

Lecture 4 notes

Part A · Which curve moved?

A2

Market: Nova, an AI assistant · *buyers:* students · *seller:* Nova

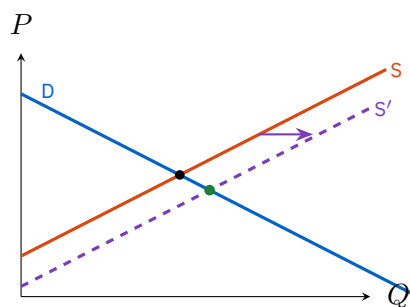
A new chip halves Nova's cost of answering each question. Which curve moved, and which way?

Who is affected? The seller: its cost per user falls.

Which way? At every price Nova can now serve more students: **supply moves right** (in " $P = \dots$ " form the intercept falls).

The other side. The price falls, so students move *along* their demand curve and buy more.

Answer: supply moved right; we move along the demand curve



A3

Market: Nova, an AI assistant · *buyers:* students · *seller:* Nova

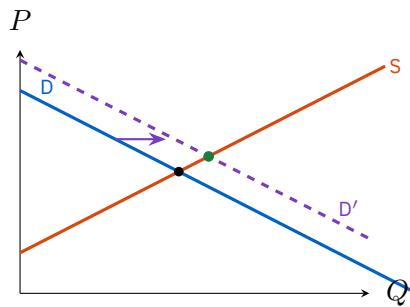
Every course at the university now expects students to use their own AI assistant. Which curve moved, and which way?

Who is affected? The buyers: students now need their own assistant.

Which way? Students now need their own assistant, so at every price more want Nova: **demand moves right** (the intercept rises).

The other side. The price rises, so Nova moves *along* its supply curve and serves more.

Answer: demand moved right; we move along the supply curve



A4

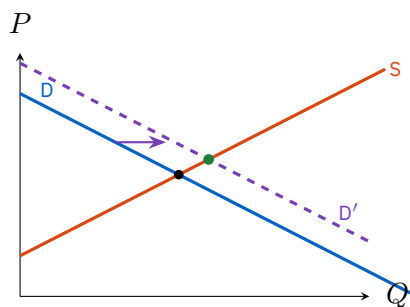
Market: Nova, an AI assistant · *buyers:* students · *seller:* Nova
More and more students want Nova. Which curve moved, and which way?

Who is affected? The buyers: more students want Nova.

Which way? Demand moves right.

Supply? Nothing in the story changes Nova's costs, so supply does **not** move. The price rises and Nova serves more: a movement along its supply curve.

Answer: demand moved right (supply did not move: movement along it)



A5

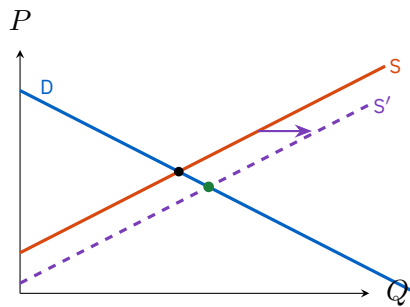
Market: Nova, an AI assistant · *buyers:* students · *seller:* Nova
Electricity for Nova's data centre gets 40 % cheaper. Which curve moved, and which way?

Who is affected? The seller: electricity is an input, part of the cost of every answer Nova gives.

Which way? Cheaper input: at every price Nova offers more. **Supply moves right** (the intercept falls).

The other side. The price falls, so students move along their demand curve.

Answer: supply moved right; we move along the demand curve



A6

Market: sponsored posts · *buyers:* brands · *sellers:* influencers

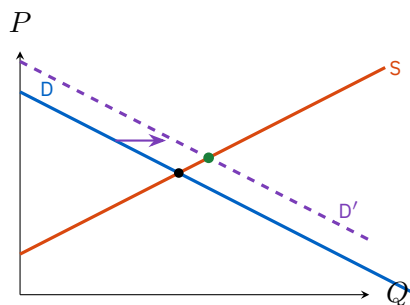
Brands spend more on social media this year. Which curve moved, and which way?

Who is affected? The buyers: brands want more posts at every price.

Which way? Demand moves right.

Supply? Nothing in the story changes the influencers' costs, so supply does **not** move. The price rises and they post more: a movement along their supply curve.

