Patent data for research in economics & management

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Outline

1. Uses of patent data in empirical research
2. Other measures of innovation
3. What is a patent anyway?
4. Dimensions that one can exploit
5. Current frontier
6. Where to find the data?

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Uses of patent data in empirical research

Do you (plan to) use patent data. And if yes, how?
What uses of patent data are you aware of?

Three main uses of patent data

1. Study the causes and consequences of innovation, with patents as one way of measuring "innovation".

2. Study features of the innovation process (*e.g.*, knowledge spillovers) with patent data providing some way of observing these features (*e.g.*, citation data).

3. Study aspects of the patent system and other questions related to intellectual property (IP) policy .

- Patent data are also used in other fields of research such as bibliometrics and complex systems (econophysics, networks). Not in the scope of today's lecture: we focus on the economic and management disciplines.

1. Causes and consequences of innovation

- Inventions are intangible and, hence, unobservable.
- But inventions that are patented are observable: every invention that is submitted through the patent system is published by the patent office.
- A patent is granted for inventions that are new to the world, non-obvious and useful. Hence, patent data seem a priori a relevant way of measuring inventions.

One of the first papers

Griliches, Z. (1981).
Market value, R&D, and patents.
Economics Letters 7(2): 183–187.

The Griliches paper in brief

- **The core idea**: To the extent that R&D investment create intangible capital for a firm, it should show up in the valuation of the firm by the market.

- Using data on U.S. listed firms, he estimates the following specification:

$$ln\ Q \approx m + d + (\Sigma b_h R_{-h})/A + u$$

where Q is market value (V) over tangible assets (A), $\Sigma b_h R_{-h}$ is a distributed lag term of past R&D expenditures and/or patents, m and d are firm and market effects, respectively.

- He finds that the long-run effect of a dollar of R&D is to add about $2 to the market value of the firm, while a successful patent is worth about $200,000.

- Many scholars have sought to replicate, and improve the study of, this research question. Most studies confirm the presence of a patent premium.

2. Features of the innovation process

- As we will see, patents contain a rich amount of information, which can be used for studying various aspects of the innovation process.

- One typical dimension is patent citation. Like scientific publications, patent documents contain references to prior art—these have been used to track knowledge spillovers.

- "By technological [=knowledge] spillovers, we mean that (1) firms can acquire information created by others without paying for that information in a market transaction, and (2) the creators (or current owners) of the information have no effective recourse, under prevailing laws, if other firms utilize information so acquired."

  (Grossman and Helpman, 1992:16)

One of the first papers

Jaffe, A. B., Trajtenberg, M., & Henderson, R. (1993).
Geographic localization of knowledge spillovers as evidenced by patent citations.
Quarterly Journal of Economics 108(3): 577–598.

The Jaffe, Trajtenberg & Henderson paper in brief

- **The core idea**: To the extent that regional localization of spillovers is important, citations should come disproportionately from the geographic area as the originating patent.

- Need to separate spillovers from correlations that arise from pre-existing pattern of geographic concentration of technologically related activities.
  Example: Say that a large fraction of citations to Stanford patents comes from the Silicon valley. They need to make sure that it is not because a lot of Stanford patents relate to semiconductors, and a disproportionate fraction of people interested in semiconductors happen to be in the Silicon valley.

- They construct control samples of patents that are not citations but have the same temporal and technological distribution as the citations. They calculate matching frequencies between the citations and originating patents, and between the controls and originating patents.

- They find that the citation matching frequency is significantly greater than the control matching frequency.

3. IP policy

- The patent system is a policy tool designed to incentivize firms to invest in R&D. It gives a monopoly right to the owner of an invention in order to increase the returns to inventing (in the hope that more inventions will be produced).

- A whole stream of research in Law & Economics and Industrial Economics looks at efficiency aspects of the patent system.

One of the first papers

Sakakibara, M., & Branstetter, L. (2001).
Do stronger patents induce more innovation? Evidence from the 1988 Japanese patent law reforms. *RAND Journal of Economics* 32(1): 77–100.

The Sakakibara & Branstetter paper in brief

- **The core idea**: The 1988 reform of patent law in Japan strengthened patent protection (expansion of the scope of patents rights).

- Using data on Japanese listed firms, they estimate the following specification:

$$r_{it} = \beta_0 + \beta_1 q_{it} + \beta_2 s_{it} + \Sigma\, \delta_c D_c + \gamma_t + \theta_i + \varepsilon_{it}$$

  where r_{it} is log of R&D spending by firm i in year t, q_{it} is a measure of the firm-level investment opportunities, D_c's are industry dummies, γ_t is the full set of year dummies.

- Identification comes from a common shifts in the time trend γ_t. The data do not show any evidence of a shift in the time trend.

- Many scholars have sought to replicate, and improve the study of, this research question. Some studies find evidence that IP rights support innovation, some do not.

Other measures of innovation

"We have, in fact, almost no good measures on [various aspects of innovation] and are thus reduced to pure speculation or to the use of various, only distantly related, "residual" measures and other proxies. In this desert of data, *patent statistics loom up as a mirage of wonderful plentitude and objectivity*. They are available; they are by definition related to inventiveness, and they are based on what appears to be an objective and only slowly changing standard."

Griliches (1990)

