2.6 — Long Run Industry Equilibrium

ECON 306 • Microeconomic Analysis • Fall 2022

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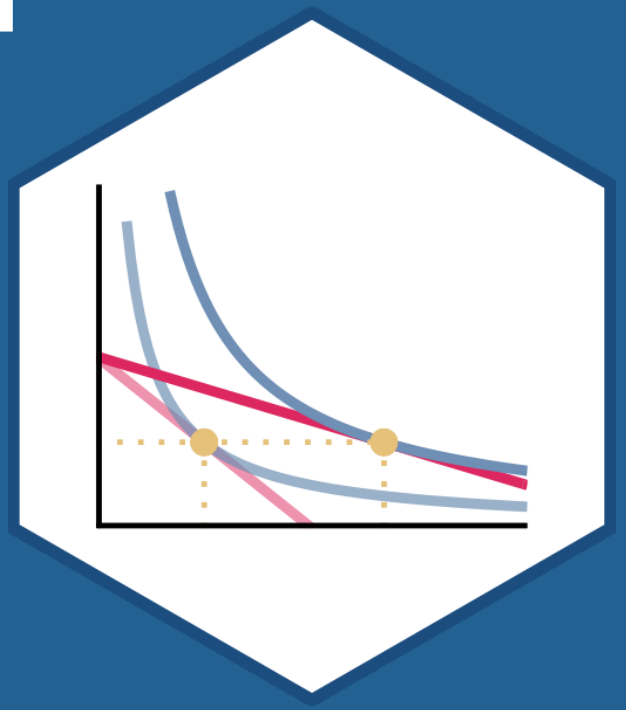
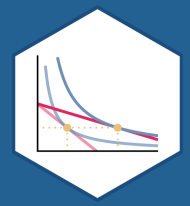
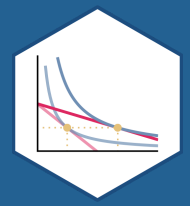


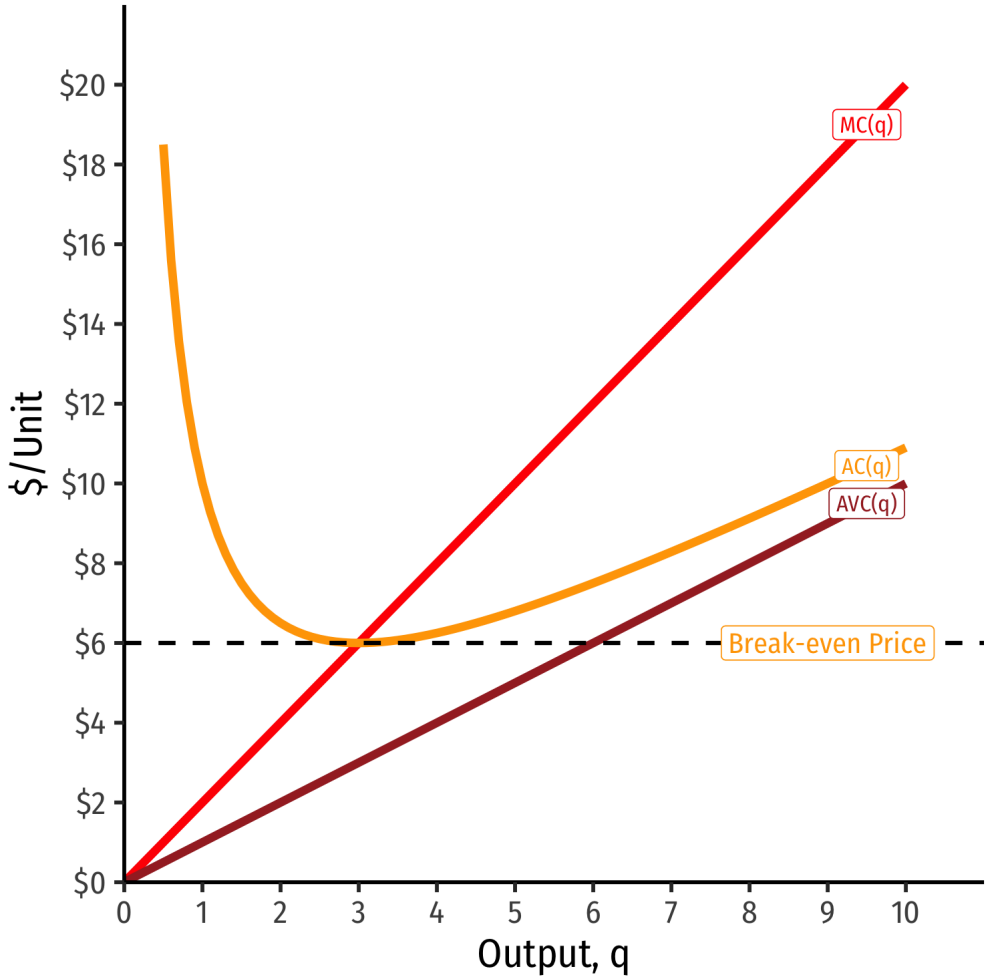
Outline





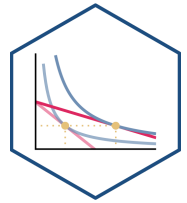
Firm's *Long Run* Supply Decisions

Firm Decisions in the Long Run I



- $AC(q)_{min}$ at a market price of $6
  - Firm earns **"normal" economic profits**
- 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

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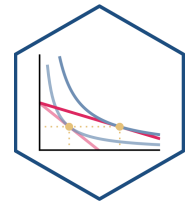
- **Long run**: firms earning losses $(\pi < 0)$ can **exit** the market and earn $\pi = 0$
    - No more fixed costs, firms can sell/abandon f at $q^* = 0$

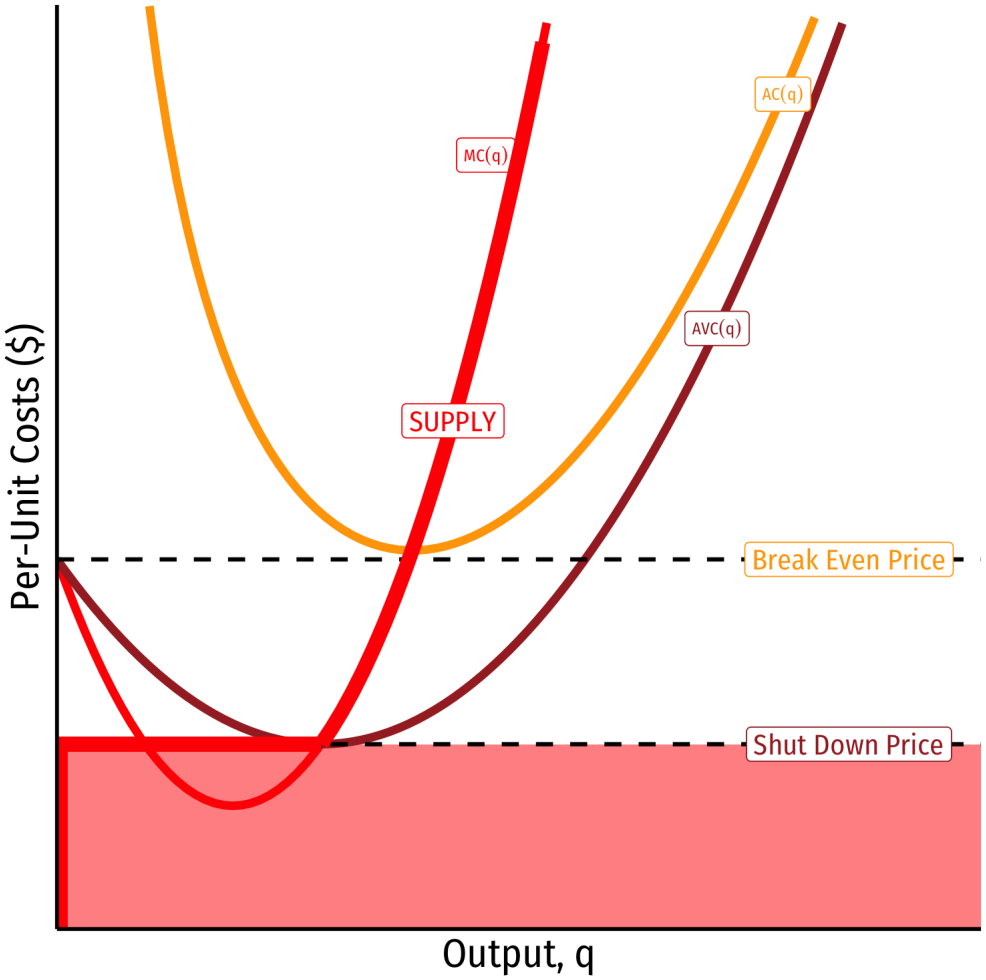
Firm Supply Decisions in the Short Run vs. Long Run



