How should we encourage pharmaceutical innovation?

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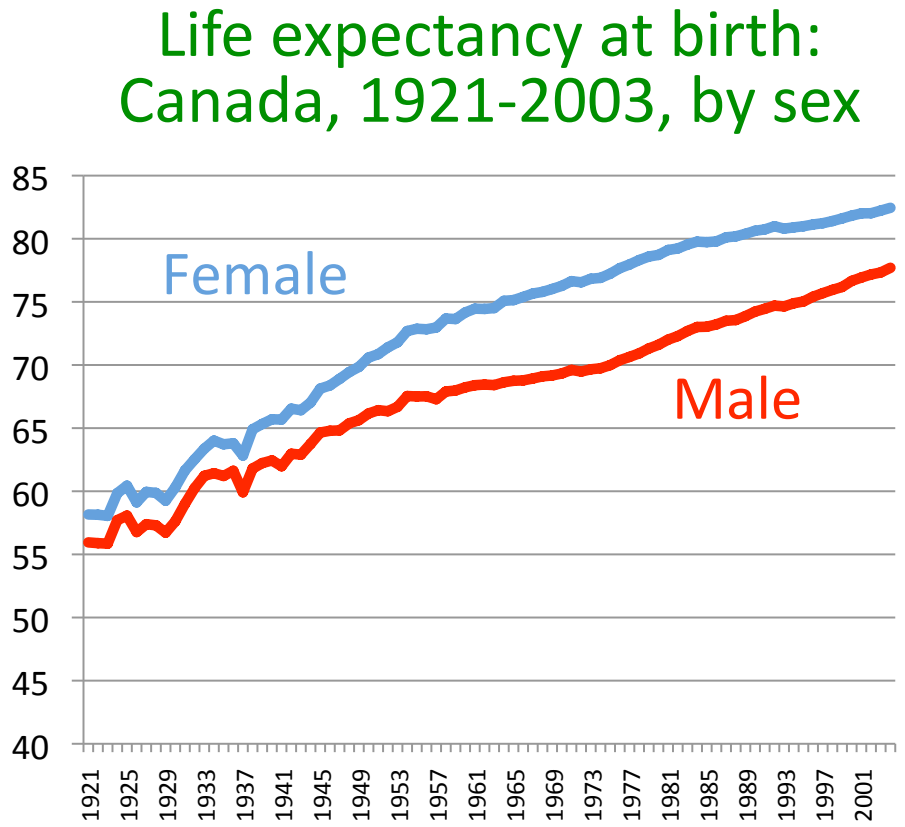
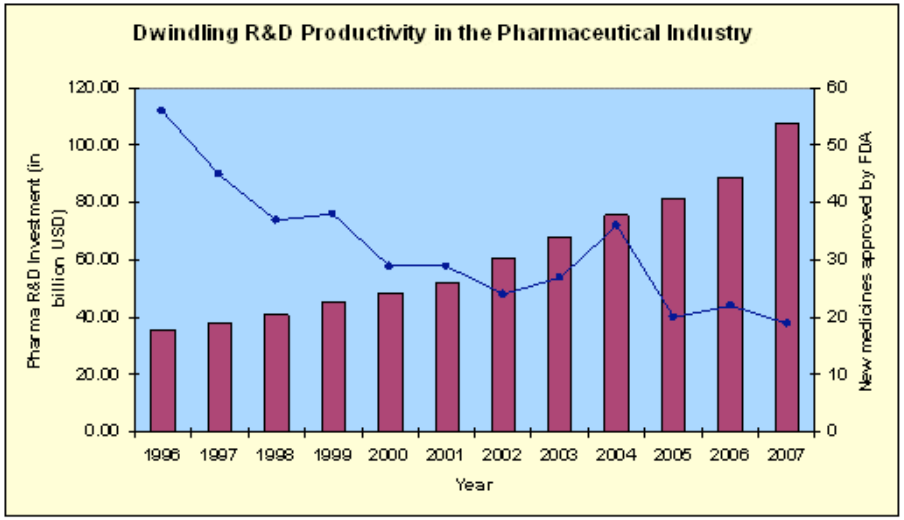
Background

- Development of new pharmaceutical ('pharma') drugs has undoubtedly contributed to the 12 year gain in life expectancy since WWII



Background

- In the last two decades, however, the rate of pharma innovation has slowed markedly.
  - New molecules discovered per $R&D has declined.



How should we encourage pharma innovation?

