Principles of Economics II

Lecture 5: The labour market: Wages, profits, and unemployment

Fall 2020
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Outline

- **The Economy's labour market model (unit 9)**
  - Price-setting and wage-setting
  - Labour market equilibrium
  - Involuntary unemployment
  - Some applications

Context

- **Models price-setting and wage-setting behaviour of firms, which determines economy-wide unemployment rate and real wage**

- **The key difference to the competitive labour market model is that contracts are incomplete**
  - The labour discipline model
  - Explains why involuntary unemployment exists even in equilibrium

Building blocks of the model

- **Model the labour market of an entire economy**

- **Firms and employees:**
  - Firms set wage sufficiently high to make job loss costly, in order to motivate employees to work hard in the absence of complete contracts (employment rent, unit 6)

- **Firms and customers:**
  - Firms set a markup above the cost of production, to maximise their profits subject to demand (Unit 7)

- **Simplification:**
  - Labour the only input and wage the only cost (!)
  - Profits depend on nominal wage, price and average output by worker

Building blocks of the model

- **The real wage is the nominal wage divided by the price level of the bundle of consumer goods purchased:**

  - Nominal wage (W): wage received by a worker in form of money

  - Price level (P): price level of a standard bundle of consumer goods

  - Real wage (w): $w = W/P$ amount of goods and services the worker can buy

The setup

- **Each firm decides on its: price, wage, how many people to hire**

- **Adding up all of these across all firms gives the total employment in the economy and the real wage**

- **Important: only one labour market**

  - Outside option is unemployment, not working in another labour market

The chain of firm's decisions

Nominal wage = f(other firms' prices and wages, unemployment rate)

Price = f(own nominal wage, demand for own product)

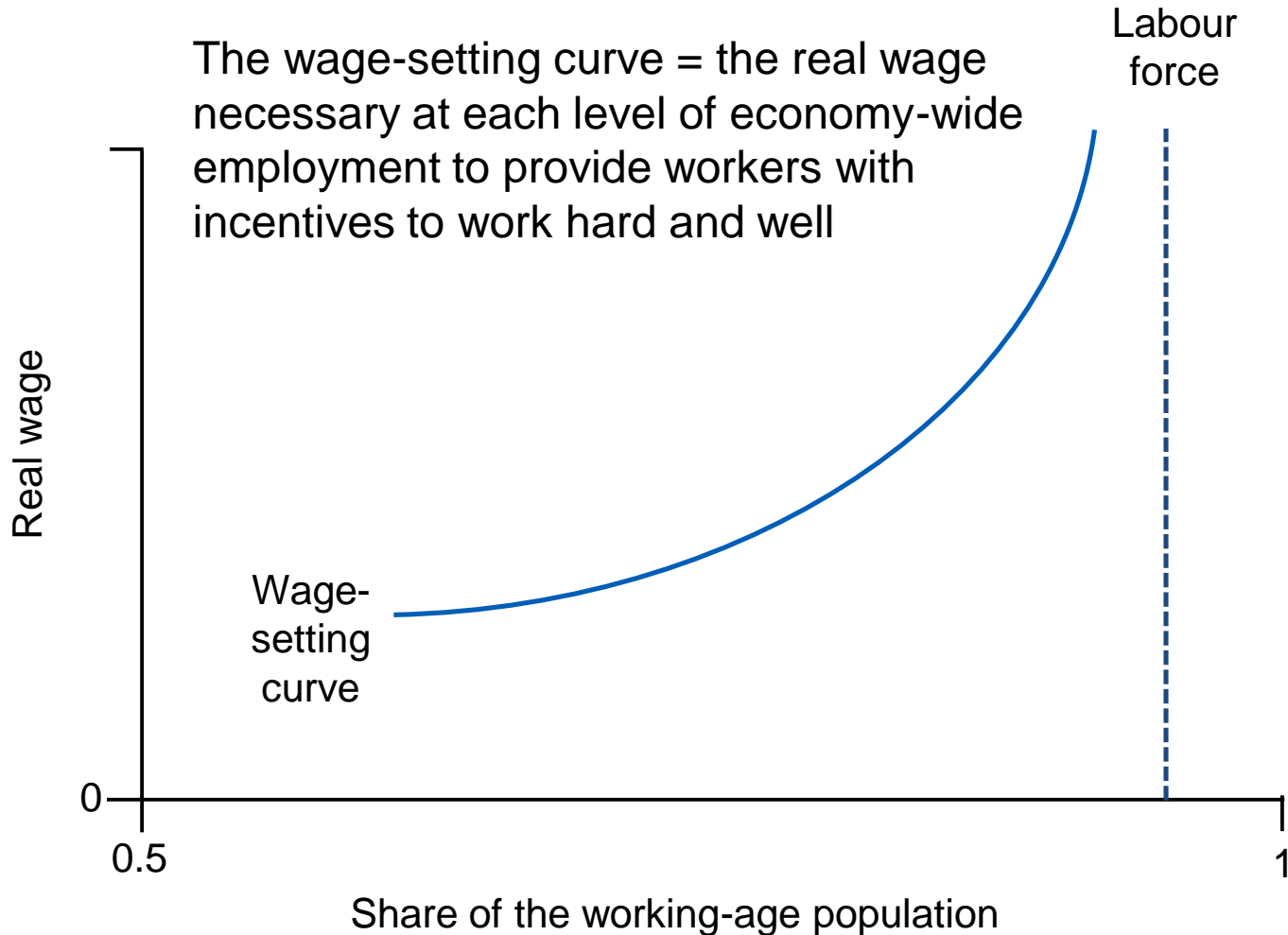**Output = f(optimal price, demand curve)**

Number of employees = f(output, production function)

The wage-setting curve

The wage-setting curve = the real wage necessary at each level of economy-wide employment to provide workers with incentives to work hard and well

Labour force

Real wage

Wage-setting curve

0

0.5

1

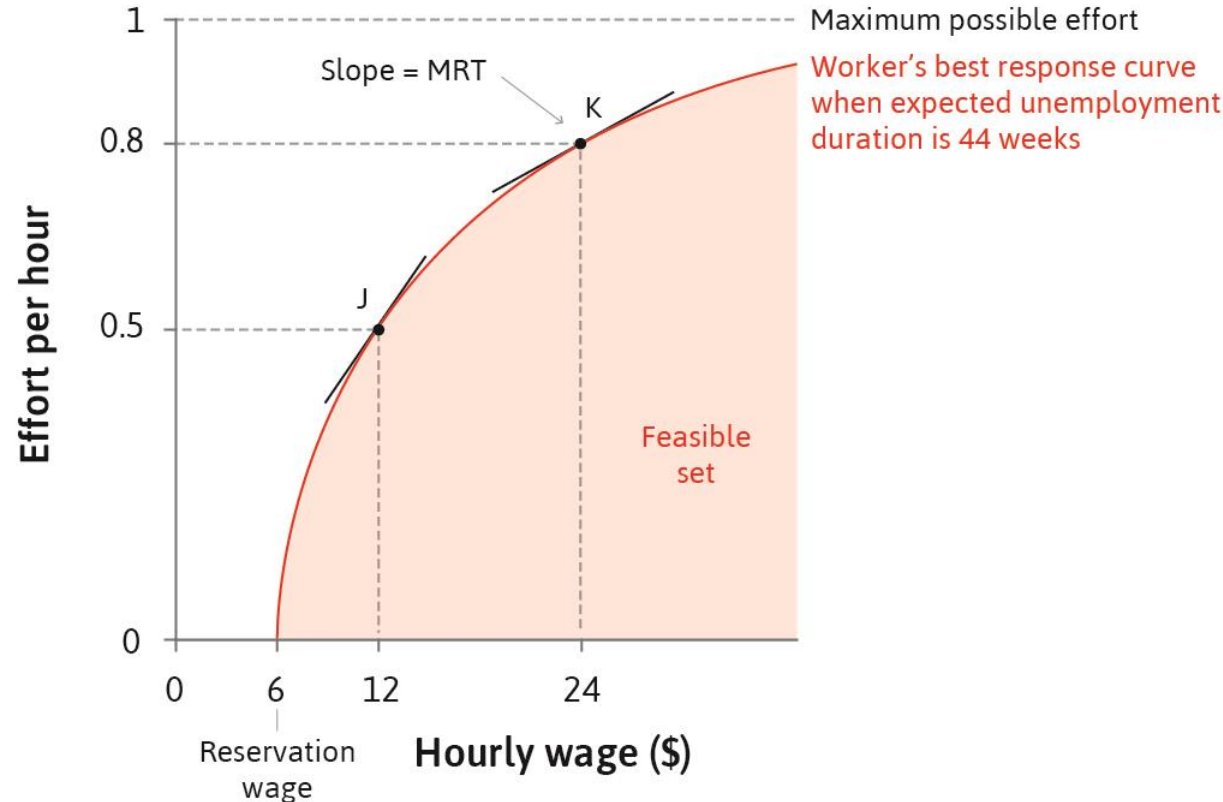Share of the working-age population

Employee's best response to the wage

Best response curve shows the optimal amount of effort workers will exert for each wage offered

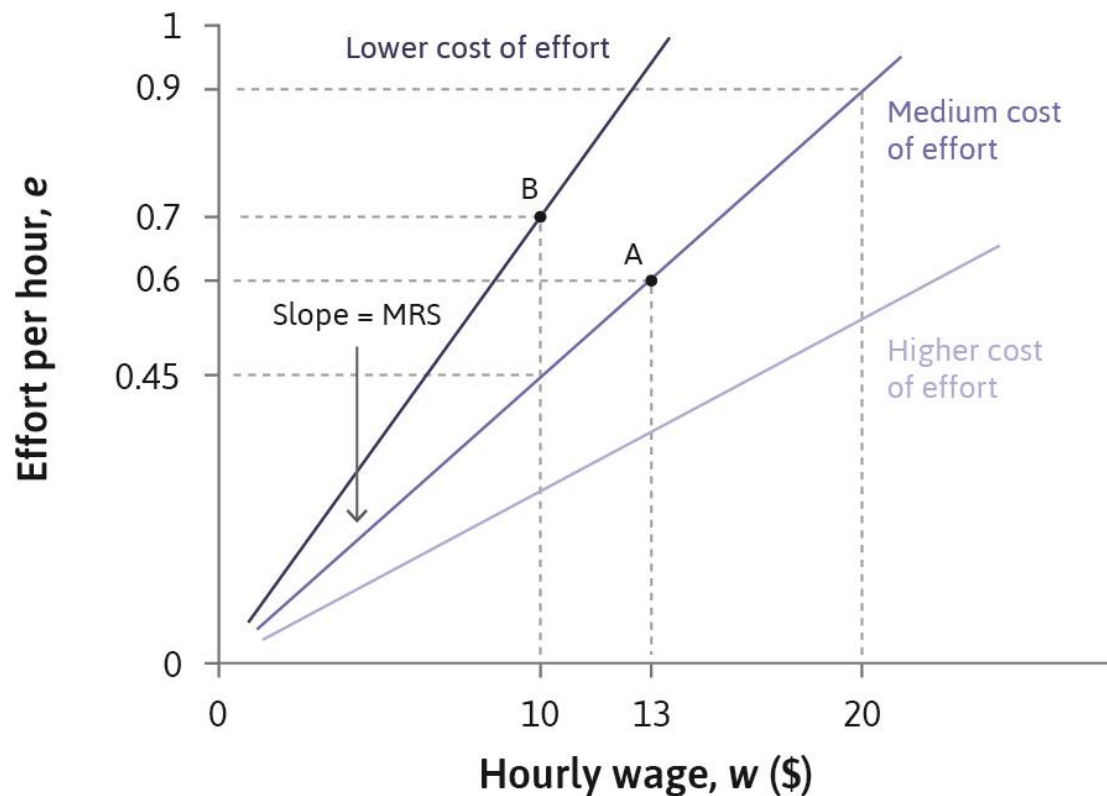Represents the firm's feasible frontier for wages and effort

