Current Issues and Trends in the Economics of Patents

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Outline

- Overview
- Some current policy questions and problems
- Patents as indicators

Overview

Two major research areas with very different aims and interests:

- Normative - patent policy and IP strategy
  - Existence of patent system
  - Design of patent system – length, breadth
  - Firm strategic choices – secrecy, patenting, litigation, licensing
  - Enforcement and administration; interaction with antitrust
- Positive - patents and citations as indicators of inventive activity and spillovers
  - Measures of inventive output (rather than input), over time, over firms, over countries
  - Citations as measures of knowledge “spillover,” where we can identify the recipient as well as the source

Patent policy

A patent creates a property right over intangible knowledge assets – the right to exclude others from using them.

- well known tradeoff between incentives and monopoly power: non-rival nature of knowledge asset implies there is a social cost to granting the property right
- less well-known: more complex issues due to strategic use of patents; cumulative innovation; interaction with other incentive systems

Penrose and Machlup on the existence of the patent system

"If national patent laws did not exist, it would be difficult to make a conclusive case for introducing them; but the fact that they do exist shifts the burden of proof and it is equally difficult to make a really conclusive case for abolishing them."

*[Edith Penrose (1951), **The Economics of the International Patent System**, Baltimore: John Hopkins University Press.]*

"If we did not have a patent system, it would be irresponsible, on the basis of our present knowledge of its economic consequences, to recommend instituting one. But since we have had a patent system for a long time, it would be irresponsible, on the basis of our present knowledge, to recommend abolishing it."

*[Fritz Machlup (1958), **An Economic Review of the Patent System**, Study No.15 of Comm. on Judiciary, Subcomm. on Patents, Trademarks, and Copyrights, 85th Cong., 2d Sess.]*

Alternative - reward systems

Proposed by R. A. Macfie (UK sugar planter) in the 19th century (although used somewhat earlier).

Modeled by Shavell and Ypersele (*JLE 2001*), who find:

- patent system superior to a reward system:
  - "effectively harnesses the private information of the innovator about the value of an innovation"
  - Many (majority) of innovations not predictable
- reward system superior to the patent system:
  - the incentive to innovate is optimized (assuming that the reward equals the actual social surplus afforded by the invention)
  - no monopoly pricing, and hence no deadweight loss due to such pricing
  - useful when innovation and its value can be predicted (e.g., malaria vaccine)

Some current policy issues

- Increase in patenting rates and consequent increase in patent office workloads worldwide, traced to
  - Subject matter expansion
  - Nonobviousness (novelty) standard falling?
  - Increased strategic use (harvesting)
- Patent scope (breadth)
  - See *Gallini and Scotchmer (IPE 2001)*
- Research tools and university patenting
- Cumulative and overlapping innovation – the patent thicket

Many of these policy problems are not new!

History of U.S. Patent reform efforts

Reform Proposal	Committee on the Relation of the Patent System to the Stimulation of New Industries (1936)	National Patent Planning Commission (1943)	President's Commission on the Patent System (1967)	Advisory Commission on Patent Law Reform (1992)
reform of obviousness standard; presumption of validity	recommended	recommended		
opposition/revocation		considered & rejected	recommended ex parte pre- and post-grant	recommended reform
Pre-grant publication	recommended	not considered	recommended	recommended
Single appellate patent court	recommended	recommended		n/a
patent trial courts	recommended the use of technical advisors		recommended the use of "Civil Commissioners"	recommended
compulsory licensing	considered & rejected	considered w/o recommendation		
20-year term		recommended	recommended	recommended
first-to-file			recommended	recommended

Source: Mark Janis (2001), “Patent Abolitionism,” U of Iowa Law School

On patent thickets

"In the manufacture with which I am connected – the sugar trade – there are somewhere like 300 or 400 patents. Now, how are we to know all these 400 patents? How are we to manage continually, in the natural process of making improvements in manufacture, to know which of these patents we are at any time conflicting with? So far as I know, we are not violating any patent; but really, if we are to be exceedingly earnest in the question, probably we would require to have a highly paid clerk in London continually analysing the various patents; and every year, by the multiplication of patents, this difficulty is becoming more formidable."

[Macfie, R.A., quoted in ***Is the Granting of Patents for Inventions Conducive to the Interests of Trade?,*** *Transactions of the National Association for the Promotion of Social Science 661, 665 (1865) (George W. Hastings, ed.)]*

On university patenting

"The way it is working out is proving dangerous: it tends to shut off unselfish exchange of ideas and information it tends to kill a critical and impartial attitude, it tends to introduce quarrels and and bitterness and to consume time and funds in lawsuits. It may quite naturally influence the choice of university personnel and the choice of research problems. If, in addition, the policy of taking out patents for revenue be interpreted as a declaration of independence the public may quite cheerfully acquiesce and leave research work to earn its own way. Why.should gifts intended for the general welfare play the role of capitalizing a business? And if what becomes of the peculiar function of university research as contrasted with that of the shrewdly administered business enterprise?"

