

M.Sc. in Economic Policy Studies

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Outline of lectures – 4: October 23rd

- Money Inflation and Real Output
 - Interest rates and expenditure
 - Inflation and the real interest rate
 - Taylor rule – inflation and potential output
 - Aggregate supply curve
 - Sticky prices – goods and labour
 - Monetary policy inflation and output
- Presentations
 - Ciara Reynolds and Paul Kilkenny

Output and Inflation – Long Run

- **Potential Output**

- Potential output is what the economy is capable of producing when its resources are used at normal rates.
- Full employment? Non-accelerating wage rate of unemployment (NAWRU)?
 - Because of the Philips curve – Unemployment reduces wage pressures.
- Normal utilisation of capital stock?
- If operating above potential output, then there will be inflationary pressures. e.g. more over-time working, difficulty hiring etc. affects wages
- Difficult to define potential output. When the economy is in equilibrium?
- The structural deficit is the deficit when actual output=potential
- http://www.esri.ie/pubs/QEC2014SPR_SA_Bergin.pdf

Potential Output

- An example defining potential output using a production function:
- $Y = AK^\alpha L^{(1-\alpha)} e^{\theta t}$
- Where Y=Output; K=Capital; L=Labour; t=time (technical progress)
 - A, α and θ are parameters
 - Because the sum of the coefficients on K and L ($\alpha + 1 - \alpha$) is one this implies constant returns to scale.
- To get potential output Y^*
- Substitute into the production function actual K and L at “normal” utilisation
 - What is “normal” – Non accelerating wage rate of unemployment (NAWRU)?

Output and Inflation – Long Run

- **Long-Run Inflation**

- In the long run inflation = growth in money supply less growth in potential output
- However, as we have learned, things are not that simple. Changes in the demand and supply functions for money mean that this relationship may not hold over extended periods.
- Nonetheless the ECB is targeting long-run inflation.

Aggregate Expenditure and Interest Rates

- $Y=C+I+G+X-M$
- Consumption (C) and Investment (I) sensitive to interest rates – why?
- Government current expenditure on goods and services (G) is not directly affected by interest rates
- Net exports (X-M) is affected by exchange rates – affected by interest rates indirectly– for next lecture

HERMES model of economy: Housing Prices

$$\log P_h = A1 + A2 * \log(Y) + A3 * \text{LOG}(1 + \text{HSTOCK}/\text{NT}) + A4 * \text{NT}2534/\text{NT} + A5(r - P_h^e) + A6 * D03$$

Range	1975A to 2009A		
	Coeff		t-stat
A1	8.31		69.18
A2	0.85		9.00
A3	-3.88		-4.36
A4	17.24		10.68
A5	-1.07		-7.59
A6	0.08		3.15

$$\begin{aligned} \text{LOG}(1 + \text{HSTOCK}/\text{NT}) &= [\log P_h - \{A1 + A2 * \log(Y) + A4 * \text{NT}2534/\text{NT} + A5(r - P_h^e) + A6 * D03\}] / A3 \\ &= \dots\dots -A5(r - P_h^e) / A3 &= \dots\dots -1.07(r - P_h^e) / 3.88 \end{aligned}$$

Where P_h = price of houses; Y=real income; HSTOCK=housing stock; NT= population; NT2534= Population 25-34
 r= nominal interest rate; P_h^e = expected house price inflation; D03= dummy for 2003

There is a significant negative coefficient on the real interest rate, -1.05. Hence the higher the interest rate the lower the housing stock – the lower the demand for houses.

HERMES model: Manufacturing Investment

- Investment is a function of long-run output, the cost of labour, material inputs and capital
- Expectations matter
- The cost of capital is a function of the interest rate
 - Higher interest rate – higher cost of capital substitute other factors for capital
 - Higher interest rate – lower competitiveness and lower output
- Therefore, the higher the interest rate the lower investment

HERMES model of economy: Consumption

$$\text{LOG}(C/\text{NT}) = A1 + A2 * \text{LOG}(Y/\text{NT}) + A3 * \text{LOG}(\text{HSTOCK} * P_h / (\text{PC}/\text{NT}))_{-1} + A4 * \text{LOG}(\text{NFW} / (\text{PC}/\text{NT}))_{-1}$$

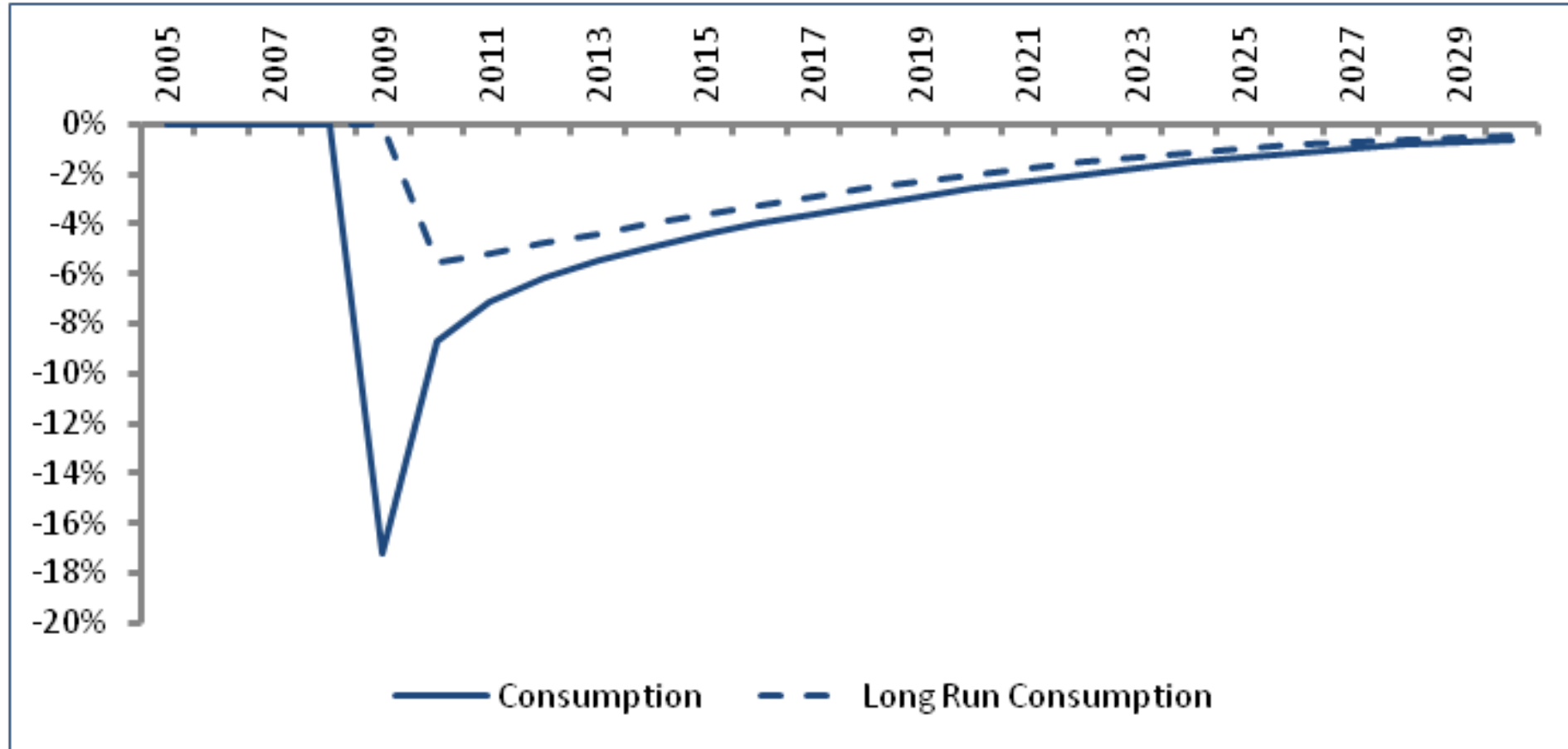
Range	1990A to 2009A	
	Coeff	t-stat
A1	-0.71	-6.03
A2	0.70	10.46
A3	0.10	4.12
A4	0.11	9.53

Where C= Consumption; P_h = price of houses; Y=real income; HSTOCK=housing stock; NT= population;
PC=consumer prices; NFW= Net financial wealth

Real consumption per head is a function of the real value of housing per head and real net financial wealth per head

A rise in interest rates would reduce house prices and the value of housing wealth. In turn, this would reduce Consumption.

