2.6 — Long Run Industry Equilibrium

ECON 306 • Microeconomic Analysis • Fall 2021

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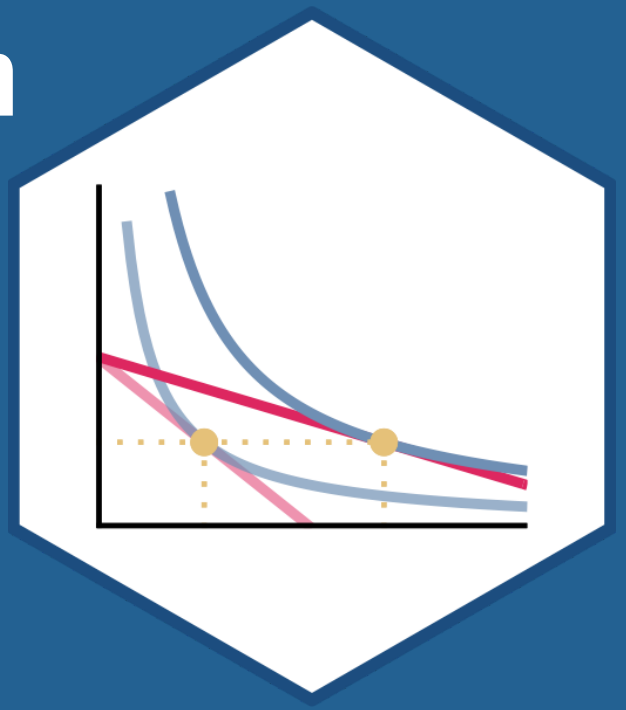
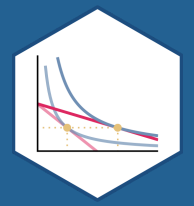
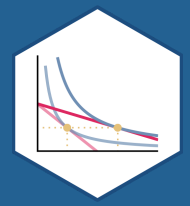


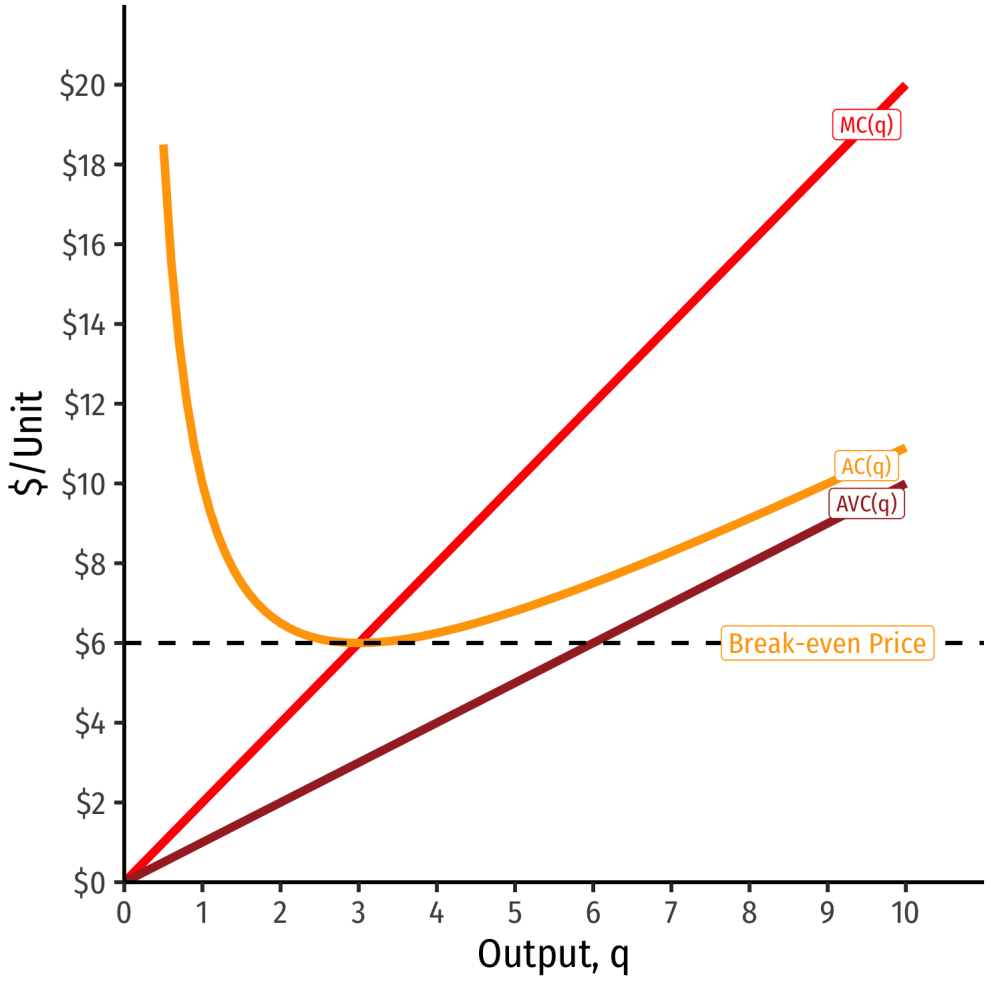
Outline





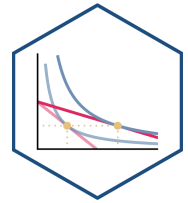
Firm's *Long Run* Supply Decisions

Firm Decisions in the Long Run I



- $AC(q)_{min}$ at a market price of $6
  - Firm earns **"normal" economic profits** (of 0)
- At any market price *below* $6.00, firm earns **losses**
  - Short Run: firm shuts down if $p < AVC(q)$
- At any market price *above* $6.00, firm earns **"supernormal" profits** (>0)

Firm Supply Decisions in the Short Run vs. Long Run



- **Short run**: firms that shut down ($q^* = 0$) stuck in market, incur fixed costs $\pi = -f$

Firm Supply Decisions in the Short Run vs. Long Run

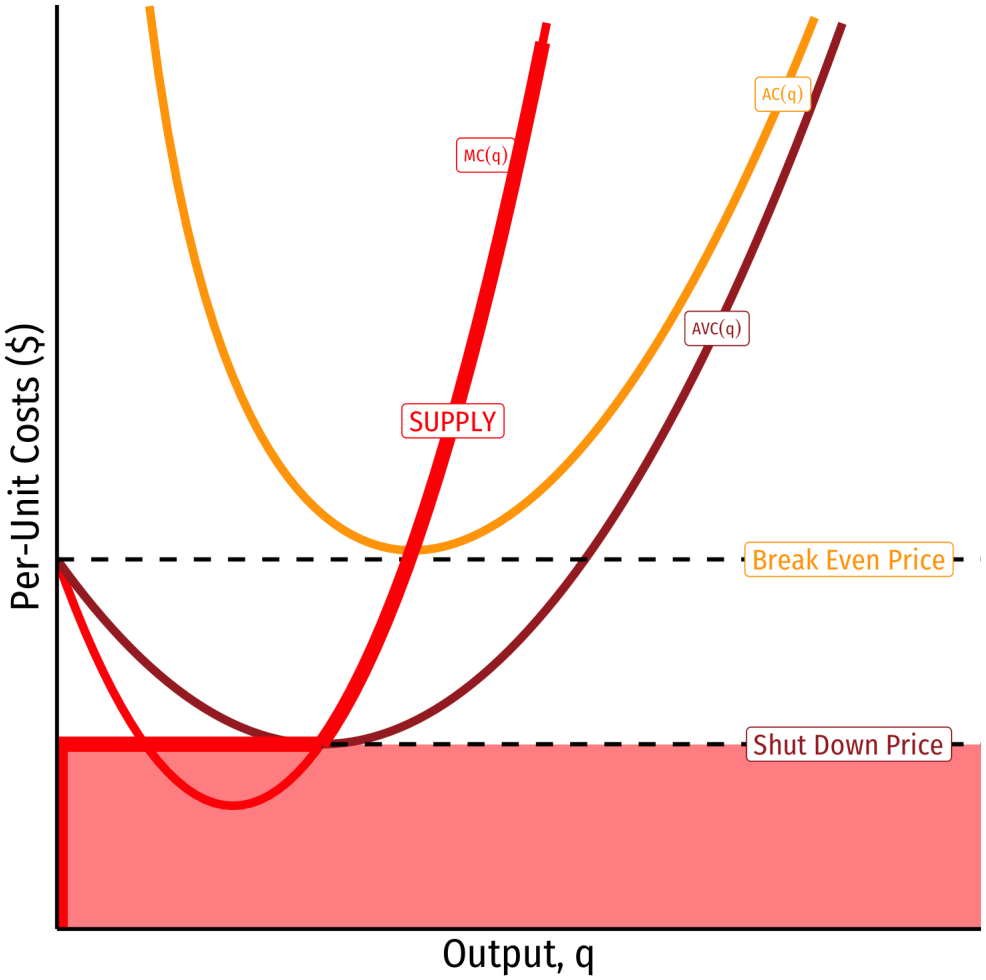
- **Short run**: firms that shut down ($q^* = 0$) stuck in market, incur fixed costs $\pi = -f$
- **Long run**: firms earning losses ($\pi < 0$) can **exit** the market and earn $\pi = 0$
    - No more fixed costs, firms can sell/abandon f at $q^* = 0$

Firm Supply Decisions in the Short Run vs. Long Run

- **Short run**: firms that shut down ($q^* = 0$) stuck in market, incur fixed costs $\pi = -f$
- **Long run**: firms earning losses ($\pi < 0$) can **exit** the market and earn $\pi = 0$
    - No more fixed costs, firms can sell/abandon f at $q^* = 0$
- Entrepreneurs not *currently* in market can **enter** and produce, if entry would earn them $\pi > 0$

