Business Economics: Lecture 1

Andre Veiga

Roadmap

1. Logistics
2. Utility
3. Consumer Theory
4. Demand
5. Production and Costs
6. Firm Supply in the short run

Roadmap

Intro/Logistics

Me

- Portuguese
- Undergraduate: Princeton 2007
- Management Consultant 2008
- Phd: Toulouse School of Economics 2013
- Postdoc: Oxford 2017
- AP at Imperial since 2017
- My research: theory and empirics of
    - digital markets
    - insurance
    - healthcare

Logistics

- Take a look at the course manual
- Email me at a.veiga@imperial.ac.uk
  - no Hub messages
- Office hours by appointment (email me)
- No eating in class. Drinking is OK
- Videos take 3 business days to go online
- The links in the slides are just for your fun. You don't have to click or read them.

Course admins

- Logistical difficulties: email the course administrators. For instance:
  - trouble registering for the course
  - want to change streams
  - trouble uploading assignment
  - have to miss a lecture
  - not sure how to submit the assignment
  - your fellow group members aren't working hard enough
  - video hasn't uploaded
- Course admin email is in the course manual

Participate!

- Participate in lecture!

Send me feedback

- Ideally by email
- Anonymously at www.andreveiga.com
    - Be nice ☺

You

- Name
- Nationality
- Academic background
- Something cool you learned recently?

Group Assignments

- Please CC all group members in ALL emails.
- Each group submits one assignment.
  - everyone in the group gets the same grade
- Use Microsoft Word
- File name should look like this:

  Group3_Assignment1.doc

- In the course manual:
  - deadlines
  - questions
  - grading criteria

BPES BE exam

- MCQs
  - Bring a calculator
  - 5 possible answers, 1 correct
  - Wrong answers: $-\frac{1}{4}$ point
- Short essays
  - Choose 2 questions from 5 possible
  - you can use bullet points, diagrams, math, etc
    - but you don't have to
  - Write legibly, plan your answers before you start
  - Can be answered in 2 paragraphs
  - Only write relevant information (you will lose points for "knowledge dumps")
  - Max 1 page per answer

Roadmap

Utility

Utility

- How do individual make decisions?
- Economists use the concept of a UTILITY FUNCTION $U(\cdot)$
  - $U(\cdot)$ attaches a number to everything: weather, wealth, bananas, health, money
  - interpretation: utility $=$ happiness
- Individuals act as if they are maximizing their utility
- Different people may have different utility functions

Example

- U(6h work, 1500 GBP/month) $=$ 100
- U(12h work, 3000 GBP/month) $=$ 92
- **Decision?**

- U(go to Bahamas, no savings left) $=$ -12
- U(go to Brighton, lots of savings left) $=$ -40
- **Decision?**
  - Levels of utility have no meaning. Only ranking matters

Rationality

- Economists often assume people are RATIONAL
- In economics, rationality means:
  - people have an opinion about everything
  - preferences are not "circular": if you prefer A to B, and prefer B to C, then you must prefer A to C.
- Rationality does NOT mean that people are selfish, greedy or stupid
  - but they might be....

Utility is typically increasing

$$U(x) = \text{utility}$$

$$U'(x) = \text{marginal utility}$$

- Typically we assume $U'(x) \geq 0$
- For instance: U(3 apples) $>$ U(2 apples)
- Justified by “free disposal”: can dispose of goods at zero (utility) cost
- **How can we test if utility is increasing?**

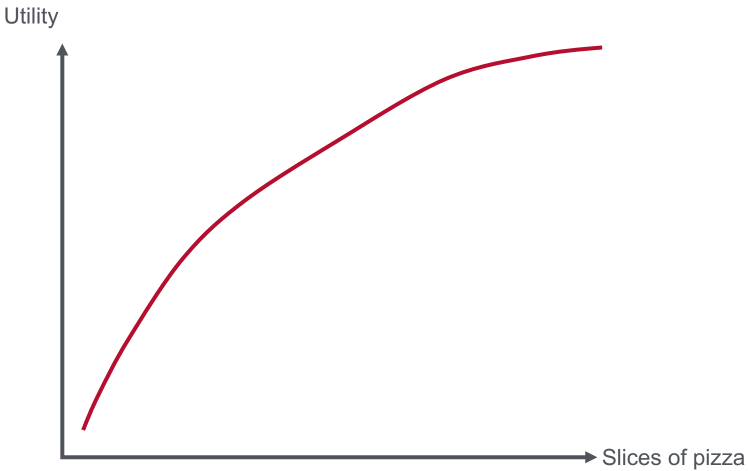
Utility is typically concave

$$U''(x) < 0$$

- Example: pizza
  - 1st slice gives a lot of utility.
  - 2nd slice gives some extra utility but not much...
  - 10th slices gives almost zero utility

A typical utility function

- Increasing and concave



Summary

- Economics models individuals acting as if they maximized a utility function
- We often assume utility is increasing and concave

Question

- $x =$ amount of pizza consumed
- $p =$ price of pizza
- Utility is
$$U(x) = \ln(x) - p \cdot x$$
- **How much pizza should you consume?**

Question

- Suppose you have two people with the same concave utility function of wealth $U(x)$.
- Ann has wealth $x_1 = 10$.
- Bob has wealth $x_2 = 100$.
- We have $\$1$ to give and we want to increase total utility. Who should we give the money to?

