Innovation, Intellectual Property Rights and Economic Development: Some Historical Perspectives

Alessandro Nuvolari
Institute of Economics
Scuola Superiore Sant’Anna, Pisa
alessandro.nuvolari@santannapisa.it
Three Lectures on

- Innovation, patents and the first industrial revolution
- Collective inventions
- Patent reform: how much should society fuel the greed of innovators?
Intellectual Property Rights: What’s in a word?

Frequency of “patents”/ “copyrights”/ “intellectual property rights” in the Google Books corpus

Foundation of WIPO (1967): “to encourage creative activity, to promote the protection of intellectual property throughout the world”

American Bar Association-Section on Patents, Copyrights and Trademark Law changed name in America Bar Association-Section on Intellectual Property Law in 1990
Intellectual property rights is a misleading (propaganda?) term used to foster the notion that government-enforced monopolies over ideas perform like rights in tangible property and have also a strong moral foundation.

“Natural rights” philosophical justifications (Locke, Hegel) of intellectual property rights (i.e., individuals have a moral entitlement to the exclusive ownership of their ideas: “I created therefore I own it”) are not really compelling.


Note: “moral rights” of authors and inventors such as ATTRIBUTION (right of the author or inventor to be identified as such) or INTEGRITY (right to oppose undue “distortions” of the original contribution) can be established independently from the current “exclusivity” logic of patents and copyrights (e.g., Berne Convention for the Protection of Literary and Artistic Works, (art. 6 bis), “Independently of the author’s economic rights…..”).
Inventive activities as collective endeavours: Technological Paradigms (Dosi, 1982)

“...a ‘technological paradigm’..[is a] ‘model’ and a ‘pattern’ of solution of selected technological problems, based on selected principles derived from natural sciences and on selected material technologies” (Dosi, 1982)

“A technological paradigm is both an exemplar - an artifact that is to be developed and improved (such a car, an integrated circuit, a lathe, each with particular technoeconomic characteristics) - and a set of heuristics...” (Dosi, 1988)

As such innovations are based both an public and on a private body of knowledge.

The philosophy of patent systems is still based on the notion of inventions made by an individual inventors in a given place at a given time (“heroic” theory of invention)
Patents and copyrights: foundations

Most sensible rationale for patents and copyrights is “utilitarian”: we grant patents and copyrights, not because it is right but because we believe they promote desirable social goals (eg, US constitution, art. 1, sect. 8)

“The Congress shall have Power...to promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Rights to their respective Writings and Discoveries...”

Compare with the discussion of “property rights” in amendment V of the US constitution: “No person...shall be deprived of life, liberty, or property, without due process of law, nor shall private property be taken for public use, without just compensation”

In other words, patents and copyrights must be understood as government interventions in the market to stimulate innovation and creativity.
The standard economic rationale for patents

Why patents can promote the progress of Science and Useful Arts?

• Patents are necessary because without them there will be no investment in inventive activities.

• Without patents, copying and imitation will dissipate the profits of the innovators preventing them from recovering their investments in inventive activities.

• Anticipating this outcome, innovators (in a world without patents) will not engage in inventive/creative activities.

• We accept the (temporary) deadweight loss of the inventor’s monopoly because this provide a fundamental incentive to invest in R&D.

• Patents also provide disclosure of technical knowledge (that can be used freely after the patent is expired).

Alternative solutions (such as systems of public rewards for innovations ex-ante or ex post) face major problems in assessing the benefits and costs of inventions. With patents, the reward of inventors is left to the market (this point was originally made by Adam Smith in the Lectures on Jurisprudence). Concerning patents, Adam Smith stated “The greatest part of exclusive privileges...are prejudicial to society”, but he thought that patents were “harmless enough”.

