

## Inflation, output and nominal money growth

The economy in the medium run

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## Preliminary remarks

- The AS-AD model is limited in the sense that it predicts zero inflation, except during the process of adjustment of the economy in the medium run. Empirically, inflation is almost always strictly positive.
- The Phillips curve provides a link between unemployment and changes in inflation. We must extend the framework to bring in output growth and nominal money growth.

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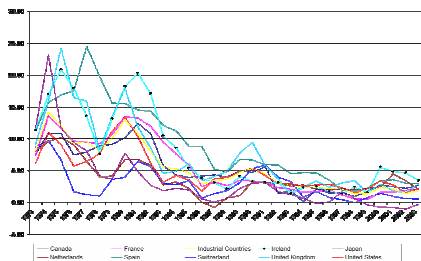
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## Inflation rates



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## Three relationships

- Okun's law: a link between the rate of unemployment and output growth.
- Phillips curve: a link between the rate of unemployment and inflation.
- Aggregate demand curve: a link between output growth and nominal money growth.

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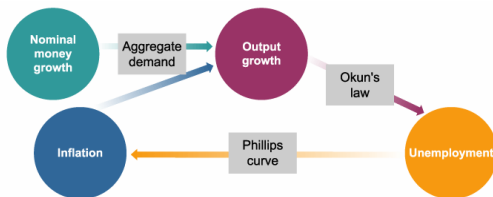
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## Three relationships



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## Okun's law

- Okun's law relates changes in the rate of unemployment and output growth.
- Standard production function: when output grows by 1%, employment grows by 1% ( $Y=N$ ), and so unemployment decreases by 1%:

$$u_t - u_{t-1} = -g_{yt}$$

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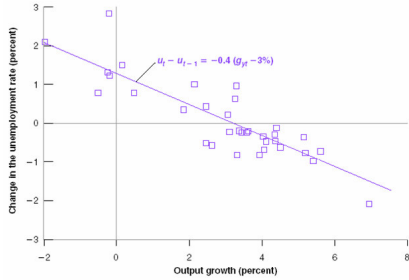
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## Okun's law



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## Okun's law

$$u_t - u_{t-1} = -0.4(g_{yt} - 3\%)$$

- Two main differences between the two equations. 1) 3%; 2) -0.4.
- 1) Labour force growth (1.7%) and productivity growth (1.3%).
- 2) "Fixed workers", labour hoarding, and new jobs.

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## Okun's law

- Output growth above normal decreases the rate of unemployment, and output growth below normal increases the rate of unemployment:

$$u_t - u_{t-1} = -\beta(g_{yt} - \bar{g}_y)$$

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## The Phillips curve

- The Phillips curve relates the rate of unemployment and changes in the rate of inflation:

$$\pi_t - \pi_{t-1} = -\alpha(u_t - u_n)$$

- Unemployment below the natural rate leads to higher inflation, and unemployment above the natural rate leads to lower inflation.

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## The aggregate demand curve

- The AD curve relates nominal money growth and output growth.
- Start from the standard AD curve, assuming that government spending and taxes are zero:

$$Y = \gamma \left( \frac{M_t}{P_t} \right)$$

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## The aggregate demand curve

- Using the result that

$$\frac{d \log x}{dx} = \frac{1}{x} dx$$

we obtain that

$$\frac{dY_t}{Y_t} = \frac{dM_t}{M_t} - \frac{dP_t}{P_t}$$

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## The aggregate demand curve

- The aggregate demand curve can thus be rewritten as

$$g_{yt} = g_{mt} - \pi_t$$

- If nominal growth exceeds inflation, real money growth is positive and so is output growth. Given inflation, an expansionary monetary policy leads to higher output growth.

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## Three relationships

- Okun's law:

$$u_t - u_{t-1} = -\beta(g_{yt} - \bar{g}_y)$$

- Phillips curve:

$$\pi_t - \pi_{t-1} = -\alpha(u_t - u_n)$$

- AD curve:

$$g_{yt} = g_{mt} - \pi_t$$

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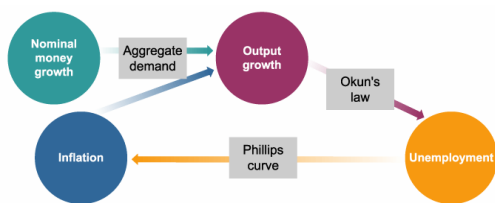
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## Three relationships



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## The effects of money growth

- The central bank sets the growth rate of nominal money (and not the level of nominal money).
- It is easier to work backward in time: first the medium run, then the short run and the process of adjustment!

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## The medium run

- Unemployment is equal to the natural rate and it is constant. Through Okun's law:

$$u_t - u_{t-1} = 0 \Rightarrow g_{yt} = \bar{g}_y$$

- In the medium run output grows at its normal rate.

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## The medium run

- With output growing at its normal rate and constant money growth, the AD curve implies that

$$g_{yt} = g_{mt} - \pi_t \Rightarrow \bar{g}_y = \bar{g}_m - \pi \Rightarrow \pi = \bar{g}_m - \bar{g}_y$$

- In the medium run there is constant positive inflation (as is empirically observed). Real money growth translates into positive inflation.

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## The medium run

- Output growth is equal to its normal growth rate.
- The rate of unemployment is equal to the natural rate of unemployment.
- Nominal growth affects only inflation, another way to look at the proposition of money neutrality!

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## The short run

- The central bank makes a restrictive monetary policy, i.e. it decreases the rate of growth of nominal money.
- Given initial inflation, lower money growth means lower output growth. The economy slows down:

$$g_{yt} = g_{mt} - \pi_t$$

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## The short run

- The slowdown in economic activity means that the rate of unemployment increases:

$$u_t - u_{t-1} = -\beta(g_{yt} - \bar{g}_y)$$

- The Phillips curve implies in turn that higher unemployment leads to lower inflation.

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## The short run

- A lower rate of nominal money growth implies that economic growth slows down.
- Unemployment increases, inflation decreases.
- In the medium run, output growth and the unemployment rate return to normal, inflation is permanently lower. Thus, monetary tightening allows for permanently lower inflation with only a temporary rise in unemployment.

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