Answer: demand moved right (supply did not move: movement along it)



Part B · Price and quantity changes with the shift

B1

Brands find that a sponsored post now brings them twice as many sales. What happens to the price and the number of sponsored posts?

Whose decision? The brands' (buyers): each post is now worth more to them, so they would pay more for every post, and at every price they want more posts. **Demand moves right** (in $P = \dots$ form: a rises).

Table. Demand right: price up, quantity up.

Answer: price up, quantity up

B2

A new AI video editor cuts the time to make a sponsored post from 5 hours to 1 hour. What happens to the price and the number of sponsored posts?

Whose decision? The influencers' (sellers): each post costs them less time, so at every price they are willing to make more posts. **Supply moves right.**

Table. Supply right: price down, quantity up.

Answer: price down, quantity up

B3 (two things at once)

Brands move their ad budgets from TV to social media. At the same time, a new AI video editor cuts the time to make a post from 5 hours to 1 hour. Which do we know for sure: what happens to the price, or to the number of posts?

Story 1. Brands want more posts: demand right $\Rightarrow$ price up, quantity up.

Story 2. Posts are cheaper to make: supply right $\Rightarrow$ price down, quantity up.

Combine. Quantity: up and up $\Rightarrow$ **certain**. Price: up and down $\Rightarrow$ depends on which change is bigger.

Answer: the number of posts rises for sure; the price can go either way

B4 (two things at once)

After a data leak, many students cancel Nova and do not want to return. In the same month, cheaper inference chips cut Nova's cost per user. What do we know for sure in the market for Nova?

Story 1. Students want Nova less: demand left $\Rightarrow$ price down, quantity down.

Story 2. Cheaper chips are an input cost: supply right $\Rightarrow$ price down, quantity up.

Combine. Price: down and down $\Rightarrow$ **certain**. Quantity: down and up $\Rightarrow$ cannot tell.

Answer: the price falls for sure; the number of subscriptions can go either way

B5 (another good)

A rival assistant, Orbit, doubles its student price. What happens in the market for Nova?

Whose decision? Students choose Nova *or* Orbit: they are substitutes. Orbit got more expensive, so at every Nova price more students want Nova. **Demand for Nova moves right.** Nova's costs did not change, so its supply stays.

Table. Demand right: price up, quantity up.

Answer: demand for Nova moves right: Nova's price up, Nova subscriptions up

B6 (a complement gets cheaper)

Print-on-demand T-shirt shops cut their prices in half, and many students start selling T-shirts with their own AI-made designs. What happens in the market for **AI image-generator subscriptions**?

Whose decision? The students' (buyers of the image generator). T-shirt printing and the image generator are used *together* (complements). Printing got cheaper, so more students want the generator at every price. **Demand right.**

Answer: demand right: price up, quantity up

B7 (a substitute gets cheaper)

Every web browser now translates any text for free with built-in AI. What happens in the market for **human translators**?

Whose decision? The customers'. Free AI translation is used *instead of* a human translator (substitute), and it just got cheaper (free). At every price fewer customers want a human translator. **Demand left.**

Answer: demand left: price down, quantity down

B8 (a complement gets dearer)

Mobile data in Austria becomes twice as expensive, and most students use Nova on their phones. What happens in the market for **Nova**?

Whose decision? The students'. Mobile data and Nova on the phone are used *together* (complements); data got dearer, so using Nova got dearer. At every Nova price fewer students want it. **Demand left.**

Answer: demand left: price down, quantity down

B9 (an input gets dearer)

The government now charges influencers €30 for each video they film in public (it was €15), and every sponsored video is filmed in public. What happens in the market for **sponsored posts**?

Whose decision? The influencers' (sellers): each post now costs them €15 more. At every price they offer fewer posts. **Supply left** (in " $P = \dots$ " form: c rises by 15).

Answer: supply left: price up, quantity down

B10 (income)

The government raises student grants by 30 %. What happens in the market for **Nova**?

Whose decision? The students': more money, and Nova is something they buy more of when they have more (a normal good). **Demand right**.

Answer: demand right: price up, quantity up

B11 (two things at once)

Human translators raise their fees. At the same time, cheaper inference chips cut the cost of running AI translation. What do we know for sure about the market for **AI translation subscriptions**?

Story 1. Human translators are a substitute that got dearer: demand for AI translation right $\Rightarrow$ price up, quantity up.