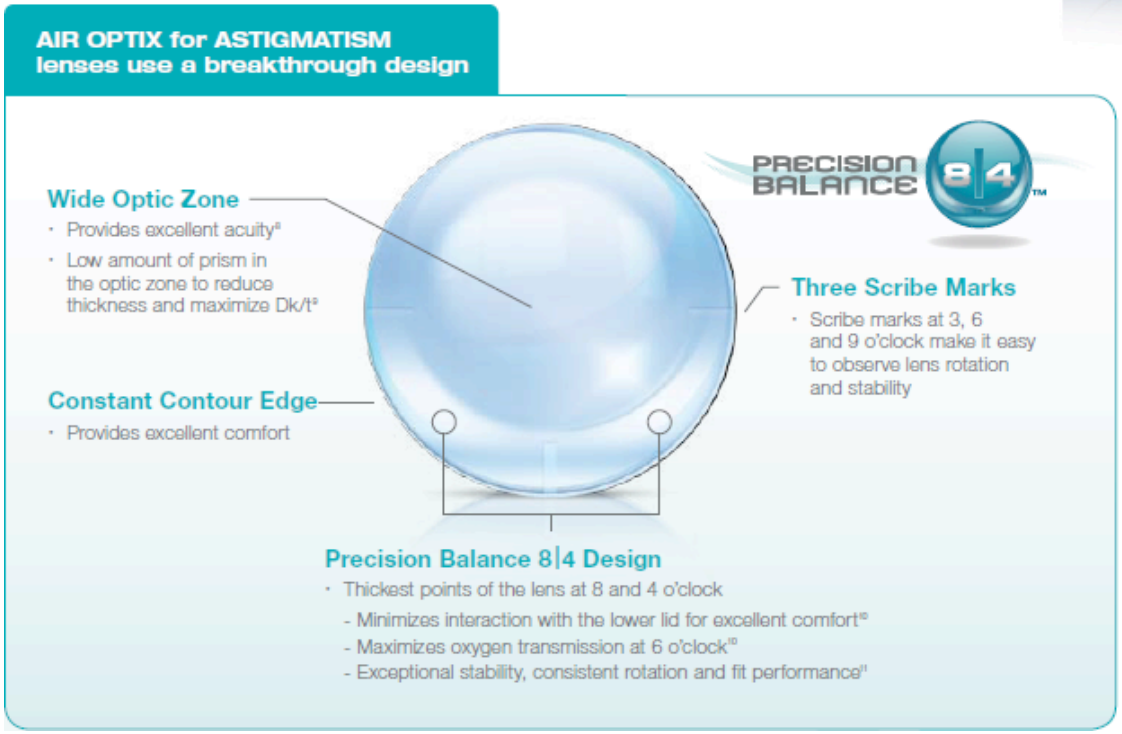
Do patent data measure inventions or innovations?

- There is ambiguity as to whether patents measure inventions or innovations.
- Invention: unique or novel device, method, composition or process.
- Innovation: the result of a process that brings together various novel ideas/inventions in a way that they affect society. Think of it as an invention put into practice.
- Patents protect inventions—*hence, they measure inventions*. However, obtaining a patent is costly and the invention must be useful, so that there is some prospect of market implementation—hence, they capture *some aspects of the innovation process*.

Example of a contact lens

AIR OPTIX® AQUA for Astigmatism Contact Lenses

There is usually not a one-to-one correspondence between a patent and what many of us would call an “invention/innovation”. Besides, one patent can be used in several “inventions”.



Covered by 7 patents

US7847016
US7456240
US7052133
US7040757
US6774178
US7135521
US7078074

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- Patents protect inventions—*hence, they measure inventions*. However, obtaining a patent is costly and the invention must be useful, so that there is some prospect of market implementation—hence, they capture *some aspects of the innovation process*.
- However, an "invention" in the patent sense is much narrower than an invention in the common sense. Patents are granted even for tiny (but always novel and non-obvious) improvements of a technology.

Patent data measure (mainly) technological innovations

- Patents are granted for novel solutions to a technical problem, that is, they capture new-to-the-world technical inventions. The fields of technology are usually classified as follows:
  A: Human Necessities
  B: Performing Operations, Transporting
  C: Chemistry, Metallurgy
  D: Textiles, Paper
  E: Fixed Constructions
  F: Mechanical Engineering, Lighting, Heating, Weapons
  G: Physics
  H: Electricity

- Patents capture very poorly service innovations and new-to-the firm innovations. Yet:
  - The service sector is growing in importance (as opposed to manufacturing, where most R&D still takes place);
  - Adoption of new-to-the firm innovations is associated with significant productivity gains (Griffith et al. 2006).

But note that service firms also apply for patents…

~13,400 patents

~4,800 patents

~1,300 patents

~30 patents

~30 patents

~15 patents

Another limitation: Effect of the propensity to patent

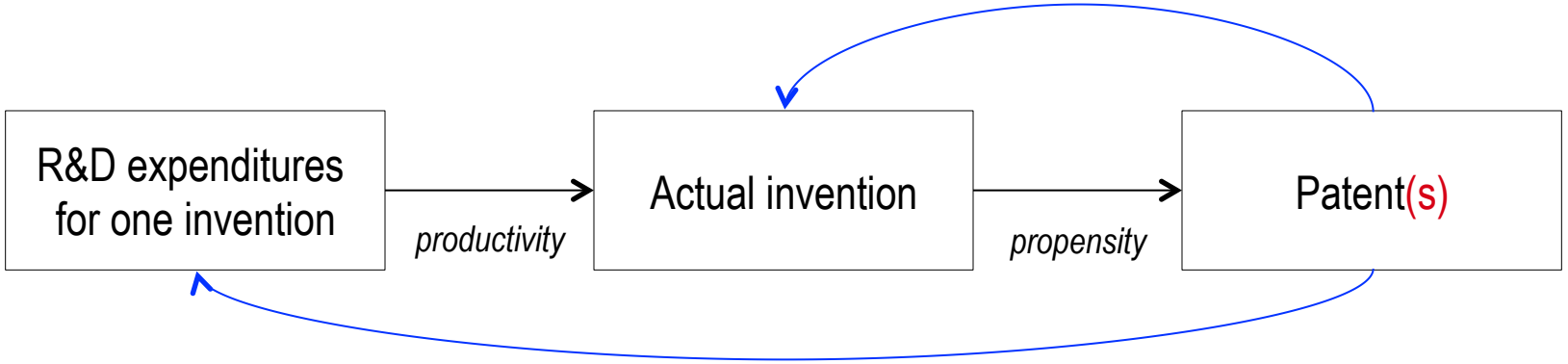
- Not all inventions are patentable, and not all patentable inventions are submitted for patent protection.

