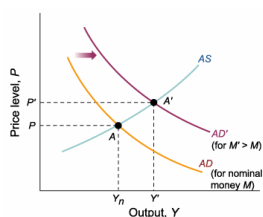
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## Monetary policy



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## Monetary policy

- The actual price level lies above the expected price level. Workers will revise their expectations, asking for higher nominal wages and leading firms to increase prices, so that the actual price level increases. The AS curve shifts upwards.
- As the actual price level increases, the real stock of money decreases, so output decreases. The adjustment is completed when the actual price level equals the expected price level.

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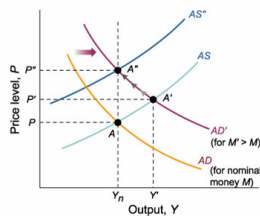
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## Monetary policy



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## Monetary policy

- We can combine the AS-AD diagram with the IS-LM diagram to understand the behaviour of the interest rate.
- Initially, the interest rate falls as the real money supply goes up. It will then converge gradually to its initial level as the real money supply decreases gradually thanks to a higher price level.

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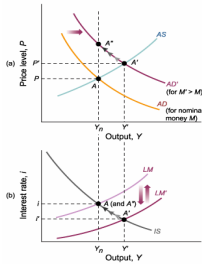
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## Monetary policy



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## Monetary policy

- In the short run, an expansionary monetary policy induces a higher level of output, a lower interest rate, and a higher price level.
- In the medium run, an expansionary monetary policy induces a higher price level while both the interest rate and output return to their respective initial levels.
- In the medium run the increase in the nominal money supply is reflected entirely in a proportional increase in the price level. There is no effect on output! Therefore, money is said to be "neutral" in the medium run.

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## Fiscal policy

- Start from a position where (i) output is at its natural level, and (ii) the expected price level is equal to the actual price level.
- What are the short-run and medium-run effects of fiscal policy? Suppose that the government engineers a deficit-reduction program. The AD curve shifts to the left. In the short run this restrictive fiscal policy induces a lower level of output and a lower actual price level.

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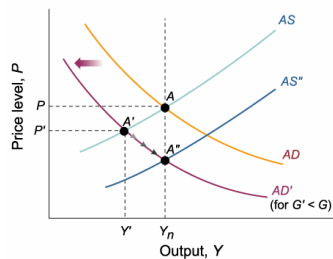
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## Fiscal policy



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## Fiscal policy

- The actual price level lies below the expected price level. Expectations of workers will adjust accordingly and the AS curve shifts downwards.
- As the actual price level decreases, the real stock of money increases, so output will increase. The adjustment is completed when the actual price level equals the expected price level and output is back at its natural level.

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## Fiscal policy

- We can again combine the AS-AD diagram with the IS-LM diagram to understand the behaviour of the interest rate.
- Initially, the interest rate falls as the IS curve shifts to the left (and the offsetting shift in the LM curve is small).
- It will then decrease further as the lower price level means a higher real stock of money, pushing the LM curve to the right.

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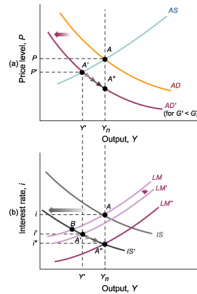
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## Fiscal policy



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## Fiscal policy

- In contrast with monetary policy, fiscal policy has a real effect on the economy. Although output returns to its natural level, the composition of aggregate demand changes.
- The interest rate is lower at the new equilibrium than at the initial equilibrium. Consequently, investment will be different between the two equilibria.

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## Fiscal policy

- The goods market equilibrium condition when output is at its natural level is given by

$$Y_n = C(Y_n - T) + I(i) + G$$

- A lower equilibrium interest rate induces a higher level of investment, while government spending decreases following the deficit-reduction program.

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## Oil shocks

- Oil is an input in production. So the price of oil will be an important determinant of prices charged by firms.
- In the 1970s there have been two major oil price increases, one in 1973-75 and another in 1979-1981.
- OPEC acts as a cartel, sets production quotas that limit oil supply and pushes up oil prices.

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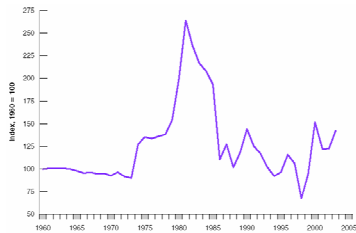
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## Oil shocks



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## Oil shocks

- How to model oil shocks in our model?
- Higher oil prices mean that given nominal wages, firms' costs will go up, so that firms will charge higher prices.
- The markup increases. The price setting equation shifts downwards.
- The natural rate of unemployment increases and as a result, the natural level of output decreases.

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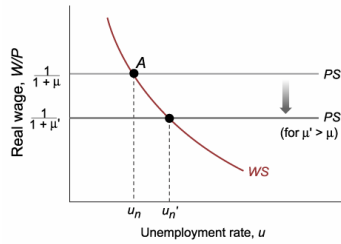
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## Oil shocks



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## Oil shocks

- The aggregate supply curve is

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

- For a given level of output and given price level expectations, the price level will be higher. Hence, the AS curve shifts upwards.
- Through the updating of expectations of workers the AS curve will continue shifting to the left until the new natural level of output is reached.

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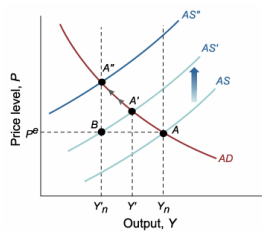
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## Oil shocks



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## Oil shocks

	1973	1974	1975
Rate of change of petroleum price (%)	10.4	51.8	15.1
Rate of change of GDP deflator (%)	5.6	9.0	9.4
Rate of GDP growth (%)	5.8	-0.6	-0.4
Unemployment rate (%)	4.9	5.6	8.5

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## Oil shocks

- Abrupt increases in oil prices lead to higher prices and lower output. This situation is referred to as stagflation, a mix of stagnation and inflation.
- Temporary vs. permanent shocks.

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## Policy responses

- Stagflation is the worst possible outcome; it is not possible for the policymaker to bring the economy back to its initial level.
- An expansionary monetary policy aiming at reducing unemployment will result in even higher prices in the short run and in the medium run.
- A restrictive monetary policy aiming at keeping the price level stable will result in even higher unemployment in the short run. In the medium run, the economy returns to the natural level of output and the price level is smaller than in the case of no policy.

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