

**MIT 14.01: Principles of Microeconomics**  
**Sp 2025, Lecture 3: Supply (Intro)**

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# Plan for Today

1. Introduction to supply
2. Supply concepts (all very analogous to demand concepts):
  - Aggregate supply function from individual optimizing behavior
  - Producer surplus
  - Elasticity of supply
  - Comparative statics

## What Have We Been Missing?

- So far we have studied demand: quantity  $D(p)$  consumers would want to buy if the price they are offered is  $p$
- Tempting to say that we have ignored *supply*: where the good comes from

# What Have We Been Missing?

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- Tempting to say that we have ignored *supply*: where the good comes from
- But not really! Demand curve  $D(p)$  is a function – an “if” statement that is true for that  $p$  no matter why that value of  $p$  arises
- Nevertheless, it's still very important to understand which  $p$  is likely to arise...and for that we have to bring in supply

# Where Does Supply Come From?

- Recall our method for deriving demand:
  - Postulated that consumers seek to maximize “utility” (s.t. constraints)
  - Posited a particular utility function (and a linear budget constraint for some given price  $p$ )
  - Let each consumer pick their (constrained) optimal choice at that  $p$
  - Summed over those choices to get aggregate demand function  $D(p)$
- We will now follow the analogous set of steps for “suppliers”
  - Analogously to demander, by “supplier” we simply mean the donor/seller on an exchange
  - Often is a firm (aka producer), but could be a person (e.g. I supply labor to MIT)
  - From now on I’ll tend to use “firm” to refer to suppliers...

# What Do Firms Maximize?

- Typical in economics to assume:
  - Firm does exactly what its owners want
  - And owners want as much profit as possible
- What important phenomena does this rule out?

# Maximizing Profits

- Like we did with demand, we will start with a very simple model of firms (bednet producers) and their profits (this is a “unit supply” model)
  - Later we will see more sophisticated models of supply
- Suppose that:
  - There are  $N_F$  firms (with  $N_F$  “large”), and each can only make one bednet
  - For firm  $i$  it costs  $c_i$  to make a bednet
  - And  $c_i$  is drawn from CDF  $G(\cdot)$
- Furthermore, each firm takes the price  $p_B$  as given (just like the consumers did)
  - We will call this the case of *perfect/pure competition* because we imagine that in cases with  $N_F$  large, any firm’s solitary action cannot affect the market much, and such settings usually imply a lot of competition between firms
  - More on relaxing this assumption in later lectures
  - For now, “perfect competition”  $\iff$  “firm  $f$  takes prices as given”
- So what is firm  $i$ ’s profit amount at  $p_B$ ?

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$$\Pi_i \equiv R_i - C_i = (p_B - c_i)B_i$$

# Supply Decision Comes from Maximizing Profits

- How can firm  $i$  maximize its profits here?
- Solve:

$$\max_{B_i} (p_B - c_i) B_i \quad \text{s.t. } B_i = \{0, 1\}$$

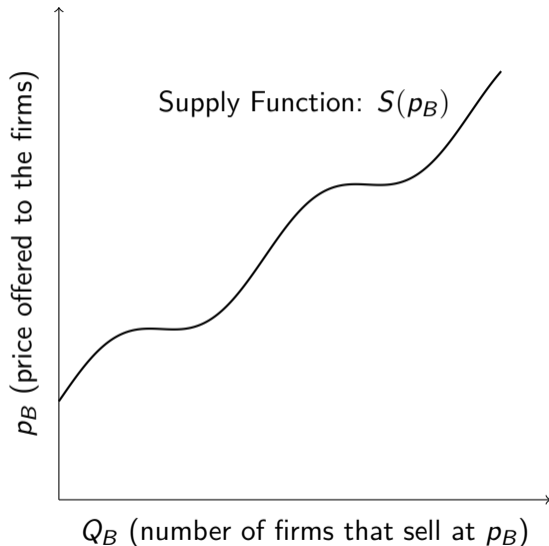
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- Again,  $B_i$  is binary, so FOCs no help. But use intuition to get to solution:
  - *Firm's supply function*:  $S_i(p_B) = 1$  if  $p_B \geq c_i$  and  $S_i(p_B) = 0$  otherwise
- Analogously to the consumer case, can define  $c_i$  as firm  $i$ 's (minimum) *willingness to accept* (WTA)
  - That is, the minimum payment that they would accept in exchange for their bednet
- Note: unlike the consumer case, the firm doesn't face a *budget* constraint

