Principles of Economics II

Lecture 10: Technological progress, employment, and living standards in the long run

Fall 2021

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Outline

- **Introduction**
- **Technological progress and living standards**
- **Technological progress and the end of work?**
- **Long-run labour market model**
- **The role of institutions and policies**

Introduction

Context

Technological change improves long-run living standards but can cause short-run unemployment by replacing labour

However, long-run patterns of unemployment across countries are not explained by national differences in innovation over time

- How can institutions and policies explain these differences?
- How can we model the effects of institutions and policies on long-run unemployment and economic growth?

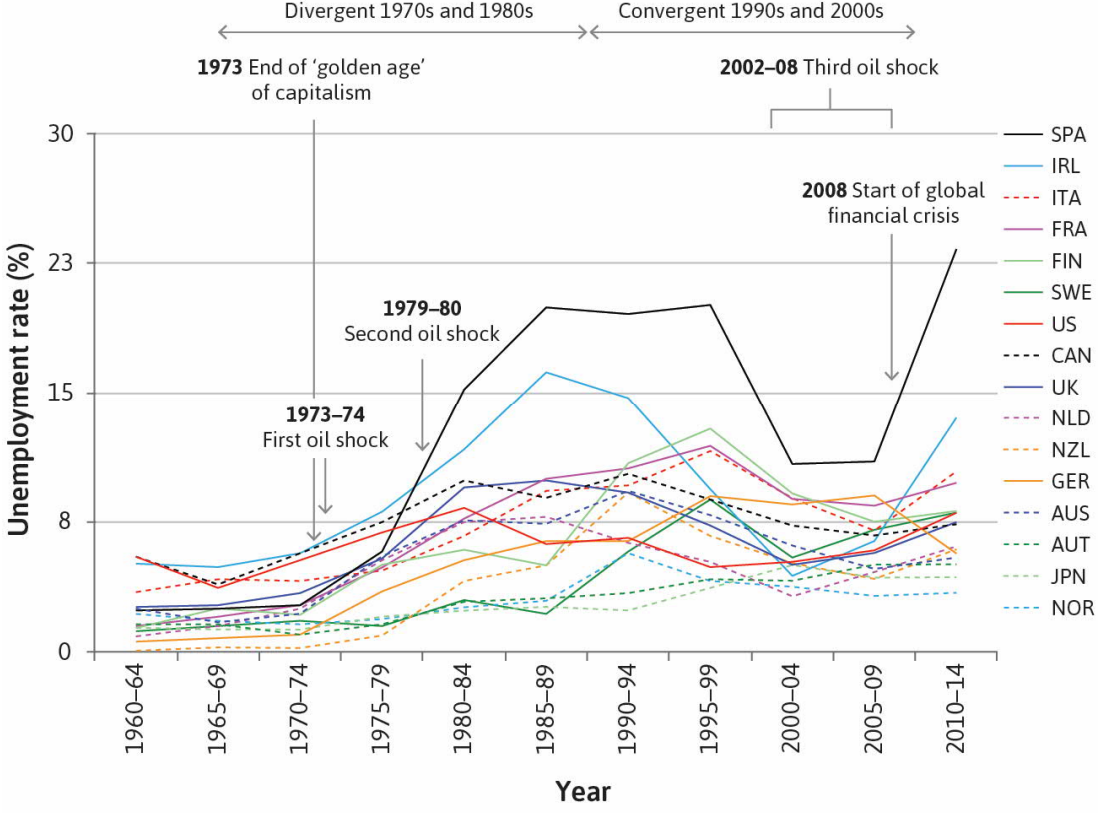
Context

Unemployment rates were low and similar in the 1960s, then diverged in the 1970s

Patterns of unemployment across countries reflect differences in institutions and policies

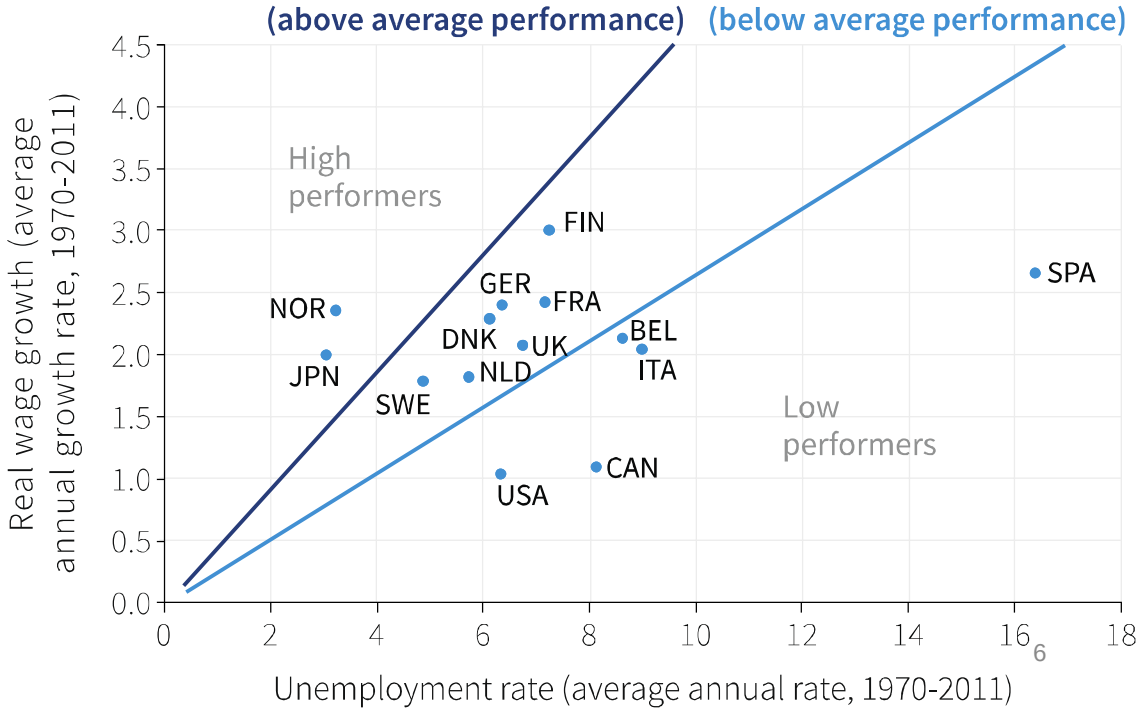
Production has become more capital intensive, without resulting in mass unemployment

How could this outcome occur?



Context

Use a long-run labour market model to explain differences in labour market performance across countries, and look at the effects of technological progress on living standards and inequality



Technological progress and living standards

Definitions

Capital

- Produced inputs (buildings, machinery)

Labour

- Physical and mental human effort used in production

Technology

- A set of instructions for combining inputs to make output
- Can also refer to ways of organizing work

Technological progress and living standards

Firms can earn innovation rents by introducing new technology

- Firms that cannot keep up with innovation eventually fail (creative destruction)

Technological progress and capital goods accumulation are complementary:

- New technologies require new machines
- Technological advance is needed for increasingly capital-intensive methods of production to be profitable

This process allows a sustained increase in average living standards

Technological progress

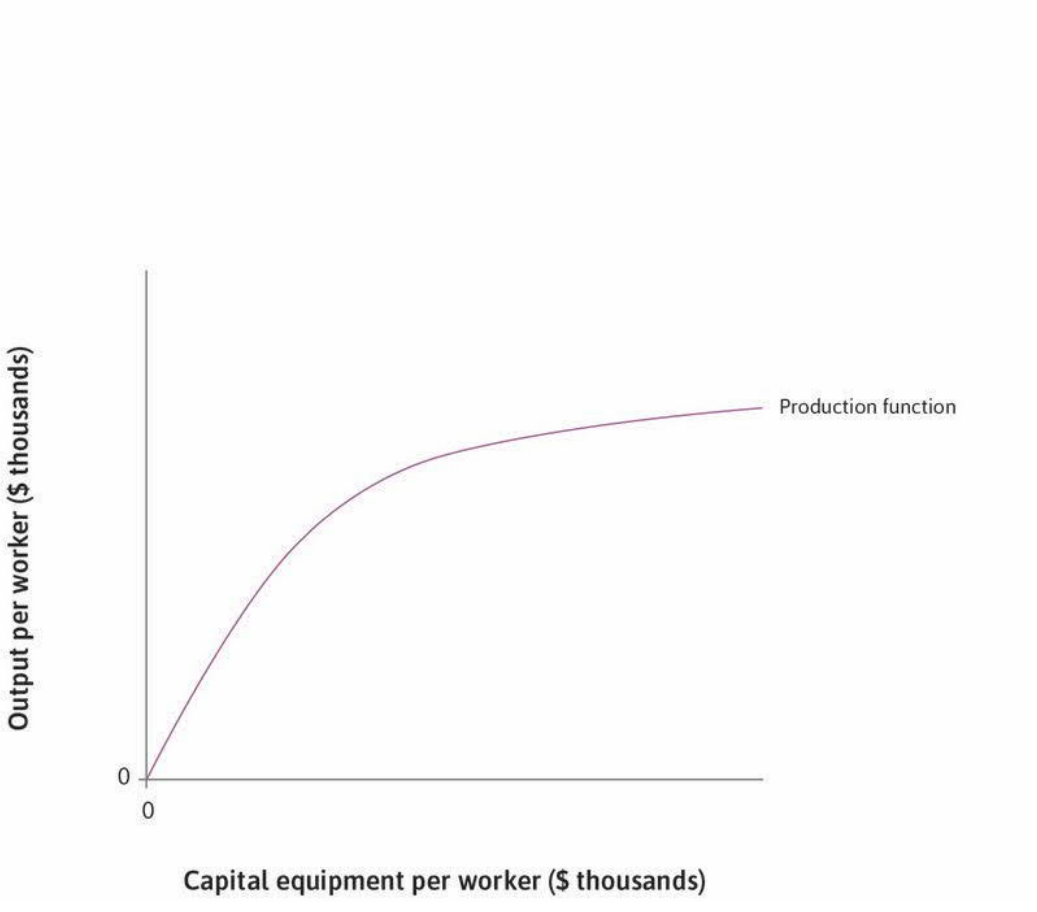
Technological progress

The economy's production function

Horizontal axis records the amount of capital goods per worker, i.e. the capital intensity of production

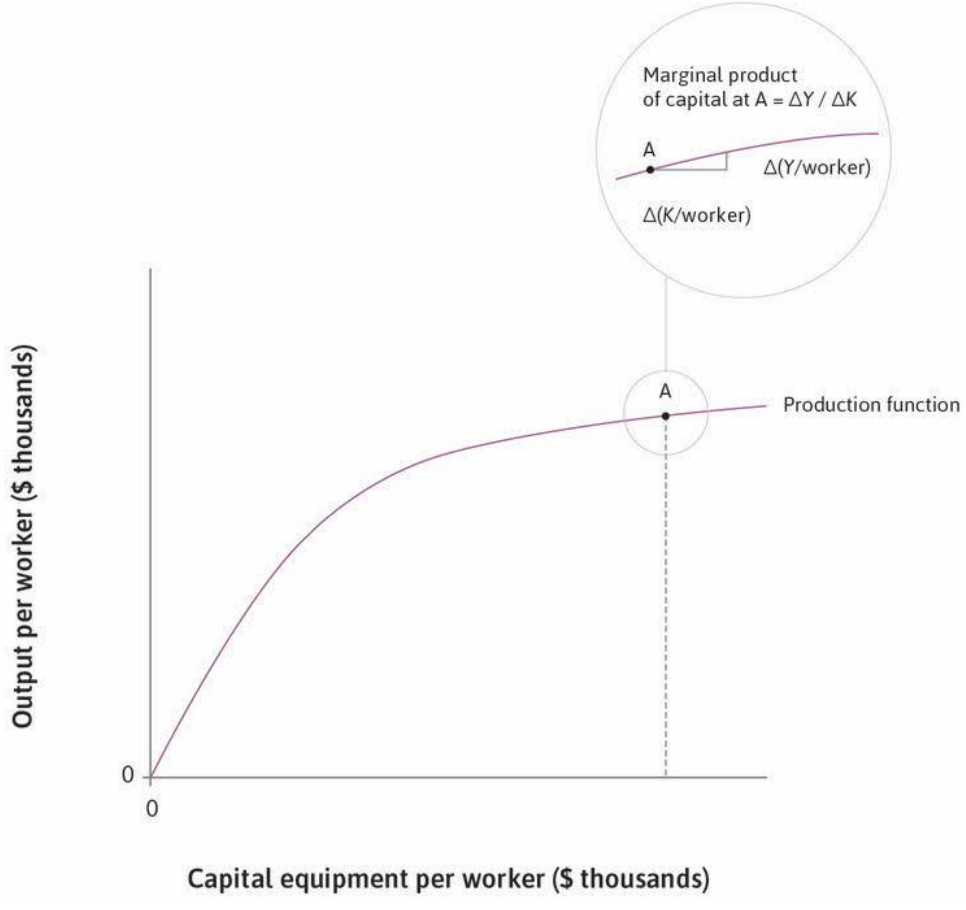
On the vertical axis, we have the amount of output per worker, also known as labour productivity