Further Reading

- CT, chapter 24
- Report: Happiness Does Not Measurably Increase Based On Zipline Ownership Once Family Owns 7 Ziplines
- Large lottery prize winners experience sustained increases in overall life satisfaction
- Money Really Does Lead to a More Satisfying Life
- Utility is a complicated philosophical concept
- Behavioral economics studies irrationality

Roadmap

Consumer Theory

Choosing how much to buy

- 2 goods: apples and oranges
- Prices p_a and p_o
- Quantities bough x_a and x_o
- Total utility is

$$U(x_a, x_o) = U_a(x_a) + U_o(x_o)$$

- Assume each $U_i(x_i)$ is strictly increasing concave
- Budget is K
- Total budget $\geq$ amount spend on apples $+$ amount spend on oranges

$$K \geq x_o p_o + x_a p_a$$

- How much to buy?

Walra's Law

- First insight: you should spend the entire budget
  - utility increasing in x_a, x_o
  - there is nothing else to buy $\rightarrow$ no point in saving
- Budget = money spent on oranges + money spent on apples:

$$K = x_o p_o + x_a p_a$$

- **Is this true in real life?**

The Problem

$$\max_{x_a, x_0} U_a(x_a) + U_o(x_o)$$

$$\text{subject to: } K = x_o p_o + x_a p_a$$

First Order Conditions

- The Lagrangian is

$$\mathcal{L} = U_a(x_a) + U_o(x_o) + \lambda(K - x_o p_o - x_a p_a)$$

- The optimal choices are $x_o = x_o^\star$ and $x_a = x_a^\star$
- First Order Conditions (FOCs) are:

$$\frac{\partial L}{\partial x_a} = U_a'(x_a^\star) - \lambda p_a = 0$$

$$\frac{\partial L}{\partial x_o} = U_o'(x_o^\star) - \lambda p_o = 0$$

- λ is the value of 1 extra unit of money at the solution
- 3 unknowns: $x_a^\star, x_o^\star, \lambda$
- 3 equations: **what are they?**

The solution

- Combine the two FOCS:
$$\frac{U_a'(x_a^\star)}{p_a} = \frac{U_o'(x_o^\star)}{p_o}$$
- If the choice is optimal, then marginal utility per £ must be equal for the two goods

Opportunity cost

- Another way of seeing it is:

$$U'_a(x_a^\star) = \frac{p_a}{p_o} U'_o(x_o^\star)$$

- Marginal benefit of an apple = opportunity cost
- Opportunity cost: the next best thing that could have been done with a resource
  - ACCOUNTING COST of an apple is p_a
  - OPPORTUNITY COST is the utility of the oranges that you could buy instead of that apple
- **What is the opportunity cost of attending university?**

Question

- Suppose the consumer is thinking about a choice x_a, x_0 where

$$\frac{U'_a(x_a^\star)}{p_a} < \frac{U'_o(x_o^\star)}{p_o}$$

- **How should she change her choice?**

Numerical example

- Utility:
$$u(x_1, x_2) = \frac{1}{4}\ln(x_1) + \frac{3}{4}\ln(x_2)$$
- BC:
$$p_1 x_1 + p_2 x_2 = 10$$
- Lagrangian:
$$\mathcal{L} = \frac{1}{4}\ln(x_1) + \frac{3}{4}\ln(x_2) + \lambda(10 - p_1 x_1 - p_2 x_2)$$

Numerical example

- Lagrangian:

$$\mathcal{L} = \frac{1}{4}\ln(x_1) + \frac{3}{4}\ln(x_2) + \lambda(10 - p_1x_1 - p_2x_2)$$

- FOCS:

$$\frac{\partial \mathcal{L}}{\partial x_1} = \frac{1}{4}\frac{1}{x_1} - \lambda p_1 = 0 \Leftrightarrow \frac{1}{4}\frac{1}{\lambda} = x_1 p_1$$

$$\frac{\partial \mathcal{L}}{\partial x_2} = \frac{3}{4}\frac{1}{x_2} - \lambda p_2 = 0 \Leftrightarrow \frac{3}{4}\frac{1}{\lambda} = x_2 p_2$$

- Use BC and FOCs to find λ:

$$p_1x_1 + p_2x_2 = \frac{1}{4}\frac{1}{\lambda} + \frac{3}{4}\frac{1}{\lambda} = 10 \rightarrow \lambda = \frac{1}{10}$$

- From the FOCs, demand for goods 1, 2 is:

$$x_1 = \frac{10}{4}\frac{1}{p_1}, \qquad x_2 = \frac{30}{4}\frac{1}{p_2}$$

- **How does x_i change with p_i?**

Same reasoning applies to EVERY decision

- Apples vs bananas
- Apples vs oranges vs bananas (imagine 3 graphs side-by-side)
- Consuming vs saving (ie, consuming in the future)
- Work vs leisure
- My consumption vs the environment
- My consumption vs my children's consumption

Summary

- It is optimal to “spend” your whole budget
- If a decision is optimal, marginal utility per £ must be equal for all goods

Question

- Utility:

$$u(x_1, x_2) = V(x_1) + V(x_2)$$

for some $V(x)$ increasing concave

- $p_1 = p_2 = 1$
- Budget $= 12$
- **If $V(x)$ concave, what is the optimal x_1^* and x_2^*?**
- **If $V(x)$ convex, what is the optimal x_1^* and x_2^*?**