*[Alan Gregg (1933), **Science** 77 (March 10):257; thanks to Steve Maurer for finding this article.]*

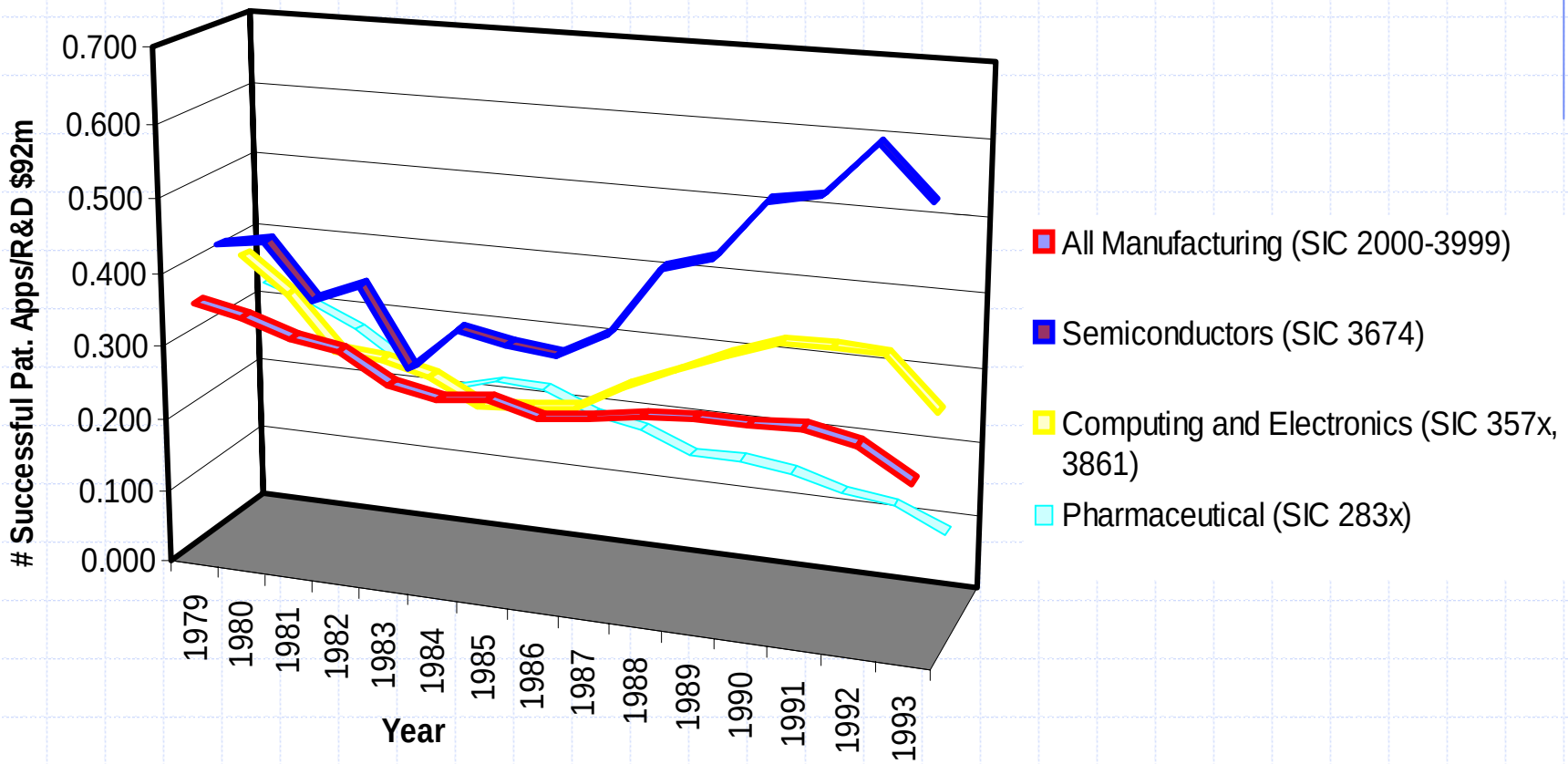
Two papers on patent policy

- Hall and Ziedonis (2001)
  - Why did patenting rate in the semiconductor industry double between 1985 and 1995? – defensive reasons
- Graham, Hall, Harhoff, and Mowery (2002)
  - Does post-grant third party opposition improve the quality or screening of patents? – possibly

Hall and Ziedonis (*RJE 2001*)

- Overall increase in US patenting since early 1980s
  - Kortum and Lerner (1998) identify several hypotheses
    - "friendly court" hypothesis – pro-patent era (CAFC 1982)
    - "regulatory capture" hypothesis
    - "fertile technology" hypothesis
    - "managerial improvements" hypothesis
- Patents still ineffectual for firms in most industries
  - Yale Survey 1982
  - Carnegie Mellon Survey (CMS) 1994
    - Firms have not increased reliance on patents for appropriating returns to R&D between these two surveys.
- Why did patenting increase in these industries?

Patent Propensity:
Semiconductors vs. All US Manufacturing, 1979-93



Summary of Interview Results

- Capital-intensive manufacturers
  - Strong demonstration effect of TI and Kodak-Polaroid cases
    - "Ramping up"; "harvesting latent inventions"
    - "If in doubt, patent"
  - Safeguard assets; avoid halt in production
    - "Exclude before you're excluded"
  - Improve bargaining position with other patent owners
    - Gain access to external technology on more favorable terms
    - Secure royalty income
  - Changes (except at TI) in management of patent process
    - "Patent advocacy committees"; increased bonuses; targets
- Design firms
  - Secure rights in niche product markets
  - Critical role of patents in attracting venture capital
  - One firm "opts out" of system

Graham, Hall, Harhoff, and Mowery (2002)

Motivation: recent surge in U.S. patenting due to

- Increased importance for strategic purposes in some industries
- Expansion of subject matter

⇒ Very large increase in patent office workload and some indications that patents issue with incomplete search of prior art (non-patent and possibly patent) *[Aharonian, Feb. 6, 2002: >60% of computing patents cite zero non-patent prior art.]*

- Would a European-style opposition system improve patent "quality"?
- What is optimal "quality" of patents?
  - Is it worth spending more time on each application when most will not be used?
  - What to do about prior art searches when prior art is not in patents?
- What are the consequences of high costs of enforcement and of achieving "freedom of action" for innovation?

