Economics, Law and Ethics

CST part 1b, 2017–8

Ross Anderson, Richard Clayton

Why teach this course?

- Systems: economics used for protocol design, congestion control, mechanisms like blockchain...
- Theory: the combinatorial auction is now seen as the archetypal complexity-theory problem
- Professional: about half of you will eventually go into consultancy, management, …
- Law: what can make you liable online?
- Ethics: how can you navigate the many grey areas?
- Empowerment: hack stuff in the right direction ...
- Ethics mandatory for CS; economics for engineers

Aims and Objectives

- Aims: introduce you to basic concepts in economics, law and ethics
- Objectives: at the end, you should have a basic appreciation of economic and legal terminology and arguments; understand some of the applications of economic models to systems engineering and their interest to theoretical computer science; and understand the main constraints that markets, legislation and ethics place on firms dealing in information goods and services

Outline

- Game theory: prisoners' dilemma, iterated games
- Classical economics with competitive markets
- Market failures – monopoly, asymmetric information, network effects, lock-in
- How information markets are different
- Auction theory and mechanism design
- Principles of law
- IT law (Richard Clayton, November 23rd)
- Ethics – where the law hasn't made up its mind

Resources

- Shapiro and Varian “Information Rules”
- Varian “Intermediate Microeconomics”
- Course website, plus as further reading:
  - Adam Smith, “The Wealth of Nations”
  - JK Galbraith, “A History of Economics”
  - William Poundstone, “Prisoners’ Dilemma”
  - Steven Pinker, “The Better Angels of our Nature”
  - Daniel Kahneman “Thinking, Fast and Slow”
  - Nufield Bioethics Council report on biodata

Studying a humanities subject

- It's not like learning to prove theorems or program in Java, which gives a testable skill
- Wide reading is important – ideas become clearer when approached from several perspectives
- College libraries are a good place to start
- Dig into some subproblem that interests you
- Work out opposing viewpoints: how would a socialist / libertarian / Keynsian / monetarist approach a problem of interest to you?
- Write proper essays! (Essay writing class in Lent)

Roadmap

- Economics as a subject is traditionally made up of macroeconomics, microeconomics and specialised topics
- ‘Macro’ is about the performance and structure of the global economy or a nation or region. It’s about models of employment, inflation, growth, investment, trade, savings, credit, tax, GNP…
- We will touch on this only occasionally

Roadmap (2)

- Microeconomics or ‘micro’ is about how individuals and firms react to incentives, how market mechanisms establish prices, and the circumstances in which markets can fail
- Many topics of interest to computer scientists & engineers include game theory, the economics of information, the economics of dependability, and behavioural economics (economics + psychology)
- Our tools range from mathematical models to empirical social science

Cooperation or conflict

- One way of getting what you want is to make it, or make something else of value and trade for it – 'Economics'
- Another way is to just take it, whether by force or via the ballot box – 'Politics'
- Choices between cooperation and conflict are made at all sorts of levels all the time
- They can evolve in complex combinations
- The main tool we use to tease them out and analyse them is game theory

Game theory

- The study of problems of cooperation and conflict among independent decision-makers
- We focus on games of strategy, rather than chance
- We abstract to players, choices, payoffs, strategies
- There are
  - games of perfect information (such as chess and go)
  - games of imperfect information (which are often more interesting to analyse)

Strategic form

- Example: matching pennies. Alice and Bob throw H or T. If they're different, Alice gets Bob's penny; else he gets hers. The strategic form is

		Bob	
		H	T
Alice	H	-1, 1	1, -1
	T	1, -1	-1, 1

- This is an example of a zero-sum game: Alice's gain = Bob's loss

Dominant strategy equlibrium

- In the following game, Bob's better off playing left; similarly Alice is always better off playing bottom

		Bob	
Alice		Left	Right
	Top	1, 2	0, 1
	Bottom	2, 1	1, 0

- A strategy is an algorithm: input state, output play
- Here, each player's optimal play is a constant
- The is called a 'dominant strategy equilibrium'

Nash equlibrium

- Consider this game:

		Bob: Left	Bob: Right
Alice	Top	2, 1	0, 0
	Bottom	0, 0	1, 2

- Each player's optimal strategy depends on what they think the other will do
- Two strategies are in Nash equilibrium when A's choice is optimal given B's, and vice versa
- Here there are two: top left and bottom right
- This game is sometimes called 'Battle of the sexes'

Pure v mixed strategies

- If we allow only deterministic algorithms, some games have no Nash equilibrium. E.g.

Bob

Alice	scissors	paper	stone
scissors	0	1, -1	-1, 1
paper	-1, 1	0	1, -1
stone	1, -1	-1, 1	0

- Alice plays scissors → Bob wants to play stone → Alice wants to play paper …
- Fix: randomised algorithm. This is called a 'mixed' strategy; deterministic algorithms are called 'pure'

Prisoners' dilemma

- Two prisoners are arrested on suspicion of planning a robbery. The police tell them separately: if neither confesses, one year each for gun possession; if one confesses he goes free and the other gets 6 years; if both confess then each will get 3 years

Benjy

Alfie

	confess	deny
confess	-3, -3	0, -6
deny	-6, 0	-1, -1

- (confess, confess) is the dominant strategy equilibrium
- It's obviously not optimal for the villains!
- Is this a problem? If so, what's the solution?

Prisoners' dilemma (2)

- You might answer 'serves them right'!
- But this can't apply to all instances of the dilemma
  - Defence spending
  - Fishing quotas
  - Free riders in file-sharing systems
  - Reducing carbon emissions
  - …
- Tough but inescapable conclusion: if the game is truly as described, there is no escape. Both will cheat rather than cooperate, with bad outcome
- To fix it, you need to change the game somehow!

The evolution of cooperation

- If PD played repeatedly, there's a fix!
- 'Tit-for tat': cooperate at round 1, then at round n do what the other guy did at n-1
- Large simulation competitions run by Bob Axelrod played off many iterated-game strategies; tit-for-tat did consistently well
- In the presence of noise, tit-for-tat gets locked into (defect, defect). So: forgive the other guy occasionally
- People have realised in the last 20 years or so that strategy evolution explains a lot of behaviour

Price-fixing

- If it costs $250 to fly someone LHR-JFK, do airlines compete and charge $255 or collude and charge $500?
- Competition laws forbid price-fixing cartels, but the same behaviour can arise implicitly
- Try charging $500 and see what other airlines do. If they ‘defect’ by competing, play tit-for-tat
- If you’re the regulator, how do you cope?

Stag hunt

- People can hunt rabbits on their own, but have to work together to hunt a stag. If your buddy runs off after a rabbit, the stag will escape

Frank

Bernard

	chase hare	hunt stag
chase hare	2, 2	5, 0
hunt stag	0, 5	10, 10

- Difference from PD: (stag, stag) is now a Nash equilibrium
- You'll only chase a rabbit if you believe your buddy will defect
- Thus while PD is payoff-dominant, stag hunt is risk-dominant

Volunteer's dilemma

- Multi-player chicken: if one person volunteers, everyone else benefits, but if no-one volunteers then everyone suffers a big loss

Everyone else

Me	someone acts	no-one acts
act	benefit - cost	benefit - cost
don't act	benefit	big loss

- The Arab Spring: "If everyone goes on the street and says 'the government is finished', it's finished. If you go on the street and say 'the government is finished', you're finished"
- Evolution of leadership: first move = fitness signal

Chicken

- In ‘Rebel without a cause’, Jim (James Dean) and Buzz (Corey Allan) drive stolen cars at a canyon and try to jump out last to prove their manhood

		Jim: jump	Jim: drive on
Buzz	jump	2, 2	1, 3
	drive on	3, 1	0, 0

- Here, (1,3) and (3,1) are Nash equilibria
- Bertrand Russell suggested this as a model of nuclear confrontation in the Cold War
- Biologists call the iterated version hawk-dove (more later)

Deadlock

- Differs from PD in that (defect, defect) is preferable to mutual cooperation.

Alice

Bob

	cooperate	defect
cooperate	1, 1	0, 3
defect	3, 0	2, 2

- That is, I'm going to defect anyway but it would be nice if you were a sucker and cooperated
- Is mutual defection a dominant strategy equilibrium, or just a Nash equilibrium?

Asymmetric games

- In the game of 'Bully', the first player plays chicken while the second plays deadlock

Deadlock player

Chicken player	cooperate	defect
cooperate	2, 1	1, 3
defect	3, 0	0, 2

- Example: the 'Wisdom of Solomon'
- The baby's real mother plays chicken (rather see the baby live) while the thief plays deadlock (rather not lose)
- (Depressing) model of military aggression

Game theory and evolution

- John Maynard Smith proposed the 'Hawk-dove' game as a simple model of animal behaviour. Consider a mixed population of aggressive and docile individuals:

	Hawk	Dove
Hawk	(v-c)/2, (v-c)/2	v, 0
Dove	0, v	v/2, v/2

- Food v at each round; doves share; hawks take food from doves; hawks fight (with risk of death c)
- If $v > c$, whole population becomes hawk (dominant strategy)
- What happens if $c > v$?

Game theory and evolution (2)

- If c > v, a small number of hawks will prosper as most interactions will be with doves. Equilibrium reached at hawk probability p setting hawk payoff = dove payoff

	Hawk	Dove
Hawk	(v-c)/2, (v-c)/2	v, 0
Dove	0, v	v/2, v/2

- I.e. $p(v-c)/2 + (1-p)v = (1-p)v/2$

  $\Leftrightarrow pv - pc + 2v - 2pv = v - pv$

  $\Leftrightarrow -pc = -v$

  $\Leftrightarrow p = v/c$

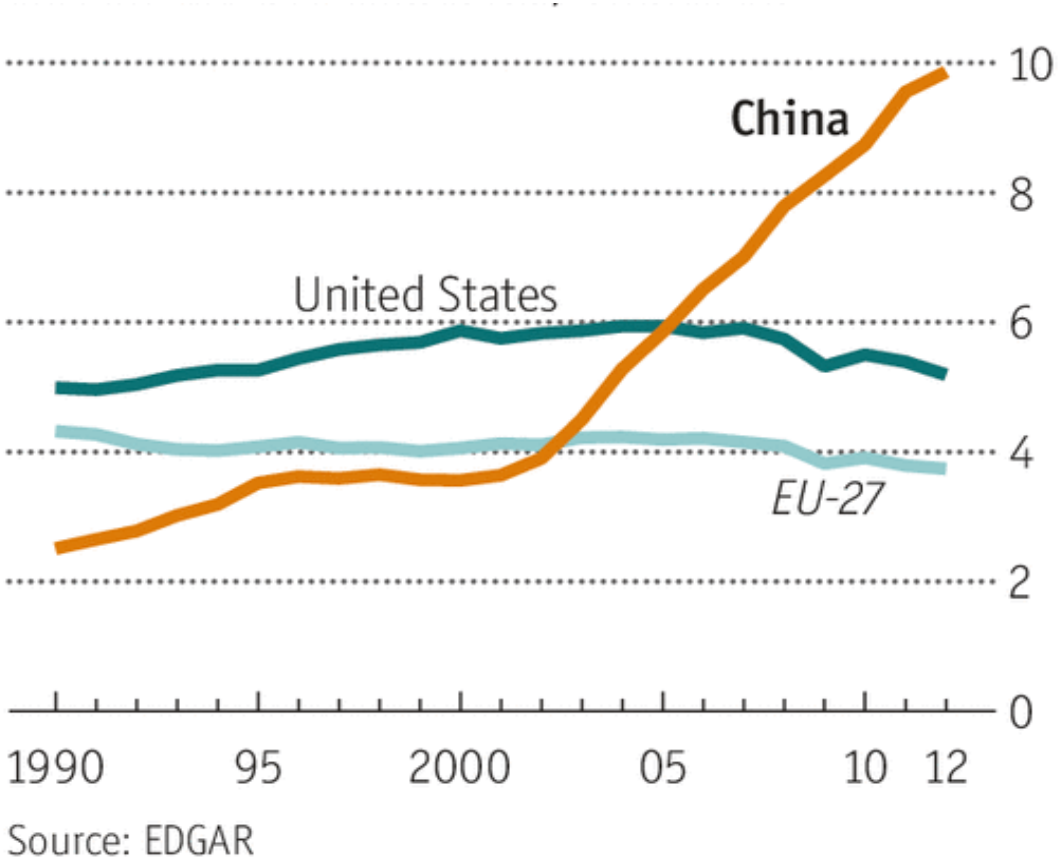
Broader implications

- In pre-state societies, if you see a man you don't recognise, you'd better kill him first (Diamond, "The World Until Yesterday", Seabright "The Company of Strangers")
- Now we live in largely peaceful societies (Pinker, "The Better Angels of our Nature")
- Evolutionary basis of morality: fairness from tit-for-tat, hierarchy from hawk-dove
- Cooperation developed by states, religions, literature, markets, rights, TV, eBay …

Broader implications (2)

- Nash, Axelrod, Maynard Smith and others opened up many applications
- Politics: models of conflict, and of when religions are dominated by fundamentalists
- Criminologists: model the Mafia as alternative contract enforcement, and tattoos as signalling
- Computer science: how do you get people in peer-to-peer systems to upload rather than free ride? How do you get AS operators to tell the truth about Internet routing? Will bitcoin converge, fork or collapse? ...