Further Reading

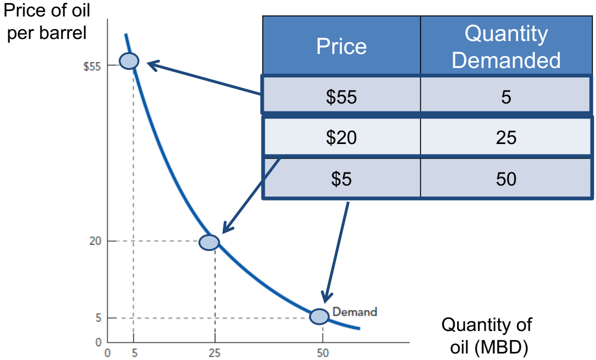
- CT, chapter 25
- Other important decisions that can be analyzed using this framework:
  - Spending now vs saving for returement
  - Stocks vs bonds: this, this, many more
  - Commit a crime vs act legally

Roadmap

Demand

The Demand Curve

- Goal: understand how GROUPS of individuals make decisions in markets
- Demand CURVE: a FUNCTION of price, $Q = D(p)$
  - relationship between quantity demanded and price
  - other things are assumed constant (incomes, weather, taxes, etc)



Price	Quantity Demanded
$55	5
$20	25
$5	50

Law of Demand

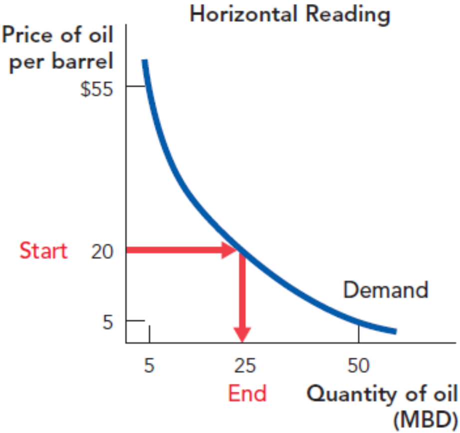
- Quantity demanded falls with price
- Substitution effect
  - Other goods are better value if price increases
  - If apples become more expensive: buy fewer apples and more oranges
- Income effect
  - If the price of the things you are buying goes up, you have lower purchasing power, so you buy less

Inverse demand

- $Q = D(p)$ is direct demand
- Inverse demand is $p = P(q)$, where q is quantity, p is price
- Example:
  - If Inverse Demand is $P(q) = a - bq$
  - Then Direct demand is $Q(p) = \frac{a-p}{b}$

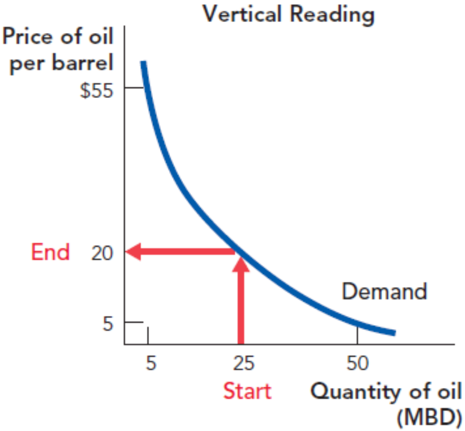
Reading demand horizontally

- At \$20 per barrel, buyers are willing to buy 25m barrels of oil per day.



Reading demand vertically

- The maximum price that buyers are willing to pay to purchase 25m barrels per day is $20 per barrel.



Price elasticity of demand

- Measures the responsiveness of demand to price

$$\epsilon_D = \frac{dQ}{dP}\frac{P}{Q}$$

- If prices increase by 1%, demand changes by ϵ_D%
- Elasticity is "unit-free" $\rightarrow$ not influenced by currency, units, etc
- Law of demand: $\epsilon_D < 0$
  - In practice, we usually use $|\epsilon_D|$
- Elastic demand: $|\epsilon_D| > 1$
- Inelastic demand: $|\epsilon_D| < 1$
- Unit elastic demand: $|\epsilon_D| = 1$

Example

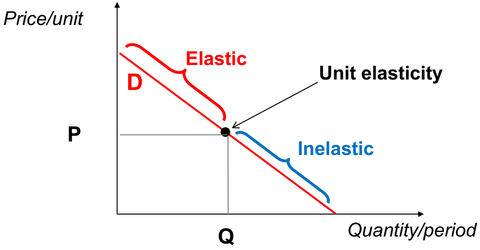
- Inverse demand is $P(q) = a - bq$
- To compute the elasticity, first, find direct demand $Q(p) = \frac{a-p}{b}$.

Example

- Inverse demand is $P(q) = a - bq$
- To compute the elasticity, first, find direct demand $Q(p) = \frac{a-p}{b}$.
- Then compute

$$\epsilon_D = \frac{dQ}{dp} \cdot \frac{p}{Q} = -\frac{1}{b} \cdot \frac{p}{\frac{a-p}{b}} = -\frac{p}{a-p}$$

