

Patents as Indicators

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Outline

- ◆ Overview
- ◆ Measures of innovation value
- ◆ Measures of knowledge flows

Patents as indicators

- ◆ A patent is a property right to a knowledge asset => patent counts can be useful measures of innovative output
 - Counts at the firm, industry, country level over time
 - Counts weighted by the number of subsequent citations that the patents receive
- ◆ Citations from one patent to another
 - an imperfect but useful map of the links between these "bits" of output or knowledge

But.....

- ◆ Using patents as indicators requires some understanding of what they mean
 - how and why they are taken out
 - how they are administered
 - how they are enforced
 - how all this changes over time

Measuring innovation using patents – early literature

- ◆ Schmookler (1960 book) – pioneer in the use of patent statistics
- ◆ Scherer's (*AER* 1965) work in oil, chemicals, steel

Griliches et al/NBER ~1980

- ◆ First work using computerized USPTO data (large sample). Conclusions:
 - Patents strongly related to R&D across firms, elasticity close to one
 - Controlling for unobserved differences across firms, elasticity lower (about 0.3)
 - Difficult to determine lag structure because R&D very smooth over time within firm
 - Used Poisson models for count data => patents exhibit overdispersion
- ◆ But, in the presence of R&D, patents add little explanatory power for sales, profits, and market value. Why?

Skewness of the distribution of patent value or importance

Citations and market value

- ◆ Hall, Jaffe, Trajtenberg (*RJE* 2005) – 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.

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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 to avoid infringement (limit scope, defense against suits)
 - Some added by the USPTO examiner (not used by inventor)
 - Some added for “teaching” (like survey articles)
- ◆ USPTO differs slightly from EPO in citation practice
 - USPTO: all relevant citations
 - EPO: minimum number needed to cover prior art

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United States Patent 4,318,440 - hntscage

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(1 of 1)

United States Patent **4,318,440**
Wilson, et al. **January 12, 1982**

Crystalline metallophosphate compositions

Abstract

A novel family of crystalline, macroporous 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 amorphous void space and yields macroporous crystalline adsorbents with uniform pores, the dimensions of which vary, among the individual species, from about 3Å to 10Å in diameter. The compositions represent a new class of adsorbents of the molecular sieve type, and also exhibit properties somewhat analogous to zeolite 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), Lak, 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, 209/112, 209/114, 209/135, 209/136, 209/138, 209/143, 209/213, 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

References Cited [Referenced By]

U.S. Patent Documents

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United States Patent 4,318,440 - hntscage

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References Cited [Referenced By]

U.S. Patent Documents

2282602	May, 1942	Dennan	252/435
2730115	Sep., 1942	Dennan	252/435
3941871	Mar., 1976	Dwyer et al.	423/326
3869273	Jul, 1976	Brown et al.	252/435
4061288	Dec., 1977	Gross et al.	423/355
4066572	Jan., 1978	Choca	252/435
4120669	Jan., 1978	Choca et al.	252/435

Other References

Bull. Soc. Chim., France, 1561, F D'Yveot.

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:

$$Al_{x}nb_{2}O_{y}mb_{3} \cdot z \cdot 6H_{2}O \cdot 2P_{2}O_{5} \cdot nb_{2}O_{3}$$

each of said framework structures being macroporous in which the pores are uniform and have nominal diameter within the range of about 3 to about 10 Angstroms, an amorphous adsorbent capable for water and alcohol and 3d species of at least 3.5 weight percent the adsorption and desorption of these being completely

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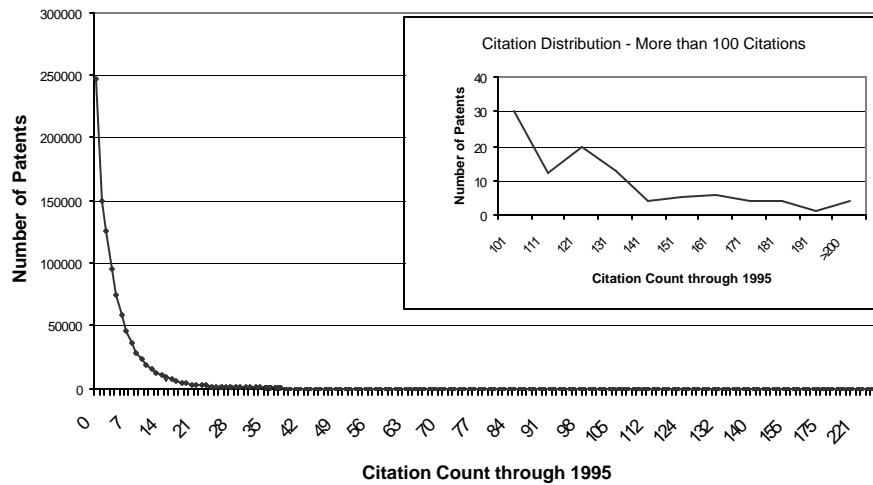
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Some facts about U. S. citations

