Markets for Technology:
State of the "Art" & Future Research Challenges

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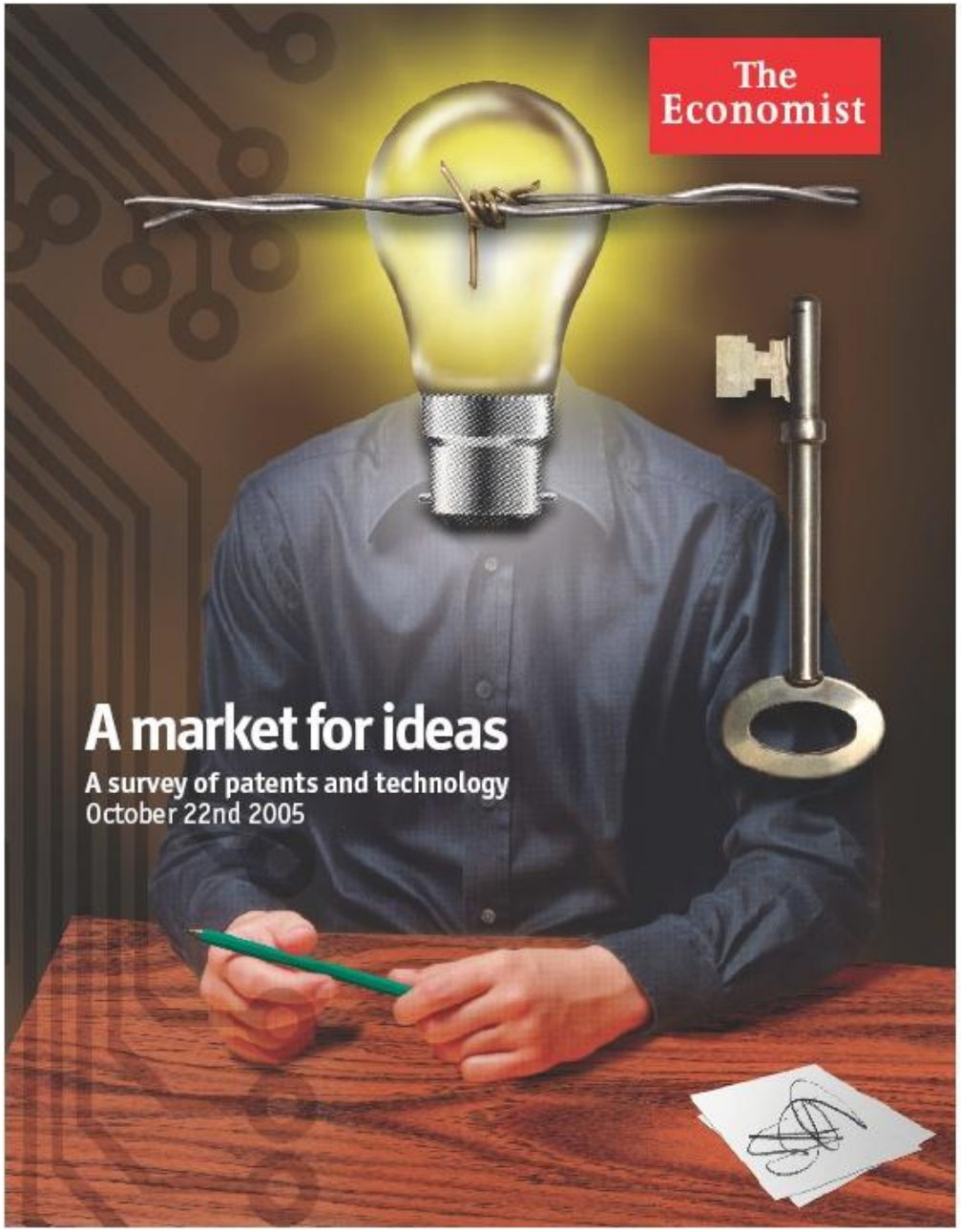
Background