Slope of best response curve = MRT

The employer's indifference curves: isocost lines for effort

The cost of effort is the same at all points on an isocost curve

Slope of isocost curve = MRS =

the rate at which the employer is willing to increase wages to get higher effort
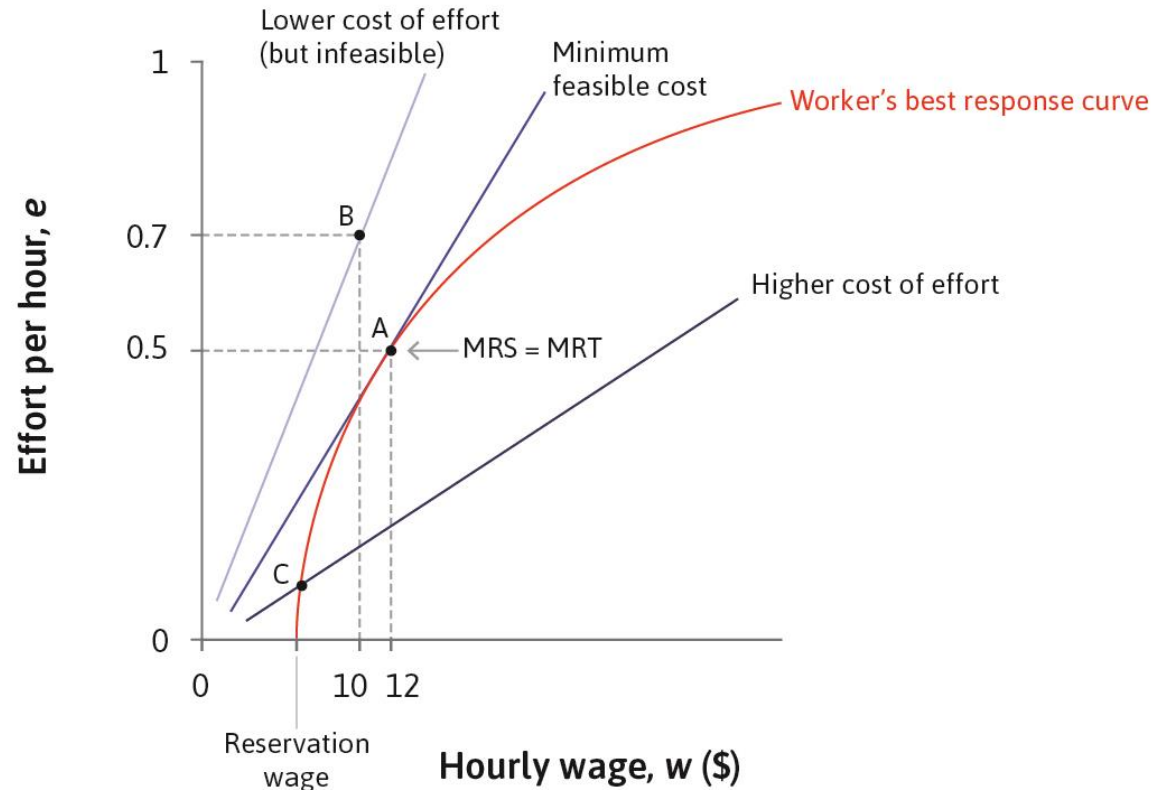
Determining wages

Profits are maximised at the steepest isocost line, subject to the worker's best response curve

MRS = MRT

Efficiency wage = wages set higher than the reservation wage so workers will care about losing the job and provide more effort

THE PAYOFFS OF HIGHER PAY:

ELASTICITIES OF PRODUCTIVITY AND LABOR SUPPLY WITH RESPECT TO WAGES

Natalia Emanuel · Emma Harrington[1]

(Job Market Paper)

This version: November 5, 2020
Latest Version: [Click here](#)

Abstract

When setting pay, firms trade off the potential benefits of higher compensation—including increased productivity, decreased turnover, and enhanced recruitment—against their direct costs. We estimate productivity and labor supply elasticities with respect to wages among warehouse and call-center workers in a Fortune 500 retailer. To identify these elasticities, we use rigidities in the firm's compensation policies that create plausibly exogenous variation relative to local outside options, as well as discrete jumps when the firm adjusts pay. We document labor market frictions that give firms wage-setting power: we estimate moderately large, but finite, turnover elasticities (-3.0 to -4.5) and recruitment elasticities (3.2 to 4.2). The firm gains \$1.10 from increased productivity for a \$1 increase in wages. By comparing warehouse workers' responses to higher wages both across and within workers, we estimate that over half of the turnover reductions and productivity increases arise from behavioral responses as opposed to compositional differences. These aggregate patterns mask considerable heterogeneity by gender: women's productivity responds more and their turnover responds less to wage changes than men's, which can lead to occupational pay gaps.

FIGURE 1: PAY CHANGE IN TREATED AND UNTREATED WAREHOUSES
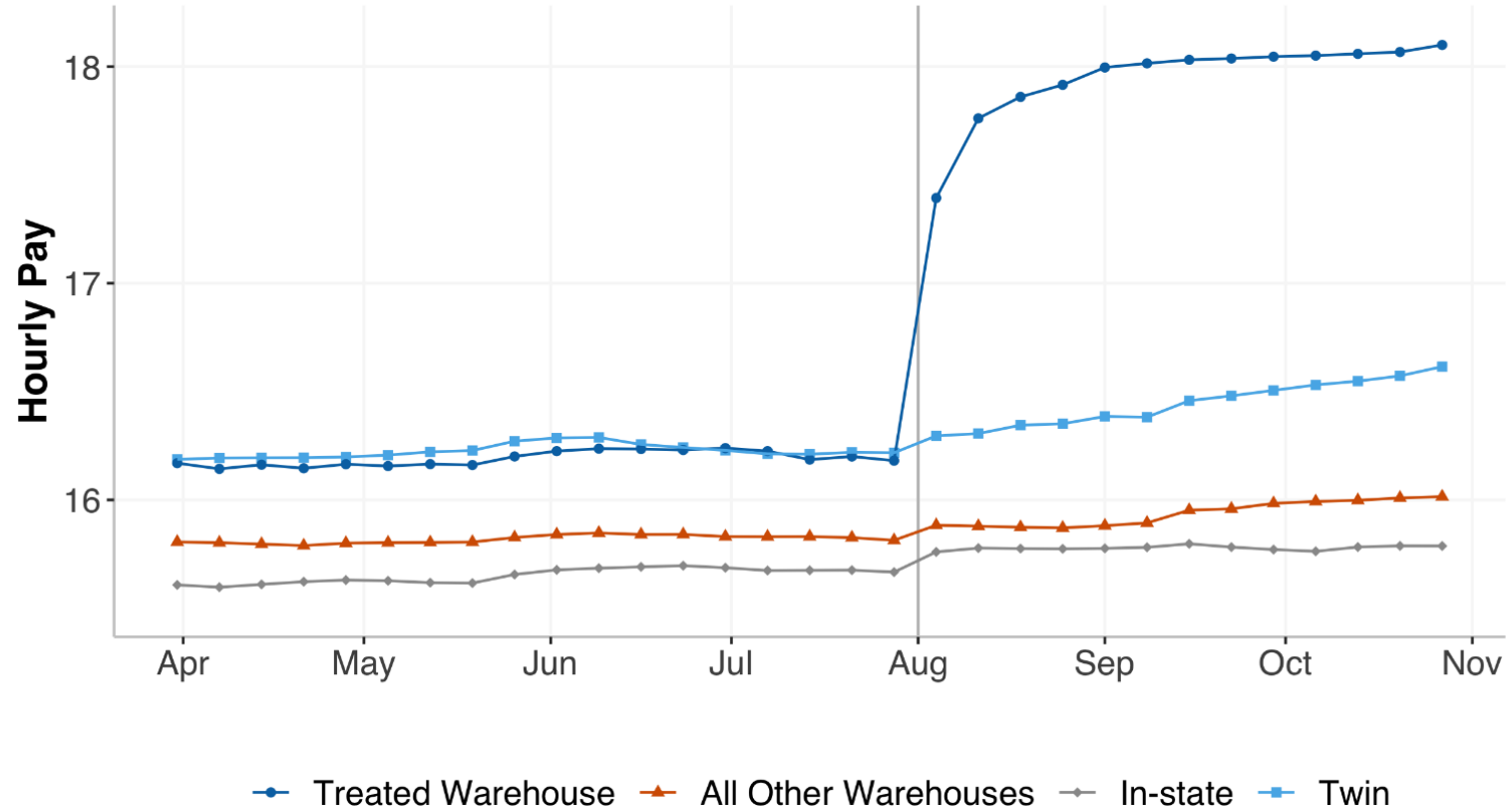
*Note:* This figure shows the average weekly pay within warehouses in 2019. Average pay for all other retailer warehouses are denoted in orange triangles, for warehouses in the same state as the treated warehouse in grey diamonds, and for "twin" warehouses that handle the same type of package in blue squares.

Panel B: Productivity in Retailer's Warehouse
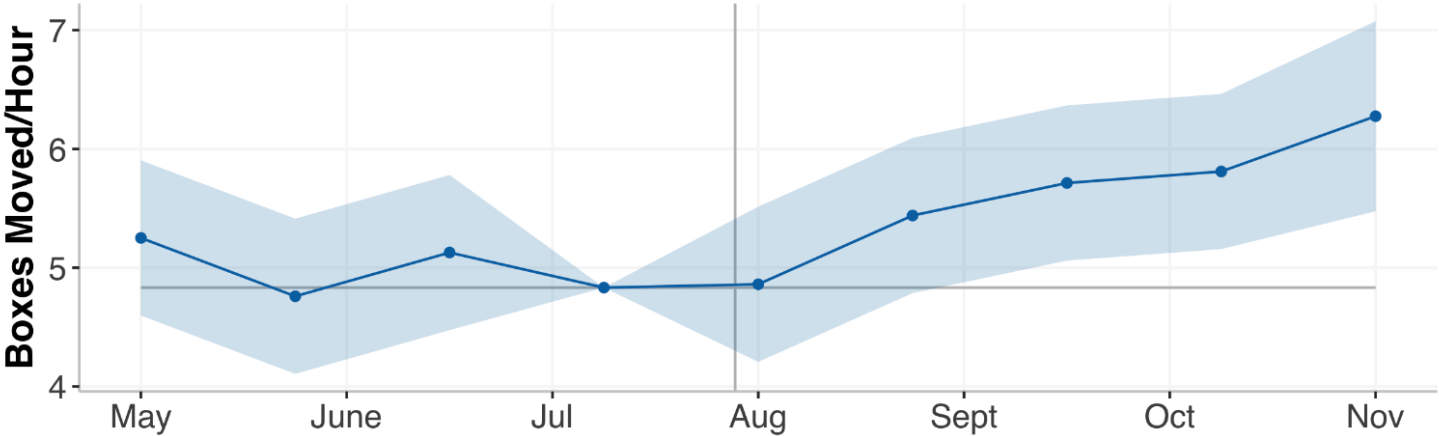
Panel C: Monthly Turnover in Retailer's Warehouse

14
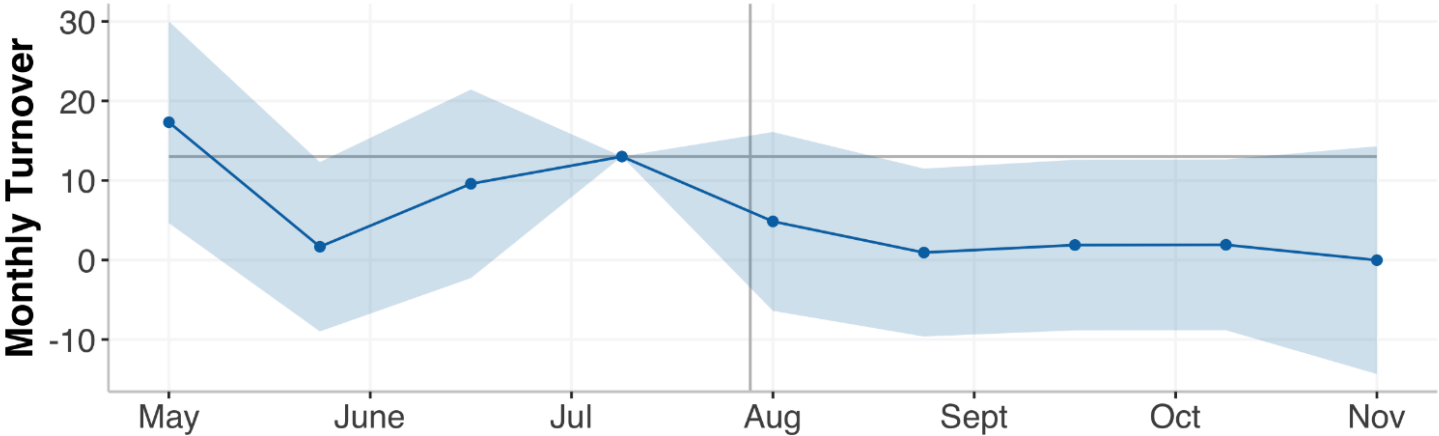
Causal effect?

- **The wage increase was not randomized by a researcher running an experiment**

- **The paper provides a lot of background information on the wage hike from**

  - High turnover before the hike compared to other warehouses of the same company possibly due to highly competitive labour market

  - Job description did not change at the same time as wages were increased etc.