- ◆ 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 per patent has increased recently with the advent of computerized search

**Figure 3
Citation Distribution**



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Hedonic regression for market value

$$\text{Log } Q_{it} = \log q_t + \lambda_t K_{it}/A_{it} + \mathbf{a}_t d(K_{it} = 0)$$

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

Interpretation:

q_t = overall market level (approximately one).

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

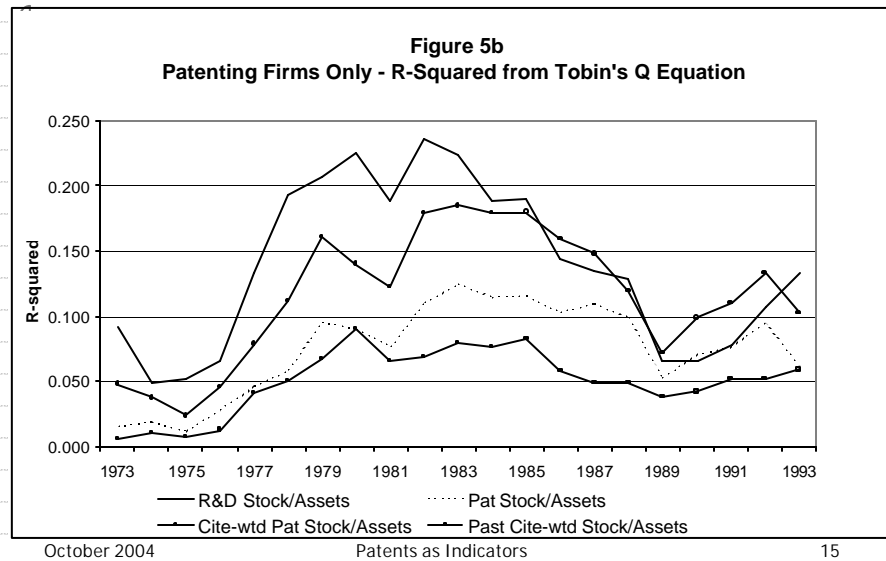
\mathbf{a}_t = Premium or discount for the absence of K assets.

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Explanatory power of knowledge stock measures



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.

Citations as indicators of knowledge flow

- ◆ 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)

Applications

- ◆ “Self” measure in HJT
- ◆ Geographic localization
 - Henderson, Jaffe, and Trajtenberg
- ◆ Macgarvie (2003)
 - Citations used to measure knowledge flow induced by exporting or importing
 - French firms begin exporting to Germany
 - ◆ Do they cite German patents more after than before?

NBER Patent Citations Data File

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

<http://emlab.berkeley.edu/users/bhhall/bhdata.html>

- ◆ ~3 million U.S. patents granted between January 1963 and December 1999 (now updated to 2002)
 - 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

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United States Patent 6,175,824

Breitzman, et al.

January 16, 2001

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

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. 08/353613 Filed: July 14, 1999

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United States Patent 6,175,824

Current U.S. Class: 705/36; 705/10; 705/35; 705/37

Intern'l Class: G06F 017/60

References Cited [Referenced By]

U.S. Patent Documents

5761442 Jun 1998 Barr et al. 705/36.; 5819238 Oct 1998 Fernholz.; 5934674 Aug 1999 Bukowsky 273/278; 5978778 Nov 1999 O'Shaughnessy 705/36; 6035286 Mar 2000 Fried 705/36.

Other References

...
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).
.....
Griliches, Z. "Patent Statistics as Economic Indicators: A Survey" (Journal of Economic Literature, vol. XXVIII, Dec. 1990, pp. 1661-1707).
Trajtenberg, M. "A Penny for Your Quotes: Patent Citations and the Value of Innovations" (Rand Journal of Economics, vol. 21, No. 1, Spring 1990 pp. 172-187).
Bronwyn, H.H., Jaffe, A. and Trajtenberg, M. "Market Value and Patent Citations: A First Look" (Apr. 1998. Paper prepared for the Conference on Intangibles and Capital Markets, New York University, May 15-16, 1998, pp. 1-34).

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United States Patent 6,175,824

Claims

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

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