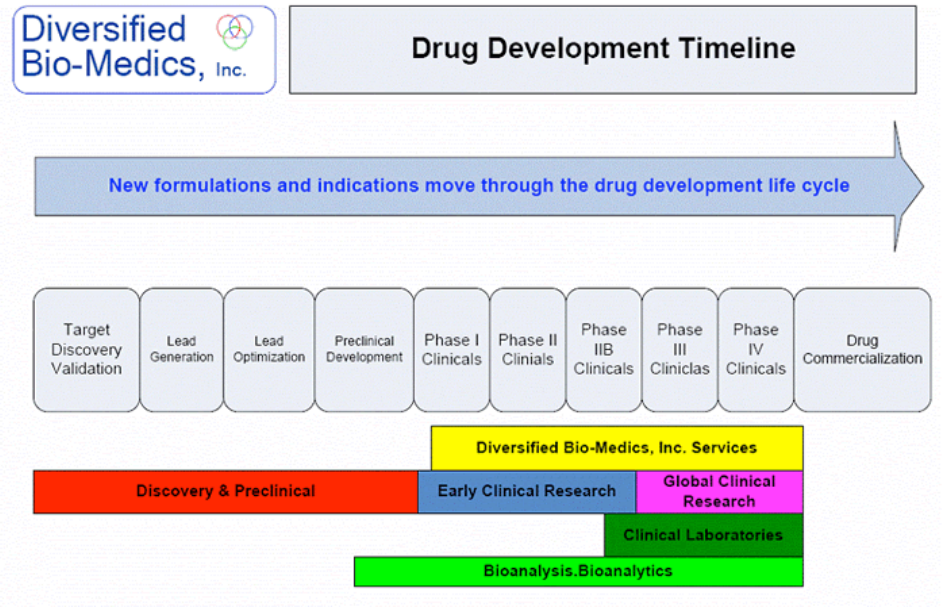
- Party line in pharma industry: we need longer periods of patent protection
- However, growing evidence that patents provide only weak incentives for innovative activity in general, and the development of new drugs in particular.
- Question: are there better ways to encourage pharma innovation?

Overview of my talk

- The rationale for patents
- Why patents might not work
- Alternatives
  - do we need government assistance?
  - recently proposed government support schemes

Standard rationale for drug patents

- Large sunk development & marketing cost
  - DiMasi et al *JHE* 2003 suggests cost is $800M including the cost of failed drugs and forgone interest on funds tied up during lengthy R&D process
- Relatively low marginal production and distribution cost for copies of the drug