Response of consumption to collapse in housing wealth in 2009



HERMES: Domestic interest rates +1%

	Year	1	2	3	4	5	6
GNP	%Δ	0	-0.3	-0.4	-0.4	-0.4	-0.3
Consumption	%Δ	0	-0.3	-0.3	-0.4	-0.1	0.2
Investment	%Δ	-0.1	-0.8	-1.5	-1.5	-1.2	-0.9
Exports of Goods and Services	%Δ	0	-0.1	-0.2	-0.2	-0.3	-0.2
Wages	%Δ	0	0	-0.1	-0.2	-0.3	-0.4
Unemployment Rate	Δ	0	0.1	0.2	0.3	0.2	0.2
Government Deficit, % of GDP	Δ	0	0.3	0.4	0.4	0.5	0.4

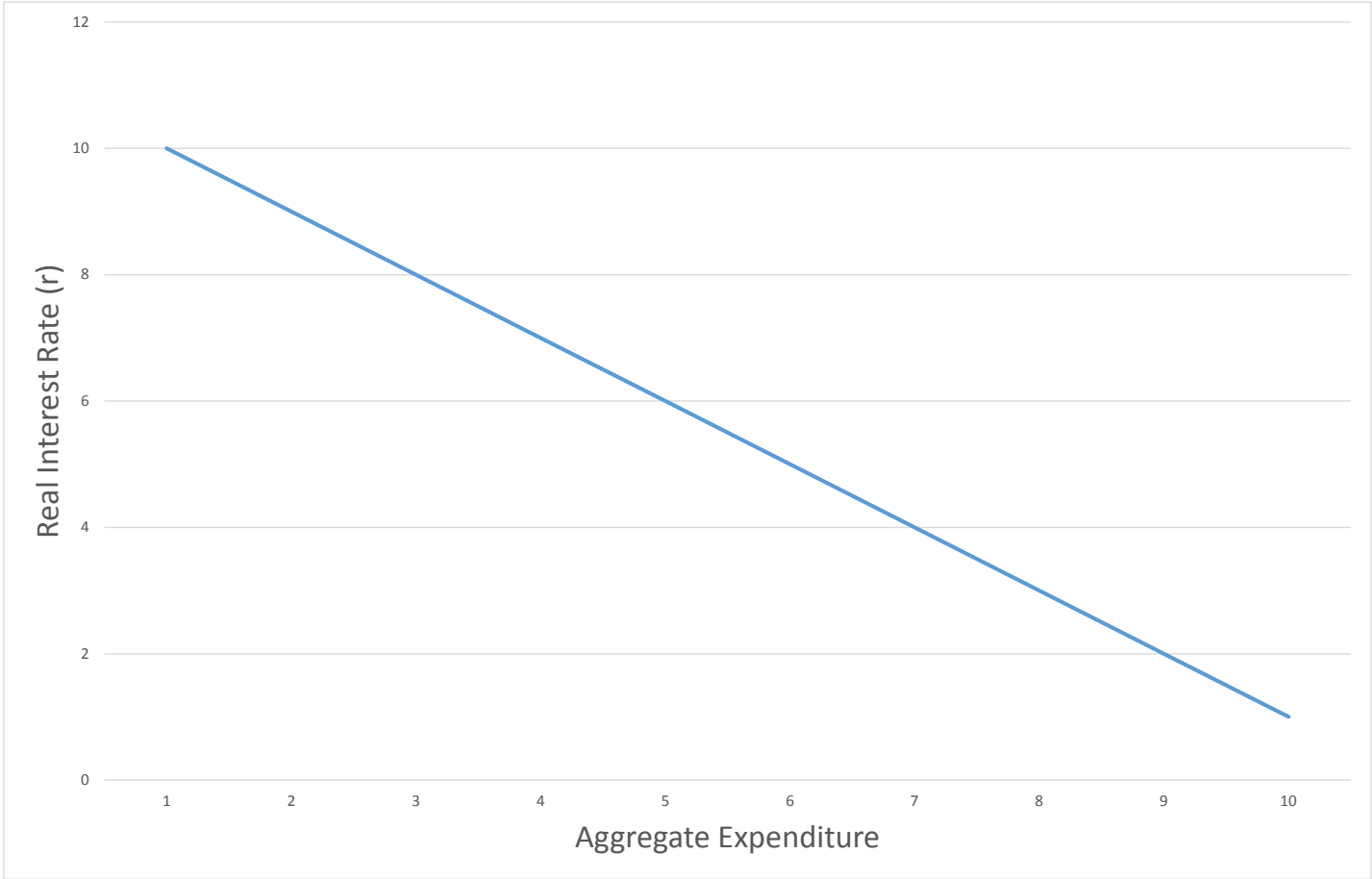
Netherlands: Domestic interest rates +1% (DELFI)

	Year	1	2	4	8
GDP	%Δ	-0.1	-0.3	-0.8	-1.0
Consumption	%Δ	-0.1	-0.6	-2.2	-3.0
Investment	%Δ	-0.5	-1.8	-3.2	-2.8
Exports of Goods and Services	%Δ	0.0	-0.1	-0.3	-0.3
Wages	%Δ	0.0	0.0	-0.1	-1.0
Unemployment Rate	Δ	0.0	0.1	0.4	0.9
Government Deficit, % of GDP	Δ	0.0	0.1	0.5	0.9