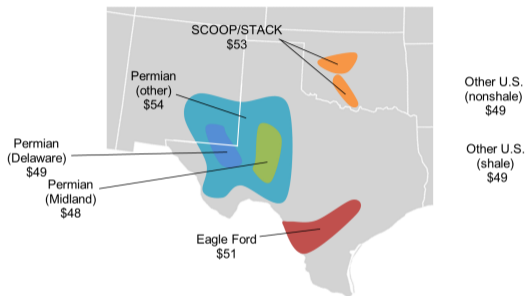
# Aggregate Supply Function



- Analogously to the case of demand:
  - $S(p_B) \equiv \sum_{i=1}^{N_F} S_i(p_B)$
  - Convention to refer to  $S(p)$ , yet plot with  $p$  on y-axis
  - Always upward-sloping (in the model we're using here)

# Estimating An Aggregate Supply Function

Average Breakeven Prices in U.S. Range from \$48 to \$54 per Barrel



NOTES: In the March 2019 Dallas Fed Energy Survey, executives from 82 exploration and production firms answered the question, "In the top two areas in which your firm is active: What WTI oil price does your firm need to profitably drill a new well?" The survey collection period was March 13–21. WTI refers to West Texas Intermediate crude oil.

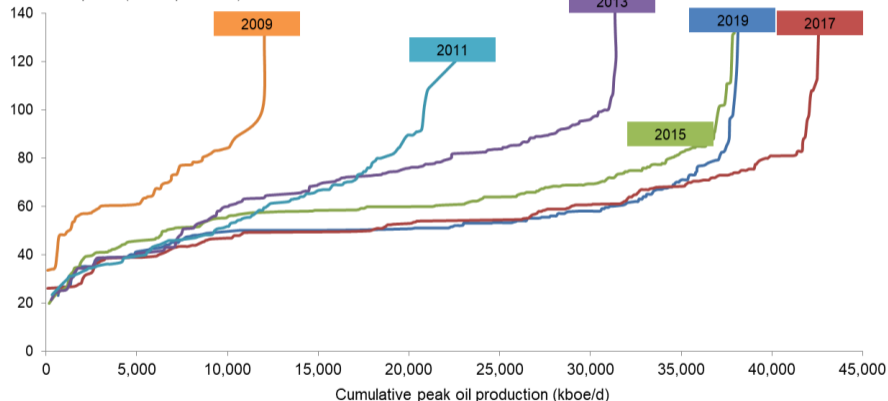
SOURCES: Energy Information Administration, Federal Reserve Bank of Dallas.

- Running an RCT (like we did with demand) is pretty hard to do for supply
- Why not just ask the firms about their costs  $c_i$ ? (Seems more plausible than asking consumers about their  $v_i$ ?)
- This example: US oil-supplying firms/wells

# Estimates of Global Oil Supply Curve (Similar Method, Now Done for Whole World)

## Oil Cost Curve Flattens in Recent Years

Breakeven prices (dollars per barrel)



NOTES: Identified projects (pre-sanction, under development and producing) are evaluated each year and assigned a breakeven price and peak oil production. The oil cost curve depicts the cumulative peak oil production of identified projects. Kboe/d is thousand barrels of oil equivalent per day.

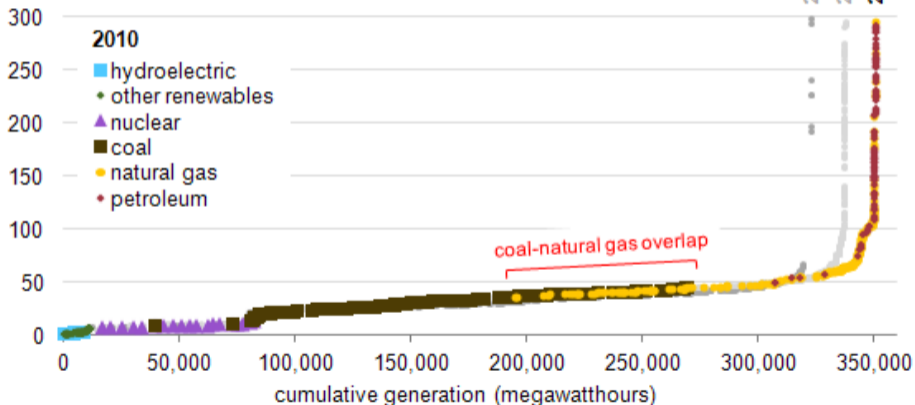
SOURCE: Goldman Sachs Global Investment Research.