Story 2. Cheaper chips are an input: supply right $\Rightarrow$ price down, quantity up.

Combine. Quantity up and up: **certain**. Price up and down: cannot tell.

Answer: more AI translation subscriptions for sure; the price can go either way

B12 (one story, two markets)

Nova cuts its price from €20 to €12 because its own new chip, which no rival can buy, cuts its costs. What happens in the market for **Orbit**, the rival assistant?

In Nova's market: supply moved right (Nova's own cheaper chip), Nova's price fell.

In Orbit's market: Nova is a substitute for Orbit and just got cheaper, so at every Orbit price fewer students want Orbit. **Demand for Orbit left**. Orbit's own costs did not change.

Answer: demand for Orbit left: Orbit's price down, Orbit's quantity down

Part C · Sponsored posts

The market

Sponsored posts: brands buy them from influencers. P = price per post in €, Q = posts per week.

Demand (brands): $Q = 300 - 2P$

Supply (influencers): $Q = P - 30$

- C1. Write both curves as “ $P = \dots$ ” (inverse demand and inverse supply). What do the two intercepts mean? _____
- C2. Find the equilibrium price and quantity. _____
- C3. The platform caps the price of a sponsored post at €90. How many posts do brands want, how many do influencers offer? Is there a shortage or a surplus, and how big? _____
- C4. Back to the free market. An AI editing tool cuts every influencer’s cost by €15 per post. What is the new supply curve? New price and quantity? _____
- C5. Back to the original market. The government charges influencers a tax of €12 per sponsored post. How many posts are made? What do brands pay, what do influencers keep? _____
- C6. Who bears how much of the €12? Would it change if the brands paid the tax instead? _____

C1 · Turn both curves around

Demand. $Q = 300 - 2P \Rightarrow 2P = 300 - Q \Rightarrow P = 150 - \frac{1}{2}Q$.

Supply. $Q = P - 30 \Rightarrow P = 30 + Q$.

Answer: inverse demand $P = 150 - 0.5Q$; inverse supply $P = 30 + Q$

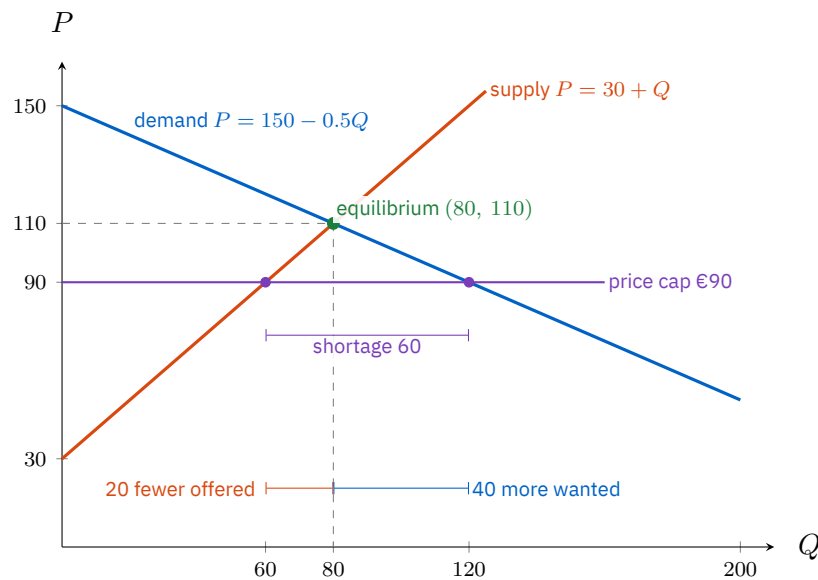
C2 · Equilibrium

Set equal (both in “ $Q = \dots$ ” form, so no turning around needed):

$$300 - 2P = P - 30 \Rightarrow 330 = 3P \Rightarrow P^* = 110$$

Quantity. $Q^* = 300 - 2 \cdot 110 = 80$. Check with supply: $110 - 30 = 80 \checkmark$. Check with the inverse curves: $150 - 40 = 110$, $30 + 80 = 110 \checkmark$.

Answer: $P^* = €110$ per post, $Q^* = 80$ posts per week



C3 · A price cap at €90

Brands at €90. $Q_D = 300 - 2 \cdot 90 = 120$ posts.