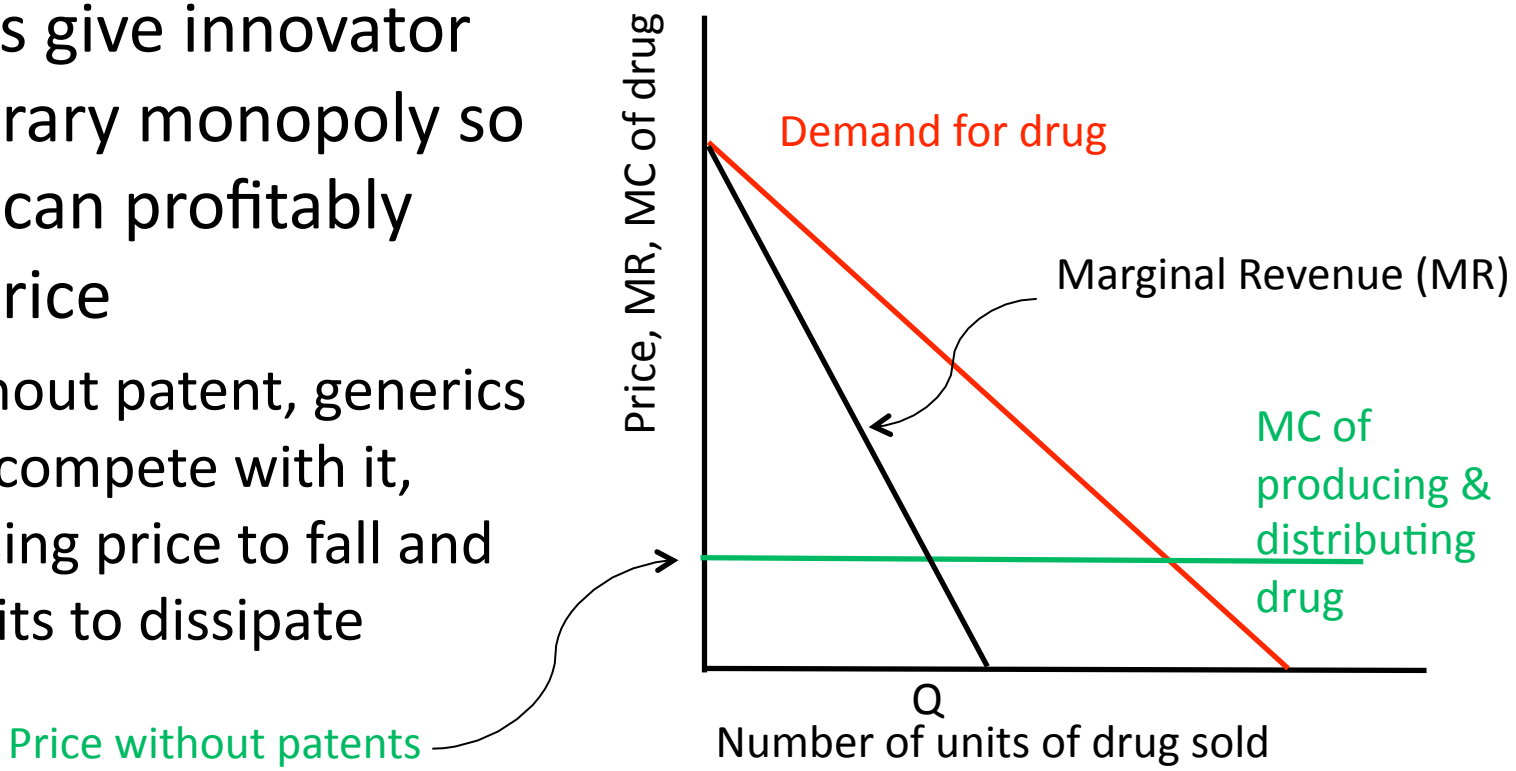


Standard rationale for drug patents

- In other words, drugs are costly to develop, but once developed, are cheap to make
- Claim: generic firms can quickly copy new drug, causing price to drop to marginal cost
  - ➢ innovator cannot recoup sunk cost at this price

Patents

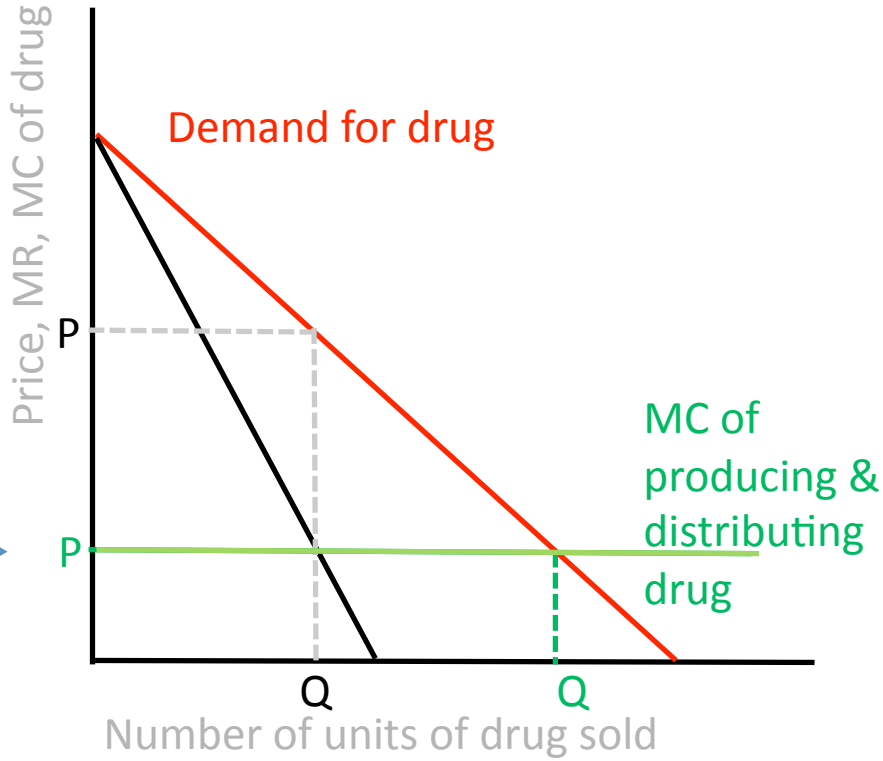
- Patents give innovator temporary monopoly so that it can profitably raise price
  - Without patent, generics can compete with it, causing price to fall and profits to dissipate