Industry *Averages on firm level data*	Propensity to patent %	Patents per M. R&D FRF	R&D/Sales %	Diversification
Chemical products	28.8	0.14	4.9	2.33
Drugs	33.6	0.09	7.0	1.64
Rubber and plastics	21.8	0.21	1.9	1.98
Non metallic products	22.3	0.16	2.2	1.29
Basic metals	28.7	0.27	1.3	1.55
Fabricated metals	32.6	0.43	3.2	1.54
Non-electrical machinery	31.5	0.34	3.3	1.39
Computers and electronics	38.6	0.19	9.7	1.50
Ships, aircraft and rail	37.0	0.10	11.0	1.57
Motor vehicles	33.8	0.59	3.9	1.30
Instruments	36.7	0.28	3.2	1.65
Textile, wood, paper and others	22.9	0.24	1.8	1.35
Sample	32.3	0.26	5.7	1.55

Duguet, E., & Kabla, I. (1998). Appropriation strategy and the motivations to use the patent system: An econometric analysis at the firm level in French manufacturing. *Annales d'Economie et de Statistique* 49/50: 289–327.

A note on the propensity to patent

- The propensity to patent is sometimes defined as the number of patents per R&D. But the proper definition is the proportion of inventions that are patented.
- We can model the R&D–patent relationship as follows:



- Researchers who study the productivity of research using patent data must be aware that there findings may be biased by the propensity to patent (example of firm size).
- More on this in de Rassenfosse and van Pottelsberghe (2009).
- That R&D-patent relationship is characterized by non-linearities and feedback loops.

Another limitation: Large variations in patent value

- Besides, there is a high variation in the value of patented inventions, with most patents being worth little.

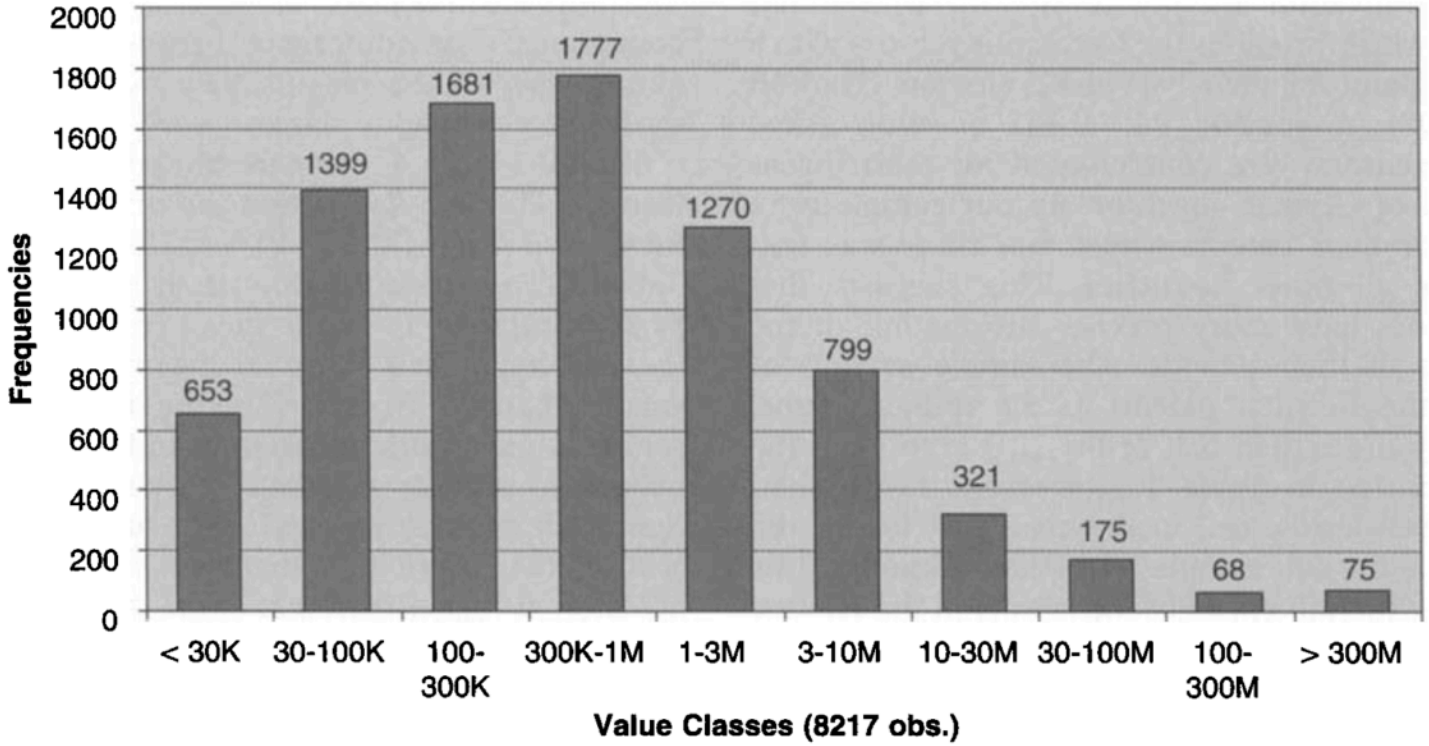


Figure 1 Distribution of VALUE. The figure shows that the PatVal-EU patent VALUE distribution is skewed. Since the difference in the logs of the boundaries of the intervals is roughly constant, the distribution in the figure is an approximation of a log-normal. Even the log-normal distribution looks skewed.

Gambardella, A., Harhoff, D., & Verspagen, B. (2008). The value of European patents. *European Management Review* 5: 69–84.

What other data could you use to study the innovation process?

There is a wealth of data available

- **Other forms of IP rights**, especially trademarks and copyrights.
- **Other tangible manifestations of "findings"**, especially scientific publications.
- **Alternative manifestations of innovation**, especially information on new products (trade fairs, product catalogues, …) and start-up firms (crunchbase.com).
- **Survey** data, the best known example being the Community Innovation Survey.
- You can also search for **sector-specific sources** (e.g., software released on GitHub).
- **Input to the innovation process**: R&D expenditures, R&D employees.
- Note that patent can be used *in conjunction with* all these sources. Examples include:
  - R&D and the patent premium (Arora et al. 2008)
  - Patent and new venture financing (Conti et al. 2013)

3/6

What is a patent?

What can you tell me about patent protection?

Key aspects of patent protection (1/2)

- A patent is an exclusive right to prohibit third parties to use commercially in the territory, where a protection is granted, one of the following rights:
  - Production
  - Usage
  - Publicity
  - Sale
  - To put in circulation
  - To import / export / transit

- Patent protection applies to technical solution of a technical problem (=invention).