Firm Supply Decisions in the Short Run vs. Long Run

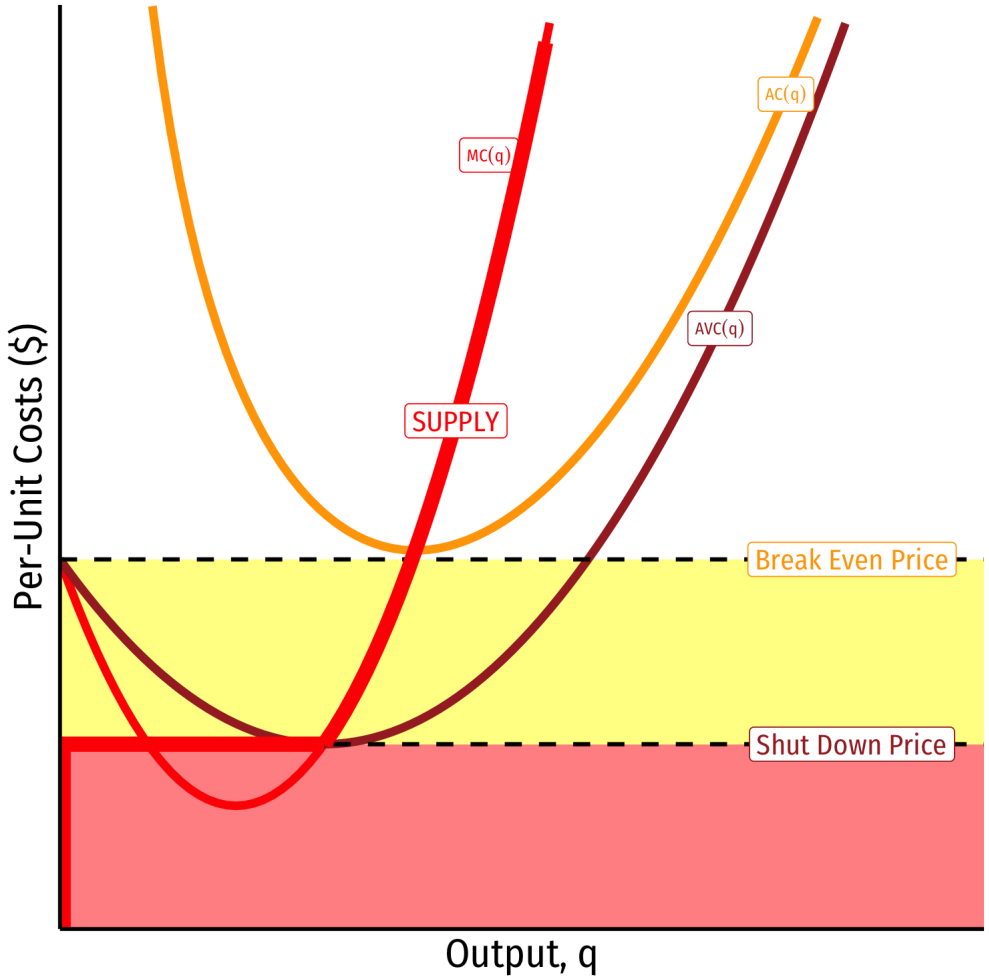
Firm's Long Run Supply: Visualizing



When $p < AVC$

- Profits are *negative*
- **Short run**: **shut down** production
  - Firm loses more π by producing than by not producing
- **Long run**: firms in industry **exit** the industry
  - *No* new firms will *enter* this industry

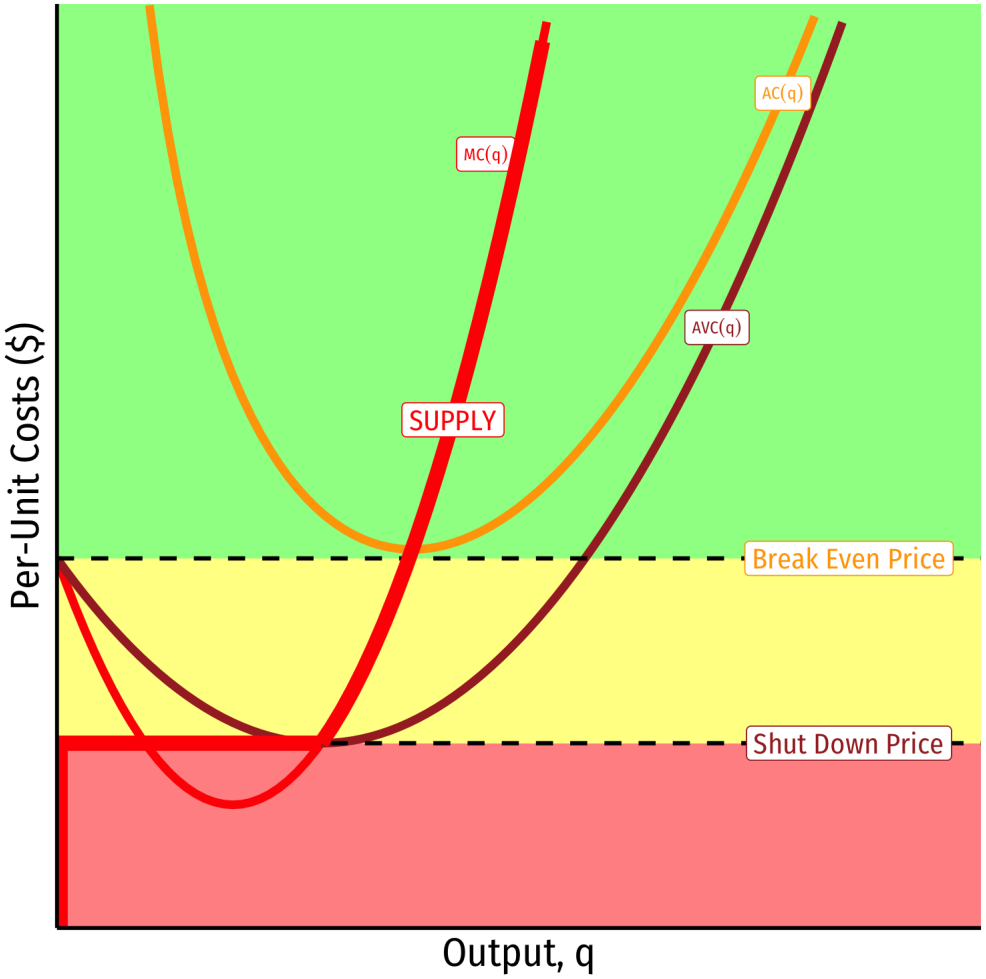
Firm's Long Run Supply: Visualizing



When $AVC < p < AC$

- Profits are *negative*
- **Short run**: **continue** production
  - Firm loses *less* π by producing than by *not* producing
- **Long run**: firms in industry **exit** the industry
  - *No* new firms will *enter* this industry

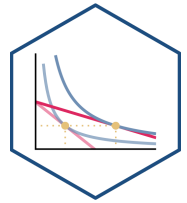
Firm's Long Run Supply: Visualizing



When $AC < p$

- Profits are *positive*
- **Short run**: **continue** production
  - Firm earning profits
- **Long run**: firms in industry **stay** in industry
  - **New** firms will **enter** this industry

Production Rules, Updated:

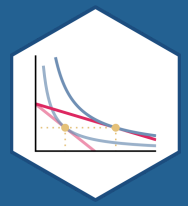


1. Choose q^* such that $MR(q) = MC(q)$

2. Profit $\pi = q[p - AC(q)]$

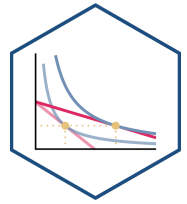
3. Shut down in *short run* if $p < AVC(q)$

4. Exit in *long run* if $p < AC(q)$



Market Entry and Exit

Exit, Entry, and Long Run Industry Equilibrium I



- Now we must combine **optimizing** *individual* firms with *market-wide* adjustment to **equilibrium**
- Since $\pi = [p - AC(q)]q$, in the **long run**, profit-seeking firms will:

Exit, Entry, and Long Run Industry Equilibrium I

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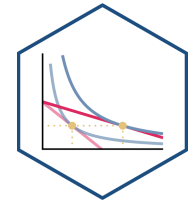
- Since $\pi = [p - AC(q)]q$, in the **long run**, profit-seeking firms will:
    - **Enter** markets where $p > AC(q)$

Exit, Entry, and Long Run Industry Equilibrium I

- Now we must combine **optimizing** *individual* firms with *market-wide* adjustment to **equilibrium**
- Since $\pi = [p - AC(q)]q$, in the **long run**, profit-seeking firms will:
  - **Enter** markets where $p > AC(q)$
  - **Exit** markets where $p < AC(q)$

Exit, Entry, and Long Run Industry Equilibrium II



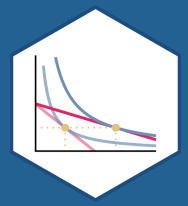
- **Long-run equilibrium**: entry and exit ceases when $p = AC(q)$ for all firms, implying **normal economic profits** of $\pi = 0$

Exit, Entry, and Long Run Industry Equilibrium II

- **Long-run equilibrium**: entry and exit ceases when $p = AC(q)$ for all firms, implying **normal economic profits** of $\pi = 0$

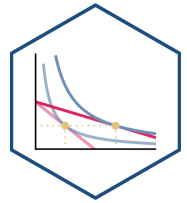
- **Zero Economic Profits Theorem**: **long run economic profits for all firms in a *competitive* industry are 0**