“That reminds me to remark, in passing, that the very first official thing I did, in my administration -- and it was on the very first day of it, too - was to start a patent office; for I knew that a country without a patent office and good patent laws was just a crab, and couldn't travel any way but sideways or backways”

Mark Twain, A Connecticut Yankee in King Arthur’s Court, 1889
Machlup and Penrose (1950)

“the controversy about patent of invention is very old, and the chief opponents of the system have been among the chief proponents of free enterprise”

Peak of patent abolitionism (1850-1875)

Lobbying for patent reform in England (1820-1850) triggers a reaction calling for the abolition of the system

Netherlands: abolition of patent system in 1869 (reintroduced in 1912)

Switzerland: no patent law until 1888, then a very “rudimentary and weak” law until 1907 (requiring to deposit “models” and forbidding patenting of processes and of products and processess in chemicals)
Arguments in the Patent Question

Natural rights arguments

- Natural property right in ideas (IP is just the legal recognition of this “natural” right)
- Just reward for (inventive) efforts

«Social welfare/Utilitaria» arguments

- Incentive for inventive efforts (without patents, little incentive to undertake inventive activities)
- Without patents many inventions will be kept secret
Arguments in the nineteenth century Patent Question: rebuttals

- “ideas” are different from tangible goods (notions of occupation, possession, appropriation, etc. cannot be applied straightforwardly to ideas)

- First mover advantage is enough to reward the inventor. Alternative approaches can be designed to reward inventors (prizes, bonuses)

- Who invents? The “seeds of invention are in the air”. Further, patents can obstruct technological advance

- Secrecy is never really working. Even with patents if an inventor prefers to keep his invention secret, he will do so.
The viewpoint of modern growth theory

"It is the presence of patents and copyrights that enables inventors to earn profits to cover the initial costs of developing new ideas. In the last century (or two), the world economy has witnessed sustained, rapid growth in population, technology and per capita income never seen before in history.

Consider how the economy would behave in absence of [intellectual] property rights. In this case, innovators would be unable to earn the profits that encourage them to undertake research in the first place, so that no research would take place. With no research, no new ideas would be created, technology would be constant, and there would be no per capita growth in the economy. Broadly speaking, just such a situation prevailed in the world prior to the Industrial Revolution“

C. I. Jones (2002), Introduction to Economic Growth, p. 121
GDP per capita vs Patent-Index (Ginarte & Park)
World Economic Performance (GDP per capita 1990 $)

The Industrial Revolution
1780-1802 (Rostow, 1960)

Source: Maddison (2008)
The Three P's for solving the market failure (David, 1993)

• Patronage
• Procurement
• Property (patents).

Since the Industrial Revolution, most economies have resorted to a mix of these institutional devices for stimulating innovation.
Patents

Advantages
• you let the market decide “ex-post” the R&D projects are worthy of being rewarded
• disclosure: knowledge is put in the public domain and after the expiration of the patent is publicly available (patent as information systems)

Disadvantages:
• deadweight loss of temporary monopoly (higher prices, lower quantity)
• delay in diffusion of technical knowledge
• blocking of "follow-up" inventions

Furthermore, industrial organization theory offers very limited insights into optimal patent design (breadth, duration).
A not so innocent assumption...

• The standard economic argument is based on the assumption that technical knowledge is easy to assimilate and imitate: there are no substantial imitation costs and imitation takes place immediately.

• In many real world contexts, technical knowledge is instead difficult to assimilate (eg, literature on diffusion of technology), so that first-mover advantages plausibly represent a powerful incentive for investing in innovation.

• A thought-experiment: in a world without patents do you think that in Business Schools they will start teaching that the road to success is not to be innovative, but to watch the innovations of competitors, check if they are successful on the market and then finally copying them?
Assessing the impact of the patent system

Table 1: The patent system trade-offs

<table>
<thead>
<tr>
<th>Effects on:</th>
<th>Benefit</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation</td>
<td>creates an incentive for R&amp;D; promotes the diffusion of ideas</td>
<td>impedes the combination of new ideas and inventions; raises transaction costs</td>
</tr>
<tr>
<td>Competition</td>
<td>facilitates entry of new small firms with limited assets; allows trading of inventive knowledge, markets for technology</td>
<td>creates short-term monopolies, which may become long-term in network industries</td>
</tr>
</tbody>
</table>

