Behavioural Finance

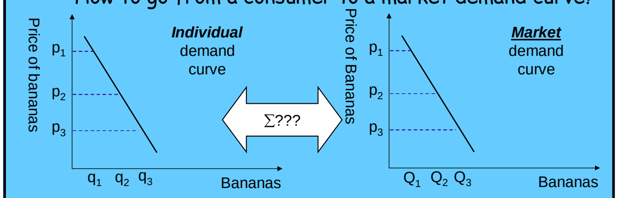
Lecture 02
Market Behaviour in Economics

Confusion re reading assignments

- Only received library PDF file last Wednesday
- No time to integrate with quiz questions
- Will do so from tomorrow
- Extending deadline by one week for first 2 weeks
- When I include links, vUWS will delete all current postings
  - So PLEASE make copy of anything you have posted
- IF question you get after reset changes, stick with the first one you got if you've done some work already
- My apologies—teething problem with new course

The Market Demand Curve?

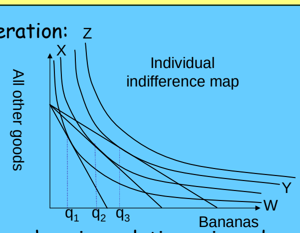
- Last week—"Revealed Preference" doesn't work
- This week…
  - *Let's assume (i.e. pretend) that RP actually does work…*
  - How to go from a consumer to a market demand curve?



- Key assumption in deriving individual demand curve is
  - ***Changing relative prices doesn't change income:***

The Market Demand Curve?

- This operation:



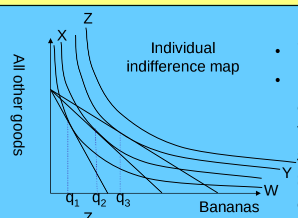
- Assumes changing relative prices doesn't alter incomes
- OK for a single consumer…
- But can't be assumed for >1 consumer
  - Prices are sources of income in neoclassical model:
    - ***Changing relative price of bananas alters distribution of income…***

The Market Demand Curve?

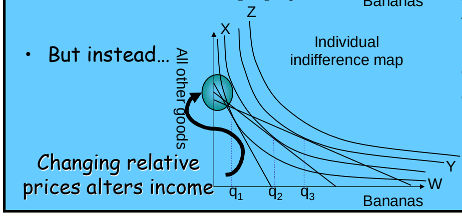
- The problem
  - With many consumers and many goods, a change in price for one commodity changes real income for all consumers
    - So income bit of budget constraint doesn't stay still when relative prices change…
- Neoclassical theorists (Gorman, Sonnenschien, Mantel, Debreu, Shafer…) set selves the problem:
  - "Under what conditions will a market demand curve obey all the properties of an individual demand curve?"

The Market Demand Curve?

- It's not…



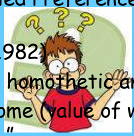
- But instead…



- The question:
- Under what conditions will this reality still result in market demand curves that, like individual demand curves…

The Market Demand Curve?

- Slope downwards?
  - Obey "Law of Demand" that decrease in price causes increase in demand?
  - Reflect rules of Revealed Preference at aggregate level?
- Shafer & Sonnenschein (1982)
  - "when preferences are homothetic and
  - the distribution of income (value of wealth) is independent of prices…"
- Gorman (1953, p. 63)
  - "*if, and only if*, the personal Engel curves are ***parallel straight lines*** for different individuals at the same prices."

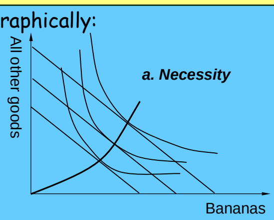


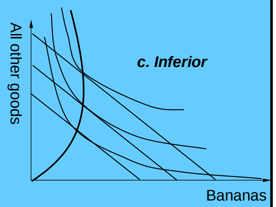
The Market Demand Curve?

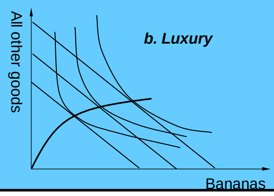
- Remember Engels Curves?
  - Show how consumption of a good changes with income
  - 3 possible classes…
    - Luxury
      - Consumption rises (relative to other goods) with income
    - Necessity
      - Consumption falls (relative to other goods)
    - Giffen
      - Consumption falls absolutely…

The Market Demand Curve?

- Graphically:



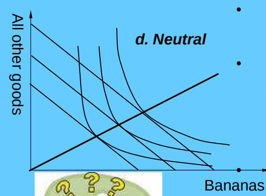




- Gorman's result:
  - ***NONE*** of these can apply if market demand curves are to be downward-sloping!
  - Instead…

The Market Demand Curve?

1. All goods have to be … "neutral":

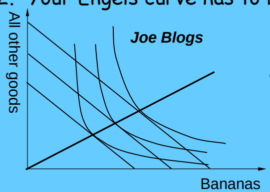


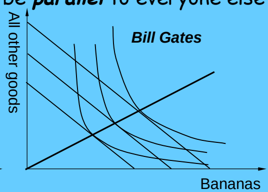
- Relative consumption does not change as income rises…
- If you consumed
  - 1 pizza, 1 coke & no Rolls Royces a day when your income was $100 a day
- Then you would consume
  - 100 pizzas, 100 cokes ***& no Rolls Royces*** a day at an income of $10,000 a day
- Ratio of relative consumption cannot change with income…

- But wait, there's more!…

The Market Demand Curve?

2. Your Engels curve has to be ***parallel*** to everyone else's…

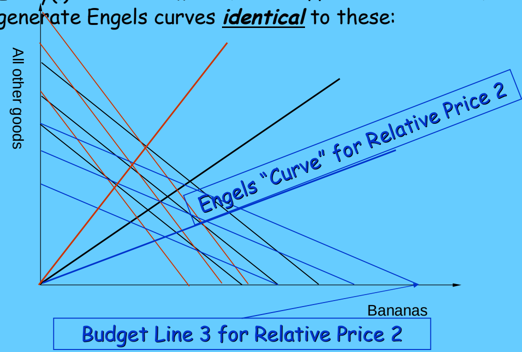




- But wait, there's even more…
  - Parallel lines ***that pass through the same point*** are the same line
  - All Engels curves must pass through 0,0 (no income, no consumption of anything)
- So all "individuals" have to have identical preferences!