- **If DID assumptions hold, this is a causal effect, and it is consistent with the labour discipline model**

Deriving the wage-setting curve

When unemployment is low, workers who lose their jobs can expect a shorter spell of unemployment

Decrease in the duration of a spell of unemployment has two effects:

- It increases the reservation wage: reducing the employment rent per hour

- It shortens the period of lost work time: decreases total employment rents (the cost of job loss)
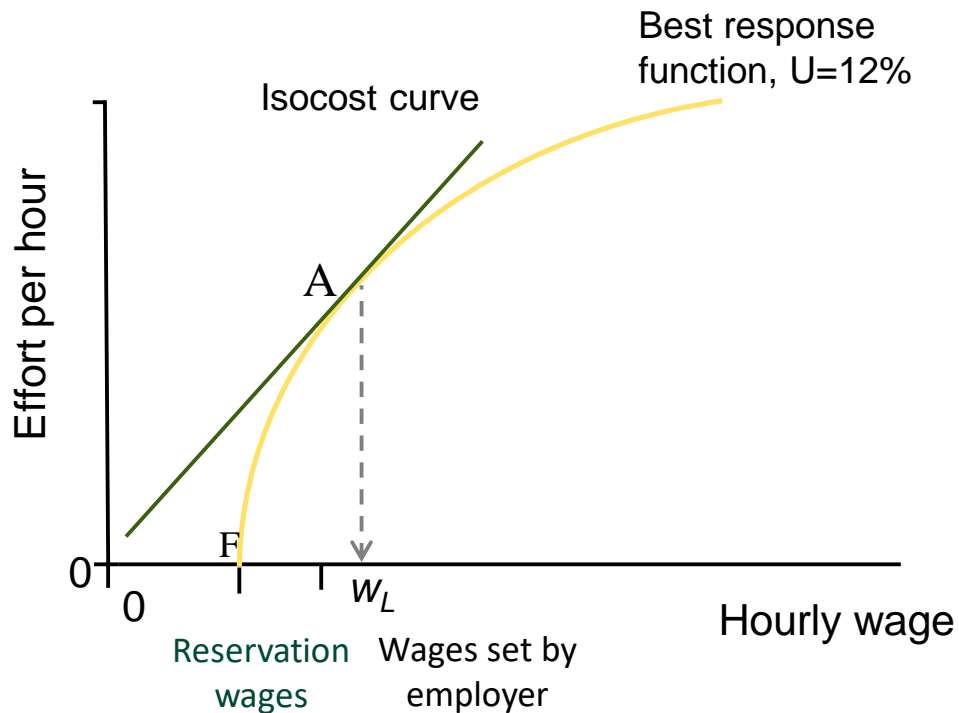
Deriving the wage-setting curve

Lowering the unemployment rate will shift worker's best response curve to the right (reservation wage↑) and increase wage

At each wage level, the worker is willing to put in less effort because the cost of job loss is lower

This results in an upward-sloping wage-setting curve
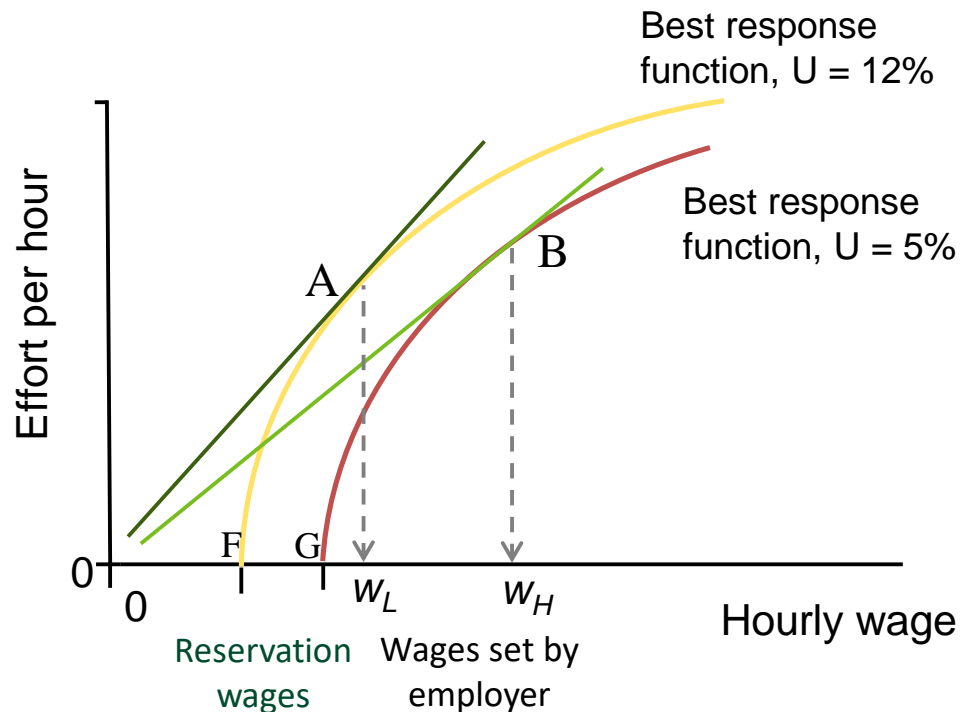
The wage-setting curve

The wage-setting curve = the real wage necessary at each level of economy-wide employment to provide workers with incentives to work hard and well

Labour force

Real wage

Wage-setting curve

0

0.5

1

Share of the working-age population
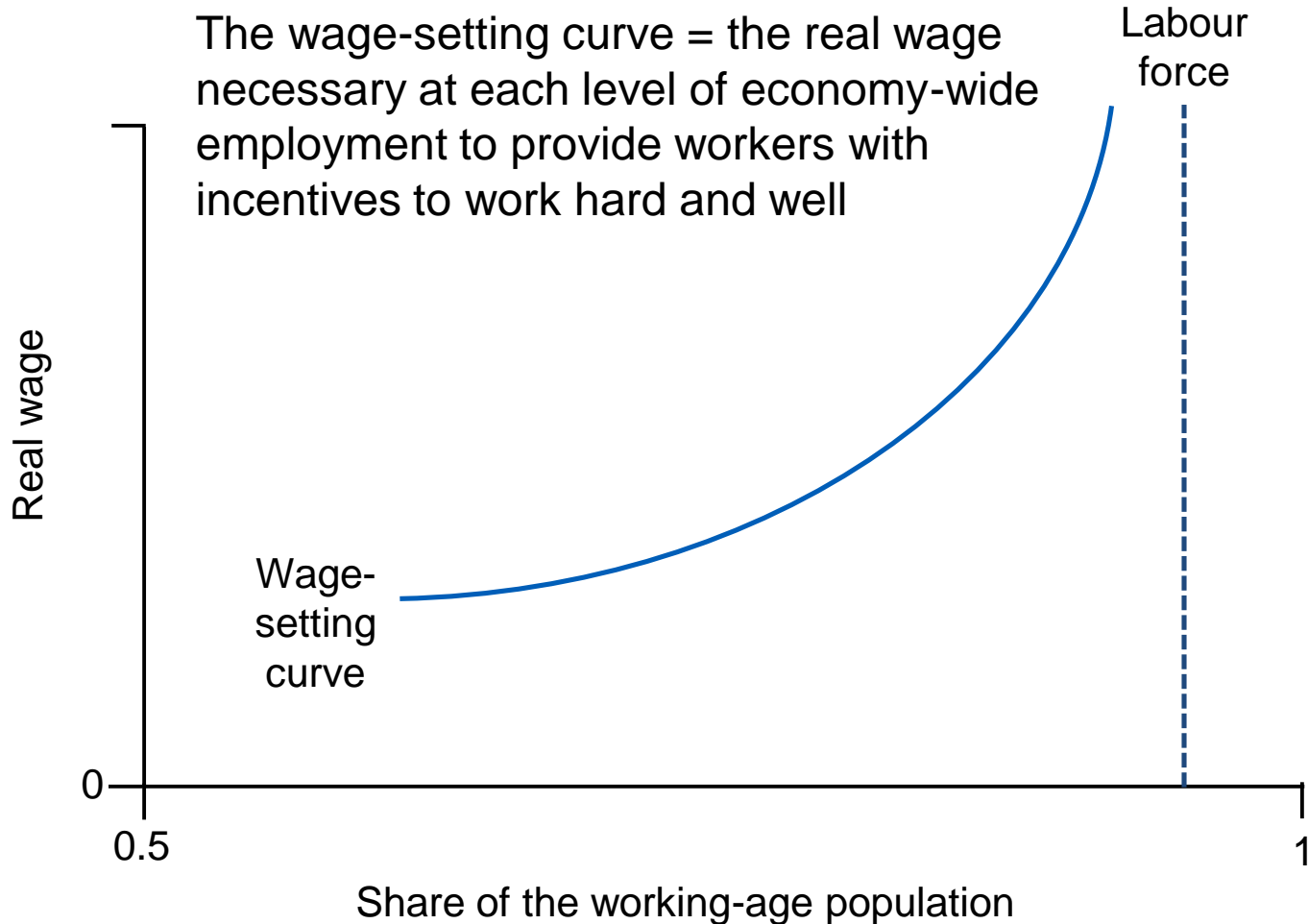
The wage-setting curve
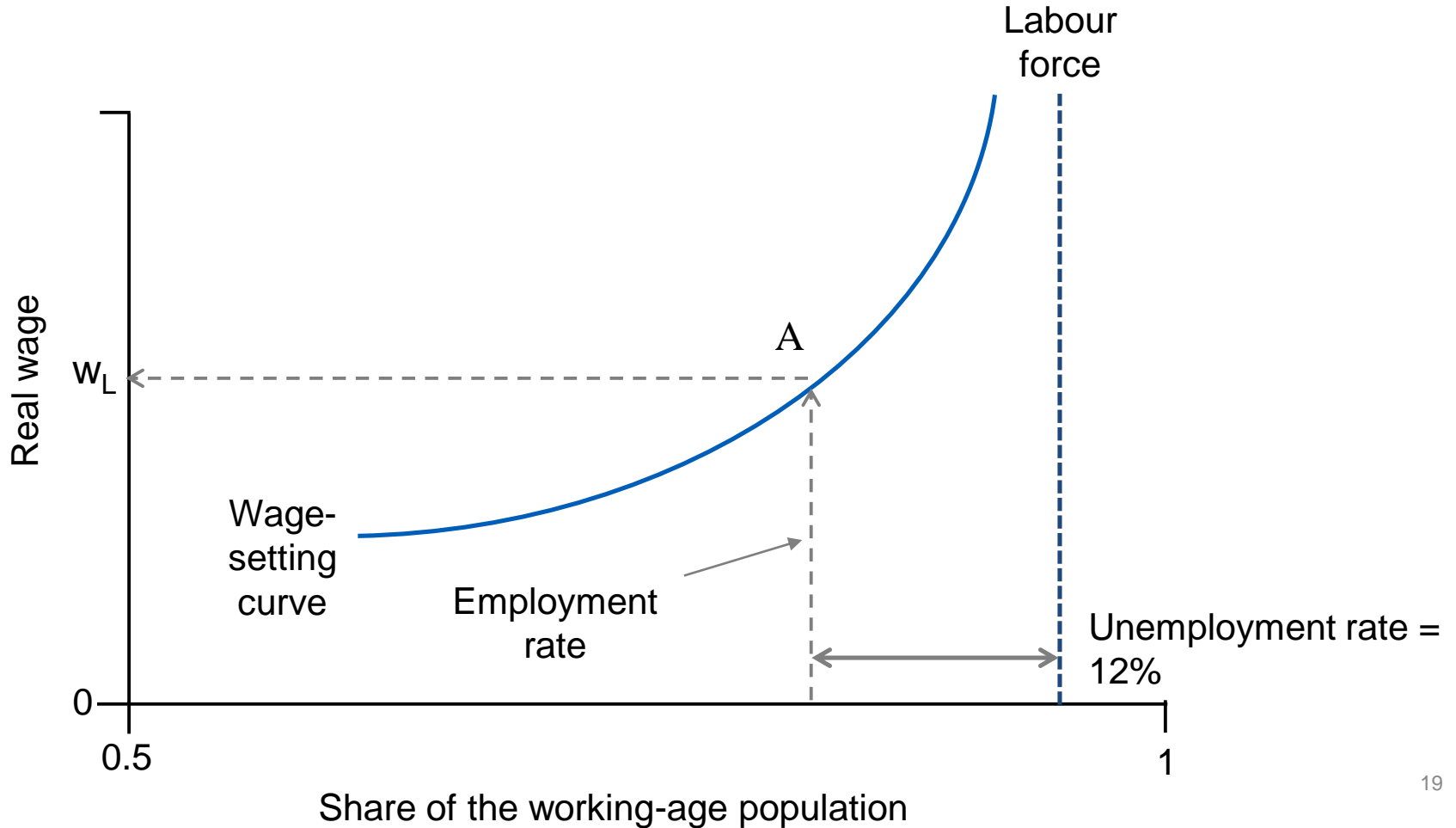
The wage-setting curve
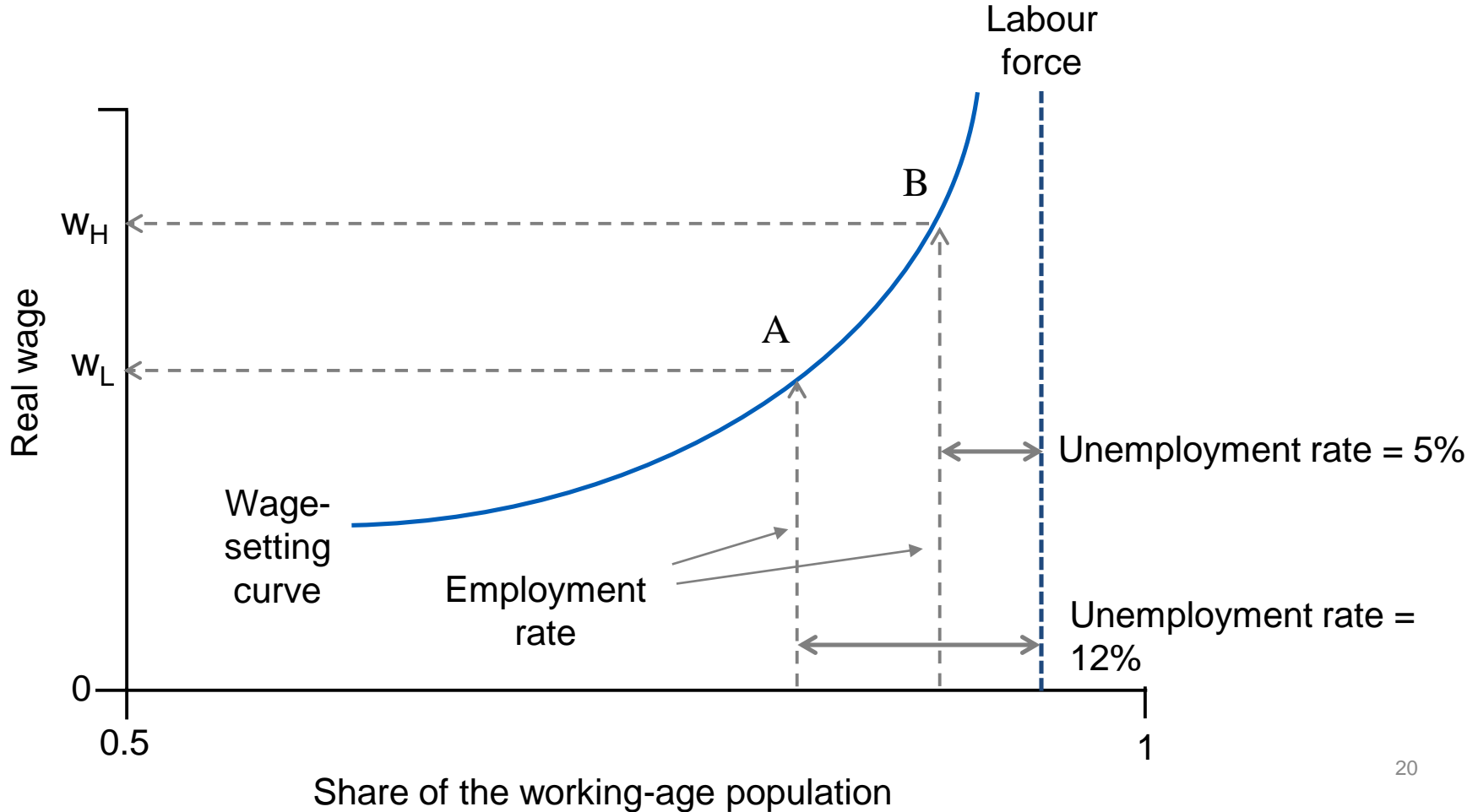
The wage-setting curve