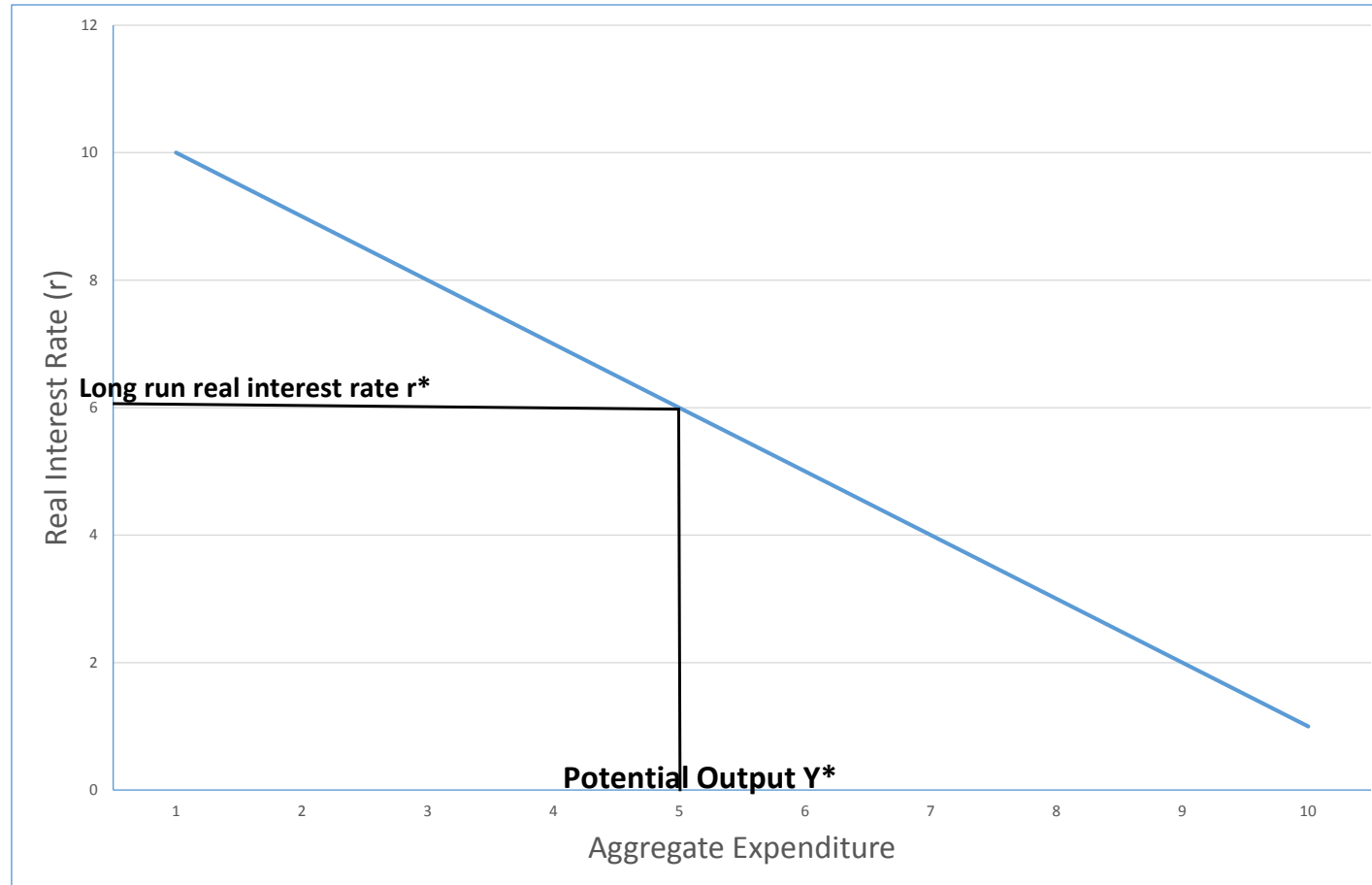
Problems with HERMES & DELFI simulations

- Looking at domestic interest rates
- However, interest rates are set by the ECB.
- A rise in ECB interest rates would affect all of the Euro area
- A fall in output in the rest of the EURO area would magnify effects
- Need to simulate a model of the EU / world and then feed results into HERMES (Ireland) or DELFI (Netherlands)
- Thus these simulations underestimate effects of interest rate changes
- Key question:
 - Why would ECB raise interest rates?

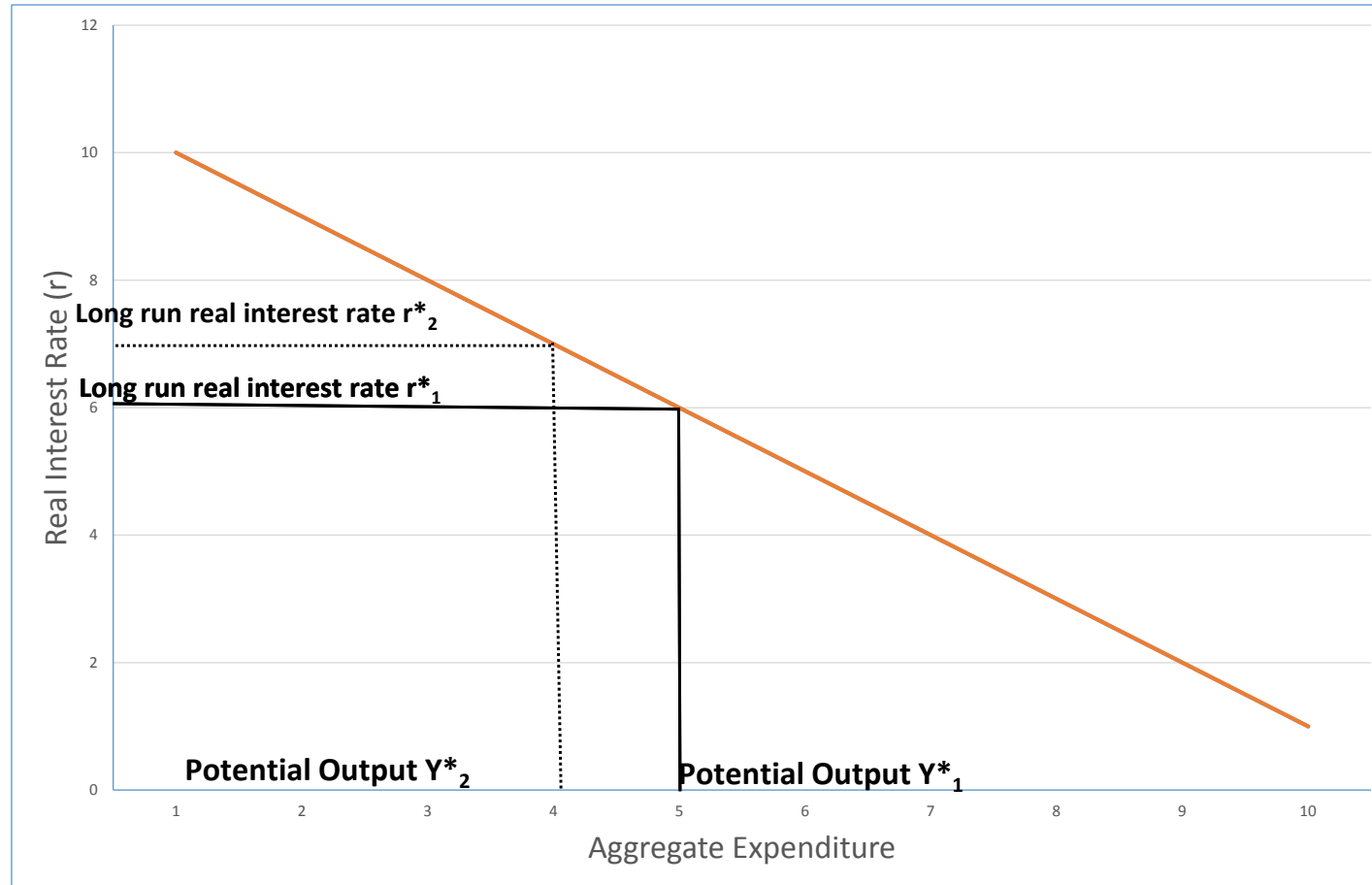
Aggregate Expenditure and Interest Rates