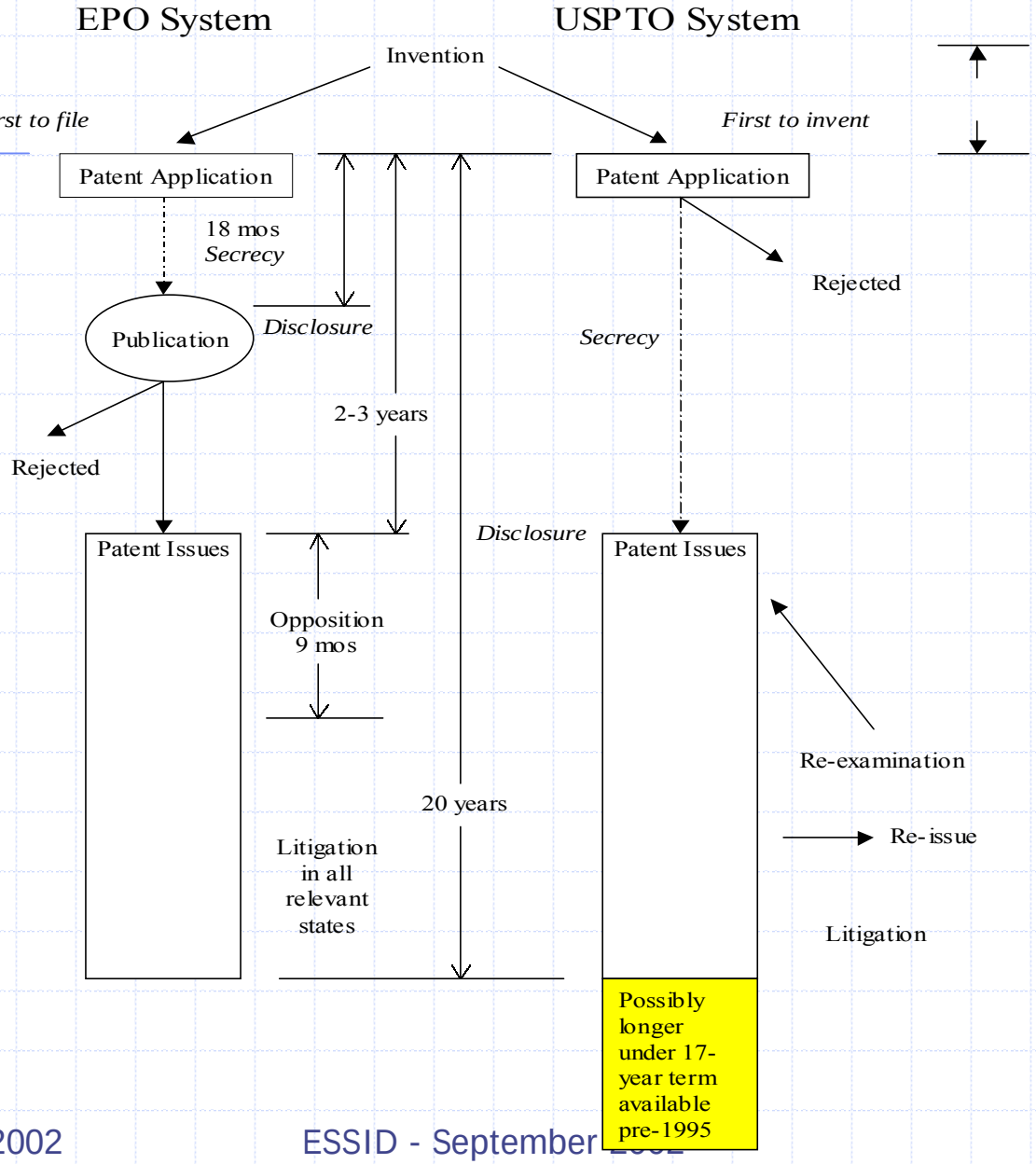
Institutional similarities: US and EU

- Requirements for Utility Patent: US
  - Available for “processes, machines, manufactures, or compositions of matter”
    - Novel
    - Useful
    - Non-obvious
- Requirements for Utility Patent: EU
  - Patents have been available from the European Patent Office (EPO) since 1977
    - Novel
    - Industrial Application
    - Inventive Step

Overview of Institutional Differences: US and EU

- United States patent challenges
  - Reexamination post-issue (during the life of the patent)
  - Litigation for validity or infringement
- EU (EPO) patent challenges
  - Opposition post-issue (within 9 mos.)
  - Litigation for validity or infringement *in national courts*

Comparative Patent Timeline



Institutional Differences: US Re-examination

- Limited to validity questions
  - Examiner (often the same) is final arbiter.
  - "Substantial" question of patentability
- Administrative *ex parte* proceeding—requester role limited to application, and to
  - Right to receive notice of decision
  - Right to receive copy of patentee's response
  - Right to file rejoinder to that response
- Admissible evidence limited
  - Only prior patents and publications as evidence of prior art overlooked
- A barrier to pursuing litigation *ex post*
- In practice, about 50% of requests are from the patentee
- Cost: $10-100K depending on complexity