- The solution must be novel (new to the world), have industrial use (=useful), involve an inventive step (=non-obvious).

- Patents are granted after an examination and are valid as long as renewal fees are paid (for a period of up to 20 years).

Key aspects of patent protection (2/2)

- A patent is granted for any invention in all fields of technology for products (manufactures, formulations, compositions), processes (e.g., manufacture of food), methods, and uses.

- Not everything is patentable: inventions that will not work (e.g., perpetual motion machine), mere ideas, discoveries (not inventions), scientific theories, mathematical solutions, game rules, lottery systems, teaching methods, computer software as such (but algorithms that achieve technical results).

- The invention is disclosed in the patent application.

US005184830A

United States Patent [19]

Okada et al.

[11] **Patent Number: 5,184,830**

[45] **Date of Patent: Feb. 9, 1993**

[54] **COMPACT HAND-HELD VIDEO GAME SYSTEM**

[75] Inventors: **Satoru Okada; Shin Kojo**, both of Kyoto, Japan

[73] Assignee: **Nintendo Company Limited**, Kyoto, Japan

[21] Appl. No.: **899,179**

[22] Filed: **Jun. 15, 1992**

Related U.S. Application Data

[63] Continuation of Ser. No. 462,400, Jan. 8, 1990, abandoned.

[30] **Foreign Application Priority Data**

Apr. 20, 1989 [JP] Japan 1-101028
Oct. 1, 1989 [JP] Japan 1-4452

[51] **Int. Cl.**[5] **A63F 9/22**
[52] **U.S. Cl.** ..... **273/433**; 273/434; 273/435; 273/85 G
[58] **Field of Search** ..... 273/433, 434, 435, 437, 273/85 R, 85 G, DIG. 28; 364/410

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,359,222 11/1982 Smith, III et al. ..... 273/85 G
4,395,760 7/1983 Soski et al. 364/410
4,438,926 3/1984 Yokoi et al. ..... 273/85 G
4,572,509 2/1986 Sitrick ..... 273/85 G
4,589,659 5/1986 Yokoi et al. ..... 273/1 GC
4,729,563 3/1988 Yokoi ..... 273/1 E
4,745,478 5/1988 Nakagawa 356/181
4,783,812 11/1988 Kaneoka 381/61
4,815,733 3/1989 Yokoi ..... 273/1 E
4,865,321 9/1989 Nakagawa et al. ..... 273/85 G
4,890,832 1/1990 Komaki 273/435

FOREIGN PATENT DOCUMENTS

58-136192 9/1983 Japan .
57989 9/1984 Japan .
60-21784 2/1985 Japan .
2033763 5/1980 United Kingdom .
8302566 8/1983 World Int. Prop. O. ..... 273/85 G

OTHER PUBLICATIONS

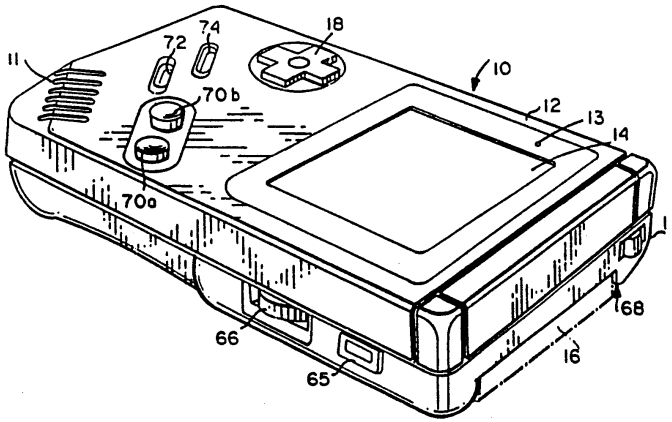
Worley, Joyce "Spitball Sparky", Electronic Games, Nov. 1984, p. 86.

Primary Examiner—Jessica J. Harrison
Attorney, Agent, or Firm—Nixon & Vanderhye

[57] **ABSTRACT**

A hand-held electronic game machine for use with attachable/detachable memory game packs wherein the game machine includes a case of a size which may be held by a hand and capable of being sandwiched by both hands with a first switch disposed at a position such that during a game it can be operated by one thumb on a front surface of the case, a second switch disposed at a position such that during a game it can be operated by the other thumb on the first surface of the case and a third operation switch means provided in a region of said front surface where imaginary loci of both thumbs intersect with each other on the front surface, and wherein the game machine can be connected with others for simultaneous multiple player competition.

21 Claims, 12 Drawing Sheets



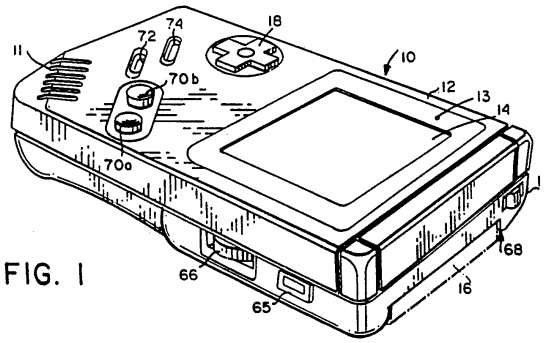
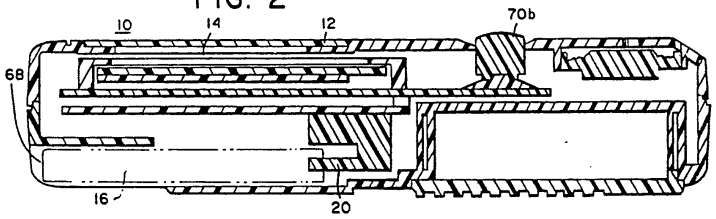


FIG. 1

FIG. 2



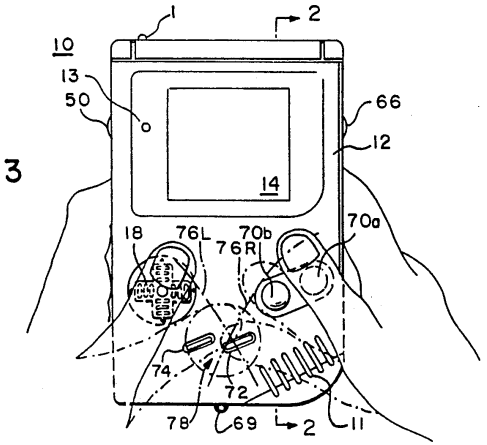


FIG. 3

COMPACT HAND-HELD VIDEO GAME SYSTEM

This is a continuation of application Ser. No. 07/462,400, filed Jan. 8, 1990, now abandoned.

