

Methodologies in economics of innovation

Themes

1. Product innovation, Process innovation and basic concepts;
2. Sources, Barriers and Drivers;
3. **History of Economics of Innovation;**
4. Open Innovation and System of Innovation;
5. Innovation and Competitivity;
6. Innovation and Employment;
7. **Methodology in Economics of Innovation;**
8. Economics of Science and Technology Transfer;
9. Intellectual Property
10. Entrepreneurship;
11. Innovation Policies

Monday 18/12/2017



Seminar by Claudia Ghisetti, JRC Ispra , time: 12.00

“On the adoption of circular economy practices at the firm level: does their financing make a difference?”

This week lecture

- A brief history and definition of patent
- Uses of patent data
- Other measures of innovation
- What is a patent?
- Patent citation
- Where to find the data?

A brief history...

- First patents – in 1474 in Venetian Republic: exclusive rights to inventors who had invented or brought new technologies to Venice.
- Then in early 16th century copied by other European rulers. In 1623 in Britain, the right to grant monopolies was transferred from the king to the Parliament.
- US constitution (1789) grants the Congress the power “to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries”.
- In the Russian Empire, Alexander I signed the “Manifesto on privileges for inventions and discoveries in the arts and sciences” in 1812. In Sweden, first patent law was signed in 1819. In Finland, the first patent was granted in 1842.
- But many countries did not have the necessity of patent systems:
 - Germany had no patent law until 1877
 - Switzerland and Japan – until 1888
 - Denmark introduced patent law in 1894
 - The Netherlands abolished its patent system in 1869 and reintroduced it only 1912

Definition of patent

- Codified form of knowledge
- Publicly accessible and searchable information
- Right to deny third parties use of invention
- Territorial right for a predetermined limited period of time:
 - No 'international' patents
 - National patent – patent only valid in jurisdiction where granted
 - Regional patent systems, for example European Patent Convention (EPC)
 - Patent Cooperation Treaty – PCT system (WIPO)
 - Substantial institutional differences across patent offices

The uses of patent data

Three main uses of patent data

- Causes and consequences of innovation
- Features of the innovation process (e.g., knowledge spillovers)
- Intellectual property (IP) policy .
- Bibliometric and complex systems (econophysics, networks).

Causes and consequences of innovation

- Inventions are unobservable *per se*.
- 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.

Griliches (1981)

- 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:

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

- where Q is market value (V) over tangible assets (A), $\sum b_h R_{-h}$ 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.

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)

Jaffe et al 1993

- 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.
- They construct control samples of patents that are not citations but have the same temporal and technological distribution as the citations.
- They find that citations to domestic patents are more likely to be domestic, and more likely to come from the same state as the cited patent
- Localization fades over time, but only very slowly
- There is no evidence that more "basic" inventions diffuse more rapidly than others.

Intellectual property right 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.

Sakakibara & Branstetter 2001

- The core idea: The 1988 reform of patent law in Japan strengthened patent protection (expansion of the scope of patents rights).
- Claim: define, in technical terms, the extent, i.e. the scope, of the protection conferred by a patent, or the protection sought in a patent application. More on claim https://en.wikipedia.org/wiki/Patent_claim
- Example of a claim: *An apparatus, comprising: a plurality of printed pages; a binding configured to hold the printed pages together; and a cover attached to the binding.* What is this? 😊
- Why Japan? Japanese patents covered a single, independent claim — meaning that **one novel advance** was permitted per patent.
- The scope of each individual claim also tended to be narrower in Japan than in the U.S., where patents could claim protection for broad classes of a product, whereas in Japan only specific products that had been proven in practice could be patented
- A 1976 amendment to the patent law allowed the inclusion of multiple dependent claims but the true reforms is in 1988 when the claims included could be dependent or independent
- One implication of the multi-claim system is that it makes the improvement of an invention over the existing technology easier to demonstrate, increasing the likelihood that a patent will be granted

- 307 publicly traded Japanese manufacturing firms, drawn from various industries
- They estimate the following specification:

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

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.

- Results:
 - The coefficients indicate that, starting in the early 1980s, there was a substantial increase in R&D spending by Japanese firms. this increase predated patent reform
 - The years 1988 and 1989 were actually marked by a relative decline in R&D spending. After, no increase attributable to the patent reform
 - Results suggest a deceleration in the rate of growth of patent applications made by firms after the reform
 - Failure to find an increase in firms' innovative output or input in response to patent reform does not prove that there was no effect. More empirical work on this policy experiment in Japan will be necessary before coming to any final conclusions concerning its impact

Other ways to measure
innovation

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.
- 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.