Hall (2007)
Main features of modern patent systems

• Basic requirements: useful, novel, non obvious
• Covered subject matter (patentable/not patentable)
• Prior examination
• Duration
• Disclosure
• Inventive step
• Restrictions to patent rights (compulsory license, research exemptions, working clause, etc.)
A difficult assessment

"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. This last statement refers to a country such as the United States of America - not a small country and not a predominantly nonindustrial country, where a different weight of argument might well suggest another conclusion"

Patent systems in historical perspective

• Origins of the word: “litterae patentes” = open letters. They were official documents by which certain privileges, rights, ranks or titles were conferred and publicly announced; hence they carried the seal of the sovereign grantor on the inside, rather than being closed by a seal on the exterior (brevetto, brevets originates from “litterae breves”)

• Remote origins: mining rights granted during the Middle Ages

• Ad hoc privileges for technology transfer/inventions: stimulate the introduction of foreign technologies via the immigration of skilled workmen

Filippo Brunelleschi and “Badalone”, 1421
Venice: patent statute of 1474

“El son in questa Cità, et anche ala zornada, per la grandeza et bontà soa concorre homeni da diverse bande, et acutissimi ingegni, apti ad excogitar et trovar varij ingegnosì artifici. Et sel fosse provisto, che le opere et artificij trovado da loro, altri viste che le havesseno, non podesseno farle, et tuor honor suo. simel homeni exercitariano l’ingegno, troveriano et fariano dele chose, che sariano de non picola utilità et beneficiio al stado nostro.

L’andara parte che per auctorità de questo Conseio, chadun che farà in questa Cità algun nuovo et ingegnosì artificio, non facto per avanti nel domino nostro, reducto chel sara a perfection, siche el se possi usar, et exercitar, sia tegnudo darlo in nota al officio di nostri provededori de Commun. Siano prohibito a chadun altro in alguna terra e luogo nostro, far algun altro artificio, ad imagine et similitudine de quello, senza consentimento e licentia del auctor fino ad anni X. Et tamen se algun el fesse, lo auctor et inventor predicto, habia libertà poderlo citar a chadun officio de questa Cità, dal qual officio, el dicto, che havesse contrafacto, sia astreto a pagarli ducati centro, et l’artificio subito sia disfacto. Siando però in libertà de la nostra Signoria, ad ogni suo piaixer, tuor et usar ne i suo bisogni chadun di dicti artificij, et instrumenti, cum questa però condition, che altri cha i auctori non li possi exercitar”
Venice: patent statute of 1474

Historical Importance:

- First formalized codification of patent rights: patent is granted on the basis of the applicant’s ability to fulfil certain fixed criteria (rather than through an individual petition to public authorities allowing discretionary choice).
- There is an examination of the patent application “officio di nostri provededori de Commun”
- Patent statute of 1474 will co-exist with the discretionary practice of individual petitions for privileges (with duration between 5 and 80 years).
- In the statute two of the three requirements of modern patent law are explicitly stated:
  - Novelty: “…algun nuovo et ingegnosso artificio, non facto per avanti nel domino nostro…”
  - Usefulness: “…reducto chel sara a perfection, siche el se possi usar, et exercitar…”
  - Non-obviousness: implicit?
England: the Statute of Monopolies 1624

Elizabeth I and James I resort to the granting of monopoly patents for revenue purposes.

Conflict between king and Parliament led to the enactment of the Statute of Monopolies:
Section 1:
“...all Monopolies...are altogether contrary to the Laws of this Realm, and so are and shall be utterly void and of none Effect, and in no wise to be put in Use or Execution”

Section 6: “...any declaration before mentioned shall not extend to any letters patent and grants of privilege for the term of fourteen years or under, hereafter to be made, of the sole working or making of any manner of new manufactures within this realm, to the true and first inventor and inventors of such manufactures....
English patent system

• Patent system is based on the clause of exemption of section 6 of the Statute of Monopolies.
• Patent is granted to “the first and true inventor” (novelty requirement: new “within this Realme”, importation of technology from abroad is still protected (eg, patent to T.Lombe for importing silk mill technology from Italy)
• Patent is of limited duration: 14 years (7 years is the normal term of apprenticeship of an English craftsman)
• Laissez-faire approach: no examination, but only registration
• Issue of specification: Liardet vs. Johnson (1778) establishes that the specification should allow anyone skilled in the art to construct the invention (practice of specifications was established around 1720s)
Constitutionalizing patents...US Constitution (article 1, section 8, clause 8):