- Firms must earn an *accounting* profit to stay in business



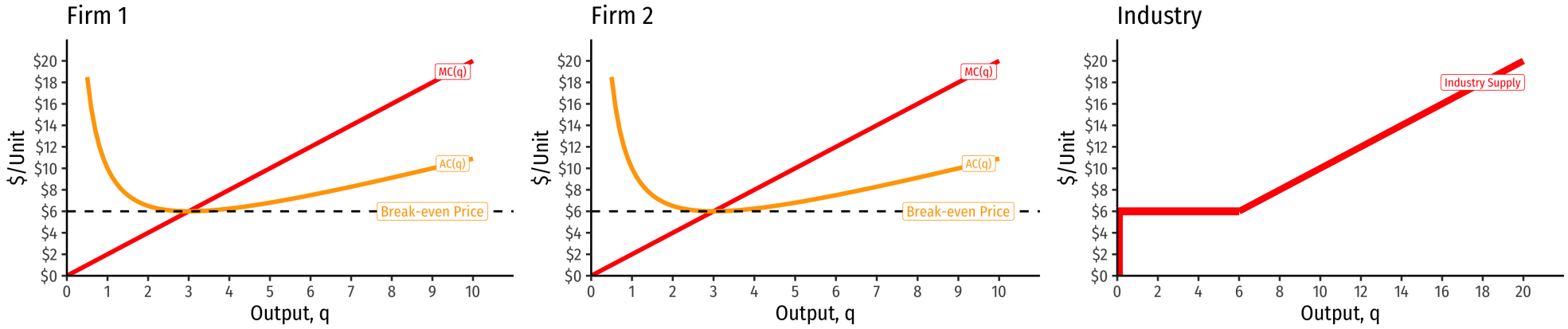
Deriving the Industry Supply Curve

The Industry Supply Curve



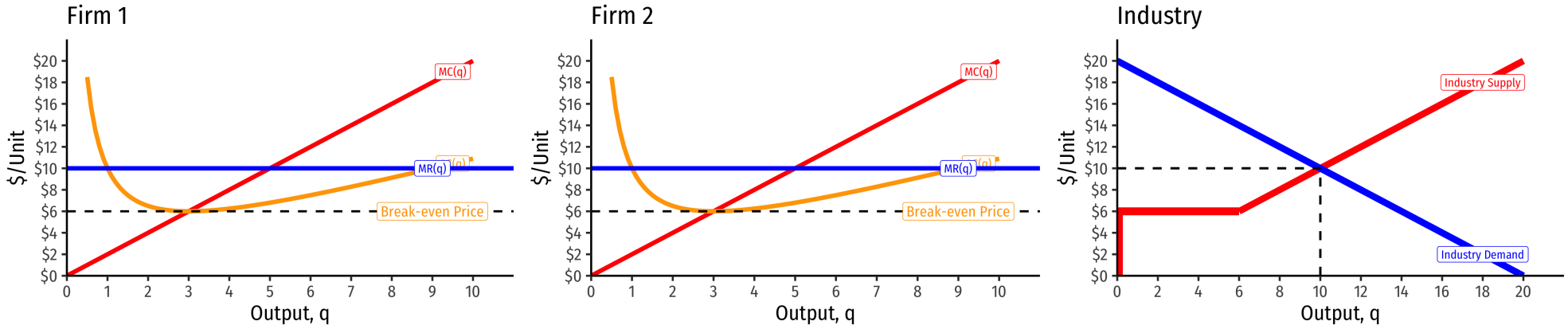
- **Industry supply curve**: horizontal sum of all individual firms' supply curves
  - recall: ($MC(q)$ curve above AVC_{min}) (shut down price)
- To keep it simple on the following slides:
  - assume no fixed costs, so $AC(q) = AVC(q)$
  - then industry supply curve is sum of individual $MC(q)$ curves above $AC(q)_{min}$

Industry Supply Curves (Identical Firms)



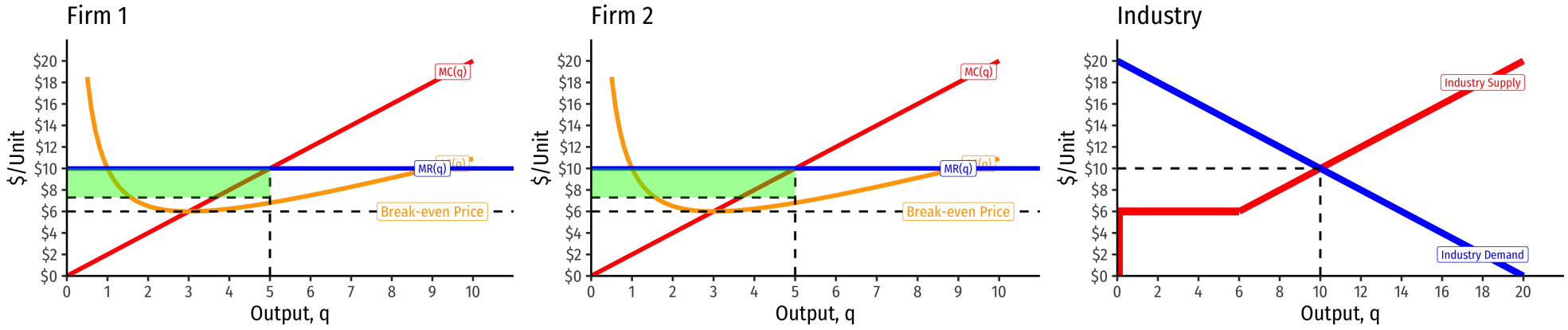
- Industry supply curve is the horizontal sum of all individual firm's supply curves
  - Which are each firm's marginal cost curve above its breakeven price

Industry Supply Curves (Identical Firms)



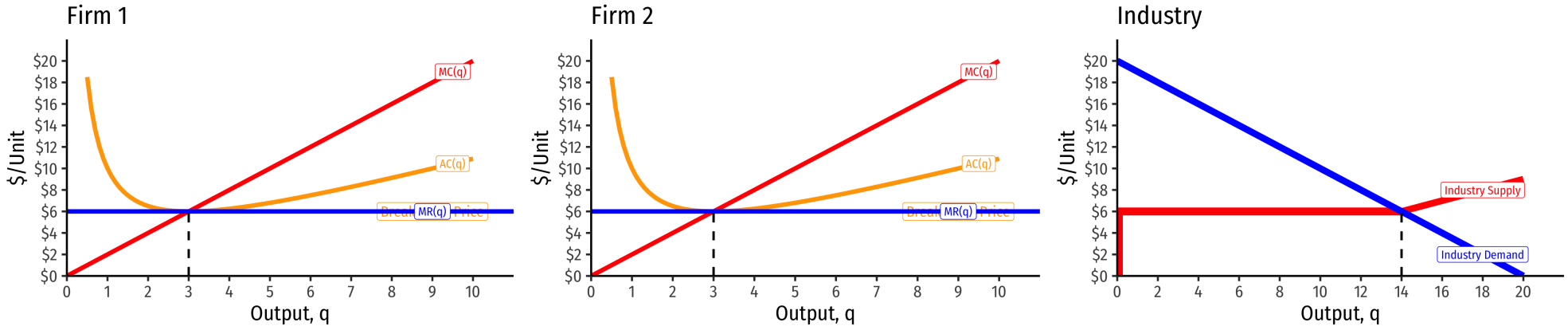
- Industry demand curve (where equal to supply) sets market price, demand for firms

Industry Supply Curves (Identical Firms)

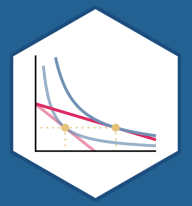


- **Short Run**: each firm is earning **profits** $p > AC(q)$
- **Long run**: induces entry by firm 3, firm 4, $\cdots$, firm n
- **Long run industry equilibrium**:

Industry Supply Curves (Identical Firms)



- **Short Run**: each firm is earning **profits** $p > AC(q)$
- **Long run**: induces entry by firm 3, firm 4, $\cdots$, firm n
- **Long run industry equilibrium**: $p = AC(q)_{min}, \pi = 0$ at $p =$ \$6; supply becomes more **elastic**



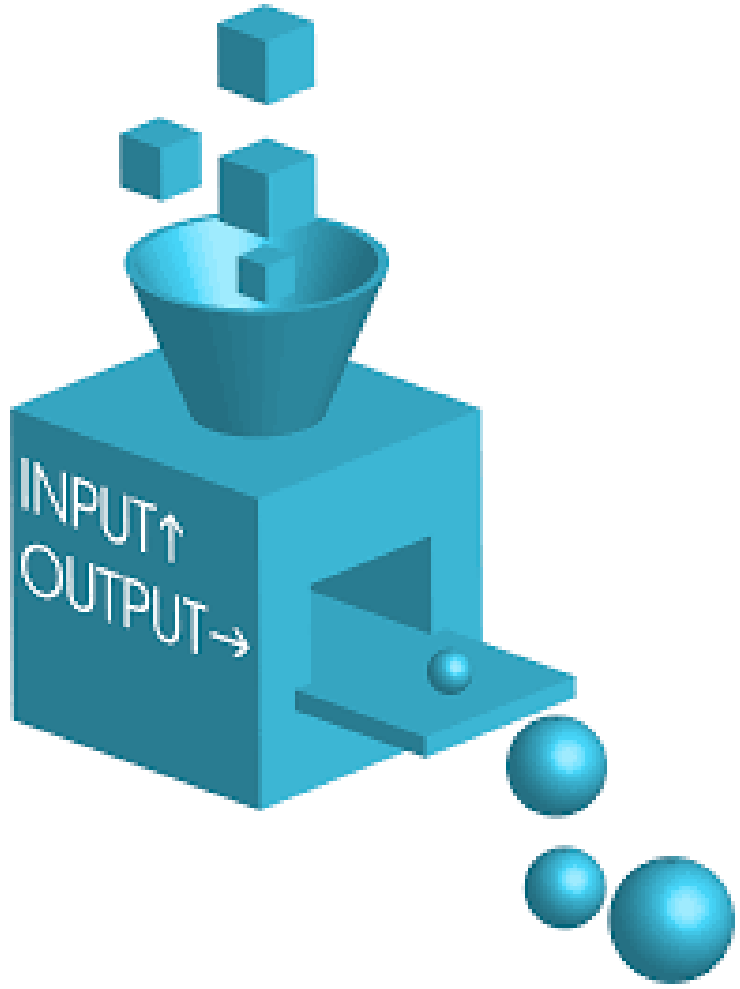
Zero Economic Profits & Economic Rents

Back to Zero Economic Profits

- Recall, we've essentially defined a **firm** as a completely **replicable recipe** (**production function**) of resources

$$q = f(L, K)$$

- **"Any idiot"** can enter market, buy required (L, K) at prices (w, r), produce q^* at market price p and earn the market rate of π