Aggregate expenditure and real interest rate



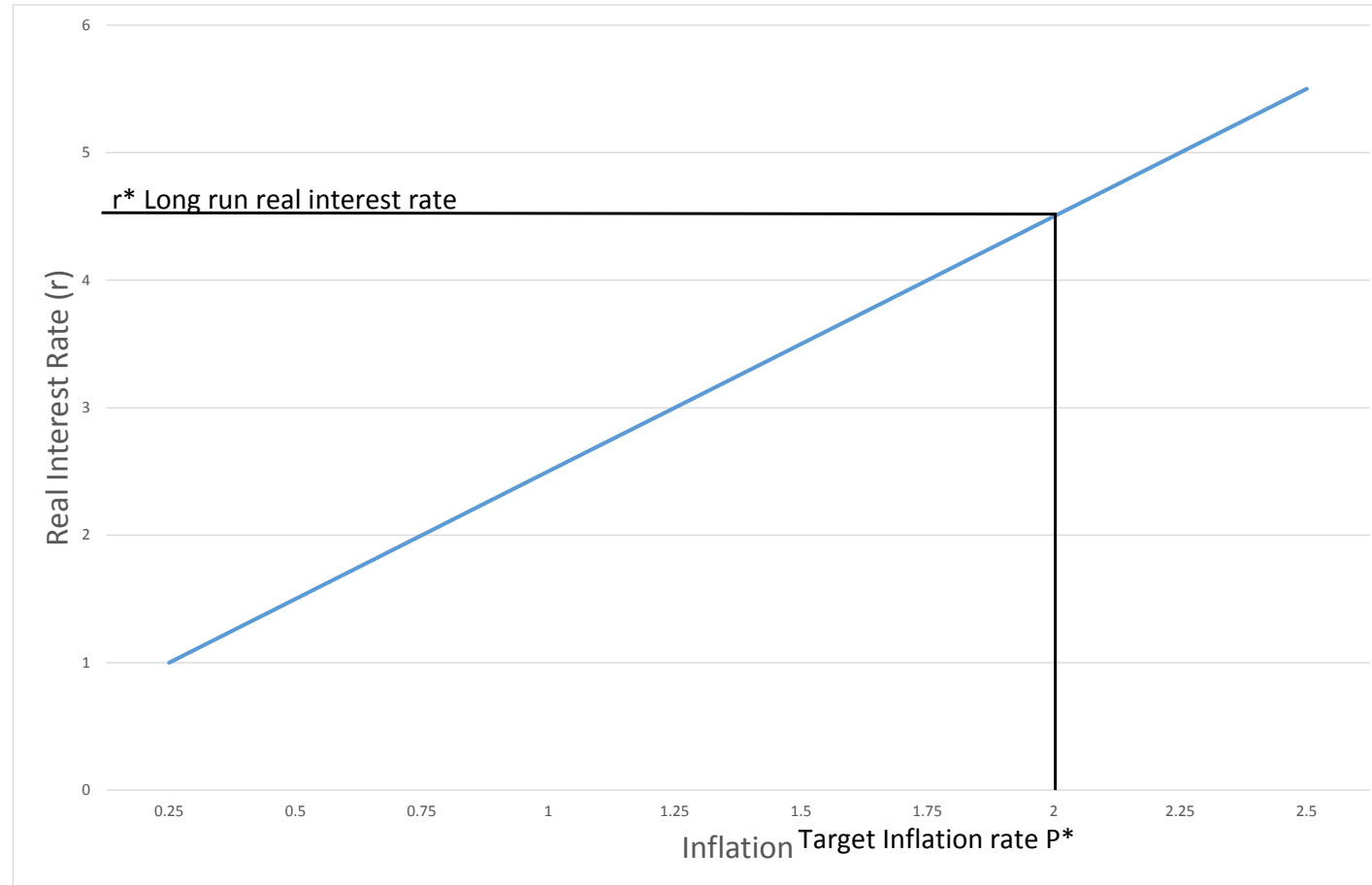
Change in potential output



Modelling behaviour of the ECB / FED

- Taylor Rule characterisation of behaviour of ECB/FED
- Incorporates their objectives in a stylised manner:
- Target interest rate = $2 + \text{current inflation} + 0.5 * \text{inflation gap} + 0.5 * \text{output gap}$
 - Output gap = Actual output – potential output
 - Inflation gap = Actual inflation – target inflation
 - Assumes growth in real output of 2%. Why?
- For example:
 - If target inflation rate is 2 and actual inflation is 2 and if actual output is equal to potential then the target interest rate is 4
- However, if the inflation gap were negative, e.g. -2, this would imply an interest rate of $2 + 0 - 1 = 1$
- While Central Banks do not follow the rule exactly, it is a useful characterisation
 - Helps explain what drives decisions

Monetary policy reaction curve



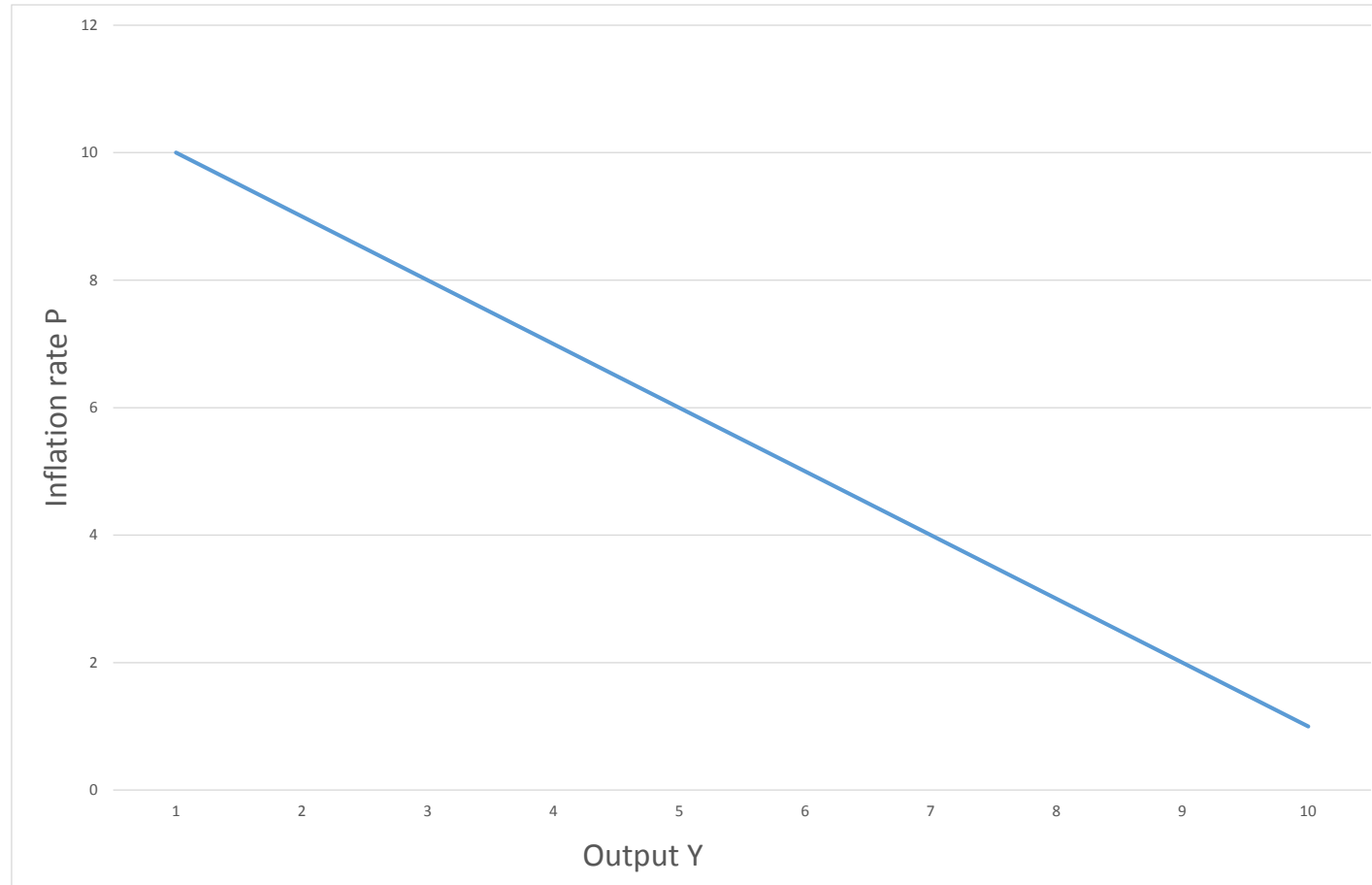
Monetary Policy Reaction Curve

- The upward slope reflects fact ECB does not like inflation
 - The higher the inflation rate the higher the interest rate
- The steepness of the slope depends on the ECB's preferences
 - The Taylor rule
- An increase in the inflation target would shift the reaction curve outwards.
 - With a stable aggregate expenditure curve a change in the target interest rate would see the monetary policy reaction curve shift out.
 - The interest rate set by the ECB would be lower for a given inflation rate. Output would be higher because of the lower inflation rate.
 - However, if $Y > Y^*$ there would still be upward pressure on interest rates