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”.



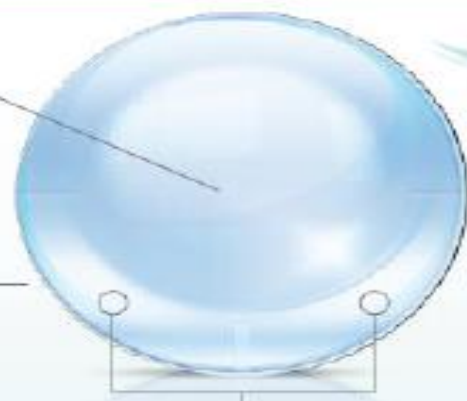
AIR OPTIX for ASTIGMATISM lenses use a breakthrough design

Wide Optic Zone

- Provides excellent acuity*
- Low amount of prism in the optic zone to reduce thickness and maximize Dk/t*

Constant Contour Edge

- Provides excellent comfort



PRECISION BALANCE 8|4™

Three Scribe Marks

- Scribe marks at 3, 6 and 9 o'clock make it easy to observe lens rotation and stability

Precision Balance 8|4 Design

- Thickest points of the lens at 8 and 4 o'clock
 - Minimize interaction with the lower lid for excellent comfort*
 - Maximizes oxygen transmission at 6 o'clock**
 - Exceptional stability, consistent rotation and fit performance*

Covered by 7 patents

US7847016

US7456240

US7052133

US7040757

US6774178

US7135521

US7078074

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).

Service's sector firms also apply for patents



~13,400 patents



~4,800 patents



~1,300 patents



~30 patents



U B E R

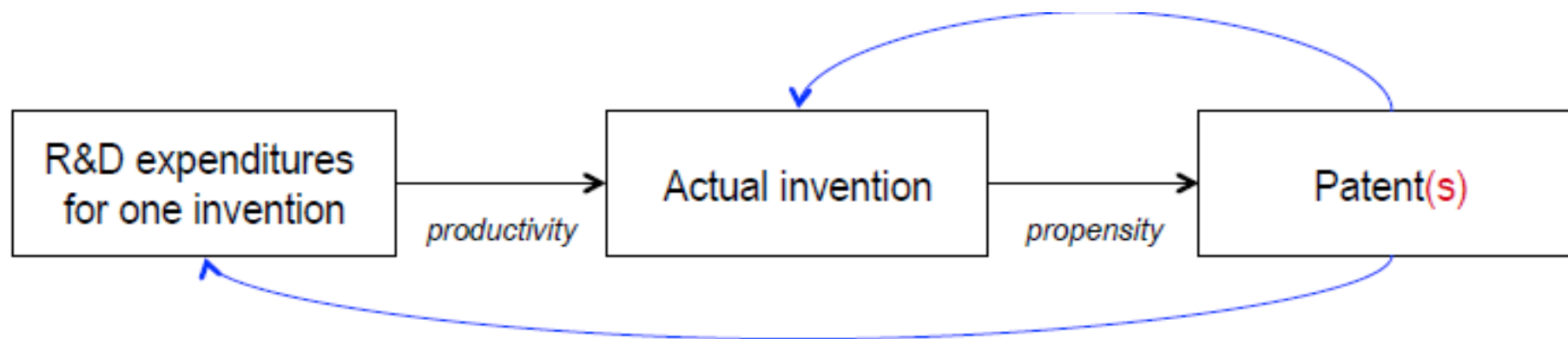
~30 patents



~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.
- 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 their findings may be biased by the propensity to patent (example of firm size). [See Rassenfosse and van Pottelsberghe (2009).]
- That R&D-patent relationship is characterized by non-linearities and feedback loops:
 - Last appropriability option
 - Strategic patenting
- beside the innovation output that requires protection, the decision to file a patent is affected by alternative mechanisms of appropriation and by the strategic role that patents can play for a firm

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.