The Market Demand Curve?

- Every(!) individual must have indifference curves that generate Engels curves ***identical*** to these:



The Market Demand Curve?

- Hang on a second…
  - If all invididuals have the same preferences…
    - ***Then there's only one individual…***

- And if your relative consumption of goods doesn't change as income changes
  - ***Then there's only one good…***
- So…

The Market Demand Curve?

- Market demand curves obey the Law of Demand (be downward sloping) if …
  - There is only one consumer; and
  - There is only one commodity!

- This is "proof by contradiction" that market demand curves won't necessarily slope downwards
  - Even if all individual demand curves do!

"Proof by contradiction?"

- Ancient technique to prove a mathematical proposition
  - Assume something is true
    - E.g. "The square root of 2 is a rational number"
  - Follow through the logic
  - Find a contradiction
    - Thus prove that "The square root of 2 is **not** a rational number"
  - If the square root of 2 is rational, then there are integers a and b which are the smallest numbers for which $\frac{a}{b}=\sqrt{2}$
- So we start with:
  - Condition that integers **a** and **b** have ***no*** factors in common (except 1); and
  - The assumption that $\frac{a}{b}=\sqrt{2}$

"Proof by contradiction"

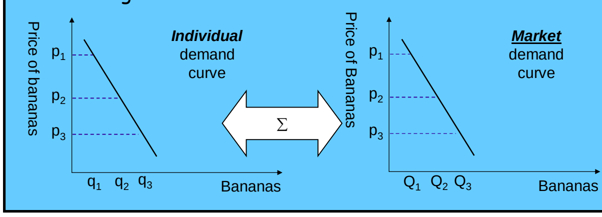
- Now we square both sides to yield $\frac{a^2}{b^2}=2$
- Rearrange to get $\boxed{a^2=2b^2}$
- Can now deduce that **a** must be an even number:
  - 2 times any integer (odd or even) is an even number
  - So we can express **a** as 2 times some other integer **c**
- So **a** squared is: $a=2c$, $a^2=(2c)^2=4c^2$
- Now substitute this into equation for **a** squared above: $a^2\left(=4c^2\right)=2b^2$
- Divide last bit by 2 to yield $2c^2=b^2$
- Which shows that b must also be even since 2 times any integer is an even number
- Therefore **b** is divisible by 2…
  - So **a** and **b** have 2 as a common factor!

"Proof by contradiction"

- But we began with the condition that **a** and **b** had no common factor—our assumption that the square root of 2 is rational has been contradicted by a series of logical steps.
- ***Therefore "proof by contradiction that the assumption that the square root of 2 is a rational number must be false***
- Therefore the square root of 2 must be *irrational*:
  - It cannot be equal to the ratio of two integers
- This is how Pythagoreans discovered irrational numbers
  - Didn't like it—began with belief that all numbers were rational—but forced to accept it by logic
- Neoclassical economists instead resist a similar result:

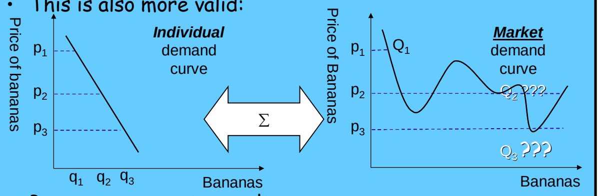
"Proof by contradiction"

- Assume market demand curves slope downwards
- Start from condition of many consumers & commodities
- Find that can only get downward sloping market demand curve if there is only 1 consumer and 1 commodity
- Proof by contradiction that market demand curves ***can have any shape at all***
  - Even if individual demand curves obey "Law of Demand"
- So though economists draw demand curves like this:



"Proof by contradiction"

- This is also more valid:



- Proper response to result:
  - Market demand curves can't be guaranteed to slope downwards
    - Supply-demand equilibrium analysis not sustainable
    - Have to replace Marshallian micro with something else
  - AND…

The "Representative Agent"

- Can't model whole economy as single individual
  - But could aggregate to classes
  - Should revive Classical economic class-based analysis
- Alan Kirman's sensible reaction to this result:
  - "If we are to progress further we may well be forced to theorise in terms of groups who have collectively coherent behaviour.
  - Thus demand and expenditure functions if they are to be set against reality must be defined at some reasonably high level of aggregation.
  - *The idea that we should start at the level of the isolated individual is one which we may well have to abandon.*" (Kirman, *Economic Journal*, 1989, p. 138)
- Honest statement of this in advanced research book:

The "Representative Agent"

- Shafer & Sonnenschein (*Handbook of Mathematical Economics* Vol II, 1982: pp. 671-2)
  - "… market demand functions need not satisfy *in any way* the classical restrictions which characterize consumer demand functions…
  - The importance of the above results is clear: strong restrictions are needed in order to justify the hypothesis that a market demand function has the characteristics of a consumer demand function.
  - Only in special cases can an economy be expected to act as an 'idealized consumer'.
    - *The utility hypothesis tells us nothing about market demand unless it is augmented by additional requirements."*
- Versus dishonest statements in postgraduate textbook:

The "Representative Agent"

- Varian *Microeconomic Analysis*:
  - "it is sometimes convenient to think of the aggregate demand as the demand of some 'representative consumer'…
    - *The conditions under which this can be done are rather stringent, but a discussion of this issue is beyond the scope of this book…"*
      - (Varian 1987: 268)
  - 2nd Edition: "This demand function can in fact be *rationalized* by a representative consumer…"
  - 3rd edition: "This demand function can in fact be *generated* by a representative consumer…"
- And even worse in undergraduate texts… (thanks to Brendan Clarke & Yuanjun Li)…

Glossing over the problem

- No discussion of conditions under which
  - "Sloman & Norris, 2002 "Macroeconomics", 2nd Edition, Pearson Education Australia, Sydney halfway down page 45 under the heading "The Demand Curve" discusses how the market demand curved is arrived at via adding up total demand of all consumers in the market for any given price."