- **Like the best-effort response function of the employee on which it is based, the wage-setting curve is a mathematical version of an 'if-then' statement:**

  - If employment rate is x, then the Nash equilibrium wage will be w

  - This means that at the employment rate x, the wage w is the result of both employers and employees doing the best they can in setting wages and responding to the wage with a given amount of effort

- **All the points in the wage-setting curve are feasible, which point are we going to end up?**

Simplification

- **We can simplify the worker motivation problem and the wage curve by letting there be just two levels of effort:**

  - 'Working': providing the level of effort that the firm's owners and managers have set as sufficient

  - 'Shirking': providing no effort at all

  - The worker is represented as like a machine with just one speed, and it is either 'on' or 'off'

- **This will be useful later because it will allow us to take the level of effort as given with wages being set to ensure this**

Simplification

In this case, the wage curve is the boundary between two 'regions':

- on and above the wage curve are all the combinations of the real wage and employment level for which employees work,

- and below it the combinations for which employees shirk

Feasible set

Wage-setting curve, WS

Above the wage-setting curve, workers work

Below the wage-setting curve, workers shirk; they do not work

Real wage

0
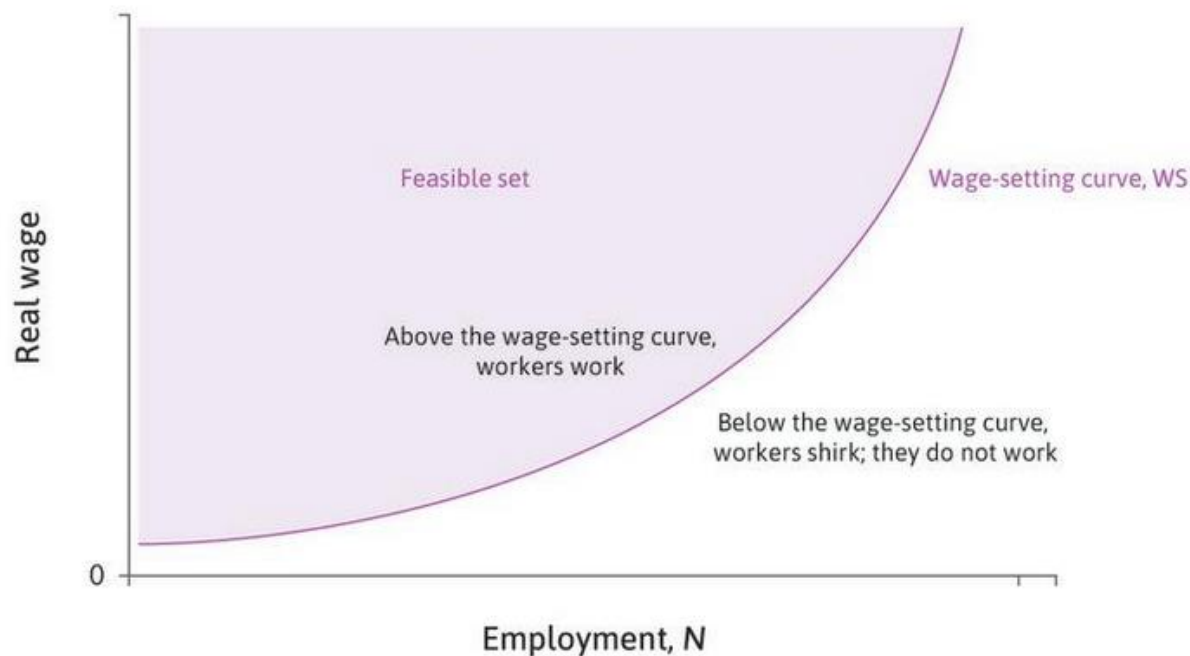
Employment, N

What shifts the wage-setting curve?

- **For any unemployment rate, increase in employment rent will shift the curve downwards**

  - Lower unemployment benefit makes it more costly if you lose your job, your employment rent is higher and the firm can set a lower wage and you will work, rather than shirk

  - Increase in the labour force: If there are more people searching for jobs, then you can expect to remain without work for longer if you lose your job

  - A new monitoring technology: makes detection of shirking less costly (such as the use of GPS trackers in trucks, monitoring their location at any time)

Firm's hiring decision

- **Labour is the only input (!), so wage is the only cost**
  - One hour of labour produces one output (given the wage)
  - Average product of labour $\lambda = 1$
  - So the wage the firm pays (W) is the cost of a unit of output

- **The firm process**
  - HR sets the wage at a level sufficient to motivate the workforce
  - MD proceeds in two steps: 1. figure out the demand curve, i.e. what combinations of p and q are feasible 2. pick a point on the demand curve (p^*, q^*)
  - PD chooses the amount of workers $n^* = q^*$

Firms hiring decision

Department	... knows	... and on this basis sets the firm's
Human resources	Prices, wages and employment in other firms	Nominal wage, W
Marketing	All of the above and firm's demand function	Price of output, p
Production	All of the above, plus **labour productivity** and amount the firm can sell	Employment, n

Profit-maximizing price
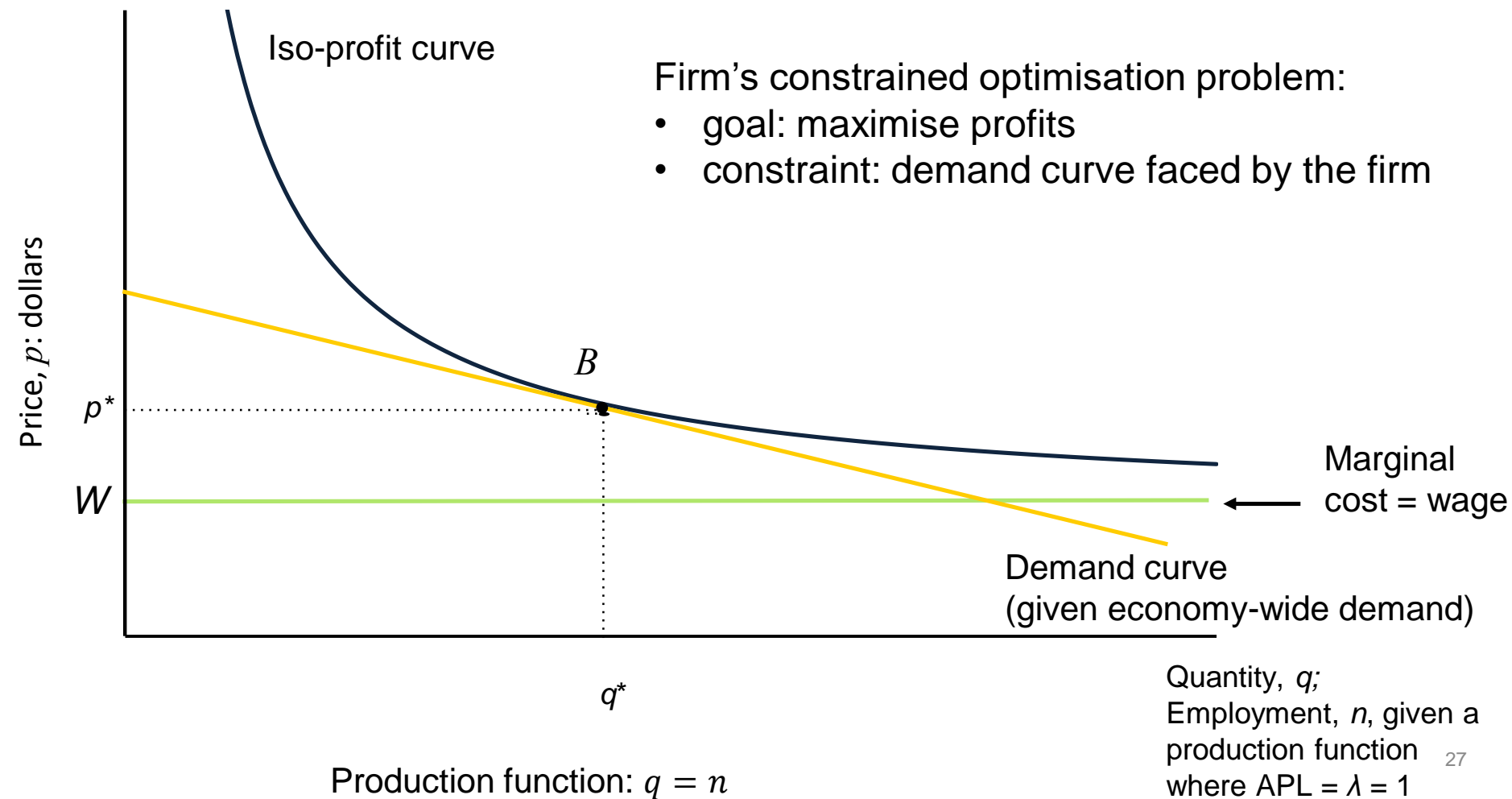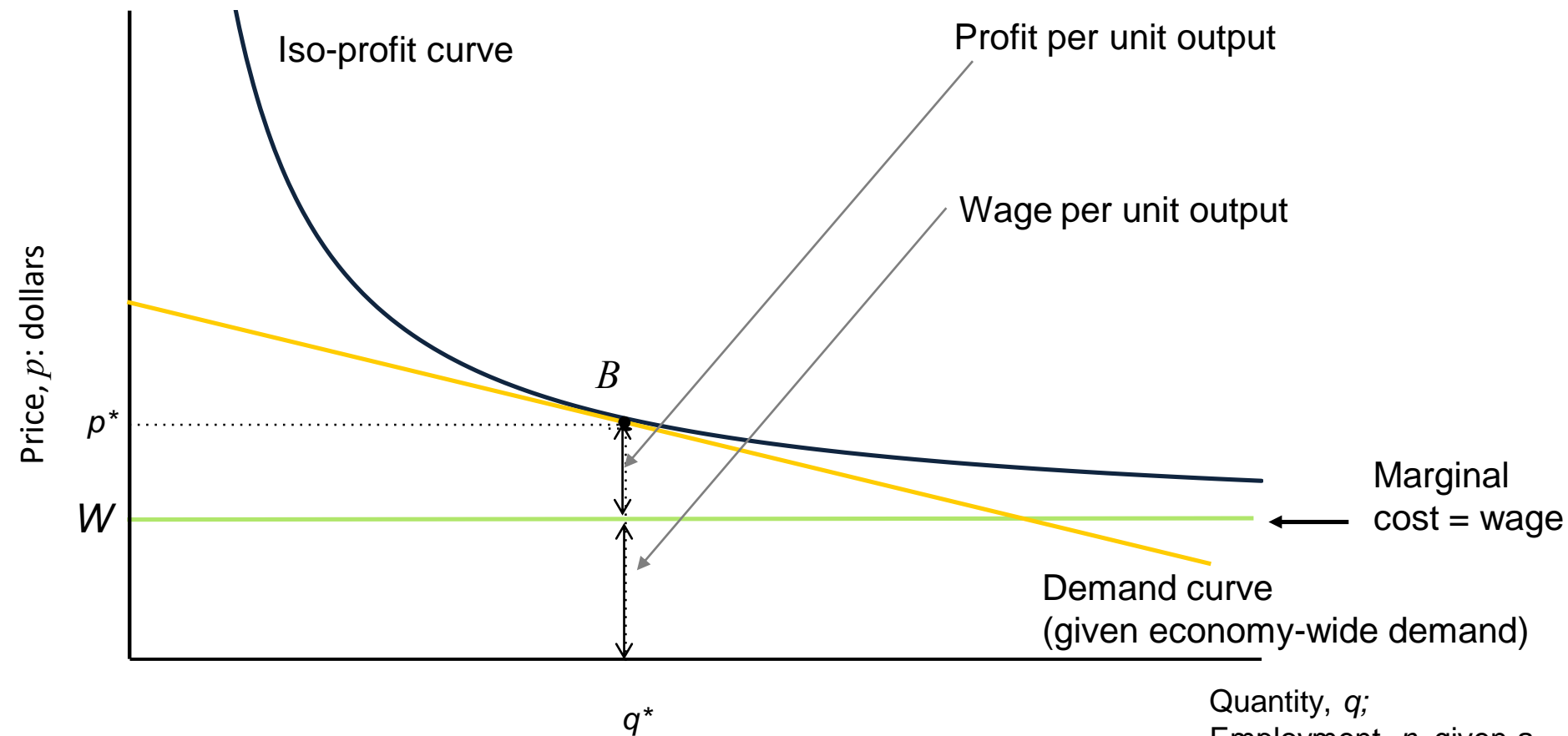
Iso-profit curve