The production function is characterized by diminishing returns to capital (concave)



The economy's production function

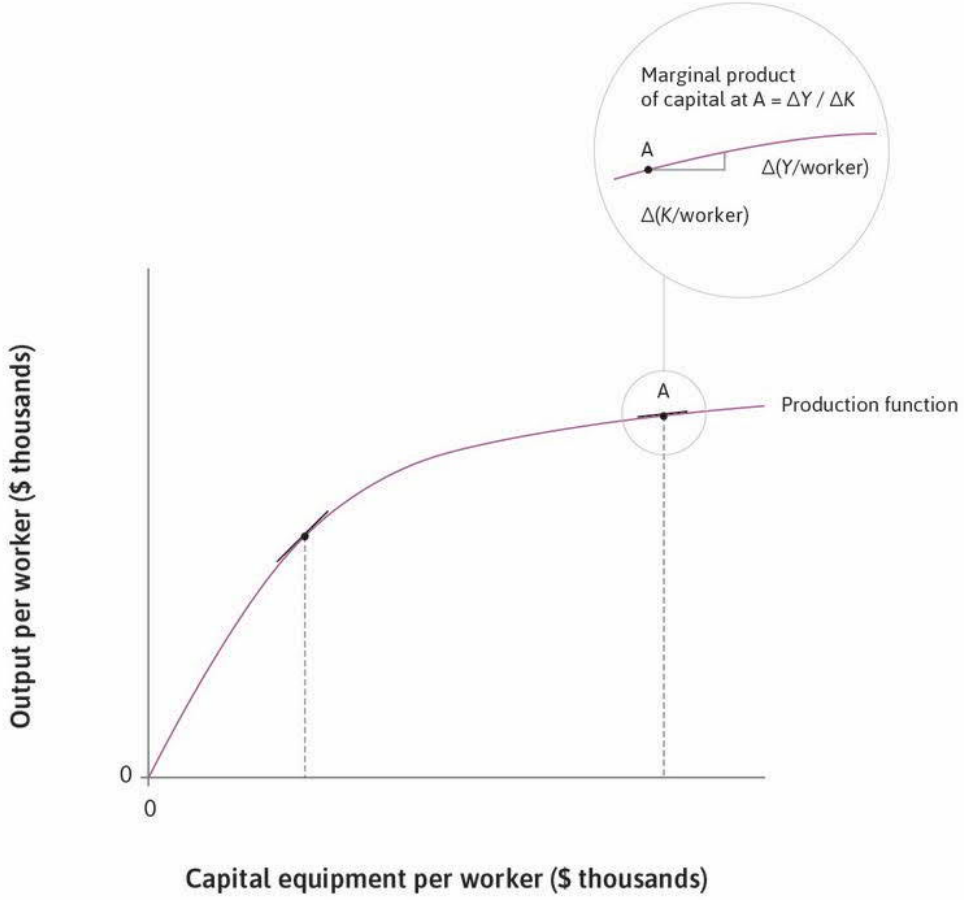
The magnified section at point A shows how the marginal product of capital is calculated: it is the slope of the tangent to the production function at A



The economy's production function

The magnified section at point A shows how the marginal product of capital is calculated: it is the slope of the tangent to the production function at A

The marginal product of capital is falling as we move along the production function to higher capital intensity

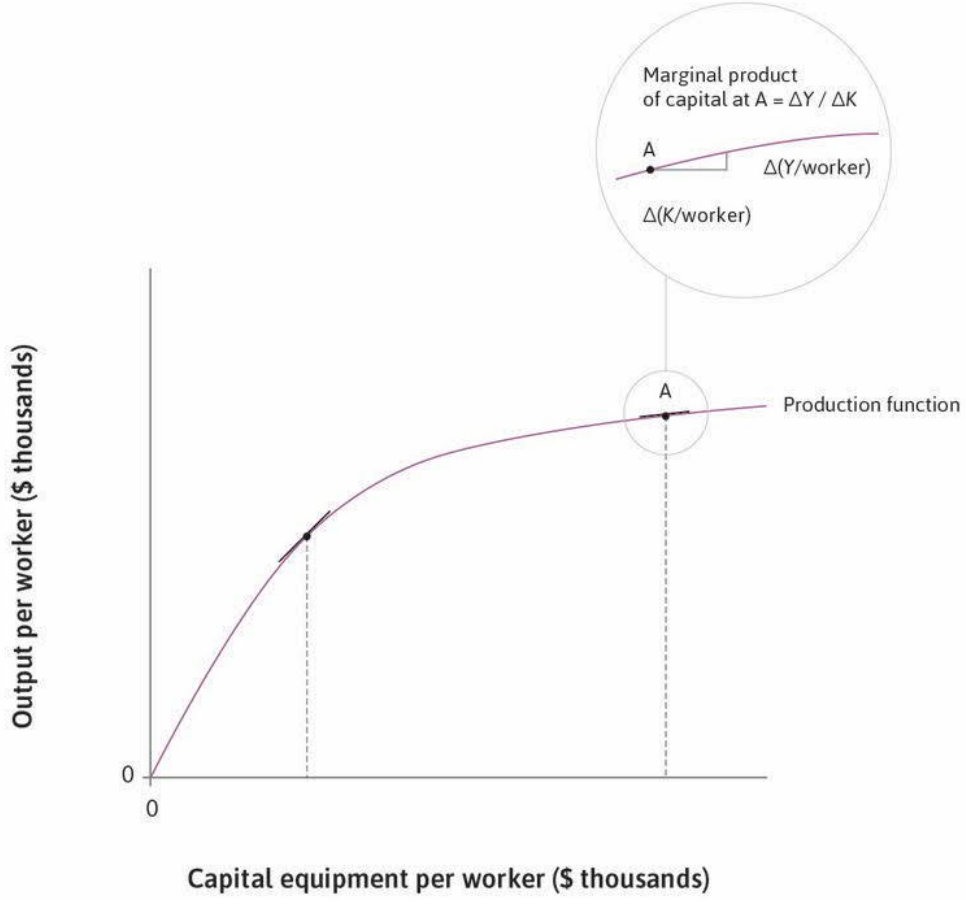


The economy's production function

Concavity means that an economy will not be able to sustain growth in output per worker simply by adding more of the same type of capital

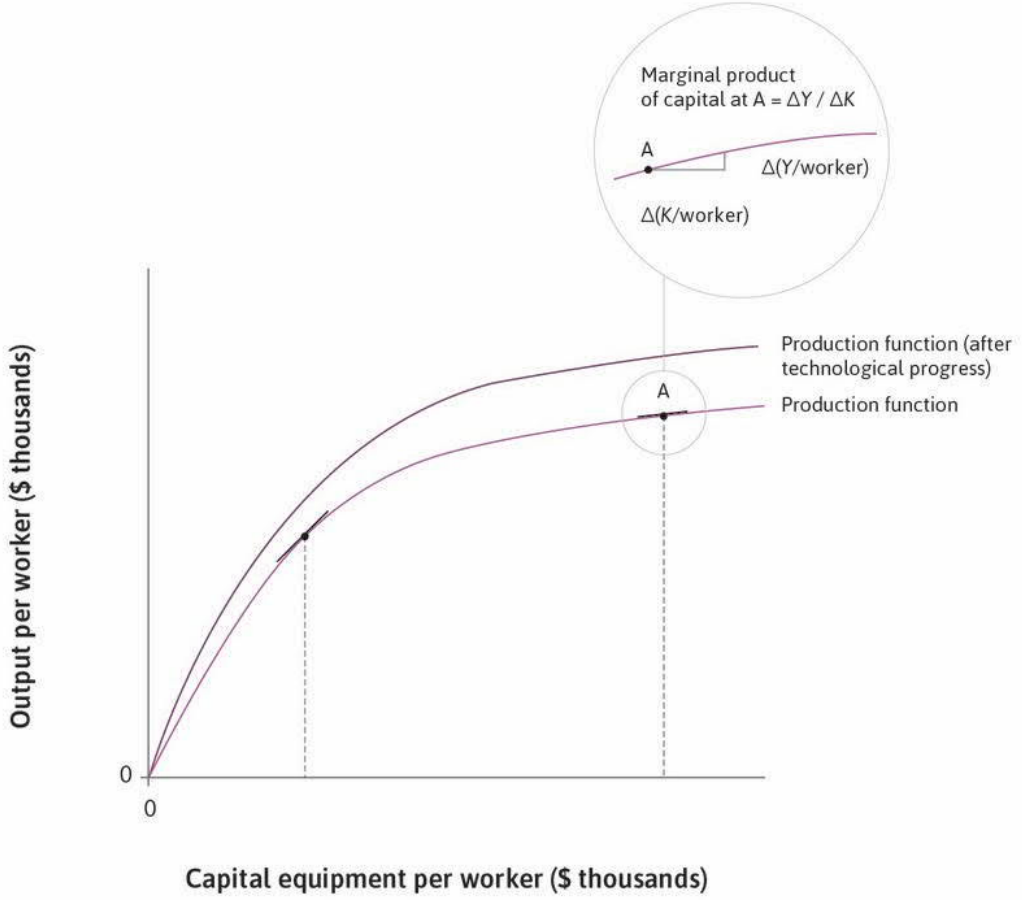
At a certain point, the marginal productivity of capital becomes so low that it is not worth investing any further

Business owners will invest domestically only if the return is high enough (ρ, r, Π)



The economy's production function and technological progress

Technological progress rotates the production function upward

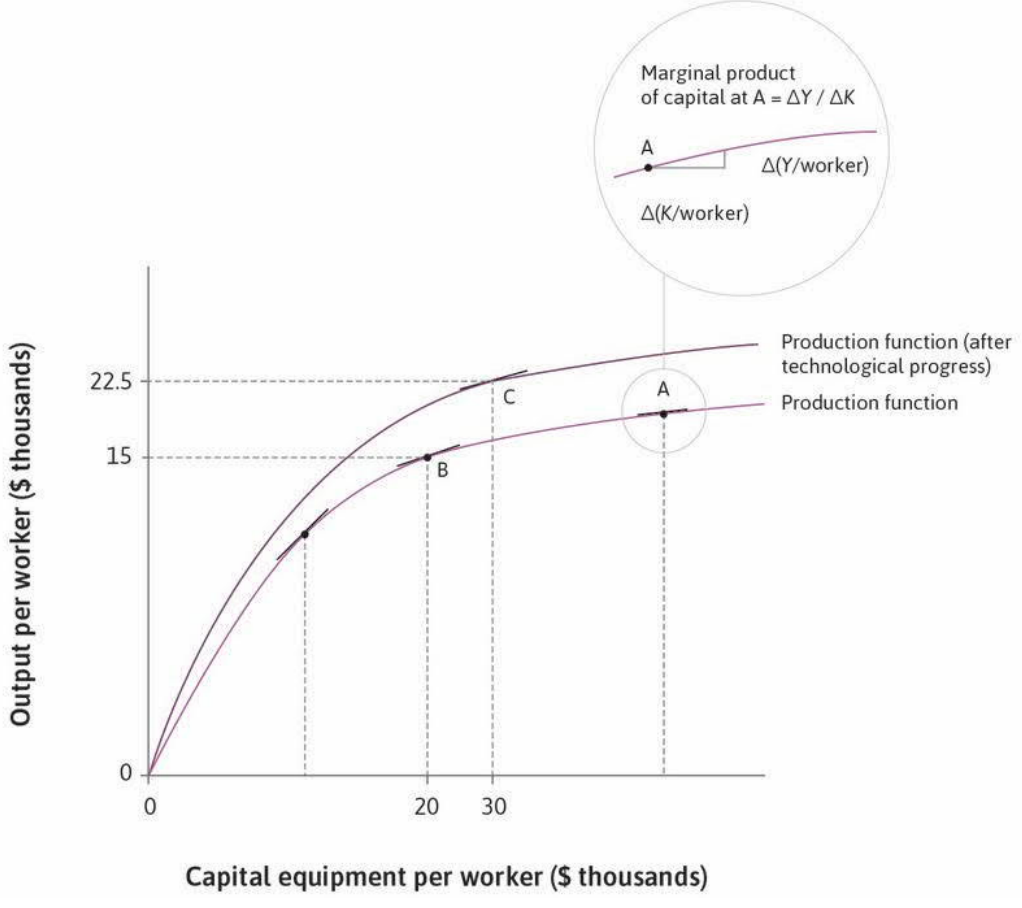


The economy's production function and technological progress

Technological progress rotates the production function upward

We have chosen point C so that the slope of the production function, and therefore the marginal product of capital, is the same as at point B