Dynamic Aggregate Demand Curve

- The higher the inflation rate the higher the interest rate set by the ECB
- The higher the interest rate the lower aggregate demand
- Hence the higher the inflation rate the lower aggregate demand

Dynamic Aggregate Demand Curve



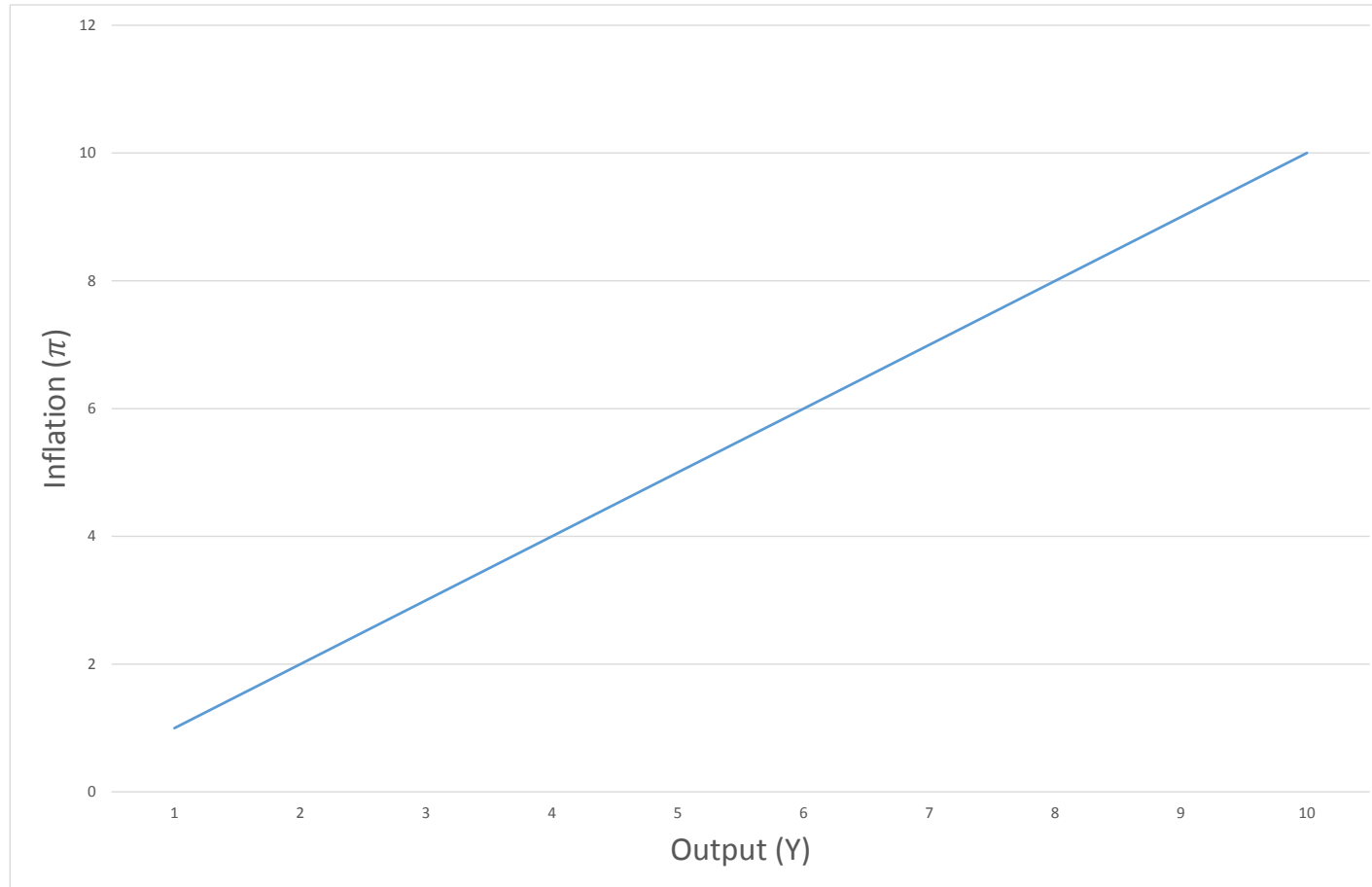
Shifting dynamic aggregate demand curve

- An increase in the ECB's target inflation rate would shift it outwards
- A rise in consumer / investor sentiment, shifting aggregate expenditure curve outwards, would also shift it to the right
- A rise in potential output, Y^* , would also shift it
 - The long run rate of interest given by the aggregate demand curve would fall.
 - The output gap (Taylor rule) would fall. This would shift the monetary policy reaction curve out.
 - Basically higher potential output means the economy can produce more without running into capacity problems, generating inflationary pressures.

Short-run aggregate supply curve

- As inflation rises producers increase output
 - In short run input costs (labour and materials) are sticky
 - A rise in the output price initially generates higher profits
- When production costs change, the short-run aggregate supply curve shifts
 - If actual output < potential – costs are rising more slowly
 - Workers and firms care about real wages and prices. If they expect higher inflation – adjust their prices accordingly. Shifts the supply curve
 - If raw materials prices rise (e.g. oil prices) reduces profitability causing higher inflation for given output. Shifts supply curve up and to left.

