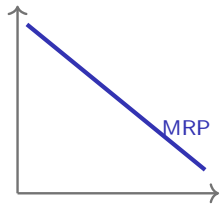
Factor Markets

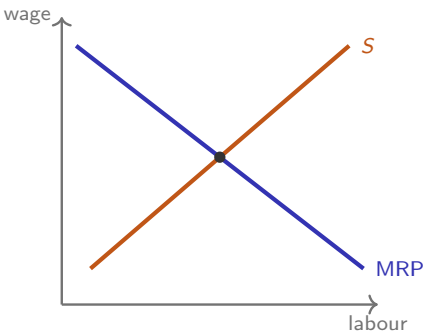
AP Microeconomics ▪ Unit 5

AP Microeconomics



What we will cover

1. Factor demand & the hiring rule
2. Shifts in factor demand & supply
3. Competitive factor markets
4. Monopsony



1 Factor demand

One bakery, two different markets

A bakery sells bread but hires workers. The bread market concerns output; the labour market concerns an input.

Identify the buyer and the reason

In the labour market, who demands workers' services? Why would stronger bread demand affect that decision?

Firms hire services; workers are not products the firm owns.

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In a **factor market** 要素市场, firms demand input services. Demand is **derived demand** 派生需求: it depends on the revenue the input helps produce.

Firms hire services; workers are not products the firm owns.

Extra output becomes extra revenue

Marginal revenue product 边际收益产品 (MRP) measures extra revenue per extra labour unit.

$$MRP = \Delta TR / \Delta L$$
$$MRP = MP_L \times MR \quad \text{at the margin}$$

Which output-market assumption matters?

Only a perfectly competitive product market has $MR = P$, so $MRP = MP_L \times P$. A **wage taker** 工资接受者 can still have market power when selling its product.

Marginal factor cost 边际要素成本 (MFC) measures the extra total input cost. Compare MRP with MFC, using the same time period and input units.

A wage taker need not be a product-price taker

A marginal comparison

Extra labour adds 5 output units at the margin. Marginal revenue is \$6 per output unit; product price is \$10. MFC is \$40 per labour unit. Is the extra labour profitable?

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$$MRP = MP_L \times MR = 5 \times 6 = \$30$$
$$\Delta\pi/\Delta L = MRP - MFC = 30 - 40 = -\$10$$

Using price would give value of marginal product $MP_L P = 5(10) = \$50$, which overstates extra revenue here.

2 Shifts in factor markets

Movement along a curve or a shift?

Predict the curve and the direction

A: this occupation's wage rises, other conditions unchanged.

B: training increases workers' marginal product.

C: more qualified workers become available.

D: other available jobs offer higher wages.

An input's own wage is on the vertical axis. Output price, productivity and outside opportunities are different determinants.

Movement along a curve or a shift?

Predict the curve and the direction

A: this occupation's wage rises, other conditions unchanged.

B: training increases workers' marginal product.

C: more qualified workers become available.

D: other available jobs offer higher wages.

A: movements along labour demand and supply. B: labour demand right, holding output-market conditions constant. C: labour supply right. D: supply left in this occupation.

An input's own wage is on the vertical axis. Output price, productivity and outside opportunities are different determinants.