Firm's constrained optimisation problem:
- goal: maximise profits
- constraint: demand curve faced by the firm

Price, p: dollars

B

p^*

W

Marginal cost = wage

Demand curve (given economy-wide demand)

q^*

Quantity, q;
Employment, n, given a production function where APL = λ = 1

Production function: $q = n$

Profit-maximizing price

Iso-profit curve

Profit per unit output

Wage per unit output

Price, p: dollars

B

p^*

W

Marginal cost = wage

Demand curve (given economy-wide demand)

q^*

Quantity, q;
Employment, n, given a production function where APL = λ = 1

Production function: $q = n$

Profit-maximizing price

Iso-profit curves

Price, p: dollars

C

B

p^*

A

W ← Wage

Demand curve
(given economy-wide demand)

q^*
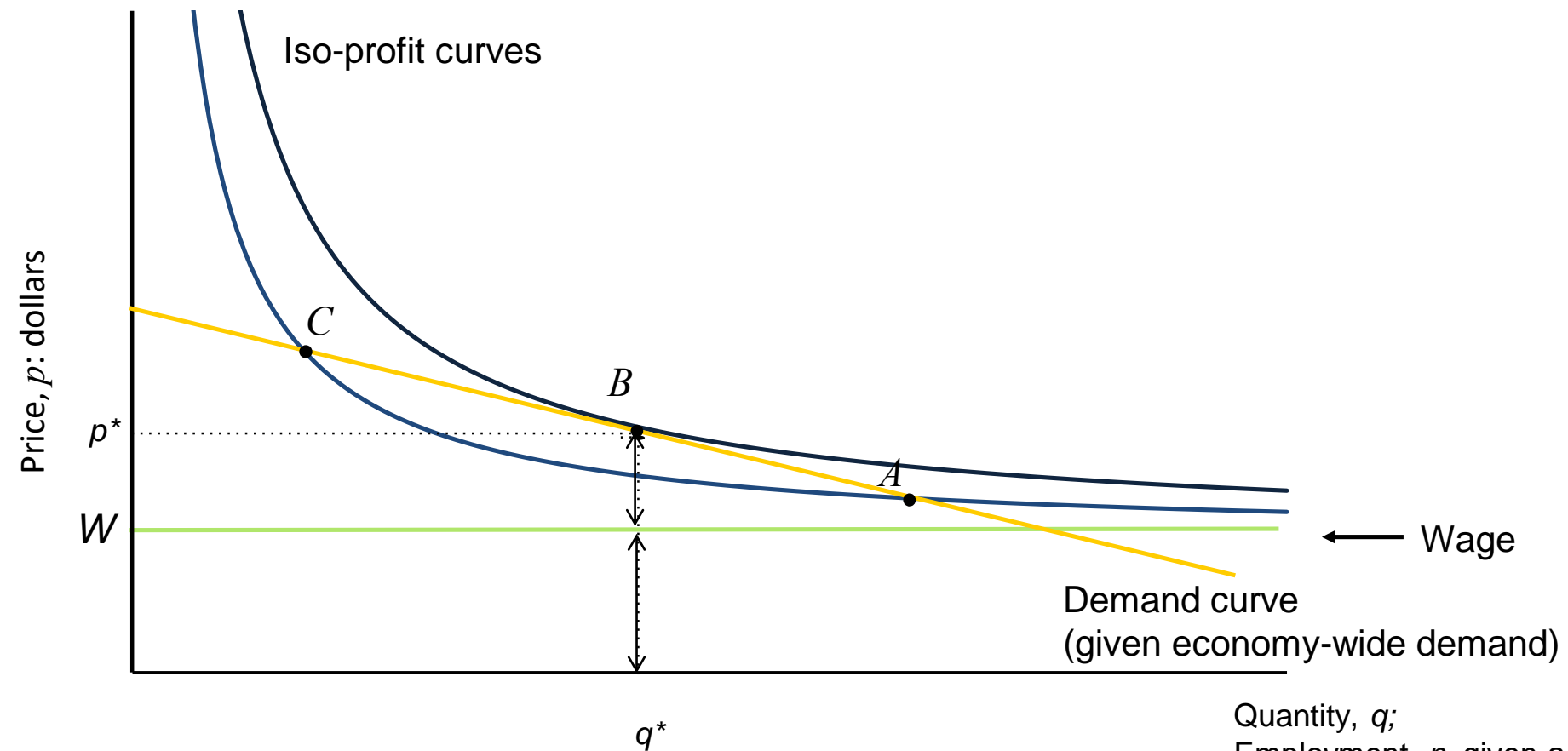
Quantity, q;
Employment, n, given a
production function
where APL = λ = 1

Production function: $q = n$

The price-setting curve

- **When the firm sets the price as a markup on its wage cost, this means that the price per unit of output is split into the profit per unit and the wage cost per unit**

- **For the economy as a whole, when all firms set prices this way, output per worker (labour productivity, or equivalently, the average product of labour, called lambda, λ) is split into**

  - Real profit per worker Π/P and

  - The real wage W/P

- **This is depicted in the next figures**

The price-setting curve
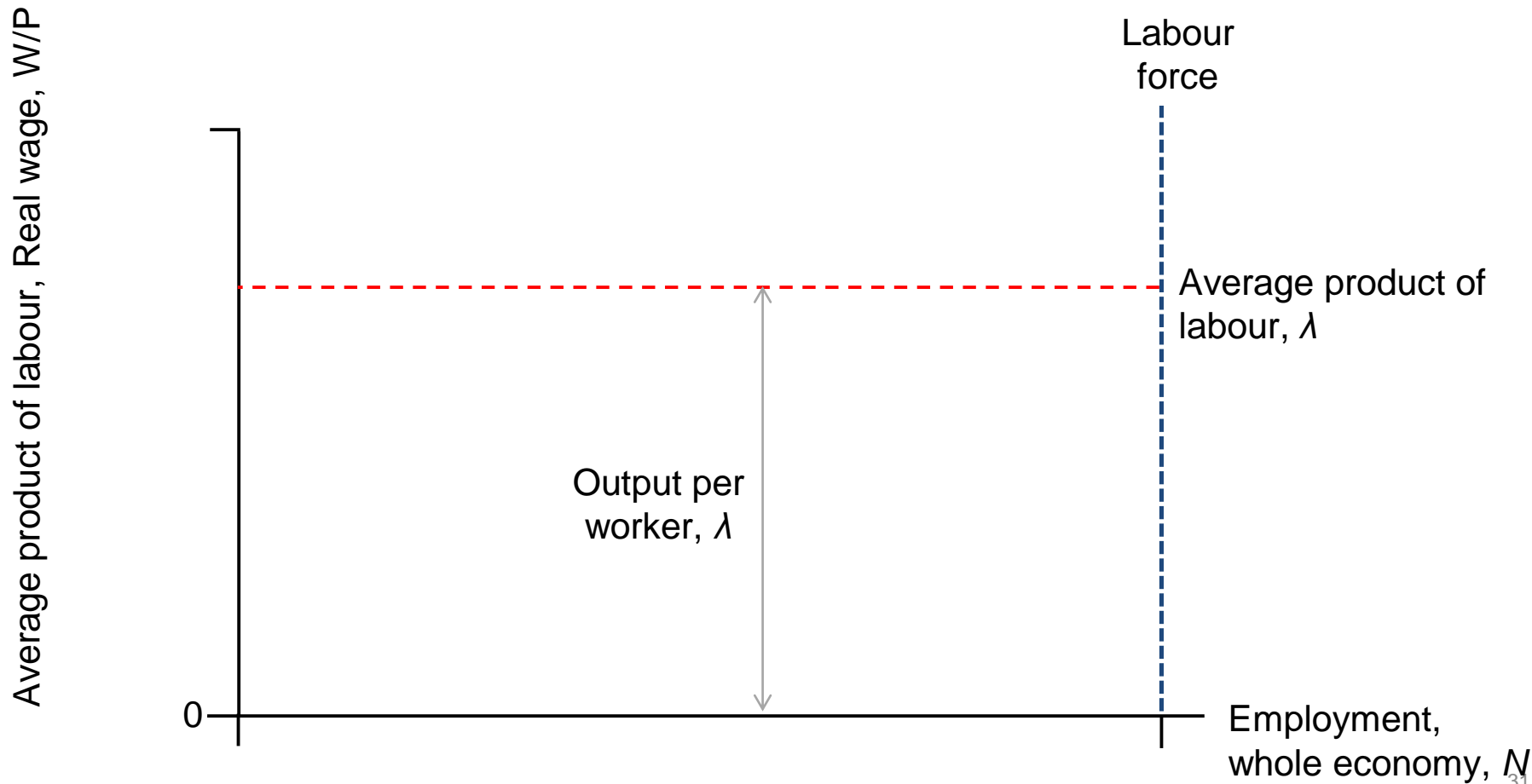
The price-setting curve

Average product of labour, Real wage, W/P

Labour force

Some of this is going to be paid to workers and some goes to profits

Average product of labour, λ

If employment is N_0, total production valued in real terms is equal to this area

