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: comparative advantage is all that's needed. Consider the following costs:

	Wheat	Wine
England	15	30
Portugal	10	15

Portugal has an absolute advantage in the production of both. However England has a comparative advantage in wheat – each unit of wheat produced costs only $\frac{1}{2}$ unit of wine versus Portugal's $\frac{2}{3}$ unit (i.e. the opportunity cost of a unit of wheat is $\frac{1}{2}$ unit of wine)

Portugal has the comparative advantage at wine - a unit costs 1.5 units of wheat rather than 2

TRADE (2)

- See how it works. Suppose England has 270 units of labour available versus Portugal's 180. Production in autarky (i.e., no trade) is

	wheat	wine
England	8	5
Portugal	9	6
Total	17	11

- Production with trade is

	wheat	wine
England	18	0
Portugal	0	12
Total	18	12

- Mill's insight : welfare gains from trade come from the ability to import some goods more cheaply. Only significant role of exports is in paying for these imports
- More modern models : e.g., Heckscher-Ohlin model looks at two factors of production : capital and labour. The country with more capital will export capital-intensive goods
- Under perfect competition, free trade is optimal. Economists' consensus : also a pragmatic optimum

GROWTH

- Adam Smith: output a function of land, labour, capital; improving technology and increasing specialisation lift productivity, support more people, facilitate land improvement / colonisation, and capital accumulates (classical theory)
- Marx: progress would lead to unemployment, pushing down wage rates and causing revolution
- The Keynesian school (Harrod, Domar, Robinson, Kaldor): growth depends on capital formation, leading to complex models of investment and of saving by workers and entrepreneurs
- Neoclassical school (Solow, Swann, ...) models growth as a function of technology, population growth, savings propensity and initial capital-labour ratios
- Objections from environmentalists, development economists
- Current leading view (Becker, Romer): it is know-how that drives growth, both via human capital (education etc) and innovation. For example, Charles Jones attributes US growth 1950-9: as 30% to better education, 50% to worldwide R+D and 20% to population growth in idea-producing countries. Ideally we should quadruple R+D!

TRAGEDY OF THE COMMONS

- Observed long ago, documented by 1830s, used to justify enclosures
- 100 peasants each graze a sheep on the village common, which uses its capacity
- What if one peasant adds an extra sheep?
- He gets twice as much, everybody else gets 1% less
- Common becomes overgrazed
- Modern examples: overhunting, overfishing
- Welfare theorems etc assume complete property rights, atomistic participants and complete information, preventing such outcomes
- When this breaks down, need to consider not just the economic cost of transactions but their social cost (total cost to all participants)

EXTERNALITIES

- Externalities are goods / bads people care about, but are not sold in markets: typically side-effects
- Example of consumption externality: smoking in restaurants. Market mechanisms may provide partial solution (smoking/nonsmoking dining rooms) but only sometimes (not in Lisbon or in San Francisco)
- Example of production externality: steelworks pollutes a river and damages a fishery. Again, market mechanisms can sometimes find a solution (steelworks buys fishery) but not always
- Positive production externality: common file formats can be recycled by other application vendors
- Anyway, in presence of externalities, competitive market outcomes are unlikely to be Pareto efficient
- We may be able to fix the problem using property rights, but this is hard for many players

PUBLIC GOODS

- In the many-player case, we often find goods (and bads) that are non-excludable
- Example: scientific knowledge. The producer can appropriate only a small part of the benefit (e.g., PhD thesis). The rest of the benefit is spillover for the whole community
- Example of a public bad: air pollution. Again, everyone gets to 'consume' the same amount
- Strong temptation for participants to free-ride rather than producing public goods.
- If production level decided communally, we get 'impossibility theorem' problems with voting etc
- Alternatives?

PUBLIC GOODS (2)

- We might ask everyone how much they were prepared to pay for a public good and if the total exceeded the cost, charge them pro-rata
- But people would lie in order to free-ride (strategic agents)
- How to design a strategy-proof mechanism?
- Suppose a TV costs £300 and three housemates are prepared to pay £50, £50 and £250 to have a TV in the house
- A Groves-Clarke tax works as follows

Person	Share	Bid	Net	Tax
Alice	100	50	-50	0
Bob	100	50	-50	0
Charlie	100	250	150	100

- Works under certain conditions (see Varian) but is not in general Pareto optimal
- CS application: try to find strategy-proof mechanisms for resource allocation in distributed systems

MONOPOLY RENTS

- If there are no barriers to entry, firms will enter the market until we have an equilibrium with zero profits and all factors of production being paid their market price (= opportunity cost)
- Limiting factors of production - natural resources, talent - all have an equilibrium rental rate
- What if we impose barriers to entry?
  - New York City taxi licences cost about $100,000, yet drivers made only $8 an hour (in 1986) after paying license rental of $55-65 per shift
  - Will raising the fares increase wages?
  - Licence owner makes about $17,000 pa after depreciation, maintenance etc - 17% pa.
  - Increasing each car's takings by $10,000 pa will increase value of licence by $60,000
  - Wage rate, set in competitive labour market, should be almost unaffected
- Monopoly / oligopoly conditions in effect create a rent
- Rent seeking refers to efforts directed at acquiring or keeping claims to factors in fixed supplies. Accounts for much political activity, from farm subsidies to med school admission.