Section 8: The Congress shall have power To lay and collect taxes, duties, imposts and excises, to pay the debts and provide for the common defence and general welfare of the United States; but all duties, imposts and excises shall be uniform throughout the United States;

To borrow money on the credit of the United States;
To regulate commerce with foreign nations, and among the several states, and with the Indian tribes;
To establish a uniform rule of naturalization, and uniform laws on the subject of bankruptcies throughout the United States;
To coin money, regulate the value thereof, and of foreign coin, and fix the standard of weights and measures;
To provide for the punishment of counterfeiting the securities and current coin of the United States;
To establish post offices and post roads;

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;

To constitute tribunals inferior to the Supreme Court;
To define and punish piracies and felonies committed on the high seas, and offenses against the Law of Nations;
To declare war, grant letters of marque and reprisal, and make rules concerning captures on land and water;
To raise and support armies, but no appropriation of money to that use shall be for a longer term than two years;
To provide and maintain a navy;
To make rules for the government and regulation of the land and naval forces;
To provide for calling forth the militia to execute the laws of the union, suppress insurrections and repel invasions;
To provide for organizing, arming, and disciplining, the militia, and for governing such part of them as may be employed in the service of the United States, reserving to the states respectively, the appointment of the officers, and the authority of training the militia according to the discipline prescribed by Congress;
To exercise exclusive legislation in all cases whatsoever, over such District (not exceeding ten miles square) as may, by cession of particular states, and the acceptance of Congress, become the seat of the government of the United States, and to exercise like authority over all places purchased by the consent of the legislature of the state in which the same shall be, for the erection of forts, magazines, arsenals, dockyards, and other needful buildings;—And
To make all laws which shall be necessary and proper for carrying into execution the foregoing powers, and all other powers vested by this Constitution in the government of the United States, or in any department or officer thereof.
US patent system

1) System of examination: from 1790-1793 examination board is composed by the Secretary of State, Attorney General and Secretary of War. From 1793-1836 we have a system of registration. From 1836 applications are examined by the Patent Office

2) “first and true inventor” (first to invent principle). Inventions must be “new to the world” importation of technology is not protected

3) Specification of the invention should be understandable by the skilled workman

4) Patent Office is in charge of systematic publications of all patents granted (patents as information systems)

5) Temporary aberrations? (Khan): until 1836 only US citizens may apply for patents (from 1836-1861 foreigners can apply but they must high fees (300$ or 500$ if they are British, after 1861 foreign applicant receive equal treatment)
D. North and the patent system

"..Innovation will be encouraged by modifying the institutional environment, so that the private rate of return approaches the social rate of return...The development of patent laws provides such protection....By 1700...England had begun to protect private property in knowledge with its patent law. The stage was now set for the industrial revolution."

[D. North and R. Thomas (1973), The Rise of the Western World]

“..The failure to develop systematic property rights in innovation until fairly modern times was a major source of the slow pace of technological change...[A] systematic set of incentives to encourage technical change and raise the private rate of return of innovation close to the social rate of return was established only with the patent system.”

[D. North (1981), Structure and Change in Economic History]
David Landes and the patent system

"A number of writers have laid stress on the incentive effect of patent legislation. I am inclined to doubt its significance...“
[D. Landes (1969), *The Unbound Prometheus*]

“On balance, patents were not the major incentive to innovation. The biggest and surest source of gain was the application of invention in one’s own enterprise - a Schumpeterian headstart....”
Map of the literature (I)

Optimists:
Patent system by creating property rights on new technological knowledge provided a key incentive to inventive activities. Patent system was a fundamental institutional foundation of the industrial revolution. Patents also promoted the diffusion of ideas.