Drug prices with & without patents

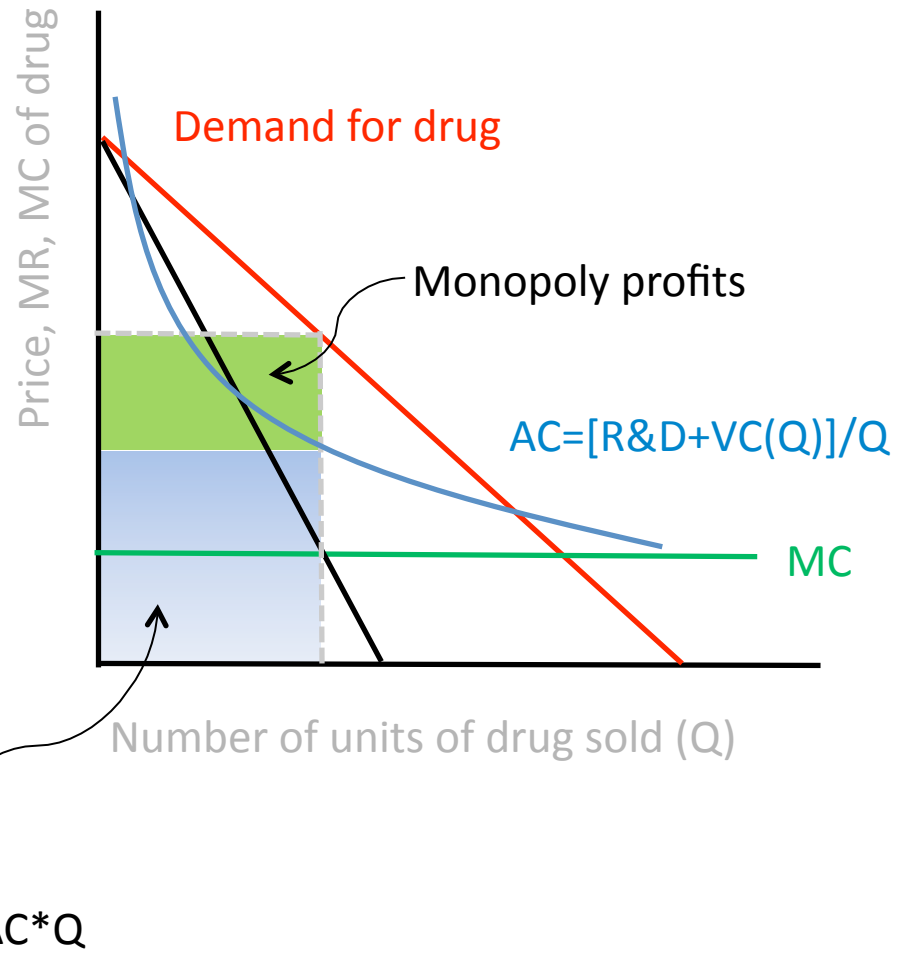
Profit maximizing price with patent: 'monopoly price'

Price without patents



Profits from Patents

- At the monopoly price, innovator can recoup sunk R&D cost and variable production, marketing & distribution costs: VC(Q)
- In this example, revenues more than cover sunk R&D and variable costs
  - Firm earns monopoly profits as well