- **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

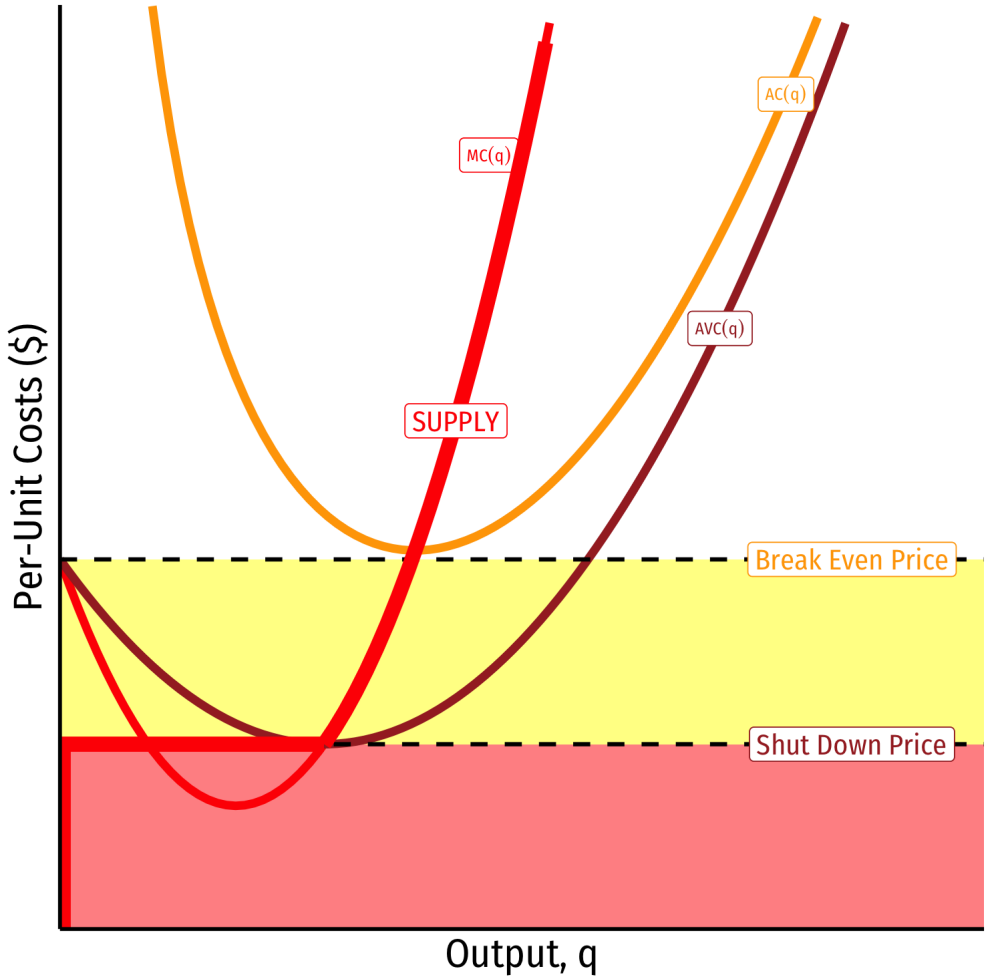
Firm's Long Run Supply: Visualizing



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
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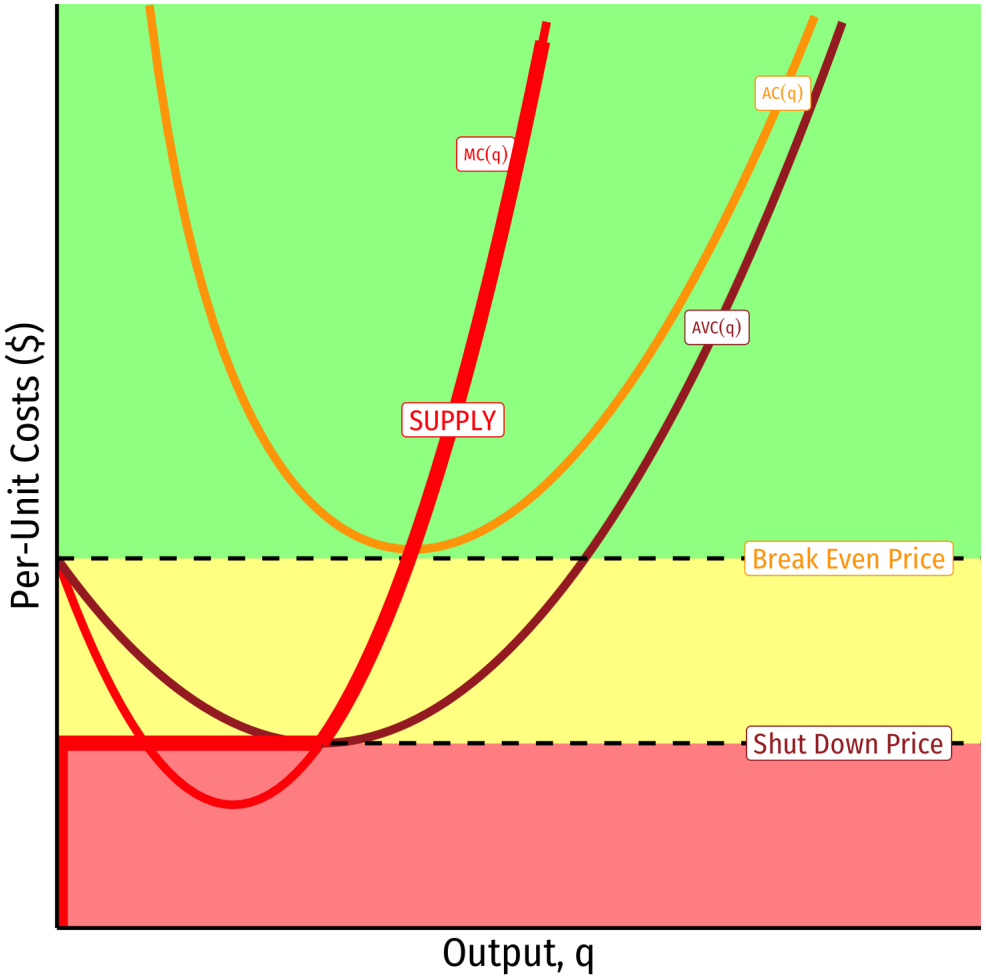
Firm's Long Run Supply: Visualizing



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

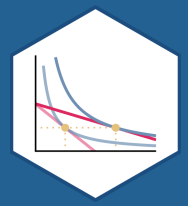
Production Rules, Updated:

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

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

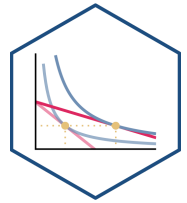
3. Shut down in *short run* if $p < AVC(q)$

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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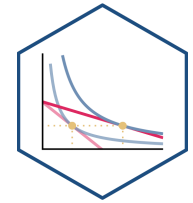
    - **Enter** markets where $p > AC(q)$

Exit, Entry, and Long Run Industry Equilibrium I

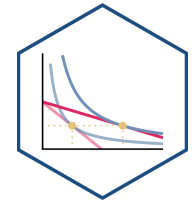
- Now we must combine **optimizing** *individual* firms with *market-wide* adjustment to **equilibrium**
- Since $\pi = [p - AC(q)]q$, in the **long run**, profit-seeking firms will:
  - **Enter** markets where $p > AC(q)$
  - **Exit** markets where $p < AC(q)$

Exit, Entry, and Long Run Industry Equilibrium II

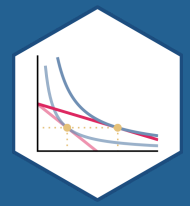


- **Long-run equilibrium**: entry and exit ceases when $p = AC(q)$ for all firms, implying **normal economic profits** of $\pi = 0$

Exit, Entry, and Long Run Industry Equilibrium II

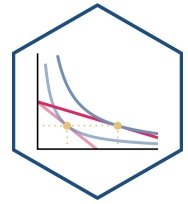


- **Long-run equilibrium**: entry and exit ceases when $p = AC(q)$ for all firms, implying **normal economic profits** of $\pi = 0$
- **Long run economic profits for all firms in a *competitive* industry are 0**
- Firms must earn an *accounting* profit to stay in business