Glossing over the problem

- 1. Paul A. Samuelson & William D. Nordhaus, 2010, Microeconomics, 19th ed. McGraw- Hill Irwin, New York, Ch3, p.48
  - "The market demand curve is found by adding together the quantities demanded by all individuals at each price.
  - Does the market demand curve obey the law of downward-sloping demand?
  - It certainly does.
  - If prices drop, for example, the lower prices attract new customers through the substitution effect.
  - In addition; a price reduction will induce extra purchases of goods by existing consumers through both the income and the substitution effects.
  - Conversely, a rise in the price of a good will cause some of us to buy less."

Glossing over the problem

- 2. W. Bruce Allen, Keith Weogelt, Neil D& Edwin M, 2009, Managerial Economics: theory, applications, and cases, 7th ed, W.W.Norton & Company. Inc, New York , Ch3, pp.83-85
  - "Think of the market demand curve as representing the sum of tastes and preferences of individual consumers.
  - It summarizes the demand curves of all individuals in the market.
  - To derive the market demand curve, we estimate the horizontal sum of all the individual demand curves.
  - At each pricing point we estimate the market total by summing the purchases of all individuals as that price."

The "Representative Agent"

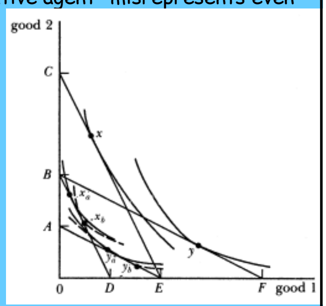
- So rather than recognising problem, most neoclassical economists…
  - Normally don't know of this problem (called "Sonnenschein-Mantel-Debreu conditions")
    - Or interpret it in "off with the Fairies" way:
      - "The necessary and sufficient condition quoted above is intuitively reasonable. It says, in effect, that an extra unit of purchasing power should be spent in the same way no matter to whom it is given." (Gorman 1953)
    - Continue teaching micro as if it's valid
    - Assume that entire macroeconomy can be modelled as a "representative agent"…
  - Advanced neoclassical textbook (Varian) hides nature of problem…

The "Representative Agent"

- "Unfortunately … the aggregate demand function will in general possess no interesting properties … The neoclassical theory of the consumer places no restrictions on aggregate behaviour in general." (Varian 1992)
- Unless we…
  - "Suppose that all individual consumers' indirect utility functions take the Gorman form … [where] … the marginal propensity to consume good j is independent of the level of income of any consumer and also constant across consumers … This demand function can in fact be rationalized by a representative consumer." (Varian 1992)
- Gave rise to practice of modelling whole economy as one individual…

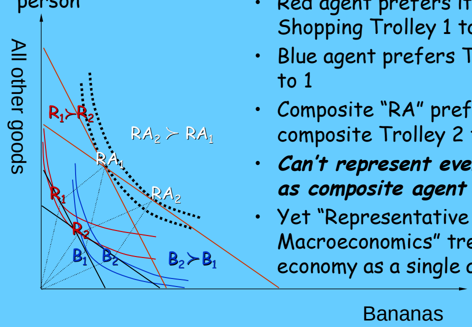
The "Representative Agent"

- Kirman shows "representative agent" misrepresents even 2 people…
- Two individuals with different indifference curves
  - A puts bundle x_a on higher indifference curve that y_a
  - B puts bundle x_b on higher indifference curve than y_b
- Combined agent makes same aggregate choices
- But "representative agent" prefers y to x!



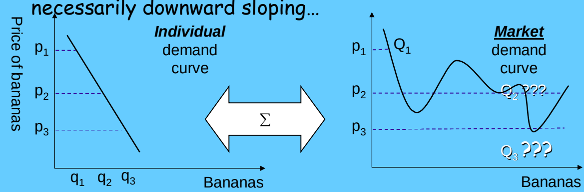
The "Representative Agent"

- Less complicated example than Kirman's still shows "representative agent" can't represent more than 1 person
  - Red agent prefers its Shopping Trolley 1 to 2
  - Blue agent prefers Trolley 2 to 1
  - Composite "RA" prefers composite Trolley 2 to 1
  - ***Can't represent even 2 people as composite agent***
  - Yet "Representative Agent Macroeconomics" treats whole economy as a single agent!



The Demand curve is suss…

- Individuals can't be utility-maximisers
  - Indifference curves from which individual demand curve is derived don't exist
- Even if they did, market demand curve won't be necessarily downward sloping…



- So what about the supply curve?
  - I'm afraid I have some bad news…; but first …
    - the world according to Mankiw's Microeconomics:

The Firm's Objective

The economic goal of the firm is to maximize profits.

Monopoly versus Competition

Monopoly
- Is the sole producer
- Has a downward-sloping demand curve
- Is a price maker
- Reduces price to increase sales

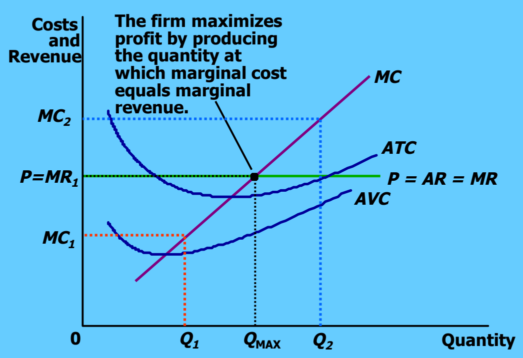
Competition versus Monopoly

Competitive Firm
- Is one of many producers
- Has a horizontal demand curve
- Is a price taker
- Sells as much or as little at same price

Profit Maximization for the Competitive Firm

- The goal of a competitive firm is to maximize profit.
- This means that the firm will want to produce the quantity that maximizes the *difference between total revenue and total cost.*

Profit Maximization for the Competitive Firm...