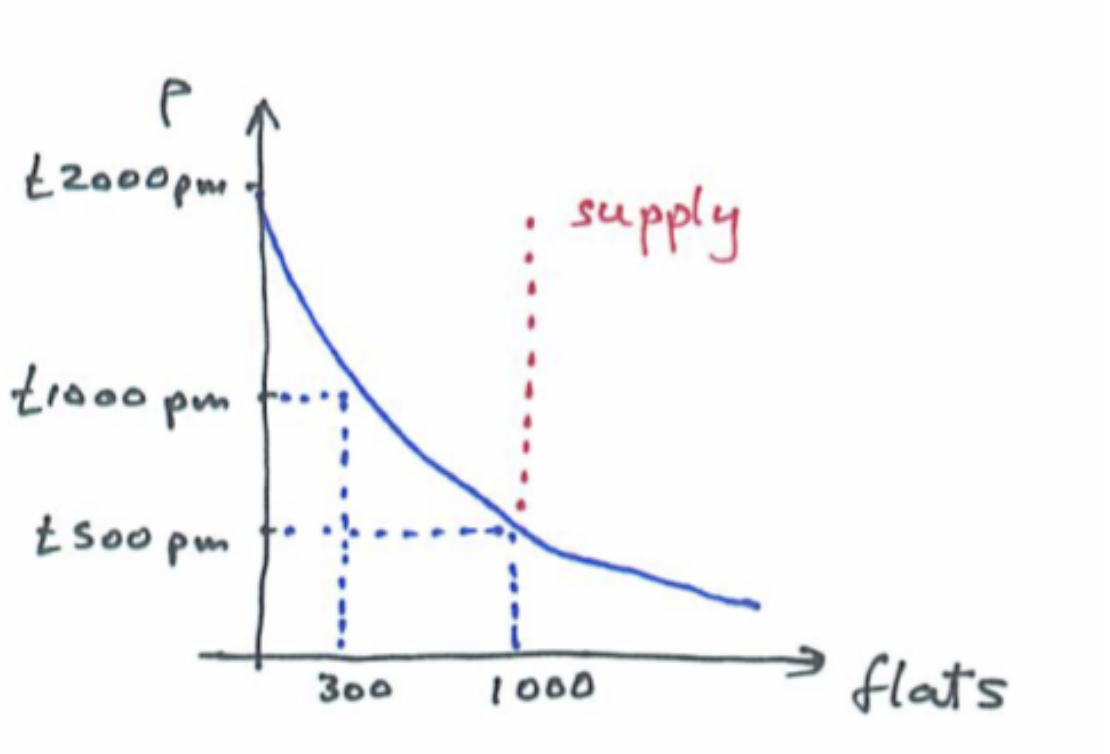
Carbon dioxide emissions (Gt)



Prices and markets

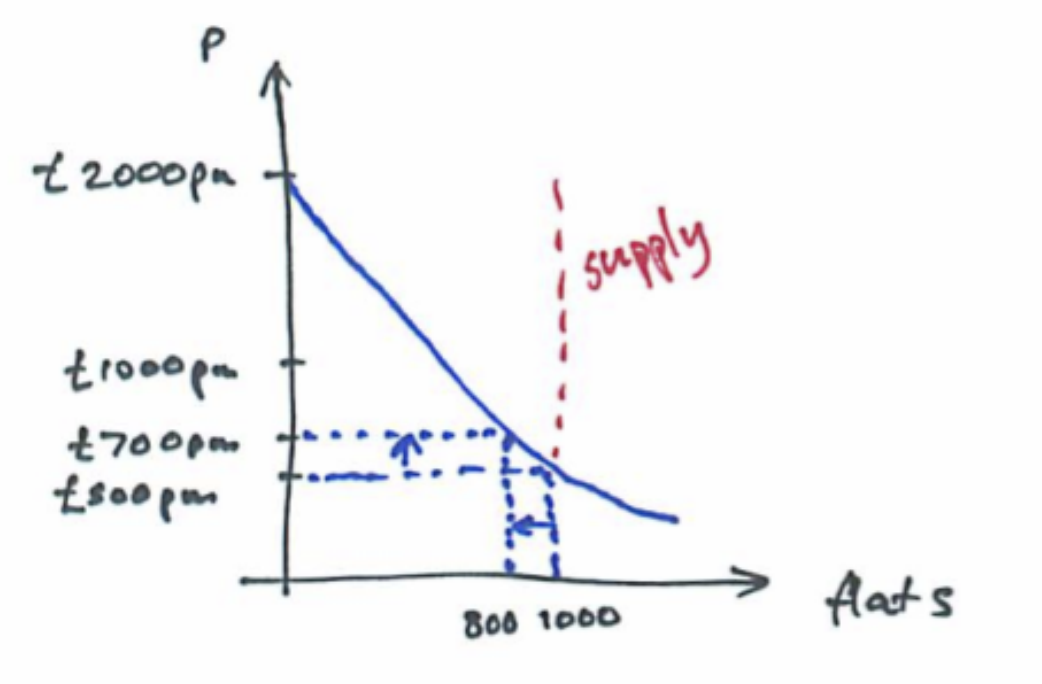
- As an introduction to theories of prices, consumers and markets, consider an idealised market for flats in Cambridge
- Simplify to two types – one-bed flats in town, or house-shares in Chesterton. People who can afford flats will rent them, and those who can't will get house-shares instead
- Assume that there are 1000 flats to rent, and that people vary in their ability / willingness to pay

Accommodation market



- So there might be 1 person prepared to pay £2000, 300 prepared to pay £1000, 1000 prepared to pay £500…
- With 1000 flats to let, the market equilibrium price p* is where the supply and demand curves cross, i.e. £500

Monopoly

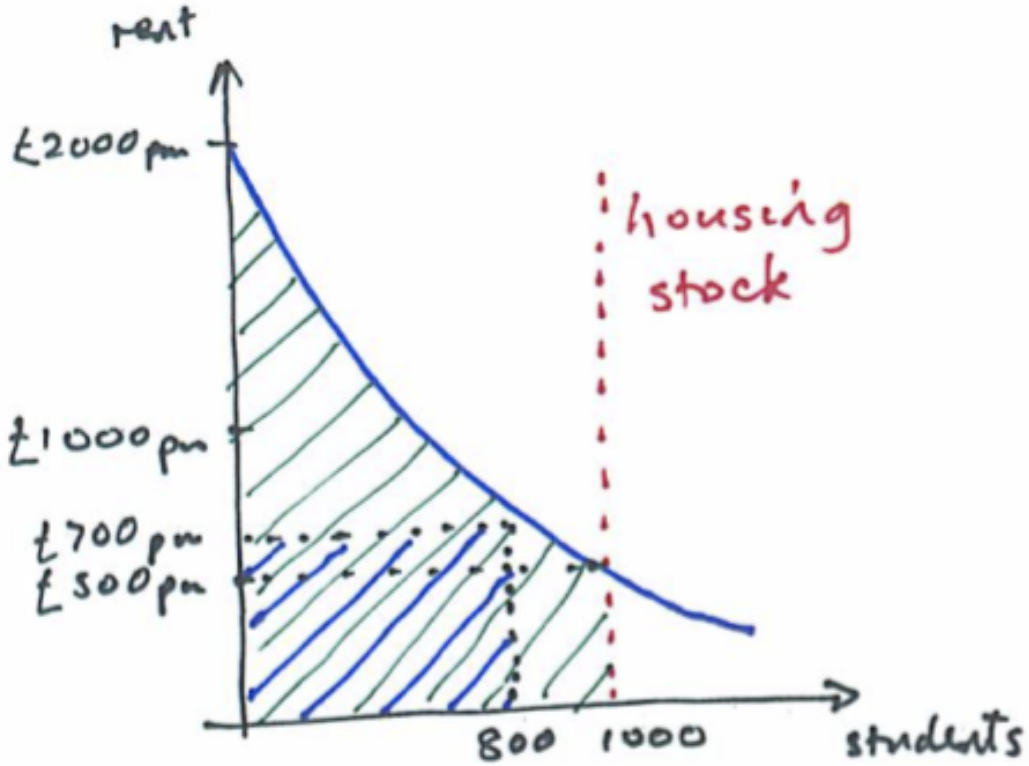


- If the market is rigged, the cartel might restrict supply – 800 flats at £700 pm can earn more than 1000 at £500 pm
- This is inefficient! (there are empty flats which people would pay to rent)
- How can we formalise this?

Efficiency

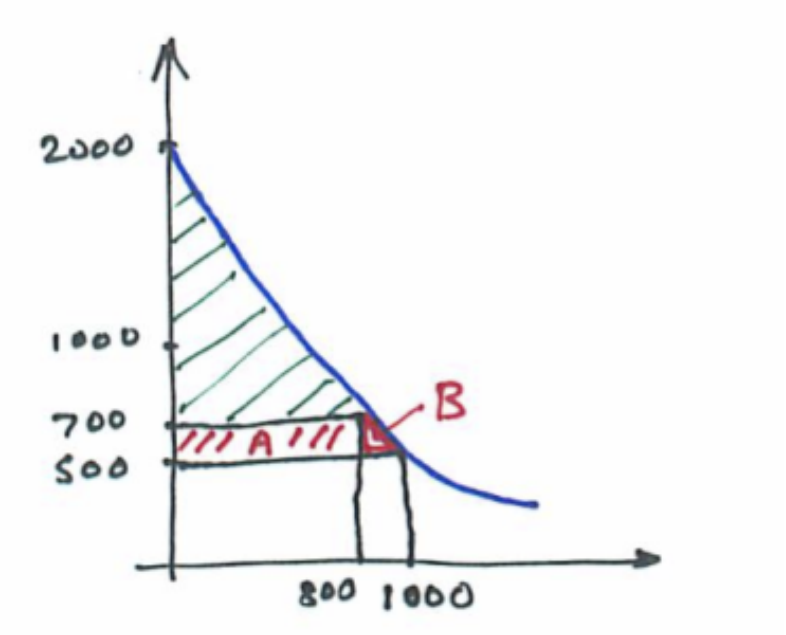
- A monopolist might leave some flats empty despite people being prepared to pay for them
- Definitions
  - A *Pareto improvement* is a way to make some people better off without making anyone worse off
  - A *Pareto efficient allocation* is such that no Pareto improvement is possible
- This is weak: pure monarchy and pure communism are both Pareto efficient!
- Anyway, is there any way for the monopolist to find a Pareto efficient allocation?