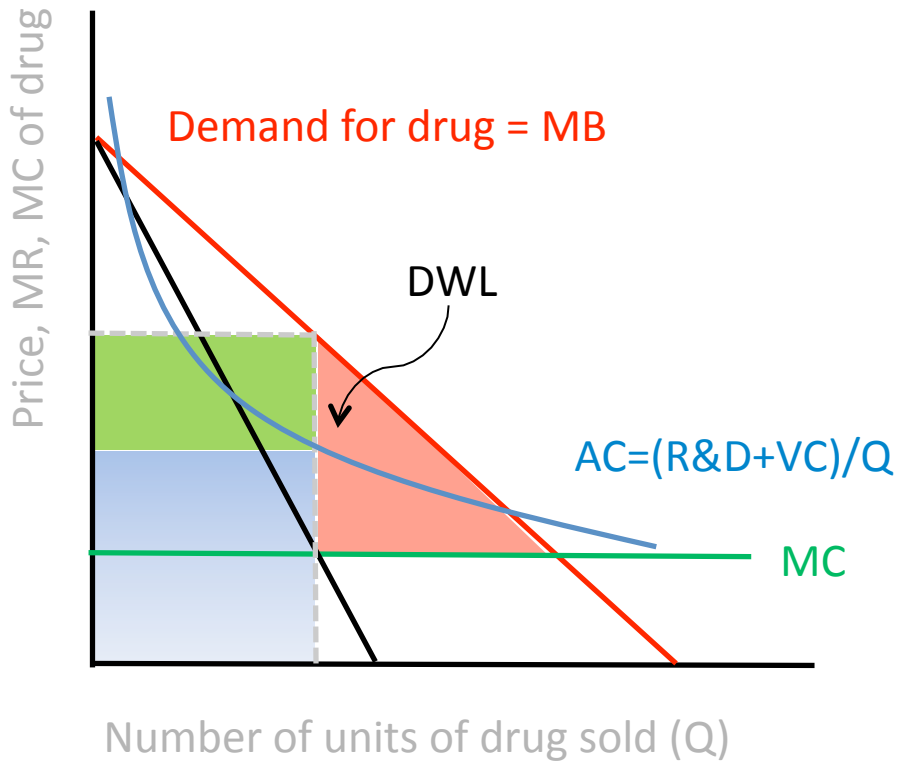


Problems with Patents

1. Create deadweight losses
2. Innovator cannot appropriate much of the profits due to 'rent seeking'
3. Increase the cost of innovation
4. Other social costs
   - **Bottom line**: a lot (most?) of potential profits from patents are wasted
   - no solid empirical evidence that stronger patents produce more drug innovation overall

Problem 1: 'Deadweight Loss' of Patents

- Dead Weight Loss = net benefit of transactions that did not take place on account of the price being set above MC
- Example: low income Africans will not purchase drugs at monopoly price

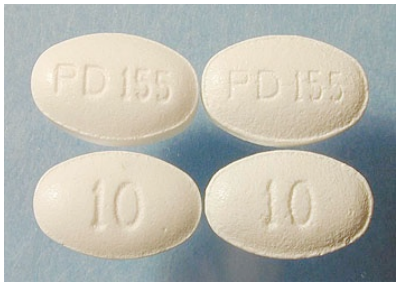


Problem 2: 'Rent seeking' dissipates innovator's profits

- Competitors will attempt to appropriate some of innovator's profits:
  - Counterfeiters
  - Resellers
  - Other drug companies
  - Drug payers
- Innovator and competitors will spend money in battle over control of profits
- In equilibrium cost of battle is equal to what patent is worth

Counterfeiters

- High margins encourage the proliferation of **counterfeit** drugs.
  - Steal market share
  - These drugs might be unsafe, harming the consumer/patient and the reputation of the pioneer firm.
- Requires innovator to invest in costly anti-fraud measures



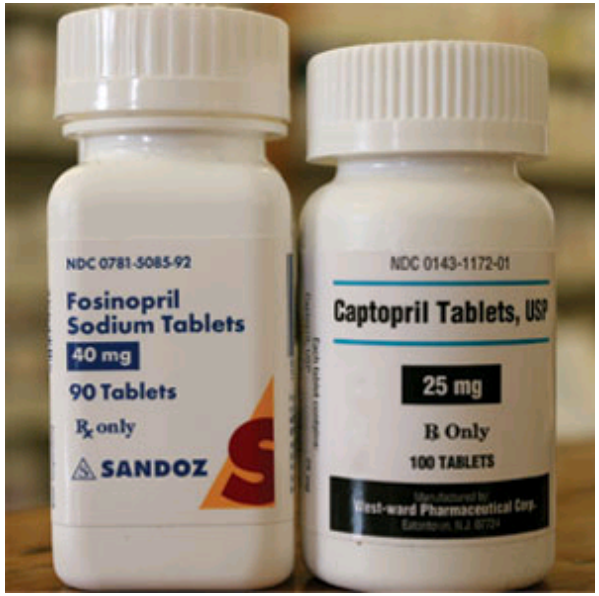
Source:
Gao Feng/Imagine China
(http://www.newscom.com)
'Counterfeit drugs being destroyed in China. Thousands of deaths and illnesses due to counterfeit drugs have prompted authorities to destroy large quantities of drugs.'