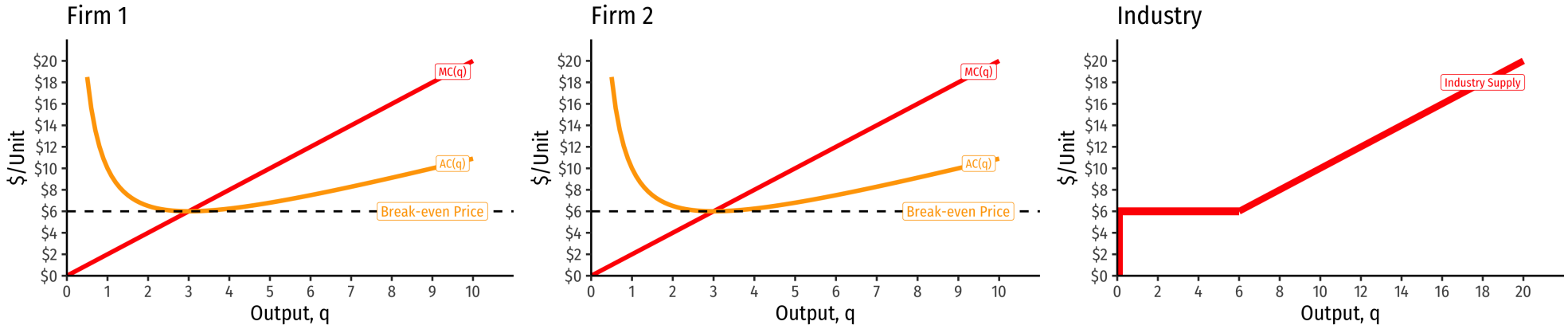
Deriving the Industry Supply Curve

The Industry Supply Curve



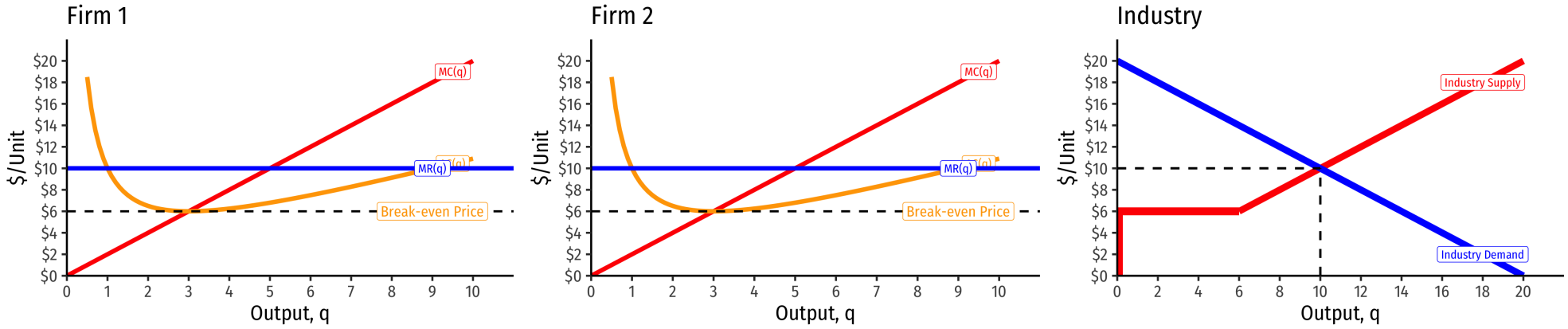
- **Industry supply curve**: horizontal sum of all individual firms' supply curves
  - recall: ($MC(q)$ curve above AVC_{min}) (shut down price)
- To keep it simple on the following slides:
  - assume no fixed costs, so $AC(q) = AVC(q)$
  - then industry supply curve is sum of individual $MC(q)$ curves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

Industry Supply Curves (Identical Firms)



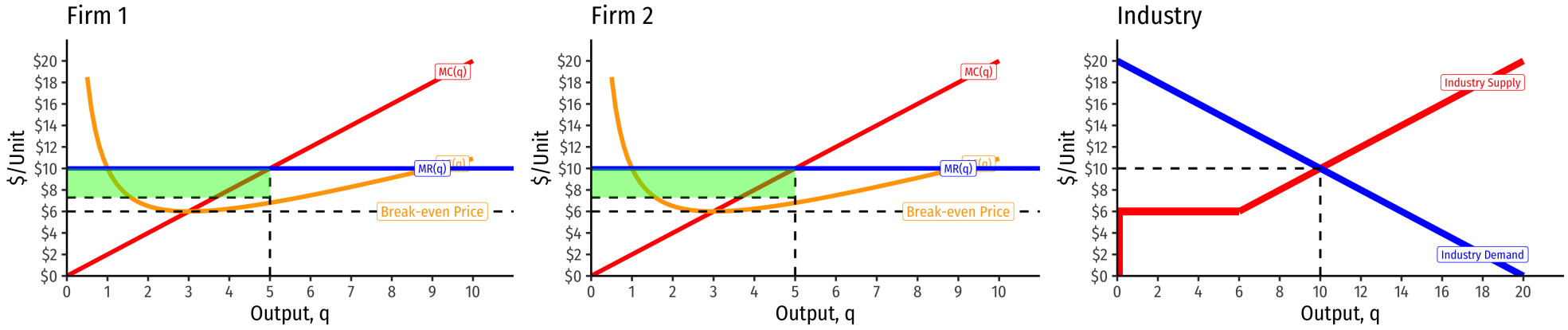
- Industry supply curve is the horizontal sum of all individual firm's supply curves
  - Which are each firm's marginal cost curve above its breakeven price

Industry Supply Curves (Identical Firms)



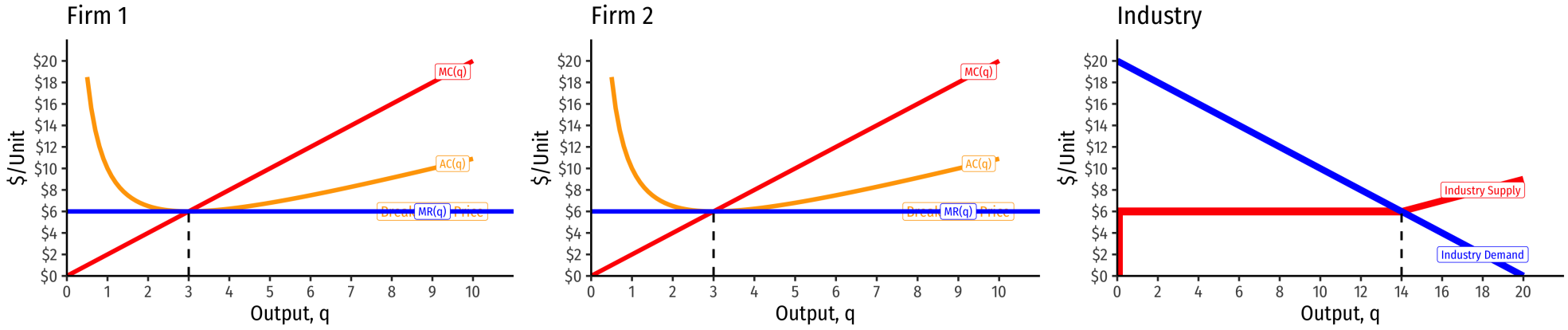
- Industry demand curve (where equal to supply) sets market price, demand for firms

Industry Supply Curves (Identical Firms)

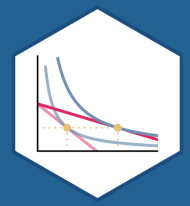


- **Short Run**: each firm is earning **profits** $p > AC(q)$
- **Long run**: induces entry by firm 3, firm 4, $\cdots$, firm n
- **Long run industry equilibrium**:

Industry Supply Curves (Identical Firms)

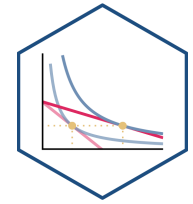


- **Short Run**: each firm is earning **profits** $p > AC(q)$
- **Long run**: induces entry by firm 3, firm 4, $\cdots$, firm n
- **Long run industry equilibrium**: $p = AC(q)_{min}$, $\pi = 0$ at $p =$ \$6; supply becomes more **elastic**