Influencers at €90. $Q_S = 90 - 30 = 60$ posts.

Gap. Brands want 120, influencers offer 60: a **shortage of 60** posts. Only 60 posts are actually made (the short side).

Where the 60 comes from. Compared with equilibrium (80): brands want $120 - 80 = 40$ more; influencers offer $80 - 60 = 20$ fewer. $40 + 20 = 60$. No curve moved: the cap only moves us along both curves.

Answer: at €90: wanted 120, offered 60, shortage 60

C4 · A shift in equations: the AI editing tool

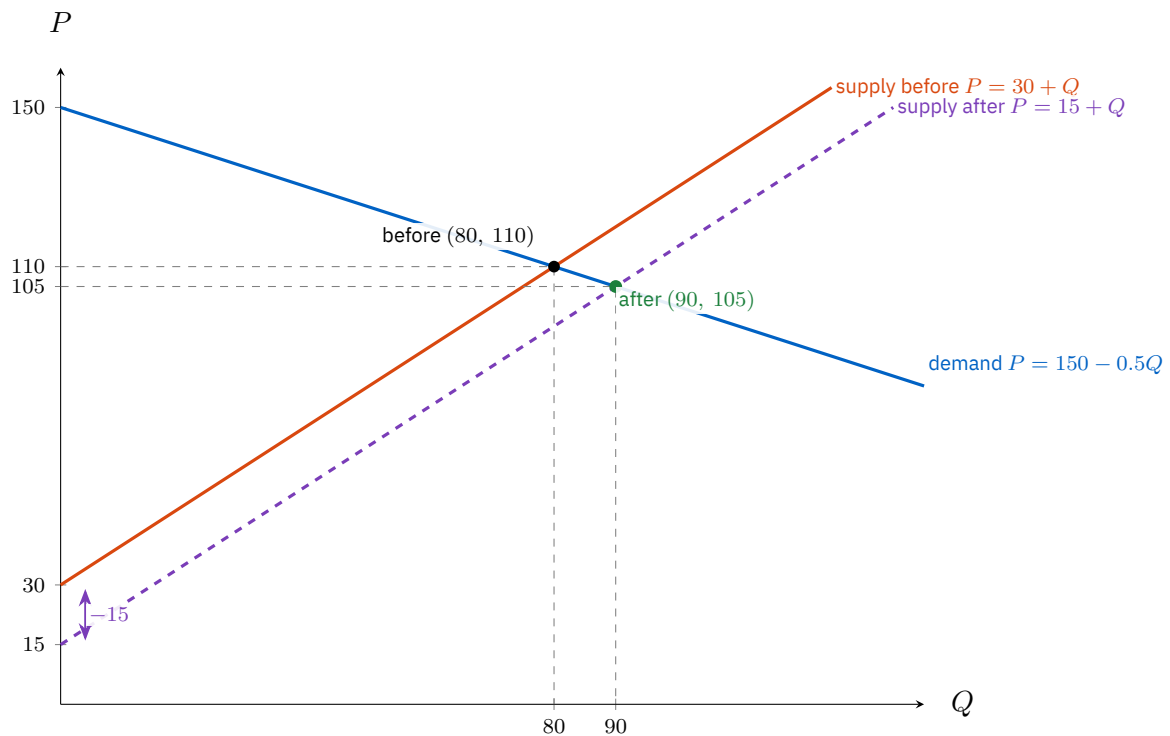
What changes. Every post costs influencers €15 less, so for every quantity they accept €15 less: supply shifts *right* (c falls by 15). Only the intercept changes:

$$P = 30 + Q \longrightarrow P = 15 + Q$$

New equilibrium. $150 - 0.5Q = 15 + Q \Rightarrow 135 = 1.5Q \Rightarrow Q = 90, P = 15 + 90 = 105$.

Compare. Price €110 $\rightarrow$ €105 (down 5, not 15: part of the cost saving goes into more posts). Quantity 80 $\rightarrow$ 90. This is “supply right: price down, quantity up” from the table, now with numbers.

Answer: new supply $P = 15 + Q$; new equilibrium $P = €105, Q = 90$



C5 · A tax of €12 per post, paid by the influencers

Which curve moves? The influencers hand €12 per post to the government. To keep the same amount for themselves, they need €12 more from the brands: supply shifts *left* (c rises by 12).