- varies with price



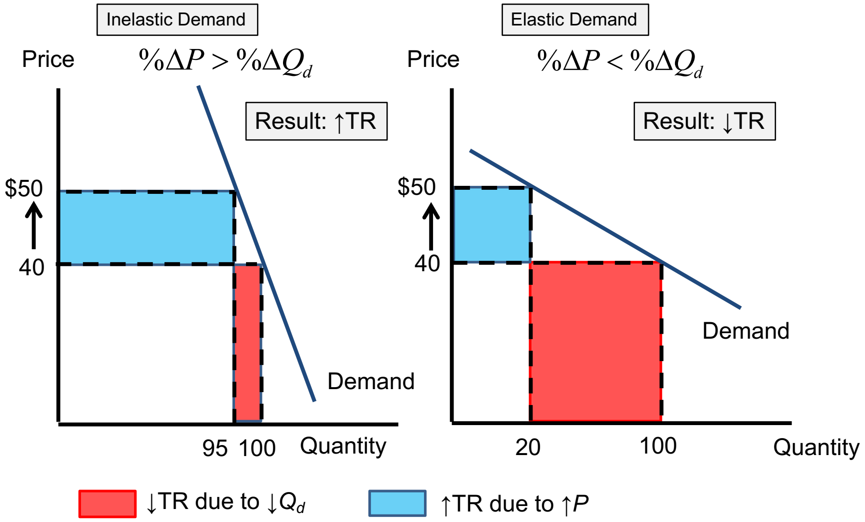
Constant elasticity demand

- Suppose demand is
$$Q(p) = kp^r$$
- Elasticity is
$$\epsilon_D = \frac{dQ}{dp}\frac{p}{Q} = krp^{r-1}\frac{p}{kp^r} = r$$
- For this special demand curve, elasticity is constant! (Does not depend on price)

Elasticity and revenue

- Revenue is
$$R = p \times q(p)$$
- Should we raise price?
$$\frac{dR}{dp} = q + p\frac{dq}{dp} = q + q\frac{p}{q}\frac{dq}{dp} = q\left(1+\epsilon\right)$$
- If $\epsilon < -1$, revenues fall
- If $\epsilon > -1$, revenues rise

Elasticity and revenues: graphically



Own Price Elasticity of different goods

Table: Selected Estimates of Demand Elasticities

	Short Run	Long Run
Cigarettes	–	0.35
Water	–	0.4
Beer	–	0.8
Physicians' Services	0.6	–
Gasoline	0.2	0.5-1.5
Automobiles	–	1.5
Chevrolets	–	4.0
Electricity	0.1	1.9
Air Travel	0.1	2.4

Source: Browning and Mark Zupan, *Microeconomics and Applications*. Hendrik Houthakker and Lester Taylor, *Consumer Demand in the United States, 1929-1970*. Kenneth Etzinga, "The Beer Industry", in *The Structure of American Industry*, edited by Walter Adams. James Sweeney, "The Response of Energy Demand to Higher Prices: What Have We Learned?" *American Economic Review*, 74, #2, May 1984

What affects own price elasticity?

- Availability of substitutes:
  - Cadbury's Dairy Milk is elastic
  - Chocolate in general is inelastic
- Demand is more elastic in the long run: if price of gasoline goes up...
  - short run: drive less
  - long run: buy a more efficient car, move closer to work
- Proportion of income spent on the good
  - Big-ticket items are usually more elastic
  - eg, demand for shoe-laces is inelastic

Cross-price elasticity of demand

- How does demand respond to the prices of OTHER goods?

$$\epsilon_{A,B} = \frac{dQ_A}{dp_B} \cdot \frac{p_B}{Q_A}$$

- Substitutes: things you buy instead of each other
  - $\epsilon_{A,B} > 0$
  - eg, Margarine and butter
- Complements: things you buy together
  - $\epsilon_{A,B} < 0$
  - eg, printers and ink cartridges

Income elasticity of demand

- How does demand respond to changes in income?
- If I is income, then

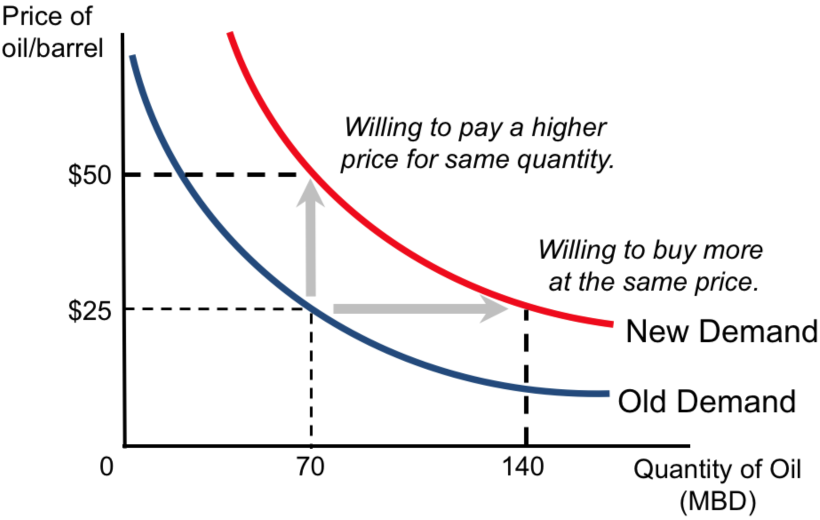
$$\epsilon_I = \frac{dQ}{dI}\frac{I}{Q}$$

- NORMAL goods: buy MORE if income rises
  - $\epsilon_I > 0$
  - Smart phones, iachts
- Luxury Goods: buy MUCH MORE if income rises
  - $\epsilon_I > 1$
- INFERIOR goods: buy LESS if income rises
  - $\epsilon_I < 0$
  - Public transportation, fast food