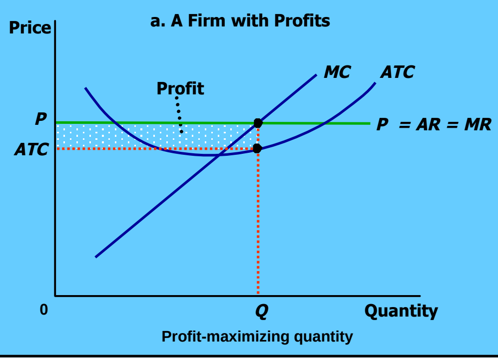
Profit Maximization for the Competitive Firm

When MR > MC ➪ **increase Q**

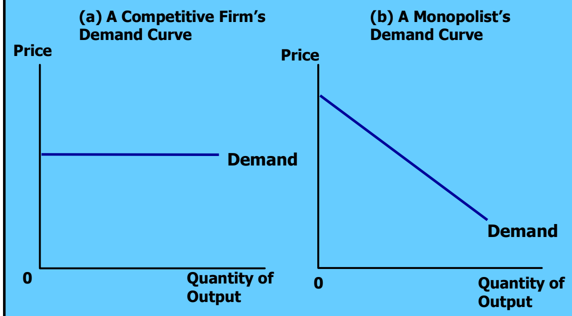
When MR < MC ➪ ***decrease Q***

When MR = MC ➪ ***Profit is maximized.***

Measuring Profit in the Graph for the Competitive Firm...



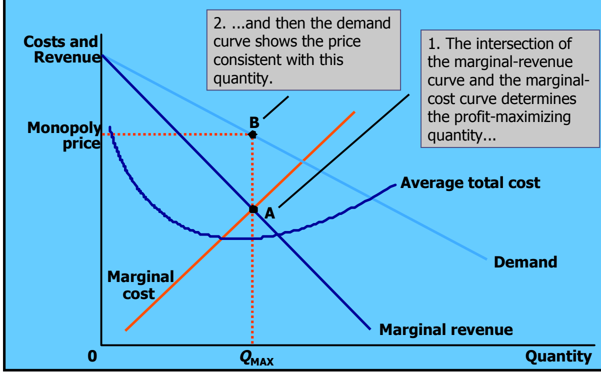
Demand Curves for Competitive and Monopoly Firms...



A Monopoly's Marginal Revenue

- A monopolist's marginal revenue is always <u>less than</u> the price of its good.
  - The demand curve is downward sloping.
  - When a monopoly drops the price to sell one more unit, the revenue received from previously sold units also decreases.

Profit-Maximization for a Monopoly...



A Monopoly's Profit

- Profit equals total revenue minus total costs.
- Profit = TR - TC
- Profit = (TR/Q - TC/Q) x Q
- Profit = (P - ATC) x Q

The Inefficiency of Monopoly...

Milton Friedman's "As if" defence of theory

- Friedman's famous "Can't criticise theory for unrealistic assumptions" "Methodology" paper
- Directed at criticisms of theory of firm because Businessmen don't equate Marginal Cost to Marginal Revenue
- Friedman's defence included "billiard player" analogy:
  - "excellent predictions would be yielded by the hypothesis that the billiard player made his shots as if he knew the complicated mathematical formulas that would give the optimum directions …
  - Our confidence in this hypothesis is not based on the belief that billiard players, … can or do go through the process described;
  - it derives rather from the belief that, unless … they were capable of reaching essentially the same result, they would not in fact be expert billiard players." (p. 21)

Milton Friedman's "As if" defence of theory

  - "It is only a short step from these examples to the economic hypothesis that under a wide range of circumstances individual firms behave as if … they knew the relevant cost and demand functions,
  - calculated marginal cost and marginal revenue from all actions open to them, and
  - **pushed each line of action to the point at which the relevant marginal cost and marginal revenue were equal**."
- So Friedman's argument is
  - Even though firms don't consciously set MC=MR
  - ***Unless what they did had the same effect, they wouldn't maximise profits…***

Testing Friedman

- Computer simulation lets us test this:
  - Set up textbook market demand curve
  - Artificial firms that are "instrumentally rational profit-maximisers"
    - Choose output level at random
    - Choose amount to vary output
    - Vary output
      - If profit rises, keep going in same direction
      - If profit falls, reverse direction
    - See what happens:
      - Do "instrumentally rational profit-maximisers" behave as neoclassical economics predicts?

The model

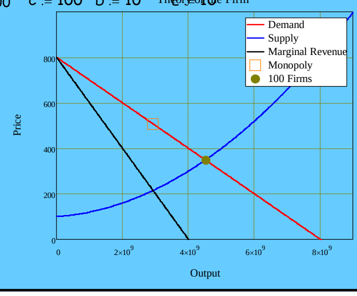
- Textbook demand and supply curves:

$P(Q) := a - b \cdot Q \quad MC(Q) := C + D \cdot Q + E \cdot Q^2 \quad MR(Q) := a - 2 \cdot Q \cdot b$

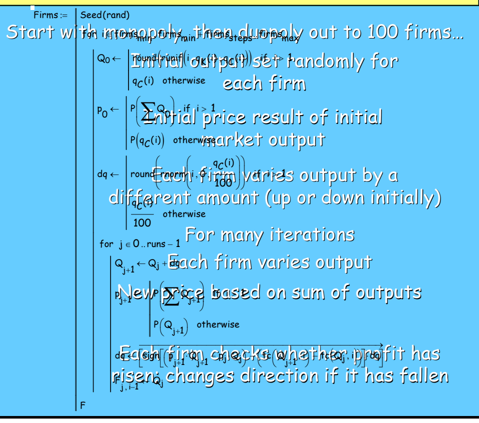
- Parameter values that give "realistic" (big!) quantities:

$a := 800 \quad b := \frac{1}{10000000} \quad C := 100 \quad D := 10^{-8} \quad E := 10^{-17}$

- So theory predictions are:



The program…

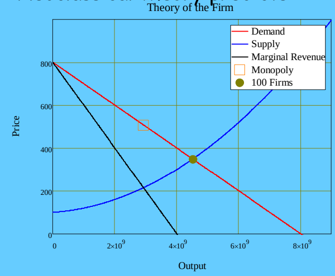


The simulation

- Program starts with 1 firm; randomly chosen output level; randomly chosen amount to vary output
  - Iterates change in output for 1,000 cycles
  - Finds where output converges to
- Does the same for 2 firms, then 3, out to 100 firms
- Neoclassical theory predicts:
  - With comparable costs (more on that later)
    - the more firms in an industry, the higher the output and the lower the price
    - In particular:
      - Monopoly output less, price higher than competitive industry (say 100 firms)…

The predictions

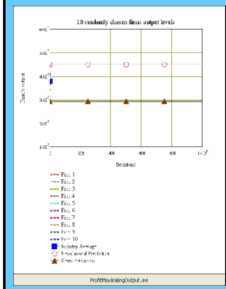
- Neoclassical theory predicts:



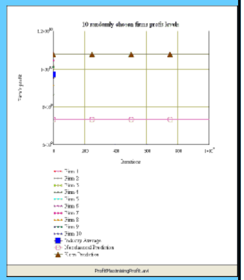
- I predict **same** output level, ***regardless*** of number of firms in industry…

The simulation

- And the winner is…



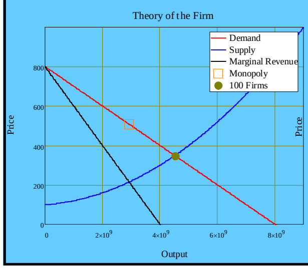
- Whoops—not the textbooks
- So maybe firms aren't profit-maximisers?