Back to Zero Economic Profits

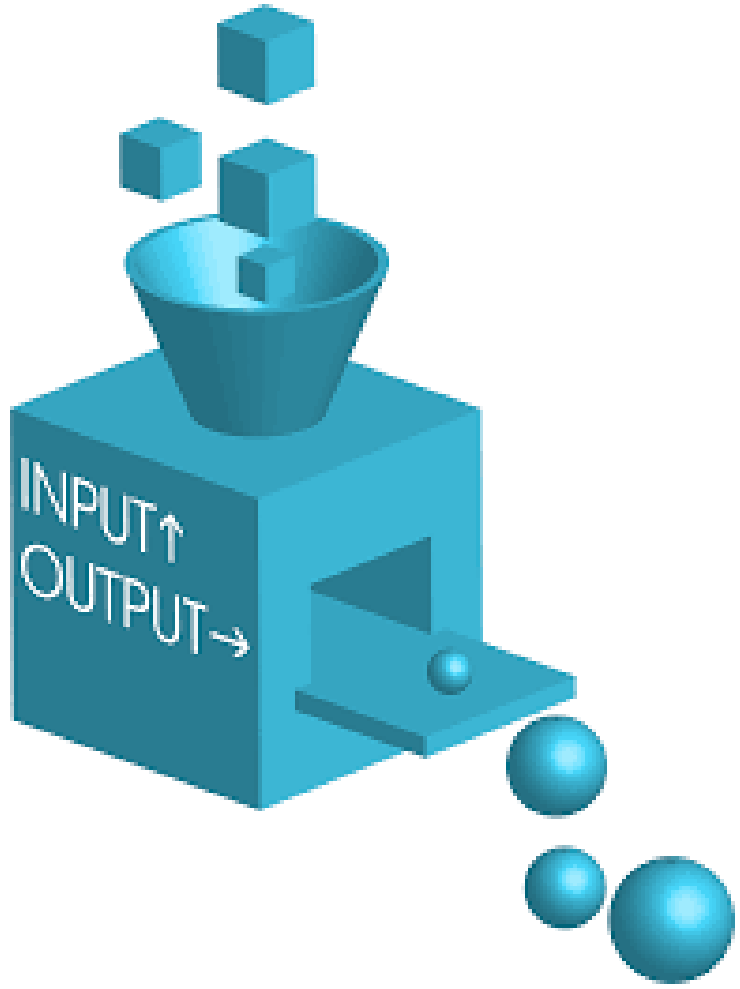
- Zero long run economic profit ≠ industry *disappears*, just **stops growing**
- Less attractive to entrepreneurs & start ups to enter than other, more profitable industries
- These are **mature** industries (again, often commodities), the backbone of the economy, just not *sexy*!

Back to Zero Economic Profits

- All factors being paid their market price
    - i.e. their **opportunity cost** — what they could earn *elsewhere* in economy
- Firms earning **normal market rate of return**
    - No *excess* rewards (economic profits) to attract *new* resources into the industry, nor *losses* to bleed resources out of industry

Back to Zero Economic Profits

- But we've so far been imagining a market where every firm is *identical*, just a recipe "any idiot" can copy
- What about if firms have *different* technologies or costs?

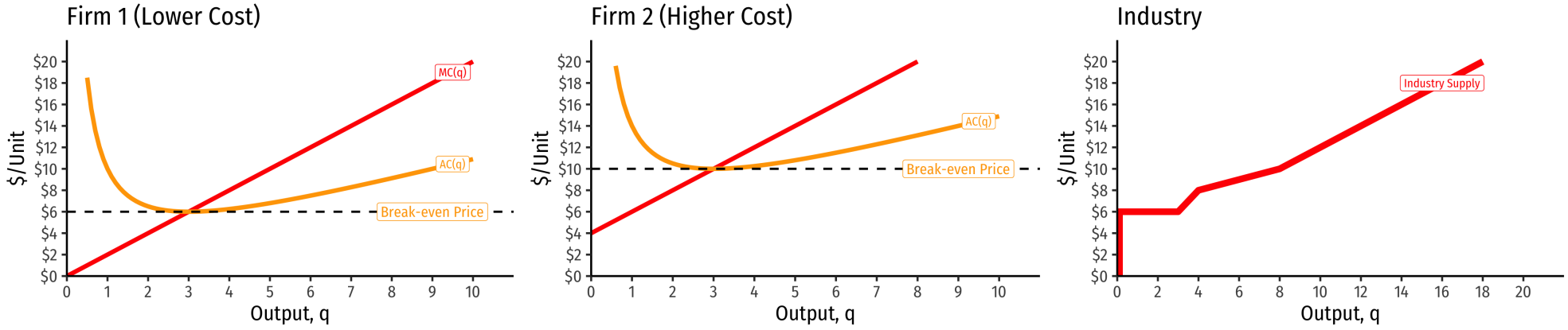


Industry Supply Curves (*Different* Firms) I

- Firms have **different technologies/costs** due to relative differences in:
  - Managerial talent
  - Worker talent
  - Location
  - First-mover advantage
  - Technological secrets/IP
  - License/permit access
  - Political connections
  - Lobbying

- Let's derive **industry supply curve** again, and see how this may affect profits

Industry Supply Curves (*Different* Firms) II



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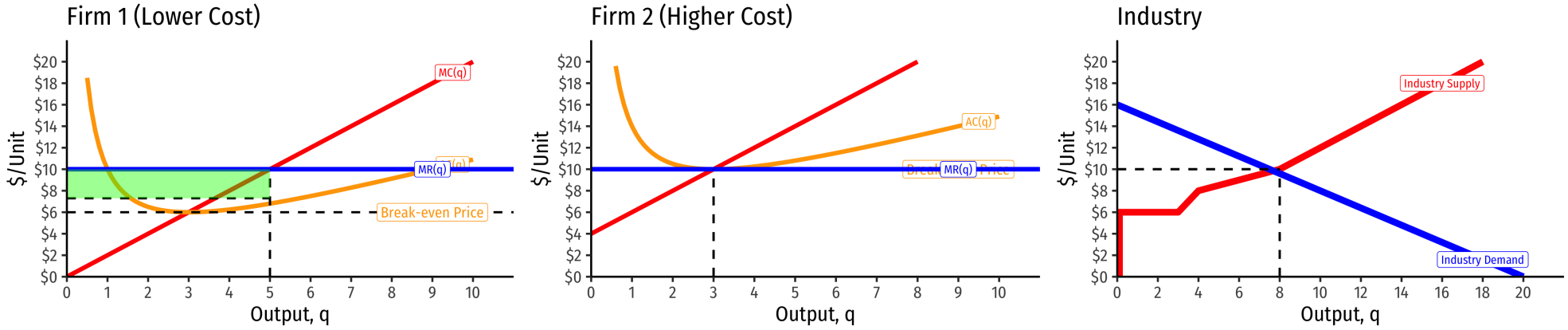
Industry Supply Curves (*Different* Firms) II



- Industry demand curve (where equal to supply) sets market price, demand for firms
- **Long run industry equilibrium**: $p = AC(q)_{min}, \pi = 0$ for **marginal (highest cost) firm** (Firm 2)
- Firm 1 (lower cost) appears to be earning **profits**...(we'll come back to this)

Economic Rents and Zero Economic Profits I

- With differences between firms, **long-run equilibrium $p = AC(q)_{min}$ of the *marginal (highest-cost)* firm**
  - If $p > AC(q)$ for that firm, would induce *more* entry into industry!

Economic Rents and Zero Economic Profits I

- **"Inframarginal" (lower-cost)** firms earn **economic rents**
  - returns **higher** than their opportunity cost (what is needed to bring them into *this* industry)
- Economic rents arise from **relative differences** between firms
  - actually using *different* inputs!

Economic Rents and Zero Economic Profits III

- **Some factors are relatively scarce *in the whole economy***
    - (talent, location, secrets, IP, licenses, being first, political favoritism)
- **Inframarginal** firms that use these scarce factors gain an *advantage*
- It would seem these firms earn **profits** (like Firm 1), as they have lower costs…
    - …But what will happen to the prices for their scarce factors over time?

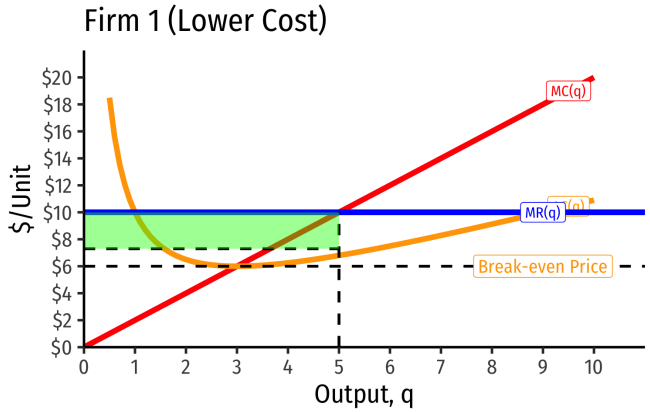
Economic Rents and Zero Economic Profits IV

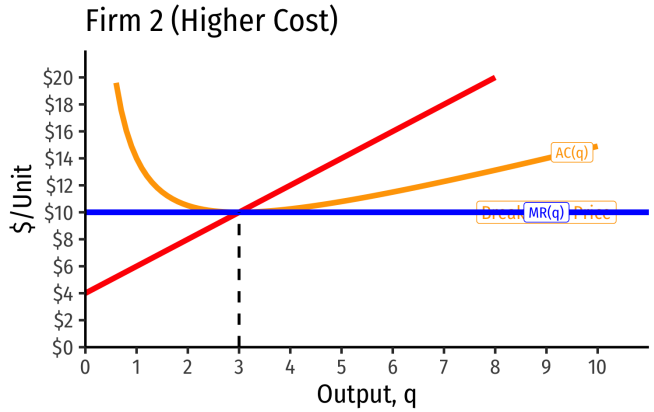
- Rival firms willing to pay for rent-generating factor to gain advantage
- Competition over acquiring the scarce factors **pushes up their prices**
    - i.e. costs to firms of using the factor!
- **Rents are included in the opportunity cost (price) for inputs over long run**
    - Must pay a factor enough to keep it *out of other uses*

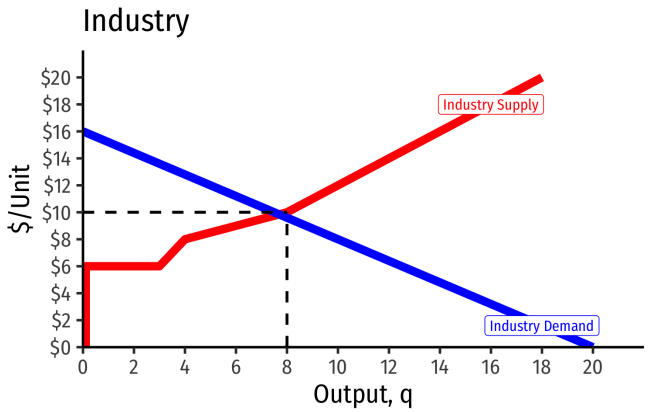
Economic Rents and Zero Economic Profits V

- **Economic rents $\neq$ economic profits!**
  - Rents actually *reduce* profits!
- Firm does not earn the rents, they raise firm's costs and squeeze out profits!
- **Owners of scarce factors** (workers, landowners, inventors, etc) **earn the rents as higher income for their services** (wages, rents, interest, royalties, etc).