Discriminating monopolist



- If you know what everyone can pay, charge them just that!
- This arrangement is Pareto efficient!
- The monopolist captures all the consumer surplus …

Consumer surplus



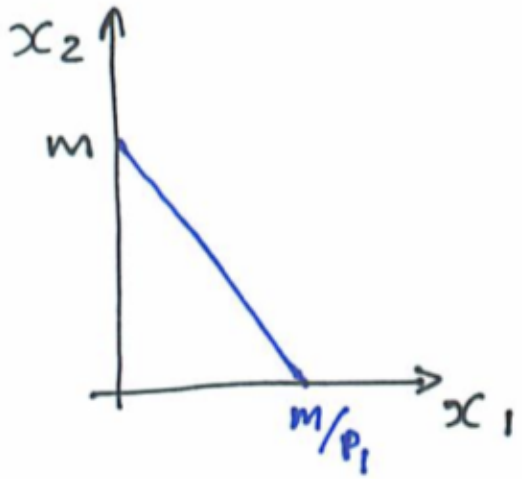
- Consumer surplus is the total amount people saved on their reservation price
- Ordinary monopoly: green area left to consumers
- The monopolist diminished surplus by A and B
- The discriminating monopolist gets the lot!

Monopoly and technology

- Monopolies are common in the information goods and services industries
- We'll study why in some detail later
- For now, monopolists have an incentive to price discriminate, to mop up all the available surplus
- Hence the many prices of Windows!
- But it's not just tech. Think airline tickets, cars, and even food.
- So what factors determine the structure of markets?

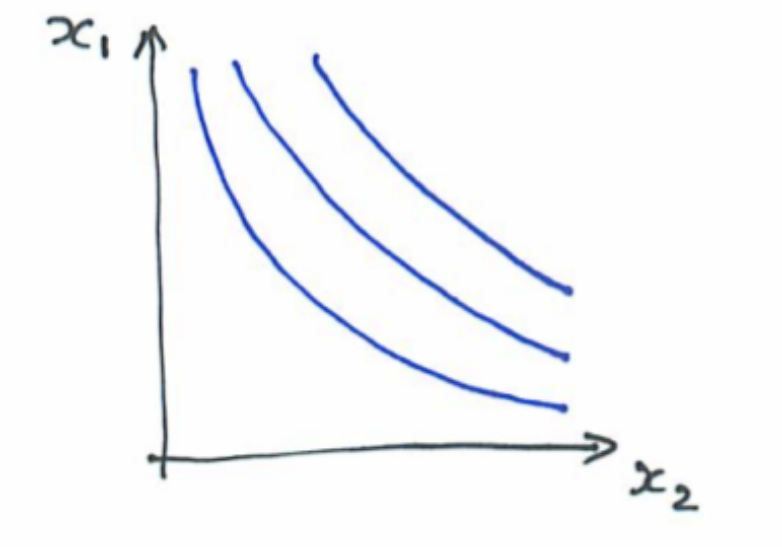
Basic consumer theory

- Examines mechanisms of choice
- Consumers choose 'best' bundle of goods they can afford
- Most of the time, two goods are enough – say books versus everything else
- Assuming a budget constraint m, $p_1x_1 + p_2x_2 \leq m$
- This gives a line on which choices must lie



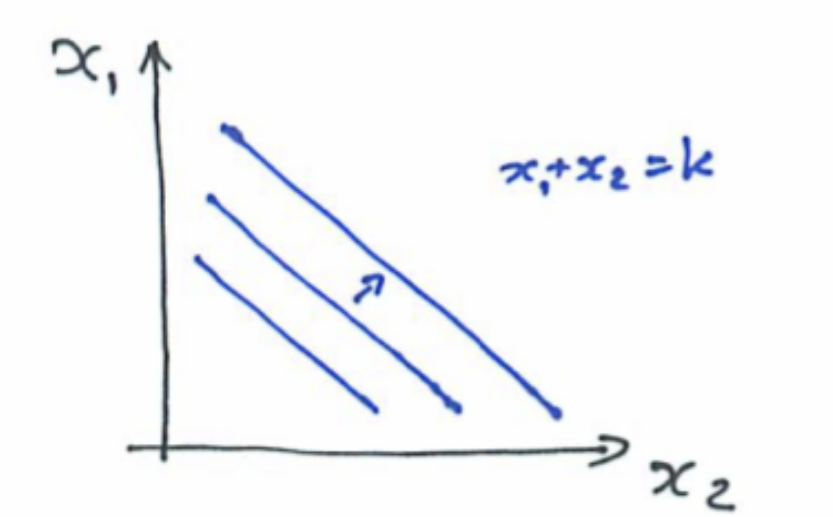
Preferences

- We draw 'indifference curves' or 'isoquants' joining mutually indifferent points – that is, where the consumer prefers bundle (x_1, x_2) equally to (y_1, y_2)
- We assume they're well behaved – the curves don't cross. I.e. if (x_1, x_2) is preferred when (y_1, y_2) is affordable, then when (y_1, y_2) is preferred, (x_1, x_2) is not affordable (the 'weak axiom of revealed preference')



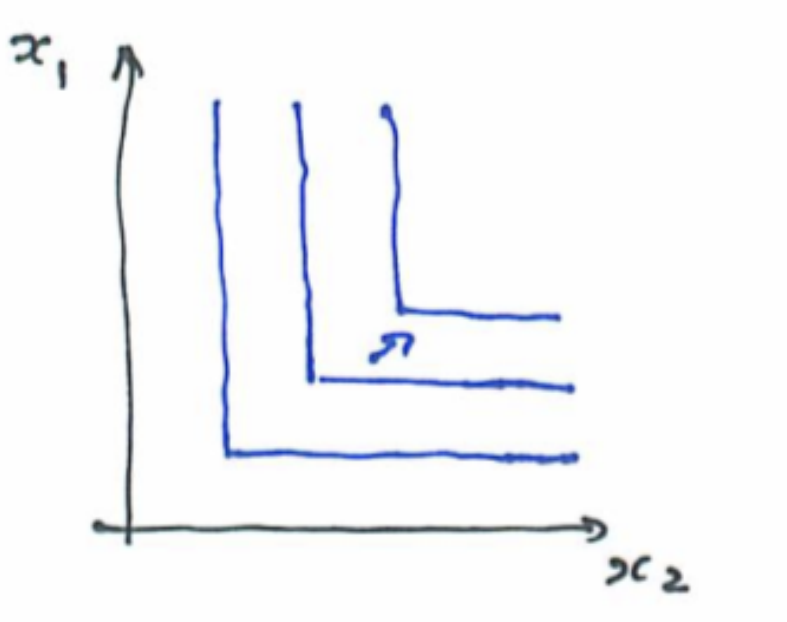
Substitutes

- Sometimes I just don't care at all whether I have good 1 or good 2
- E.g.: Tesco's sugar or Sainsbury's sugar
- Such goods are called substitutes



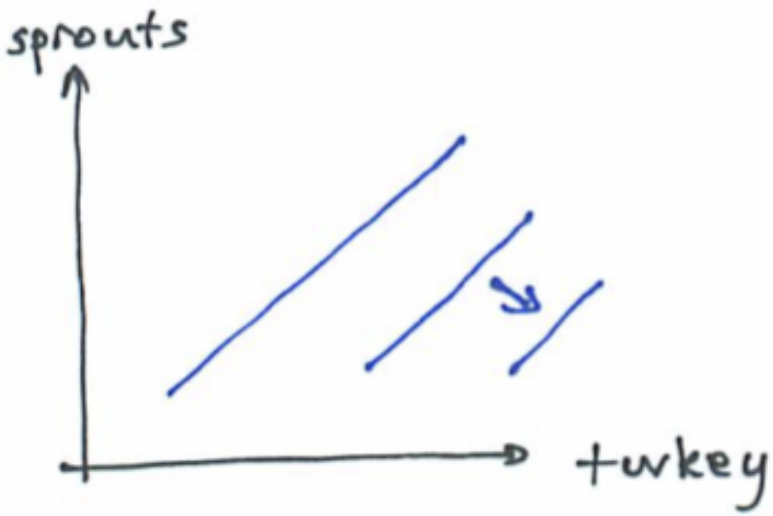
Complements

- Sometimes I want exactly the same quantity of good 1 and good 2
- E.g. left shoes and right shoes
- Such goods are called complements



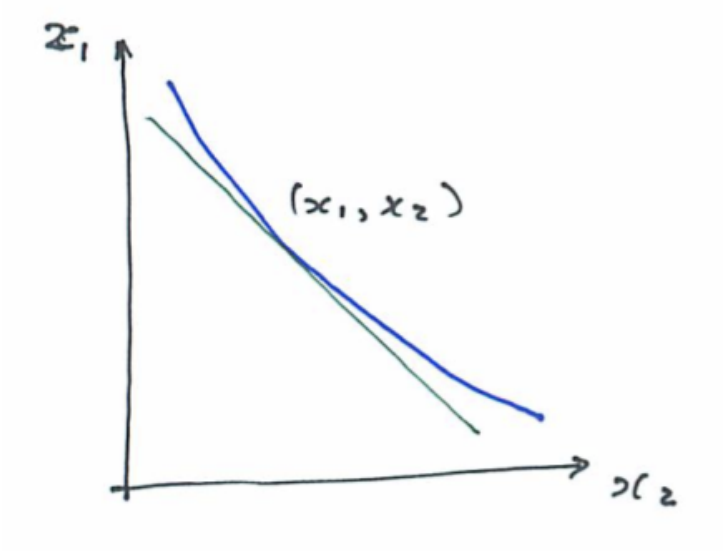
Bads

- There are some goods I'd rather avoid!
- But sometimes I have to consume some of a bad in order to enjoy some of a good



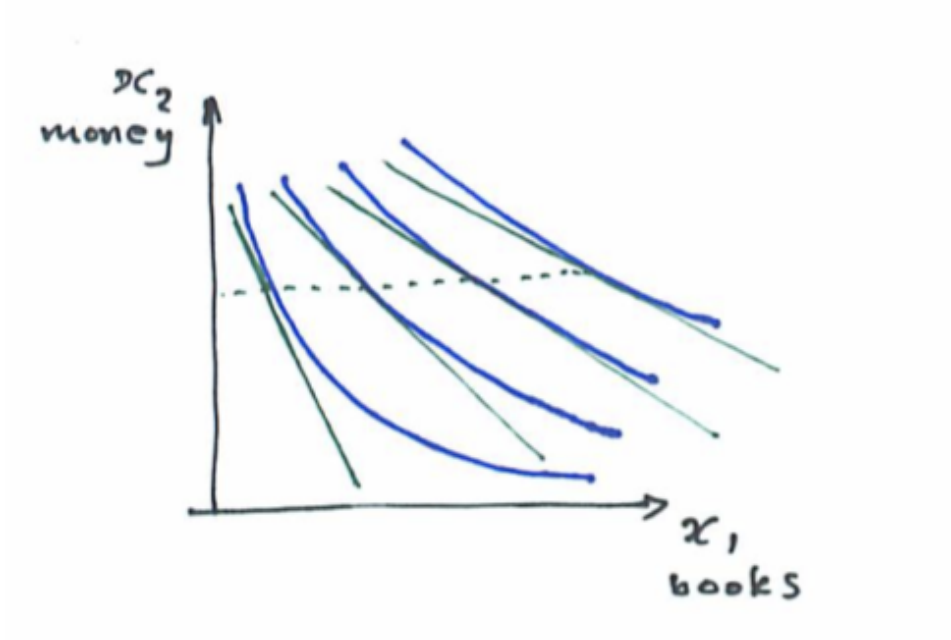
Marginal rate of substitution

- The tangent to an isoquant gives the marginal rate of substitution (MRS)
- This is the exchange rate at which the consumer will trade the two: MRS = $\Delta x_1/\Delta x_2$
- Convex curves: you're more likely to trade the good if you have more of it



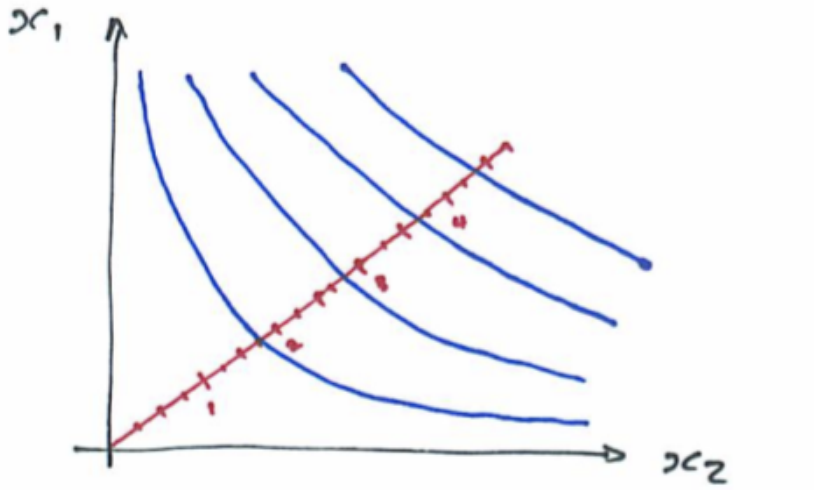
Diminishing MRS

- The more you have of x_1 relative to x_2, the more likely you are to trade x_1 for x_2, in the strictly convex case
- I.e. you become less willing to pay for 'one more'