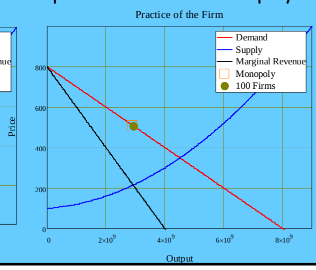


- Nope: "instrumentally rational profit maximisers" make ***higher*** profit than neoclassical MC=MR formula yields!

Theory vs reality…?

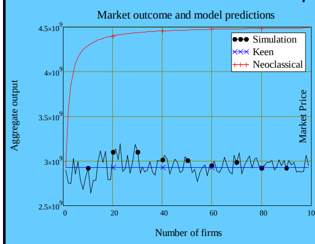
- In practice, Friedman's billiard players do not behave as he expected
  - Don't equate MC & MR;
  - Make higher profits than theory predicts as a result!
  - No difference between competitive firms & monopoly

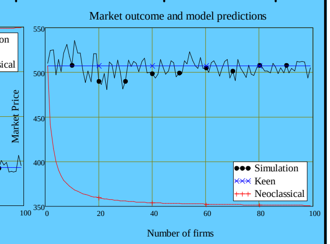




Theory vs reality…?

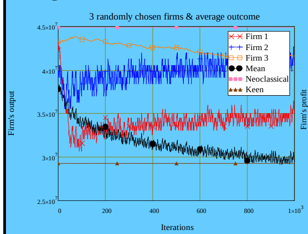
- Number of firms has no impact on market price or output

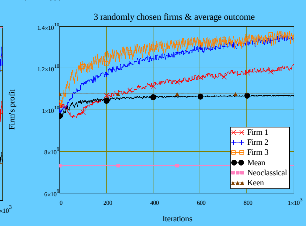




Theory vs reality…?

- Doesn't involve collusion either…





- So what's going wrong???

What's going wrong?

- Equating marginal cost to marginal revenue **doesn't** maximise profits;
- Demand curve for individual firm **can't** be horizontal…
- And lots more…
  - Individual firm demand curve can't be horizontal (under assumptions of Marshallian model):
    - Firms "atomistic"—don't consider what other firms are doing
    - Market demand curve downward sloping
    - If individual firm increases own output, industry output rises by same amount
    - Slope of single-firm demand curve identical to slope of market demand curve…
- Fact that dP/dq=dP/dQ known since 1957:

The 1st Fallacy…

- Stigler (1957). "Perfect competition historically contemplated", *Journal of Political Economy*, 65: 1-17

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PERFECT COMPETITION, HISTORICALLY CONTEMPLATED
GEORGE J. STIGLER

[31] Let one seller dispose of q_i, the other sellers each disposing of q. Then the seller's marginal revenue is

$$\frac{d\,(p\,q_i)}{d\,q_i} = p + q_i\,\frac{dp}{dQ}\,\frac{dQ}{d\,q_i},$$

Letting $Q = nq_i = nq$, and writing E for

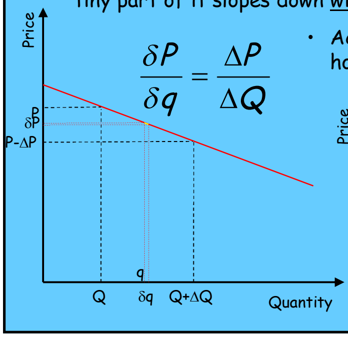
$$\frac{dQ}{dp}\,\frac{p}{Q},$$

we obtain the expression in the text.

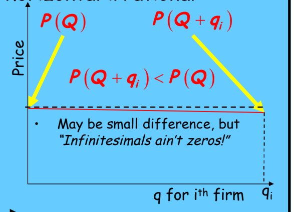
- Leading journal
  - *Lead article too!*
- Leading neoclassical:
  - Stigler main opponent of
    - Sweezy ("kinked demand curve")
    - Means ("actual administered pricing policies of real companies")
- See Freedman (1995, 1998)

The 1st Fallacy

- The graphical intuition:
  - If the market demand curve slopes down, then any tiny part of it slopes down with the same slope:



- Acting "as if" demand curve horizontal *irrational*:



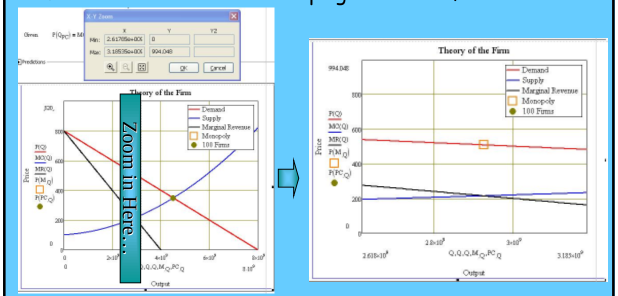
The 1st Fallacy

- How do neoclassicals get horizontal firm demand curve from downward sloping market one?
  - Simple!…

- Visually: zoom in on horizontal axis while leaving vertical at full scale…
- Which "flattens" the line…