Technological progress makes it possible to increase the use of capital without lowering the marginal product of capital

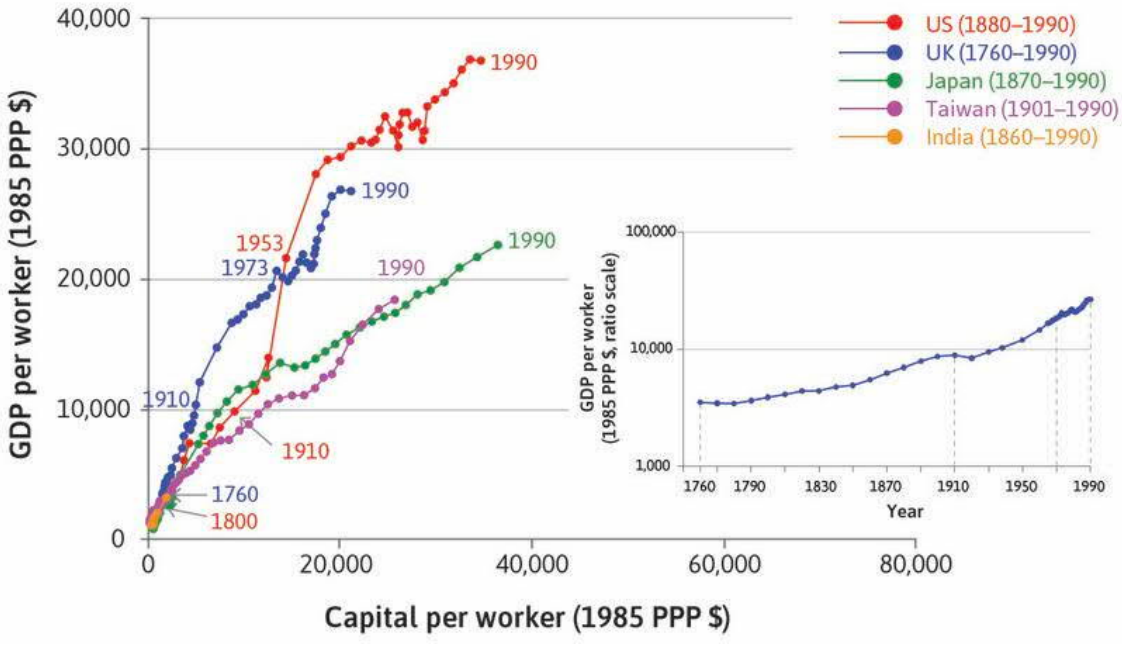


Long-run growth trajectories of selected economies

Countries that are rich today have seen labour productivity rise over time as they became more capital-intensive

Unlike the concave production function, capital productivity remained roughly constant over time in the technology leaders

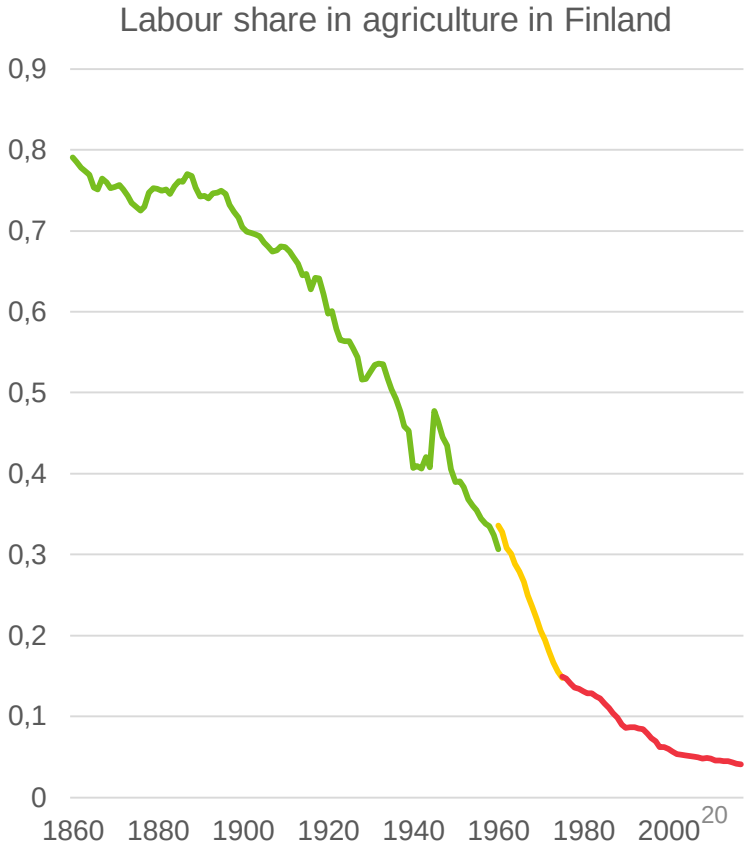
They experienced both capital accumulation and technological progress



Technological progress and the end of work?

Are robots taking away all the jobs?

They already did!



NACA computers in 1950s

Maybe AI will do the job

All jobs may disappear in 120 years, AI researchers say

Humans will have a comparative advantage at something?

Reading for those who are interested in this subject (not for the exam!):

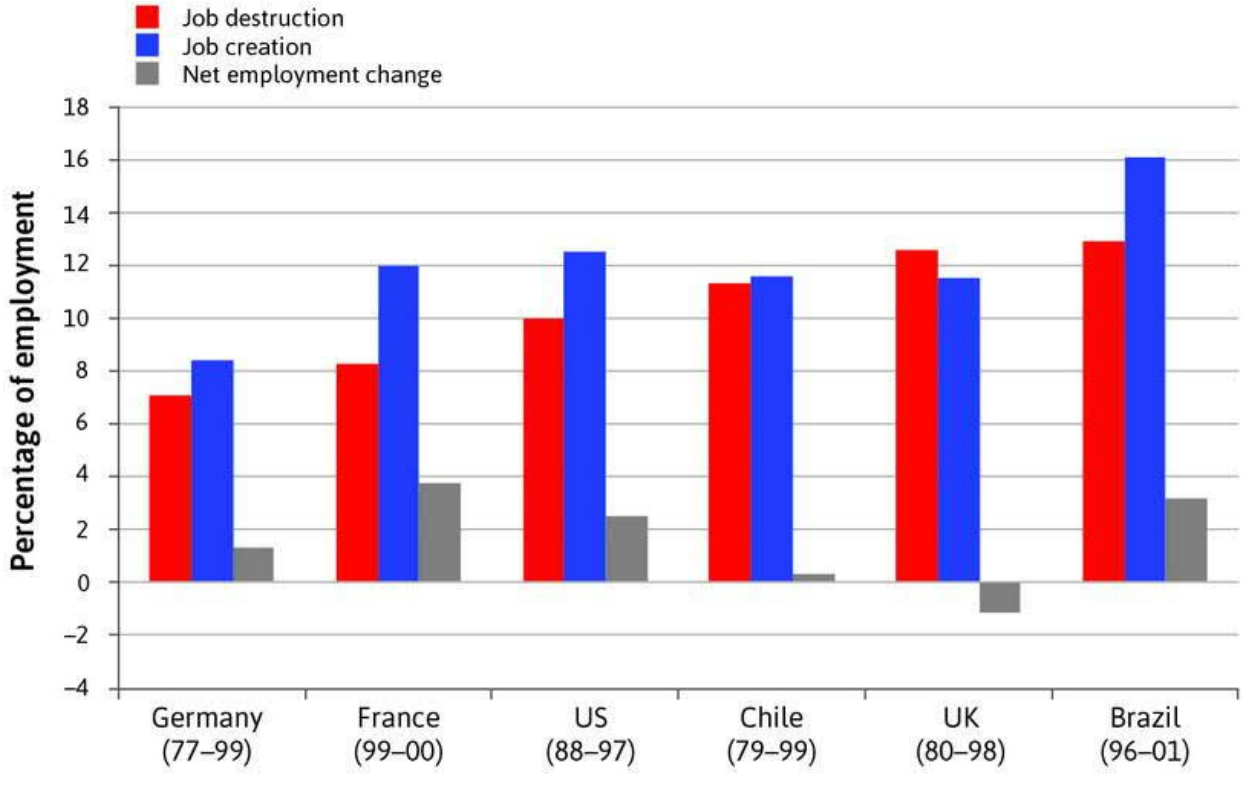
- Why Are There Still So Many Jobs? The History and Future of Workplace Automation (David Autor, JEP2015)

KEINOÄLY | Samuli Känsälä 30.5.2017 klo 15:54

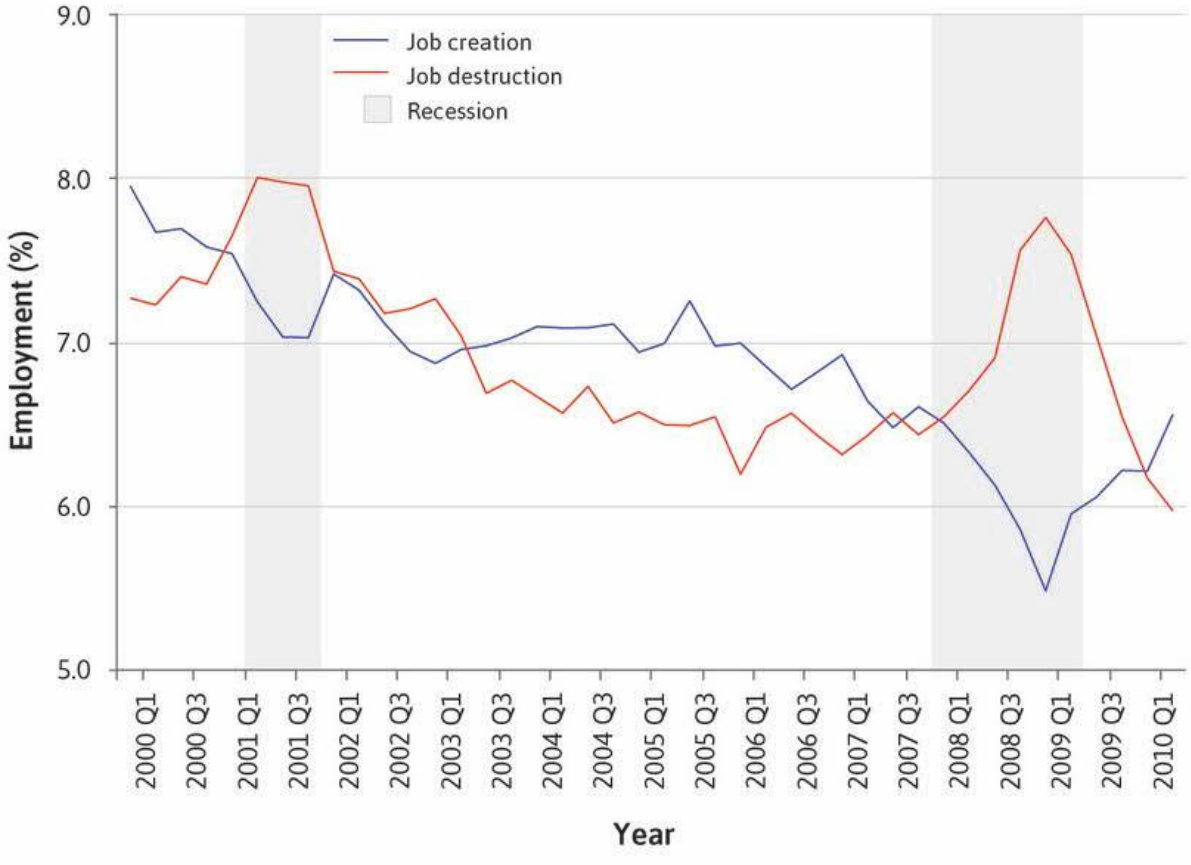
Kaikki työpaikat saattavat olla vaarassa 120 vuoden sisällä – keinoäly vie myös keinoälytutkijoiden työt