One competitive market: wage and employment

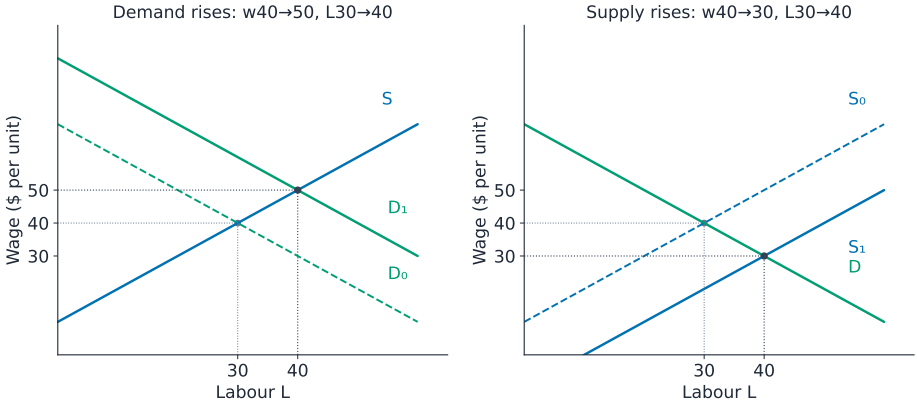
A common baseline for both shocks

Labour demand $w = 70 - L$; labour supply $w = 10 + L$. Wage is dollars per labour unit per period; L is market labour.

$$
\begin{aligned}
D_L = S_L \quad &\Rightarrow \quad 70 - L = 10 + L \\
L &= (70 - 10)/2 = 30 \text{ labour units} \\
w &= 10 + L = 10 + 30 = \$40
\end{aligned}
$$

Compare each shock with this same baseline. Keep the other curve unchanged unless the question changes it.

Two rightward shifts, different wage effects



Both shifts raise employment to 40; only the demand rise raises the wage.

Solve each shock before combining them

Demand rises to $w = 90 - L$

$$90 - L = 10 + L$$
$$L = (90 - 10)/2 = 40$$
$$w = 10 + L = \$50$$

Supply rises to $w = -10 + L$

$$70 - L = -10 + L$$
$$L = (70 + 10)/2 = 40$$
$$w = -10 + L = \$30$$

If both changes occur here: $90 - L = -10 + L$ gives $L = 50$, $w = 40$. Employment rises; wage is unchanged *in this example*.

> With both curves shifting right, the wage direction generally depends on relative shifts.

A cheaper robot: two effects can compete

Do not decide from the word "technology"

A robot becomes cheaper and can replace a worker's task. Does labour demand necessarily fall?

Identify whether capital replaces or supports the task.

Complementary equipment or training can instead raise workers' marginal product.

A cheaper robot: two effects can compete

Do not decide from the word "technology"

A robot becomes cheaper and can replace a worker's task. Does labour demand necessarily fall?

For a given output, substitution toward robots can reduce labour use. Lower costs can also expand production and increase labour needed. The net effect needs evidence.

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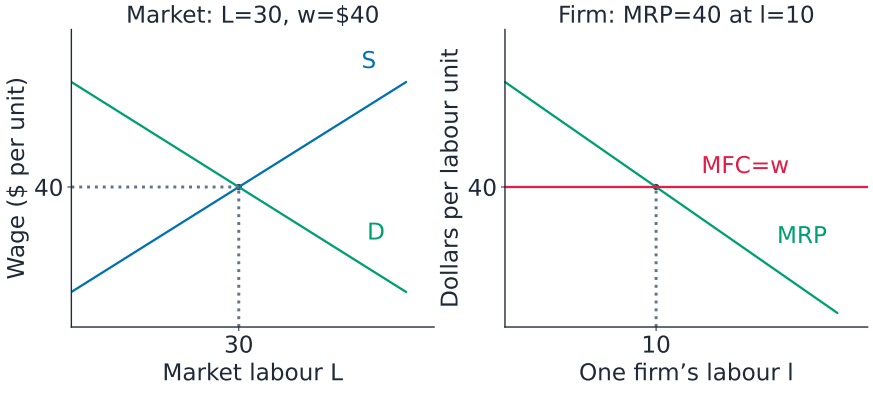
Identify whether capital replaces or supports the task.

3 Competitive factor markets

The market sets wage; one firm chooses its hiring



Market supply slopes up. A small wage-taking firm's supply is horizontal at w=$40; its MFC equals that wage.

Different quantities: market L and firm I

One firm's MRP is $70 - 3l$; the competitive market wage is \$40.

$$\begin{aligned} MRP &= MFC = w \\ 70 - 3l &= 40 \\ l &= (70 - 40)/3 = 10 \text{ labour units} \end{aligned}$$

Three identical firms would together demand $L = 30$ at this wage. The smooth falling-MRP model gives an interior equality.