CROSS-REFERENCES TO RELATED APPLICATIONS

The subject application is related to the following copending commonly-assigned U.S. patent applications filed concurrently herewith:

U.S. Ser. No. 07/462,491, now U.S. Pat. No. 5,095,798 entitled "METHOD AND APPARATUS FOR GENERATING PSEUDO-STEREO SOUND"

U.S. Ser. No. 07/462,397 entitled "SYSTEM FOR PREVENTING THE USE OF AN UNAUTHORIZED EXTERNAL MEMORY"

FIELD OF THE INVENTION

The present invention generally relates to a hand-held electronic game which utilizes a pluggable external memory and includes several operational control switches disposed in such a manner that the game can be conveniently held in both hands with the switches being operated by the thumbs. More specifically, the invention relates to a compact, hand-held video game system of the above noted nature wherein attachable/detachable game pack external memories can be utilized for individual play or simultaneous multiple player competition via linking cable.

BACKGROUND AND SUMMARY OF THE INVENTION

As evidenced by Japanese Utility Model No. 57989/1986 laid-open on Apr. 18, 1986, games using a liquid crystal display are known. In this game, a game cartridge, attachable to a main body, incorporates a game program and an operating system program to be executed by a central processing unit within the body. The main body also includes a liquid crystal display ("LCD") system.

The present invention provides a uniquely compact video game system for portable hand-held video action involving interchangeable game packs. The game packs are in the form of pluggable memory devices including game programs involving one or more players. Where the game involves two players, for example, a linking cable is pluggably connected between two game machines with identical game program memory packs attached to each machine. Each machine case additionally includes uniquely placed operation switches allowing the machine to be sandwiched by the player's hands and operated by the thumbs.

In one exemplary embodiment, the information processing apparatus is constructed as a hand-held electronic game machine which is intended to be operated while the machine is sandwiched by the player's hands'. Such a hand-held electronic game machine includes a hand-held case; a first operation switch disposed at a position where it can be operated by the thumb of the left hand on a front surface of the case; a second operation switch disposed at a position where it can be operated by the thumb of the right hand on the front surface of the case; and a third operation switch provided in a region where an imaginary loci of the thumbs of the left hand and right hand intersect with each other on the front surface of the case.

A direction designating switch (specifically, a cross-key switch) which is utilized for designating a moving direction of a game character is arranged as the above described first operation switch, and an action key (specifically, a push-button switch) for designating one of various kinds of action or motion of the game character. For example, the depression of such a push-button switch may cause a game character to jump, use a weapon, throw a ball or the like. These first and second operation switches are usually operated during the game. The first and second operation switches are arranged at positions where they can be easily operated during game play.

The above-described third operation switch, may, for example, be a start switch for designating the start of the game and/or a select switch for selecting a mode of operation of the game. Such a third operation switch is arranged in a region where the imaginary loci of the thumbs of the both hands intersect each other. Therefore, the third operation switch is disposed to be readily operated by the thumb on either hand. Thus, the third switch may be operated during game play without requiring the user to change the position of the hands during the game.

These and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the embodiments of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view showing an exemplary exterior housing of a game machine in accordance with an exemplary embodiment of the present invention;

FIG. **2** is an illustrative view showing a cross-section along a line II—II in FIG. **3**;

FIG. **3** is an illustrative view showing an arrangement of switches or keys such as a start switch, select switch, and so on i;: the FIG. **1** embodiment;

FIG. **4** is a block diagram showing the electronic components of the FIG. **1** embodiment;

FIG. **5** is a block diagram showing a major portion of FIG. **4** in further detail;

FIG. **6** is a circuit diagram showing an exemplary memory selecting circuit such as shown generally in FIG. **5**;

FIGS. **7**(A) through **7**(D) are a memory map showing address spaces to which CPU core can access;

FIGS. **8**(A) and **8**(B) are illustrative views showing examples of character data to be displayed;

FIG. **9** is a flowchart showing a sequence of authenticating operations controlled by the processing system shown in FIG. **4**;

FIG. **10** is a flowchart showing a sequence of operations for comparing first character data with second character data;

FIG. **11** is a flowchart showing a sequence of operations in an inhibiting process when a first character data and a second character data are inconsistent with each other;

FIG. **12** illustrates a key-matrix for detecting a key or switch input;

FIG. **13** is an exemplary character RAM memory map;

FIG. **14** is an exemplary VRAM memory map; and

FIGS. **15**(A) through **15**(L) are exemplary embodiments of various addressable registers associated with the LCD controller.

US005184830A

United States Patent [19]

Okada et al.

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[45] **Date of Patent: Feb. 9, 1993**

Inventor names and addresses

Assignee names and addresses

Family identification

Technological field

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Abstract (and full text)