- MFT = sales or licensing of technology disembodied from products
- Potential benefits
  - Firms have more options (make, buy)
  - Division of innovative labor (comp. adv.)
  - Higher innovation rate
  - More diffusion & use of technology
- Potential shortcomings
  - Fear of IP litigation & "hunting" for infringement
  - E.g., recent bid of 4.5b USD for Nortel patents or other "defensive" purchases
  - Tax on innovation?
- MFT more important since late XX centrury



- + world market
- + firm licensing
- + licensing royalty rates
- + "open innovation" strategies of firms
- + technology specialist firms
- patent auctions
- intermediaries
- NPE
- + attention of institutions
- + academic literature

This Talk

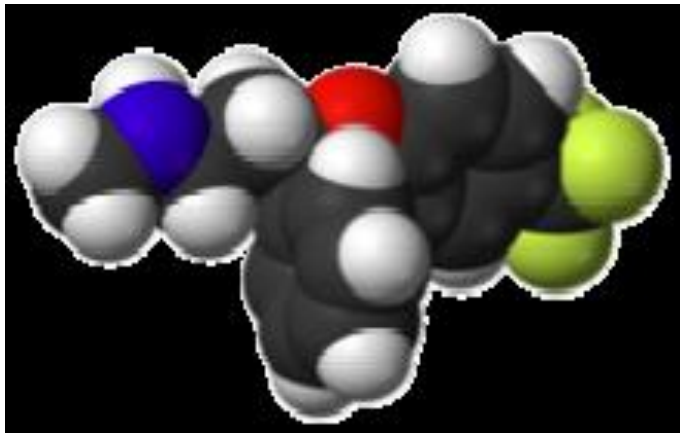
- What we have learned
  - Factors affecting MFT & some implications
  - Evidence
- Open questions/research (focus on two)
  - MFT and the organization of firms
  - Do IP markets reduce litigation?
- *Not exhaustive, sorry if I miss important stuff!*

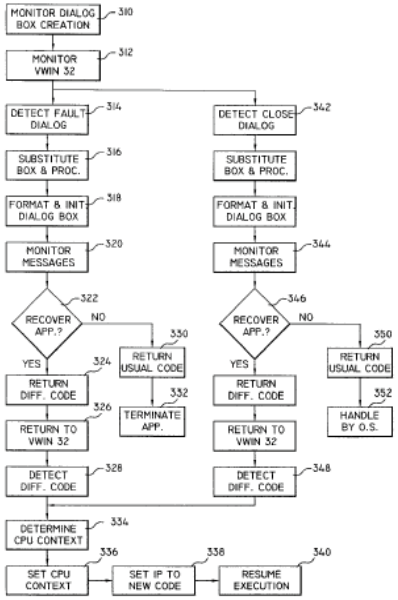
What we know: Factors affecting MFT

- Nature of knowledge
- IP
- Determinants of firm's licensing decision
- Size of MFT
- Uncertainty

Factors affecting MFT: *Knowledge*

- MFT more likely when knowledge is more codified or can be embodied in some "object" (e.g., compound, algorithm, formula)





- Life sciences, engineering sciences, software make this easier … also eases patentability and definition of claims

Factors affecting MFT: *IP*

- Weak IP discourage:
  - *technology sales vs. integration* (Gans et al. 2002)
    - especially by smaller firms with no downstream assets (Arora & Ceccagnoli, 2006)
  - *entry of technology specialists*
    - chemical engineering (Arora et al., 2001)
    - semiconductors (Hall & Ziedonis, 2001)
    - Software (Cockburn & McGarvie, 2006)
- b/c can hardly profit just from technology sale
- Ziedonis (2008): this is a "social" benefit of IP

Factors affecting MFT: *Licensor's rent dissipation*

- Arora & Fosfuri (2003) argue that firms license if ***Revenue from licensing (RL) > Rent dissipation from creating competitors (RD)***
- *RL* depends on *strength of IP*, *bargaining power*, *transaction costs in MFT*
- *RD* ↓ if
  - Product market share of licensor ↑
  - Product differentiation in licensor's product market ↓