Economic Rents Reduce Profits

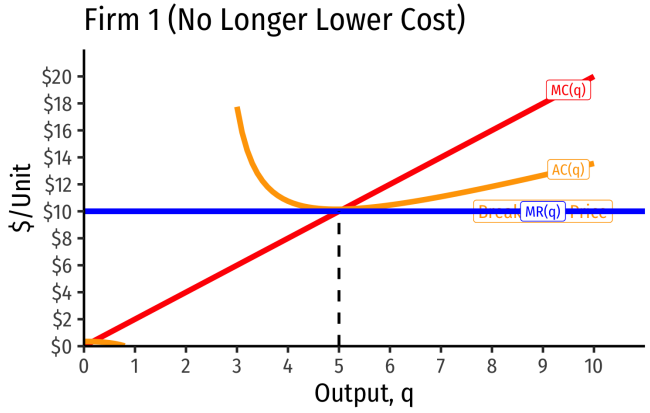


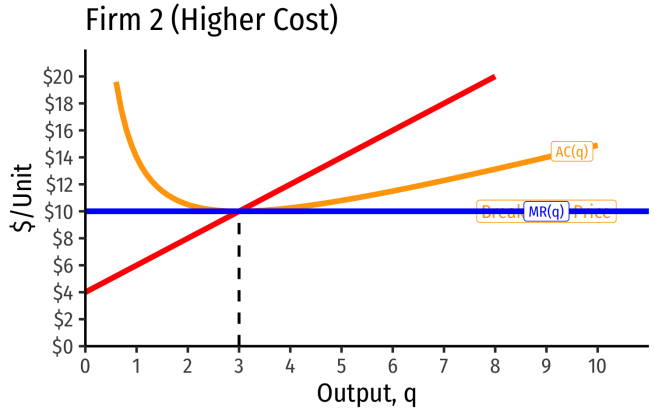


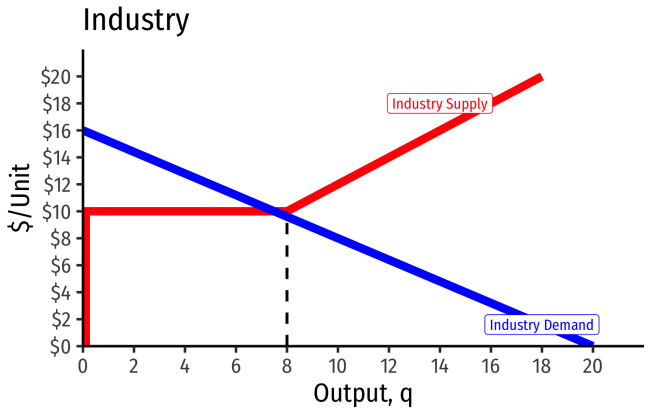


- **Short Run**: firm that possesses scarce rent-generating factors has lower costs, perhaps short-run profits

Economic Rents Reduce Profits



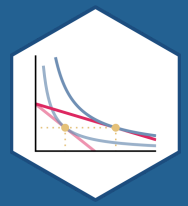




- **Short Run**: firm that possesses scarce rent-generating factors has lower costs, perhaps short-run profits
- **Long run**: competition over those factors pushes up their prices, **raising costs to firm**, until its profits go to zero as well
    - Increase in *fixed* cost (scarce factor), raising AC(q), which now includes rents (more info here)

Recall: Accounting vs. Economic Point of View

- Recall **"economic point of view"**:
- Producing *your* product pulls scarce resources *out of other productive uses* in the economy
- **Profits attract resources**: pulled out of other (less valuable) uses
- **Losses repel resources**: pulled away to other (more valuable) uses
- **Zero profits keep resources where they are**
    - Implies **society is using resources optimally**



Supply Functions

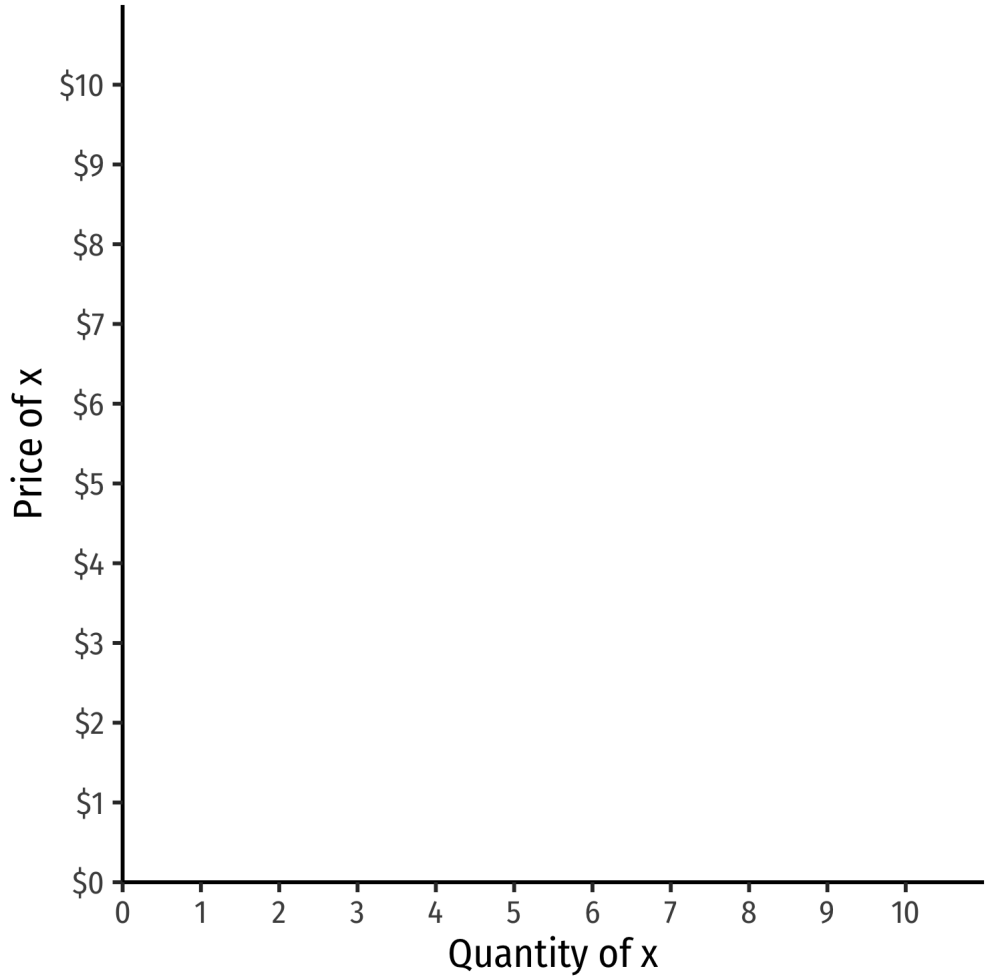
Supply Function

- **Supply function** relates quantity to price

Example:

$$q = 2p - 4$$

- Not graphable (wrong axes)!



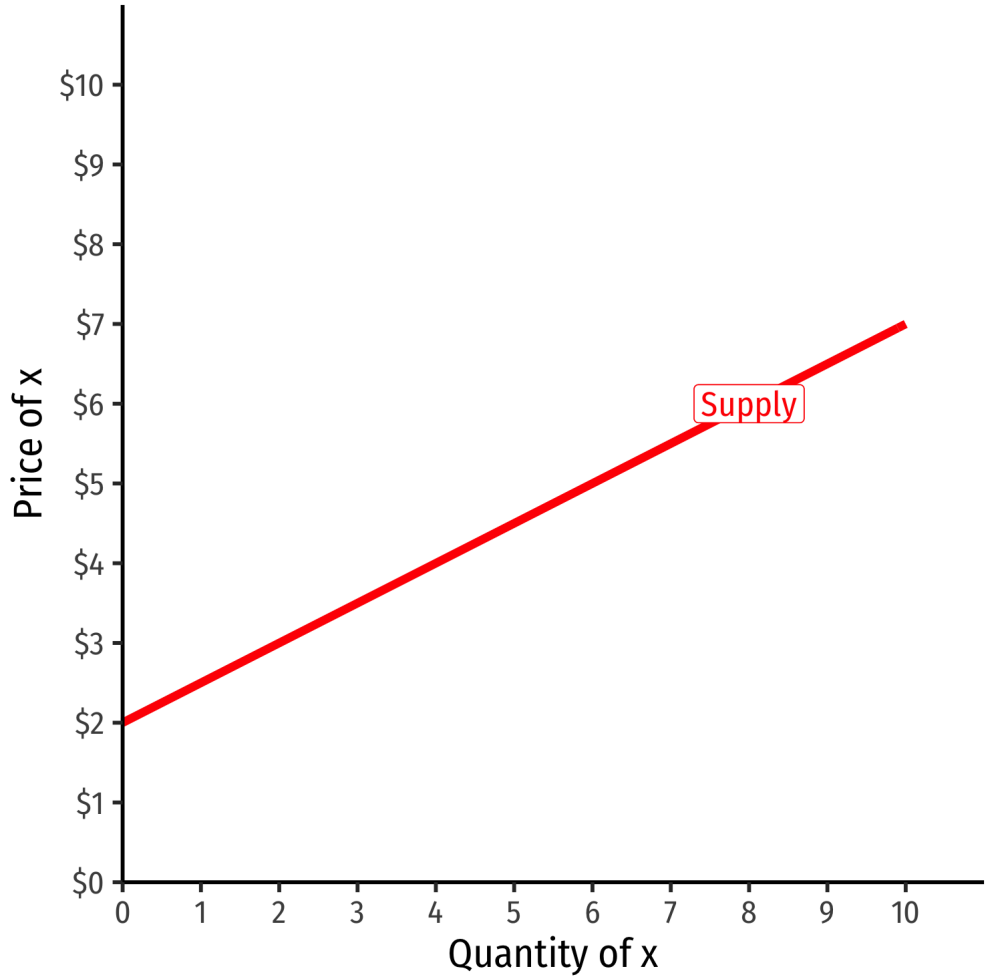
Inverse Supply Function

- ***Inverse* supply function** relates price to quantity
  - Take supply function, solve for p

Example:

$$p = 2 + 0.5q$$

- Graphable (price on vertical axis)!