⇒*Significant limitations to the use of this procedure*

Institutional Differences: US Litigation

- Adversarial appeal to court-arbiter
- Costly: estimates of patent suits run $1-5M, or $500K per claim
  - some as high as $20M in biotech, $48M for Polaroid.
- Challenge contingent upon a charge by the patentee of infringement
- Patent afforded a presumption of validity
- Burden of proof is much more than a mere preponderance—"clear and convincing" standard
- Judge and/or jury may have limited expertise

Institutional Differences: EPO Opposition

- Validity only (not infringement)
- Administrative adversarial proceeding initiated by any third party (*de novo*)
- Time limit - 9 months of patent grant
- Patent may be challenged on any of the grounds of patentability
  - novelty, inventive step, industrial application
- No limits on the kinds of evidence admissible
- Examiners and then administrative judges (on appeal) hear challenge
- Cost: 13-22K$.
- Much lower cost than litigation, but slow
  - Lacks due process safeguards, which leads to late submission of information by firms
  - Biotech patents can be tied up in opposition until end of useful life (Blackburn)

Institutional Differences: European Litigation

- No EPO challenge
  - separate litigation in each of the individual nations in which the patent was claimed (some spillover effects, no systematic analysis available)
- German example
  - ~1% of patents
  - Proceedings delayed if opposition proceedings
  - No jury; 3 judge panel plus a technical expert
  - Time – 18 months
  - Cost – $45-450K
  - Shortcoming - no discovery
  - Loser pays costs

Some preliminary conclusions

- US re-examination system differs in virtually all its features from EPO opposition and cannot really be compared (non-adversarial, requestor is often patentee, take-up is much lower).
- Evidence that the whole EPO system has longer lags, but a tighter distribution; may take as long as U.S. system including litigation to resolve disputes. However, cost appears to be lower (per case).
- EPO-opposed patents and their US equivalents are more valuable or “important”, based on citations, number of states, acceleration requests. They are also far more likely to be litigated in the US, especially in biotech/pharmaceuticals.
- EPO outcomes more often involve revocation of the patent, and especially when the equivalent patent is litigated in the US.

Commercial break:
NBER Patent Citations Data File

Available at http://www.nber.org/patents

- ~3 million U.S. patents granted between January 1963 and December 1999
  - Patent number, application and grant dates
  - Country and state of first inventor
  - Main US patent class; number of claims
  - Number of citations, forward and backward; generality and originality measures based on citations
- All citations made to these patents between 1975 and 1999 (over 16 million).
- Match of patenting organizations to Compustat (the data set of all firms traded in the U.S. stock market).
  - enables ownership assignment for part of the dataset

Patents as indicators

Because patents a property right to knowledge asset, they are potentially useful to economists who seek measures of innovative output.

- Simple counts at the firm, industry, country level over time provide such a measure (imperfectly).
  - Substantial evidence, both European and U.S., that weighting such counts by the number of subsequent citations that the patents receive improves the quality of the measures.
- Citations from one patent to another can also provide an imperfect but useful map of the links between these “bits” of output or knowledge.
- Use of patents in this way requires some understanding of what they mean - how and why they are taken out, administered, and enforced, and how this changes over time, so the two research areas are not truly disjoint.

Measuring spillovers using patents

- Jaffe (*AER 1986*) – measured "closeness" of firms in technology space as the angle between patent portfolio vectors (# patents in each tech class) – "closer" R&D spills more.
- Jaffe, Henderson, Trajtenberg (*R E Stat 1993*) – used citations from one patent to another as an indication of a spillover of knowledge from one inventor to another (see Jaffe *et al* inventor survey for justification of this metric)
  - many other papers use this idea

Measuring innovation using patents

Early work – brief overview:

- Schmookler (1960 book) – pioneer in the use of patent statistics.
- Scherer's early work in oil, chemicals, steel.
- Griliches et al ~1980 (incl. Hall) – first large sample work using computerized USPTO data. Concluded:
  - Patents strongly related to R&D in cross section, elasticity close to one
  - Controlling for unobserved differences across firms, elasticity lower (about 0.3).
  - Difficult to determine lag structure – R&D very smooth over time within firm.
  - Poisson-type models – patents exhibit overdispersion.
  - In the presence of R&D, patents add little explanatory power for sales, profits, market value, etc. Why?

Example: Citations and Value

Hall, Jaffe, Trajtenberg (*2001*) – do patents weighted by forward citations provide a better measure of patent "value" than patent counts themselves?

Broad firm-level analysis – previous studies invention- or narrow industry-specific:

- Trajtenberg (*RJE 1990*) - consumer welfare for CAT scanners and citations
- Klock and Shane (*AER 1995*) - market value of citation weighted patents in semiconductors
- Austin (1993) - event studies on citation-weighted biotech patents
- Hirschey et al (1998); Lev et al (1998) - accounting-based work similar to ours.

What are patent citations?

Somewhat like citations in a research paper:

- References to prior technology, either patents or other scientific literature on which the current patent builds or which it uses
- Some added by the USPTO examiner (the “referee”)
- Some added after the fact (not used by inventor)
- Some added to avoid infringement (limit scope, defense against suits)
- Some added for “teaching” (like survey articles)

Jaffe, Trajtenberg, Fogarty inventor survey, NBER

- About half correspond to some kind of knowledge flow
- About one quarter to a very substantial flow
- Remainder are primarily those added by others (not the inventor)

United States Patent ***4,310,440***
Wilson , et al. **January 12, 1982**

Crystalline metallophosphate compositions

Abstract

A novel family of crystalline, microporous aluminophosphate compositions is synthesized by hydrothermal crystallization at elevated temperatures of aluminophosphate gels containing a molecular structure-forming template. The family comprises a number of distinct species, each with a unique crystal structure. Calcination removes volatile extraneous matter from the intracrystalline void space and yields microporous crystalline adsorbents with uniform pores, the dimensions of which vary, among the individual species, from about 3A to 10A in diameter. The compositions represent a new class of adsorbents of the molecular sieve type, and also exhibit properties somewhat analogous to zeolitic molecular sieves which render them useful as catalysts or catalyst bases in chemical reactions such as hydrocarbon conversions.