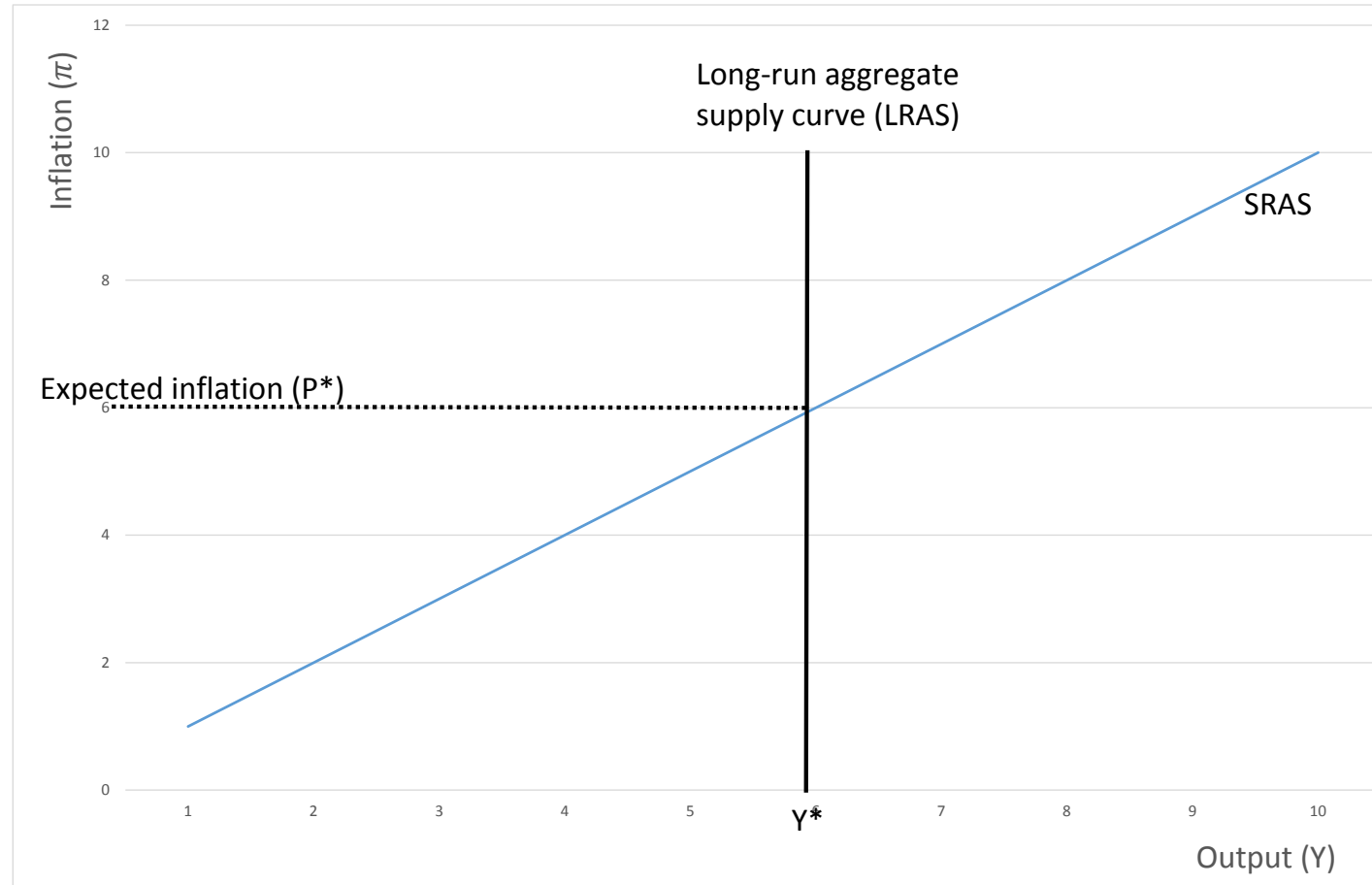
Short-run aggregate supply curve



Long-run supply curve

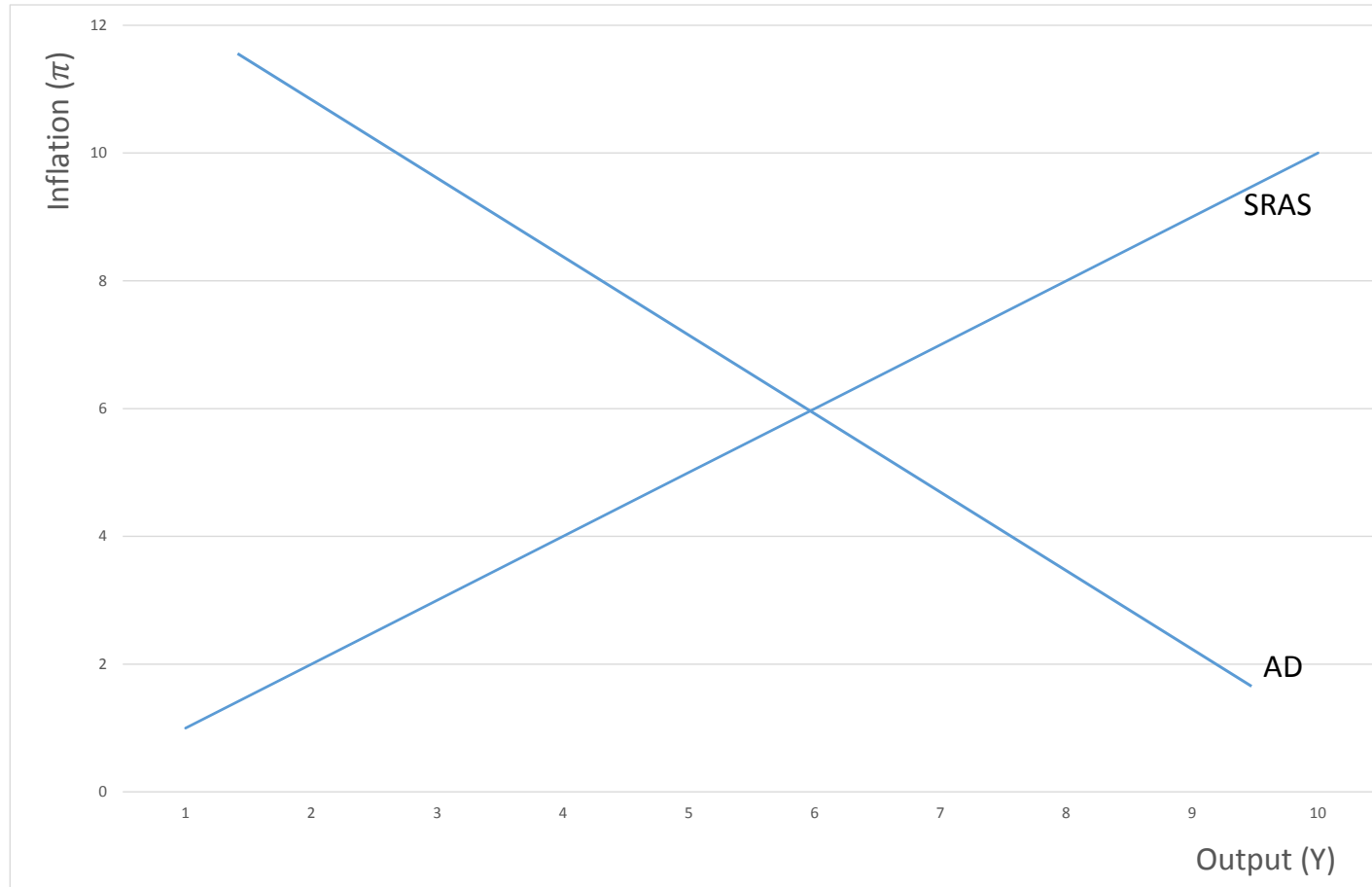
- After prices and output have adjusted to new equilibrium
 - Actual output = potential output ($Y=Y^*$)
 - Inflation is determined by monetary policy
- The long-run aggregate supply curve is vertical at $Y=Y^*$
 - If $Y>Y^*$ inflationary pressures are rising – ECB will raise interest rates
 - Raising interest rates will bring inflation into line AND reduce output so $Y=Y^*$
 - Intersects with short-run aggregate supply curve where expected inflation is equal to the ECB target rate of inflation.