The 1st Fallacy

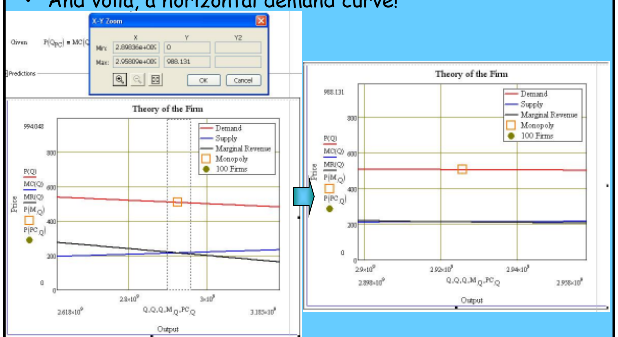
- How to turn a downward sloping line into a flat one:



- Do it again…

The 1st Fallacy

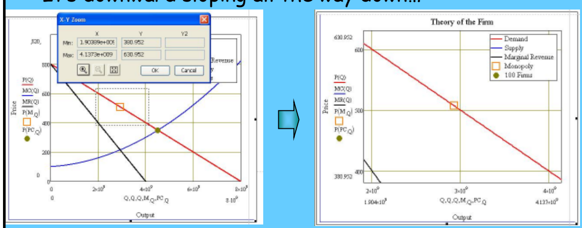
- And voila, a horizontal demand curve!



- But if you zoom on vertical and horizontal axes…

The 1st Fallacy

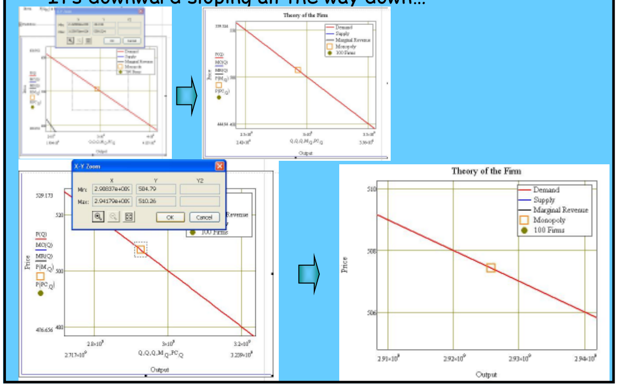
- It's downward sloping all the way down…



- Do it again…

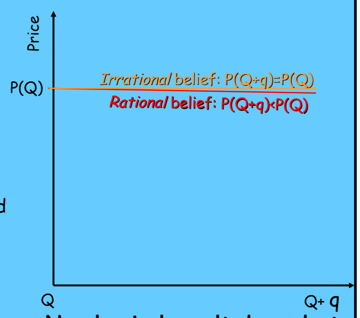
The 1st Fallacy

- It's downward sloping all the way down…



The 1st Fallacy

- *"Can't we just assume price-taking?"*
  - Firm assumes can sell as much as it likes at market price…
  - Sure—but this is *irrational behavior*, not rational
  - *If* the market demand curve slopes downwards, *then* any increase in output, no matter how small, *must* cause market price to fall, however infinitesimally.



- **Neoclassical result dependent upon *irrational* behavior…**

The 1st Fallacy

- Summing up so far:
  - Marginal revenue for individual firm less than price…
  - Demand curve for single atomistic firm *can't* be horizontal
  - Introductory economics teaching a fallacy for over 40 years…
  - Can standard tuition still be justified?
    - Stigler 1957: Yes!
      - reworked marginal revenue for the i^{th} firm in terms of the number of firms n and market elasticity of demand E:

The 1st Fallacy

- Convergence to perfect competition argument
- Profit maximizers equate marginal cost & marginal revenue:

$$\frac{d}{dq_i}P\cdot q_i = P + q_i\cdot\frac{d}{dQ}P \quad \text{Introduce } \frac{P}{P}\frac{Q}{Q} \quad = P + q_i\cdot\frac{P}{P}\cdot\frac{Q}{Q}\cdot\frac{d}{dQ}P$$

$$\text{Introduce } q_i = \frac{Q}{n} \quad = P + \frac{Q}{n}\cdot\frac{P}{P}\cdot\frac{Q}{Q}\cdot\frac{d}{dQ}P \quad \text{Rearrange } P's \,\&\, Q's$$

$$\frac{Q}{n}\cdot\frac{P}{P}\cdot\frac{Q}{Q} = P\frac{1}{n}\cdot\frac{Q}{P}\cdot \quad \text{So now we have} \quad \frac{d}{dq_i}P\cdot q_i = P + P\cdot\frac{1}{n}\cdot\frac{Q}{P}\cdot\frac{d}{dQ}P$$

$$\text{where } \frac{Q}{P}\cdot\frac{d}{dQ}P = {}^{1}\!\Big/_{\frac{P}{Q}\cdot\frac{dQ}{dP}} = {}^{1}\!/_{E} \quad \text{So that} \quad \frac{d}{dq_i}P\cdot q_i = P + \frac{P}{n\cdot E}$$

- And… "this last term goes to zero as the number of sellers increases indefinitely" (Stigler 1957: 8)
- Just one problem: *equating marginal cost & marginal revenue isn't profit-maximizing behavior!*

True!

MC=MR maximizes profits… The 2nd Fallacy

- Aggregate effect of equating MC & MR:

Substitute $\frac{dP}{dq_i} = \frac{dP}{dQ}$

$$\sum_{i=1}^{n}\left(mr_i - mc(q_i)\right) = 0 = \sum_{i=1}^{n}\left\{P + q_i\frac{d}{dq_i}P(Q)\right\} - \sum_{i=1}^{n}mc(q_i)$$

n copies of P Substitute $mc(q) = MC(Q)$

Replace with Q $= n\times P + \sum_{i=1}^{n}q_i\frac{d}{dQ}P - \sum_{i=1}^{n}MC(Q)$ **n copies of MC**

Move a P… $= n\times P + Q\times\frac{d}{dQ}P - n\times MC(Q)$ **& a MC…**

$$= (n-1)\times P + \left(P + Q\frac{d}{dQ}P\right) - (n-1)\times MC(Q) - MC(Q) = 0$$

This is MR(Q) (industry, not firm) **Rearranging this:**

The 2nd Fallacy (first proof)

$$MR - MC = -(n-1)\times(P - MC) < 0$$

- "Profit maximizing" strategy of each firm maximising profit w.r.t. its own-output results in aggregate output level where marginal cost exceeds marginal revenue
- Why? Own-output marginal revenue is not total marginal revenue
- Revenue for single firm depends on what other firms do, whether or not it reacts to them or can influence them:

$$dTR_i(Q_R, q_i) = \frac{\partial}{\partial Q_R}\left(P(Q)\cdot q_i\right)dQ_R + \frac{\partial}{\partial q_i}\left(P(Q)\cdot q_i\right)dq_i$$

