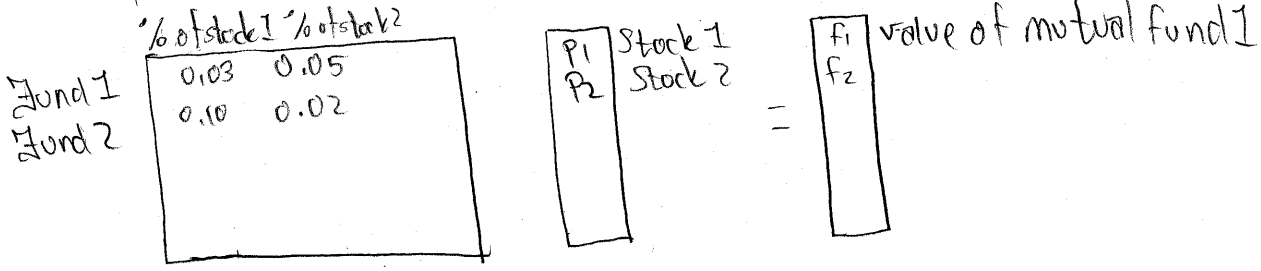
# Patents and Technology

- Past five years: big boom in patenting (ie software patenting.)
- State Street versus Signature Financial
  - patent on method of evaluating mutual fund portfolio value:




  - ie matrix multiplication
  - 1998: Business Process patents were allowed
  - amazon: 1 click purchasing
  - Priceline: "Name your own price"
  - Gemstar patented practically every format of TV showtime listings, forcing TV Guide to sell out to them.

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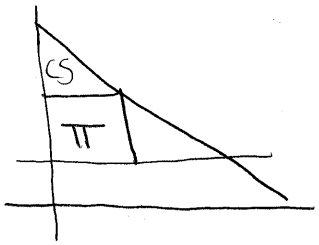
Suppose can invest $E$ and invent good with demand $P(q)$ and cost $c$ (which are known.)

Social surplus is maximized if $p=c$

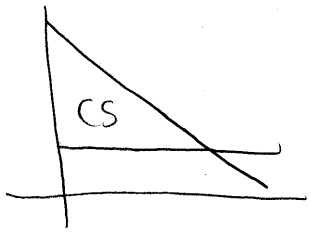
- $\underbrace{GS}_{\text{gross surplus}} = \int_0^\infty e^{-rt} \int_0^{\bar{q}} [P(q^m) - c]\, dq\, dt$, where $P(\bar{q}) = c$
- Social optimum: invest if $GS > E$ and price at $p=c$ if this product doesn't affect other products.

(ie no business stealing, no complementarities.)

Patent: Inventor gets monopoly rights for 20 years from time of invention.




$0 \le t \le 20$




$t > 20$

- $\Pi = \int_{t=0}^{20} e^{-rt} \left( \int_{q=0}^{q^m} (P(q) - c)\, dq \right) dt$
- monopolist invents if $\Pi > E$

Distortions:

1] Incentives to innovate are too low.

2] Distortion due to deadweight loss.

- want to trade-off these two effects.

"second best problem"

SB: $\max \int_0^\infty (\Pi(p_t) + CS(p_t)) e^{-rt} dt$

s.t. $\int_0^\infty \Pi(p_t) e^{-rt} \ge \bar{E}$

FOC will give: $\frac{\partial \Pi}{\partial p_t} + \frac{\partial CS}{\partial p_t} = \lambda \frac{\partial \Pi}{\partial p_t}$. This is time-invariant, so $p_t$ should be constant over time.

Thus, patents aren't even second best.

What is the socially optimal patenting policy?

## Full Optimum for Social Planner

1] Prize subsidy program: Gov't pays GS to inventor and makes all inventions public

2] Research subsidy program: Gov't pays E to company wanting to do research. (if E<GS)
- Gov't owns the good.

Problems:

1] asymmetric information: Gov't needs to know GS and E.

2] Need to monitor research effort.

3] Unique abilities

4] Lobbying/commitment problems

5] Administrative costs

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## Kremer

- Patent owner offers to sell to the public
  - auction for monopoly rights
  - suppose b is the winning bid
  - with probability p, good is sold at b to the winner
  - with probability 1-p, good retained by the gov't. Mb paid to inventor ($M \simeq 2$)

- This only really solves 2]. The other problems are still relevant for this model.

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Bessen-Maskin: Sequential Innovation

- Two firms, sequence of innovations $v_0, v_1, v_2, \ldots$
- Cost $c$ gives prob. $p$ of invention if produced the previous quality.
- Firms get profits $\begin{cases} v_t & \text{if monopolist at } t \\ sv_t & \text{if duopolists at } t \end{cases}$
- Can copy if no patents exist.
- No patents: probability of invention $v_{t+1}$ conditional on $v_t$ invented:
  - $\Pr[v_{t+1} \text{ invented} \mid v_t] = 1-(1-p)^2 = 2p-p^2$
  - $\Pr[v_{t+1} \text{ not invented} \mid v_t] = (1-p)^2$
- $E[\#\text{ inventions}] = \dfrac{2p-p^2}{(1-p)^2}$
- Welfare: $\dfrac{2p-p^2}{(1-p)^2}(v-2c)-2c$ (if we assume that $v_{t+1}=v_t+v$)
- Under monopoly.

  Welfare: $\dfrac{2p-p^2}{(1-p)}(v-c)-2c$

- comparisons:
  - duopoly advantage - better at * innovations
    - worse at effort duplication.
- can show that both social welfare and profits can be lower with patents.
  - ie with c small and $s=\frac{1}{2}$.

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Green-Scotchmer

Consider sequential innovation

| 1st period | 2nd period |
|---|---|
| x | x, y |

- quality innovations
- product with both innovations has quality boost of x+y.

Monopoly profits - $\pi_x^m(T)$, $\pi_{x+y}^m(T)$ if get T periods of patent protection
- get $\pi_x^c(T)$, $\pi_y^c(T)$ if duopoly for T periods

Assume x invented first and then one firm gets chance to invent y at cost $c_2$.

Assume firms can negotiate before y invented

Patent breadth:
- For what values of y can firm 2 produce x+y?

Proposition 1: Under certainty, firm 1 always has insufficient incentives to invest in inventing x.

- Firm 1 does not capture all the benefits of invention

Proposition 2: With no uncertainty about values or $c_2$, it is optimal to never let firm 2 produce $x+y$. (ie infinitely broad patents)

Proposition 3: With uncertainty, can be optimal to have less broad patents.