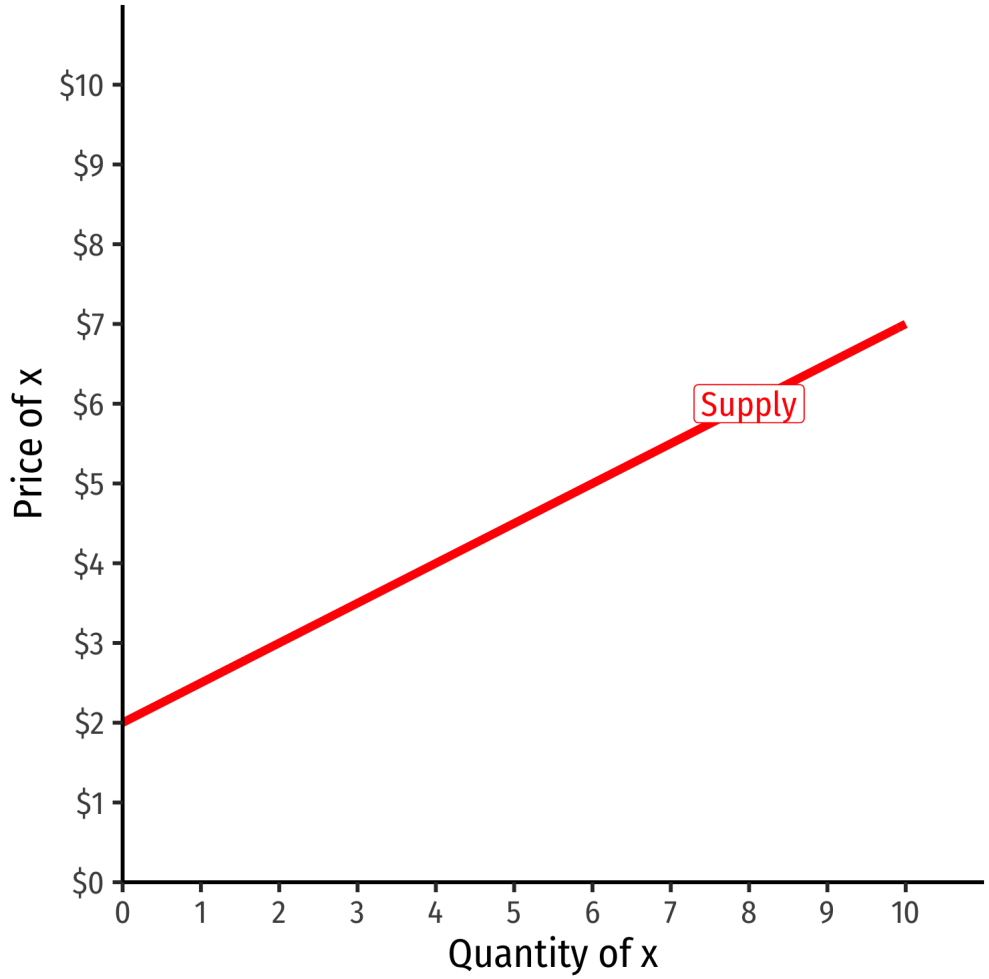


Inverse Supply Function

Example:

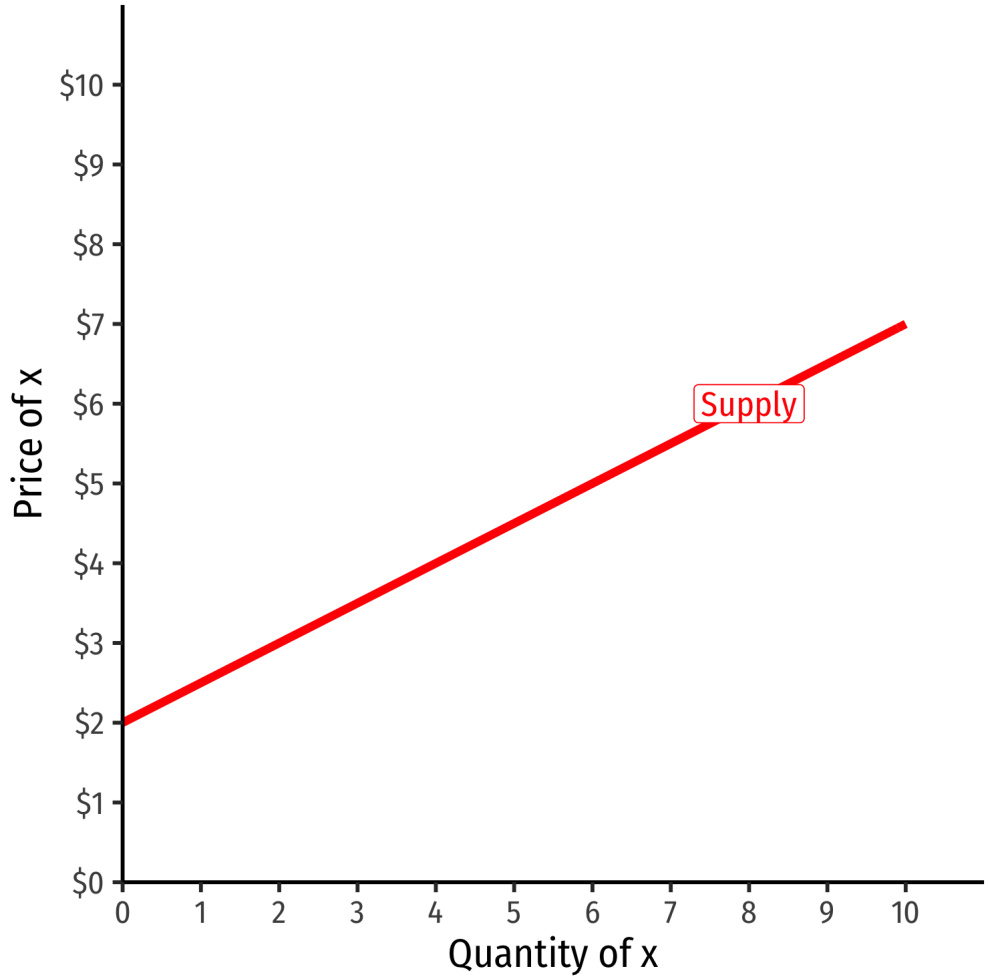
$$p = 2 + 0.5q$$

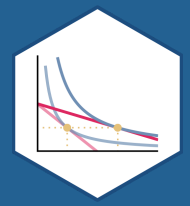
- Slope: 0.5
- Vertical intercept called the **"Choke price"**: price where $q_S = 0$ ($2), just low enough to discourage *any* sales



Inverse Supply Function

- Read two ways:
- Horizontally: at any given price, how many units firm wants to sell
- Vertically: at any given quantity, the **minimum willingness to accept (WTA)** for that quantity





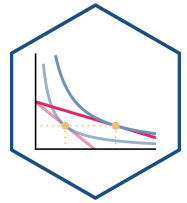
Price Elasiticity of Supply

Price Elasticity of Supply

- **Price elasticity of supply** measures *how much* (in %) quantity supplied changes in response to a (1%) change in price