Pessimists:
Incentive effect of patents was limited. Patents in some cases had a negative impact on inventive activities ("blocking effect").
Map of the literature (II)

<table>
<thead>
<tr>
<th></th>
<th>OPTIMISTS</th>
<th>PESSIMISTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sullivan (1989, 1990)</td>
<td>O’Brien et al. (1992);</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moser (2005);</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Greasley &amp; Oxley (2007)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clark (2007)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allen (2009);</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mokyr (2009)</td>
</tr>
</tbody>
</table>
British patents 1661-1852

Acceleration of Invention ? Breakpoint 1759

Source: Sullivan (1989)

But according to more recent research: causation can run in opposite direction, i.e. from industrial growth to patents (Greasley & Oxley, 2007)
### Table 2. Steam-power patents analysed by type, 1800-1900

| Year     | No. of patents | Type A | | | Type B | | | Type C | | | Type D | |
|----------|----------------|--------|---|---|--------|---|---|--------|---|---|--------|---|---|--------|
|          | No.     | (%)    | No. | (%) | No.    | (%) | No.  | (%) | No. | (%) | No.    | (%) | No. | (%)   |
| 1800-30  | 220     | (43)   | 47  | (21) | 28     | (13) | 50   | (23) |
| 1835     | 20      | (35)   | 2   | (10) | 3      | (15) | 8    | (40) |
| 1840     | 34      | (24)   | 8   | (24) | 6      | (18) | 12   | (34) |
| 1845     | 26      | (38)   | 4   | (15) | 1      | (4)  | 11   | (42) |
| 1850     | 50      | (47)   | 9   | (17) | 5      | (9)  | 11   | (21) |
| 1855     | 191     | (52)   | 18  | (9)  | 17     | (9)  | 56   | (29) |
| 1860     | 211     | (65)   | 12  | (6)  | 17     | (8)  | 45   | (21) |
| 1870     | 189     | (59)   | 15  | (8)  | 23     | (12) | 40   | (21) |
| 1880     | 267     | (64)   | 27  | (10) | 19     | (7)  | 51   | (19) |
| 1890     | 369     | (76)   | 42  | (11) | 8      | (2)  | 39   | (11) |
| 1900     | 432     | (66)   | 62  | (14) | 42     | (10) | 42   | (10) |
| **Total**| 2,009   |        | 246 |     | 169    |     |      | 365   |

**Note:**
- Type A: stationary and marine steam engines
- Type B: rotary steam engines and turbines
- Type C: locomotives and road vehicles (mis-filed from class 79)
- Type D: perpetual motion and other ideas judged not to have been technically viable at the time they were patented.

**Source:** Abridgements of Specifications
In 1712 Newcomen invented an ‘atmospheric’ steam engine that pumped water from a mine. Steam from the boiler filled the cylinder. When water was injected into the cylinder, the steam condensed, and depressed the piston raising the pump.

James Watt improved the efficiency of this engine inventing the separate condenser.
Blocking patents: Watt vs. Hornblower

James Watt’s patent for the separate condenser covered 6 broad design features (specification with no drawings):

1) cylinder with closed top,
2) piston pressed down by steam,
3) steam case,
4) separate condenser
5) air-pump
6) piston kept tight by oil or grease.

Boulton & Watt succeed in blocking the development of the Hornblower compound engine (see however revisionist paper by Selgin & Turner, 2011)
Joseph Bramah’s assessment of Watt’s patent

“Mr. Watt took his patent not for what he had invented, but for what he might invent in future. Thus says he, ‘I will lay an indeterminate foundation, which will enable me to lock up the brains and hands of every inventive genius; and if any have the hardihood to stir in the great field of improvement, to make any saving in the expence of fuel....by any means whatever, I will have at them with the hammer of the Law....”