Federal Reserve Bank of Dallas

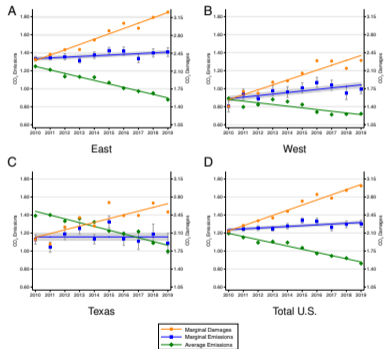
# Estimate of Electricity Supply Curve in US Southeast (Similar Method, Now for Electricity)

Southeast historical supply curve, summer 2010-2012

dollars per megawatthour



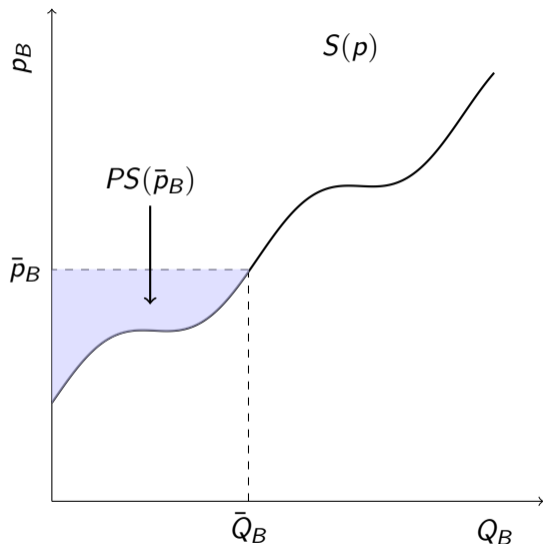
# If You Switch to an EV, Did You Switch to a CV (Coal Vehicle?)



Mansur et al (*PNAS*, 2022)

- As shown here (in green), average carbon emissions in US electricity sector have fallen (partly due to rise of wind/solar)
- Yet, as shown here (in blue), *marginal* emissions have actually been rising
  - This happens iff the marginal unit has become more likely to be produced using coal
  - And it's even worse if you look at total "damages" (in red), which include all pollution harm from coal
- Important implication: demand-side policies (which encourage drivers to switch to EVs) actually backfire because they switch drivers from gasoline to the *marginal* unit of electricity (which is coal!)

## Producer Surplus (= Total Profits)



- Each firm's profit at  $p_B$  is  $\Pi_i(p_B) \equiv \max\{0, p_B - c_i\}$
- Analogously to consumer surplus, we often refer to profit as “producer surplus”:  
 $PS_i(p_B) = \Pi_i(p_B)$
- Aggregate PS (= aggregate profit) = area above supply function (but below  $\bar{p}_B$ ):  
$$PS(\bar{p}_B) \equiv \sum_{i=1}^{N_F} PS_i(\bar{p}_B) = \int_0^{\bar{p}_B} [S(p)] dp$$
- E.g. try an eyeball estimate for oil in 2019 (avg. 2019 oil price was \$57)...

# Elasticity of Supply

- Same idea as with demand...

$$\varepsilon_{S,p}(p) \equiv \frac{p}{S} \frac{dS(p)}{dp} = \frac{d \ln S(p)}{d \ln p}$$

- E.g. try an estimate for oil in 2019 ....

# Comparative Statics for Supply

- What would happen to  $S(p)$  if...
  - A hurricane destroys the factory of one of the lowest-cost  $c_i$  producers?
  - One of the highest-cost  $c_i$  producers decides to pursue another career and drops out?
  - A clever MIT student invents a new technology that makes production costless, and gives that technology to the 20% of firms who initially had the lowest values of  $c_i$ ?
  - All firms use labor in production and the wage goes up?
- And what would happen to the  $S(\cdot)$  function if  $p$  were to go down?

# Concluding Remarks

- **Key concepts from today's lecture:**
  - Firm-level supply function  $S_f(p)$  = how much of the good will firm  $f$  sell if the price is  $p$  – follows from the firm's profit-maximization problem, taking prices as given
  - When a firm's actions have no effect on the market price we say that the firm is participating in a perfectly competitive market
  - We solved for  $S_f(p)$  in the case of the unit supply model
  - Aggregate supply function:  $S(p) = \sum_f S_f(p)$
  - Empirical example of oil/electricity
  - Producer surplus: area above supply curve but below price
  - Elasticity of supply
  - Comparative statics of supply
- **Next lecture:**
  - Putting supply and demand together: equilibrium
  - What is a "good" equilibrium?