0

N_0

Employment, whole economy, N
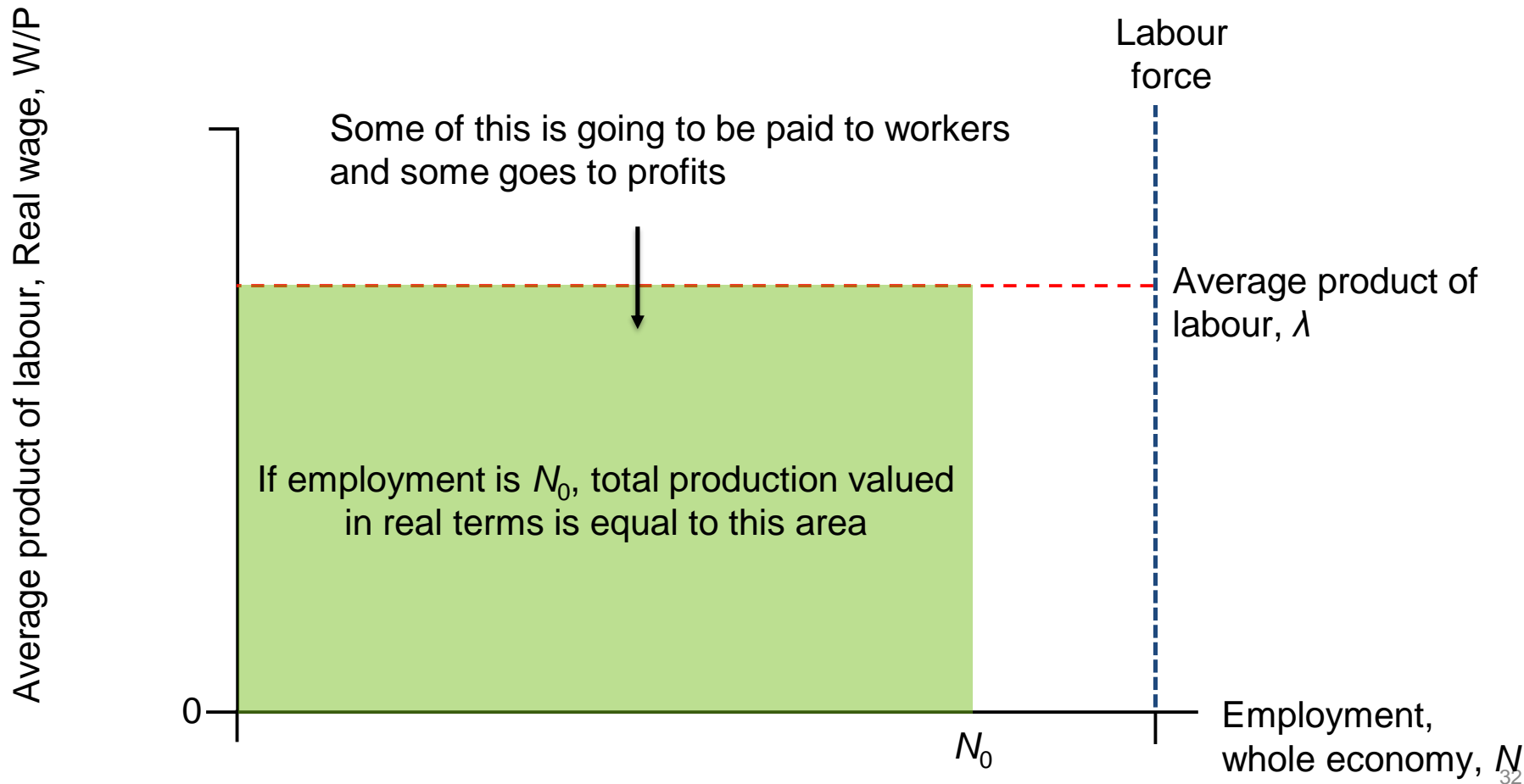
The price-setting curve
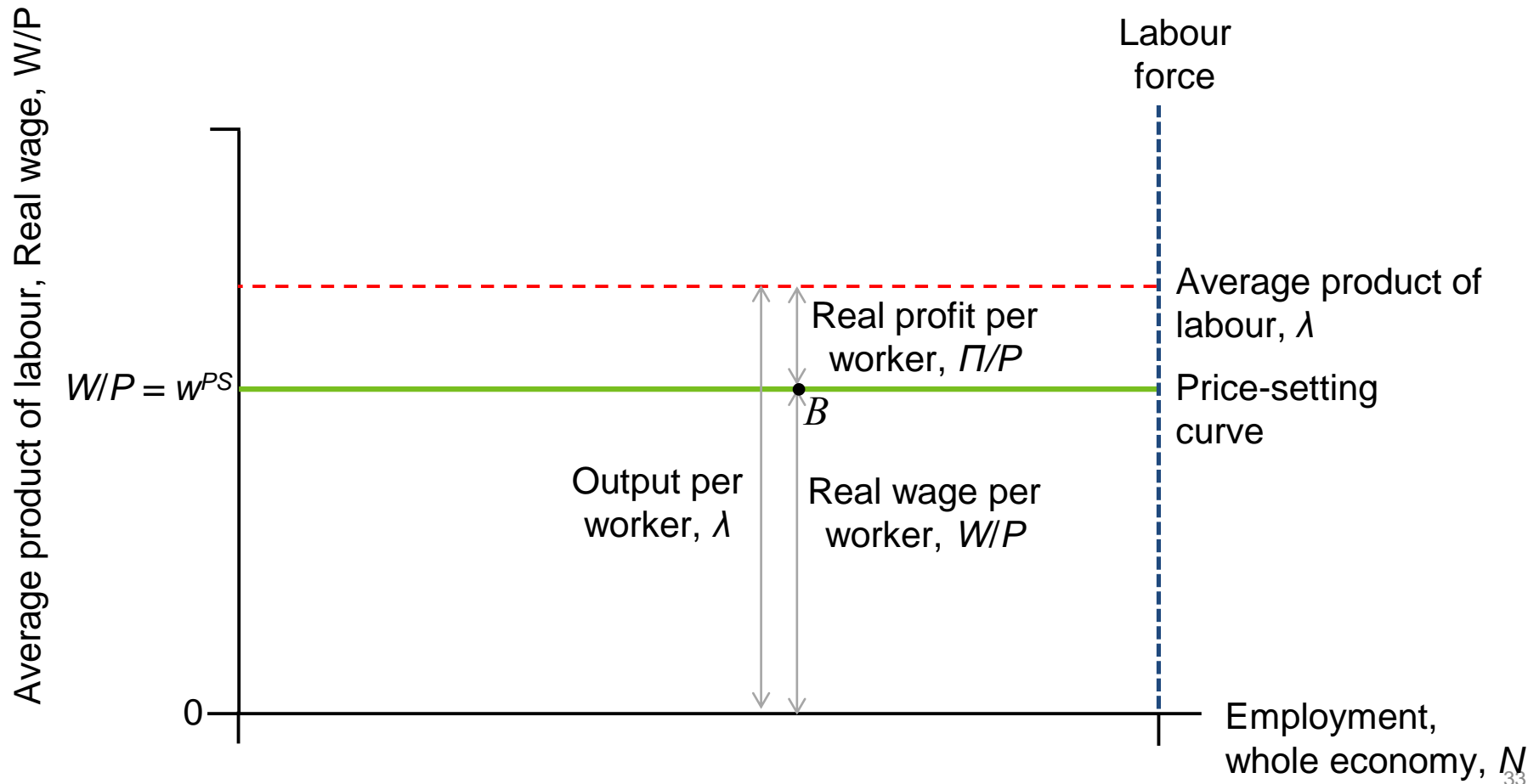
The price-setting curve

- **The price-setting 'curve' is just a single number** that gives the value of the real wage that is consistent with the markup over costs, when all firms set their price to maximize their profits

- The value of the real wage consistent with the markup does not depend on the level of employment in the economy, so it is shown as a horizontal line at the height of w^{PS}

- Point B in the figure on the price-setting curve shows the outcome of profit-maximizing price-setting behaviour of firms for the economy as a whole

The price-setting curve

At point A, real wage too high and markup too low; firms raise price; and given demand, output falls

- Vertical axis: Average product of labour, Real wage, W/P
- Labour force
- Average product of labour, λ (red dashed line)
- $W/P = w^{PS}$
- Price-setting curve (green line)
- Point A
- Point B
- 0
- Horizontal axis: Employment, whole economy, N

The price-setting curve

Average product of labour, Real wage, W/P (vertical axis)

Labour force

At point A, real wage too high and markup too low; firms raise price; and given demand, output falls

Average product of labour, λ

$W/P = w^{PS}$

A

Price-setting curve

B

C

At point C, real wage too low and markup too high; firms lower price; and given demand, output rises

0

Employment, whole economy, N
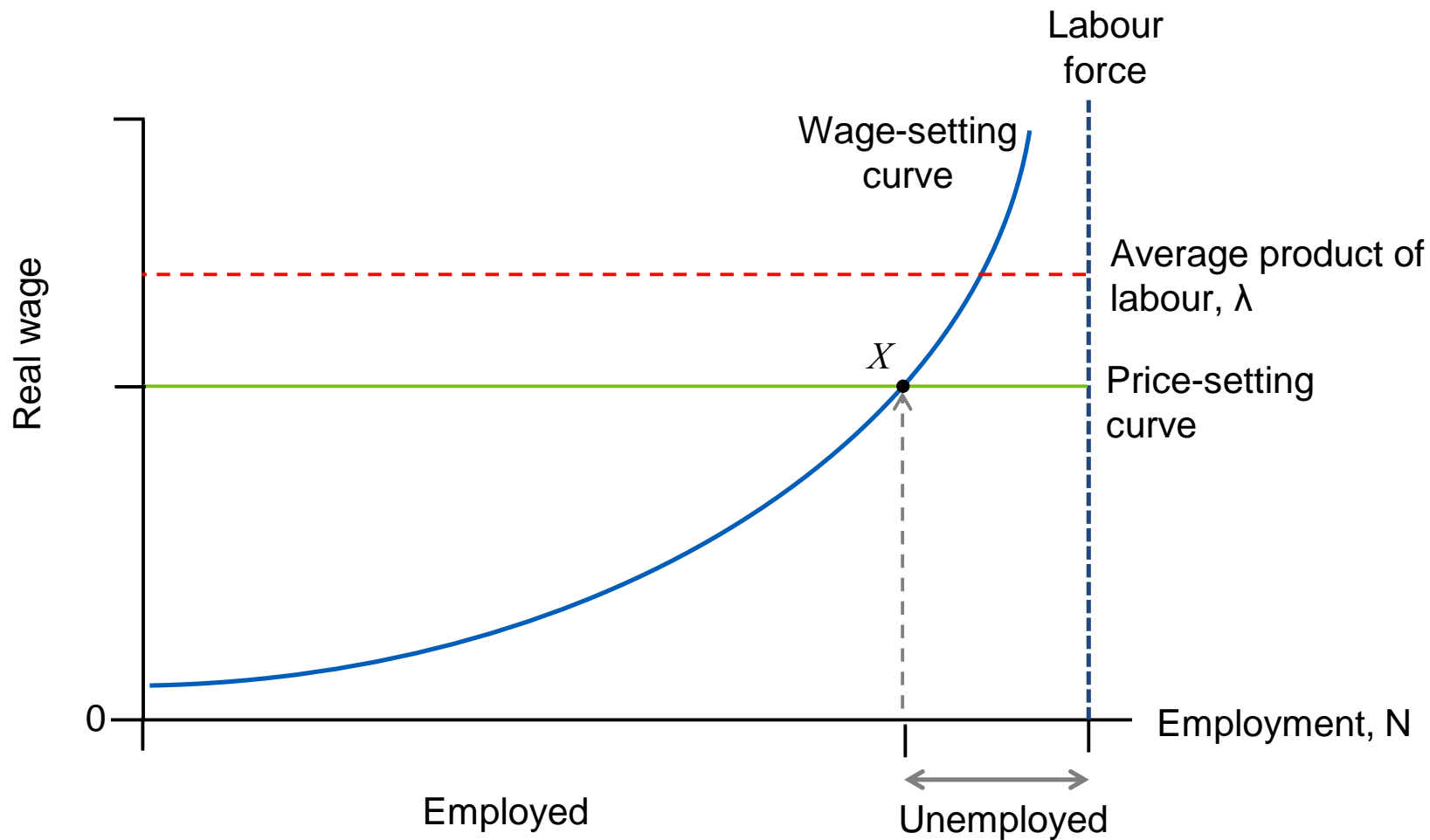
Height of the price-setting curve

- **Competition determines the extent to which firms can charge a price that exceeds their costs**
  - The less the competition, the steeper the demand curve the greater the markup and profit per worker
  - Since this leads to higher prices across the whole economy, it implies lower real wages, pushing down the price-setting curve
- **Labour productivity:**
  - For any given markup, the level of labour productivity—how much a worker produces in an hour—determines the real wage
  - The greater the level of labour productivity (λ), the higher the real wage that is consistent with a given markup => the price-setting curve will shift upwards, raising the real wage
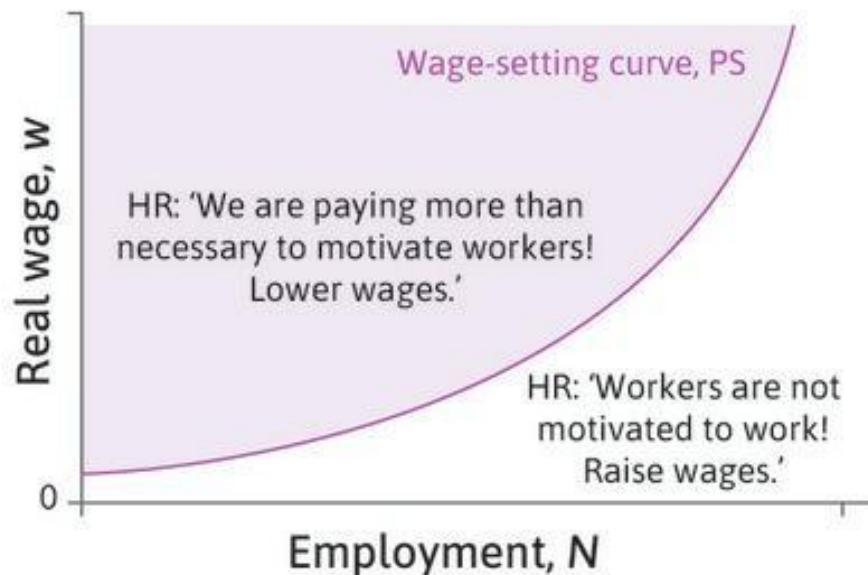
Equilibrium

Equilibrium

- **The equilibrium of the labour market is where the wage- and price-setting curves intersect (*X*)**

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

  - Each firm is setting the nominal wage where the isocost curve is tangent to the best response function (Unit 6), and is setting the profit-maximizing price (Unit 7)

Equilibrium

- **Taking the economy as a whole, at the intersection of the wage- and price-setting curves (point X):**

  - The firms are offering the wage that ensures effective work from employees at least cost (on the wage-setting curve). HR cannot recommend an alternative policy that would deliver higher profits

  - Employment is highest it can be (on the price-setting curve), given the wage offered. MD cannot recommend changing prices or output

Equilibrium

Equilibrium

- **Taking the economy as a whole, at the intersection of the wage- and price-setting curves (point X):**
  - Those who have jobs cannot improve their situation by changing their behaviour. If they worked less on the job, they would run the risk of becoming one of the unemployed, and if they demanded more pay, their employer would refuse or hire someone else
  - Those who fail to get jobs would rather have a job, but there is no way they can get one—not even by offering to work at a lower wage than others

Involuntary unemployment

- **Unemployment can exist in Nash equilibrium in the labour market**

- **In fact, there will always be unemployment in labour market equilibrium, i.e. equilibrium unemployment**

- **Reasoning:**

  - No unemployment → zero cost of job loss → no effort

  - Therefore some unemployment is necessary to motivate workers!