Long-run aggregate supply curve



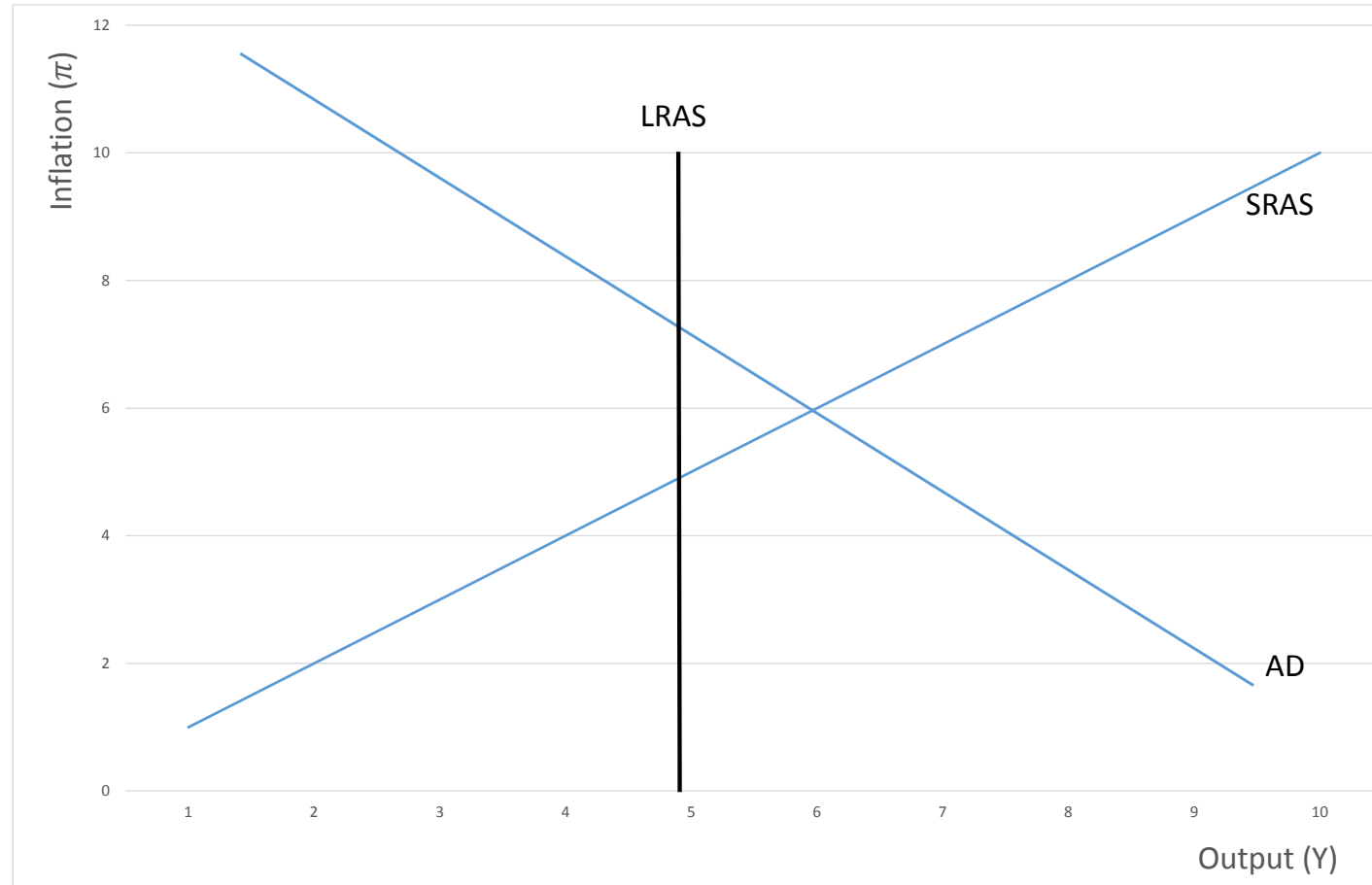
Equilibrium and adjustment

The intersection of
The SRAS and the
AD curves
determines output
and inflation



Equilibrium and adjustment

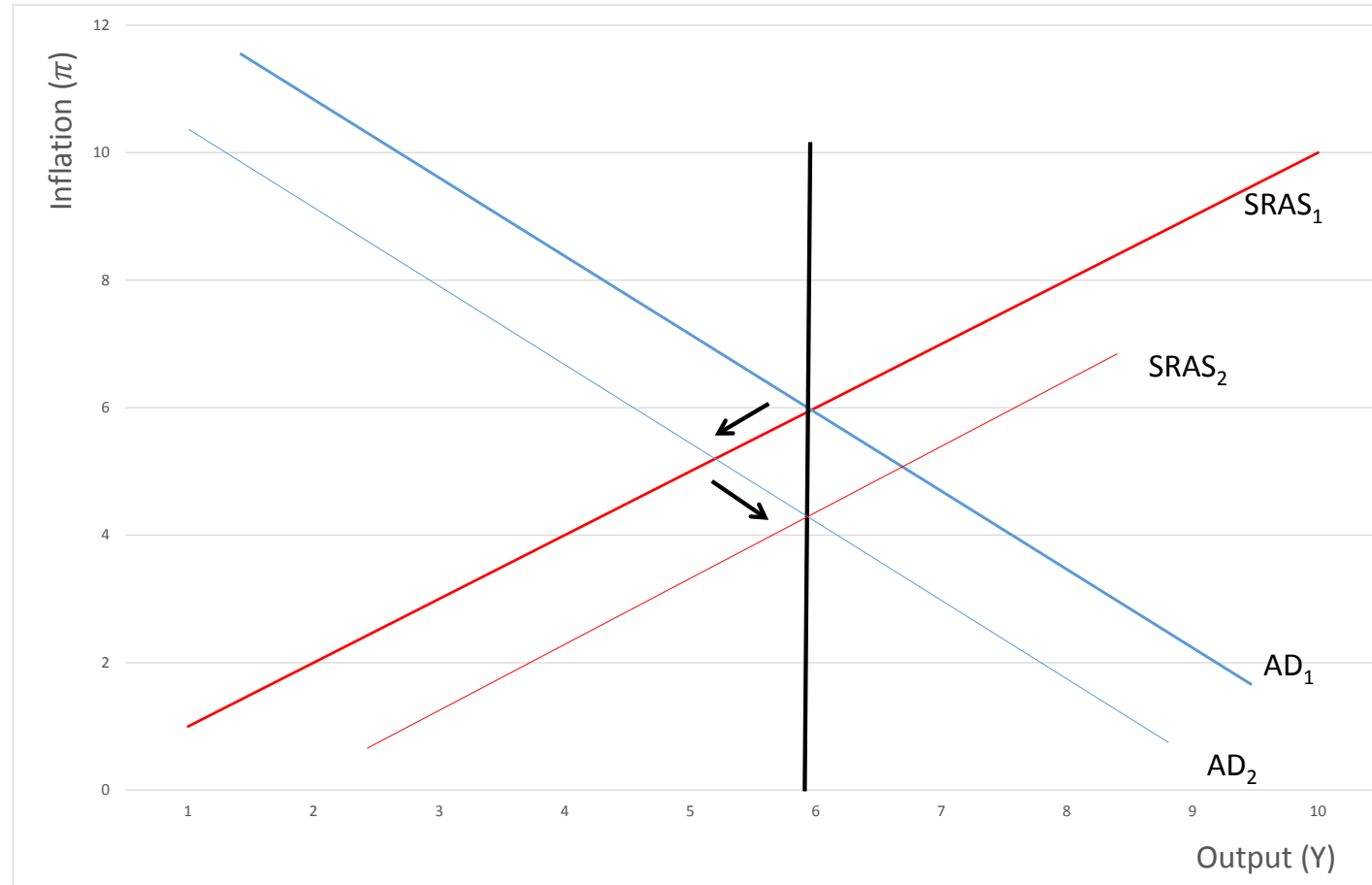
Actual output is initially greater than potential. There is upward pressure on production costs. This shifts SRAS to the left till $Y=Y^*$. In equilibrium: $Y=Y^*$; inflation is at the ECB target rate and actual inflation = expected inflation



Output and inflation model - a wider model

- The adjustment of other prices, such as wages, is determined in other markets (e.g. the market for labour)
 - Equilibrium is needed there too.
- For example, if wage rates are being driven upwards by excess demand for labour this puts upward pressure on inflation
 - ECB will raise interest rates to return inflation to target
 - This will reduce activity and pressure in the labour market
 - Hence the labour input at “potential output” is that level of employment that is consistent with no excess pressure in the labour market – the Non-Accelerating Wage Rate of Unemployment (NAWRU). May not be full employment
 - Is this appropriate for Ireland? Important question when the measure of potential output is used for other purposes – e.g. measuring the structural deficit
 - However, for the EU as a whole the NAWRU is relevant for the ECB