Inventors: **Wilson; Stephen T.** (Shrub Oak, NY); **Lok; Brent M.** (New York, NY); **Flanigen; Edith M.** (White Plains, NY)
Assignee: **Union Carbide Corporation** (New York, NY)
Appl. No.: **166333**
Filed: **July 7, 1980**

Current U.S. Class: **502/208**; 208/112; 208/114; 208/135; 208/136; 208/138; 208/143; 208/213; 208/254H; 423/305; 502/510; 502/511; 585/418; 585/419; 585/467; 585/475; 585/481
Intern'l Class: B01J 027/14; B01J 031/02; C01B 015/16
Field of Search: 252/435,430 423/305

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U.S. Patent Documents

References Cited [Referenced By]

U.S. Patent Documents

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2330115	Sep., 1943	Drennan	252/435.
3941871	Mar., 1976	Dwyer et al.	423/326.
3969273	Jul., 1976	Brown et al.	252/435.
4061724	Dec., 1977	Grose et al.	423/335.
4066572	Jan., 1978	Choca	252/435.
4132669	Jan., 1979	Choca et al.	252/435.

Other References

Bull. Soc. Chim., France, 1961, F. D'Yvoire.

Primary Examiner: Metz, Andrew
Assistant Examiner: Wright, William G.
Attorney, Agent or Firm: Miller, Richard G.

Claims

What is claimed is:

1. Crystalline aluminophosphates each having a framework structure whose chemical composition expressed in terms of mole ratios of oxides is:

Al.sub.2 O.sub.3 :1.0+-0.2 P sub.2 O.sub.5 :

each of said framework structures being microporous in which the pores are uniform and have nominal diameters within the range of about 3 to about 10 Angstroms, an intracrystalline adsorption capacity for water at 4.6 torr and 24 degree. C. of at least 3.5 weight percent, the adsorption and desorption of water being completely

Patent Database Search Results: ref/4,310,440 in 1982-2001 - Netscape

File Edit View Go Communicator Help

Results of Search in 1982-2001 db for:
REF/4,310,440: 219 patents.
*Hits **1** through **50** out of **219***

Next 50 Hits

Jump To

Refine Search ref/4,310,440

	PAT. NO.		Title
1	6,187,981	T	Process for producing arylalkanes and arylalkane sulfonates, compositions produced therefrom, and uses thereof
2	6,140,263	T	Process for the production of supported zeolite membranes, and zeolite membranes so produced
3	6,060,415	T	Aligned molecular sieve crystals grown on anodic alumina membrane
4	6,051,746	T	Oxygenate conversions using modified small pore molecular sieve catalysts
5	6,020,533	T	Hydrocarbon conversion processes using crystalline manganese phosphate compositions
6	6,001,328	T	Crystalline metallophosphates
7	5,989,518	T	Process for synthesizing and controlling the particle size and particle size distribution of a molecular sieve
8	5,976,491	T	Synthesis of and composition of ECR-40, large pore aluminophosphate
9	5,942,104	T	Alumina source for non-zeolitic molecular sieves
10	5,939,349	T	Method of preparing non-zeolitic molecular sieve catalyst
11	5,912,393	T	Metallo aluminophosphate molecular sieve with novel crystal morphology and methanol to olefin process using the sieve
12	5,892,125	T	Preparation of n-butyraldehyde and/or n-butanol
13	5,879,655	T	Method of making microporous non-zeolitic molecular sieves
14	5,830,427	T	Metallochalcogenide microporous compositions having metal-metal bonds
15	5,785,748	T	Titanium dioxide pigments
16	5,780,003	T	Crystalline manganese phosphate compositions