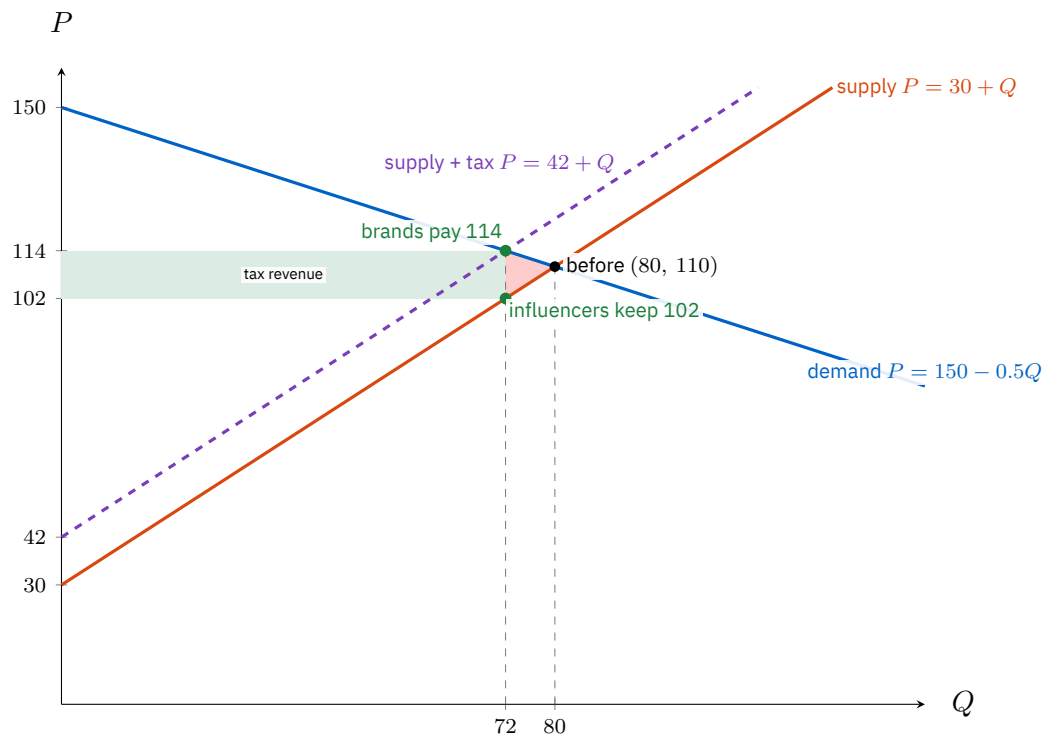
$$P = 30 + Q \longrightarrow P = 42 + Q \quad (\text{what brands must pay})$$

Quantity. $150 - 0.5Q = 42 + Q \Rightarrow 108 = 1.5Q \Rightarrow Q = 72$.

What brands pay. On demand: $P_b = 150 - 0.5 \cdot 72 = 114$.

What influencers keep. $P_s = 114 - 12 = 102$. Check on the old supply: $30 + 72 = 102 \checkmark$.

Answer: 72 posts; brands pay €114, influencers keep €102 (the gap is the €12 tax)



C6 · Who bears the €12?

	before	after	change
brands pay	€110	€114	+€4: brands bear €4
influencers get from brands	€110	€114	
influencers hand to the government	0	€12	
influencers keep	€110	$114 - 12 = €102$	-€8: influencers bear €8
posts per week	80	72	

Split. The €12 splits into €4 ($\frac{1}{3}$) for brands and €8 ($\frac{2}{3}$) for influencers: $4 + 8 = 12$.

Who hands it over vs who bears it. The influencers hand over the whole €12, but get €4 of it back through the higher price brands pay.

Why this split. The steeper side bears more. “ $P = \dots$ ” slopes: demand 0.5, supply 1: supply is steeper. Brands’ share $= \frac{0.5}{0.5 + 1} = \frac{1}{3} \checkmark$.

If the brands paid the tax instead. Demand would shift left (a falls by 12): $P = 138 - 0.5Q$. Then $138 - 0.5Q = 30 + Q$ gives $Q = 72$ again; influencers get 102, brands pay $102 + 12 = 114$. **Nothing changes:** who hands over the money does not decide who bears it.