The job creation and destruction process

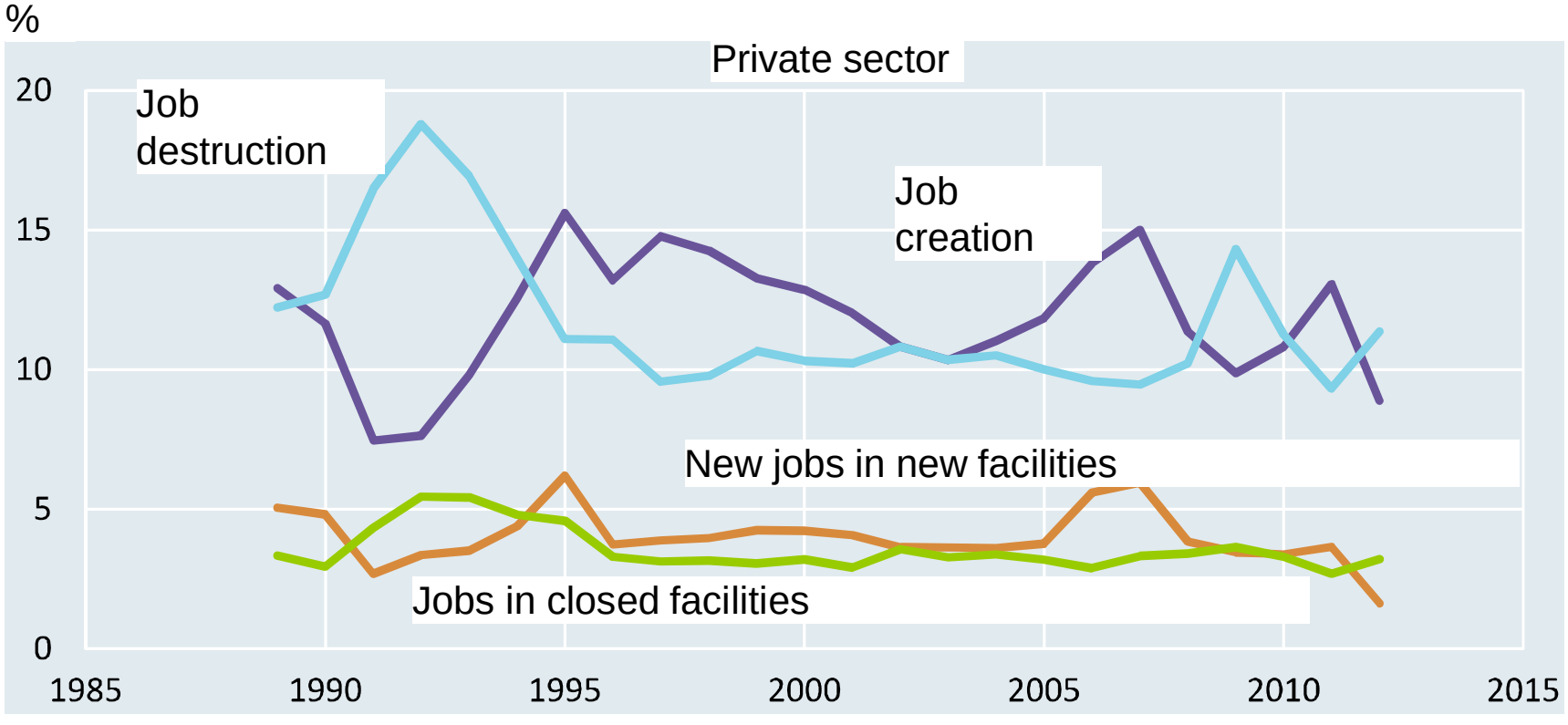
Job destruction, job creation, and net employment across countries



Job creation and destruction during business cycles in the US



Job destruction, job creation, and net employment in Finland



The Beveridge curve

English economist Lord William Beveridge (1879–1963)

Beveridge noticed that when unemployment was high, the vacancy rate was low; and when unemployment was low, the vacancy rate was high

- During recessions, there will be high unemployment: When the demand for a firm's product is declining or growing slowly, firms can manage with their current staff even. As a result, they advertise fewer positions. In the same conditions of weak demand for firms' products, people will be laid off or their jobs entirely eliminated.
- During booms, unemployment will decline: The number of vacant jobs posted by firms increases, and more workers will be employed to cope with rising demand for products.

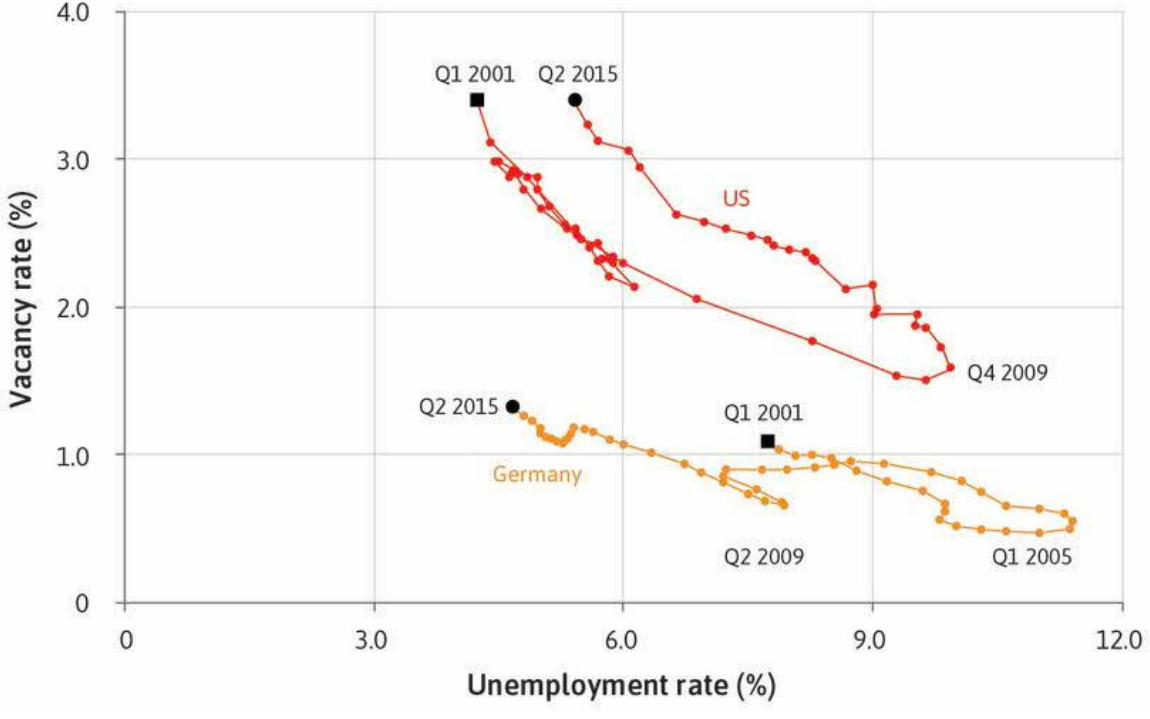
The Beveridge curve

- **Job creation is strongly procyclical (rises in booms and falls during recessions), whereas job destruction is countercyclical**
- **The Beveridge curve shows the inverse relationship between the unemployment rate and the job vacancy rate**

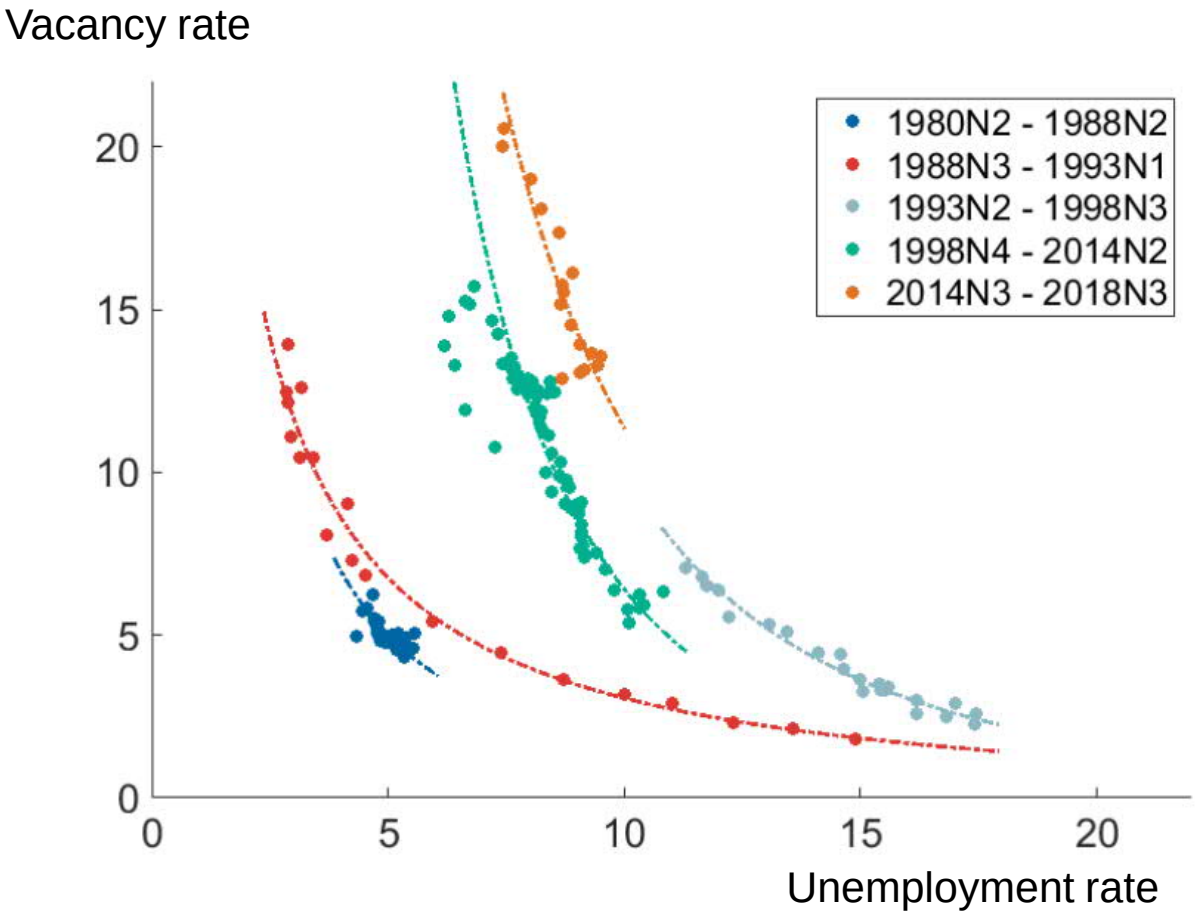
Beveridge curves for the US and Germany

During recessions, firms post fewer vacancies and lay off more workers due to lower demand

During booms, firms post more vacancies and need more workers to cope with rising demand



Beveridge curve for Finland



Labour market matching

Newly posted vacancies are not filled instantly because of issues with labour market matching:

- Mismatch – unemployed workers may not have the skills required for the job; jobseekers and vacancies may be located in different parts of the country
- Jobseekers and/or employers may not know about each other
- Industry-specific shocks or shocks that prevent workers from moving increase the mismatch (lower efficiency)