For whole workers or a kink, equality may not be available. Compare the extra benefits and costs or the feasible total profits.

Hiring whole workers from a production table

Try before the solution

Bread price \$5 per loaf; wage \$25 per worker-day. Equal daily hours; labour is the only variable input. Daily fixed cost is \$30.

Workers L	0	1	2	3	4	5
Loaves per day Q	0	8	18	24	28	30

Calculate MP and MRP. When do diminishing marginal returns begin? How many workers maximize profit? Calculate daily profit.

> First calculate changes in output. Then value them at price because this *product* market is competitive.

MRP need not fall from the first worker

Worker	1	2	3	4	5
MP (loaves per worker-day)	8	10	6	4	2
MRP (dollars per worker-day)	40	50	30	20	10

$$MP_2 = \Delta Q/\Delta L = (18-8)/(2-1) = 10$$
$$MRP_2 = MP_2 P = 10(5) = \$50 \text{ per worker-day}$$

Diminishing marginal returns begin with worker 3: MP falls from 10 to 6. MRP first rises, then falls.

> At wage 25, include worker 3: MRP 30>25. Exclude worker 4: MRP 20<25. Hire 3 even though no MRP equals the wage.

Hiring three workers: calculate the total profit

At $L = 3$, output is 24 loaves per day, price 5, wage 25 and fixed cost 30.

$$TR = PQ = 5(24) = \$120 \text{ per day}$$
$$TVC = wL = 25(3) = \$75 \text{ per day}$$
$$\pi = TR - TVC - TFC = 120 - 75 - 30 = \$15 \text{ per day}$$

Change only unavoidable fixed cost to $80

Does the hiring comparison change? Calculate profit and compare operating with not operating today.

Hiring three workers: calculate the total profit

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Change only unavoidable fixed cost to $80

Does the hiring comparison change? Calculate profit and compare operating with not operating today.

Still hire 3: MRP and MFC are unchanged. Profit is $120 - 75 - 80 = -\$35$; not operating loses 80. Operating contributes 45 to fixed cost.

Equality: two equally good hiring choices

Change the bakery's wage to $30

Original output table; fixed cost $30. Third worker MRP $30. Must the optimal worker count be unique?

Equal MRP and wage can mean two optimal counts. Compare the feasible profits.

Equality: two equally good hiring choices

Change the bakery's wage to $30

Original output table; fixed cost $30. Third worker MRP $30. Must the optimal worker count be unique?

$$\pi_2 = PQ_2 - wL_2 - TFC = 5(18) - 30(2) - 30 = \$0$$
$$\pi_3 = PQ_3 - wL_3 - TFC = 5(24) - 30(3) - 30 = \$0$$

Both 2 and 3 workers maximize profit here. The third adds no net profit; the fourth would reduce it.

> Equal MRP and wage can mean two optimal counts. Compare the feasible profits.

The least-cost input combination

Same output goal, two divisible inputs

$MP_L = 40$, wage $w = \$20$; $MP_K = 30$, capital rental $r = \$10$. Which input gives more extra output per dollar?

An interior **least-cost combination** 最低成本组合 equates $MP_L/w = MP_K/r$. Assumes divisible inputs and feasible adjustment.

The least-cost input combination

Same output goal, two divisible inputs

$MP_L = 40$, wage $w = \$20$; $MP_K = 30$, capital rental $r = \$10$. Which input gives more extra output per dollar?

$$MP_L/w = 40/20 = 2 \text{ output units per dollar}$$
$$MP_K/r = 30/10 = 3 \text{ output units per dollar}$$

Shift spending toward capital; recalculate as marginal products change.

An interior **least-cost combination** 最低成本组合 equates $MP_L/w = MP_K/r$. Assumes divisible inputs and feasible adjustment.

Show why reallocating spending can reduce cost

Use the initial marginal products 40 and 30 from the previous example. Assume they stay constant over a small \$10 transfer.