PRICE COMPETITION

- Where the marginal cost of production of information is zero — i.e., all the costs lie in producing the first copy - you expect competition to drive the price to zero
- Example - machine readable phone books
  - 1986 - Nynex charged $10,000 per disk
  - ProCD had the phone book retyped in Beijing and started selling for $300
  - American Business Information joined in...
  - Now a CD phone book costs under $20 (and there are free services online)
- That's why there's so much free material online!
- FSF etc: 'information wants to be free'
- So how can you make money out of selling information? Sometimes you can get a legal monopoly (patent, copyright, ...) and sometimes you use other strategies

LOCK-IN

- Often, buying a product commits you to buying more of it, or investing in
  - durable complementary assets, eg software for a computer or PBX, CDs for a sound system, videocassettes for a VCR
  - skills, eg fluency with Office / Windows or Mac or Linux
  - services, e.g. network service for a PC or mobile phone, directory service for TiVO
  - combinations of the above, e.g. integrating a new general ledger package with your business systems, and general hassle factor
- The same can apply with services – it can be expensive to switch facilities management contracts
- This is not entirely new – more people change their spouses than their bankers – but the effects are very pronounced in information goods markets

LOCK-IN (2)

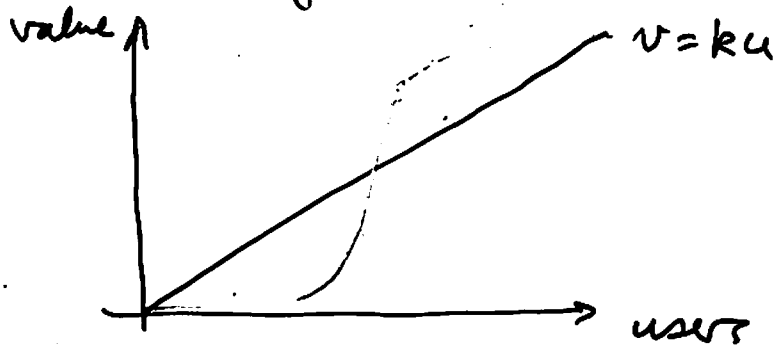
- 'Fundamental theorem': the net present value of your customer base is the total cost of switching
- Why this works:
  - suppose you're an ISP, and it costs £25 to set up a new customer
  - suppose it costs a customer £50 of hassle to switch to a new ISP
  - so total switching costs = £75
  - if you can figure out a business model that makes this customer worth £100,
  - offer them £60 cashback to switch
    they are £10 ahead, you're £15 ahead
- Is it a good idea to replace the half-dozen or so population registers in the UK (DVLA, tax, NI, births/deaths, passports, ...) with a single system?

LOCK-IN (3)

- Incumbent will try to maximise switching costs; competitors to minimise them
  - 'file format wars' between Word, WordPerfect
  - loyalty programs
  - regulatory struggles, eg phone number portability
  - promote complementary goods and services and find ways to lock customers in to them - from apps that only run on your operating system, to tied game cartridges
- Asymmetric switching costs make things more complex
  - eg mobile phone networks - to get a new customer you need to give them a phone, while existing customers can be bribed with extra minutes whose marginal cost is zero
  - similarly, pay-TV and set-top-boxes
- But where the asymmetry is based on physical assets (phones, mainframes, telephone switchgear) it will depreciate, + with it the lock-in

NETWORK EXTERNALITIES

- Many networks have the property that the more people use them, the more valuable they are to each user - as there are more people to talk to
- 'Metcalfe's law' - the value of a network is proportional to the square of the number of users
- Locally, at least, it's even more pronounced: the value to each user is more than linear in the total number of users



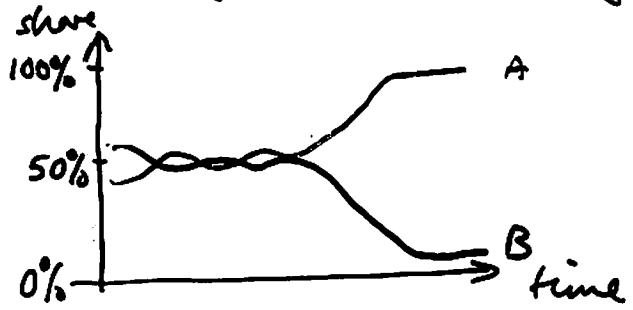
- Examples
  - telephone, late 19th century
  - fax, 1985-88
  - email, 1995-99

NETWORK EXTERNALITIES (2)

- Phone, fax, and email are 'real' networks
- There are also 'virtual networks' that depend on complements. The classic example is PCs and software
- People buy PCs (rather than Macs or Sun workstations) because there's lots of software for them
- Companies write software for PCs (and specifically, Windows) first, because the market is bigger than for Macs or Sun
- Bads as well as goods: virus writers target windows for the same reason
- Many other examples
  - credit cards and merchants
  - petrol-engined cars and petrol stations

NETWORK EXTERNALITIES (3)

- Markets with network externalities may 'tip' in favour of one competing standard



- Classic example: PC versus Mac in 1980s. Eventually PC was perceived as the likely victor, so developers wrote software for the PC first, so more people bought PCs...
- Demand-side economies of scale cause positive feedback, and 'winner-takes-all'
- Historical examples (see Shapiro and Varian):
  - rail guages in 19th century
  - colour TV standards in 1950s
  - VHS versus Betamax videocassettes

STRATEGIC ISSUES

- Combination of high fixed costs, low marginal costs, high switching costs and network externalities leads to a dominant-firm model
- Huge first-mover advantages
- Hence race for market share during dotcom bubble
- Hence also 'ship it Tuesday and get it right by V.3'
- Incumbents aren't completely invulnerable Hunger
  - technological progress (PC beat mainframe; CD beat LP; DVDs ousting VCRs ...)
  - change the nature of the platform (netscape challenge to MS)
  - antitrust law (breakup of AT&T)
  - industry reaction (everyone paranoid about IBM 20 years ago, about Microsoft now)
  - ...