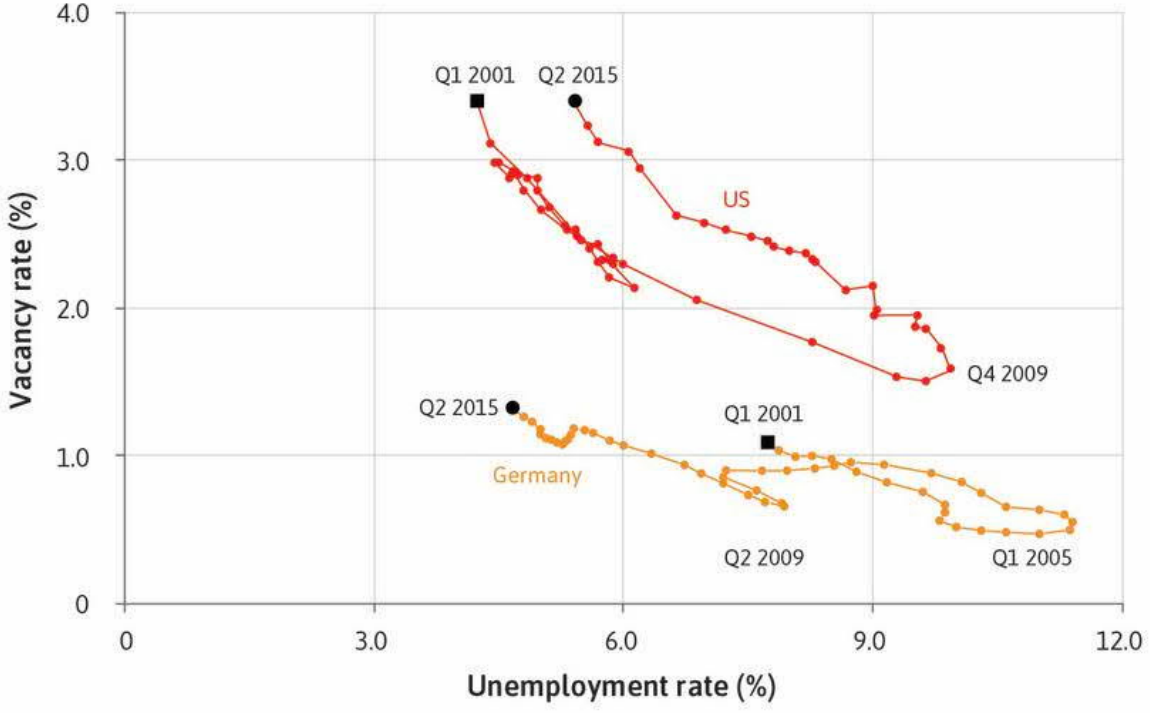
Policies and technology can improve efficiency

Beveridge curves for the US and Germany

Both curves slope downward, as expected

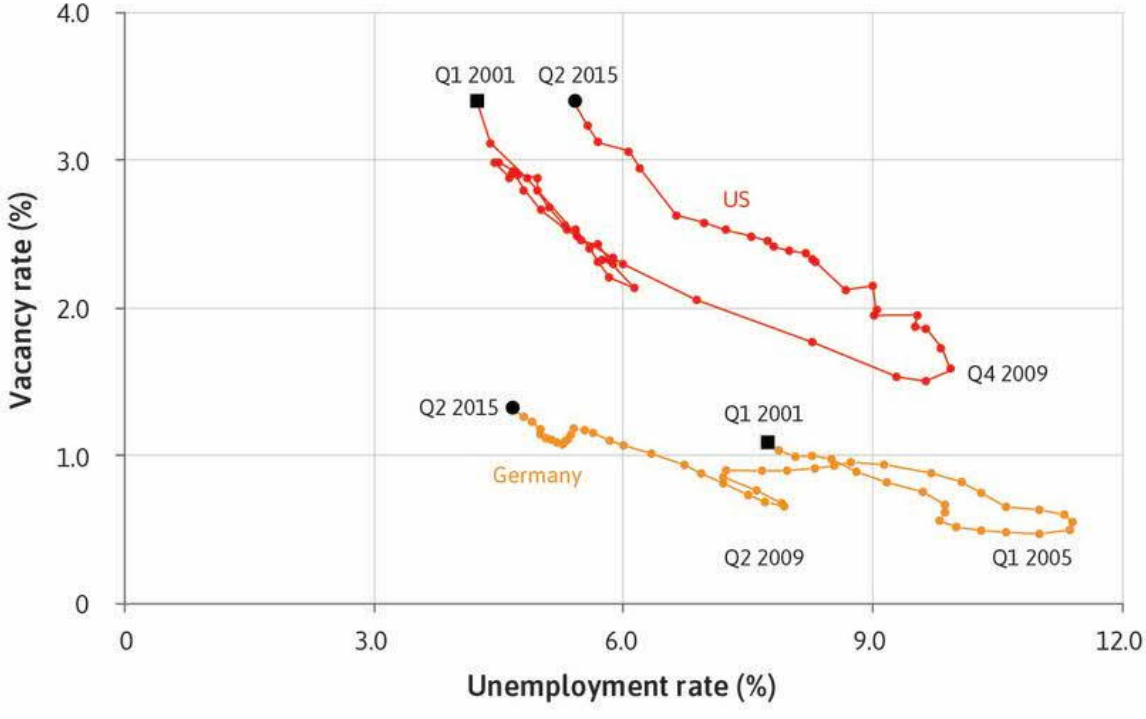
The position of each nation's Beveridge curve is different

Both the curves shifted over the course of the decade



Beveridge curves for the US and Germany

The German labour market appears to do a better job of matching workers seeking jobs to firms seeking workers



Long-run labour market model

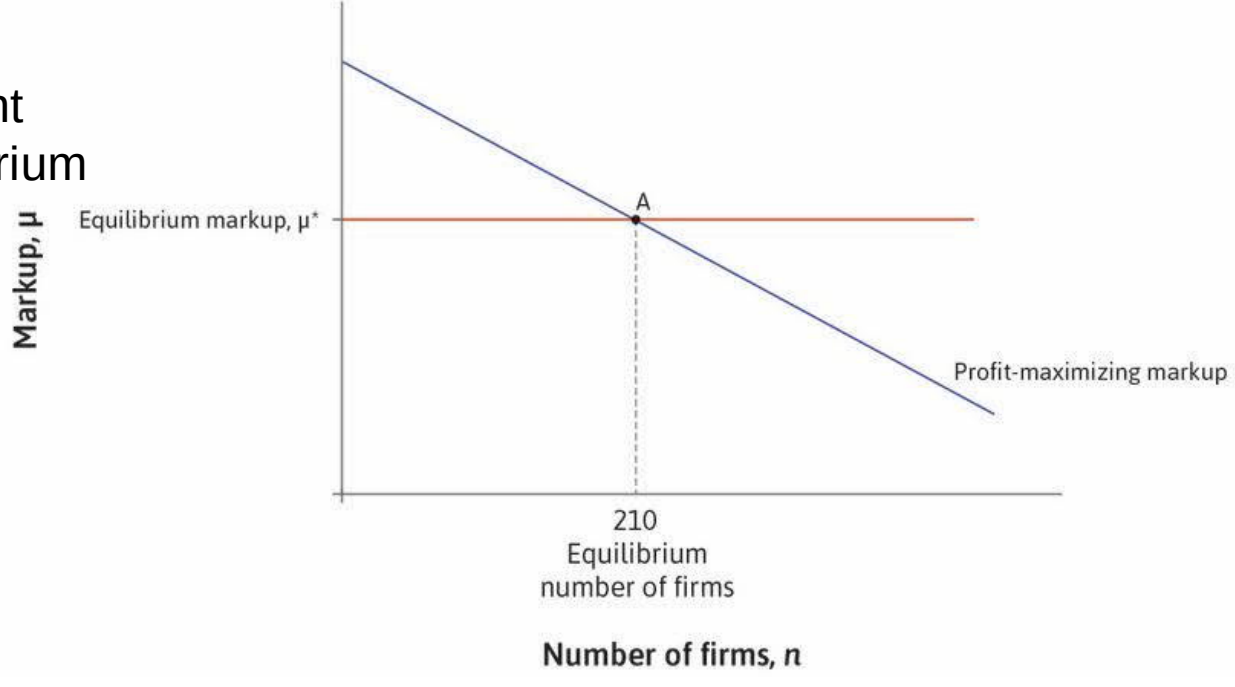
Long-run unemployment

- **To explain trends and differences in unemployment over time, we can extend the labour market model to the long run**
- **In the long run, firms can enter/exit (so capital stock can change)**
- **Long-run employment rate depends on how well policies and institutions deal with:**
  - Work incentives - depend on wage-setting curve
  - Investment incentives - depend on price-setting curve
- **Long-run equilibrium in the labour market is when wages, employment level, and the number of firms are constant**

Firm entry, exit, and the equilibrium markup

The downward sloping line gives the markup that maximizes the firm's profits, for a given number of firms

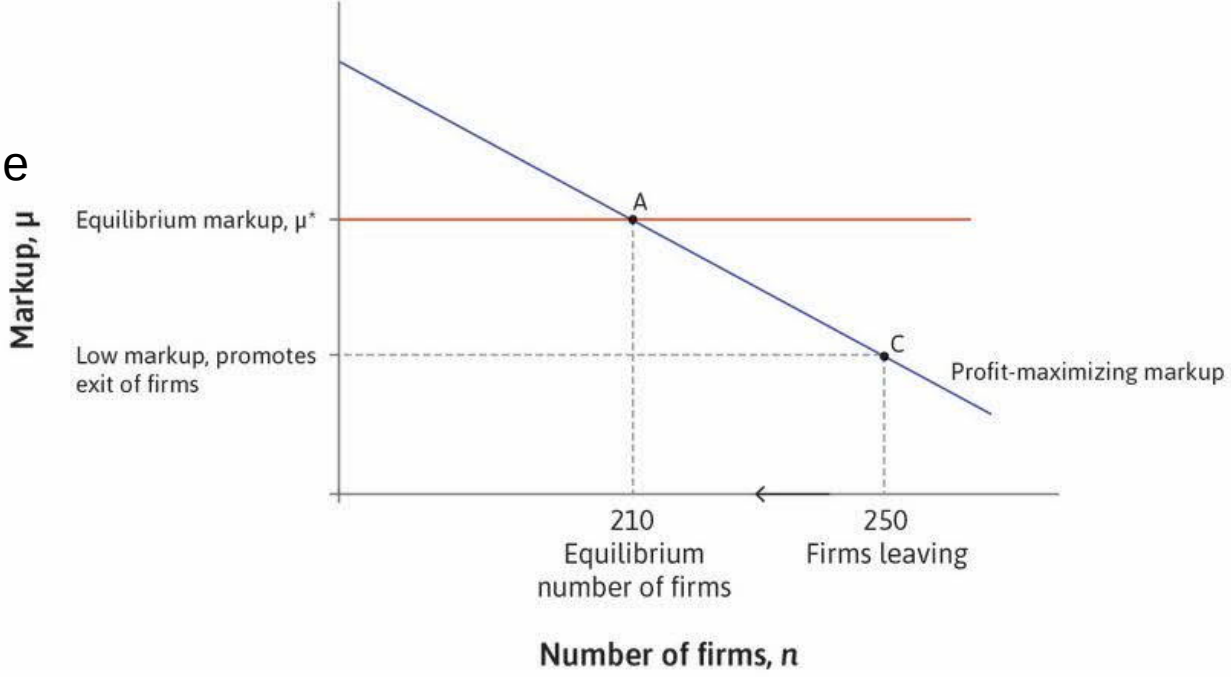
The number of firms is constant and equal to 210 at the equilibrium markup, μ*.