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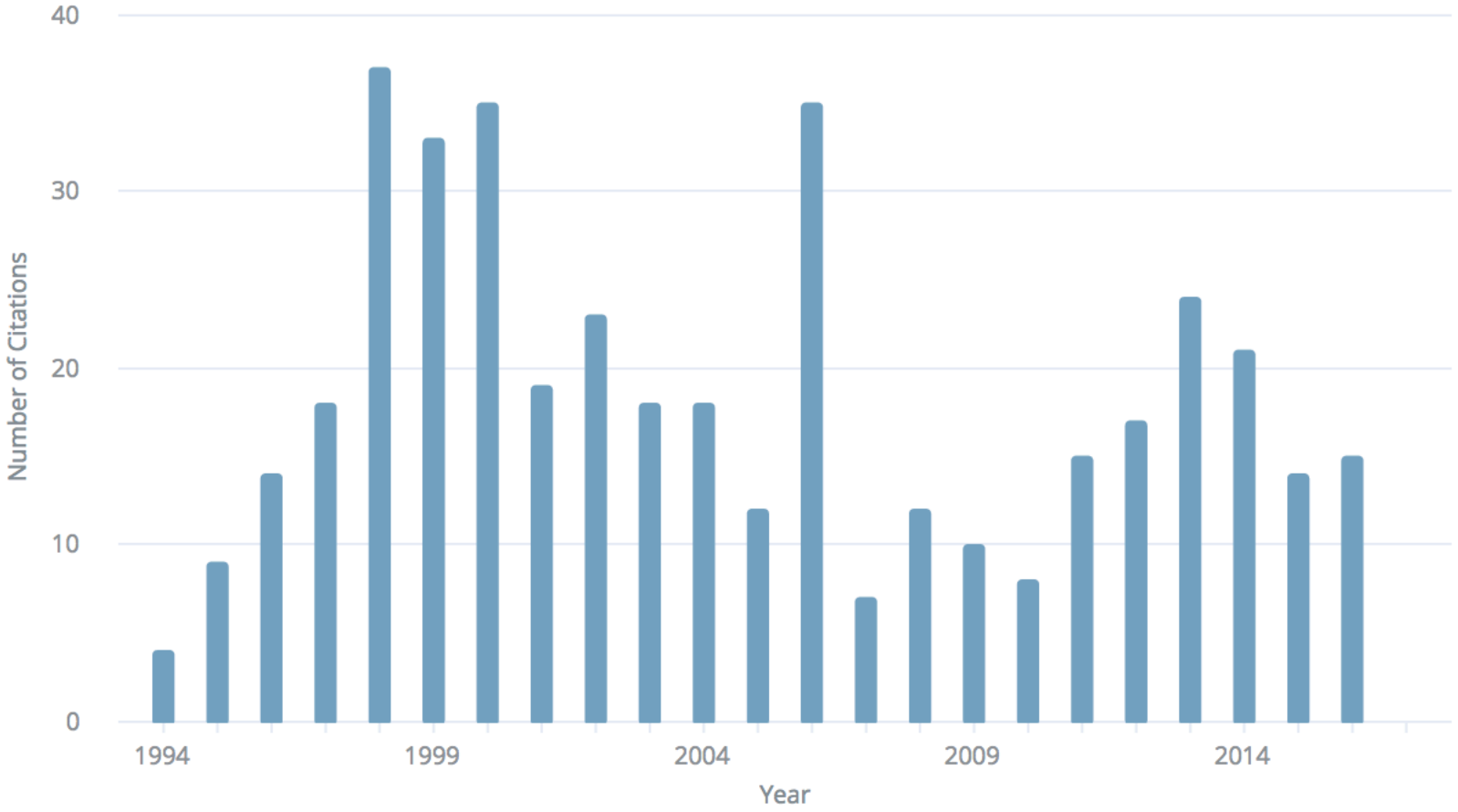
Number of claims

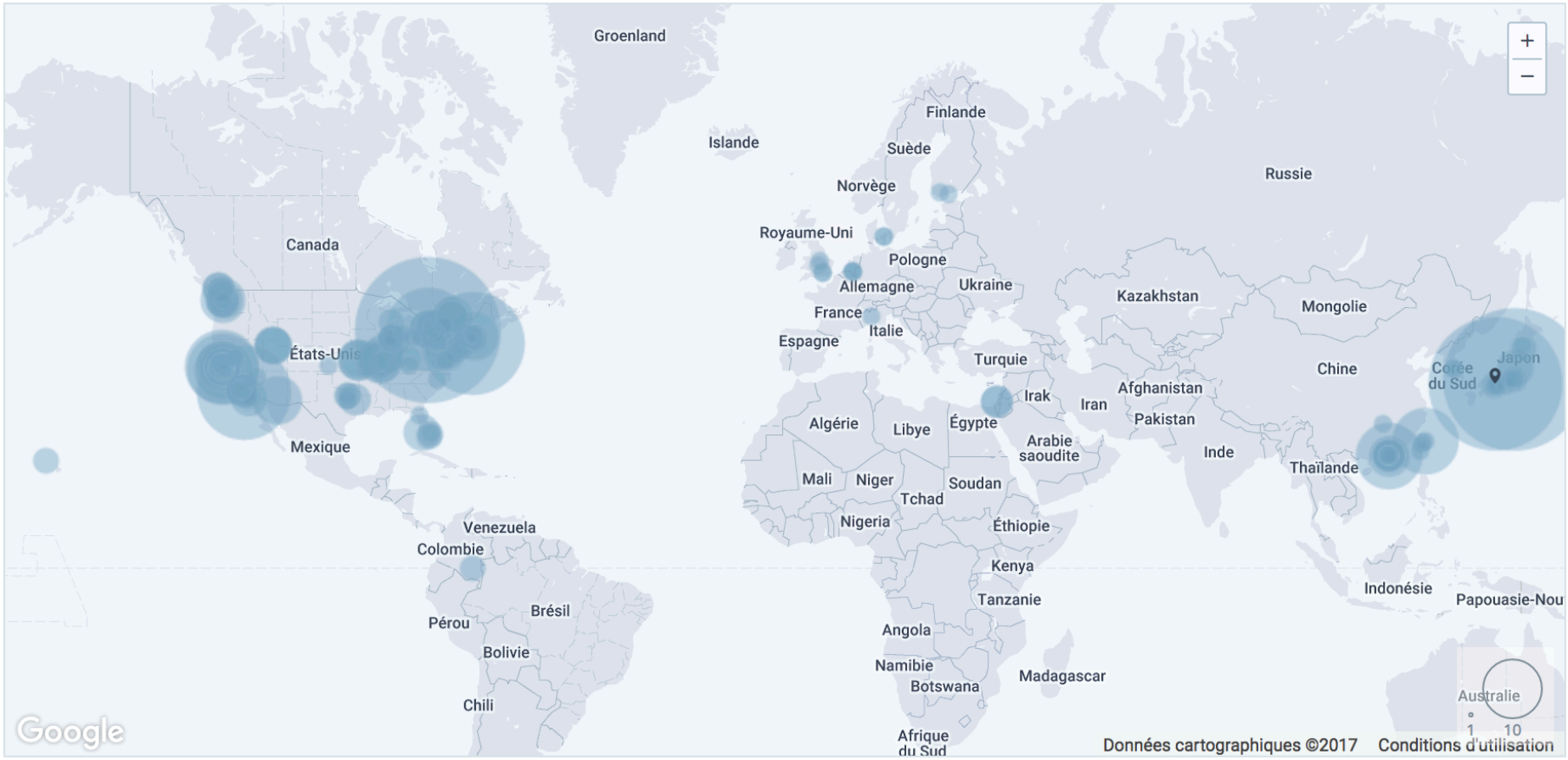
21 Claims, 12 Drawing Sheets

Citations over time of the Game Boy patent



Source: patentsview.org

Origin of citations for the Game Boy patent



Source: patentsview.org

4/6 Dimensions that one can exploit

“We use the term quality to emphasise both the technological and value dimensions of an innovation.”