Drug resellers

- Drug sellers will exploit price differences across jurisdictions
- Requires innovator to invest in costly measures to prevent resale
  - different drug forms
  - supply chain controls

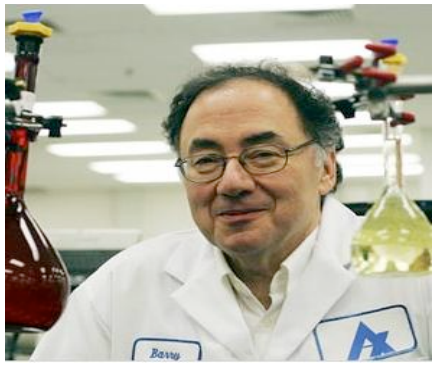
Me-too drugs

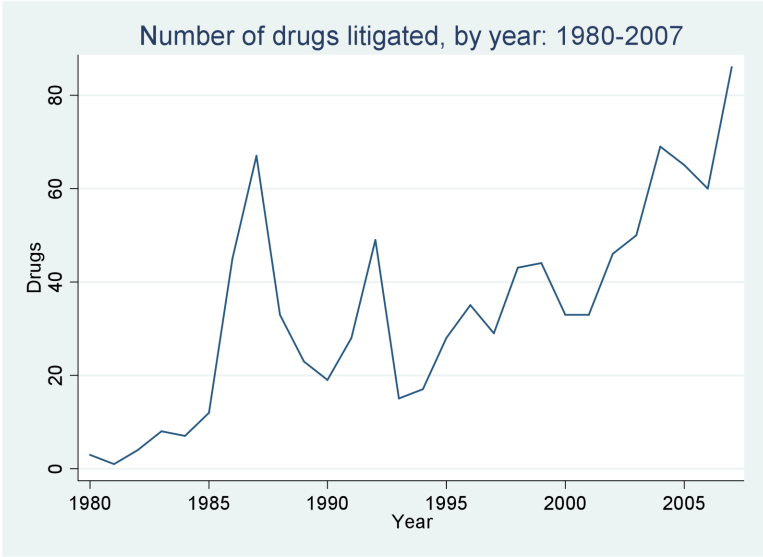
- Innovator will face competition from therapeutically similar drugs that are sufficiently differentiated to avoid patent infringement
- Pioneer and me-toos battle for market share with costly promotion of dubious social value



Generic drugs

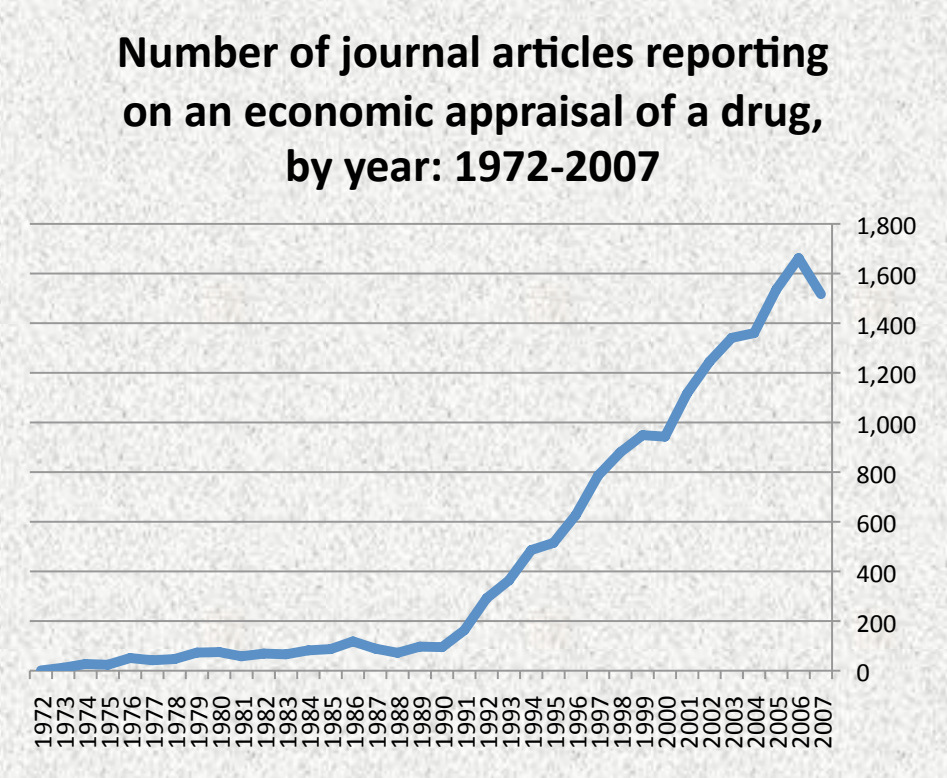
- Innovator will face competition from bio-equivalent generic drugs that will enter as early as possible
- Pioneer and generics in Canada almost always engage in costly legal battle





Drug payers

- High drug prices trigger government-imposed price regulation and other restrictions that defeat purpose of patents
  - PMPRB
  - Common Drug Review of cost effectiveness
  - Cost sharing and formulary restrictions
- Drug companies then hire market access lobbyists



Problem 3: Patents increase the cost of innovation

- Standard textbook model of patents applies to a 'standalone' invention
- Increasingly, however, drug innovation is sequential, building on previous discoveries
  - therapeutic proteins, diagnostic tests for genetic diseases, raw genomic DNA sequences, and receptors useful for screening potential pharmaceutical products.
- In this world, patents can be mixed blessing
  - Good if you can get a patent but getting one is more expensive if new drug builds on patented technologies.