  - These are the involuntarily unemployed

- **Unemployment = excess supply in the labour market**

Involuntary unemployment

- **Competition among many buyers and sellers results in an equilibrium outcome—the wage w^* and the level of employment N^*—that is not Pareto efficient**

  - There is some other outcome—a different wage and level of employment that is feasible from the standpoint of the available resources and technology—that both employers and employees would prefer

  - But Pareto improvements are not economically feasible due to incompleteness of labour contracts

Applications

Unemployment and aggregate demand

- **The firm's demand for labour depends on the demand for their goods and services (derived demand for labour)**

- **Aggregate demand = sum of the demand for all of the goods and services produced in the economy**

- **The increase in unemployment caused by the fall in aggregate demand is called demand-deficient unemployment**

Demand deficient unemployment

Low aggregate demand moves the economy from labour market equilibrium (X) to point B

B is not a Nash equilibrium:
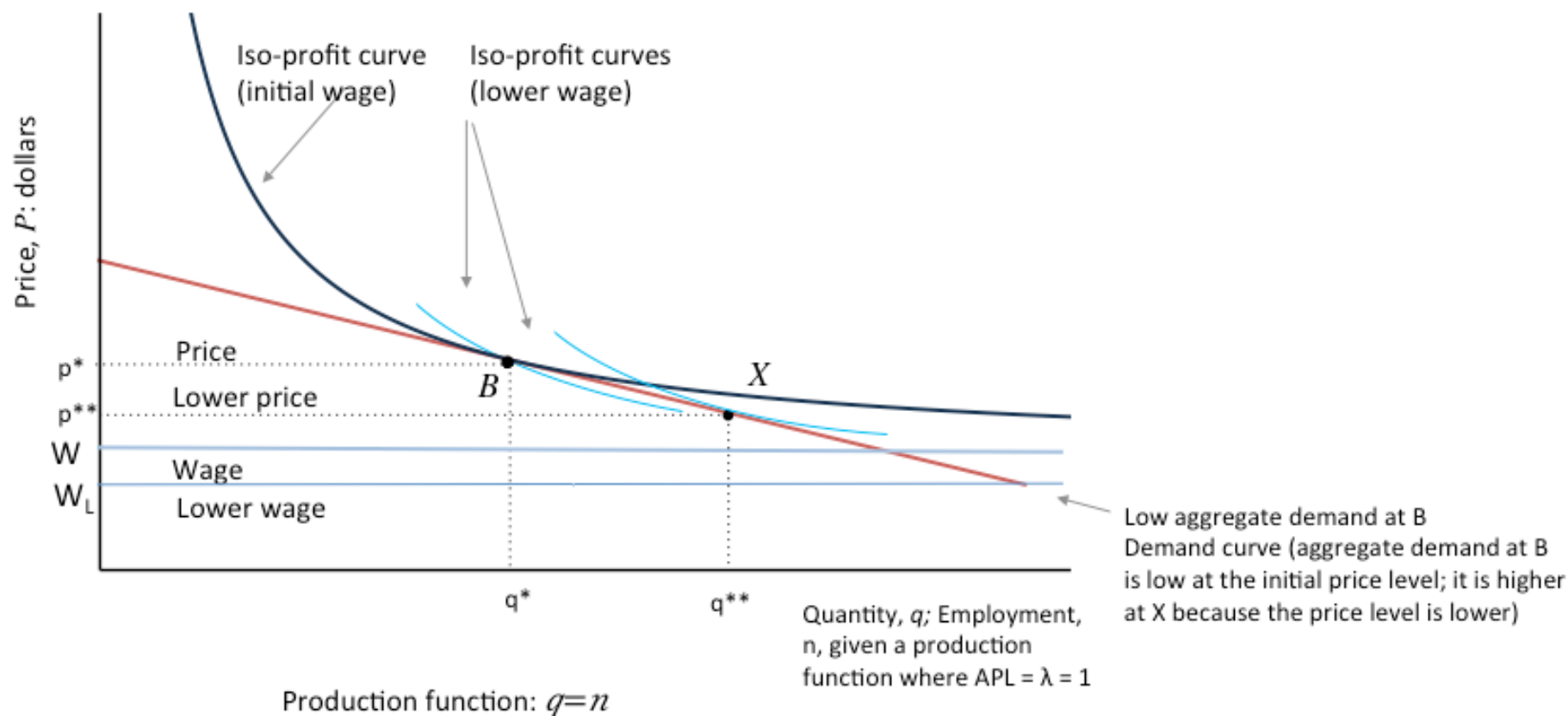
- Firms could lower wages
- Lower costs → lower prices
- Increase output and employment
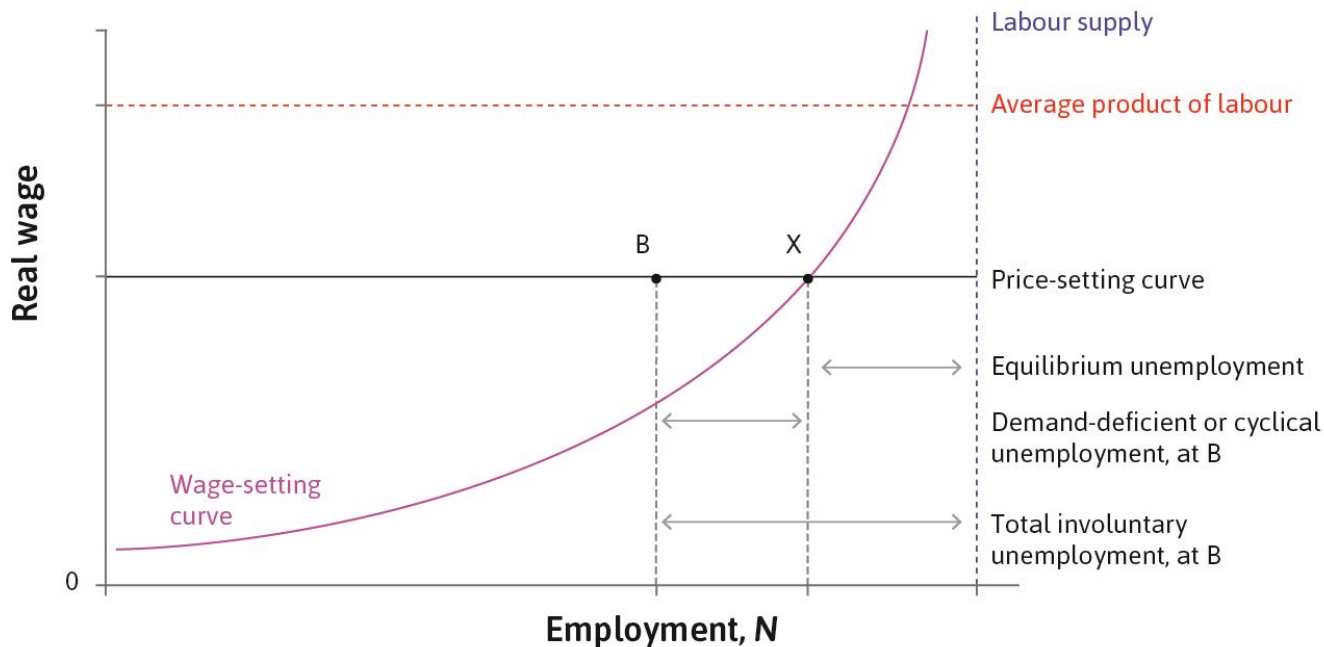
Automatic adjustment

- **Point B is not a Nash equilibrium:**

  - Firms could lower wages without lowering workers' effort

  - Lower wages allow them to cut their prices

  - Lower prices stimulate demand → output rises

  - Firms hire more workers to produce more

  - ... unemployment falls back to X

Automatic adjustment

Iso-profit curve (initial wage)

Iso-profit curves (lower wage)

Price, P: dollars

p^*
Price

p^{**}
Lower price

W
Wage

W_L
Lower wage

B

X

q^* q^{**}

Quantity, q; Employment, n, given a production function where APL = λ = 1

Production function: $q=n$

Low aggregate demand at B
Demand curve (aggregate demand at B is low at the initial price level; it is higher at X because the price level is lower)
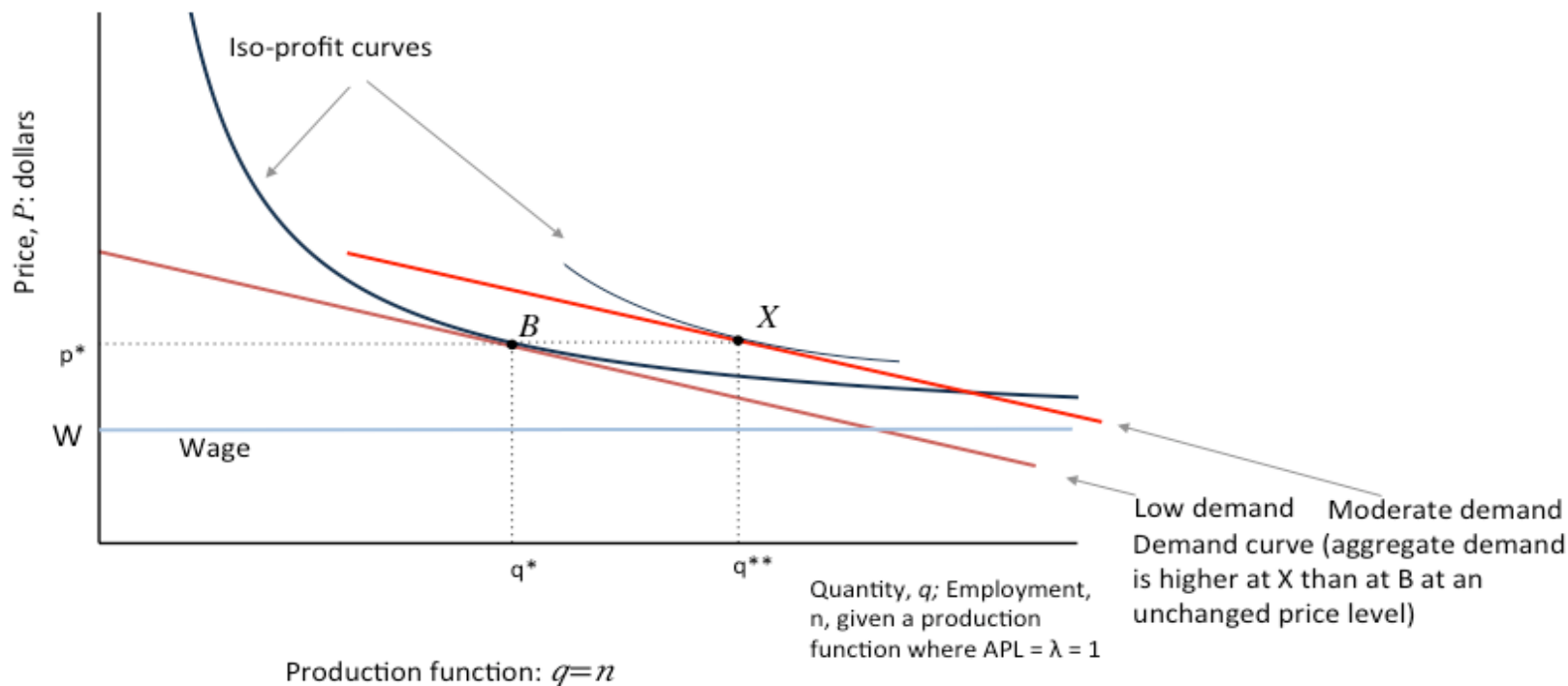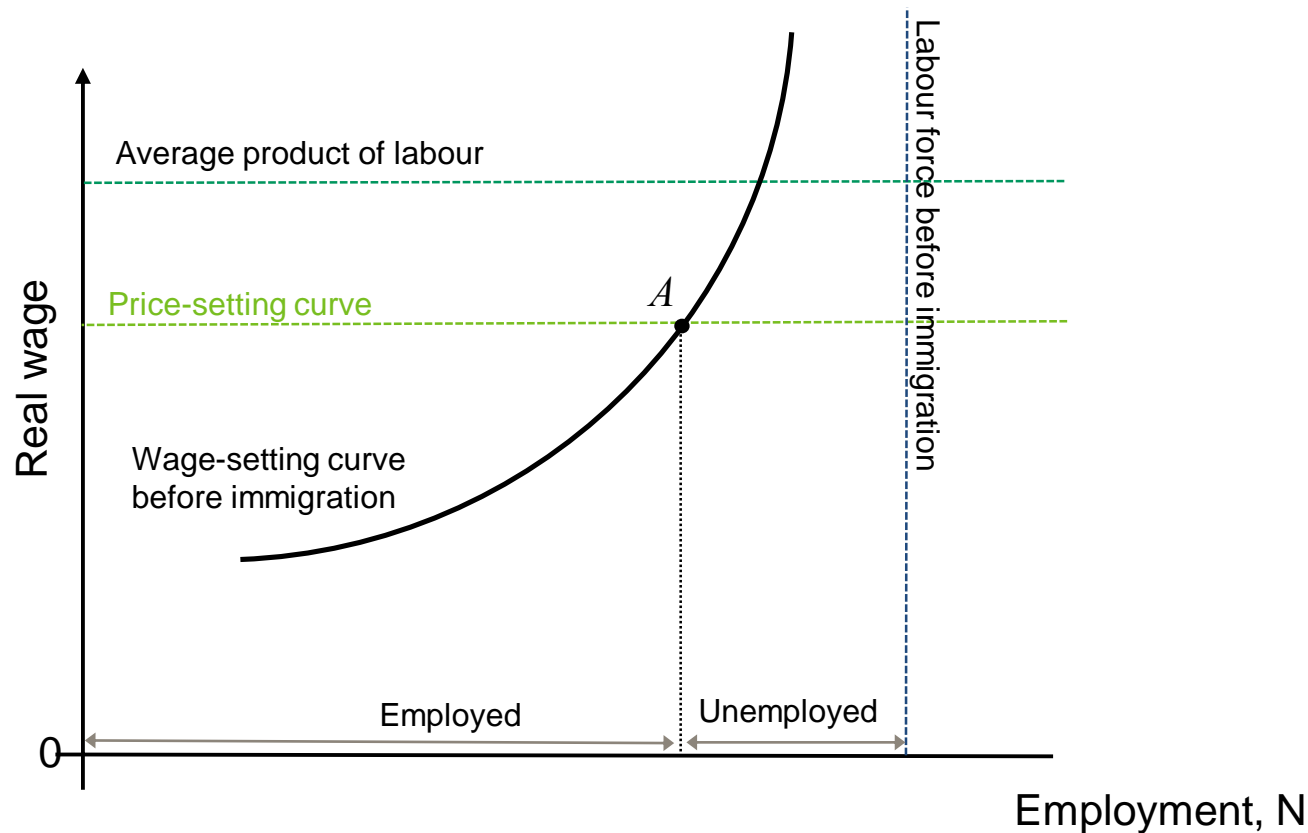
Automatic adjustment in practice