Lanjouw and Schankerman (2004:443)

Often, scholars need to measure "quality"

- Scholars often mix the notion of economic/technological value and quality, using them interchangeably. There are various aspects to consider:

- Quality
  - Of the invention: technological merit of the invention
  - Of the patent right: how strong is the patent; would it stand up in court if it were challenged?

- Private value
  - Of the invention: How much would the owner be willing to sell the invention for?
  - Of the patent right: value of the exclusive right conferred by the patent ("premium")

- Social value
  - Of the invention: how much is the invention worth to society
  - Of the patent right: how much is the exclusive right conferred by the patent for society (could be negative)

There are many dimensions of "quality"

- These dimensions are inter-related: a high-quality patent right can be sold for more (higher value), and a high-quality invention may be more difficult to imitate (hence worth more to its owner).
- You will often hear that citations measure patent "value" or patent "quality". It is now clear that this is a loose statement.
- There is a large literature on the use of citation data, which is been recently summarized.

A nice literature review ☺

OPEN ACCESS

Jaffe, A. B., & de Rassenfosse, G. (2017).
Patent citation data in social science research: Overview and best practices.
Journal of the Association for Information Science and Technology, forthcoming.

http://dx.doi.org/10.1002/asi.23731

Is it possible to disentangle value from quality?

- There are several indicators that are affected by both value and quality: number of forward citations received, geographic family size (number of countries where the invention is protected), renewals (number of years renewal fees were paid), and number of independent claims (indication of the scope of the invention).

- In de Rassenfosse and Jaffe (2014) we put forward a non-linear latent variable model of patent quality and value. We estimate:

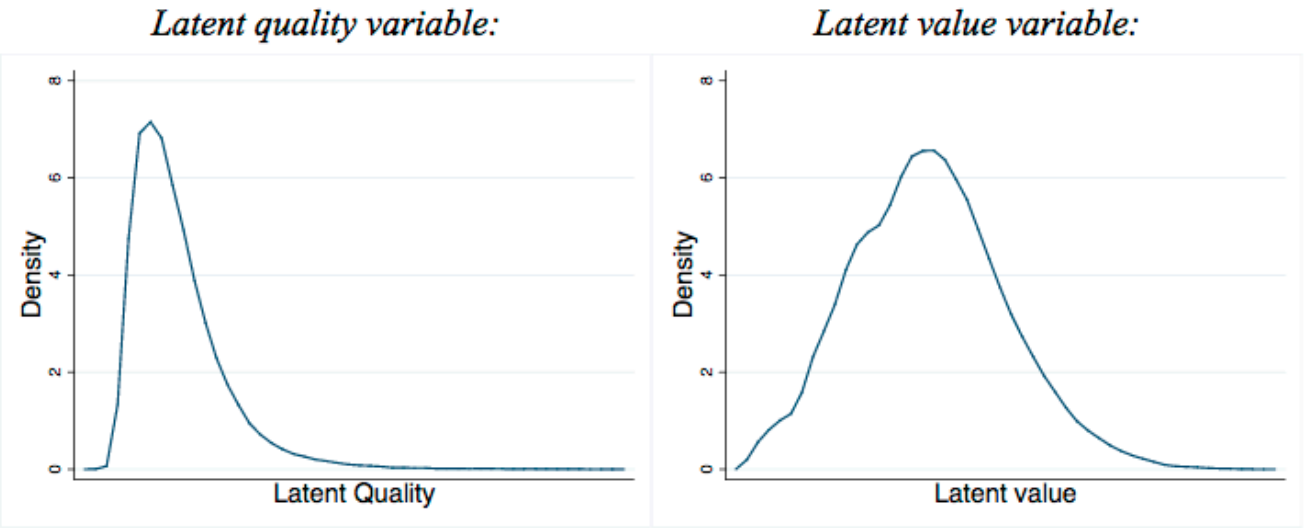
$$E[Y_k|Q^*, V^*] = G(C\beta_{k,1} + V^*\beta_{k,3} + Q^*\beta_{k,4})$$

where Y_k (k = 1, …, 4) is the N x 1 vector of values for the k-th quality indicator, G(.) is a link function, C is the vector 1, V^* is the vector of latent economic and Q^* is the vector of latent technical quality. We impose that $\beta_{family\ size,4} = \beta_{renewals,4} = 0$.

- We can then estimate the values for Q^* and V^*.

Results of the two-factor model

Figure 2. Density estimates of the latent quality variables



Source: de Rassenfosse and Jaffe (2014)

Other dimensions have been used in a variety of ways

- Citations to non-patent literature
  - Evidence of science-based inventions
- Assignee information:
  - Multiple assignees as evidence of R&D collaboration (reinhilde?)
  - Change in assignees as evidence of patent transfer (Serrano)
- Inventors
  - Measure of team size
  - Identification of star inventors
  - Mobility of inventors
- Agents
  - Role as knowledge brokers (Hoisl?)
- Procedural information (time to grant, within-office family size)
  - Indication of filing strategies (vam zeebroeck>)

Other dimensions have been used in a variety of ways

- Citations to non-patent literature
  - Evidence of science-based inventions
- Assignee information:
  - Co-assignees as evidence of R&D collaboration
  - Change in assignees as evidence of patent transfer
- Inventors
  - Measure of team size
  - Identification of star inventors
  - Mobility of inventors
- Agents
  - Role as knowledge brokers
- Procedural information (time to grant, within-office family size)
  - Indication of filing strategies, operational information

5/6 Current frontier

Pushing the frontier with data science

- While it used to be true that papers exploiting patent data only could be published in top journals, this is less true today.