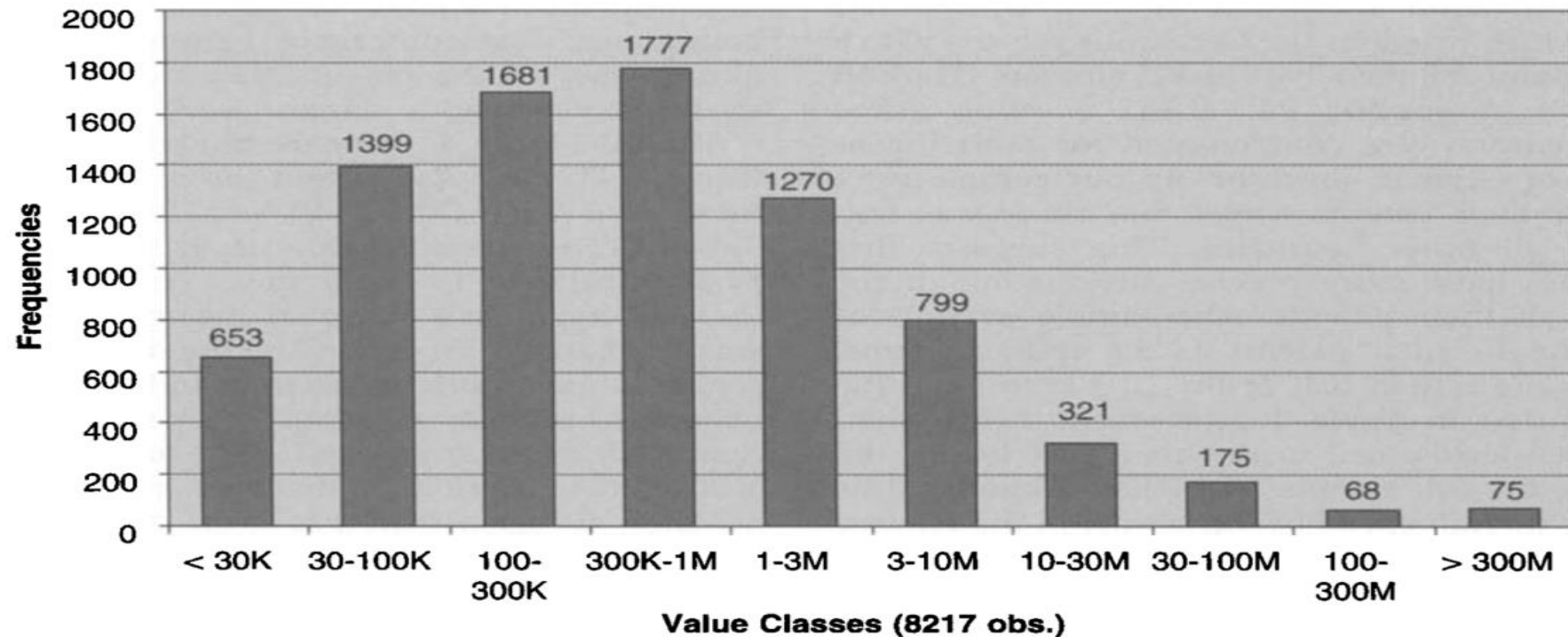


Figure 1 Distribution of VALUE. The figure shows that the PatVal-EU patent VALUE distribution is skewed. Since the difference in the logs of the boundaries of the intervals is roughly constant, the distribution in the figure is an approximation of a log-normal. Even the log-normal distribution looks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

We might 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)

Other available sources of data on innovation

- **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.
<http://ec.europa.eu/eurostat/web/microdata/community-innovation-survey>
- You can also search for **sector-specific sources** (e.g., software released on GitHub). <https://github.com/>
- **Input to the innovation process**: R&D expenditures, R&D employees.
<http://ec.europa.eu/eurostat>
- Patent data can always be used in conjunction with those sources

What is a patent?