Remove labour spending

$$\Delta L = -10/w = -10/20 = -0.5$$

$$\Delta Q_L = MP_L \Delta L = 40(-0.5) = -20$$

Add capital spending

$$\Delta K = 10/r = 10/10 = 1$$

$$\Delta Q_K = MP_K \Delta K = 30(1) = 30$$

Net extra output is 10 at the same cost. Alternatively, save spending while keeping the output target.

> Cost minimization concerns input choice for a given output. Profit-maximizing output also requires revenue information.

4 Monopsony

Why is extra labour more costly than its wage?

A **monopsony** 买方垄断 has one buyer in the relevant factor market. Use uniform wage supply $w = 10 + L$.

Count the whole wage bill

At $L = 2$, pay \$12 each. To attract $L = 3$, pay \$13 to all three. Find the extra wage bill.

Why is extra labour more costly than its wage?

A **monopsony** 买方垄断 has one buyer in the relevant factor market. Use uniform wage supply $w = 10 + L$.

Count the whole wage bill

At $L = 2$, pay \$12 each. To attract $L = 3$, pay \$13 to all three. Find the extra wage bill.

$$\Delta\text{wage bill} = w_3 L_3 - w_2 L_2$$
$$\Delta\text{wage bill} = 13(3) - 12(2) = \$15$$

The new unit costs 13, plus a 1 raise for each of two existing units. The finite-interval extra cost exceeds the wage.

Choose employment using MFC; read wage on supply

Continuous model: $S: w = 10 + L$, $MFC = 10 + 2L$, $MRP = 70 - L$.

Choose employment

$$MRP = MFC$$
$$70 - L = 10 + 2L$$
$$L_M = (70 - 10)/3$$

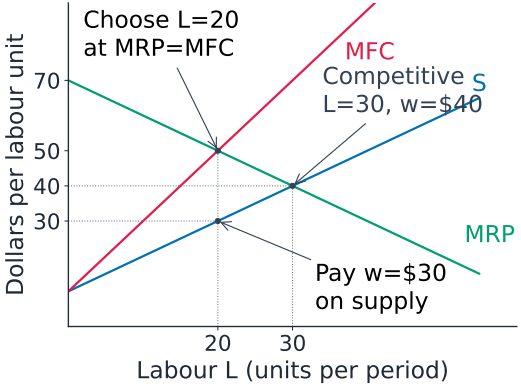
Pay the supply wage

$$w_M = 10 + L_M = 10 + 20 = \$30$$
$$\text{Wage bill} = w_M L_M$$
$$\text{Wage bill} = 30(20) = \$600$$

$L_M = 20$ workers

MFC at 20 is $10 + 2(20) = \$50$. It determines the hiring comparison; it is not the \$30 wage paid.

Monopsonistic markets: compare the same underlying curves



Monopsony: $L = 20$, wage 30. Competition: set MRP=supply to get $L = 30$, wage 40. Keep supply and MRP unchanged for this comparison.

Stronger product demand shifts MRP

Change MRP, holding labour supply fixed

MRP rises from $70 - L$ to $85 - L$. Supply remains $w = 10 + L$ and MFC remains $10 + 2L$. Find employment, wage and MFC of the last unit hired.

Stronger product demand shifts MRP

Change MRP, holding labour supply fixed

MRP rises from $70 - L$ to $85 - L$. Supply remains $w = 10 + L$ and MFC remains $10 + 2L$. Find employment, wage and MFC of the last unit hired.

$$MRP = MFC \quad \Rightarrow \quad 85 - L = 10 + 2L$$
$$L = (85 - 10)/3 = 25 \text{ labour units}$$
$$w = 10 + L = 10 + 25 = \$35$$
$$MFC = 10 + 2L = 10 + 2(25) = \$60$$

The firm moves up its unchanged MFC curve. MFC of the last unit rises from 50 to 60. This is not a supply shift.