Firm entry, exit, and the equilibrium markup

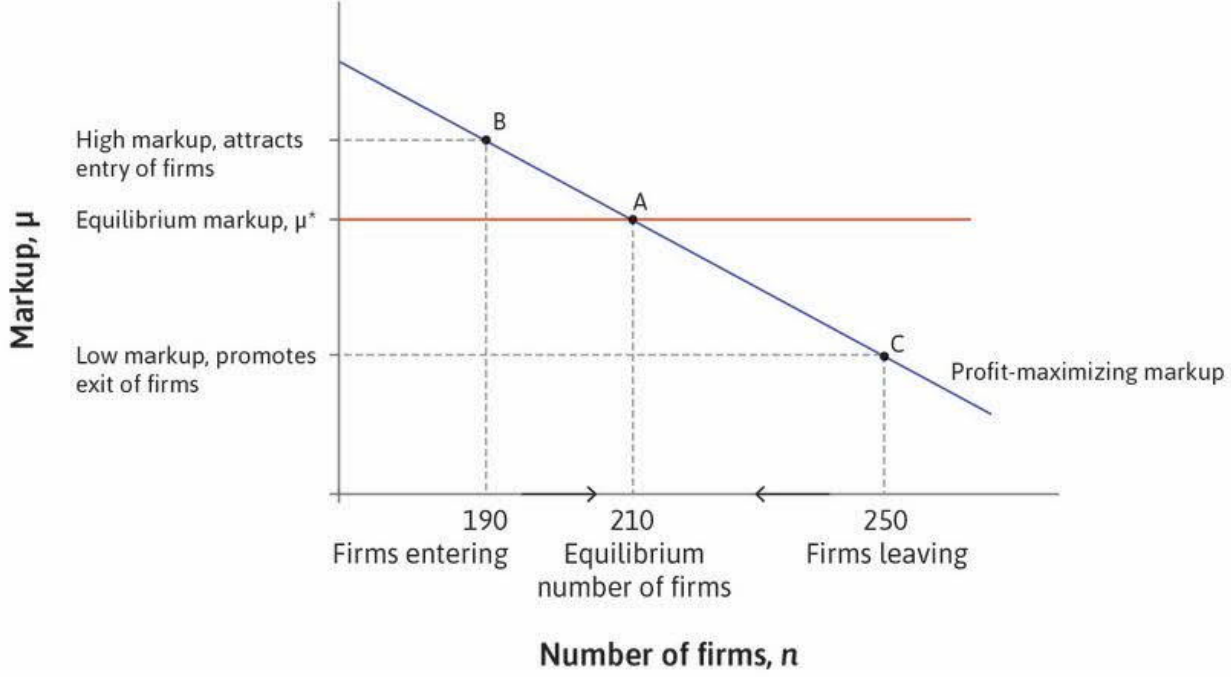
The more firms there are, the more competitive the economy, which will result in a higher elasticity of demand and a lower markup

With 250 firms, the markup is below μ* and firms will leave the economy



Firm entry, exit, and the equilibrium markup

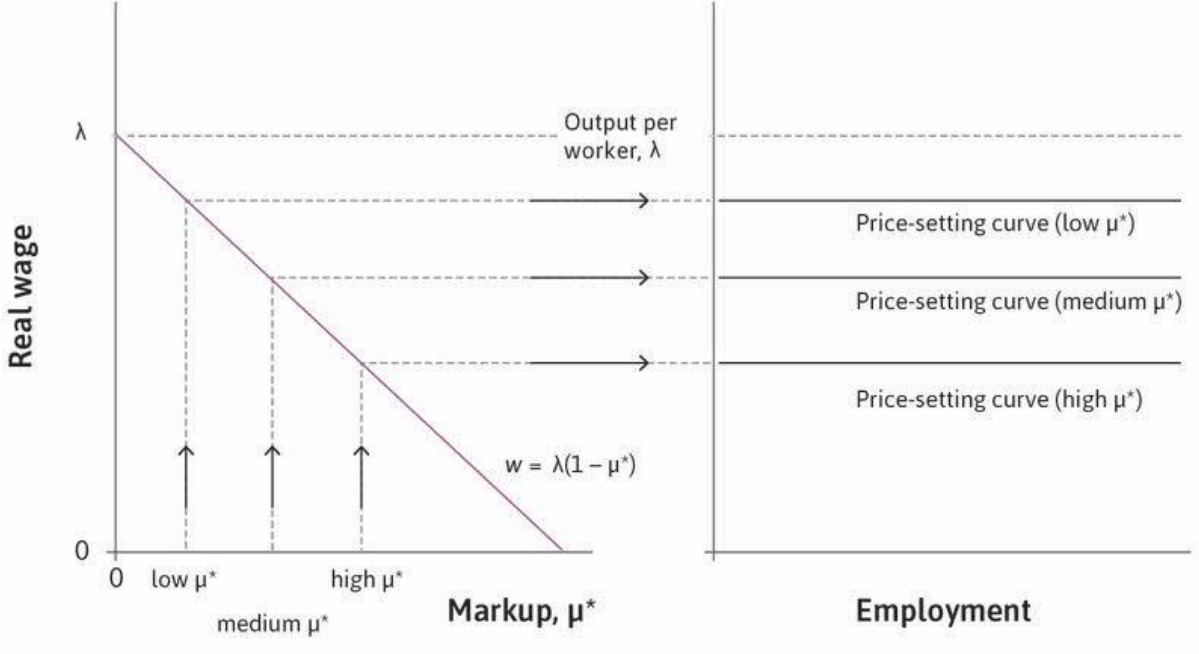
With 190 firms, the economy is at B and the markup exceeds μ*, so new firms will enter



Changes in the long-run markup shift the price-setting curve

Once we know the markup μ* and the average product of labour λ, we know the real wage w that must result

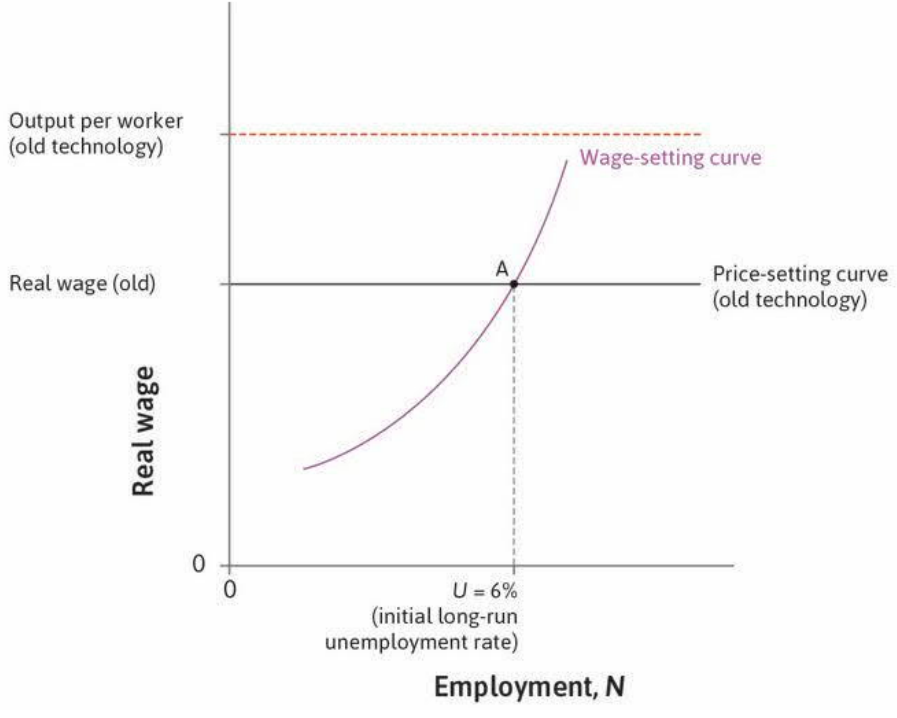
It is the share of the average product of labour that is not claimed by the employer through the markup



The long-run unemployment rate and new technology

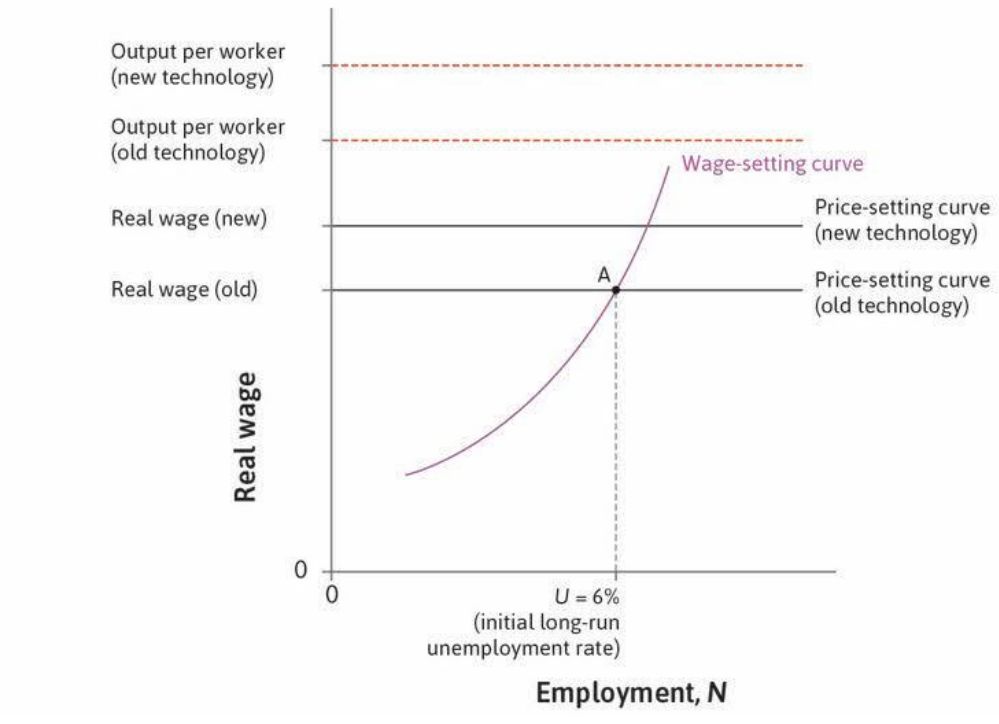
The long-run equilibrium before the new technology is introduced (point A)

This is a Nash equilibrium because all parties are doing the best they can, given what everyone else is doing



The long-run unemployment rate and new technology

A technological advance shifts output per worker and the price-setting curve upwards

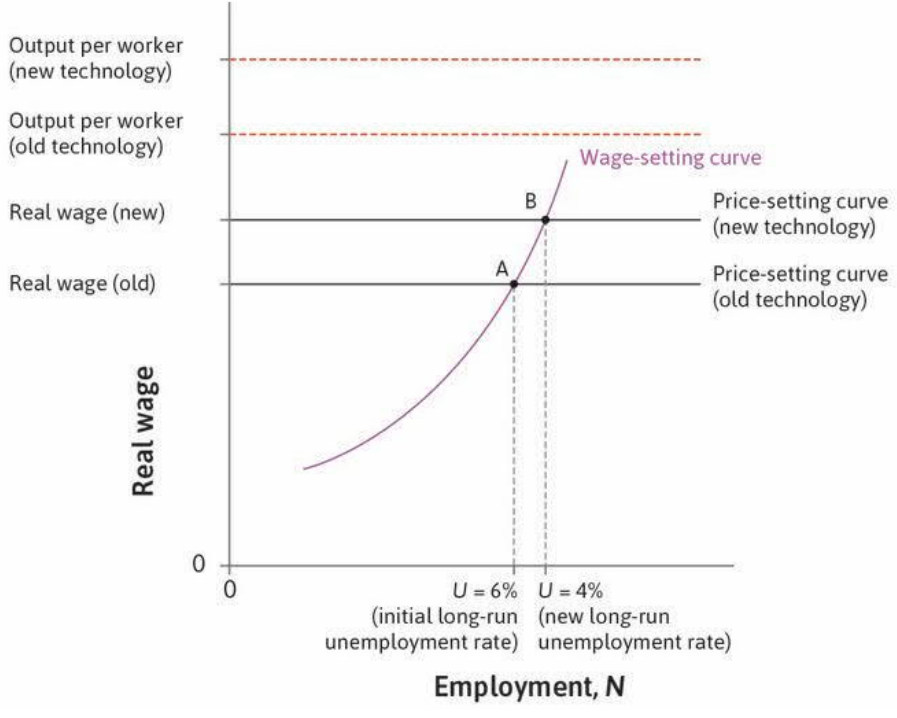


The long-run unemployment rate and new technology

The long run equilibrium effect on employment: At point B, the real wage is higher and unemployment is lower

The model shows that technological progress need not raise unemployment in the economy as a whole

Note however, that the wage-setting curve may also shift due to, for example, changes in unemployment benefits

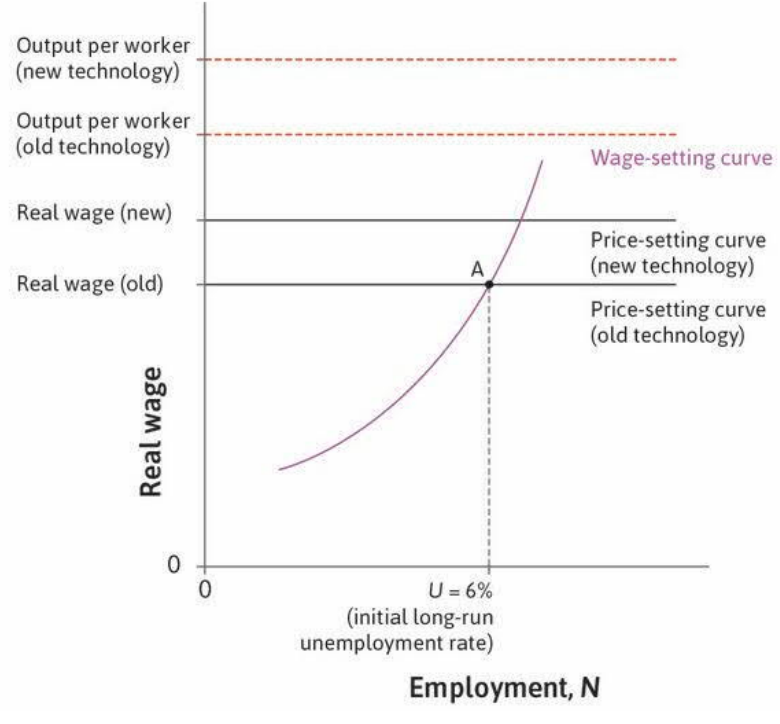


Adjustment to technological change: employment and wage adjustment gap

The response to new technology

A new technology means that fewer workers can produce the same output

How does the economy adjust?