Increases the cost of innovation

- Evidence that any increased incentive to innovate is more than offset by the increased difficulty of doing so
- Peter Ringrose, chief scientific officer at Bristol Myers Squib, told the *New York Times*:

  there were 'more than 50 proteins possibly involved in cancer that the company was not working on because the patent holders either would not allow it or were demanding unreasonable royalties'

  - (B&L page 250)

In general, how can pharma firms recover sunk costs?

- Two ways might be possible:
  - Without government aid
  - With government aid
- Boldrin and Levine in their book "Against intellectual monopoly"

  http://www.dklevine.com/papers/imbookfinalall.pdf

  note that innovating firms can often cover sunk costs without government help

Covering sunk costs without government aid (B&L Chapter 6)

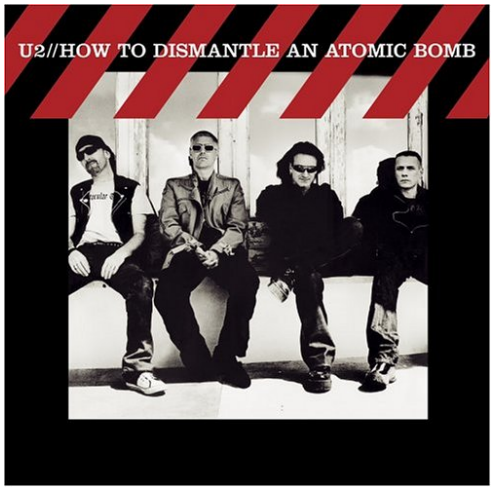
- Sale of complementary services
- First mover advantages
- Capacity constraints
- Trade secrets

Digital copy of a U2 album

- Sunk cost of making album is high (U2's time, studio time, producers, etc.)
- Digital copies of the album can be produced and distributed at very low cost

Sale of complementary goods

- Firm produces 2 goods.
  1. subject to low duplication cost (e.g. U2 album)
  2. is not (e.g. U2 concert)
- Suppose that U2 album widely downloaded
- This will increase consumers' WTP to see U2 perform live.
- Profits from U2's tour can cover sunk cost of producing album



First mover advantages

- It takes time for imitators to reverse engineer the new good, develop productive capacity, produce, promote and sell the good
  - During this time, the innovator is the monopolist and can charge higher prices

Covering sunk costs with government assistance.

Desirable characteristics of a drug innovation assistance system

- Revokes 'intellectual property' rights
  - Avoids unproductive battles over patents
  - Reduces cost of innovation
  - Drug prices closer to MC
    - Reduces rent seeking activities
    - Reduces DWL
- Rewards development of more 'important' drugs
- Contributions by donors are transparent and reneging on commitments not possible

Proposed forms of assistance

- Subsidies for inputs into drug discovery (i.e. cost of drug development)
  - Support for drug testing in humans (Boldrin & Levine)
  - Support for basic science (Edwards)
- Subsidies for outputs of drug discovery (i.e. new drugs):
  - payments are higher, larger the population health gains of new drugs (Hollis)
  - payments for providing say 1,000,000 doses of an effective vaccine (Kremer)

Michele Boldrin & David Levine

- “Clinical testing is a classic public good”
- The public should pay for it.