Key aspects of patent protection

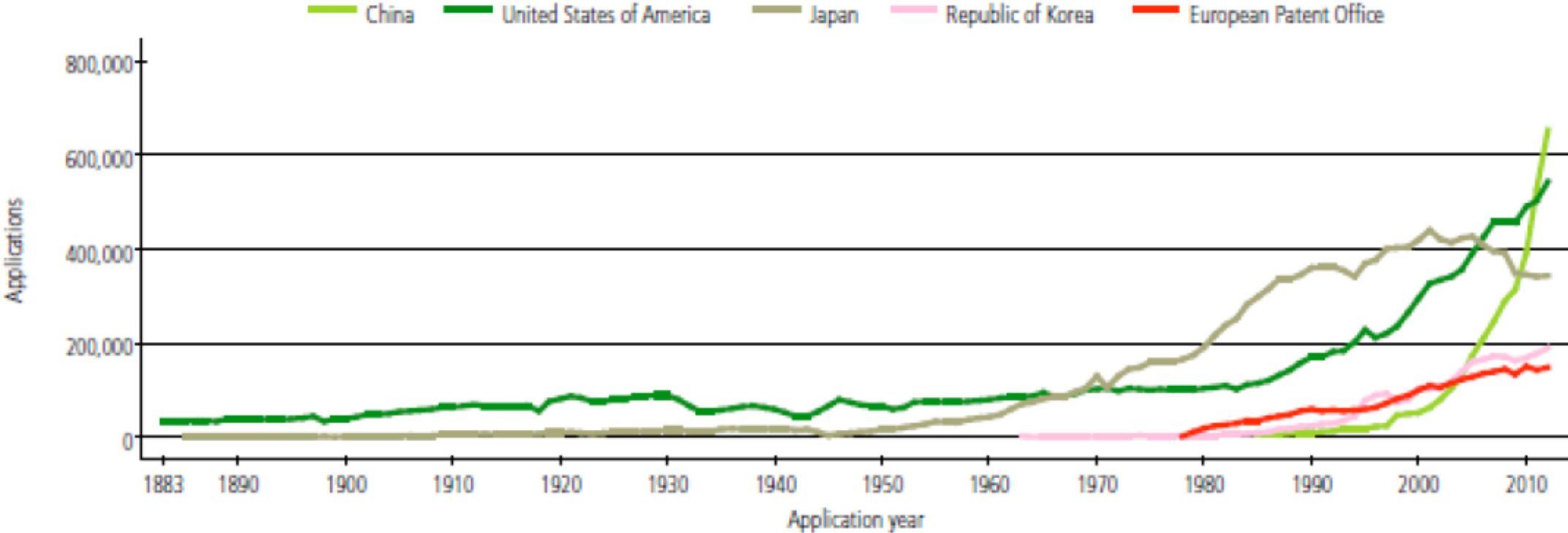
- patent is an exclusive right to prohibit third parties to use commercially in the territory, where a protection is granted, one of the following rights:
 - Production
 - Usage
 - Publicity
 - Sale
 - To put in circulation
 - To import / export / transit
- Patent protection applies to technical solution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

- 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.

Principal criteria for patentability of an invention:

- Novelty: invention must not yet be in public domain anywhere in the world before the priority date of the corresponding patent.
- Inventive step: invention must not be an obvious modification of what is already known, meaning that the invention must be neither re-producible based solely on existing patented claims nor ex-ante an obvious solution to the problem to someone skilled in the art
- Utility: The patented invention must contain the potential of commercial value through an industrial application.
- A number of new concepts and methods are excluded from patent protection by the European Patent Office (EPO): scientific or mathematical discoveries, theories or methods, literary, dramatic, musical or artistic works, schemes, rules or methods for performing a mental act, playing a game or doing business, and methods of medical treatment.