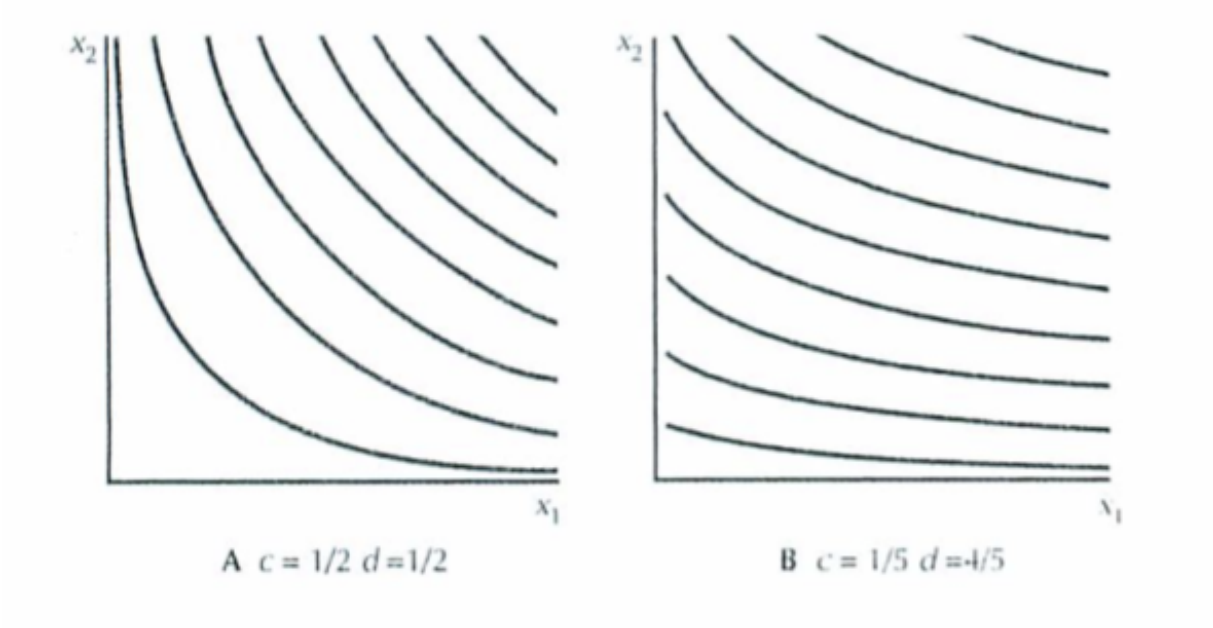
Utility

- Often indifference curves can be parametrised
- Marginal utility $MU_1 = dU/dx_1$
- Then $MRS = -MU_1/MU_2$
- Utility functions can be useful for describing consumer choices
- They can often be inferred from shopping behaviour, and answer questions about the value of better / faster / …



Cobb-Douglas utility

- Commonly used: $U(x_1, x_2) = x_1^c x_2^d$
- If the utility is believed to depend on a number of observed factors, take logarithms and look for a fit



The marginalist revolution

- Until 1871, no-one had a good theory of supply and demand. Why are essentials like water cheap, while diamonds are expensive?
- Solution: the value of the last and least wanted addition to your consumption of a good sets its value to you (Karl Menger, Stanley Jevons, 1871)
- Shifted thinking from costs of production to demand, and led to 'classical synthesis' of Marshall and others – interlocking models of consumption, production, labour, finance etc in a world of free competition

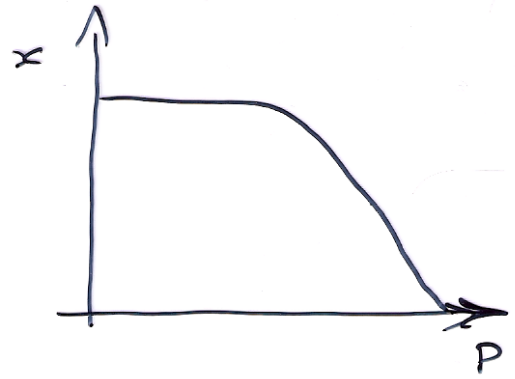
Concrete example

- Suppose a local coal market in 1840 had three typical suppliers / customers

Sea coal gathering	8s	Blacksmiths	15s
Small deep mine	5s	Households	8s
Open-cast mine	2s	Export	3s

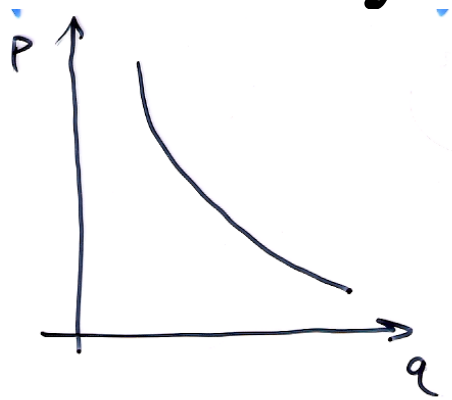
- The market price determines who produces and who consumes
- It's determined by the marginal transaction
- It fluctuates with demand (weather) and can evolve in the long term with tech, investment…

Demand



- Assuming functions well-behaved, we can get a consumer's demand from their utility or vice versa
- Market demand is the sum of demand over consumers
- In general a price change will have a substitution effect (if beer goes up, drink more wine) and an income effect (if rent goes up, you're poorer)
- At the level of this course, we can ignore this…

Elasticity

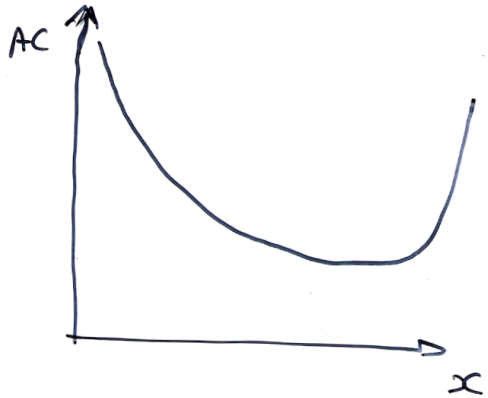


- Given a market demand curve, elasticity measures the effect on demand of a small change in price
- Formally, $\varepsilon(p) = (\Delta q/q)/(\Delta p/p) = p\Delta q/q\Delta p$
- Elasticity = 1 means there are substitutes
- Revenue R = pq, so

  $\Delta R/\Delta p = q + p\ \Delta q/\Delta p$

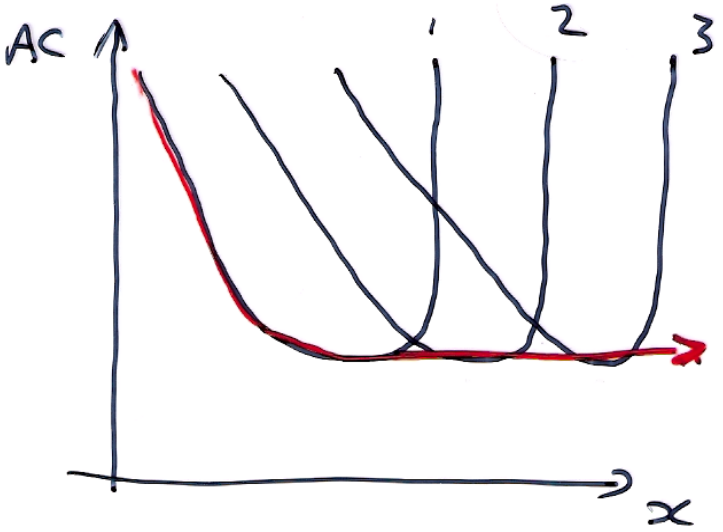
  $= q\ (1 + \varepsilon(p)\ ) = q\ (1 - |\varepsilon(p)|\ )$
- Key fact: price increases boost revenue iff $|\varepsilon(p)| < 1$

Supply



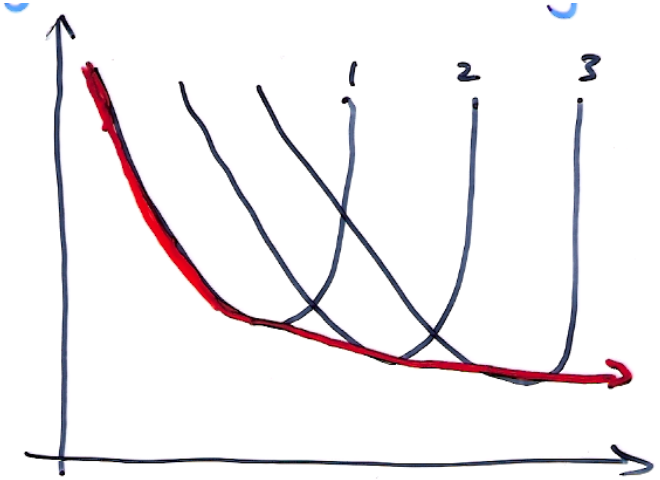
- Firms typically have fixed costs and variable costs, so the average cost of goods initially falls with output
- The variable costs typically rise at some point (overtime etc) and eventually rise sharply due to capacity constraints
- Thus the supply curve typically takes the above convex shape, at least in the short run (static analysis)

Cost evolution



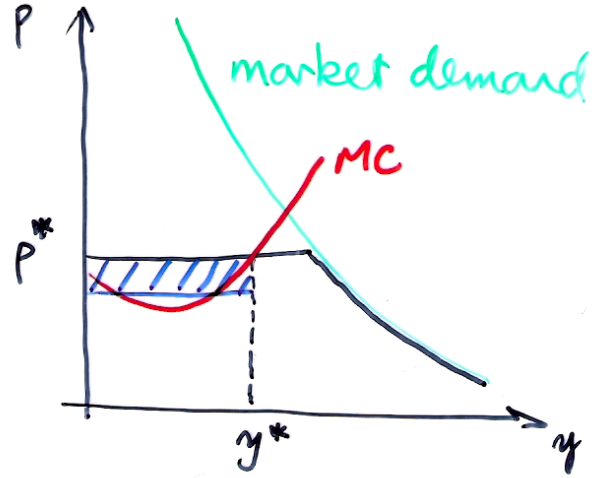
- In the long run, firms can fix capacity constraints by building more factories
- This gives nearly constant fixed costs and thus constant returns to scale as the firm / industry expands

Effects of technology



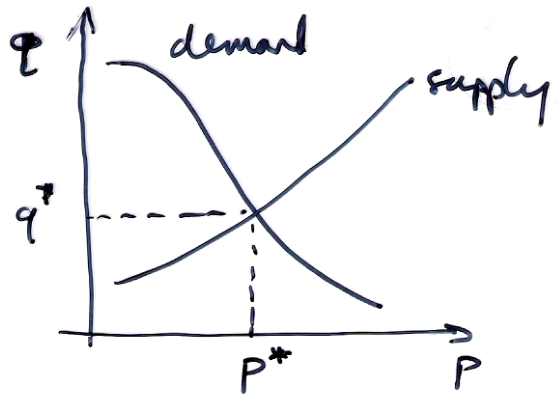
- In a traditional industry, technology can improve the process; larger / newer factories may be better
- Some industries have natural limits (not everyone wants to drive a Ford)
- In information goods and services industries, marginal costs may never rise – so firms like Microsoft enjoy ever-increasing returns to scale

Firm supply



- In a competitive market, firms are price takers
- The demand curve faced by each firm is in black – at any price above p*, demand is zero, while at any price below p*, the firm would face all the demand
- The firm's profit is maximised when it sets output so that its marginal cost equals the price p*

Putting it all together



- In the classical synthesis, prices are set where supply and demand curves intersect in competitive markets
- Key: p* will be the marginal cost of the marginal supplier
- Similar models apply in markets for labour etc
- Intrinsic advantages of non-marginal suppliers (e.g. easily mined coal, good farmland) get built into rental values
- By 100 years ago, people thought they understood the 'invisible hand' and just had to guard against monopoly

Equilibrium

- Studying supply and demand for one good is ‘partial equilibrium analysis’. ‘General equilibrium analysis’ adds in labour, capital etc
- First theorem of welfare economics: market equilibrium is Pareto optimal
- Second theorem: any Pareto optimal allocation can be achieved by market forces provided preferences are convex
- Technical conditions include rational actors, property rights, complete information, no transaction costs … (more later)

Efficiency, welfare and justice

- Efficiency does not imply justice! Giving the king all the money is Pareto efficient
- Different theories of justice are consistent with different welfare functions
  - $W = \sum U_i$ is classical utilitarian welfare
  - $W = \min U_i$ is Rawlsian welfare – that of the most miserable citizen
- Pigou: diminishing marginal utility of money means that transferring £1 from a rich man to a poor one will generally increase welfare
- But – there's a methodological problem!