- **This component ignored by conventional belief**
- **But firms *can* work out what it is…**

The 2nd Fallacy (first proof)

- Profit maximizing formula is not $MR_i=MC_i$ but:

$$mr(q_i)-mc(q_i)=\frac{n-1}{n}\times\left(P(Q)-MC(q_i)\right)\geq 0$$

- Take earlier formula and rearrange so that industry MR-MC is on one side of equals sign:

$$\sum_{i=1}^{n} mr_i-mc_i=(n-1)\times P-(n-1)\times MC+MR-MC$$

$$\left(\sum_{i=1}^{n} mr_i-mc_i\right)-(n-1)\times P-(n-1)\times MC=MR-MC$$

- Set this to zero to find maximum aggregate profit;
- Take terms in P and MC inside summation:

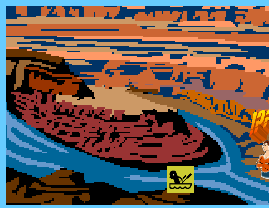
The 2nd Fallacy (first proof)

- Equating this expression to zero maximizes profit:

$$\sum_{i=1}^{n}\left((mr_i-mc_i)-\frac{n-1}{n}\times(P-MC)\right)=0$$

- True single-firm profit-maximization rule is:

$$mr_i-mc_i=\frac{n-1}{n}\times(P-MC)$$

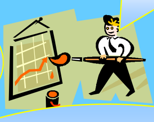


- *Standard rule wrong in multi-firm industry*
- "Maximize profits with respect to own output only" a bit like "row across river and ignore the current"…
- *Even if you can't control other firms, must take their existence into account…*

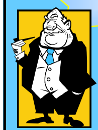
The 2nd Fallacy (second proof)

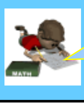
- "But firms can't know that!"
  - *Yes they can!*
    - Problem is…

Economist: "Easy! Equate MR & MC! "



"Work out the output level that maximizes my profits!"





Mathematician: "Hmm! Interesting problem: set total derivative of profit to zero…"

The 2nd Fallacy (second proof)

- The mathematician's logic:
- What other firms do affects your profit
  - *Even if you can't control them;*
  - Even if they don't react (game theory style) to what you do…
- So profit maximized by zero of *total* differential
- So must solve: $\frac{d}{dQ}(\pi(q_i))=0$

Impact of j^{th} firm on i^{th}s profit

Sum over j firms

- Expanding: $\frac{d}{dQ}(\pi(q_i))=\sum_{j=1}^{n}\left(\frac{\delta}{\delta q_j}\pi(q_i)\cdot\frac{\delta q_j}{\delta Q}\right)=0$

Equals 1 since with "atomism" $\frac{\delta q_j}{\delta Q}=1\div\frac{\delta Q}{\delta q_j}=1$

- Expanding: $\sum_{j=1}^{n}\left(\frac{\delta}{\delta q_j}\pi(q_i)\right)=\sum_{j=1}^{n}\left(\frac{\delta}{\delta q_j}(P(Q)\cdot q_i)-\frac{\delta}{\delta q_j}TC(q_i)\right)$

The 2nd Fallacy (second proof)

- Profit maximization rule for single firm is:

$$\sum_{j=1}^{n}\left(\frac{\delta}{\delta q_j}(P(Q)\cdot q_i)-\frac{\delta}{\delta q_j}TC(q_i)\right)=0$$

- Second bit is marginal cost once & zero n-1 times

$$1\cdot\frac{\delta}{\delta q_i}TC(q_i)+(n-1)\cdot\frac{\delta}{\delta q_j}TC(q_i)=MC(q_i)+(n-1)\cdot 0$$

- First bit is:
- Equals 1 <u>once</u> when i=j

$$\sum_{j=1}^{n}\left(\frac{\delta}{\delta q_j}(P(Q)\cdot q_i)\right)=\sum_{j=1}^{n}\left(P(Q)\cdot\frac{\delta}{\delta q_j}(q_i)+q_i\cdot\frac{\delta}{\delta q_j}(P(Q))\right)$$

- (n-1) times this is zero since firms independent
- This is $\frac{dP}{dq_j}=\frac{dP}{dQ}$ n times

MC=MR… The 2nd Fallacy

- So for profit maximization the firm sets q_i so that:

$$\sum_{j=1}^{n}\left(\frac{\delta}{\delta q_j}(P(Q)\cdot q_i)-\frac{\delta}{\delta q_j}TC(q_i)\right)$$

$n\cdot q_i\approx Q$ $\quad =P(Q)+n\cdot q_i\cdot P`(Q)-MC(q_i)=0$

- Conventional economic formula leaves out the n:
- Since P`(Q) negative, with rising (?) marginal cost & falling price, true profit maximizing q_i a lot less than "MR=MC" level
- Real "MR" for firm same as industry MR
- Conventional formula only right for monopoly…
- "Competitive" profit maximizers produce same output level as monopoly (given comparable costs…)
- An example (with constant MC; rising considered later)

MC=MR… The 2nd Fallacy

- Standard *false* neoclassical advice:
  - equate MR_i & MC
  - Output converges to PC result as number of firms increases (Stigler's result):
- Conditions:

$$P(Q)=a-b\cdot Q$$
$$\frac{dP}{dQ}=-b$$
$$MR_i=P+q\cdot\frac{dP}{dQ}=P-b\cdot q$$
$$MC=c$$

- Result:

$$MR_i=P-b\cdot q=MC=c$$
$$a-b\cdot Q-b\cdot q=c$$
$$a-b\cdot n\cdot q-b\cdot q=c$$
$$b\cdot(n+1)\cdot q=a-c$$
$$q=\frac{1}{n+1}\frac{a-c}{b}$$

Monopoly: $Q=\frac{1}{2}\frac{a-c}{b}$

Competition: $Q=n\cdot q=\frac{n}{n+1}\frac{a-c}{b}\to\frac{a-c}{b}$ as $n\to\infty$