Answer: brands $\frac{1}{3}$ (€4), influencers $\frac{2}{3}$ (€8); the same if the brands paid it

Part E · No curve shifts: a price floor and a quota

E1 · A price floor

To “protect creators”, the platform sets a **minimum price** of €130 per sponsored post.

E1.1 How many posts do brands want at €130? _____

E1.2 How many posts do influencers want to make at €130? _____

E1.3 Shortage or surplus? How big? How many posts are actually made? _____

E1.4 Did a curve shift? _____

E1.5 What if the minimum price were €100 instead? _____

E1.1 · Brands at €130

Read demand at the price. $130 = 150 - 0.5Q \Rightarrow 0.5Q = 20 \Rightarrow Q_D = 40$.

Answer: brands want 40 posts

E1.2 · Influencers at €130

Read supply at the price. $130 = 30 + Q \Rightarrow Q_S = 100$.

Answer: influencers want to make 100 posts

E1.3 · Surplus

Gap. Above the equilibrium price, sellers offer more than buyers want: a **surplus** of $100 - 40 = 60$ posts.

Where the 60 comes from. Compared with 80: brands want $80 - 40 = 40$ *fewer*; influencers offer $100 - 80 = 20$ *more*. $40 + 20 = 60$.

Posts made. Nobody can force the brands to buy: only **40** posts are made (the short side, here the buyers). 60 influencer posts find no brand.

Answer: surplus of 60; only 40 posts are made

E1.4 · Did a curve shift?

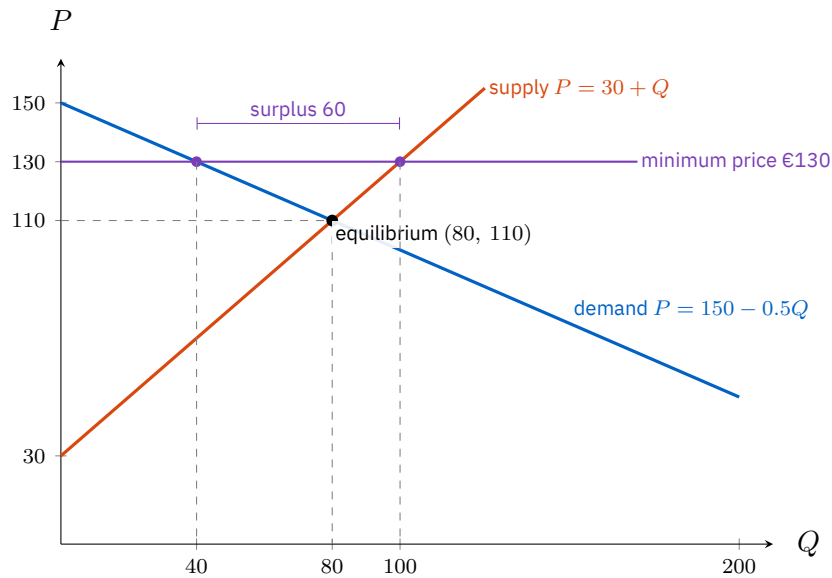
No. Nothing changed for brands or influencers except the price, which the rule holds at €130. Brands slide up along demand (they want fewer posts); influencers slide up along supply (they *want to make* more posts, but only 40 are made).

Answer: no shift: two movements along the curves

E1.5 · A minimum price of €100

Compare with the equilibrium. The market price is €110, already above €100. The rule does not stop anything: the market stays at 80 posts and €110.

Answer: no effect: a price floor only matters above the equilibrium price (a cap only below it)



E2 · A quota

New advertising rules limit sponsored posts to **60 per week** (a quota). Influencers who make the 60 posts sell them to brands as usual.

E2.1 With only 60 posts, what is the most brands are willing to pay per post? _____

E2.2 What is the least influencers would accept for the 60th post? _____

E2.3 What price do brands pay, and who gets the gap between the two? _____

E2.4 Did a curve shift? _____

E2.5 What if the quota were 100 posts instead? _____

E2.1 · Brands at 60 posts

Read demand at the quantity. $P = 150 - 0.5 \cdot 60 = 120$.

Answer: brands would pay up to €120 per post

E2.2 · Influencers at 60 posts

Read supply at the quantity. $P = 30 + 60 = 90$.