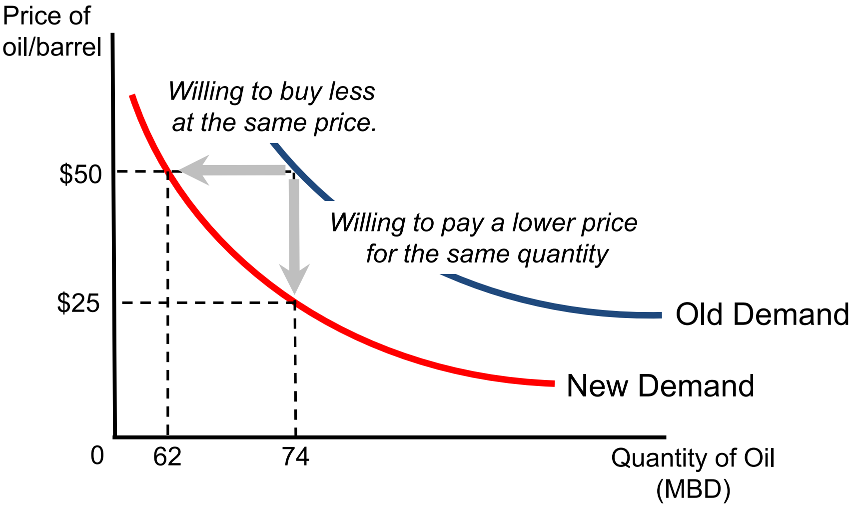
Demand shifts

- A demand curve is a function of PRICE only
- If something else changes we draw a NEW demand curve
- Demand can shift due to
  - changes in income
  - changes in population
  - other prices, technology
  - Future prices (buy less now if you think it's going to get cheaper in the future)
  - **What else?**

Demand shifts: an increase



Demand shifts: a decrease



Summary

- Demand is the optimal response of consumers to price
- Demand slopes down
- We measure the responsiveness of demand using elasticities
  - own-price elasticity
  - cross price elasticity
  - income elasticity

Question

$$Q(p) = Kp^{\alpha}$$

- **What is the elasticity at price $p = 17$?**
- **How elastic is the demand for an addictive illegal drug?**
- **Why are there so many takeout restaurants in nightclub districts of cities?**

Further Reading

- CT, Chapter 3
- CT, Chapter 5
- The Demand Curve
- Are children an inferior good?

Roadmap

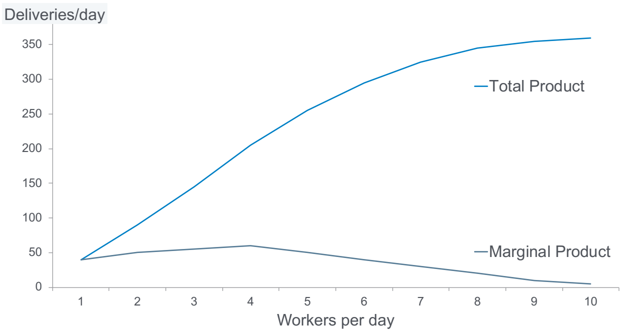
Producer Theory

Two ways of looking at firms

1. PRODUCTION: For given inputs, how much can be produced?
2. COSTS: How much would it cost (in inputs) to produce a certain output?

Typically, MP increase & then decreases

- TP = Total Product = output as function of some input
  - assumes everything else fixed (technology, taxes, etc)
- MP = MARGINAL Product = derivative of TP (wrt input, eg labour)
  - EXTRA output from an EXTRA worker



Typically, MP increase & then decreases

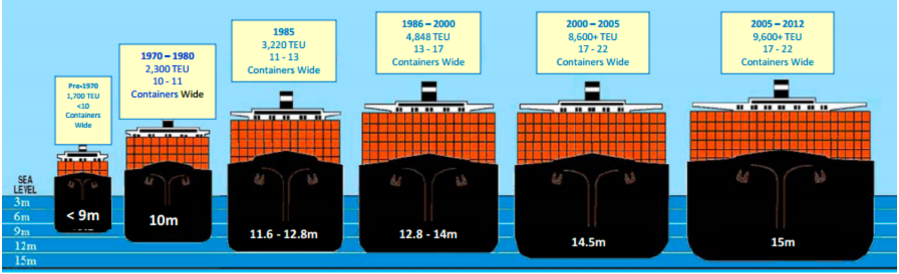
- Total product is always increasing. **Why?**
- At low output, MP is typically increasing:
  - Specialization
  - Learning by doing
  - less time wasted moving between tasks
- At high outputs, MP is typically decreasing: **Why?**
  - diminishing returns: fixed factors shared between many workers
  - New hires might be less skilled

Returns to scale

- INCREASING returns to scale
  - increasing ALL inputs by 1% increases output by MORE THAN 1%
- DECREASING returns to scale
  - increasing ALL inputs by 1% increases output by LESS THAN 1%
- CONSTANT returns to scale
  - increasing ALL inputs by 1% increases output by exactly 1%

- Typically, SMALL firms have INCREASING returns
- Typically, LARGE firms have DECREASING returns
- But some industries are known for increasing returns...