Bramah, J., A Letter on th3 Subject of the Cause Boulton & Watt v. Hornblower & Maberley..., 1797
Patents abolished: Arkwright and the water frame

- Arkwright adopts a similar patent strategy to Watt
- Arkwright’s patent (again with a very dubious specification comprising many possible roller spinning design) is declared void in 1785.
- In 1795 there are 438 cotton mills in England.
- Arkwright dies in 1795 with a wealth of 500,000 pounds.
Petra Moser and the Crystal Palace Exhibition of 1851

It was the most popular event of its age: more than 6 millions visitors (London had 2 millions inhabitants)
Innovation without patents: Evidence from Crystal Palace (1851)

**Table 3: Patenting Rates Across Industries, British Exhibits in 1851**

<table>
<thead>
<tr>
<th>Industry</th>
<th>All Exhibits</th>
<th>Britain</th>
<th>United States</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% Pat.</td>
<td>Total</td>
<td>% Pat.</td>
</tr>
<tr>
<td>Mining and metallurgy</td>
<td>418</td>
<td>5.0%</td>
<td>74</td>
<td>5.4%</td>
</tr>
<tr>
<td>Chemicals</td>
<td>136</td>
<td>5.1%</td>
<td>75</td>
<td>8.0%</td>
</tr>
<tr>
<td>Food processing</td>
<td>140</td>
<td>7.9%</td>
<td>73</td>
<td>9.6%</td>
</tr>
<tr>
<td>Engines</td>
<td>406</td>
<td>24.6%</td>
<td>80</td>
<td>38.8%</td>
</tr>
<tr>
<td>Manufacturing machinery</td>
<td>242</td>
<td>29.8%</td>
<td>70</td>
<td>47.1%</td>
</tr>
<tr>
<td>Civil, mil., naval engineering</td>
<td>559</td>
<td>13.4%</td>
<td>88</td>
<td>15.9%</td>
</tr>
<tr>
<td>Agricultural machinery</td>
<td>261</td>
<td>19.9%</td>
<td>37</td>
<td>40.5%</td>
</tr>
<tr>
<td>Scientific instruments</td>
<td>581</td>
<td>9.6%</td>
<td>139</td>
<td>15.8%</td>
</tr>
<tr>
<td>Manufactures</td>
<td>1,955</td>
<td>10.2%</td>
<td>601</td>
<td>16.3%</td>
</tr>
<tr>
<td>Textiles</td>
<td>1,679</td>
<td>6.8%</td>
<td>522</td>
<td>8.6%</td>
</tr>
<tr>
<td><strong>All industries</strong></td>
<td><strong>6,377</strong></td>
<td><strong>11.1%</strong></td>
<td><strong>1,759</strong></td>
<td><strong>15.6%</strong></td>
</tr>
</tbody>
</table>

Source: Moser (2005 and 2010)
Countries without patent laws do not seem to be characterized by lower innovation rates!
Innovation without patents: Evidence from the “Great” Inventors

Use of the evidence from the “great” inventors to assess the evidence from patenting (Khan and Sokoloff, 1993)

Dictionary of National Biography: 63 volumes, published in 1882 - 1900. It was meant to provide “full, accurate and concise biographies of all noteworthy inhabitants of the British Islands”. 29,120 entries comprising “all men and women of British or Irish race who have achieved any reasonable measure of distinction in any walk of life”.

MacLeod and Nuvolari (2006) indentified all individuals (383) in the original DNB (born 1650-1850) who are credited with at least 1 invention, 40% of these did not take patents (MacLeod and Nuvolari, 2006). Entries of many of these inventors were written by R. Prosser and H. Wood, senior clerks at the Patent Office.

Patenting behaviour of Bob Allen (2009)’s “great inventors”, compilation based on Singer (1954-84) and Mokyr (1990), 79, 32% of these did not take patents.

Patenting behavior of Meisenzhal and Mokyr (2011)’s (visible) “tweakers”: they identified 759 individuals, 40% of these did not take patents.