Economic Rents, Profits, & Competition

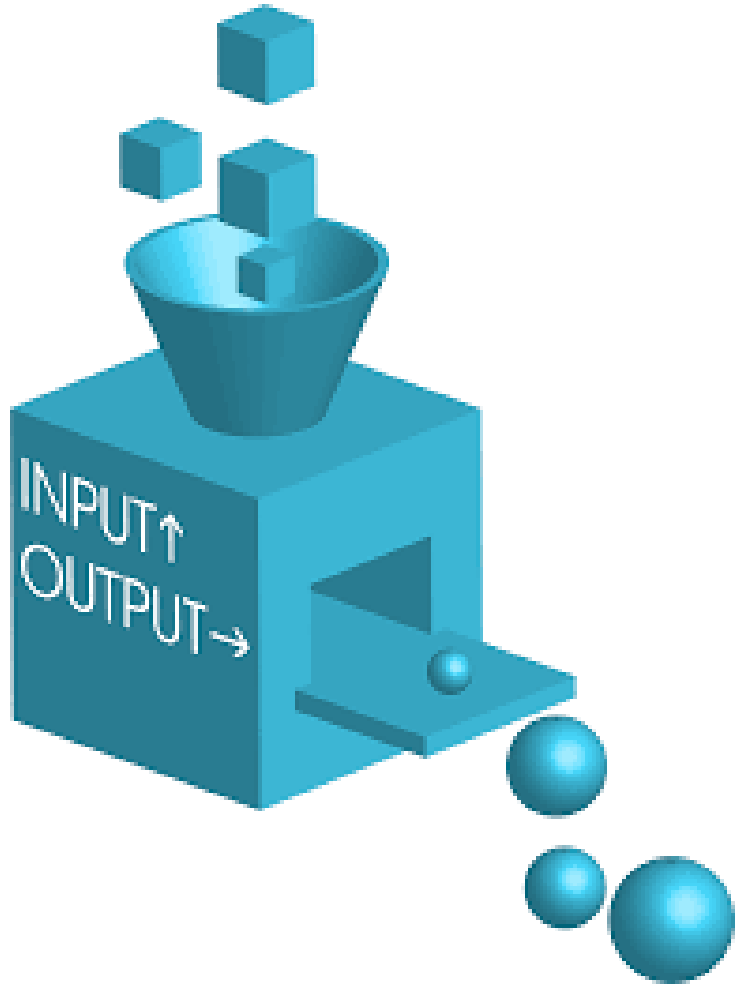
Back to Zero Economic Profits



- 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

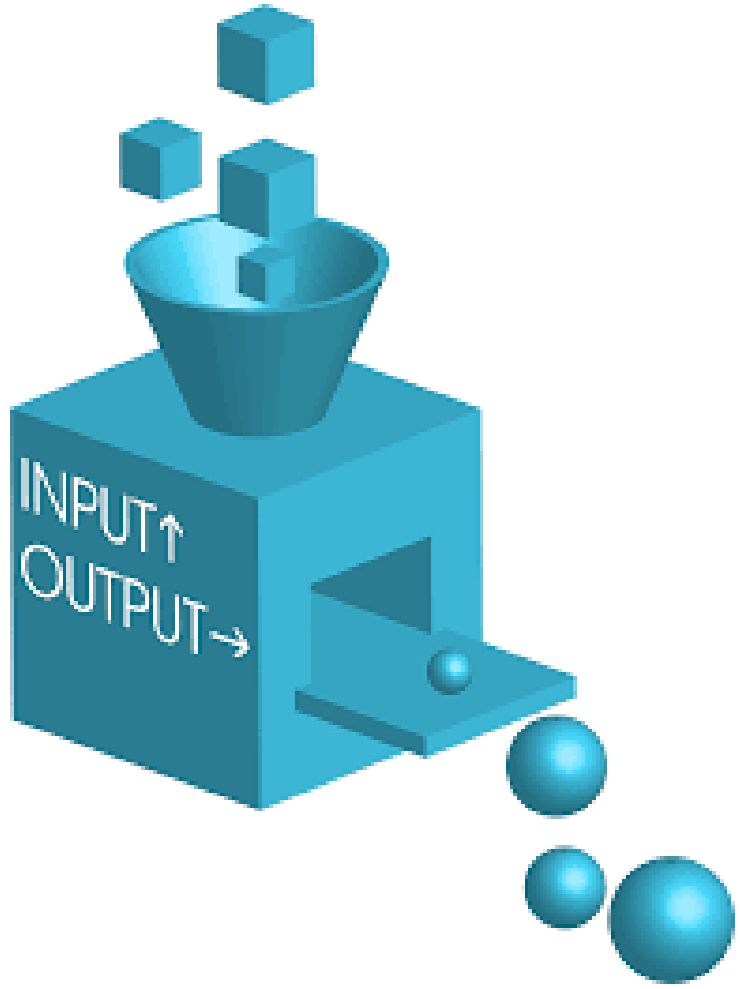
- Zero long run economic profit $\neq$ industry *disappears*, just **stops growing**
- Less attractive to entrepreneurs & start ups to enter than other, more profitable industries
- These are **mature** industries (again, often commodities), the backbone of the economy, just not *sexy*!

Back to Zero Economic Profits

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

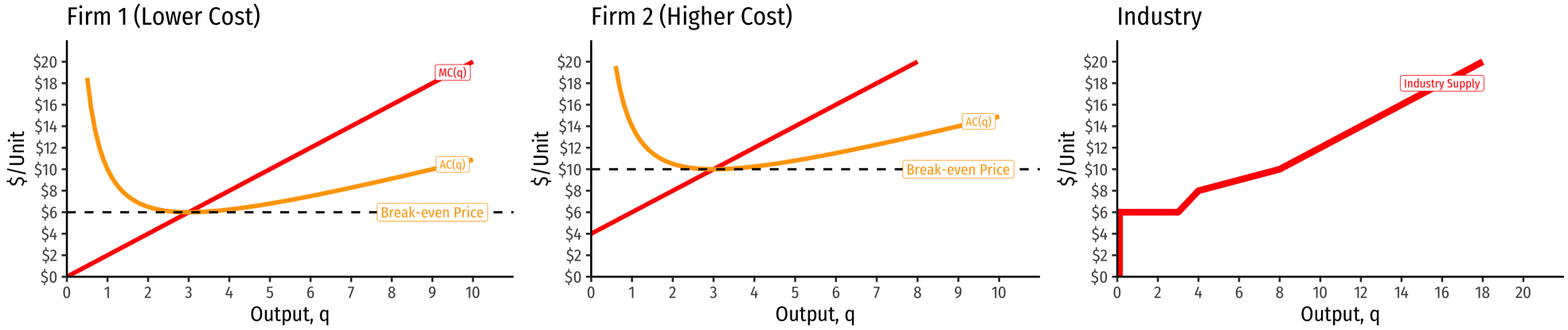


Industry Supply Curves (*Different* Firms) I

- Firms have **<u>different</u> 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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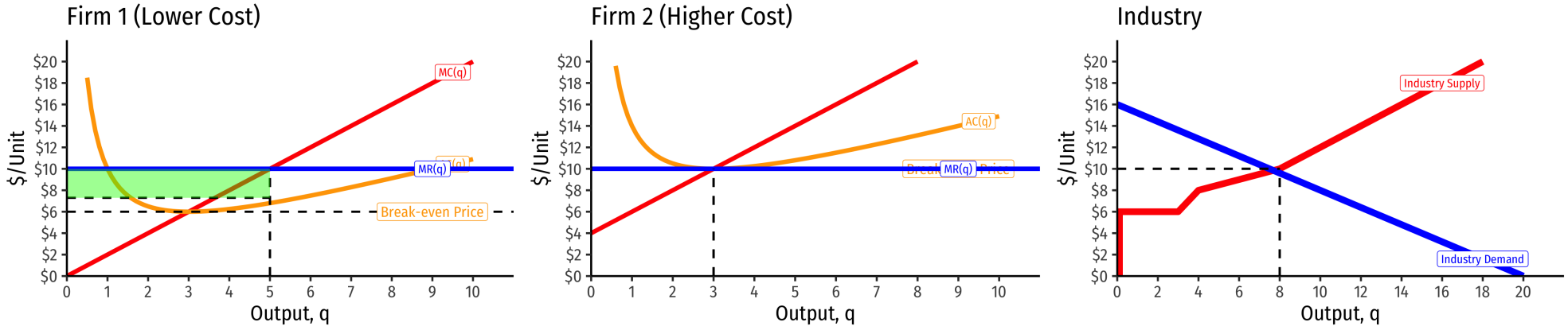


- Industry demand curve (where equal to supply) sets market price, demand for firms
- **Long run industry equilibrium**: $p = AC(q)_{min}, \pi = 0$ for **marginal (highest cost) firm** (Firm 2)
- Firm 1 (lower cost) appears to be earning **profits**...(we'll come back to this)

Economic Rents and Zero Economic Profits I

- **Long-run equilibrium $p = AC(q)_{min}$ of the *marginal (highest-cost)* firm**
- **The marginal firm earns normal economic profit (of zero)**
  - Otherwise, if $p > AC(q)$ for that firm, would induce *more* entry into industry!

Economic Rents and Zero Economic Profits I

- **"Inframarginal" (lower-cost)** firms are using resources that 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 resources

Economic Rent

- **Economic rent**: a return or payment for a resource above its normal market return (opportunity cost)
- Has no allocative effect on resources, entirely “inframarginal”
- A windfall return that resource owners get for free

Sources of Economic Rents

- **Some factors are relatively scarce *in the whole economy***
  - (talent, location, secrets, IP, licenses, being first, political favoritism)

Firms Using Resources with Economic Rents

- **Inframarginal** firms that employ these scarce factors gain a **short-run profits** from having lower costs/higher productivity
- ...But what will happen to the prices for their scarce factors over time?

Economic Rents Examples

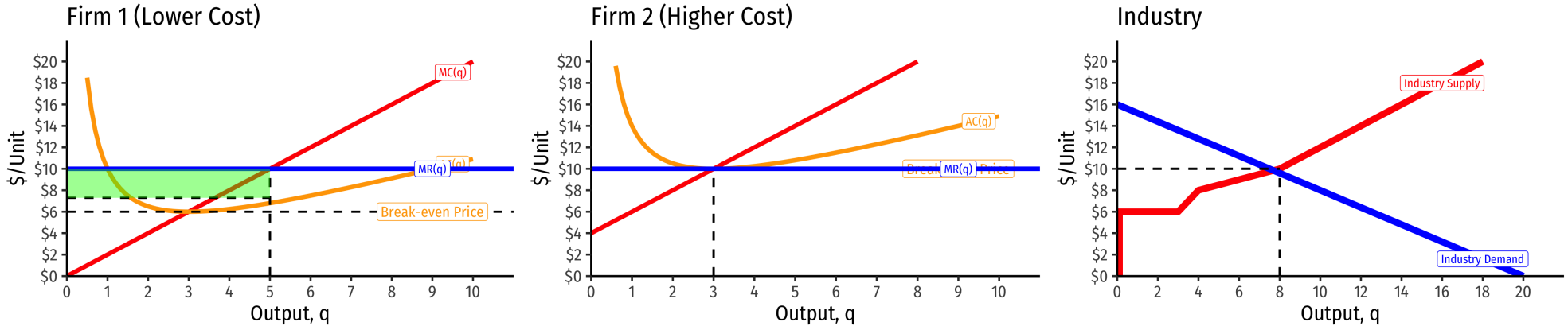
Economic Rents and Zero Economic Profits