$$\epsilon_{q_S,p} = \frac{\%\Delta q_S}{\%\Delta p}$$

Price Elasticity of Supply: Elastic vs. Inelastic



$$\epsilon_{q_S,p} = \frac{\%\Delta q_S}{\%\Delta p}$$

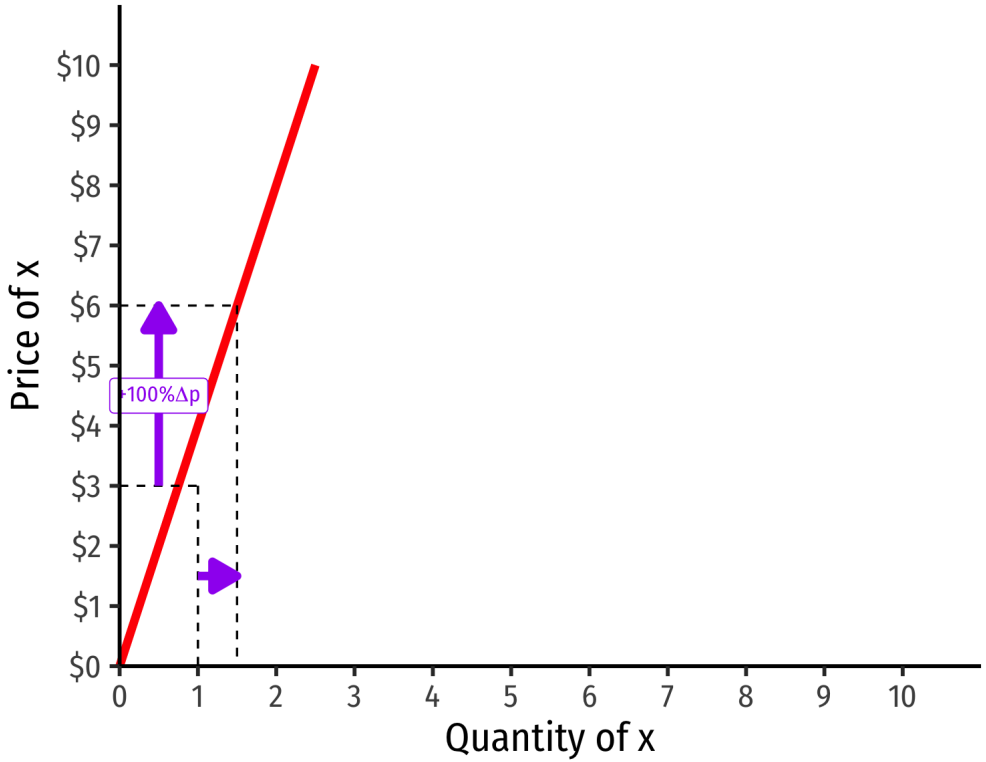
	"Elastic"	"Unit Elastic"	"Inelastic"
Intuitively:	**Large** response	Proportionate response	**Little** response
Mathematically:	$\epsilon_{q_s,p} > 1$	$\epsilon_{q_s,p} = 1$	$\epsilon_{q_s,p} < 1$
	Numerator > Denominator	Numerator = Denominator	Numerator < Denominator
A 1% p-change	**More than 1%** change in q_S	**1% change** in q_S	**Less than 1%** change in q_S

Compare to price elasticity of demand

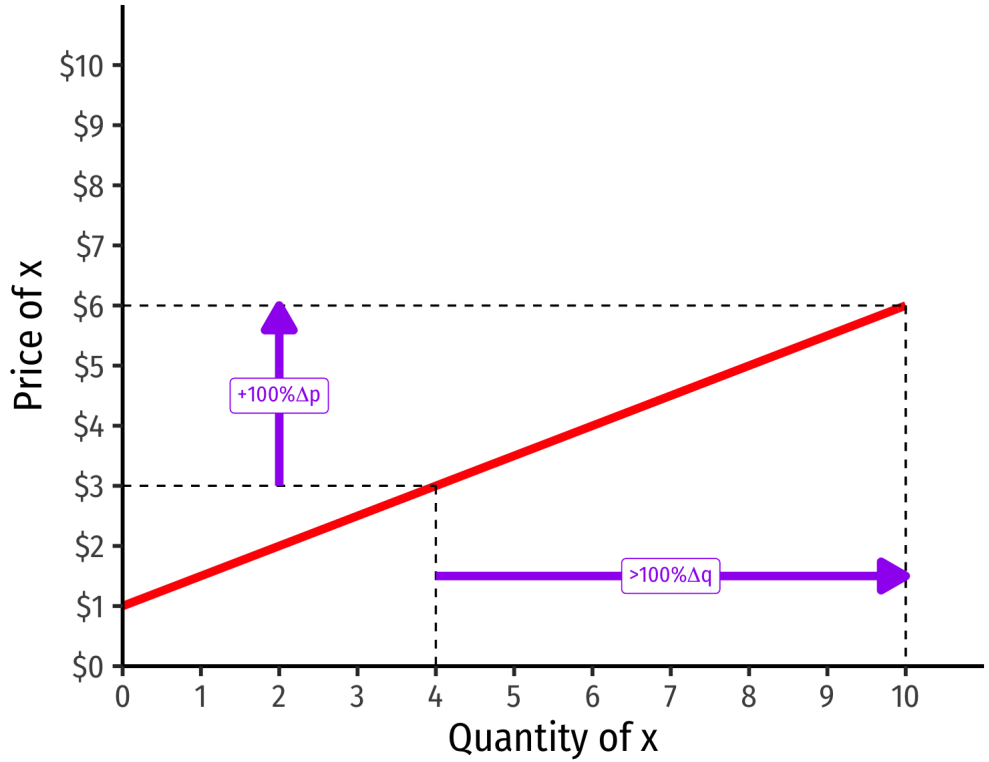
Visualizing Price Elasticity of Supply

An identical 100% price increase on an:

"Inelastic" Supply Curve



"Elastic" Supply Curve



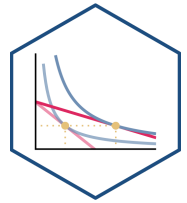
Price Elasticity of Supply Formula

$$\epsilon_{q,p} = \frac{1}{\text{slope}} \times \frac{\text{p}}{\text{q}}$$

- First term is the inverse of the slope of the inverse supply curve (that we graph)!
- To find the elasticity at any point, we need 3 things:

1. The price
2. The associated quantity supplied
3. The slope of the (inverse) supply curve

Example



Example: The supply of bicycle rentals in a small town is given by:

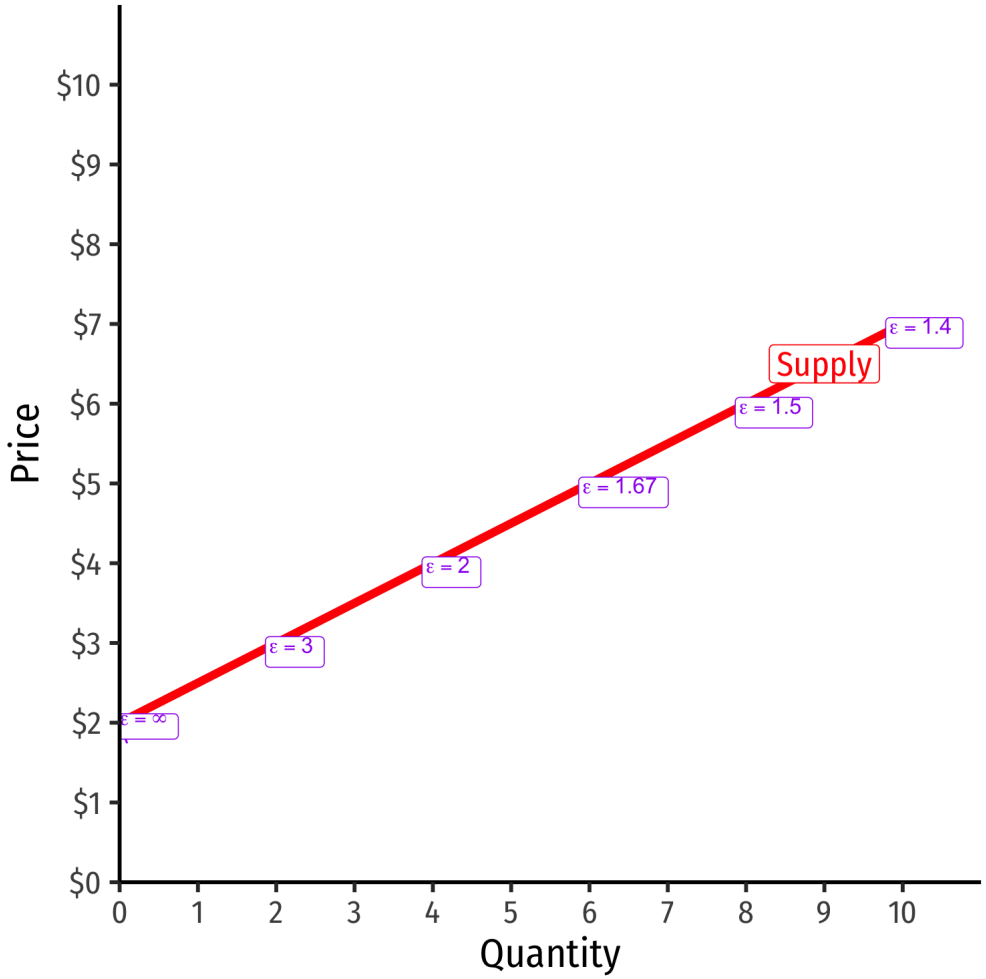
$$q_S = 10p - 200$$

1. Find the inverse supply function.

2. What is the price elasticity of supply at a price of $25.00?

3. What is the price elasticity of supply at a price of $50.00?

Price Elasticity of Supply Changes Along the Curve



$$\epsilon_{q,p} = \frac{\mathbf{1}}{\mathbf{slope}} \times \frac{\mathbf{p}}{\mathbf{q}}$$

- Elasticity ≠ slope (but they are related)!
- Elasticity changes along the supply curve
- Often gets *less* elastic as ↑ price (↑ quantity)
  - Harder to supply more

Determinants of Price Elasticity of Supply I

What determines how responsive your selling behavior is to a price change?

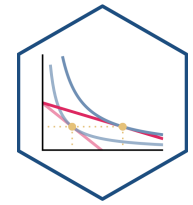
- **The faster (slower) costs increase with output**
  $\Longrightarrow$ less (more) elastic supply
  - Mining for natural resources vs. automated manufacturing
- Smaller (larger) **share of market for inputs**
  $\Longrightarrow$ more (less) elastic
  - Will your suppliers raise the price much if you buy more?
  - How much competition is there in your input markets?