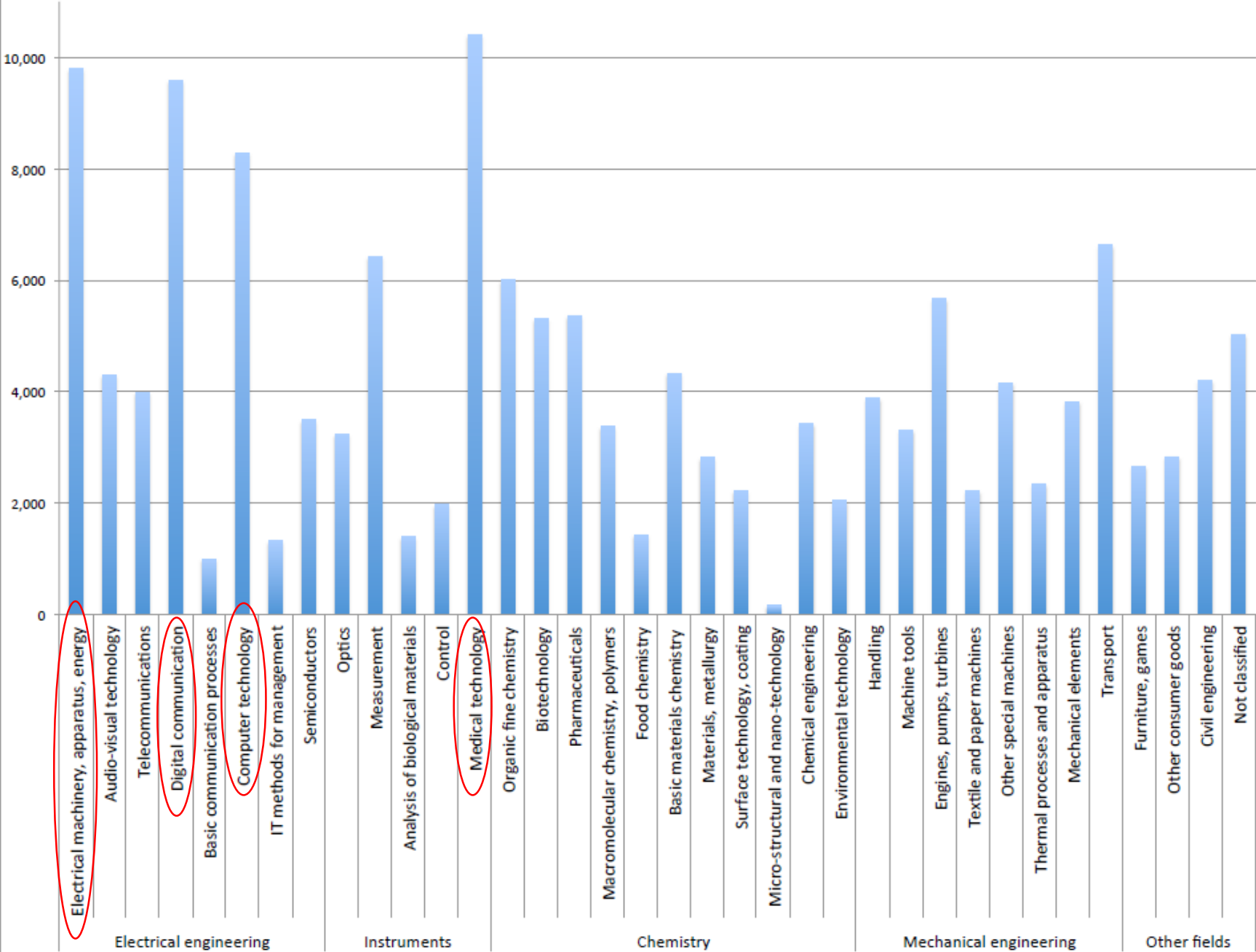
Figure A.2.1.2 Trend in patent applications for the top five offices



Note: The top five offices were selected based on their 2012 totals.

Source: WIPO Statistics Database, October 2013

Patents granted by the European Patent Office, 2012





US005184830A

[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 Koje, both of Kyoto, Japan
[73] Assignee: Nintendo Company Limited, Kyoto, Japan
[21] Appl. No.: 899,179
[22] Filed: Jun. 15, 1992

4,865,321 9/1989 Nakagawa et al. 273/85 G
4,890,832 1/1990 Kozuki 273/435

FOREIGN PATENT DOCUMENTS
58-136192 9/1983 Japan
57989 9/1984 Japan
60-21784 2/1985 Japan
2003763 5/1980 United Kingdom
8302586 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

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. 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
4,395,780 7/1983 Yoski et al. 364/410
4,438,826 3/1984 Yoski et al. 273/85 G
4,572,509 2/1986 Strick 273/85 G
4,589,699 5/1986 Yoski et al. 273/1 GC
4,729,563 3/1988 Yoski 273/1 E
4,745,478 5/1988 Nakagawa 356/181
4,783,832 11/1988 Kanoaka 381/61
4,815,733 3/1989 Yoski 273/1 E