Minimum wages: the level matters

A **minimum wage** 最低工资 is a wage floor. Original MRP $70 - L$, supply $10 + L$; unregulated $L = 20$, $w = 30$.

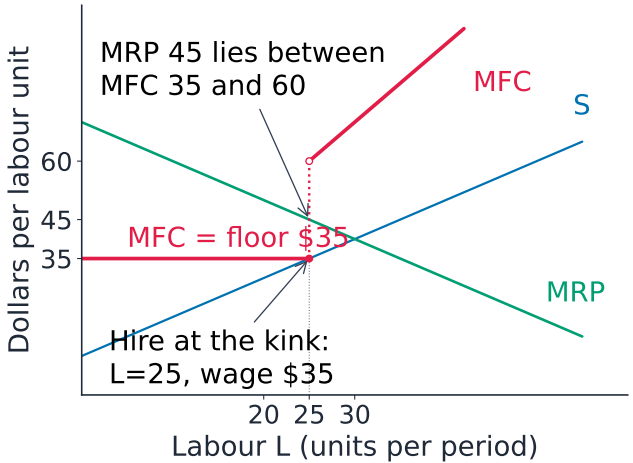
An enforced floor of \$35

How much labour is available at 35? Can the firm keep hiring indefinitely at marginal cost 35? Decide before looking at the changed MFC schedule.

$$L_S = w - 10 = 35 - 10 = 25 \text{ labour units}$$

The wage floor holds marginal cost at 35 only up to available labour 25. Beyond that, attracting more labour requires raising the wage for everyone.

A kink: do not extend the flat MFC forever



At $L = 25$, MFC jumps from 35 to 60; MRP is 45.

Hire 25 at wage 35. Profit peaks at the kink, without smooth MRP=MFC equality.

A high floor can reduce monopsony employment

Wage floor	Labour hired	Wage paid	Wage bill
None	20	\$30	\$600
\$35	25	\$35	\$875
\$40	30	\$40	\$1,200
\$55	15	\$55	\$825

At 55, labour available is 45, but $MRP = 55$ gives $70 - L = 55$, so hire 15. Wage bill $wL = 55(15) = \$825$.

In a competitive market with the same curves, floor 55 creates excess supply $45 - 15 = 30$ labour units.

> A suitably set floor can raise monopsony wages and jobs. A higher floor can reduce jobs below the unregulated level. Calculate the stated case.

Exam tips

Draw and justify, starting from blank axes

Use $MRP = 70 - L$, $S : w = 10 + L$, and $MFC = 10 + 2L$.

1. Label all three curves. Mark monopsony labour at MRP=MFC; read wage on supply, then calculate wage bill.
2. Mark the competitive benchmark from MRP=supply. Compare wages and employment using these same curves.
3. Add floor 35. Limit its flat MFC segment to labour available 25; show the kink and justify the hiring choice.
4. Repeat for floor 55. State whether employment rises or falls from the unregulated monopsony case, with numbers.

5 Recap

Check yourself: compare the next feasible choice

1. Bakery wage 25: worker 3 adds 30 revenue, worker 4 adds 20. Must MRP equal wage for hiring 3 to be optimal?
2. A firm is a wage taker but sells output with $MR < P$. Which output measure values marginal product when finding MRP?
3. Original monopsony: floor 55, supply $w = 10 + L$, MRP $70 - L$. Find actual employment and wage bill. Is supply 45 the number hired?

Use the extra revenue, extra cost and availability relevant to the stated market. Attempt before seeing the solutions.

Check yourself

1. No exact equality is needed. Worker 3 raises profit by $30 - 25 = 5$; worker 4 would lower it by $20 - 25 = -5$. Hire 3.

2. Use marginal revenue: $MRP = MP_L \times MR$ at the margin. Product price works only when MR=P.

3. At floor 55, $70 - L = 55$ gives $L = 15$. Wage bill $wL = 55(15) = \$825$. Supply 45 shows availability, not actual employment. Jobs fall from the unregulated 20 to 15.