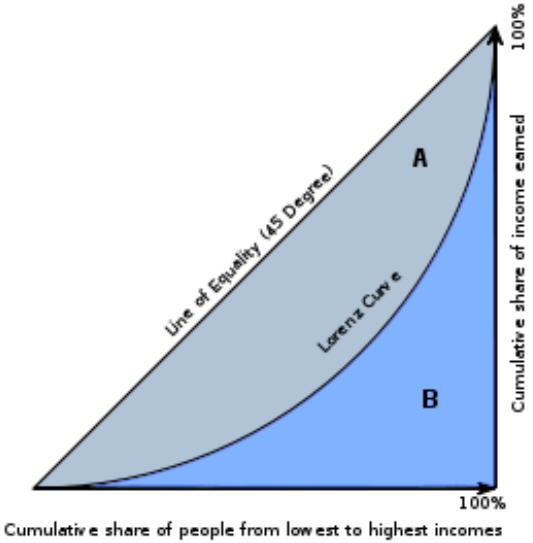
Efficiency, welfare and justice (2)

- Composing utilities into welfare is hard!

	A	B	C
First	X	Y	Z
Second	Y	Z	X
Third	Z	X	Y

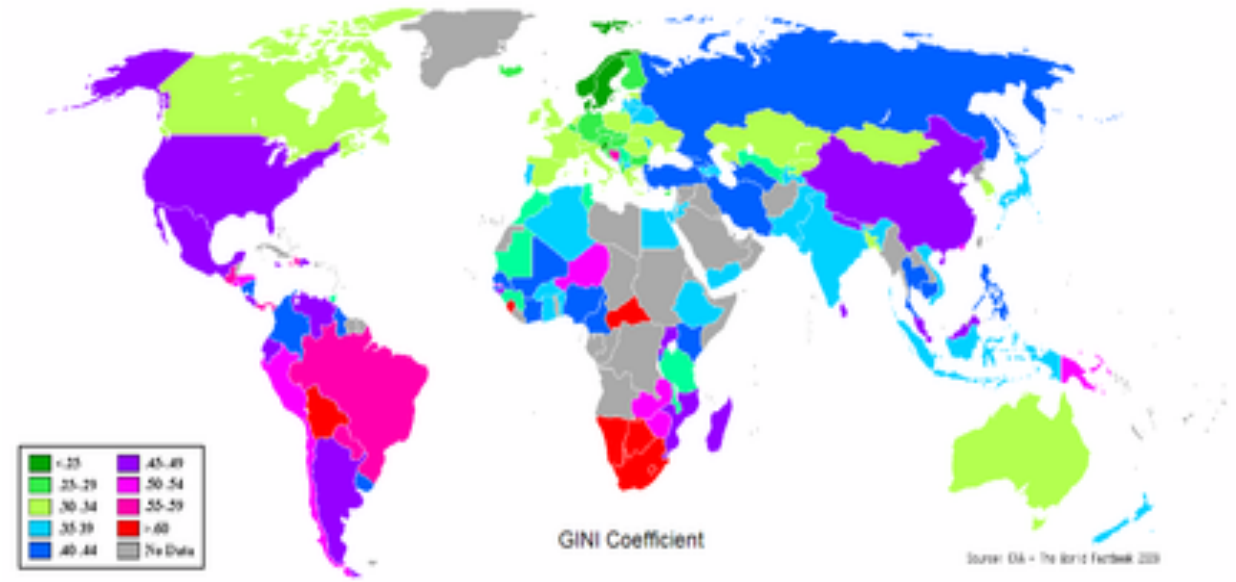
- Arrow's impossibility theorem says there is no perfect way to aggregate personal choices into social welfare that's consistent with democracy

Income distribution



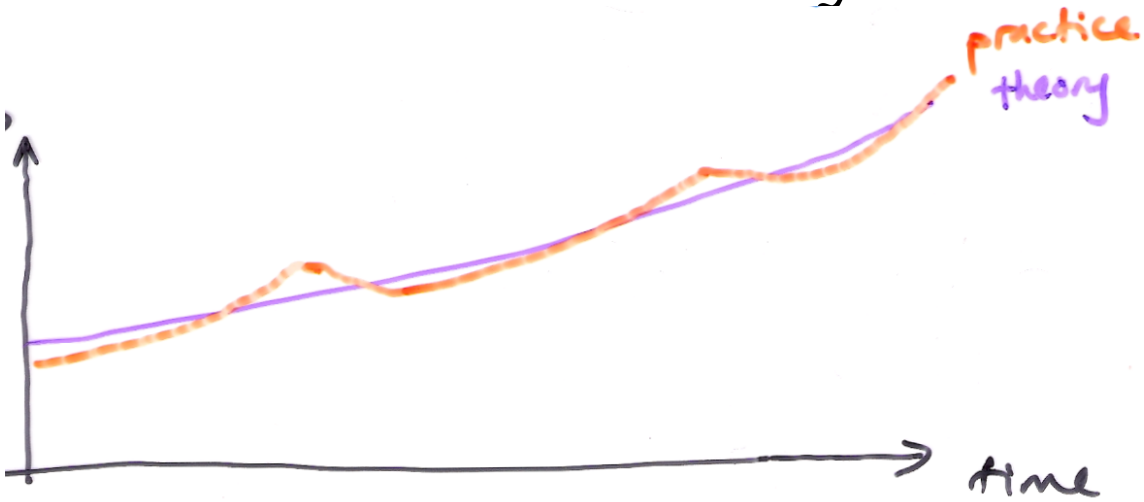
- The Gini coefficient is used to measure inequality
- Gini = A/(A+B) in the above graph where B is the cumulative income distribution
- Gini = 0: communism; Gini = 1: the king has the lot

Income distribution (2)



- Generally speaking, Gini falls with development
- Ranges from 0.247 in Denmark to .707 in Namibia
- Conflict theory explanation: over time, the poor fight harder for welfare than the rich resist them
- Democracy cuts both ways though: e.g. farm policy that brings each farmer £20000 but costs each nonfarmer £200

The business cycle

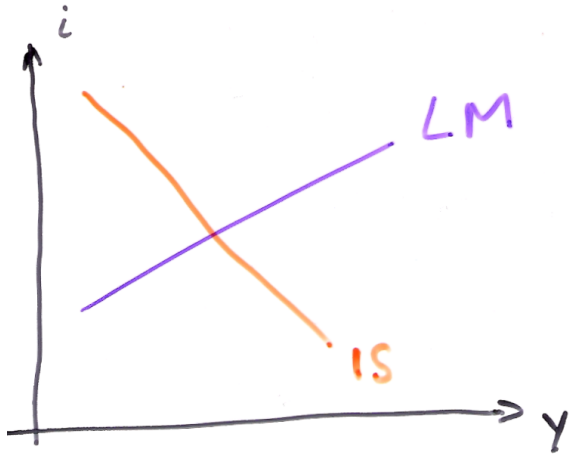


- The business cycle was a puzzle for classical economists. Why the pattern of boom and bust?
- Falling wages should clear the labour market, and the money firms spend on wages, raw materials etc should be exactly enough to buy their output (Say's law: supply and demand in the economy should be equal)

The business cycle (2)

- Mill and Ricardo argued that demand for goods + savings = supply of goods + investment, and savings = investment, so demand = supply
- Malthus and Sismondi argued that savings and investment could differ in the short term; falling confidence → people hoard cash
- 1930s: Keynes' more sophisticated model of 'liquidity preference'. People want a certain level of savings – maybe 3 months' salary. In a recession, liquidity preference rises
- Many other dynamic effects, different timescales…

The business cycle (3)

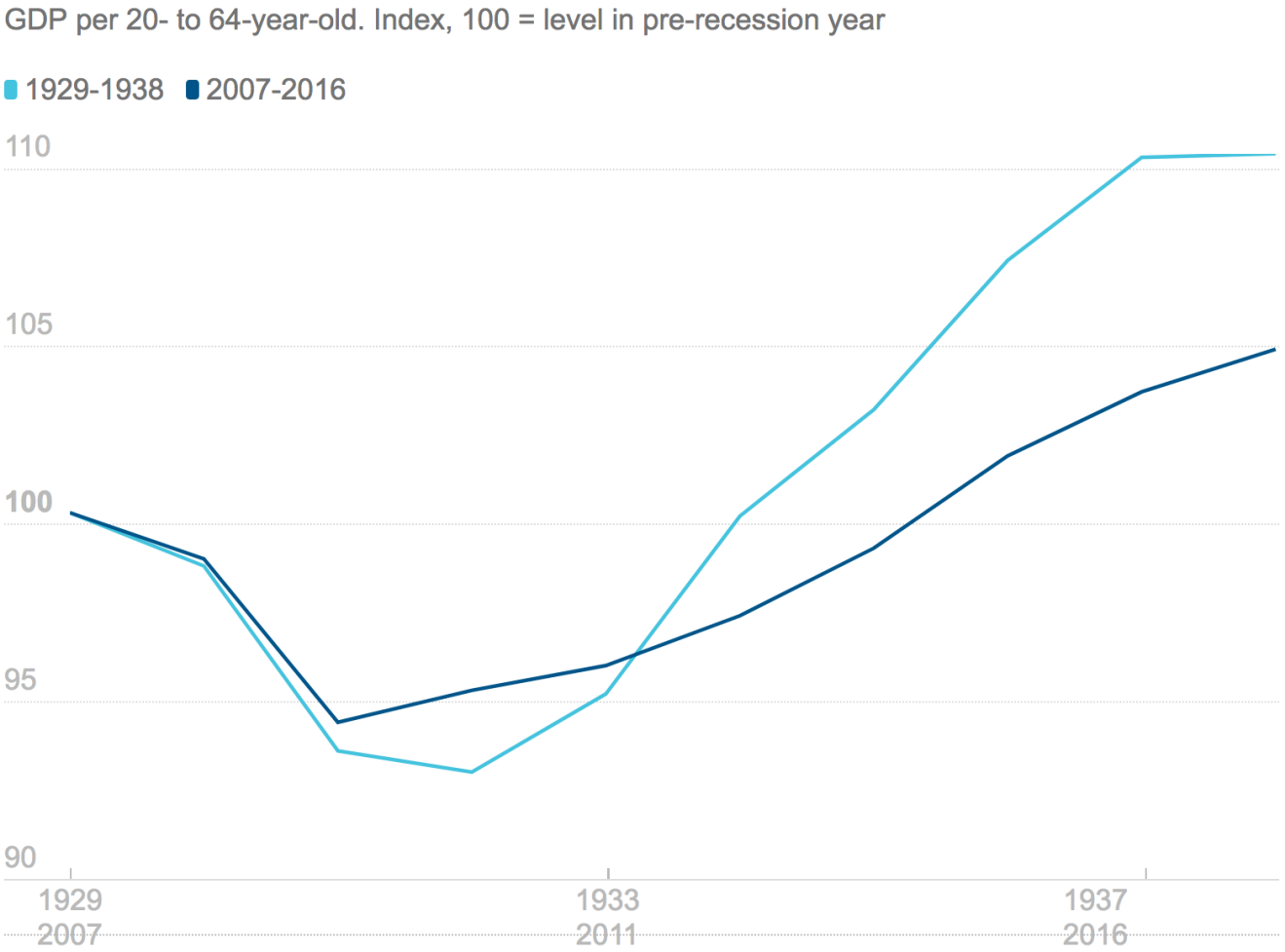


- In the 1930s, the world stuck in recession for years
- Keynes' 'General Theory' set out in 1936 to explain why. A summary is in Hicks' IS-LM diagram
- i: interest rate Y: national income IS: investment / savings LM: liquidity preference / money supply
- Idea: when savings, investment and money supply are modelled in detail, the equilibrium might not be one with full employment (see Roubini's macro notes for more)