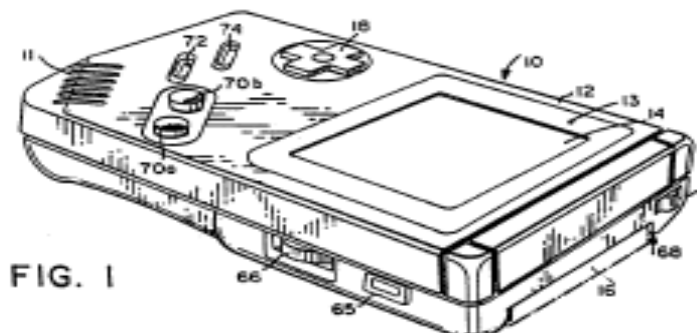
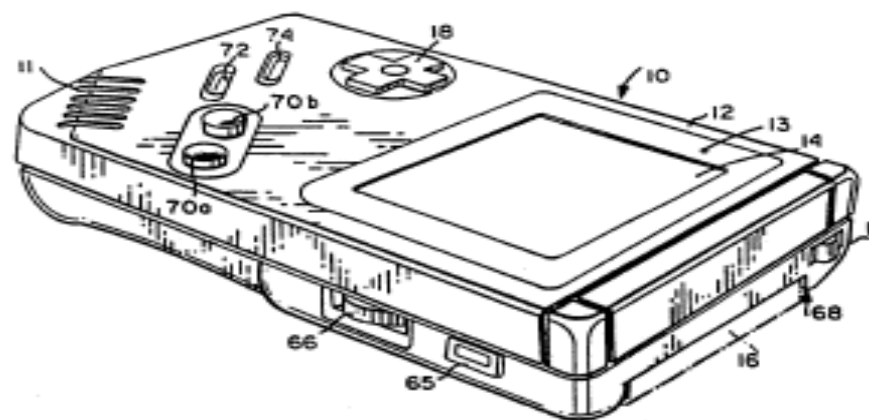


FIG. 1

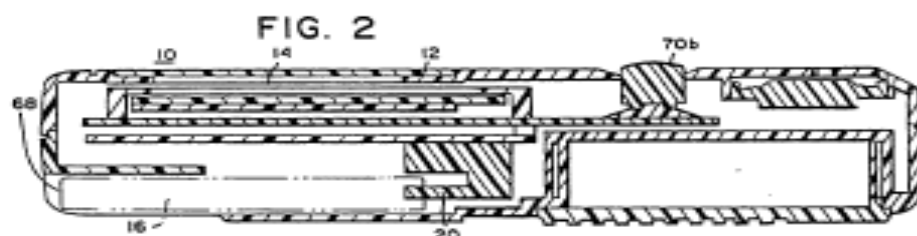


FIG. 2

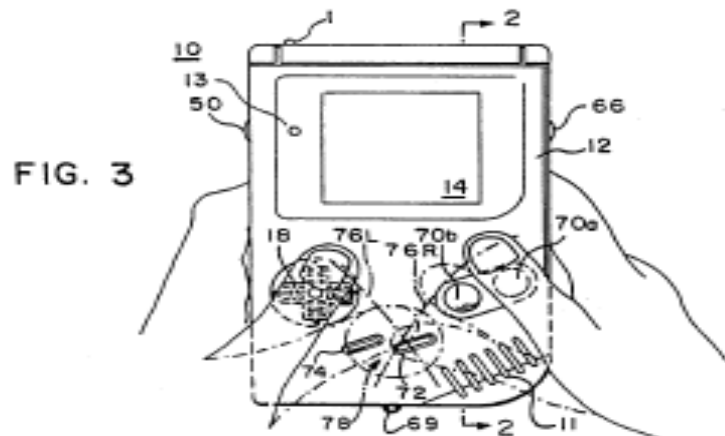


FIG. 3

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. 57089/1986 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 in 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.

[11] **Patent Number:** **5,184,830**[45] **Date of Patent:** **Feb. 9, 1993**Inventor
names and addresses[54] **COMPACT HAND-HELD VIDEO GAME SYSTEM**[75] **Inventors:** Satoru Okada; Shin Kojo, both of Kyoto, Japan[73] **Assignee:** Nintendo Company Limited, Kyoto, JapanAssignee
names and addresses[21] **Appl. No.:** 899,179[22] **Filed:** Jun. 15, 1992

Family identification

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Technological field

[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

References

[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 E4,865,321 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**

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Abstract
(and full text)**21 Claims, 12 Drawing Sheets**