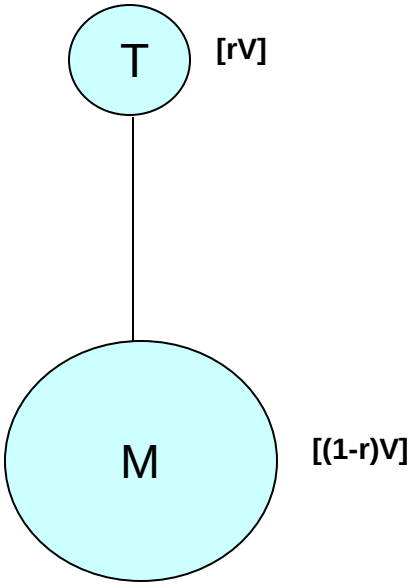
1. ***Firms with fewer stakes in product markets more likely to license (technology specialists)***
2. ***MFT more likely in competitive product markets (b/c of lower dissipation of product market profits)***

Factors affecting MFT: *Size of MFT*

- Dedicated vs general-purpose technologies (GPT)
  - one vs many applications
- In fragmented product markets
  - higher benefit of making the technology useful for another application → GPT (Bresnahan & Gambardella, 1998)
  - you can license the GPT to a "distant" competitor → more licensing (Gambardella & Giarratana, 2010)
- Thus, "ideal" conditions for MFT
  - GPT & Fragmented product markets
- In addition, GPT suppliers better control the sources of their rents (Gambardella & McGahan, 2010) →

Dedicated technologies vs GPT: shares of industry rents

Dedicated technology [rents]

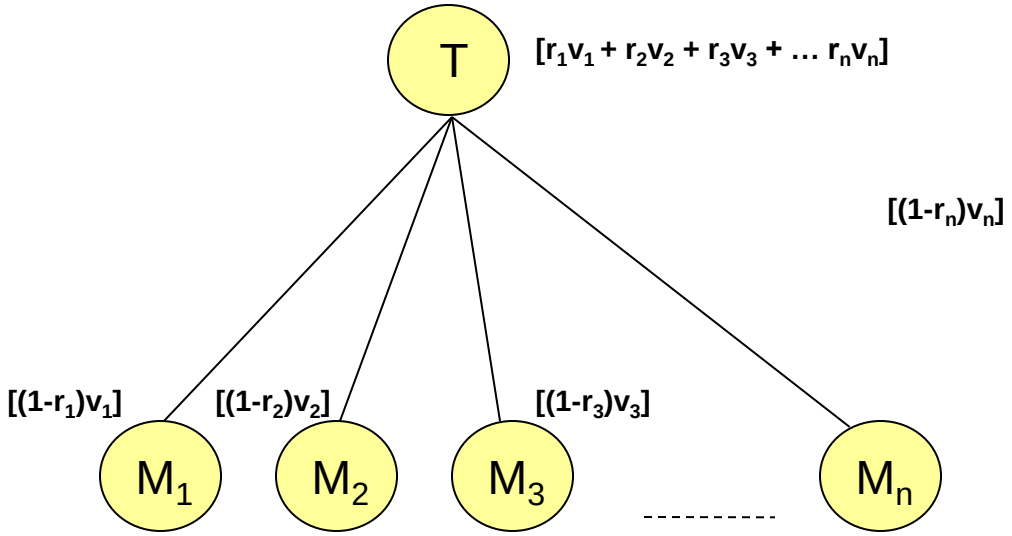


V = Total value in the vertical chain

r = Share accruing to the technology firm

T = Technology firm. M, M_1, M_2, M_3, …, M_n = Manufacturers

GPT [rents]



v_1, v_2, v_3, … v_n = Total value in each vertical chain

r_1, r_2, r_3, … r_n = Share accruing to the technology firm

Factors affecting MFT: *Uncertainty*

- Gans et al. (2008) show that US patent licensing occurs largely around grant b/c of lower uncertainty about extent of IP (claims, scope)