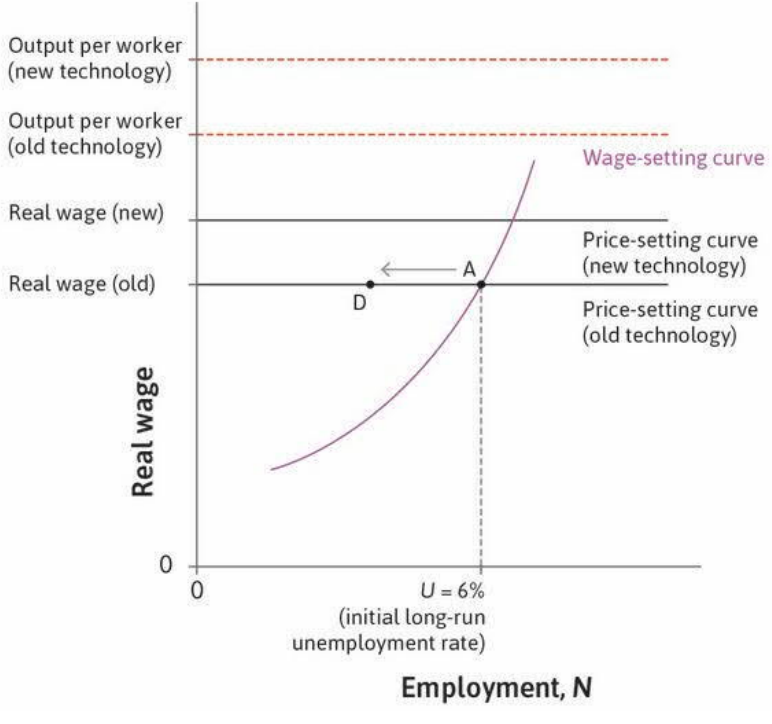


New technology shifts up output per worker and the price-setting curve

Adjustment to technological change: employment and wage adjustment gap

The new technology initially displaces a substantial number of workers from their jobs

At point D, the wage is the same but there are fewer jobs



New technology shifts up output per worker and the price-setting curve

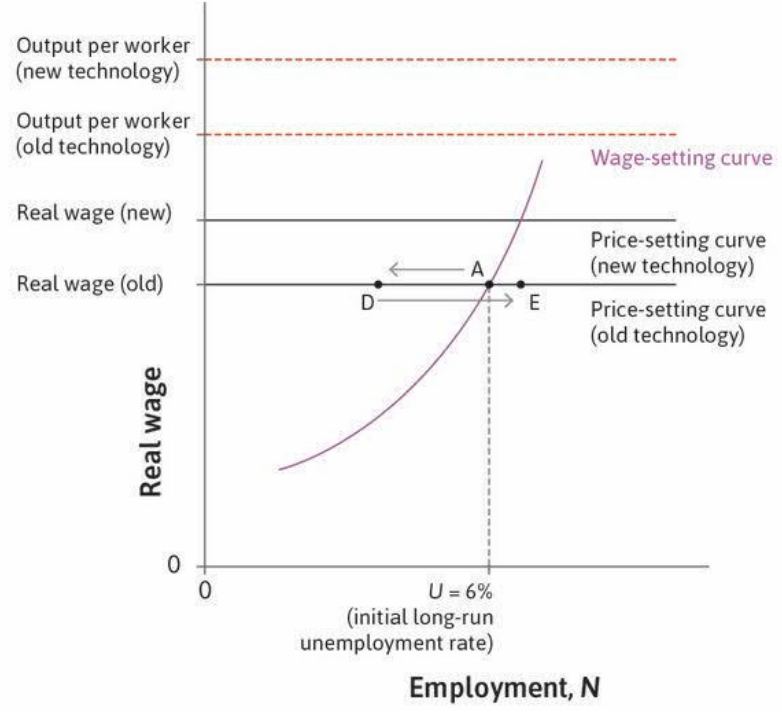
A→D: Introduction of a new technology leads to a rise in unemployment

Adjustment to technological change: employment and wage adjustment gap

Economic profits are high at D

New firms will be attracted to the economy and investment will rise

Unemployment eventually falls as the economy moves from D to E



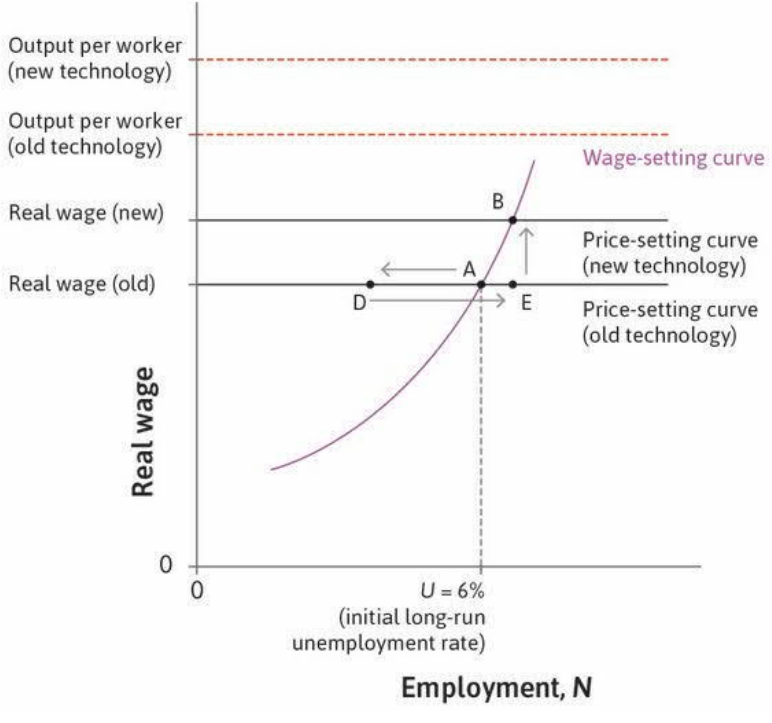
New technology shifts up output per worker and the price-setting curve

A→D: Introduction of a new technology leads to a rise in unemployment

D→E: High profits encourage new firms to enter

Adjustment to technological change: employment and wage adjustment gap

With lower unemployment, firms have to set higher wages to secure adequate worker effort, so wages go up



New technology shifts up output per worker and the price-setting curve

A→D: Introduction of a new technology leads to a rise in unemployment

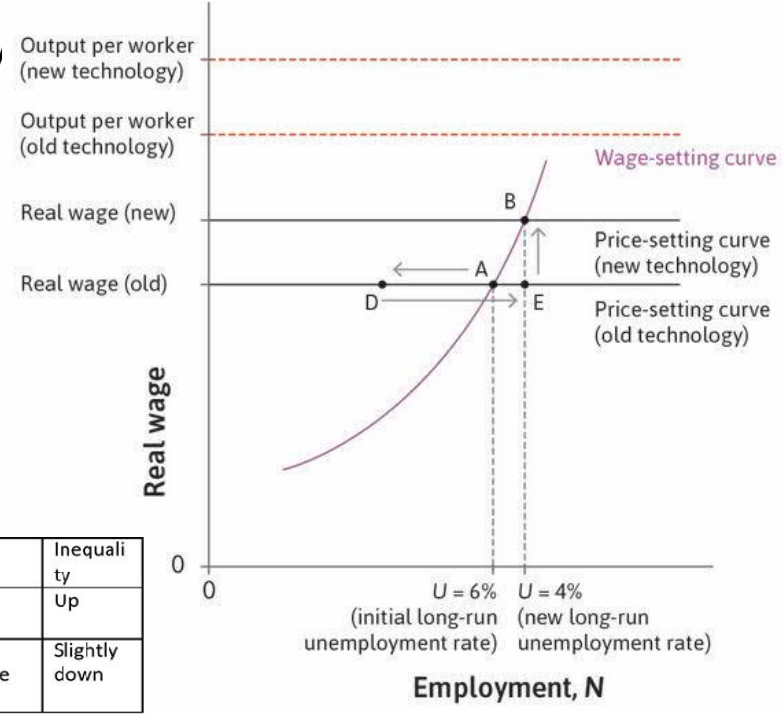
D→E: High profits encourage new firms to enter

E→B: Lower unemployment leads to rising real wages

Adjustment to technological change: employment and wage adjustment gap

A new equilibrium

Adjustment stops when the economy is at point B, with higher real wages and lower long-run unemployment



New technology shifts up output per worker and the price-setting curve

A→D: Introduction of a new technology leads to a rise in unemployment

D→E: High profits encourage new firms to enter

E→B: Lower unemployment leads to rising real wages

B: The new long-run rate of unemployment is 4%

	In Figure 16.9b	Employment	Unemployment	Wage share	Inequality
Short Run (number of firms and their capital stock do not change)	A to D	Down	Up	Down	Up
Long run (outcome adjusts fully to the new Nash equilibrium of the model; no change in wage-setting curve)	A to B	Up	Down	No change	Slightly down

Long vs. short run

	In Figure 16.9b	Employment	Unemployment	Wage share	Inequality
Short Run (number of firms and their capital stock do not change)	A to D	Down	Up	Down	Up
Long run (outcome adjusts fully to the new Nash equilibrium of the model; no change in wage-setting curve)	A to B	Up	Down	No change	Slightly down

Was this a win-win journey?

Only if you compare the start and end points or have a sufficiently long time-horizon

- The time between the introduction of new technology and the new long-run equilibrium is usually measured in years or even decades
- Younger workers might have more to gain from the eventual higher wages and employment, but older workers might never experience the outcome at B

Why hasn’t unemployment decreased?

- **Why the unemployment rate does not shrink continuously in a world with continuous technological progress?**
- **The reason is that other forces in the economy lead to the wage-setting curve shifting upwards**
  - Trade unions could be responsible for this shift (as in Unit 9), but there are other explanations
  - Unemployment benefits: Politicians wish to assist those out of work due to changes in technology. This improves the reservation position of workers and shifts the wage-setting curve up

How long is the long run?

The economy can go through a long adjustment process before reaching the new long-run equilibrium

- In the long run, we are all dead. John Maynard Keynes (1923)

Example: Adjustment of the US labour markets to the Chinese import shock

- Many economists thought that this shock would not have a major negative effect on wages or employment, because workers in import-competing sectors could easily relocate to other regions
- However, they underestimated the size of the shock and overestimated the degree of labour mobility – 2.4 million jobs were lost, and the labour market is still adjusting