Answer: the 60th post needs only €90

E2.3 · The price

Price. Only 60 posts exist and brands compete for them, so the price rises until only 60 posts are wanted: **€120** (on demand). Before the quota: 80 posts at €110.

The gap. Brands pay €120, the 60th post costs the influencer €90: €30 per post goes to the influencers who are allowed to post (a “quota rent”): $30 \times 60 = €1,800$ per week.

Answer: brands pay €120; the €30 gap per post goes to the influencers with the right to post

E2.4 · Did a curve shift?

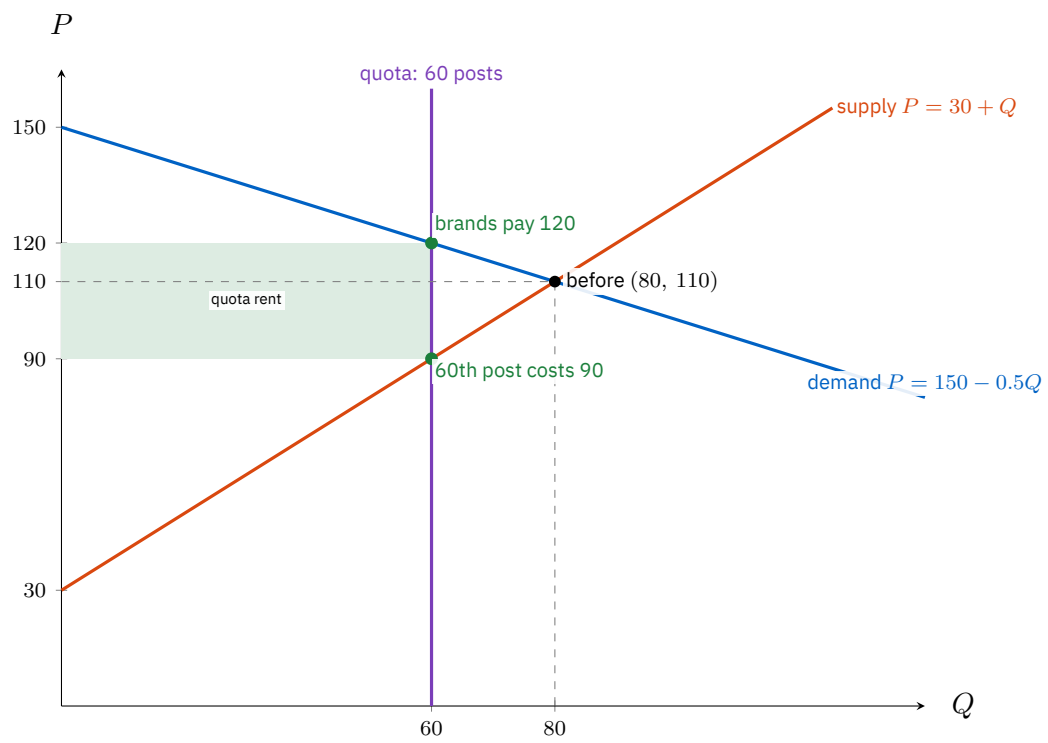
No. Demand and supply stay where they are; the rule only adds a wall at 60 posts. The market moves along demand until the price is €120 (brands buy fewer posts at a higher price).

Answer: no shift: the quota cuts the quantity, the price is read on demand

E2.5 · A quota of 100

Compare with the equilibrium. The market only wants 80 posts. A limit of 100 stops nothing.

Answer: no effect: a quota only matters below the equilibrium quantity



Part F · A tax and a subsidy in the same market

F · AI assistant subscriptions

Students buy monthly subscriptions to AI assistants. $P = \text{€}$ per month, $Q = \text{thousand subscriptions}$.

Demand (students): $P = 28 - 0.5Q$ Supply (AI companies): $P = 4 + Q$

- F1. Find the equilibrium price and quantity. _____
- F2. The government charges the AI companies a **tax of €6** per subscription. Which curve shifts, and how? New quantity, what students pay, what companies keep? Who bears how much? _____
- F3. Instead (no tax), the government pays students a **subsidy of €6** per subscription. Which curve shifts, and how? New quantity, what companies get, what students pay out of their own pocket? Who gets how much of the €6? _____
- F4. What happens if the government does **both** at once (tax €6 on the companies and subsidy €6 to students)? _____

F1 · Equilibrium

$28 - 0.5Q = 4 + Q \Rightarrow 24 = 1.5Q \Rightarrow Q^* = 16, P^* = 4 + 16 = 20$. Check: $28 - 8 = 20 \checkmark$.