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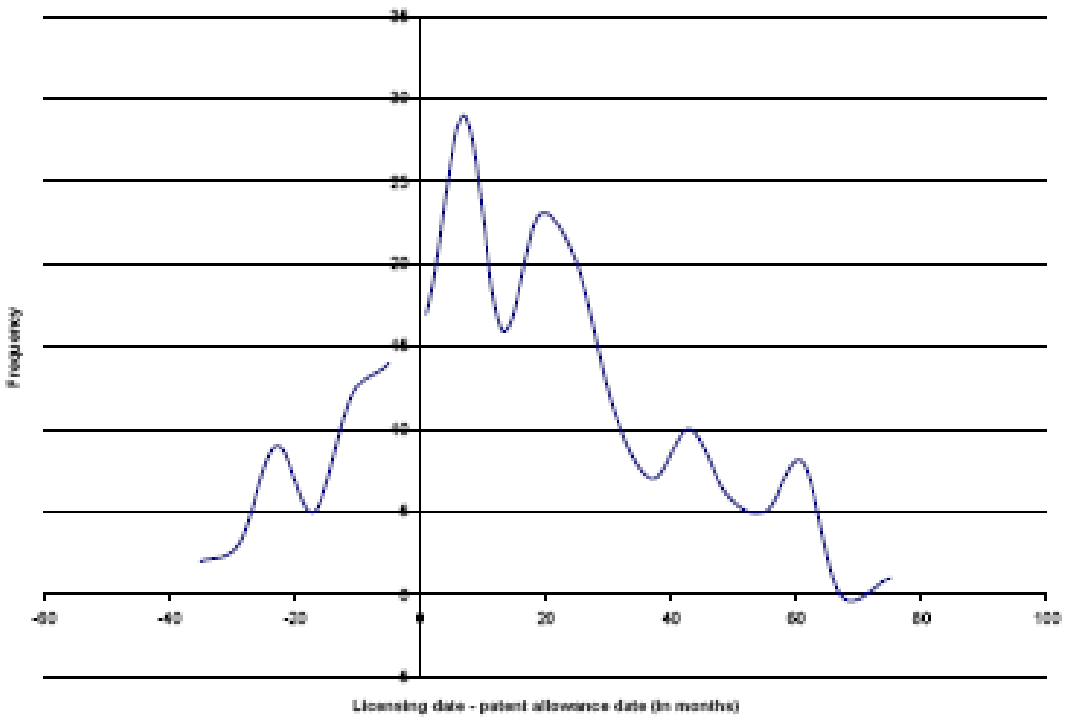