Determinants of Price Elasticity of Supply II

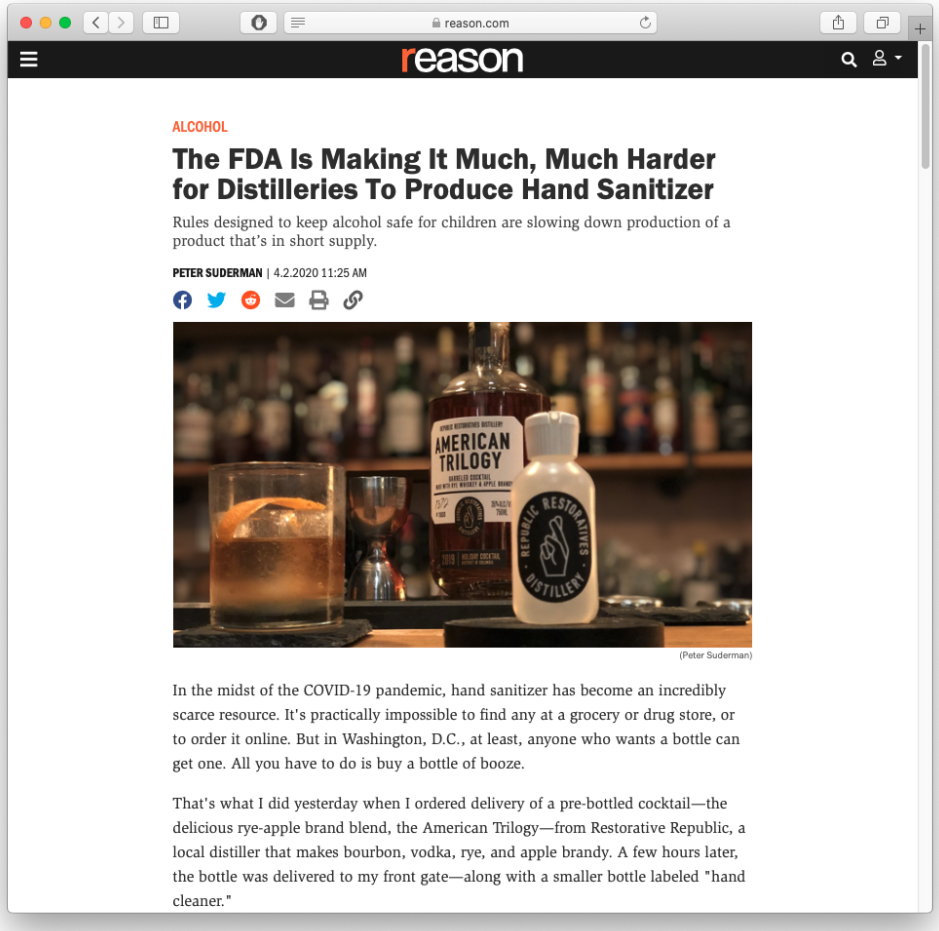
What determines how responsive your selling behavior is to a price change?

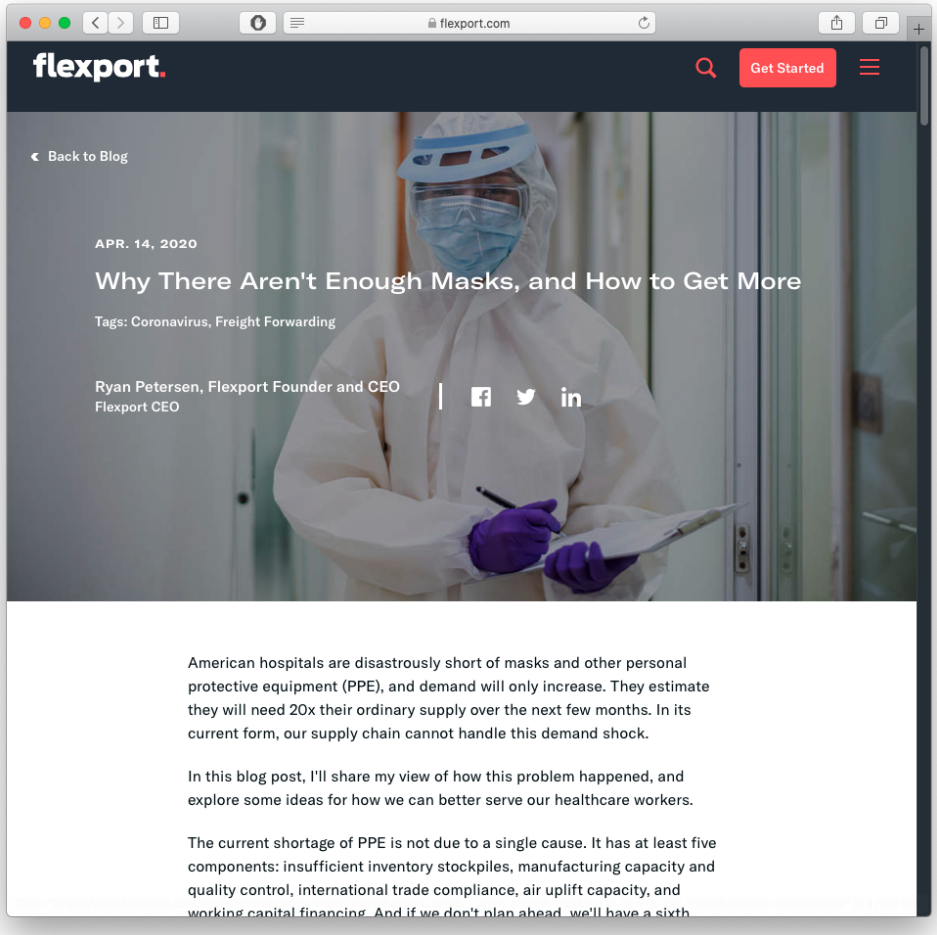
- More (less) **time to adjust** to price changes $\Longrightarrow$ more (less) elastic
  - Supply of oil today vs. oil in 10 years

Price Elasticity of Supply: Examples



Price Elasticity of Supply: Examples





Price Elasticity of Supply: Examples

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The Supply of Housing Has Become LESS Elastic

by Alex Tabarrok *August 15, 2019 at 7:27 am in* Economics

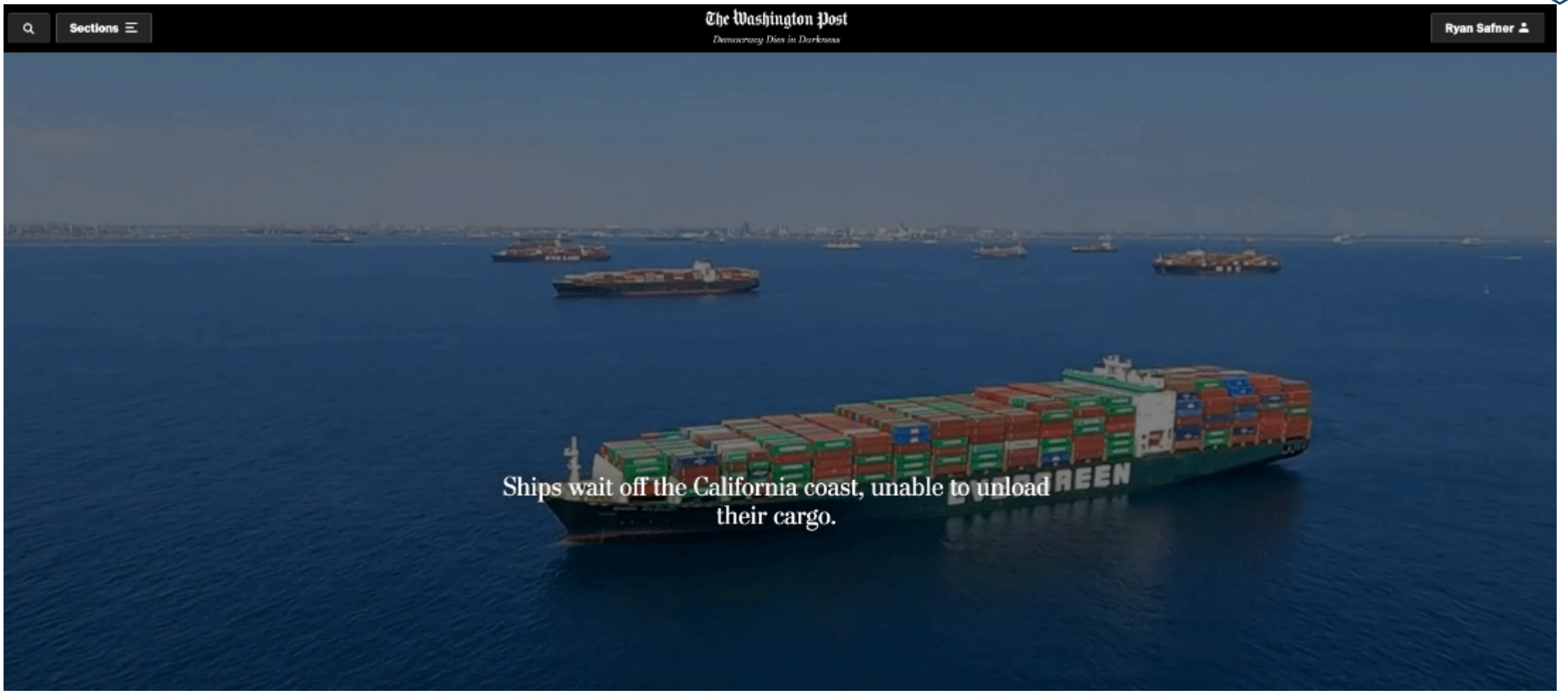
We are now well into another housing boom but as shown by Aasteveit, Albuquerque and Anundsen this boom is in some ways worse than the previous 1996-2006 boom because the supply response has been lower. The first figure, for example, shows that since the trough in 2012 house prices have risen a little bit *faster* in this boom than in the 1996-2006 boom and they have risen much faster relative to income (HPI is housing price index).

Notes: The figure tracks the evolution of real house prices at a quarterly frequency (left panel) and house prices scaled by income per capita (right panel) during the two house price booms. The zero on the x-axis marks the beginning of each housing boom. We scale the series to 100 at that point. We measure real house prices with the FHFA house price index, a weighted, repeat-sales index, deflated by CPI. The solid orange line refers to the boom between 1996q4 and 2006q4, while the blue line is from 2012q2 to 2017q2.

Over the same time, however, the number of new building permits and housing starts has been lower than in the previous boom (top two panels of figure 2 below). If prices have gone up as much as before but quantity has not, it follows that the elasticity of housing supply has fallen. Occasionally it's suggested that there is an "overhang" of housing from the previous boom but that is not true. If anything, as shown in the bottom left panel, there is a decline in the housing stock relative to population.

> "[T]he number of new building permits and housing starts has been lower than in the previous boom...if prices have gone up as much as before but quantity has not, it follows that the elasticity of supply has fallen."

Price Elasticity of Supply: Examples



Source: Washington Post (Oct 2, 2021): "Inside America's Broken Supply Chain"

Price Elasticity of Supply: Examples