- In a competitive market, over the long run, **profits are dissipated through competition**
    - Rival firms willing to pay for the scarce factor to gain an advantage
- Competition over acquiring the scarce factors **pushes up their prices**
    - i.e. higher 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

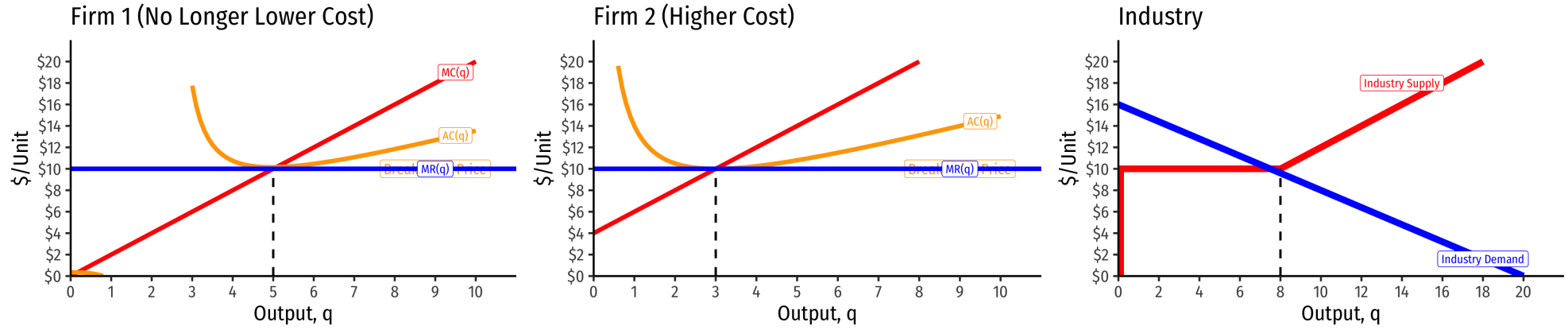
- From the firm's perspective, over the long-run, **rents are included in the price (opportunity cost) of the scarce factor**
    - Must pay a factor enough to keep it out of other uses
- Firm does not earn the rents, they raise firm's costs and squeeze profits to zero!

Economic Rents Reduce Firms' Profits Over Long Run



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

Economic Rents Reduce Firms' Profits Over Long Run



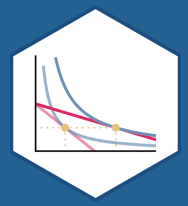
- **Short Run**: firm that possesses scarce rent-generating factors has lower costs, perhaps short-run profits
- **Long run**: competition over those factors pushes up their prices, **raising costs to firm**, until its profits go to zero as well
    - Increase in *fixed* cost (scarce factor), raising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

Economic Rents Go To Resource Owners

- **Owners of scarce factors** (workers, landowners, inventors, etc) **earn the rents as higher income for their services** (wages, land rent, interest, royalties, etc).
- Often induces competition to supply alternative factors, which *may* dissipate the rents (to zero)
    - More workers invest in becoming talented, try to create new inventions, build new land, etc.

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

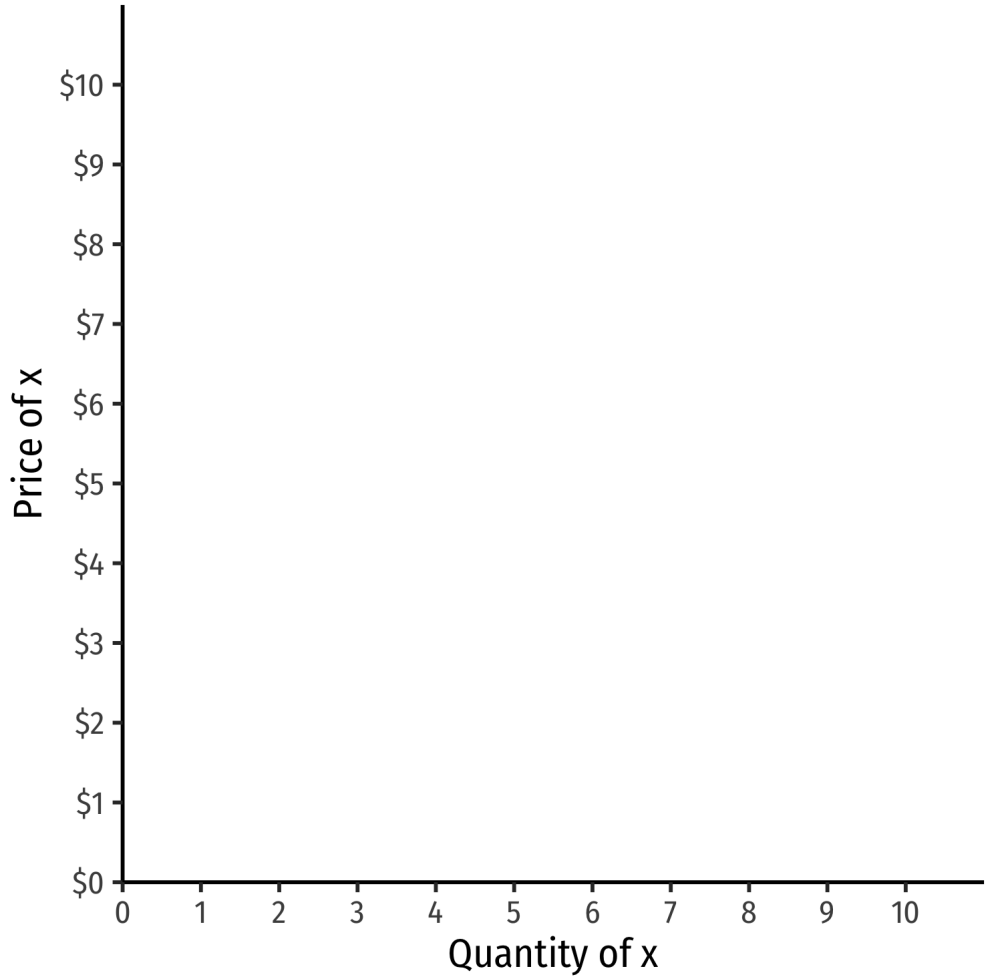
Supply Function

- **Supply function** relates quantity to price

Example:

$$q = 2p - 4$$

- Not graphable (wrong axes)!



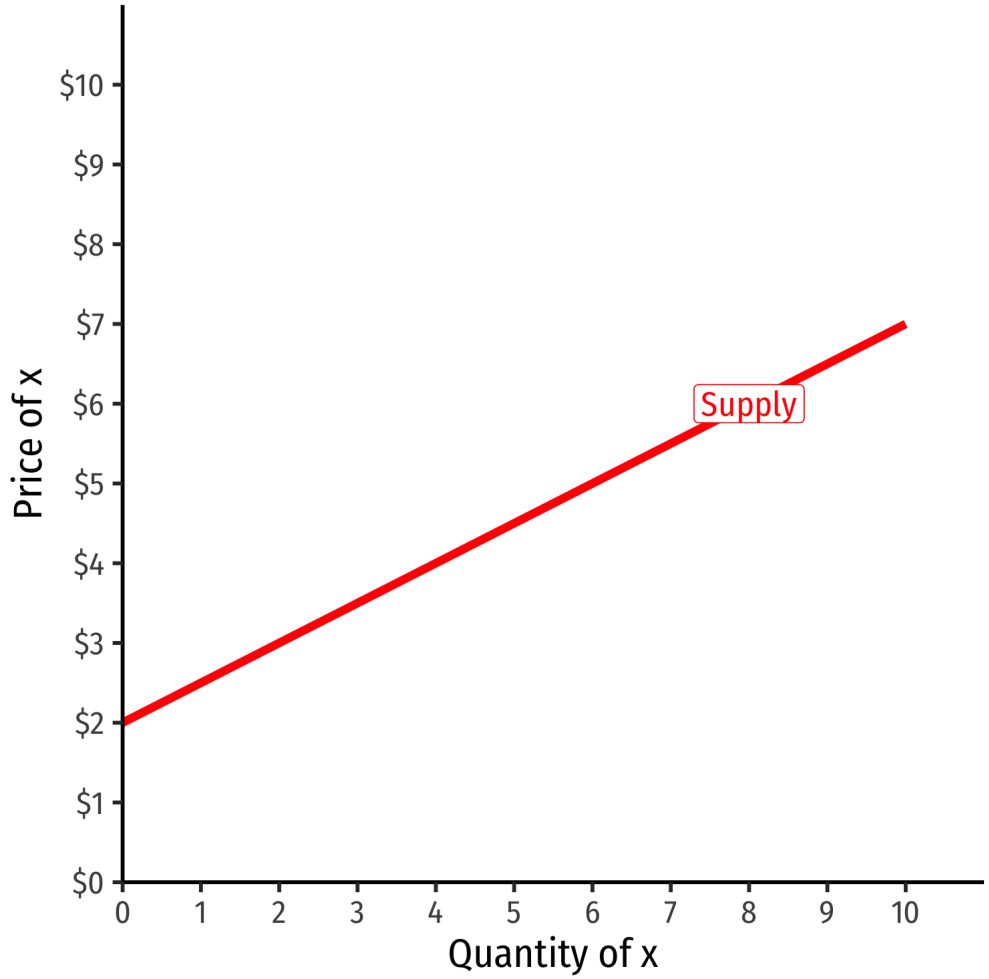
Inverse Supply Function

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

Example:

$$p = 2 + 0.5q$$

- Graphable (price on vertical axis)!