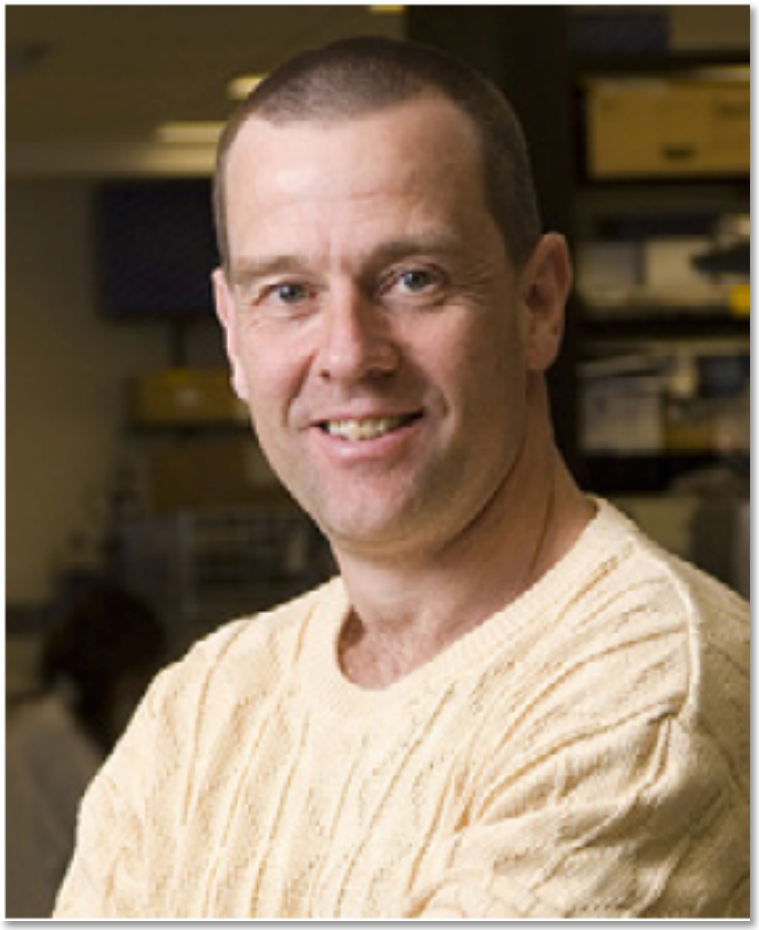
David Levine

Boldrin & Levine

- Testing of safety and efficacy of new drugs on humans is a classic public good and should be funded by governments
  - This would dramatically reduce the cost of drug R&D to drug companies
  - Also would produce more informative clinical trials
    - Meaningful health outcomes could be compared
    - Trials could compare efficacy of new drugs vs standard therapies
      - Currently all trials need to do is establish that they work better than nothing
  - Making government pay for the trial would curb government's tendency to make trials more costly by adding more and more regulations and conditions.

Aled Edwards

- Open source model to research basic science to support drug discovery



Aled Edwards

- Major rate-limiting hurdles to drug discovery are best overcome through collective action of academic research groups funded by public and private sectors
- Results are placed in public domain without restrictions being put on their use
- Advantages:
  - Avoids duplication of effort across research groups
  - Avoids squabbles over IP ownership
  - Spreads risk across number of partners
- Issues
  - Incentivizing academics to meet targets
  - Getting buy-in from stakeholders

Aled Edwards

- Major rate limiting hurdles in development:
  - Target Validation, Predictive Toxicology and better Models of Human Disease.
- Specific sub-projects might include, for example:
  - the creation of specific, selective and bioavailable chemical probes for all human enzymes, the generation of highly selective protein affinity reagents for all human proteins and the creation of a well-annotated dataset of toxicity profiles for every compound that has been in clinical or pre-clinical development.

Michael Kremer

- Award contracts to firms that deliver a pre-specified number of doses of a vaccine which meet specific efficacy targets

Kremer's idea

- Kremer: award funds to drug companies that develop effective drugs
- Problem is specifying the technical characteristics of the drug beforehand and the amount of money needed to induce effort
- Also problem with sponsor reneging on commitments

Aidan Hollis

- Reward new drug developers a share of a Global Pharmaceutical Innovation Fund

Hollis' idea

- He operationalizes Kremer's idea by giving innovators a share of a pharmaceutical innovation fund that is proportional to the increase in Net Benefits that their drug generates
  - Increase in Net Benefit from your drug A compared to existing drug B = $(\text{Net benefit})^A - (\text{Net benefit})^B$
  - $(\text{Net benefit})^A = [p*QALY^A - c^A]*q^A$
  - Where
    - p = standardized value of a QALY (Quality Adjusted Life Year) produced by a unit of your drug
    - c^A = production cost of unit of your drug
    - q^A = units of your drug consumed
    - The firm would obtain points for every sale of its drug, no matter who produced or sold it

Limitations of Hollis' idea

- Primary problem is one of measuring the QALY gains of each new drug
  - How to measure utility weights for various health states?
  - How to estimate effect of drug from other factors?
    - Rewards would not be determined until enough time had elapsed for QALY gains to be realized.
- Also races to be first so that the bar (i.e. net benefit from existing drug) is set relatively low