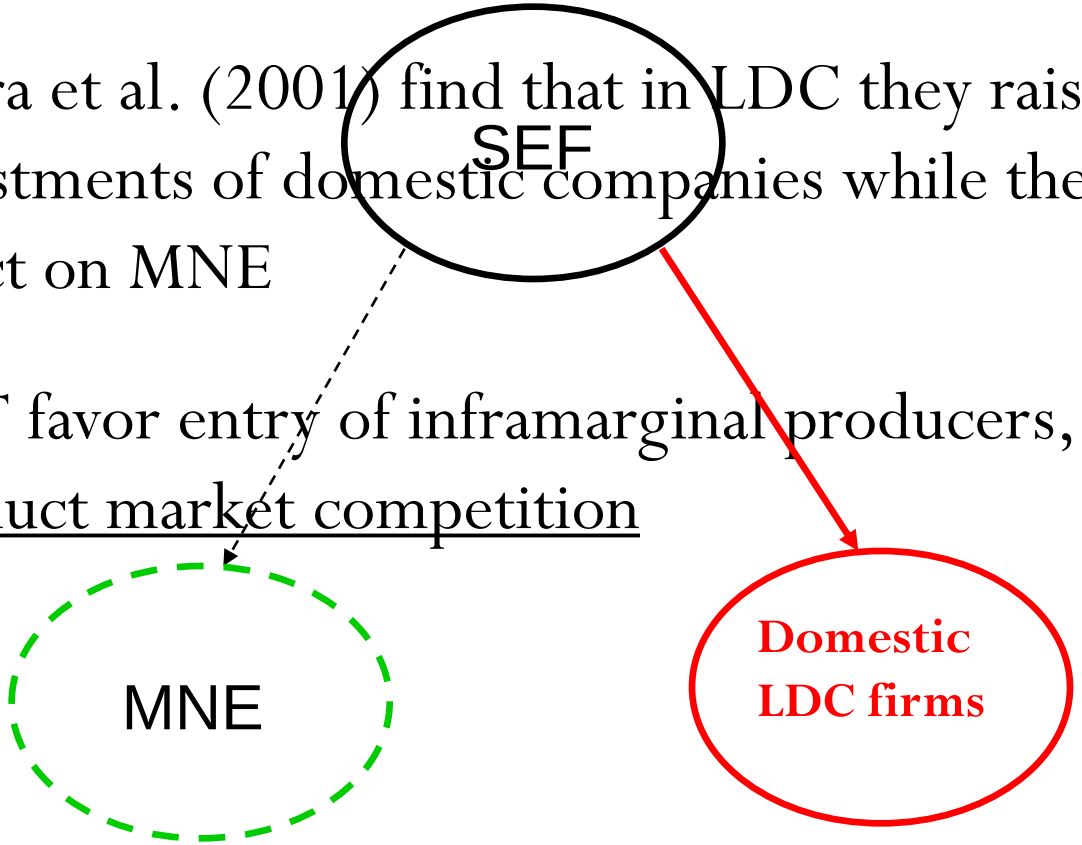
Evidence I: Determinants of MFT

- Using PatVal-EU data on 7k patents, Gambardella et al. (2007) find the following reasons for licensing patents
  - Breadth (size of the market)
  - Science (cognitive)
  - Marginal technologies
  - Protection (# claims)

- But the most important determinant is **firm size** (willingness vs actual licensing)
  - Large firms 16% vs 9%
  - Small firms 37% vs 26%

Evidence II: Industry-wide benefits

- Specialized chemical process engineering firms (SEF) sell their technologies to chemical producers
- Arora et al. (2001) find that in LDC they raise the investments of domestic companies while they have no effect on MNE
- MFT favor entry of inframarginal producers, and product market competition