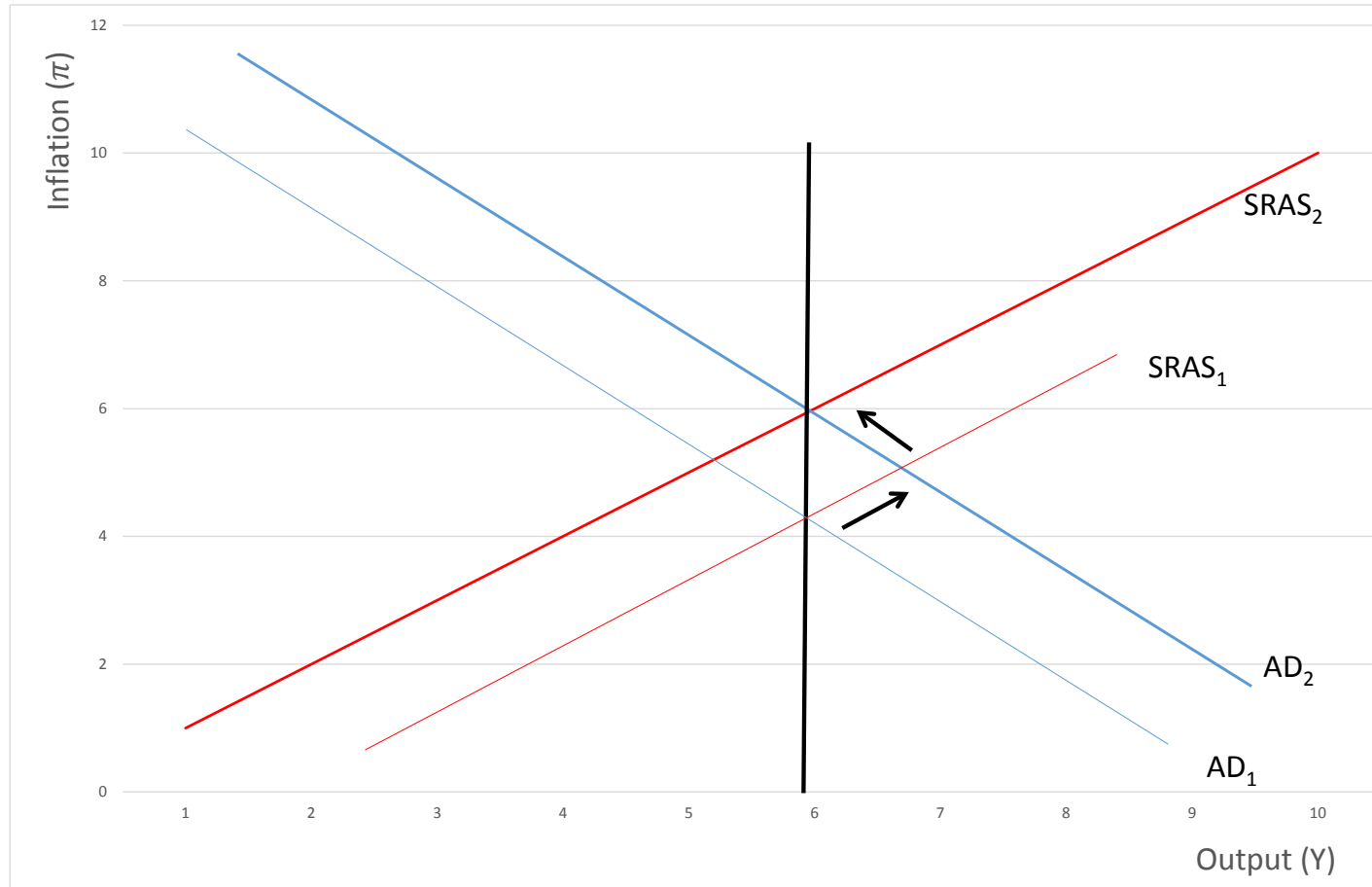
Moving to new target inflation



An example: new inflation target

- Initially in equilibrium where AD1 intersects SRAS1 at potential output
- The ECB cuts its inflation Target – interest rates rise
- The AD curve shifts in to AD2 – short-run equilibrium $Y < Y^*$
- Because there are unused inputs, e.g. labour, costs fall
- Results in shift in short-run supply curve to SRAS2.
- Results in a new equilibrium at potential output and lower inflation
- Speed of adjustment may depend on sticky prices (wages) and adjustment of investment.

An increase in government expenditure



An example: rise in government expenditure

- If economy at potential output $Y=Y^*$
 - Increase in G moves aggregate demand from $AD1$ to $AD2$
 - This sees an increase in inflation as inputs are in short supply
 - The ECB raises interest rates to choke off inflation because it is above target
 - The SRAS shifts and output falls due to the rise in interest rates
 - Pressures ease in the market for inputs (labour)
- If economy below potential output $Y<Y^*$
 - Increase in G moves aggregate demand from $AD1$ to $AD2$
 - This sees an increase in inflation BUT only brings inflation to target level
 - Because it restores equilibrium then there would be no change in interest rates
 - Output would be moved back to potential $Y=Y^*$

Netherlands: Domestic oil prices -\$30 (DELFI)

	Year	1	2	4	8
GDP	%Δ	0.0	0.1	0.4	0.7
Consumption	%Δ	0.3	0.8	1.4	2.0
Investment	%Δ	-0.1	-0.1	0.1	0.4
Exports of Goods and Services	%Δ	-0.5	0.0	0.7	1.2
Wages	%Δ	-0.1	-0.6	-1.1	-1.7
Unemployment Rate	Δ	0.0	0.0	-0.2	-0.6
Government Deficit, % of GDP	Δ	0.2	0.4	0.3	0.1

World: effects of \$40 fall in oil prices (NiGEM)

	Year	1	2	3	4	5
Euro area - temporary		0.3	0.4	0.0	-0.3	-0.2
Euro area - permanent		0.7	1.4	1.7	1.7	1.6
USA - temporary		0.2	0.5	0.1	-0.4	-0.5
USA - permanent		1.2	2.6	3.0	3.0	2.9

Questions

- Why are the Euro area effects from NiGEM significantly greater than for the Netherlands from DELFI?
- What has been the effect of Euro area output being below potential on ECB policy?
- How sensitive is demand to interest rates?
- What determines speed of adjustment to a change in interest rates?
 - What affects speed with which aggregate demand adjusts?
 - What affects speed with which short-run supply curve moves?

Presentations

- Ciara Reynolds:
 - Looking at the balance sheet for Irish banks and the Central Bank in 2007 did they look risky? What evidence can you see in data available at the time that Ireland was on the edge of a financial cliff? What lessons can be learned for the future?
- Paul Kilkenny:
 - Is there a problem with variable rate mortgages? What should the state do about variable rate mortgages if there is a problem? What are the risks involved in different courses of action? Is there a market failure? Should there be a policy on mortgage finance for housing?

References

- Cecchetti and Schoenholtz, *Money, Banking, and Financial Markets*, Chapter 21 and 22
- Blanchard, Amighini and Giavazzi, *Macro-Economics a European Perspective*, Chapter 4.
- Shocks to cost of production – oil price fall
 - <http://ner.sagepub.com.elib.tcd.ie/content/231/1/F43.full.pdf+html> NIER quarterly, January 2015.
- Taylor Rule – for Euro area, and Ireland
 - http://papers.ssrn.com/sol3/papers.cfm?abstract_id=280811
- Model of Netherlands
 - <http://delfi.dnb.nl>
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