The business cycle (4)

- Credit actually introduces instability at many levels.
- In a boom, people and firms borrow assets that appreciate faster than the interest costs
- A bank that takes in £100 in deposits might lend out £94; so £6 of capital underwrites £94 of lending – a multiplier of 94/6 = 15.7
- In a recession many things happen at once:
  - Some loans go bad, eating into capital
  - The bank's share price falls, further eating capital
  - The regulator raises capital requirements from 6% to 8%
  - The government competes for the available loans
- So the money supply contracts sharply

The Great Recession

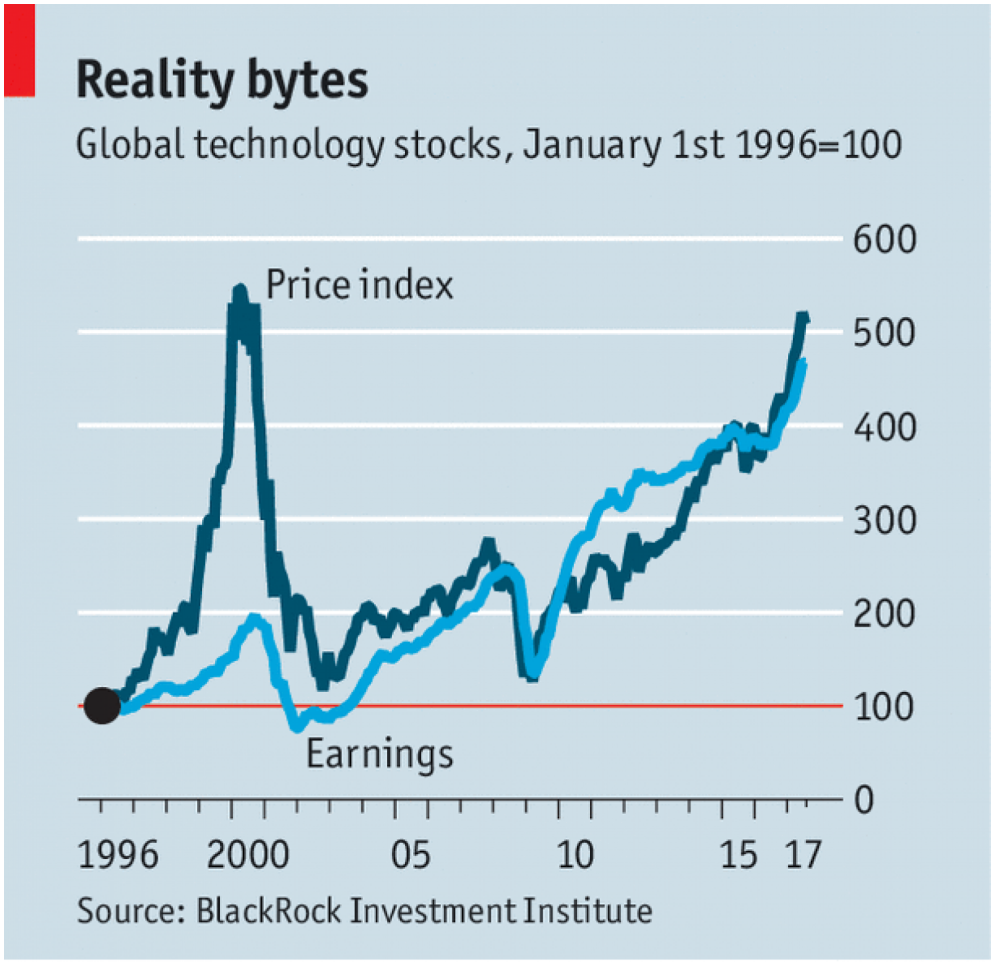


Guardian graphic | Source: House of Commons Library, Bank of England, Central Statistics Office, ONS

Recession and tech

- Great Recession kicked off by US mortgage crisis of 2007 which led to collapse of money markets
- Recessions may be fed by bubbles bursting but are often tied up with technology change
- Railways 1840s, electricity 1880s, cars 1920s, tech now – boom creates capacity, bust slashes prices
- We've killed whole industries (telephone switchgear), taken over others (bookselling), marginalized others (local newspapers, music publishers) and are disrupting most of the rest
- Schumpeter: 'creative destruction'

Recession and tech (2)



Trade

- Adam Smith “Wealth of Nations” (1776):

  ‘If a foreign country can supply us with a commodity cheaper than we ourselves can make it, better buy it of them with some part of the produce of our own industry, employed in a way in which we have some advantage’

- Ricardo, 1817: it’s comparative advantage that matters

Trade (2)

- Ricardo considered the following costs:

	wheat	wine
England	15	30
Portugal	10	15

- Portugal has an absolute advantage at producing both
- But England has a comparative advantage in wheat – each unit costs 1/2 unit of wine versus Portugal's cost of 2/3 a unit of wine

Trade (3)

- Suppose England has 270 units of labour, Portugal 180

	wheat	wine
E	8	5
P	9	6
Total	17	11

	wheat	wine
E	18	0
P	0	12
Total	18	12

- Mill: welfare gains from trade come from cheap imports
- Heckscher-Olin model: capital v labour (outsourcing)
- Under perfect competition, free trade optimal; almost all economists agree it's also a pragmatic optimum; but there can still be losers. English vintners?

Growth

- Adam Smith: output = f(land, labour, capital); so growth means land improvement / colonisation, education / specialisation, capital accumulation
- Keynes: it's all about capital formation
- Neoclassical school (Solow, Swann…): it's all about technology and population growth
- Modern view (Becker, Romer): mostly know-how
- Chad Jones: US growth 1950–93 due 50% to worldwide R&D, 30% better education, 20% to population growth in idea-producing countries
- Prescription: spend four times as much on R&D!

Tragedy of the commons

- 100 peasants each graze a sheep on the common
- If one peasant adds one more, he gets 100% more, while the others get 1% less
- Overgrazing, overfishing …
- Welfare theorems assume complete property rights, atomistic principals and full information
- Where this fails, private cost ≠ social cost
- Observed forever, documented by 1830s, used to justify enclosure movement, inspired Malthus

Externalities

- Externalities are goods / bads people care about, but not traded: typically side-effects
- Consumption externalities include smoking in restaurants, domestic heating emitting CO_2
- Production externalities include a steelworks polluting a fishery downstream, or emitting CO_2
- Positive externalities include education (1 more year = 2% crime reduction), file formats,…
- In the presence of externalities, competitive equilibria are unlikely to be Pareto efficient
- Can in theory fix with property rights (Coase) but this is harder with many players, or delays

Public goods

- A public good is non-rivalrous and non-excludable
- Example: scientific knowledge. The producer can appropriate a small part of the benefit (e.g. PhD thesis); the rest spills over to all
- Example of a public bad: CO_2 emissions. Again, everyone gets to 'consume' the same amount
- Strong temptation for people to free-ride!
- If production is decided communally, there are potential 'impossibility theorem' issues
- Alternatives? Prizes / taxes? Cap-and-trade? …

Club goods

- Traditional communities can simply limit scale
- E.g. fishermen in Turkey: 40 fishermen gather in tea-house, arrange rota, signed by mayor
- Self-enforcing: if you find another boat in a good spot when it's your turn, chase them
- Elinor Ostrum studied many examples to work out the conditions under which this is sustainable
- Internet routing used to work this way!
- But what happens when the club breaks down?

Enter politics …

- Buchanan: ‘Politics is a structure of complex exchange among individuals, a structure within which persons seek to secure collectively their own privately defined objectives that cannot be efficiently secured through simple market exchanges.’
- But politics has costs too!

Monopoly rents

- Absent barriers to entry, firms will enter a market until excess profits competed away
- What if we regulate prices?
  - In 1986, New York taxi licenses cost $100,000 yet drivers earned $8 an hour
  - License owner makes $17k p.a. net – 17% ROI
  - Politicians put up fares, supposedly to help drivers
  - Extra $10,000 p.a. just added $60K to the value of a license, so they helped the owners instead!
- Monopoly / entry barriers in effect create a rent
- 'Rent-seeking' drives much of politics

Competition and information

- The marginal cost of producing information is zero, so that's the market clearing price!
- Example – machine-readable phone books
  - 1986 – Nynex charge $10,000 per disk
  - ProCD had the phone book retyped in Peking and started selling for $300
  - ABI joined in
- Now it's a few bucks for a CD, or free online
- Hence Free Software Foundation slogan: 'information wants to be free'
- So how can you make money out of selling information – software, books, music, …?

Lock-in

- Often, buying a product commits you to buying more of it, or spending money on one or more of:
  - durable complementary assets, such as apps for a computer or phone, tunes for your iPod
  - skills, e.g. fluency with Win/Mac/Linux or Office
  - services, e.g. network service for a PC or mobile phone, directory service for a PVR
- Same applies to services – facilities management firms make it hard to switch to their competitors
- Not entirely new (fewer people change their bankers than their spouses) but has some pronounced effects in information goods markets

Lock-in (2)

- 'Fundamental theorem' (Shapiro, Varian); the net present value of your customer base is the total cost of switching
  - Suppose you're an ISP and it costs £25 to set up a new customer
  - Suppose it costs a customer £50 of hassle to switch
  - If your new business model makes the customer worth £100, offer them £60 cashback to switch
  - They're £10 ahead, you're £15 ahead
- So the value of Microsoft is what it would cost people to switch to Google Docs and Linux …

Lock-in (3)

- The incumbent will strive to maximise switching costs, competitors to minimise them
  - file format wars
  - loyalty programs
  - phone number portability
- Incumbents promote complementary goods and services that increase lockin – from tied printer cartridges to Gmail and Facebook Connect
- Asymmetric switching costs – a phone network has to supply a phone to win a customer, but to keep one can offer extra minutes which cost it nothing

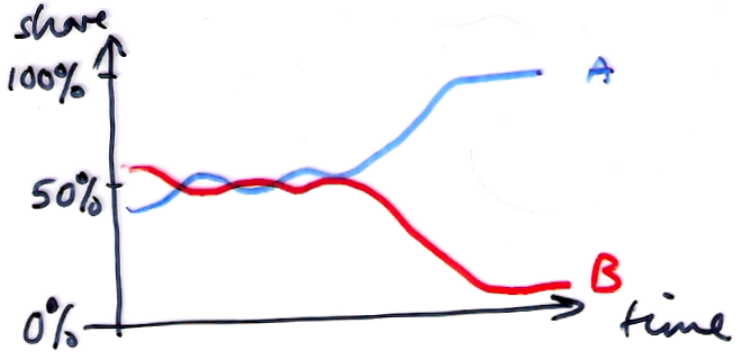
Network externalities

- Many networks become more valuable to each user the more people use them
- Metcalfe's law: the value of a network is proportional to the square of the number of users
- It's actually more complex than this (local effects are stronger) but still more than linear
- Overall effect: past some threshold, network use takes off rapidly
  - Telephone – late 19th century
  - Fax – 1985–88
  - Email – 1995–99

Network externalities (2)

- As well as ‘real networks’ like fax and email there are ‘virtual networks’ such as PCs and software
  - Most people used to buy PCs rather than Macs because of software
  - Back in 1985 companies started to write software for PCs first and Macs second, as they thought the PC was winning
  - So it won – people bought PCs for the software
- It works for bads as well as for goods: malware writers target Windows although Mac (and Linux) are also vulnerable

Network externalities (3)