Increasing returns in shipping



- Reasons for Economies of Scale
  - Big buyers get better deals
  - Volumes increase faster than areas
  - Entry costs (eg, build infra-structure)
- Reasons for Diseconomies of Scale
  - Managerial diseconomies / Coordination difficulties

Costs

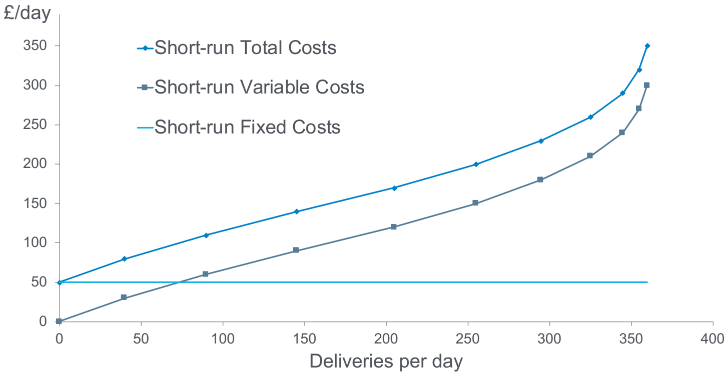
- The flip-side of production is COSTS.
- FIXED costs DO NOT vary with output
  - Rent, council tax. **What else?**
  - Fixed costs are constant in QUANTITY, not necessarily in TIME. **Example?**
- VARIABLE costs DO vary with output
  - Electricity, Raw materials. **What else?**
- Sunk costs: costs unavoidable even if firm shuts down
  - All sunk costs are fixed costs, but not vice-versa
  - Money spent on advertising: SUNK
  - Money spent buying a machine: FIXED, NOT SUNK

Sunk costs should be ignored

- Firms and individuals should ignore sunk costs when making decisions
  - "don't cry over spilt milk"
- **You buy a theatre ticket for £100. 20m in, you realize the play is horrible. Should you leave?**
- **A firm invested \$1bn to R&D on a more efficient CD player. No success yet. Should they continue investing?**

Costs: LR vs SR

- SHORT run: only variable costs can be avoided (not fixed costs)
- LONG run: all costs are variable and can be avoided (except sunk costs)



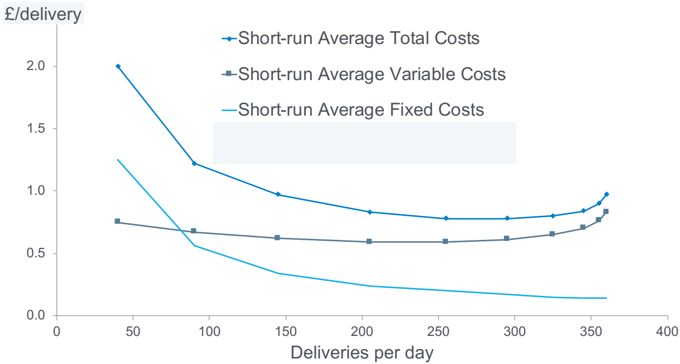
Average Costs

$$\text{AFC} = \text{average fixed cost} = \frac{\text{fixed cost}}{\text{output}}$$

$$\text{AVC} = \text{average variable cost} = \frac{\text{variable cost}}{\text{output}}$$

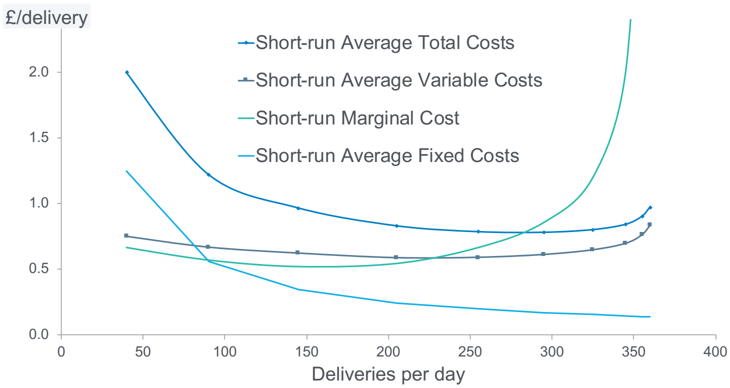
$$\text{ATC} = \text{average total cost} = \frac{\text{total cost}}{\text{output}}$$

- AFC is decreasing in output. **Why?**



Marginal Costs

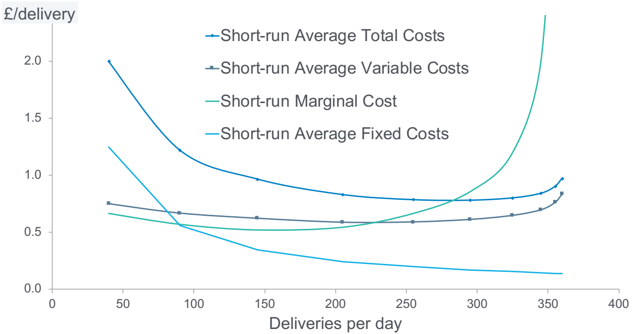
- Marginal Cost (MC) is the EXTRA cost of an EXTRA unit of output
  - eg, cost of going from 1000 iPhones to 1001
  - $=$ derivative of total cost with respect to output ($\frac{dTC}{dq}$)



- Typically, MC is first decreasing and then increasing. **Why?**

AC vs MC

- MC cuts the bottom of AVC or ATC
  - If MC<AC, then AC is falling
  - If MC>AC, then AC is rising
  - so MC=AC at the minimum of AC



Question: Airline costs

- For an airline, what type of costs are these?
  - Wages for staff
  - Price of buying an aircraft
  - Fuel
  - Operating licenses

Summary

- TP is increasing
  - MP is typically increasing, then decreasing
- TC is increasing
  - MC is typically decreasing, then increasing
- Returns to scale measure how efficiency of production changes with output.
  - It can be increasing, constant, decreasing

Further Reading

- CT, Chapter 11
- What I Learned From Making Hot Sauce at Scale
- How Tesla promotes economies of scale
- Are Amazon's economies of scale beneficial for society?