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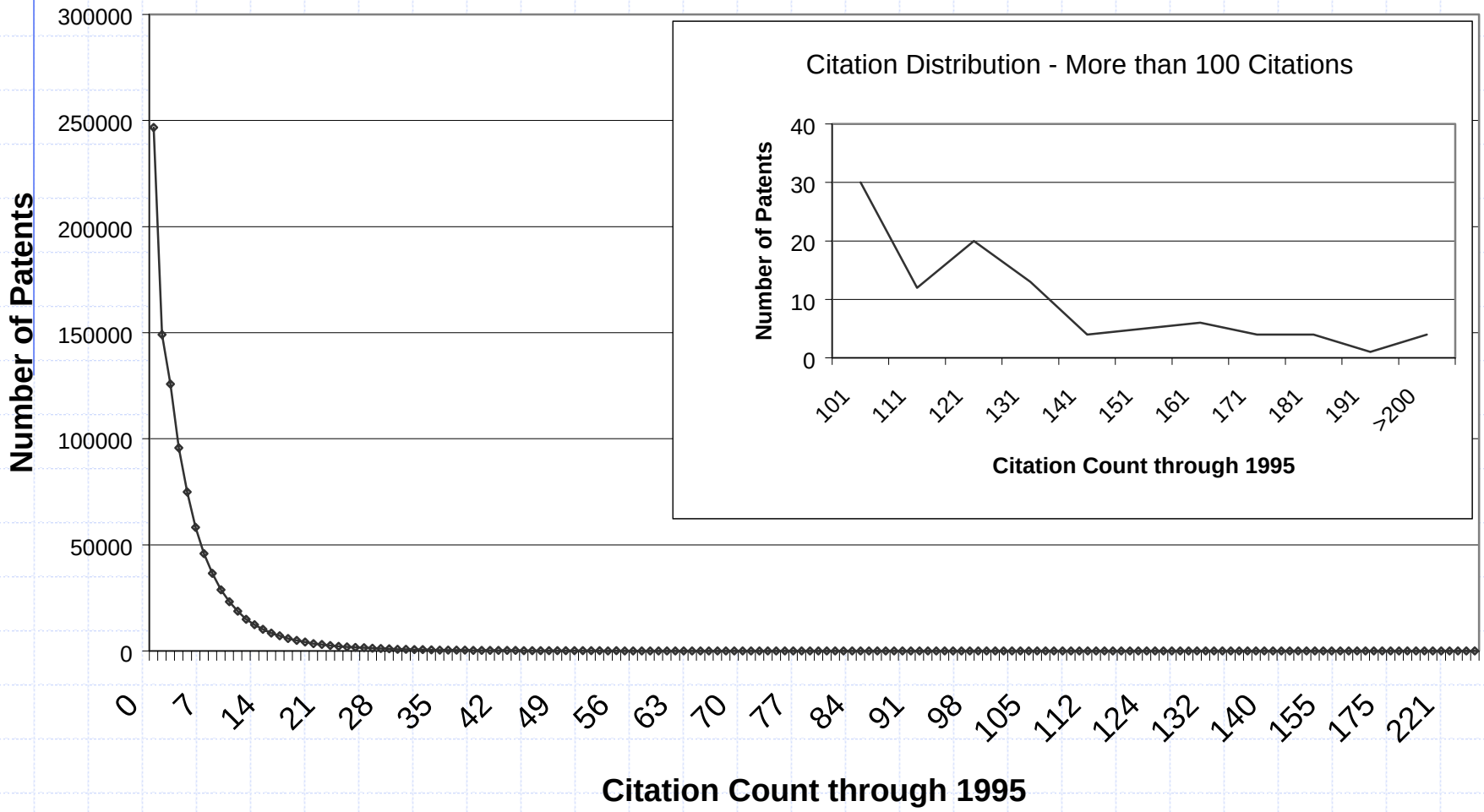
Some facts about citations

- Prior work finds more valuable patents are cited more.
- One quarter of patents receive no citations.
- 0.01% receive more than one hundred citations.
- Lag distribution is skew to the left with a mode at about 3.5 years. Most cites happen by 10 years, but there can be long lags (30 years).
- Number included per patent has increased recently with the advent of computerized search.

Figure 3
Citation Distribution



Hedonic regression for market value

$$\text{Log } Q_{it} = \log q_t + \gamma_t K_{it}/A_{it} + \alpha_t d(K_{it} = 0)$$

where $Q_{it} = V_{it} / A_{it}$ (market to book or Tobin's Q)

Interpretation:

q_t = overall market level (approximately one).

γ_t = Relative shadow value of K assets (=1 if depreciation correct, investment strategy optimal, and no adjustment costs).

α_t = Premium or discount for the absence of K assets.