Khan (2015): 337 inventors active in the period 1750-1930: 10% did not take patents
Patents and industrialization (USA)

Sokoloff, Lamoreaux and Khan (1990s)

- First modern patent system was the American, not the British!
- “Democratic”: low cost of access, whereas the British was extremely expensive
- Full disclosure (applicant must provide detailed specifications and after 1836 pass through examination)

Effects

- Powerful stimulus to inventive activities (in the 1810s the US overtake Britain in patents per capita).
- Creation of well functioning “market for technologies” (Lamoreaux & Sokoloff) based on specialized intermediaries and journals
- “Almost optimal” division of innovative labour
<table>
<thead>
<tr>
<th>Variable</th>
<th>1870–1871</th>
<th>1890–1891</th>
<th>1910–1911</th>
</tr>
</thead>
<tbody>
<tr>
<td>New England</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patents/population</td>
<td>775.8</td>
<td>772.0</td>
<td>534.3</td>
</tr>
<tr>
<td>Percentage of patents assigned</td>
<td>26.5</td>
<td>40.8</td>
<td>50.0</td>
</tr>
<tr>
<td>Patent attorneys/population</td>
<td>—</td>
<td>2.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Middle Atlantic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patents/population</td>
<td>563.4</td>
<td>607.0</td>
<td>488.6</td>
</tr>
<tr>
<td>Percentage of patents assigned</td>
<td>20.6</td>
<td>29.1</td>
<td>36.1</td>
</tr>
<tr>
<td>Patent attorneys/population</td>
<td>—</td>
<td>2.2</td>
<td>2.0</td>
</tr>
<tr>
<td>East North Central</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patents/population</td>
<td>312.3</td>
<td>429.9</td>
<td>442.3</td>
</tr>
<tr>
<td>Percentage of patents assigned</td>
<td>14.7</td>
<td>27.9</td>
<td>32.3</td>
</tr>
<tr>
<td>Patent attorneys/population</td>
<td>—</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>West North Central</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patents/population</td>
<td>146.5</td>
<td>248.7</td>
<td>272.0</td>
</tr>
<tr>
<td>Percentage of patents assigned</td>
<td>9.0</td>
<td>21.8</td>
<td>17.5</td>
</tr>
<tr>
<td>Patent attorneys/population</td>
<td>—</td>
<td>0.3</td>
<td>0.7</td>
</tr>
<tr>
<td>South</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patents/population</td>
<td>85.8</td>
<td>103.1</td>
<td>114.4</td>
</tr>
<tr>
<td>Percentage of patents assigned</td>
<td>6.4</td>
<td>25.0</td>
<td>22.7</td>
</tr>
<tr>
<td>Patent attorneys/population</td>
<td>—</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>West</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patents/population</td>
<td>366.7</td>
<td>381.6</td>
<td>458.4</td>
</tr>
<tr>
<td>Percentage of patents assigned</td>
<td>0.0</td>
<td>25.4</td>
<td>21.4</td>
</tr>
<tr>
<td>Patent attorneys/population</td>
<td>—</td>
<td>0.5</td>
<td>1.1</td>
</tr>
<tr>
<td>All patents, including foreign</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patents/population</td>
<td>325.4</td>
<td>360.4</td>
<td>334.2</td>
</tr>
<tr>
<td>Percentage of patents assigned</td>
<td>18.5</td>
<td>29.1</td>
<td>30.5</td>
</tr>
<tr>
<td>Patent attorneys/population</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Source: Lamoreaux and Sokoloff (2001)
Table 2
REGRESSIONS WITH THE REGIONAL SHARE OF INDUSTRIAL GLASS PATENTS
GRANTED TO RESIDENTS OF THE UNITED STATES AS THE DEPENDENT VARIABLE