Questions

- What would the Marginal Cost curve look like for a piece of software?
- In the case of Uber, what are the fixed and variable costs? What about a traditional taxi company?

Roadmap

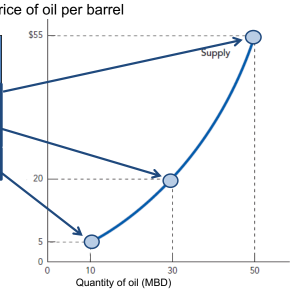
1. Logistics
2. Utility
3. Consumer Theory
4. Demand
5. Production and Costs
6. **Firm Supply in the short run**

Short Run Supply

The Supply Curve

- How many cars should BMW produce?
- How many iPhones should Apple produce?
- What is a firm's supply curve?
- Supply CURVE: quantity supplied, as a function of price (only!)
- Law of supply: "Other things being equal, supply slopes UP"

Price	Quantity Supplied
$55	50
$20	30
$5	10

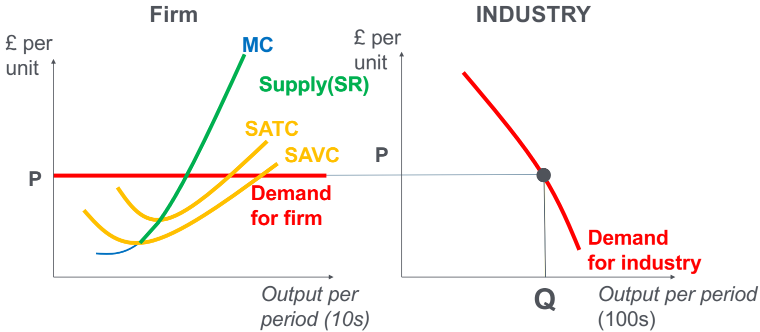


Perfect Competition

- We will assume perfect competition
  - Firms choose quantity to maximize profit, taking price as given
- Many buyers and sellers
  - each firm is small relative to the market
  - each firm's output decision has no effect on price
- Homogenous product
  - It doesn't matter who you buy from or sell to
- Perfect information about quality and price
  - No customer will buy for more than the market price
  - No firm will sell for less than the market price
- There is free entry and exit of firms, in the long run
- **Examples?**

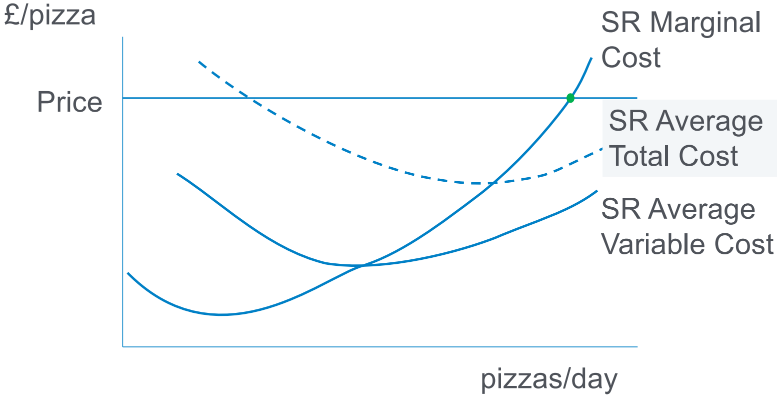
Firm demand

- INDUSTRY demand slopes down
- Perfect competition: firm perceives
  - price as fixed.
  - its own demand curve as flat (infinitely elastic) at the price