Figure 5b
Patenting Firms Only - R-Squared from Tobin's Q Equation

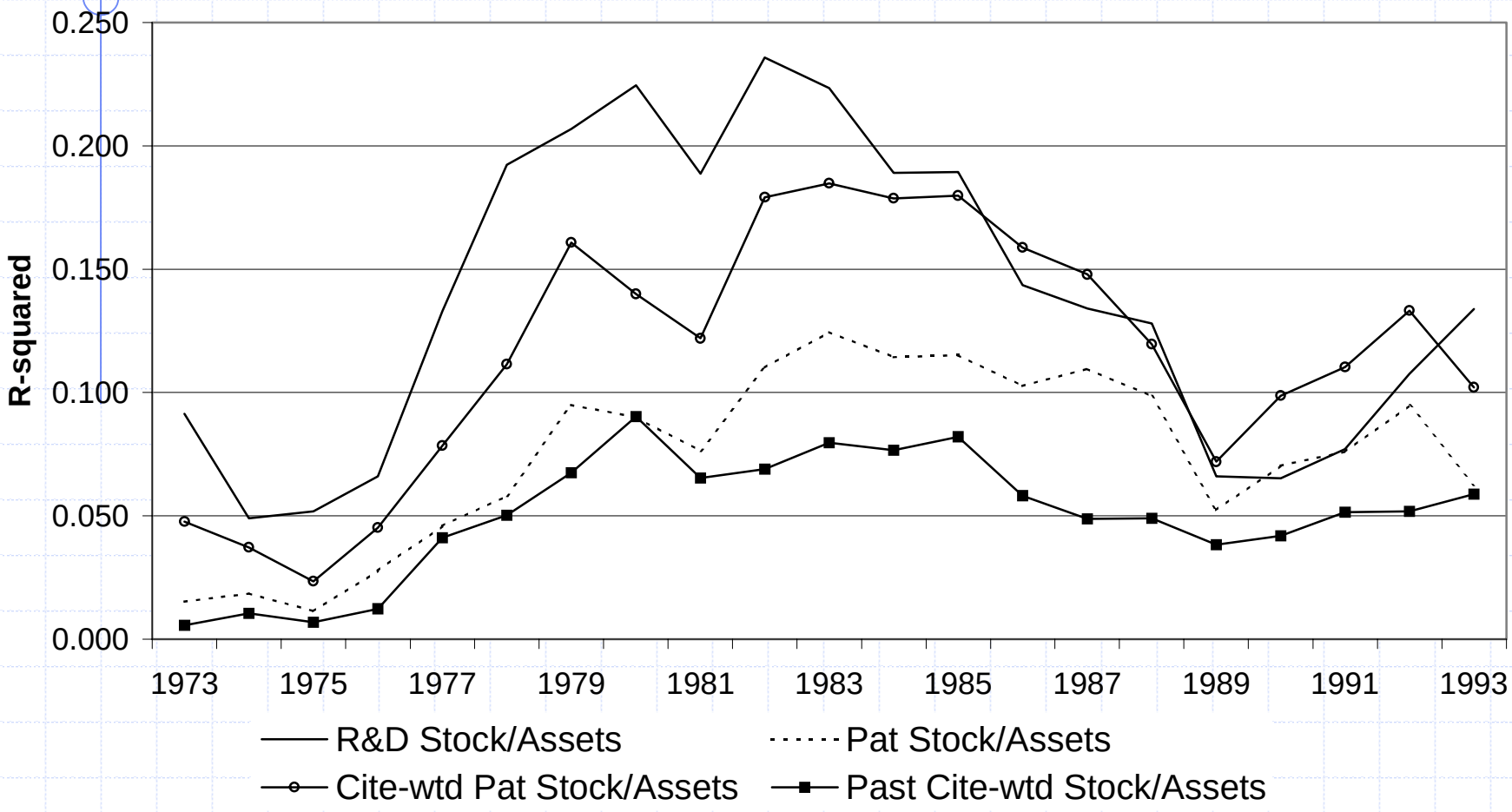
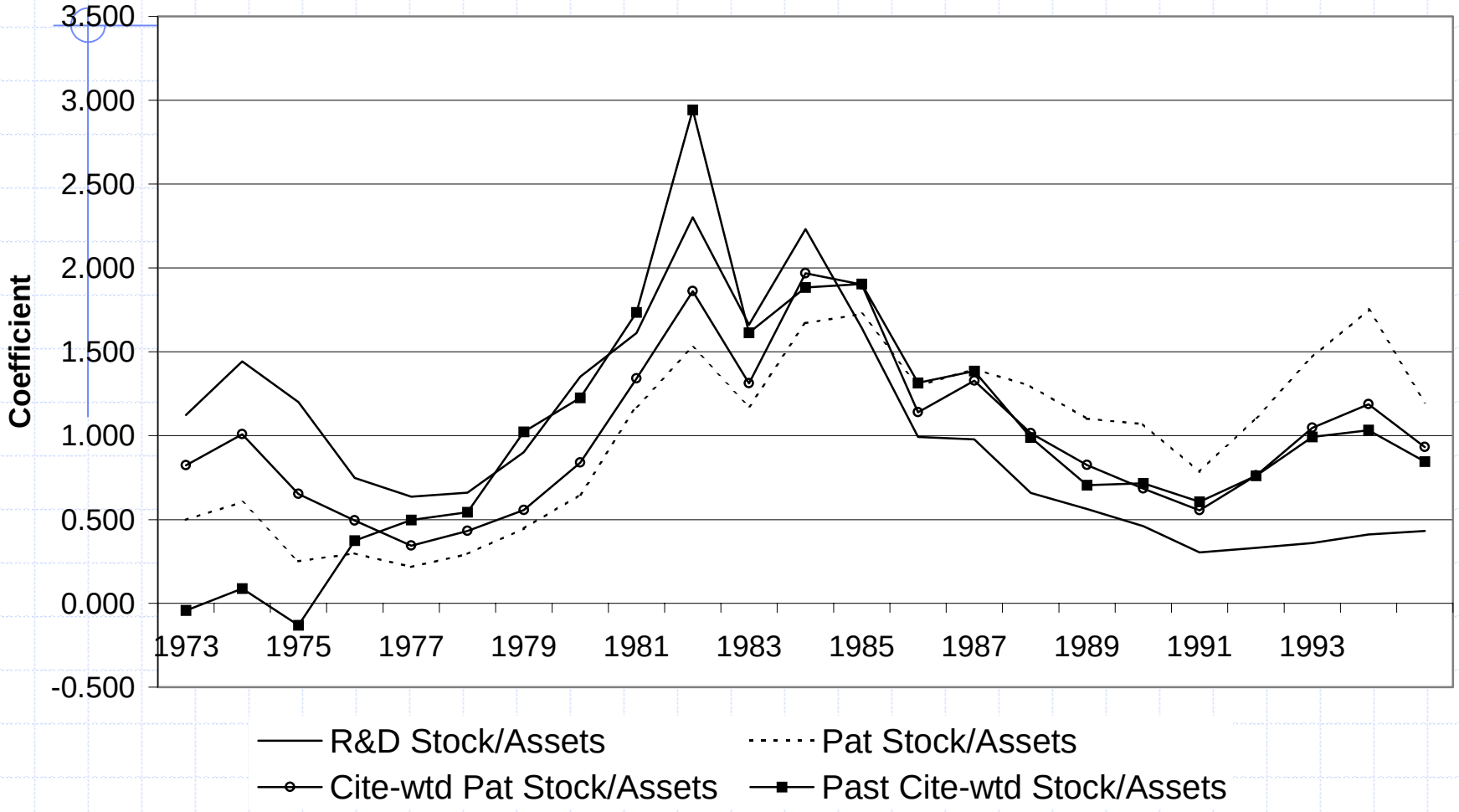