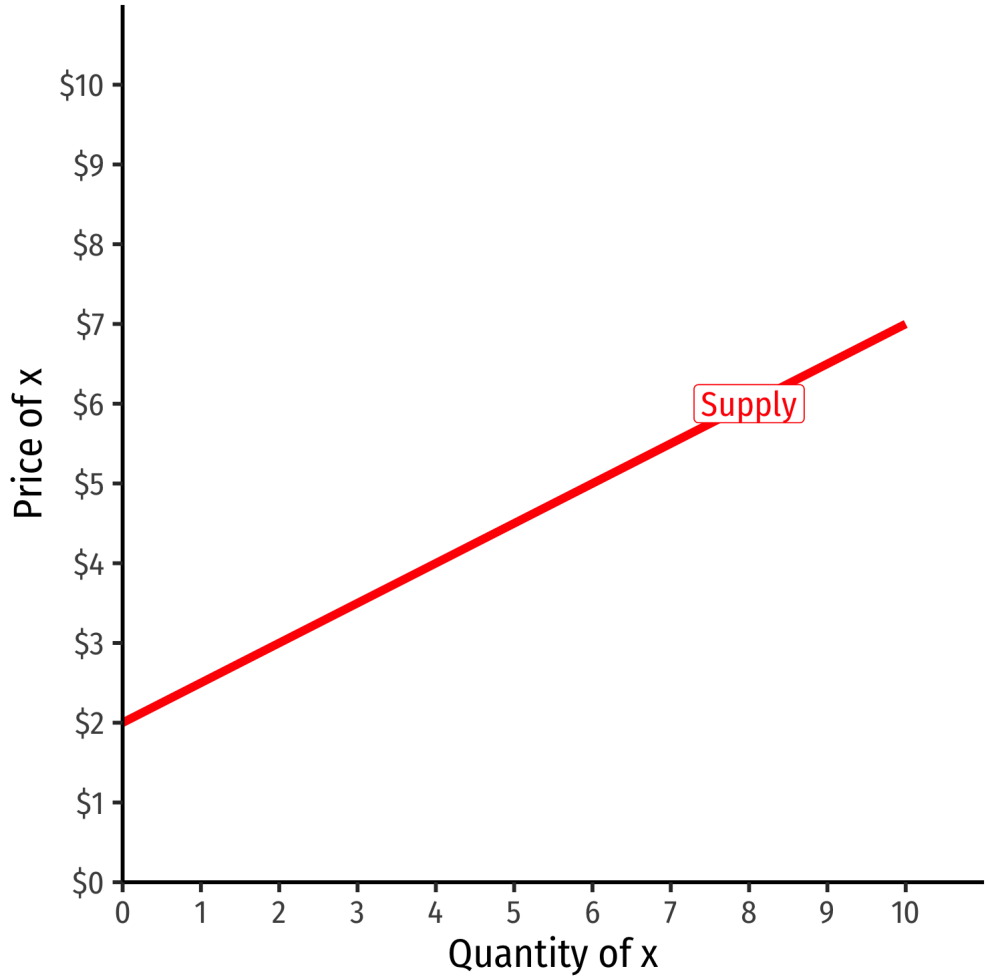


Inverse Supply Function

Example:

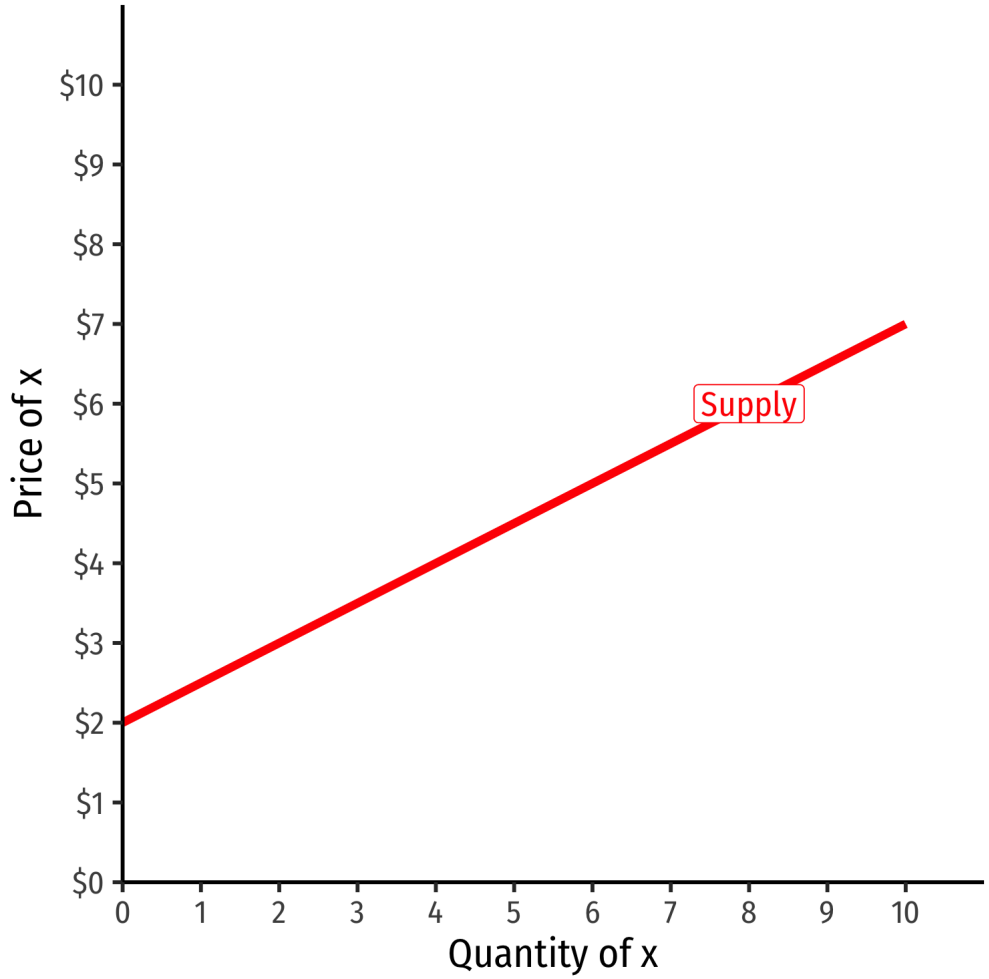
$$p = 2 + 0.5q$$

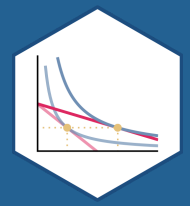
- Slope: 0.5
- Vertical intercept called the **"Choke price"**: price where $q_S = 0$ ($2), just low enough to discourage *any* sales
  - Consider the shut-down price...



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





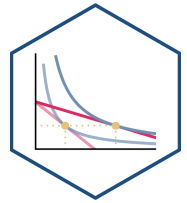
Price Elasiticity of Supply

Price Elasticity of Supply

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

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

Price Elasticity of Supply: Elastic vs. Inelastic



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

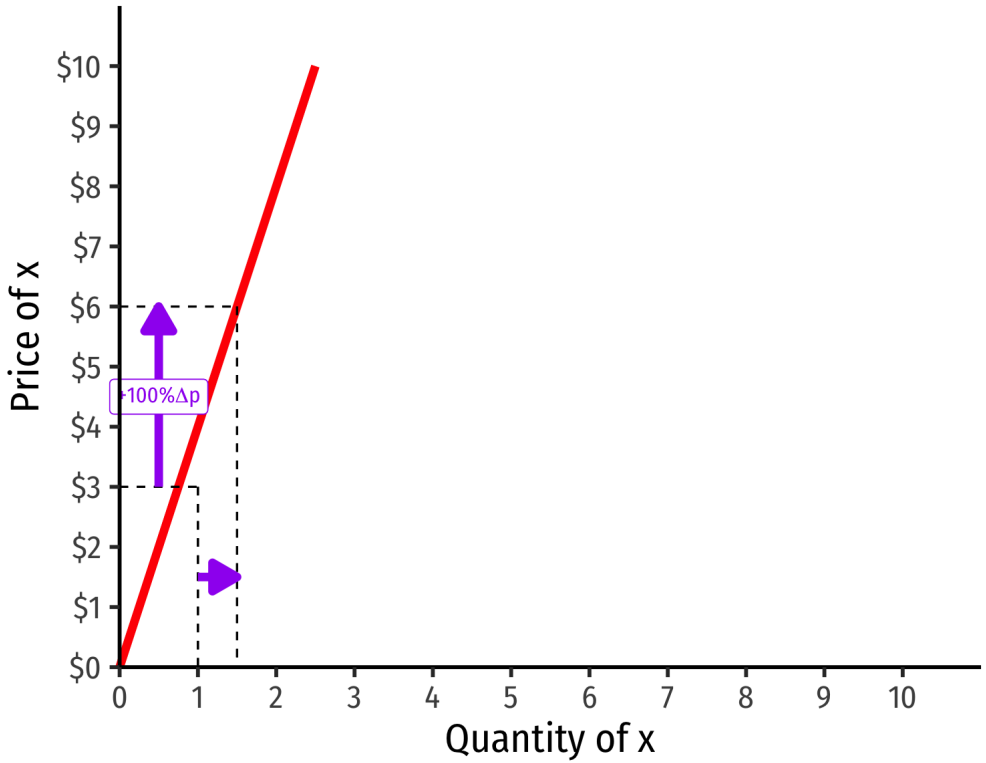
	"Elastic"	"Unit Elastic"	"Inelastic"
Intuitively:	**Large** response	Proportionate response	**Little** response
Mathematically:	$ \epsilon_{q_s,p} > 1$	$ \epsilon_{q_s,p} = 1$	$ \epsilon_{q_s,p} < 1$
	Numerator $>$ Denominator	Numerator $=$ Denominator	Numerator $<$ Denominator
1% change in p causes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