Number of claims

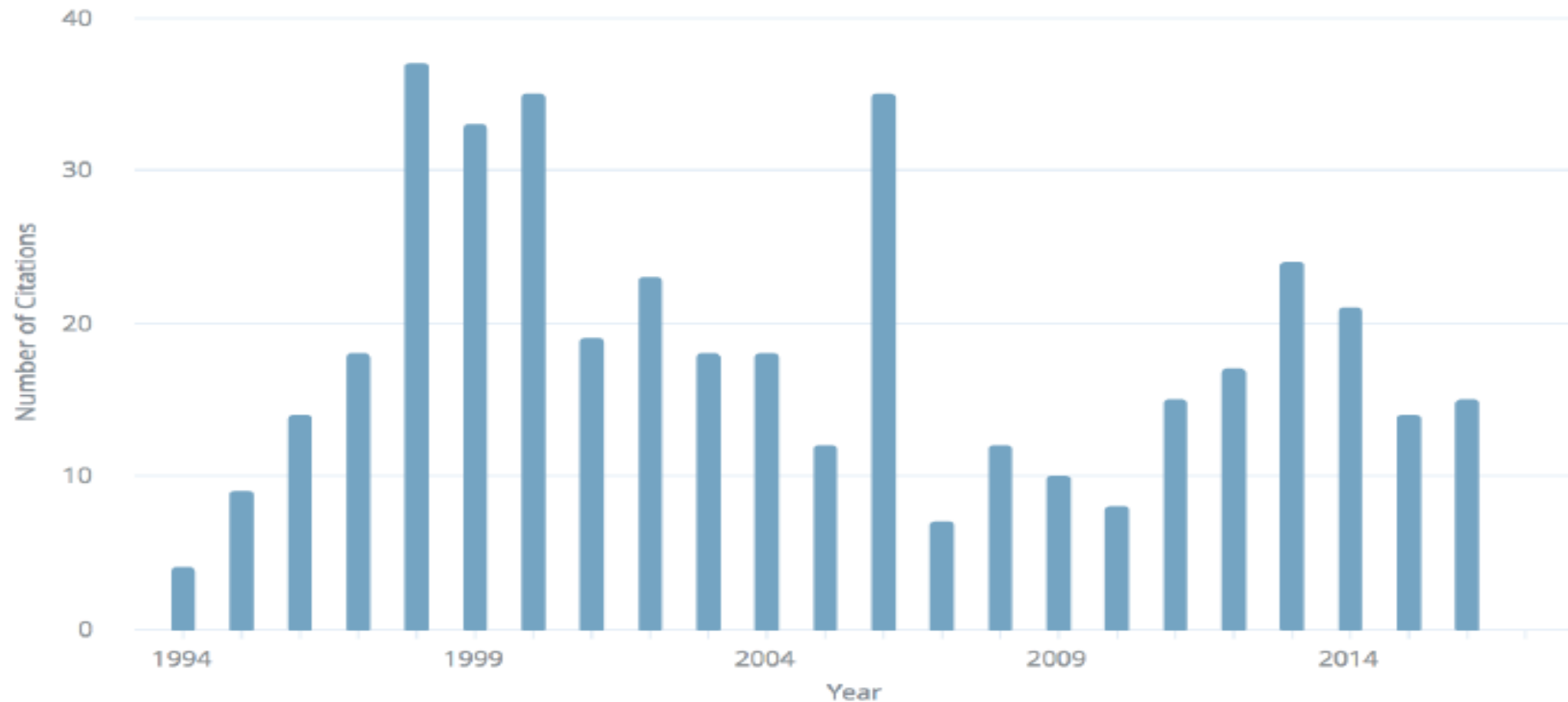
Patent citation

- 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)
- USPTO: need to include all relevant citations
- EPO: minimum number needed to cover prior art
- Defensible as a partial measure of knowledge transfer
- Suggest spillover localization in region and country

Issues in using citations to measure spillovers

- Link between two inventions:
 - spillovers accompanied by citations (Jaffe et al. 1993)
 - citations that occur where there was no spillover
 - spillovers that occur without generating a citation
- A citation might occur without being a spillover (e.g. contracted development)
- Citation added by the examiner (as in USPTO) of which the inventor was unaware
- there are an enormous number of spillovers with no citations, since only a small fraction of research output is ever patented

Citations over time of the Game Boy patent



Source: patentsview.org

Origin of citations for the Game Boy patent



Data sources on patents

- 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 will also need data patent in the future
- **Clarivate Analytics' Thomson Innovation:** More user friendly than PATSTAT, but less flexible and (much) more expensive.
- NBER US Patent citation data file: free to download but only contains US patent data
- **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
- **Patent offices websites:** Likely to contain detail prosecution data but not always easy and fast to parse (UKIPO Ipsum, JPO Platpat, etc.).