Figure 5c - Patenting Firms Only
Normalized Coefficients from Tobin's Q Equation



Exploration of the functional form

- Include stock of R&D, patents per R&D, and cites per patent. Cites per patent are more important than patent yield itself:

Increase of one cite per patent is associated with an increase of 3-4% in market value

- Break up cites per patent into five ranges: 0 to 4, 4 to 6, 6 to 10, 10 to 20, over 20

Only the latter three categories are positive; the other two are zero – 50-75% boost to market value if citations per patent average above 20!

- Timing – do citations received before value is measured matter more or less than those received after?

Less, although they are useful for forecasting. Predictable and unpredictable citations receive approximately equal weight.

Self citations

- Self-cites = citations to patents owned by the same firm.
  - More valuable => “owning” a technology trajectory, cumulativeness is valuable
  - Less valuable => cite whatever is at hand, does not necessarily signify any value
- Results
  - High self-citation share is valuable (worth about twice as much) if firm is small or medium-sized, neutral if firm is large.
  - Not having self cites is negative if firm is large, positive if firm is small.

Conclusions

- Patents as indicators
  - Useful, especially citation-weighted – correlated with value, R&D, litigation, profits, etc.
  - However, important, especially over time, to understand the impact of the policy changes that have taken place on these indicators.
- The big question: “do patents increase innovation?”
  - Not answered yet, although we understand some of the complexities and issues better
  - Moser (2001); Lerner (2001)
  - An alternative view: Boldrin-Levine (CEPR 2001)

United States Patent 6,175,824

Breitzman , et al. **January 16, 2001**

Method and apparatus for choosing a stock portfolio, based on patent indicators

Abstract

A portfolio selector technique is described for selecting publicly traded companies to include in a stock market portfolio. The technique is based on a technology score derived from the patent indicators of a set of technology companies with significant patent portfolios. Typical patent indicators may include citation indicators that measure the impact of patented technology on later technology, Technology Cycle Time that measures the speed of innovation of companies, and science linkage that measures leading edge tendencies of companies. Patent indicators measure the effect of quality technology on the company's future performance. The selector technique creates a scoring equation that weights each indicator such that the companies can be scored and ranked based on a combination of patent indicators. The score is then used to select the top ranked companies for inclusion in a stock portfolio. After a fixed period of time, as new patents are issued, the scores are recomputed such that the companies can be re-ranked and the portfolio adjusted to include new companies with higher scores and to eliminate companies in the current portfolio which have dropped in score. A portfolio of the top 10-25 companies using this method and a relatively simple scoring equation has been shown to greatly exceed the S&P 500 and other indexes in price gain over a ten year period.

Inventors:
Breitzman; Anthony F. (Cedarbrook, NJ); Narin; Francis (Ventor, NJ)
Assignee:
CHI Research, Inc. (Haddon Heights, NJ)
Appl. No.: 353613
Filed: July 14, 1999

United States Patent 6,175,824

Current U.S. Class: 705/36; 705/10; 705/35; 705/37
Intern'l Class: G06F 017/60
Field of Search: 705/36,10,35,37
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5978778 Nov., 1999 O'Shaughnessy 705/36. 6035286 Mar., 2000 Fried 705/36.
Other References
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CHI Research, Inc. Introduces Tech-Line Analysis Tool Technology, Information Today, v 15, n 9, p 66,Oct. 1998.
Deng, Z., Lev, B., and Narin, F. "Science and Technology as Predictors of Stock Performance" (Financial Analysts Journal, vol. 55, No. 3, May/Jun. 1999, pp. 20-32).
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Bronwyn, H.H., Jaffe, A. and Trajtenberg, M. "Market Value and Patent Citations: A First Look" (Apr. 1998. Paper prepared for the Conference on Intagibles and Capital Markets, New York University, May 15-16, 1998, pp. 1-34).
....
Primary Examiner: Swann; Tod R.
Assistant Examiner: Patel; Jagdish N
Attorney, Agent or Firm: Akin, Gump, Strauss, Hauer & Feld, L.L.P.

United States Patent 6,175,824

Claims

What is claimed is:
1. A computer-implemented method of selecting a portfolio of company stocks for a client which is predicted to have future performance that achieves a predesired financial outcome, the method comprising:
(a) calculating a score for a plurality of companies whose stock may be potentially selected to be in the portfolio by using the equation: ##EQU3##
wherein x.sub.i are company indicators which include industry normalized patent indicators, .alpha..sub.i are weighting coefficients for the respective company indicators, at least one of the weighting coefficients being non-zero, the weighting coefficients being selected so that companies which receive a high score are predicted to contribute to achieving the predesired financial outcome, and .beta..sub.i are weighting exponents, and that companies which receive a low score are predicted to not contribute to achieving the predesired financial outcome, each company being assigned to a predefined industry;
(b) ranking the calculated scores from highest to lowest and generating recommendations of which company stock to purchase for the portfolio based upon the ranking; and
(c) displaying the recommendations on a summary report for review by the client or the client's financial manager, or buying amounts of company stock for the portfolio in accordance with the recommendations, or selling amounts of company stock from the portfolio in accordance with the recommendations.

Etc. for 62 further claims