Answer: 16 thousand subscriptions at €20 a month

F2 · A tax of €6 paid by the companies

Which curve shifts? The companies pay it: for them it is an extra cost of €6 on every subscription. They need €6 more: **supply shifts left** (c rises by 6).

$$P = 4 + Q \longrightarrow P = 10 + Q$$

New equilibrium. $28 - 0.5Q = 10 + Q \Rightarrow 18 = 1.5Q \Rightarrow Q = 12, P = 10 + 12 = 22$: what **students pay**. Students move along their demand curve: $(16, 20) \rightarrow (12, 22)$.

What companies keep. $22 - 6 = 16$ (check on the old supply: $4 + 12 = 16 \checkmark$).

Who bears it?

	before	after	change
students pay	€20	€22	+€2: students bear €2
companies get from students	€20	€22	
companies hand to the state	0	€6	
companies keep	€20	$22 - 6 = €16$	-€4: companies bear €4
subscriptions (thousand)	16	12	

Split. The €6 splits into €2 ($\frac{1}{3}$) for students and €4 ($\frac{2}{3}$) for companies: $2 + 4 = 6$.

Who hands it over vs who bears it. The companies hand over the whole €6, but get €2 of it back through the higher price students pay.

Why this split. The steeper side bears more: supply (slope 1) is steeper than demand (0.5). Students' share = $\frac{0.5}{0.5 + 1} = \frac{1}{3} \checkmark$.

Answer: supply shifts left to $P = 10 + Q$; 12 thousand; students pay €22, companies keep €16; students bear €2, companies €4

F3 · A subsidy of €6 paid to students

Which curve shifts? The students receive it: for every subscription they get €6 back, so they are willing to pay the *company* €6 more than before at every quantity. **Demand shifts right** (a rises by 6).

$$P = 28 - 0.5 Q \longrightarrow P = 34 - 0.5 Q$$

New equilibrium. $34 - 0.5 Q = 4 + Q \Rightarrow 30 = 1.5 Q \Rightarrow Q = 20$, $P = 4 + 20 = 24$: what **companies get**. Companies move along their supply curve: $(16, 20) \rightarrow (20, 24)$.

What students pay out of pocket. $24 - 6 = 18$ (check on the old demand: $28 - 10 = 18 \checkmark$).

Who gets the €6?

	before	after	change
companies get	€20	€24	+€4: companies gain €4
students pay the company	€20	€24	
students get from the state	0	€6	
students pay out of pocket	€20	$24 - 6 = €18$	–€2: students gain €2
subscriptions (thousand)	16	20	

Split. The €6 splits into €2 ($\frac{1}{3}$) for students and €4 ($\frac{2}{3}$) for companies: $2 + 4 = 6$.

Who receives it vs who gains. The students receive the whole €6, but pass €4 of it on to the companies through the higher price.

Why this split. The steeper side gains more: supply (slope 1) is steeper than demand (0.5). Students' share = $\frac{0.5}{0.5 + 1} = \frac{1}{3} \checkmark$. Same split as the tax, in the other direction.

Answer: demand shifts right to $P = 34 - 0.5Q$; 20 thousand; companies get €24, students pay €18; students gain €2, companies €4

F4 · Both at once

Shift both curves. Supply shifts left (c rises by 6: $P = 10 + Q$), demand shifts right (a rises by 6: $P = 34 - 0.5Q$).

Solve. $34 - 0.5Q = 10 + Q \Rightarrow 24 = 1.5Q \Rightarrow Q = 16, P = 26$ (paid to the companies, tax included).

What each side ends with.

	before	after	change
students pay the company	€20	€26	
students get from the state	0	€6	
students pay out of pocket	€20	$26 - 6 = €20$	0
companies get from students	€20	€26	
companies hand to the state	0	€6	
companies keep	€20	$26 - 6 = €20$	0
subscriptions (thousand)	16	16	0

The state takes €6 per subscription and gives €6 back: net zero. Nobody bears or gains anything.

Answer: nothing changes: 16 thousand at €20 for both sides; the tax and the subsidy cancel