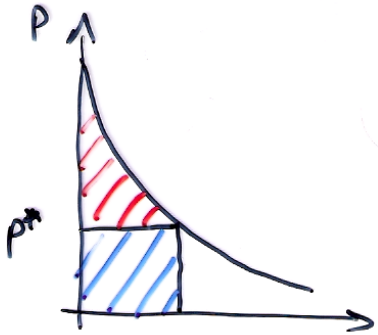


- So markets with network effects can 'tip'
- It's particularly common with two-sided markets
- Other examples:
  - Rail gauges in the 19th century
  - Colour TV standards in the 1950s
  - VHS v Betamax, Blu-Ray vs HD-DVD, …
  - Paypal v First Virtual etc
  - Facebook v Myspace, Bebo, Friendster, …

Strategic issues

- Each of these factors – high fixed costs plus low marginal costs, significant switching costs due to technical lock-in, and network externalities – tends to lead to a dominant-firm market model
- With all three together, monopoly is even more likely
- Hence the race for market share whenever a new information market opens up
- Hence the 1990s Microsoft philosophy ‘ship it Tuesday and get it right by version 3’
- Policy: do you hope that tech change will make incumbents obsolete, or do you regulate?
- “Competition in the market or competition for the market”

Price discrimination



- Recall: an efficient monopolist sells to each customer at her reservation price – 'selling to value'
- Pigou's three degrees of price discrimination:
  1. Personalised pricing (e.g. haggling, loyalty cards …)
  2. Versioning (e.g. first / business / economy class)
  3. Group pricing (e.g. student and OAP discounts)
- Around forever – but getting more powerful and pervasive
- Tech simultaneously increases the motive and the means

Price discrimination (2)

- Versioning can include ‘pricing for sharing’, e.g. scientific journals charge libraries more than private readers
- Disney DVDs are cheaper than titles people rent
- Versioning can include marketing – e.g. magazines cheap for students but expensive for business
- Much of the promised efficiency gain from e-commerce was based on hope of more effective price discrimination
- But discrimination is often unpopular!

Cruel, mean or lavish …

It is not because of the few thousand francs which would have to be spent to put a roof over the third-class seats that some company or other has open carriages with wooden benches. What that company is trying to do is prevent the passengers who can pay the second class fare from travelling third class; it hits the poor, not because it wants to hurt them, but to frighten the rich. And it is again for the same reason that the companies, having proved almost cruel to the third-class passengers and mean to the second-class ones, become lavish in dealing with first-class passengers. Having refused the poor what is necessary, they give the rich what is superfluous. (Jules Dupuit, 1849)

Bundling

- One way to conceal discrimination in ‘bundling’: selling a number of products together, as with Microsoft Office
- Suppose Alice and Bob have the following reservation prices for Word and Excel

	Word	Excel
Alice	£50	£75
Bob	£75	£50

- With separate pricing, MS would charge £50 per product and get £100 per customer, or £75 and get £75
- By selling them together, it gets £125
- Can sell different bundles, e.g. annual sub with Office 365

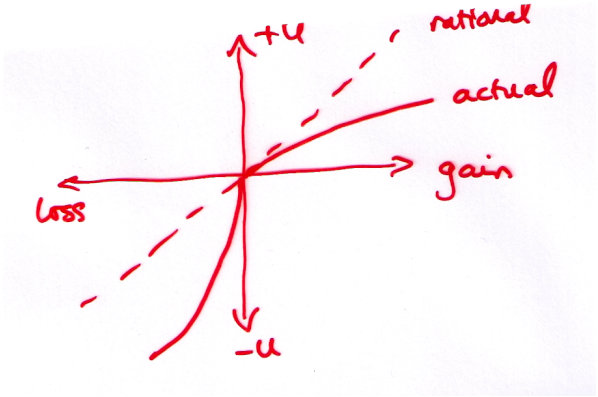
Asymmetric information

- Akerlof won the Nobel for the 'market for lemons'
  - 100 used cars for sale – 50 good cars worth $2000, 50 lemons worth $1000
  - Buyers can't tell difference – so price $1000
- One fix is for sellers to offer a warranty – this is cheaper for owners of good cars, so can act as a 'signal' for the hidden information
- The value of a Cambridge degree? It's hard for employers to tell smart diligent employees from interview, so use education as a signal
- Signaling theory is also important for recommender systems – Google, eBay, Grameen

Asymmetric information (2)

- Do Volvo drivers have more accidents because:
  - Bad drivers buy a Volvo to survive accidents better
  - Volvo drivers compensate for safety by driving faster?
- The first effect is ‘adverse selection’ and the second ‘moral hazard’: examples of ‘hidden information’ versus ‘hidden action’
- Lemons market: adverse selection
- Insurance markets can also be trashed by moral hazard; hence excess, no-claims bonus, …
- Moral hazard can lead to surveillance, rationing

Bounded rationality



- People offered £10 or a 50% chance of £20 usually prefer the former; if offered a loss of £10 or a 50% chance of a loss of £20 they usually prefer the latter!
- Kahneman and Tversky's 'prospect theory' seeks to explain this via mental heuristics and biases
- That's why marketers talk 'discount' or 'saving' – framing actions to make them more attractive
- The misperception of risk is a big deal (terrorism)
- 'Behavioural economics' studies all this stuff

Bounded rationality (2)

- Herb Simon coined ‘bounded rationality’ in the 1950s along with ‘satisfice’
- People try to make just-good-enough decisions
- A satisficer will work hard until his lifestyle goals are met, then slack off.
- Most of us are satisficers, and VCs don’t like this!
- Another common rationality bound is ‘hyperbolic discounting’: people disregard far-future events (most people have inadequate pensions)
- The endowment effect: people generally demand a higher price for something they already own

Bounded rationality (3)

- Decisions are heavily influenced by framing. E.g. the 'Asian disease problem' where the subject is making decisions on vaccination. Two options put to subjects. First:

  A: "200 lives will be saved"

  B: "with p=1/3, 600 saved; with p=2/3, none saved"
- Here 72% choose A over B!
- Second option is

  C: "400 will die"

  D: "with p =1/3, no-one will die, p=2/3, 600 will die"
- Here 78% prefer D over C!
- Defaults also matter. Most people won't opt in, or opt out. 'Libertarian paternalism' sets socially optimal defaults (e.g. you have to opt out of records-based medical research)

Agency effects

- Classical economics sees institutions as rational
- But decisions are made by individual managers, who optimise their own utility too
- ‘New institutional economics’: study managers’ behaviour. Should you give them stock options to align their interests with shareholders?
- ‘Public-choice economics’: apply this incentive analysis to civil servants and elected politicians (“Yes, Minister”). What’s the cost of democracy?
- Why do public-sector IT projects fail more often?

Transaction costs

- Trades are not free! Time & effort; commissions; search; bargaining; policing and enforcement
- Ronald Coase (1937): why do some sectors have large companies, and others small ones? External transaction costs higher than internal ones
- Jensen-Mockling (1976): agency costs within firms also matter hugely
- Oliver Williamson (1980s-90s): incomplete contracts: frequency, specificity, uncertainty, limited rationality, opportunistic behavior
- So should tech make firms smaller on average?

Auctions

- Around for millennia; standard way of selling livestock, fine art, mineral rights, bonds…
- Many other sales from corporate takeovers to house sales are also really auctions
- Auctions are a big success of the Internet, from eBay to Google
- Spectrum auctions a big deal for tech biz
- Rapidly growing interest in theoretical computer science: auction resources in distributed systems
- Many issues of asymmetric info, signalling, strategic play… – plus some solid theory!

Types of auction

- English, or ascending-bid: start at reserve price and raise till a winner is left (art, antiques)
- Dutch, or descending-bid: start high and cut till somebody bids (flowers)
- First-price sealed-bid auction: one bid per bidder (government contracts)
- Second-price sealed-bid auction, or Vickrey auction: highest bidder wins and pays second-highest bid (postage stamps)
- All-pay auction: everyone pays at every round until one remaining bidder gets the goods (war, litigation, winner-takes-all market race)

Strategic equivalence

- A Dutch auction and a first-price sealed-bid auction give the same result: the highest bidder gets the goods at his reservation price
- They are 'strategically equivalent'
- Ditto the English auction and the second-price sealed-bid auction (modulo the bid increment)
- But the two pairs are not strategically equivalent!
  - in a second-price auction it's best to bid truthfully
  - in a Dutch / first-price auction, you should bid low if you think your valuation is much higher than everybody else's

Revenue equivalence

- This is weaker – not ‘who will win’ but ‘how much money on average’
- According to the revenue equivalence theorem, you get the same revenue from any well-behaved auction under ideal conditions
- These include risk-neutral bidders, no collusion, Pareto efficiency (highest value bidder gets goods), reserve price, independent valuations, …
- Then the English, Dutch and all-pay auction yield the same, as bidders adjust their strategies
- So when you design an auction, you must focus on any ways the conditions aren’t ideal

What goes wrong (1)

- In a 'private-value auction', each bidder's value v_i is exogenous (think: sculpture). In a second-price auction, everything you buy is a bargain
- In a 'public-value auction', each item has a true price which bidders estimate at $v + \varepsilon_I$ (think mineral leases; spectrum auctions). The buyer is the sucker who overestimated the most!
- This is called 'the winner's curse'
- Many real auctions lie somewhere between these two extremes

What goes wrong (2)

- Bidding rings – bidders collude to buy low, have a private auction later, split the proceeds
- First-price auctions are harder to rig; with second-price, New Zealand bids of $7m and $5000
- Entry detection / deterrence: in 1991, ITV franchise auction required bidders to draw up a detailed programming plan. In Midlands & Central Scotland, no competition; bids under 1p per head (vs £9–16 elsewhere)
- Predation: 'we'll top any other bid' in takeovers
- Sniping and other boundary effects

What goes wrong (3)

- Risk aversion: if you prefer a certain profit of £1 to a 50% chance of £2, you'll bid higher at a first-price auction
- Signaling games: show aggression by a price hike
- E.g. in simultaneous auctions, as in the USA, signal "we want SF, LA, SD and if you compete with us there we'll push prices up in your patch")
- Budget constraints: if bidders are cash-limited, all-pay auctions are more profitable
- Externalities between bidders – e.g. arms sales

Combinatorial auctions

- Externalities lead to preferences for particular bundles of goods: landing slots at airports, spectrum, mineral rights…
- Bid ($x for A+B+C) or ($y for A+D+E) or…
- Critical app for CS: routing in presence of congestion (bid for AB and BC, or AD and DC…)
- The allocation problem is NP-complete; practical algorithms work up to a few thousand objects
- Also: how can we make the auction strategy-proof (i.e. truth-telling is the best strategy)?
- New field of 'algorithmic mechanism design'

Introduction to Law

- Two lectures
- This lecture:
  - how can you end up being liable for things you do online (contract vs tort)
  - how do you make the agreements you want to, and enforce them
  - when you need advice, and the context in which to understand it
- Next (Richard Clayton): IT-specific laws

What is law?

- We can't get all we want by private action because of externalities etc
- Politics: "a structure within which persons seek to secure collectively their own privately defined objectives that cannot be efficiently secured through simple market exchanges" (Buchanan)
- The main mechanism is law

What is law (2)?

- Many origins and flavours (state vs religion, common vs Roman vs Napoleon …) but two main divisions: criminal and civil
- Criminal: Alice harms Bob seriously, so the state prosecutes Alice
- Civil: Alice harms Bob, or breaks a contract with Bob, so Bob sues Alice
- Significant overlap

Criminal law

- In general a crime requires
  - A guilty act (actus reus)
  - A guilty mind (mens rea) – so legal advice or going to the ethics committee may shield you! But some offences are ‘strict liability’
- Prosecution must prove the case beyond reasonable doubt
- CPS guidelines matter (e.g. ‘hacking tools’) and agreements (e.g. with the IWF)

Civil law

- Contract – making the agreements you want
- Tort – avoiding infringement of the rights of others, and giving adequate notice to others of your rights that you may want to enforce
- Regulation – specific things you need to do to enforce your rights or avoid penalties
- International – choice of law and venue
- Arbitration, costs etc

Contract

- A contract consists of offer and acceptance by competent persons for a lawful purpose involving consideration
- Can be made in writing, orally, by conduct
- We make dozens of informal contracts every day; but an online business will usually want to formalise its standard terms and conditions (you may want advice here!)