- **Real economies do not function so smoothly:**

  - Workers resist cuts to their nominal wage (lower morale, strikes)

  - Lower wages means people spend less → aggregate demand falls further

  - Falling prices across the economy may lead consumers to postpone their purchases in hope to get even better bargain later

Role of government policy

The government could increase its own spending to expand aggregate demand through monetary or fiscal policy

Iso-profit curves

Price, P: dollars

$p*$

W

Wage

B

X

$q*$

$q**$

Low demand   Moderate demand
Demand curve (aggregate demand
is higher at X than at B at an
unchanged price level)

Quantity, q; Employment,
n, given a production
function where APL = λ = 1

Production function: $q=n$

Effect of immigration on wages and employment

Effect of immigration on wages and employment
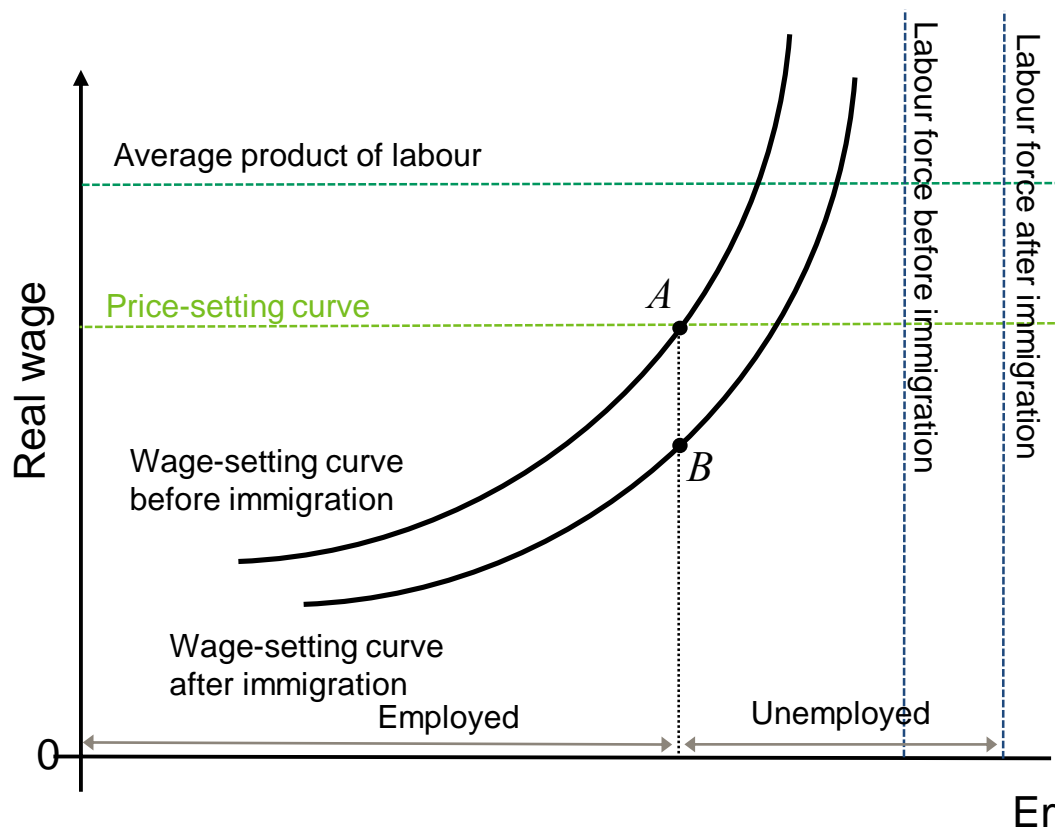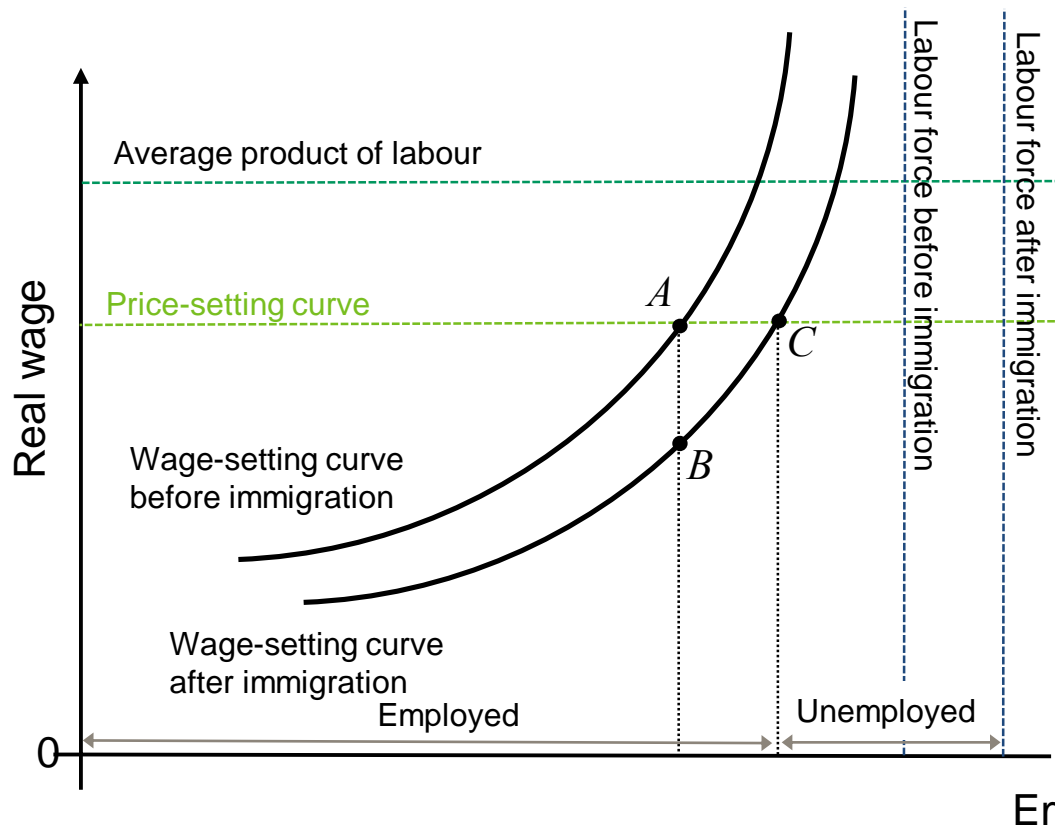

Labour supply shifts to the right

An increase in labour supply shifts the wage-setting curve downward:

- Greater pool of unemployed
- Higher employment rents
- Lower cost of effort

Effect of immigration on wages and employment

Reduction in wage reduces marginal cost

If demand stays the same, firm hire more workers

Employment expands so that the economy is again at the intersection of the PS and the new WS curve

How is this different from the competitive labour market model?

- **In the case of immigration, the models produce the same result (both for different reasons and mechanisms)**

  - Immigration has no long-term effects on the labour market

  - It is useful to know that by changing the assumptions in this way has no effects on this result

- **But there are clear differences**

  - Voluntary vs. involuntary unemployment

  - This is also useful information: we know which assumptions are critical in this respect

Other explanations for equilibrium unemployment

- **Search models**
  - It takes time and effort to find a new job

- **Union models**
  - Unions set wages and may set higher in order to benefit some workers but lead to unemployment for others

- **Wage stickiness**
  - Reluctance to lower nominal wages

Search models

- **In 2010, Peter Diamond, Dale Mortensen and Christopher Pissarides were awarded the Nobel Prize for their work on markets with search frictions**

  - In many markets, time and effort are required in order to bring buyers and sellers into contact with each other and agree on conditions for a transaction

  - In the labor market, such search frictions imply that unemployed job searchers will have to use time and other resources to find jobs

  - Analogously, it takes time for firms to fill their job vacancies

  - Unemployment is a feature of these types of models

Search models

Search models

- **A search market is characterized by external effects which are not taken into consideration by individual agents**

  - If someone who is unemployed increases his, or her, search activity, it will become more difficult for other job seekers to find employment

  - At the same time, it will be easier for a recruiting firm to fill its vacancies

  - No reason to expect the equilibrium to be efficient

Summary

- **Behaviour of firms sets wages and employment in an economy**

  - The wage-setting curve tracks the combinations of wages and unemployment feasible with workers' effort

  - The price-setting curve determines the real wage corresponding to profit-maximising price

- **There will always be involuntary unemployment**

  - Incomplete contracts

  - Compare to the competitive model

Summary

- **We have devoted an entire unit to the labour market for two reasons:**

  - Its functioning is very important for how well the economy serves the interests of the population

  - It is different enough from the way that many familiar markets work that it is essential to know these differences to understand how the economy works

  - We will also be using this model when we think about unemployment and fiscal and monetary policy

Differences between the labour market and competitive goods markets

Market	Bread: a market clearing equilibrium of price-takers	Baristas: price-setting by employers and equilibrium unemployment
Buyers	Individual consumers	Firms (employers)
Sellers	Firms (shops)	Individual workers
What is sold?	A loaf of bread	The worker's time
What does the buyer want?	A loaf of bread	The employee's effort on the job; not the worker's time
Competition among sellers?	*Yes*: There are many bakeries competing to sell bread.	*Yes*: There are many actual or would-be baristas competing to sell their time.
Is the contract complete?	*Yes*: If the bag labeled bread did not contain bread, you get your money back.	*No*: The firm's profits depend on the worker's effort per hour/week/month worked, which is not in the contract.
Price-taking buyers?	*Yes*: Individual buyers cannot bargain for a lower price than others are willing to pay (and would not want to pay more).	*No*: The buyer (the firm) sets the wage to minimize the cost of getting the worker to work; it cannot benefit by offering the lowest wage at which the worker (the seller) would accept the job.
Is there excess supply or demand in equilibrium?	*No*: The market clears. Sales take place at the lowest price the seller would accept.	*Yes*: Firms offer a wage higher than the worker's reservation wage (minimum price the seller would accept) to maximize their profits.