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.294</td>
<td>0.971</td>
<td>1.000</td>
<td>0.272</td>
<td>0.872</td>
<td>0.857</td>
</tr>
<tr>
<td></td>
<td>(1.25)</td>
<td>(2.12)</td>
<td>(1.17)</td>
<td>(1.17)</td>
<td>(2.04)</td>
<td>(1.14)</td>
</tr>
<tr>
<td>Percentage of labor force</td>
<td>0.980***</td>
<td>1.014***</td>
<td>1.016***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.08)</td>
<td>(0.07)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of production</td>
<td>0.982***</td>
<td>1.003***</td>
<td>1.006***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.07)</td>
<td>(0.07)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional dummies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern New England</td>
<td>5.293*</td>
<td>5.254**</td>
<td>5.502**</td>
<td>5.507**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.71)</td>
<td>(2.20)</td>
<td>(2.62)</td>
<td>(2.13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New York</td>
<td>-1.600</td>
<td></td>
<td></td>
<td>-1.922</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.50)</td>
<td></td>
<td></td>
<td>(2.41)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.49)</td>
<td>(2.12)</td>
<td></td>
<td>(2.45)</td>
<td>(2.06)</td>
<td></td>
</tr>
<tr>
<td>Ohio</td>
<td>2.412</td>
<td></td>
<td></td>
<td>2.865</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.53)</td>
<td></td>
<td></td>
<td>(2.46)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indiana</td>
<td>-5.962**</td>
<td>-6.015***</td>
<td></td>
<td>-5.828**</td>
<td>-5.840***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.53)</td>
<td>(2.13)</td>
<td></td>
<td>(2.45)</td>
<td>(2.07)</td>
<td></td>
</tr>
<tr>
<td>Other Midwest</td>
<td>1.994</td>
<td></td>
<td></td>
<td>1.268</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.60)</td>
<td></td>
<td></td>
<td>(2.49)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other United States</td>
<td>-2.451</td>
<td></td>
<td></td>
<td>-2.088</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.64)</td>
<td></td>
<td></td>
<td>(2.56)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.72</td>
<td>0.85</td>
<td>0.84</td>
<td>0.75</td>
<td>0.86</td>
<td>0.85</td>
</tr>
<tr>
<td>$N$</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>54</td>
</tr>
</tbody>
</table>

*** denotes significance at the 0.01 level, ** the 0.05 level, and * the 0.10 level.
Technology trade without patents

Knowledge may be partially revealed as a promotional device

“The design of the Author, in [this] publication... is rather to intimate the probability of a complete system of brewing, than to promulgate one. Were he prompted by inclination to the undertaking, his interest would forbid the execution of it. The ordinary emoluments arising from the sale of a book... would be a compensation very inadequate to the fatigue of many years wearisome attention to the multifarious practice of a brewhouse...

“[T]he illustration of practice is necessary, where it is the intention of the enquirer perfectly [to learn] the Author’s system... Such an illustration must be personal, in consequence of special agreement.”

John Richardson, Theoretic Hints on an Improved Practice of Brewing, 1777.
Technology trade in the brewing industry
(Nuvolari and Sumner, 2013)

John Richardson: published philosophical treatises (1777-1805). Private instructor; promotes saccharometer

John Tuck: published brewing handbook (1822). Private instructor, valuer and plant consultant

John Levesque: published treatises and directions (1836-53). Promotes thermometer

William Tizard: publishes most extensive brewing handbooks of his generation (1843-57). Promotes mashing attemperator (patent, 1852) and other proprietary plant

William Loftus: publishes brewing handbook (1856-7). Promotes wide range of retail instruments

Loftus saccharometer, as promoted in Loftus’s manual
Alternative to patents: procurement and patronage (David, 1993)

Procurement:
- Longitude Act (1714): prize assigned in 1774 to John Harrison for his “perfect watch”
- Rainhill Locomotive Trials, prize of £500 won by George and Robert Stephenson with the “Rocket”
- Mining Safety Lamp: prize of £1,000 assigned to Sir H. Davy (1815)
- Block-making machinery (Royal dockyards)
- Cannon boring machine (John Wilkinson)

Patronage
- Charles Babbage’s “difference engine” (1821-1834)
Conclusions

Big counterfactual question: “Would there have been the Industrial Revolution without the patent system?”

Probably yes! Despite the “optimist” discussion of patents in some “popular” books (eg, Acemoglu & Robinson, Ferguson, Rosen, etc.), there seems a new sceptical view of the English patent system emerging.

Roots of Western industrialization were wider and deeper. In our judgement patent system was not a fundamental institutional foundation of the industrial revolution.

Why patents not so important? Diffusion of technology did not dissipate innovators’ rents (constrained capacity due to shortages of “implementation skills”) in such context it can even be convenient not patent, but share knowledge (Bessen and Nuvolari, 2017)

Overall these recent historical studies suggest that a more cautious approach towards patent reform should be in order also today (but the overall trend is that of strengthening of patent protection worldwide)
References