Compare to price elasticity of demand

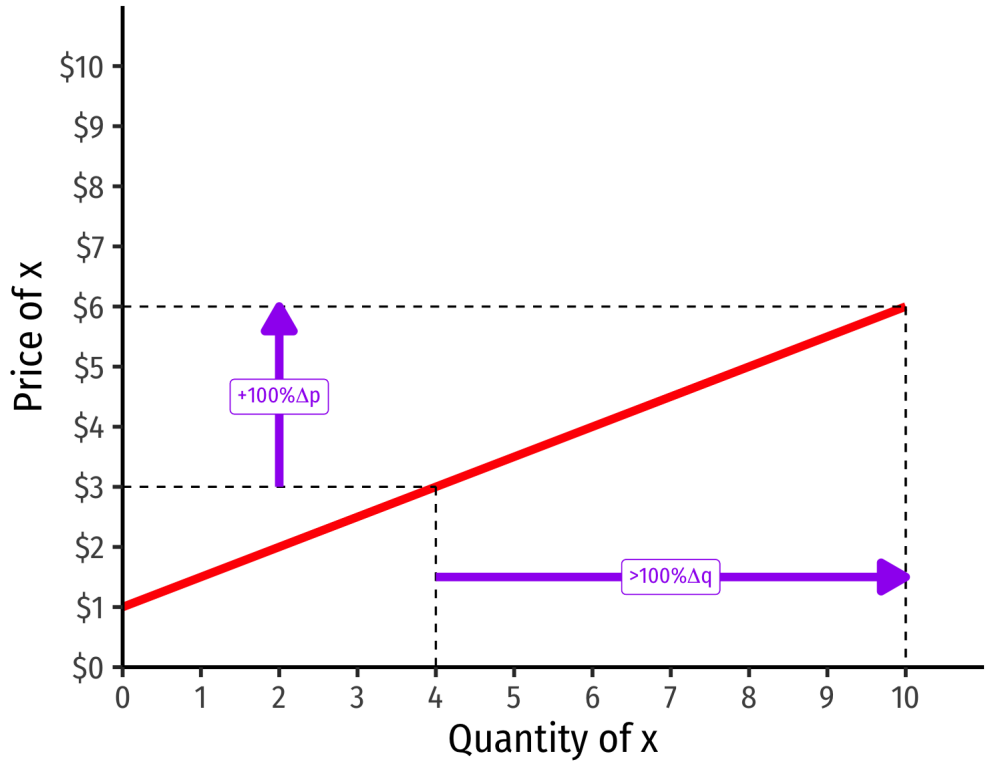
Visualizing Price Elasticity of Supply

An identical 100% price increase on an:

"Inelastic" Supply Curve



"Elastic" Supply Curve



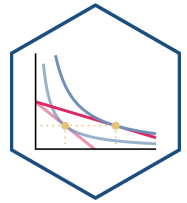
Price Elasticity of Supply Formula

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

- 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:

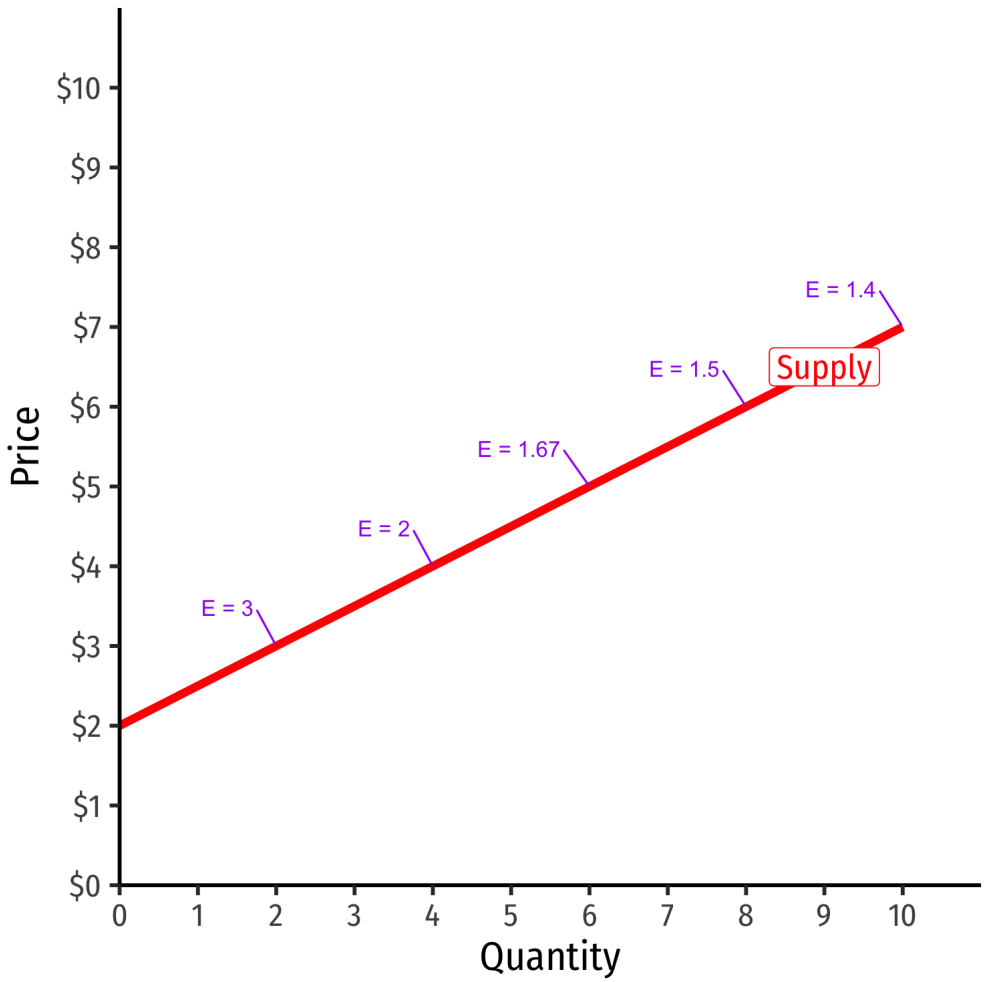
$$q_S = 10p - 200$$

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 $\neq$ 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?

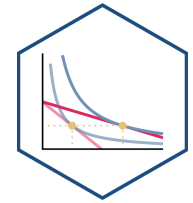
- **The faster (slower) costs increase with output**
  $\Longrightarrow$ less (more) elastic supply
  - Mining for natural resources vs. automated manufacturing
- Smaller (larger) **share of market for inputs**
  $\Longrightarrow$ more (less) elastic
  - Will your suppliers raise the price much if you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

Determinants of Price Elasticity of Supply II

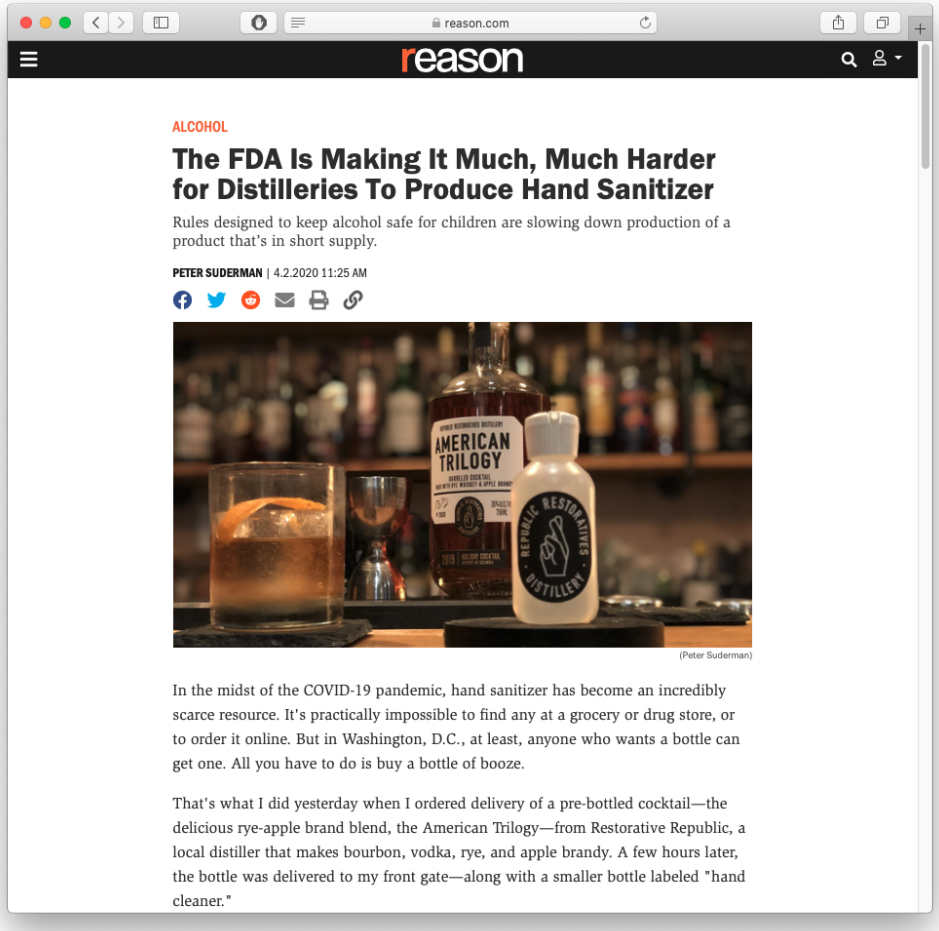
What determines how responsive your selling behavior is to a price change?