- There are three main approaches for publishing in top journals exploiting patent data:
  - Combine patent data with external data sources.
  - Use patent data only and find a (really) cool question;
  - Use patent data only but push the frontier of how you use it.

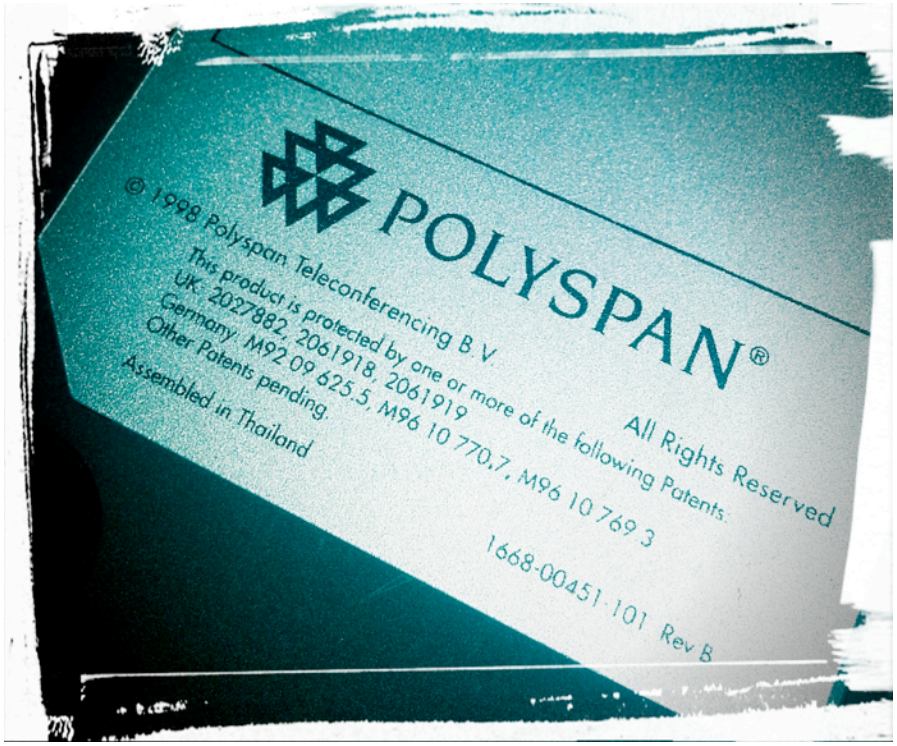
- Lee Fleming at UC Berkeley's Fung Institute, working on the disambiguation of inventors. Allows studying questions related, e.g., to the mobility of inventors.

- Ken Younge (EPFL) and Jeffrey Kuhn (UC Berkeley), working on patent-to-patent text-based similarity measures.

The "IPRoduct" initiative at EPFL

http://iproduct.epfl.ch

- Acknowledging the limitation of patent data but also the rich source of information that it provides, we are currently building a database that links patents to products.
- We do so by exploiting patent marking information available online.
- There is too much information, this cannot be done manually.
- We have built a targeted web crawler on a locally-hosted archive of the web (approx. 2 billion webpages) and are developing a information extraction software to identify the relevant webpages, and the relevant information within a web page.
- Contact me if you want to know more.



6/6

Data sources

What data sources are you aware of
or actively using?

The most important data source is certainly PATSTAT

- PATSTAT contains bibliographical and legal status patent data from leading industrialised and developing countries.
- Data are extracted from the EPO's databases and are provided as raw data or online.
- Hard to use at first (requires knowledge of SQL), but the learning cost is certainly worth it if you are at the start of your PhD.

A nice introductory article ☺

de Rassenfosse, G., Dernis, H., & Boedt, G. (2014).
An introduction to the Patstat database with example queries.
Australian Economic Review 47(3): 395–408.

OPEN ACCESS

http://dx.doi.org/10.1111/1467-8462.12073

Data sources for patent-level data

- **Clarivate Analytics' Thomson Innovation**: More user friendly than PATSTAT, but less flexible and (much) more expensive.
- **NBER U.S. Patent Citation Data File**: Free to download and link to Compustat, but contain data for U.S. patents only and becoming outdated.
- **USPTO's patentsview.org**: Free to download and contain information on harmonized assignees and inventors but contain data for U.S. patents only.
- **lens.org, google.com/patents**: Free-to-use online interfaces that contain data similar to PATSTAT and can be crawled, but not designed for research purposes (hence some aspects are obscure).
- **Patent offices websites**: Likely to contain detail prosecution data but not always easy and fast to parse (UKIPO Ipsum, JPO Platpat, etc.).

References

References (not already mentioned in slides)

Arora, A., Ceccagnoli, M., & Cohen, W. M. (2008). R&D and the patent premium. *International Journal of Industrial Organization* 26(5): 1153–1179.

de Rassenfosse, G, & Jaffe, A. (2014) Are patent fees effective at weeding out low-quality patents? *NBER Working Paper* 20785.

de Rassenfosse, G., & van Pottelsberghe de la Potterie, B. (2009). A policy insight into the R&D–patent relationship. *Research Policy* 38(5): 779–792.

Conti, A., Thursby, J., & Thursby, M. (2013). Patents as signals for startup financing. *The Journal of Industrial Economics* 61(3): 592–622.

Duguet, E., & Kabla, I. (1998). Appropriation strategy and the motivations to use the patent system: An econometric analysis at the firm level in French manufacturing. *Annales d'Economie et de Statistique* 49/50: 289–327.

Gambardella, A., Harhoff, D., & Verspagen, B. (2008). The value of European patents. *European Management Review* 5: 69–84.

Griffith, R., Huergo, E., Mairesse, J., & Peters, B. (2006). Innovation and productivity across four European countries. *Oxford Review of Economic Policy* 22(4): 483–498.

Lanjouw, J. O., & Schankerman, M. (2004). Patent quality and research productivity: Measuring innovation with multiple indicators. *Economic Journal* 114(495): 441–465.