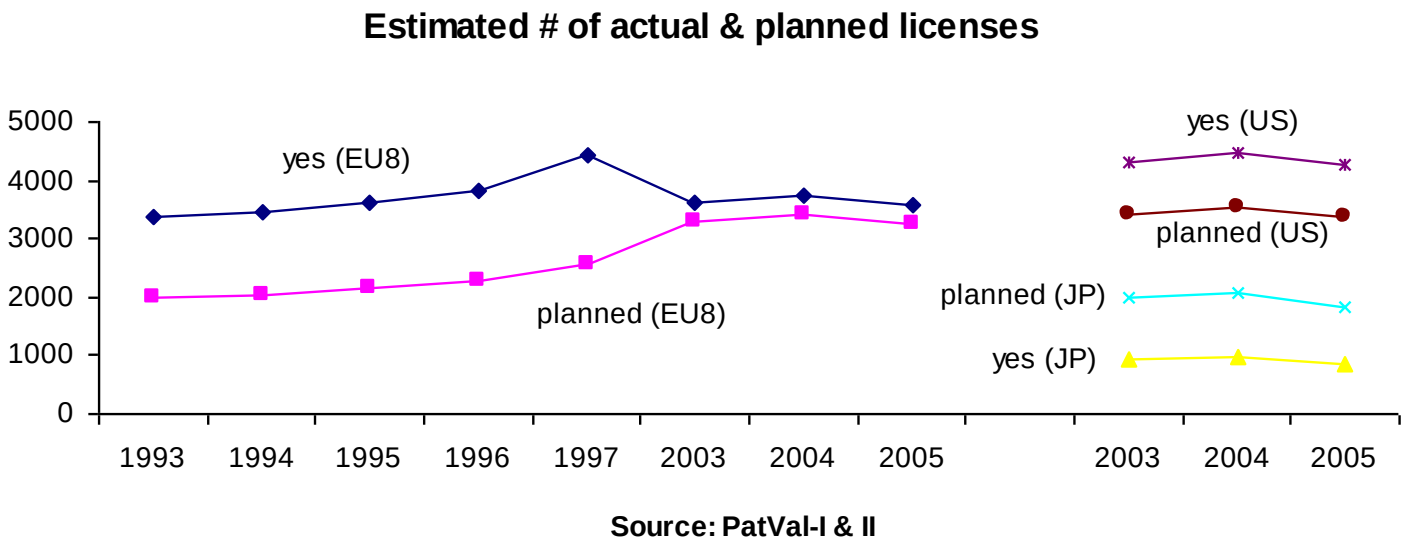


Evidence III: Gains from Trade (GFT) in the MFT

- Serrano (2011) (US patent sales data)
  - 23% patents traded at least once
  - Value of traded patents
    - = 50% total value of all patents
    - = 3 times + valuable than non-traded patents (USD 160K vs 50k, age 1)
- **Very skewed** GFT (*value of patent if traded – value of patent if not traded*)
  - 50% traded patents gains < 3.4K
  - 10% traded patents gains = 70% total GFT
  - 1% traded patents gains = 25% total GFT
- MFT are efficient!

Evidence IV: Are MFT shrinking?

- PatVal data show reduced % licensing (22-15%) vs "strategic" patents (18-26%)
- Sheer # of licensed patents not increasing in 2000s



- *This leads to our two final remarks about future research*

Future Challenges: MFT and the Organization of Firms

- Most of the literature on MFT has focussed on smaller firms as potential suppliers
- However, the large untapped source of unused technologies is the larger firms – e.g., in seminconductors established firms are increasingly targets of litigation (Hall and Ziedonis, 2007)
- But, as we showed, they do not seem to be that active in this market (e.g., Gambardella et al., 2007)
- Till large firms are inactive suppliers, MFT will not really grow to the next level

Future Challenges: MFT and the Organization of Firms

- Arora et al. (2011) argue that the lack of large firm action as suppliers in the MFT may stem from some basic features of their organization structure
- They show that decentralizing the decision to "license or produce" to the business units makes licensing less likely
- Top managers reward the licensing profits of the divisions less than production profits because the latter depend to a greater extent on the unit's effort (as opposed to information)
- Thus, we expect to see ***higher rates of licensing when firms centralize the decision to license in specialized licensing/IP units***

Future Challenges: MFT and the Organization of Firms

- Case studies of IBM, Dow, Being, Motorola, Xerox, and Procter & Gamble suggest that
  - In firms that license extensively, licensing is handled by a specialized business unit (often treated as an independent business)
  - licensing is incentivized in various ways (licensing revenues are typically shared with operating units)
  - there is often a marked (discrete) jump in licensing revenues when firms remove licensing authority from the business units and manage it centrally
- On-going research shows decentralization of the licensing decision is associated with lower licensing rates
- A potential limitation of MFT may stem from the organization of large firms that are still too much focussed on production vs licensing

Future Challenges: Do IP Markets Reduce Litigation?

- Using PatVal data, Giuri and Torrisi (2011) find that the "intention" of cross-licensing a patent does not reduce the probability that the patent is opposed
- However, they argue that this may stem from two opposite effects on litigation
  - Cross-licensing = more likely to settle (–)
  - Litigation to gain bargaining power in cross-licensing deals (+)
- They also find that the # of XY backward references (overlapping claims) increases the "intention" of cross-licensing

Future Challenges: Do IP Markets Reduce Litigation?

- Galasso et al. (2011): ***patent trade*** not only b/c of comparative advantages in commercializing innovations (Teece, Arora et al.), but also ***in patent enforcement***
- The former increases litigation (b/c profits increases), the latter reduces it
- Empirically find reduced litigation suggesting that the latter effect dominates (*but* individually-owned patents)
- Marginal treatment effect of trade on litigation is heterogenous … in particular, change in ownership more likely for larger gains (MFT are efficient)

Conclusions

- The finding that MFT are efficient is encouraging
- Main research challenge is how revamp their growth
  - GPT, uncertainty (patent systems)
  - organization of firms, effects on litigation
  - patent pools & related issues (pricing of technology, bargaining models)
  - contracts (in markets or pools)
  - relationships b/w openness vs appropriability

Thank you!

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