- 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



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ALCOHOL

The FDA Is Making It Much, Much Harder for Distilleries To Produce Hand Sanitizer

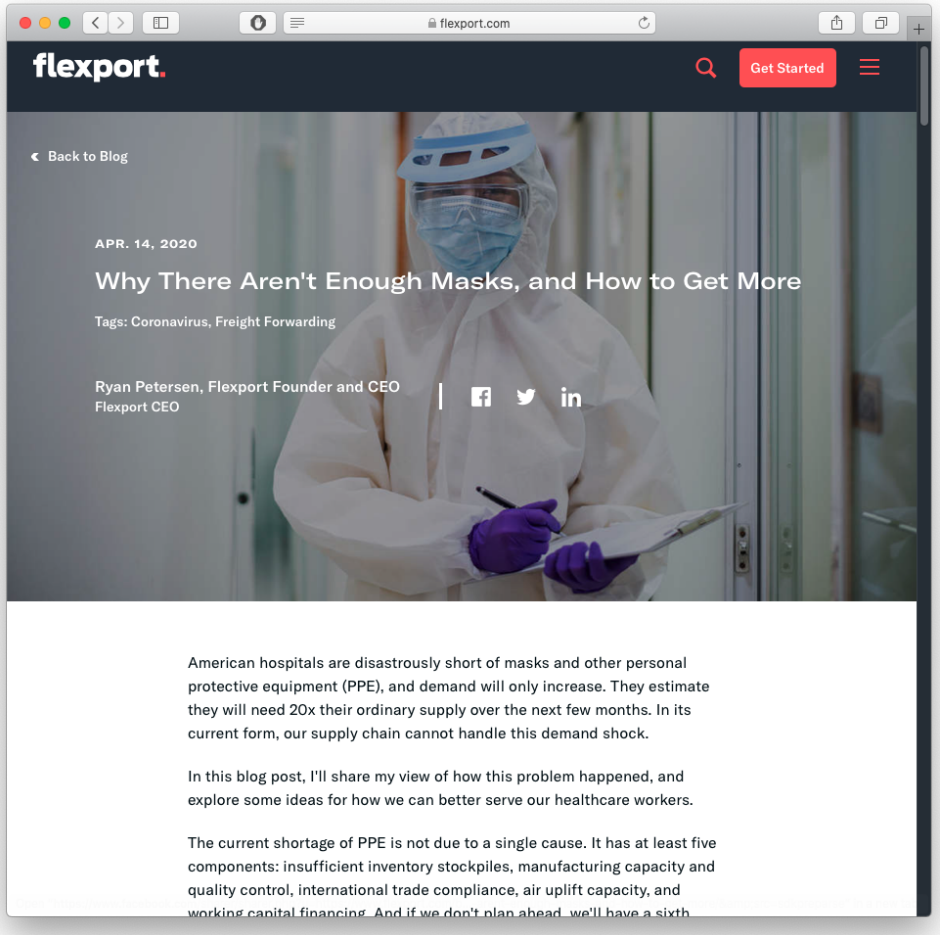
Rules designed to keep alcohol safe for children are slowing down production of a product that's in short supply.

PETER SUDERMAN | 4.2.2020 11:25 AM

(Peter Suderman)

In the midst of the COVID-19 pandemic, hand sanitizer has become an incredibly scarce resource. It's practically impossible to find any at a grocery or drug store, or to order it online. But in Washington, D.C., at least, anyone who wants a bottle can get one. All you have to do is buy a bottle of booze.

That's what I did yesterday when I ordered delivery of a pre-bottled cocktail—the delicious rye-apple brand blend, the American Trilogy—from Restorative Republic, a local distiller that makes bourbon, vodka, rye, and apple brandy. A few hours later, the bottle was delivered to my front gate—along with a smaller bottle labeled "hand cleaner."



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APR. 14, 2020

Why There Aren't Enough Masks, and How to Get More

Tags: Coronavirus, Freight Forwarding

Ryan Petersen, Flexport Founder and CEO
Flexport CEO

American hospitals are disastrously short of masks and other personal protective equipment (PPE), and demand will only increase. They estimate they will need 20x their ordinary supply over the next few months. In its current form, our supply chain cannot handle this demand shock.

In this blog post, I'll share my view of how this problem happened, and explore some ideas for how we can better serve our healthcare workers.

The current shortage of PPE is not due to a single cause. It has at least five components: insufficient inventory stockpiles, manufacturing capacity and quality control, international trade compliance, air uplift capacity, and working capital financing. And if we don't plan ahead, we'll have a sixth

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

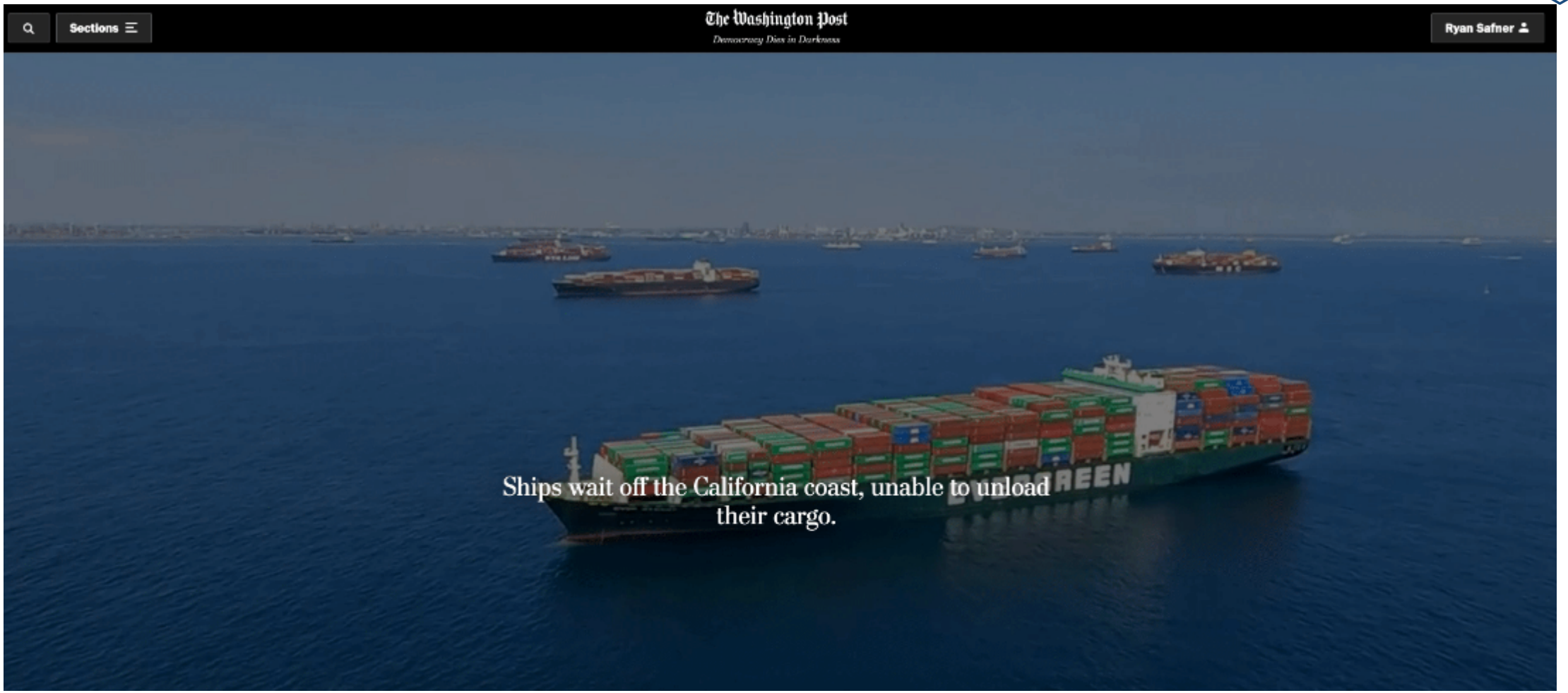
We are now well into another housing boom but as shown by Aasteveit, Albuquerque and Anundsen this boom is in some ways worse than the previous 1996-2006 boom because the supply response has been lower. The first figure, for example, shows that since the trough in 2012 house prices have risen a little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

Price Elasticity of Supply: Examples