MC=MR… The 2nd Fallacy

- But *profit maximizers* solve: $MR-MC=\frac{n-1}{n}(P-MC)$

$$P-b\cdot q-c=\frac{n-1}{n}(P-c)$$
$$b\cdot q=P-c-\left(\frac{n-1}{n}(P-c)\right)$$
$$q=\frac{P-c}{n\cdot b}$$
$$q=\frac{a-b\cdot n\cdot q-c}{n\cdot b}=\frac{a-c}{n\cdot b}-q$$
$$q=\frac{1}{2}\frac{a-c}{n\cdot b}$$

- **Competitive industry produces "monopoly" level output at "monopoly" price**
- **Industry output independent of number of firms**
- **Similar result for other marginal cost functions: "competitive" outcome same as monopoly**
- **Aggregating:**

$Q=n\cdot q=\frac{1}{2}\frac{a-c}{b}$ · ***Same as for monopoly***

MC=MR… The 2nd Fallacy

- Does it make much difference?
  - *It does if you're trying to maximize profits!*
- Accepted formula: $q_c=\frac{1}{n+1}\frac{a-c}{b}$

$$\pi(q_c)=\left(a-b\cdot\frac{n}{n+1}\frac{a-c}{b}\right)\cdot\frac{1}{n+1}\frac{a-c}{b}-c\cdot\frac{1}{n+1}\frac{a-c}{b}$$

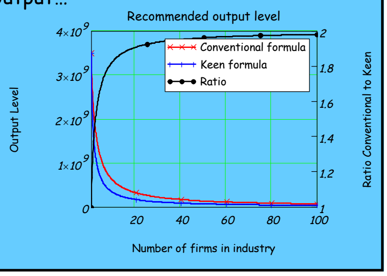
- Solving for profit: $\pi(q_c)=\frac{(a-c)^2}{b\cdot(n+1)^2}$
- Correct formula: $q_k=\frac{1}{2}\frac{a-c}{n\cdot b}$

$$\pi(q_k)=\left(a-b\cdot n\cdot\frac{1}{2}\frac{a-c}{n\cdot b}\right)\cdot\frac{1}{2}\frac{a-c}{n\cdot b}-c\cdot\frac{1}{2}\frac{a-c}{n\cdot b}$$

- Solving for profit: $\pi(q_k)=\frac{1}{4}\frac{(a-c)^2}{n\cdot b}$
- For n>1 $\pi(q_k)=\frac{1}{4}\frac{(a-c)^2}{n\cdot b}>\pi(q_c)=\frac{(a-c)^2}{b\cdot(n+1)^2}$

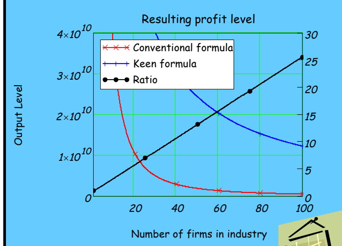
MC=MR… The 2nd Fallacy

- How much difference is that?
  - *Lots!* And the more firms, the more it matters
  - Try a=800, b=1/10,000,000, c=100
- Conventional formula recommends up to twice true profit-maximizing output…



MC=MR… The 2nd Fallacy

- And results in 96% less profit (with 100 firms)



- Mr Businessman's reaction to the advice?

Summing up "Marshall"

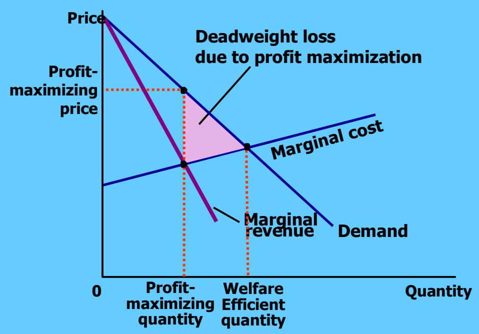
- "Marshallian" theory of the firm incoherent
  - Monopoly/perfect competition distinction based on mathematical fallacy
  - "Atomistic competition" leads to same output as monopoly (*if* costs comparable… another problematic issue!)
  - Rational profit-maximizing incompatible with welfare maximization
    - Can't achieve welfare ideal of Marginal Cost=Price if firms profit-maximize
- Welfare results of theory turned on head

Summing up "Marshall"

- "PC" prices at same level as monopoly
- Profit maximization incompatible with welfare maximization
- General equilibrium analysis invalidated
- Monopoly <u>better</u> than competition according to corrected neoclassical theory: same aggregate pricing policy (MR=MC), lower costs via economies of scale…
- Theory is a shambles…
  - "Deadweight loss of monopoly" actually "deadweight loss of profit maximization"

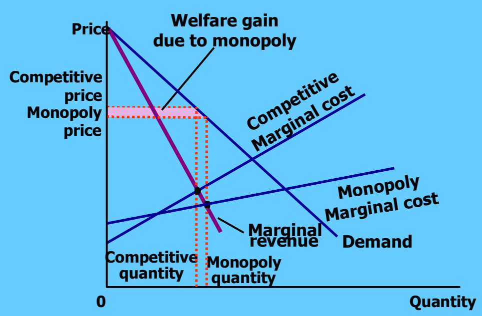
Summing up "Marshall"

The aggregate picture (correcting Mankiw)



Summing up "Marshall"

- Monopoly better than perfect competition if costs lower (as is likely):



Um… What's "rational" again???

- Remember we started with definition of rational
  - Found it was empirically falsified
    - (or that 100% of people are irrational!)
  - Computationally impossible
  - Has problems of "emergence": even if individuals behaved that way, market demand curves could have any shape at all
    - Yet neoclassical economists assume they're downward-sloping using fiction of "representative agent"
      - RA can't even aggregate two people properly
      - Yet economists model entire economy as single Representative Agent!
- & economists ignore problems in supply theory too…
- This is rational???

Economics and Rationality

- Whatever rationality is, it isn't what economists define it to be…
  - Need definition of rationality that makes sense
    - Before we describe some market behaviour as "rational" and other as "irrational"
    - Clearly computational issue vital
      - "Rational" reasoning must allow decision-making in reasonable time
      - By definition, ***cannot*** involve optimal decision-making
  - Definition of "rational" wide open…