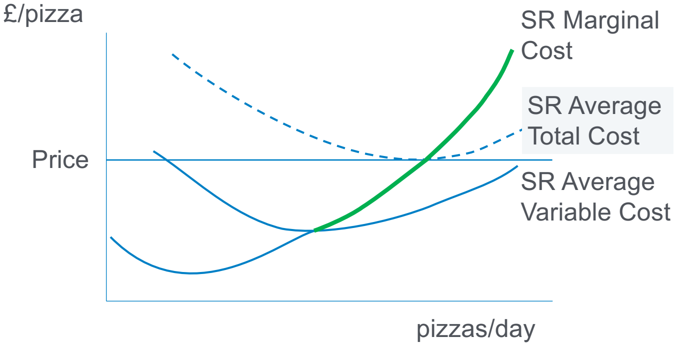
$P > min(ATC)$

- **How much should the firm produce?**



$min(AVC) < P < min(ATC)$

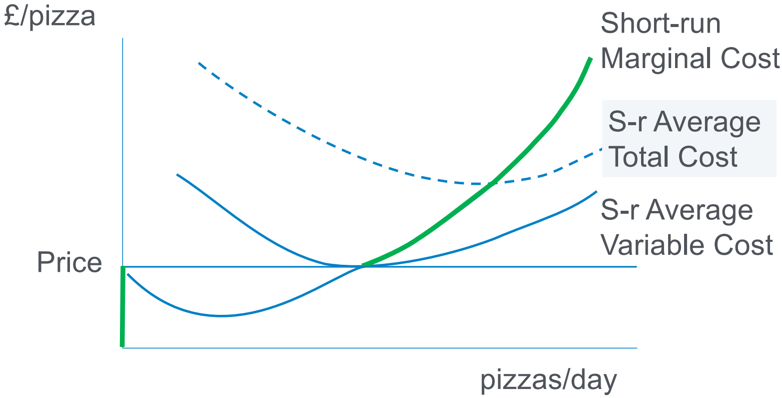
- **How much should the firm produce?**



- **What is the firm's profit in the short run?**

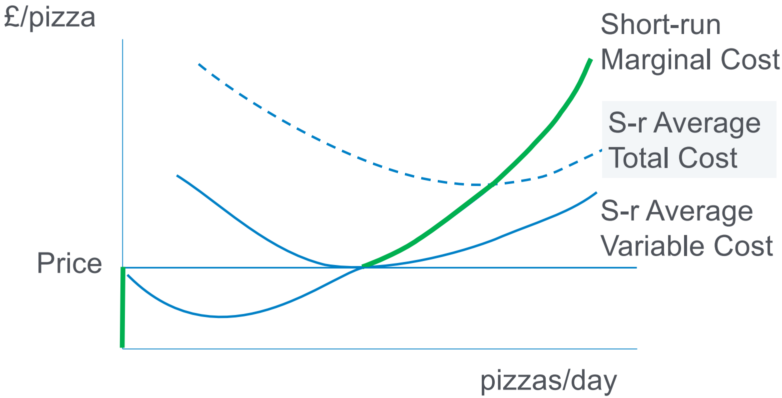
$P < min(AVC)$

- For the first unit, MC(1)=AVC(1)+FC (not shown well in the image)
- **What is the marginal profit on the first unit produced?**
- **How much should the firm produce?**



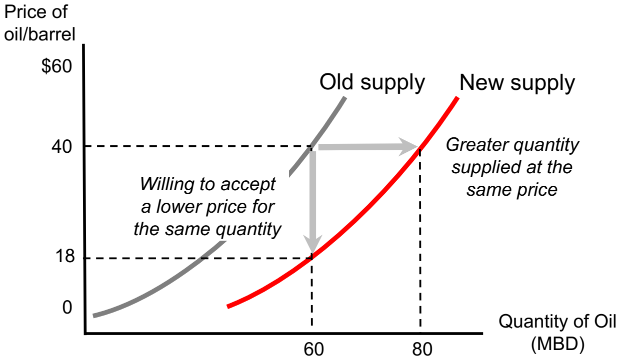
What is the short run supply curve?

- Firm's SR Supply curve = firm's optimal output at each price = MC curve above SR-AVC



Shifts in supply

- The Supply Curve is a function of price only
  - assumes other things (taxes, technology) are constant
  - if these things change, we draw a new supply curve



Why might supply shift?

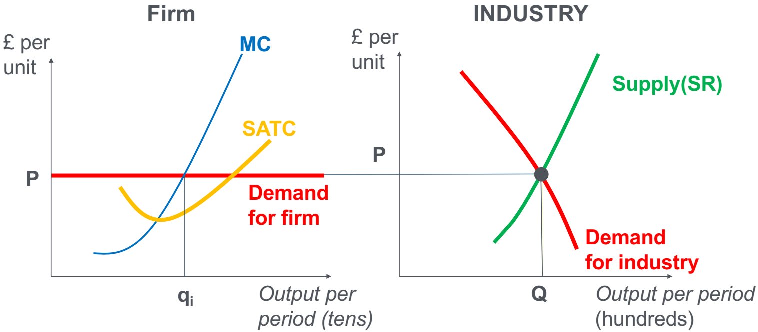
- Technological shifts
- Price of INPUTS (price of fuel increases $\Rightarrow$ fewer flights sold)
- Price of SUBSTITUTES IN PRODUCTION:
  - price of business class increases, sell LESS economy class
- Price of COMPLEMENTS IN PRODUCTION:
  - price of freight cargo increases, sell MORE economy tickets

Elasticity of supply

- Let quantity supplied be $Q_s = S(p)$
$$\epsilon_S = \frac{\text{\% change in quantity supplied}}{\text{\% change in price}} = \frac{dS}{dp}\frac{p}{S}$$
- Law of supply: $\epsilon_S > 0$

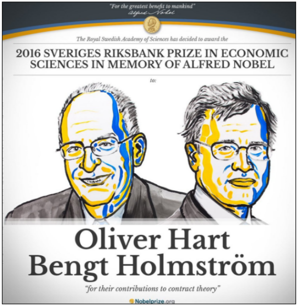
Industry supply

- INDUSTRY supply is the sum of the supply of all firms
- Notice $Q >> q_i$:



Do firms really maximize profit?

- Modern firms are run by managers who may have other objectives
  - personal remuneration
  - career concerns



- But profit maximization is a reasonable assumption in many circumstances

Summary

- In a competitive market, INDUSTRY demand curve slopes down
  - each FIRM perceives its own demand curve as flat
- SR: firms produce an output such that P=MC
  - unless P< min(SR AVC). If so, produce zero
- We measure the responsiveness of supply to price using the elasticity of supply

Further Reading

- CT, Chapter 3
- CT, Chapter 11
- CT, Chapter 12
- An interesting example where the SR supply behaves somewhat differently (not needed for exam)
- Complements in production: Because We're All Driving Less Due To The Pandemic It's Affecting Beer And Soda Production, Somehow

Questions

- If the government increases the minimum wage for car factory workers, how would the supply curve of cars shift?
- If an oil producing company predicts that the price of oil will be higher next year, what happens to the supply of oil today?
- If a factory has lots of spare production capacity on a good, how elastic is the supply for this good?