Trade is "technology": **https://www.youtube.com/watch?v=uXMnAPGY1uE**

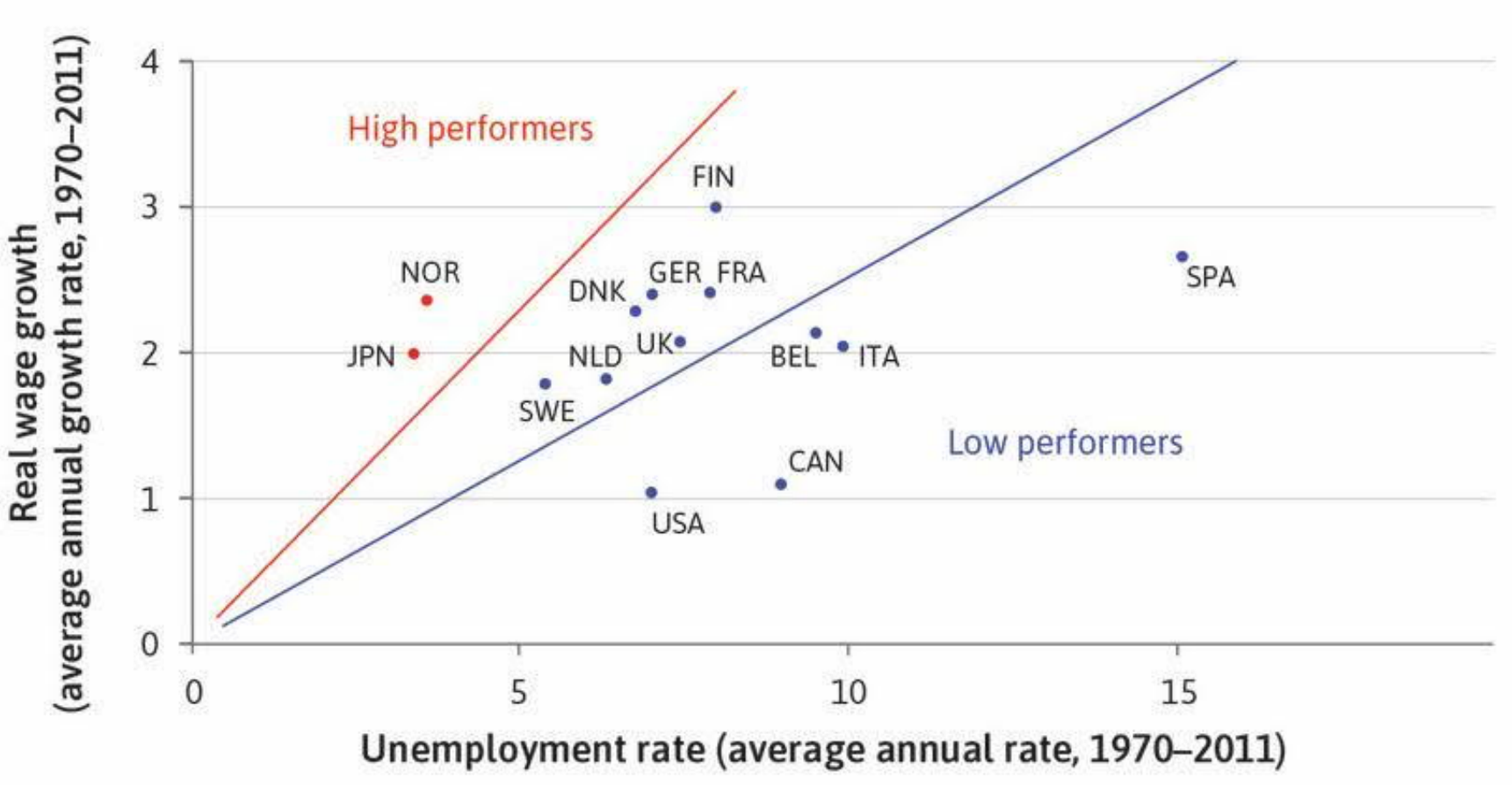
The role of institutions and policies

Institutions and policies

To achieve ‘good’ economic performance, an economy must:

- Ensure the price-setting curve shifts up more than the wage-setting curve
- Adjust rapidly and fully so the whole economy benefits from technological progress

Differences across countries



Differences across countries

Cross-country differences can be explained by:

- Institutions – inclusive trade unions (represent many firms and sectors) choose not to exercise maximum bargaining power because wage increases affect job creation in the long run.
- Policies – well-designed unemployment insurance schemes and job placement services can achieve low unemployment rates

No magic formula: Institutions and policies differ across successful countries and over time

Examples

Norway:

- Inclusive trade unions and employers' associations set wage demands in accordance with the productivity of labour, and also supported legislation and policies that shifted the wage-setting curve downwards, further expanding long-run unemployment

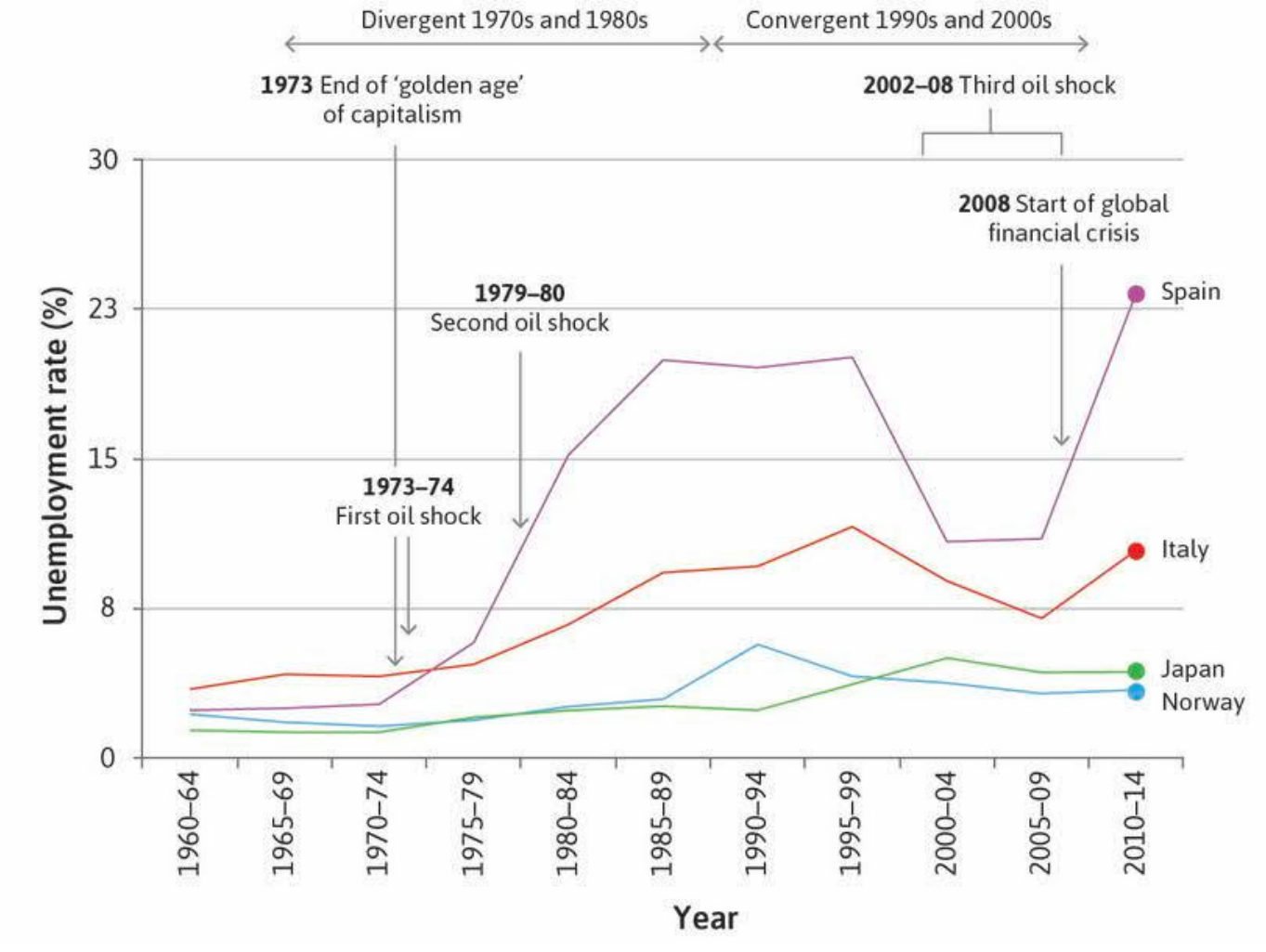
Japan:

- Employers' associations coordinate wage setting across firms. Corporations deliberately do not compete in hiring workers, to avoid raising wages

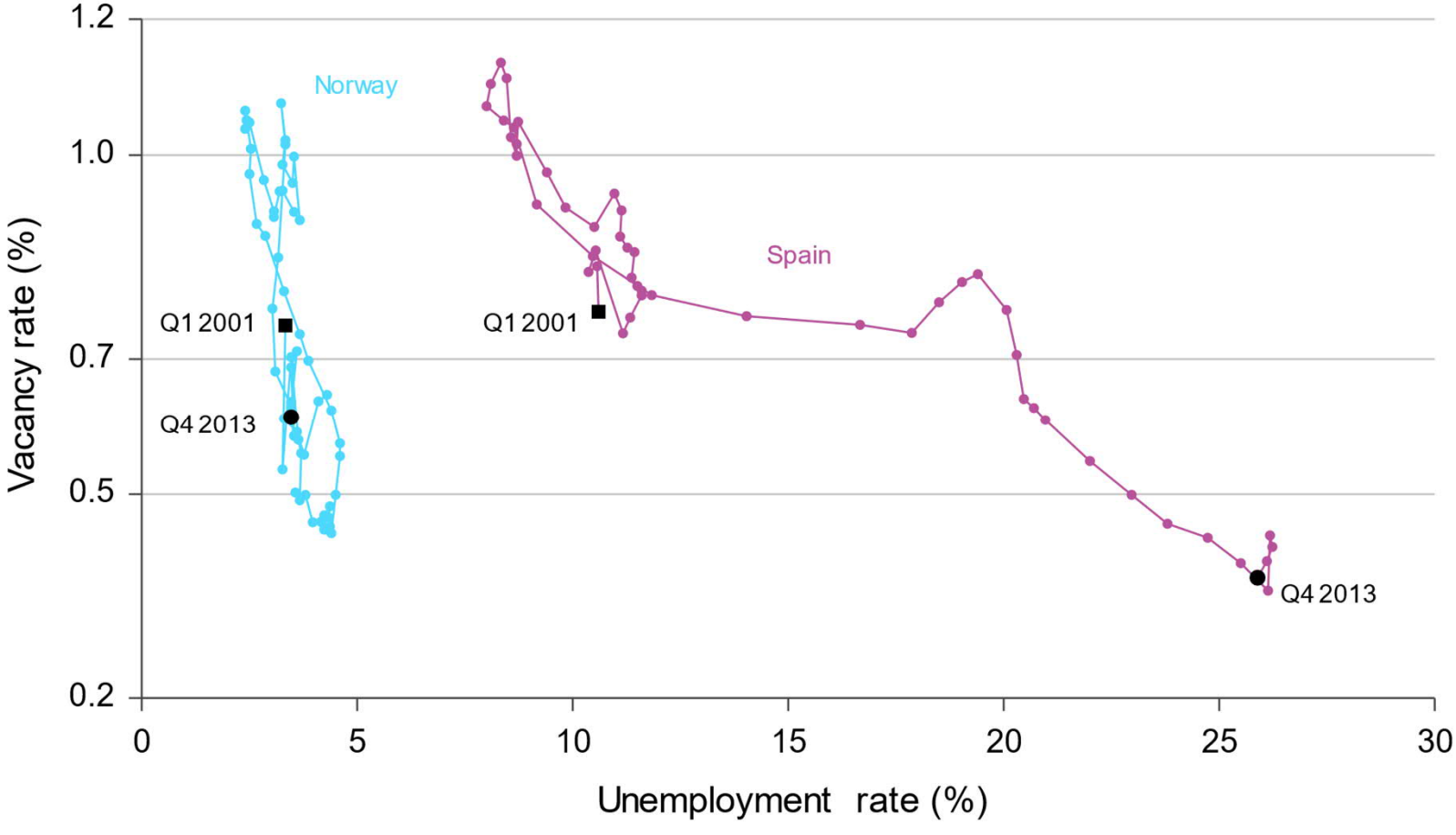
Spain:

- A combination of non-inclusive unions and government legislation that protects jobs rather than workers may help to account for Spain's 'poor' labour market performance

Examples


Divergent 1970s and 1980s
Convergent 1990s and 2000s
1973 End of 'golden age' of capitalism
2002–08 Third oil shock
2008 Start of global financial crisis
1979–80 Second oil shock
1973–74 First oil shock
Spain
Italy
Japan
Norway
Unemployment rate (%)
30
23
15
8
0
1960–64
1965–69
1970–74
1975–79
1980–84
1985–89
1990–94
1995–99
2000–04
2005–09
2010–14
Year

Examples


1.2
1.0
0.7
0.5
0.2
Vacancy rate (%)
Norway
Q1 2001
Q4 2013
Spain
Q1 2001
Q4 2013
0
5
10
15
20
25
30
Unemployment rate (%)

Summary

Unemployment is a market failure:

- There are people willing to work at the current market wage but cannot find a willing employer
- Job destruction is a constant feature of capitalist economies, in which technological changes tend to raise productivity and put some workers out of their jobs
- A well-functioning economy will feature high levels of investment ensuring that jobs are created at least as fast as they are destroyed

Fundamental incentive problems of a capitalist economy

- Ensuring that firms will invest both in technological progress and in job creation
- Ensuring that workers have the incentive to put in sufficient effort to do their jobs (and finding them)