Contract (2)

- When a shop offers goods in the window this isn't the offer but an 'invitation to treat'. The customer makes the offer for the good and the shopkeeper accepts
- When offering goods online it's wise to make this clear, in case you run out of stock
- Linking clearly to terms and conditions is in general enough (as with a railway ticket)

Contract (3)

- Many national laws require some contracts to be in writing (real estate; insurance; guarantees; in the USA, goods over $500)
- Many jurisdictions have electronic signature laws; in general electronic writing is fine as the essence of signature is intent
- The US ESIGN Act of 2000 made clickwrap licenses explicitly enforceable

Limits

- Consumer Rights Act 2015 extends previous legislation to software (you're now liable for malware you give your customers)
- Retailer has one chance to repair or replace (at customer's choice) else refund
- Can't enforce unfair contracts against retail customers
- Can't exclude liability for death or injury (a separate EU rule, applying to all products)

Globalisation

- It can be tiresome for a firm in England to be sued by a customer in Australia
- Make clear whose law is to apply, and separately where cases should be heard
- Enforcement of foreign judgments is not straightforward (the USA is almost rogue)
- One fix is to specify arbitration of disputes

Arbitration

- A contract can specify binding dispute resolution by an arbitrator
- It can also specify applicable law and set other parameters such as limits on costs
- The Convention on the Recognition and Enforcement of Foreign Arbitral Awards makes awards enforceable everywhere, even in the USA

Costs

- US system – each side pays its own costs. Can be expensive for some firms
- UK system – loser generally pays the winner's costs. May make it uneconomic for most customers to sue you, but a dispute with a rich one can be ruinous
- UK rules on costs are bad for consumer protection, and for free speech (later)

Tort

- Tort is the second main way you can become liable online, after contract
- A tort (in Scotland called a delict) is a wrong which unfairly causes someone else to suffer loss or harm
- Examples are negligence (whether in product liability or in giving advice), defamation and copyright infringement

Negligence

- Arises if you break the duty of care owed by a reasonable person and cause harm directly
- Usual yardstick is the standard of the industry. Some exceptions apply
- Liability often tied up with insurance rules; e.g. car crashes, medical malpractice
- NB: if your software harms a non-customer or a child, you didn't disclaim liability to her as she didn't make a contract with you

Defamation

- Libel (if spoken, slander) is a tort, and the UK is a popular venue for forum shoppers
- Direct defamation; innuendo; linking
- Burden of proof on defendant in UK
- Also the UK system of costs shifting – loser pays winner's costs
- Defamation Act 2013 excludes trivial claims, creates public interest defence, and makes claimants pursue the author first

Patent

- Mechanism to tackle the underprovision of R&D from externality in research
- Protects an invention which must be
  - Novel ("prior art" disallows)
  - Useful (no perpetual motion machines)
  - Non-obvious (to "someone skilled in the art")
- Typical duration – 20 years
- Traditionally only physical inventions; can't protect 'the theories above, or the facts beneath'
- However USPTO in particular has really stretched the boundaries, to business methods, genes, …

Patent overstretch

- E.g. long fight by ACLU to overturn patents by Myriad on human genome
- US 5,747,282 (1998) includes any 15-nucleotide sequence appearing in BRCA1 breast cancer gene – that's 1.6m sequences of 1.06bn possible.
- Every human gene contains on average 15 such
- Most lab directors had decided not to develop a test / perform a service because of a patent
- See "I patent your ass. And your leg. And your nostril", Ben Goldacre's 'Bad Science' blog, April 2 2010

Trademarks

- Marks capable of distinguishing your goods or services from others (e.g. ‘IBM’)
- May be registered (®) or not (™) – registering can make litigation easier
- Registered trademark owners usually win domain name disputes
- Can sue infringers, but have to show a misrepresentation that damages your business
- Pitfalls – some companies are very aggressive about registration and enforcement (McDonalds)

Copyright

- Since Statute of Anne (1709–10), copyright has protected your literary works – extending from novels and drama to art, music
- Is the main protection for the software you write
- No need to register – but asserting copyright ("© RJ Anderson 2017") can make litigation easier
- Duration – has steadily increased over recent years and is now author's lifetime + 70 years (was 50 years for sound recording rights, now 70)
- Protects against copying etc; but "fair use" and "fair dealing" get-outs for criticism, parody…
- Moral rights remain yours even if copyright sold

Copyright (2)

- What about the ‘anti-commons’ of orphan works – books, pictures etc whose owners aren’t known?
- Stallman – GPL; Lessig – Creative Commons
- Google Books – see supplementary material page!
- EU Orphan Works Directive – no commercial use
- ‘Instagram Act’ (Enterprise & Regulatory Reform Act) facilitates collective rights organisations, allowing ministers to regulate ‘extended collective licensing’ and ‘orphan works’ (2013)

Other ‘IPRs’

- Specialist rights
  - Database rights (EU only)
  - US Semiconductor Chip Protection Act
  - Plant breeder’s rights
  - Design rights
- Rights based on contract
  - Materials transfer agreements
  - Confidential information
- Limits – e.g. an employer can’t restrict knowledge that’s become part of the ‘tools of your trade’

Software

- Primary protection is copyright
- Software patents in theory not allowed in Europe: EPC Art 52 “The following shall not be regarded as inventions … rules and methods for performing mental acts, playing games or doing business, and programs for computers”
- Don’t you believe it! The courts keep stretching it
- In general, innovation in CS is highly incremental: a large program can use thousands of ideas, while a blockbuster drug is a single patentable molecule
- So far only four CS patents earned serious money; there have been more cases of progress stalled

DRM

- Copyright owners panicked at printing, audiocassette, videocassette … and the Internet
- Huge push to introduce DRM over last 20 years
- Not so clear that file sharing harms musicians!
- DRM shifted power to Apple, Google, Amazon from old-style record companies
- Yet the legal bandwagon continued from DMCA to ACTA to Digital Economy Bill…
- Lexmark v SCC, compared with IPRED
- Now: html 5
- Will abuses spread to everything, with the IoT?

Strategy

- 'IPR' often a combination (biochip h/w patent + software copyright + MTA on reagents …)
- IT industry strategy: patent portfolios mostly defensive, used to get access by cross-licensing
- Compound models, e.g. GPL the linux version, sell the Windows version, charge for support…
- Startups: VCs like to see some IP (mantra is 'global sustainable competitive advantage')
- The real game is how you lock customers in
- Biggest winnings historically went to those who control platforms and interfaces

Ethics

- In our field, laws are often ten years behind, and even then often don't fit reality very well
- Practical ethics: in what circumstances should we restrain our actions more than the law requires?
- Analogy: medical ethics (used to) require doctors to observe stricter confidentiality than either the law of confidence or data protection law required
- The philosophy of ethics asks "What are true moral values?" and "Why?"

Philosophies of ethics

- Authority theories mostly derive from religion. But God usually talks via scriptures or a priesthood; so how do you resolve disputes?
- Intuitionist theories say we can tell what's good and bad, like we can tell something is green. But again, our intuitions can differ, and how do you resolve disputes?
- Egoist theories say we act rationally in our own self-interest. We've seen the limits on that…

Philosophies of ethics (2)

- Consequentialist theories include Hume, Bentham and Mill's utilitarianism: maximise $W = \sum U_i$ (or, 'greatest happiness of the greatest number')
- But how do you work out consequences in detail?
- Social choice issues: we can't define W in a way that's consistent with democracy
- Also: Epicurus, Machiavelli, Cheney … even Bentham's starving beggar who steals a loaf
- Modern debate: act vs rule utilitarianism

Philosophies of ethics (3)

- John Rawls ‘Theory of Justice’: we should make moral decisions about a society behind a “veil of ignorance” of whether we’ll be born high or low
- Deduces: we should maximise $W = \min U_i$
- Same problems as before with bounded rationality
- And what about randomised algorithms? What if a small minority is badly off? Omelas?
- Would you rather be reincarnated in the USA or a country that was poorer but with better welfare?

Philosophies of ethics (4)

- Aristotle: consequentialist theories are ‘for beasts’: you’d be happier if you were stupid
- People should act in accordance with nature and duty: they will do good and be happy
- It’s not just the consequences of actions that make them right or wrong, but the motives of the actors
- There are many flavours, ranging from religious duty to good will

Philosophies of ethics (5)

- Kantian deontology (theory of duty): act only on maxims that you'd like to be universal (i.e. do as you would be done by) and treat people as ends not means
- Natural-rights / libertarian version: no-one has the right to initiate force or fraud against another human, and we mustn't interfere with basic rights of others such as assembly and free speech

Empirical approaches?

- Example: Todd Kendall, "Pornography, rape and the Internet" (2007)
  - Internet uptake went at different speeds in different US states
  - What crimes were correlated?
  - Rape and prostitution went down, while 'runaways' went up
  - The first two had significance concentrated among 15-24yo males
- For more, see "Freakonomics", "Everybody Lies"

Current debates include:

- Evolutionary psychology (monkeys do tit-for-tat; Machiavellian brain hypothesis …)
- Neuroethics (from moral development of children to consciousness as an epiphenomenon …)
- Experimental ethics: e.g. whether you'd divert a runaway trolley to save two people but kill one
- People trust moral absolutists more than relativists as they are predictably dependable

Live policy debates

- Censorship
  - All countries have some (e.g. child porn). But then along come Hollywood, libel lawyers…
- Export control
  - Is it ethical for GCHQ to allow DPI equipment exports to Iran / Syria? Should we complain?
- Surveillance
  - See the Snowden revelations, care.data …

Live policy debates (2)

- Freedom of Information
  - Like privacy laws, FOI laws push back on the 'natural' flow of data from the weak to the strong
- Privacy
  - Economic analysis alone is insufficient as privacy is very context dependent. Data protection regulation changing from 2018
  - Privacy often a touchstsone issue in ethics

Privacy

- 2014 report on Big Data by the US President's Council of Advisers on Science and technology
- Spread of gesture, speech and video interfaces will lead to cameras, microphones everywhere
- Can't stop data collectors; can't regulate processors (they claim); so have to regulate uses
- Problem: US privacy law regulates only a few uses (such as video rentals) and is weak even there

Privacy (2)

- Google v González, European Court of Justice, 13 May 2014
- Search on Mr González returned reference to a lawsuit against him in 1998
- Google said, that's not our problem.
- ECJ: Oh yes it is! He can ask either the newspaper or Google to take old stuff down

Privacy (3)

- David Cameron said in 2011 that NHS records would by default be made available for research (the ‘transparency’ agenda …)
- Don’t worry: our records would be anonymised, and we’d have an opt out
- But anonymisation doesn’t really work for such rich data
- What about a search on ‘atrial fibrillation, Hammersmith, Mar 19 2003?’

Privacy (4)

- The Hospital Episode Statistics (HES) database has a record of every finished consultant episode going back 15 years (about a billion in total)
- Mar 2014: formal complaint to ICO that PA put HES data in Google cloud despite many rules on moving identifiable NHS data offshore
- Apr 2014: HSCIC reveals that HES data sold to 1200 universities, firms and others since 2013
- HES ID leaks postcode, dob in most cases

European case law

- European law based on s8 ECHR right to privacy, clarified in the I v Finland case
- Ms I was a nurse in Helsinki, and was HIV+
- Her hospital's systems let all clinicians see all patients' records
- So her colleagues noticed her status – and hounded her out of her job
- European Court of Human Rights: we have the right to restrict our personal health information to the clinicians caring for us (2010)

How can researchers deal ethically with privacy?

- See Nuffield Bioethics Council project on biodata for four principles
  - Ethics based respect for persons
  - Satisfy human-rights and other applicable law
  - Set reasonable expectations in discussion with people who have morally relevant interests
  - Effective and justified systems of governance and accountability

Conclusion

- Technology is constantly changing status, money and power. How do we navigate?
- Lawmakers take 10–20 years to catch up
- Human-rights law can give broad principles but it's a floor rather than a ceiling
- So even if your business model is legal today, it might not be tomorrow
- Does it pass the "front page test"?