

# An introduction to intellectual property

**Dr. Andreas Panagopoulos**  
UoC, Economics Department

A decorative graphic consisting of several horizontal lines of varying lengths and colors (teal, light blue, white) extending from the right side of the slide towards the center.

# Defining R&D

- Research and development.
- The R is mostly basic and fundamental research i.e the invention of the transistor by Bell.
- Development is sometimes far more costly.
- There is a lot of uncertainty especially in R; no one could initially value the transistor, nor the internet, nor the computer.
- Other firms specialize on R and others on D.
- Universities specialize on R; fundamental research

# Product and Process innovations

- **Process innovations lowers the marginal cost of producing a product.**
- **Product innovation implies the development of a new product. This product could change the ability of a monopolist to discriminate among consumers.**
- **This is also know as horizontal and vertical innovation.**

- **Innovations are by definition cost reducing production techniques.**

# Solow residual

- Regressing  $Y=Kn$  reveals that only a small fraction of per capita growth can be explained by the increase of the capital-labour ration (by  $K$  and  $n$ ); the residual is called the Solow residual.
- Hence, starting with Solow (1957) economists started arguing about technology.

# Schumpeter

- The first one to talk about innovation was Schumpeter; in the 1930s.
- **Main points:**
- A monopoly is the breeding ground of innovations; WHY??
- Creative destruction

# Incentives to innovate; Arrow

- Schumpeter's point about a monopoly was captured by Arrow (1962).
- Arrow noted that:
- Patents act as incentives to innovate, but there is tendency for “Resting on one's laurels”.

# Patents as incentives to innovate

- **Arrow argued that patents, granting a monopoly, provide incentives to innovators, because they allow them to recoup their R&D expenses.**

# An alternative R&D reward scheme

- Prizes
- Tax incentives; orphan drugs act
- Auctions of ideas so that the market reveals the actual value that the patent is worth; Cremer (2000)

# Trademarks



# Copyrights

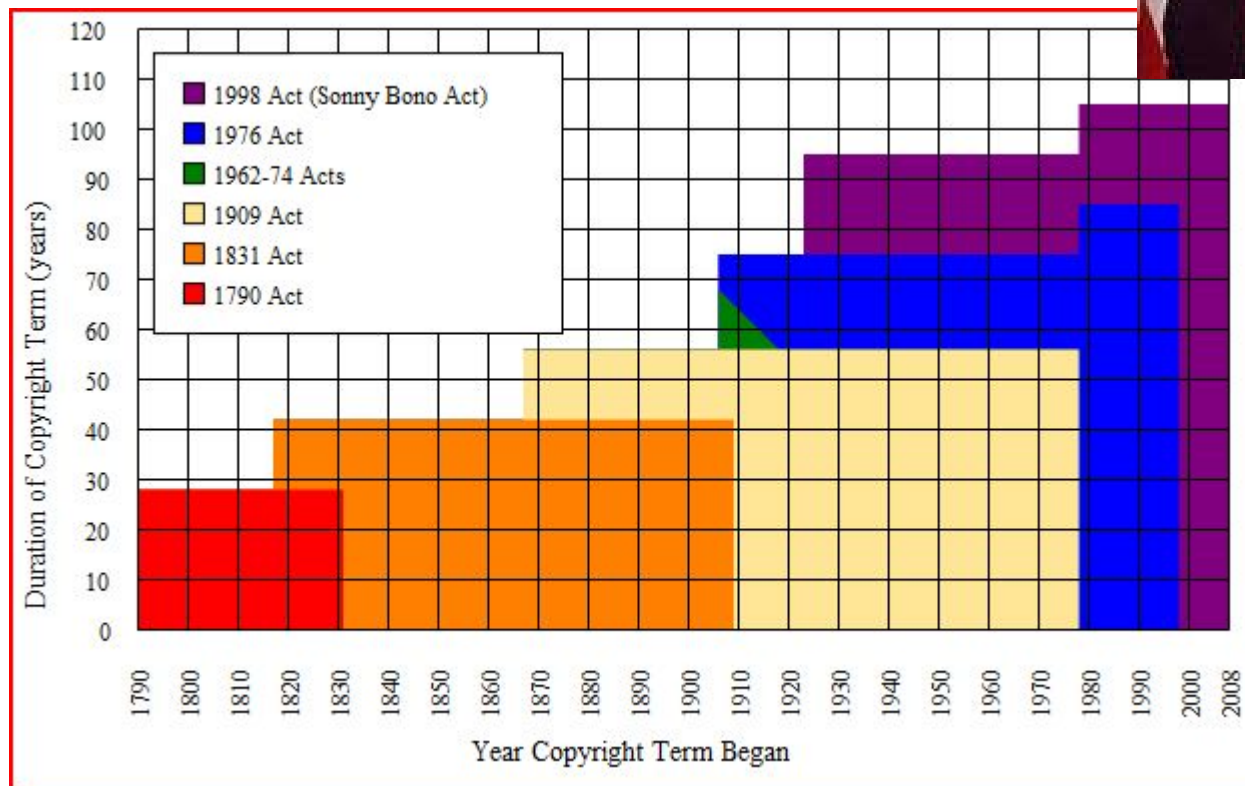
- **The mostly focus on music and written material.**
- **In the EU software is also protected by copyright.**

# An example

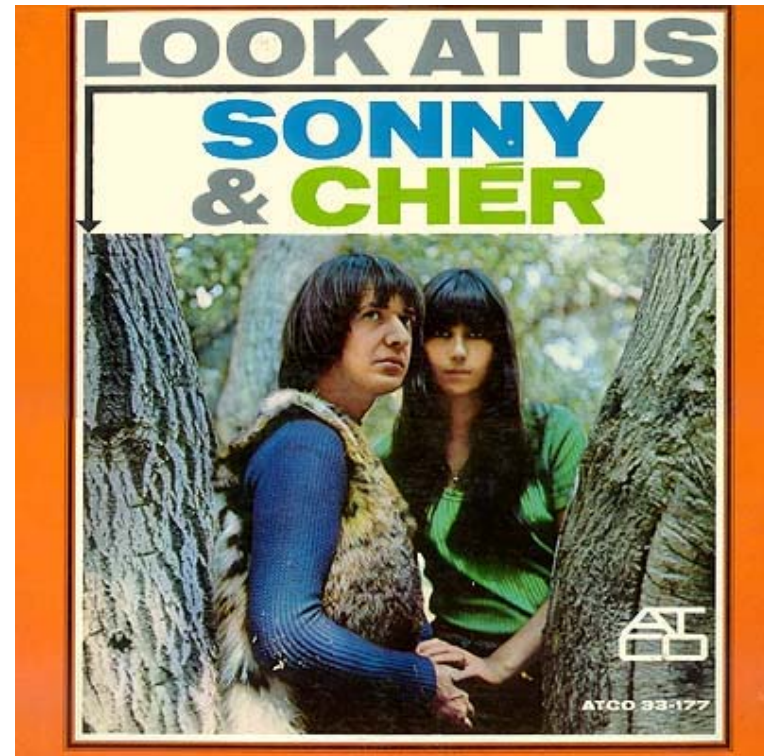


# Mickey Mouse Protection act

- **Sonny Bono Act**



Dr. A. Panagopoulos  
UoC: An intro to IP



# Patents

- **Two dimensions**
- **Length (20 years),**
- **Breadth: the technological territory claimed for control through the right to sue for infringement.**

# Welfare analysis of patents

- **Like all monopolies patents carry the Dead Weight Loss (DWL).**

# Dead weight loss

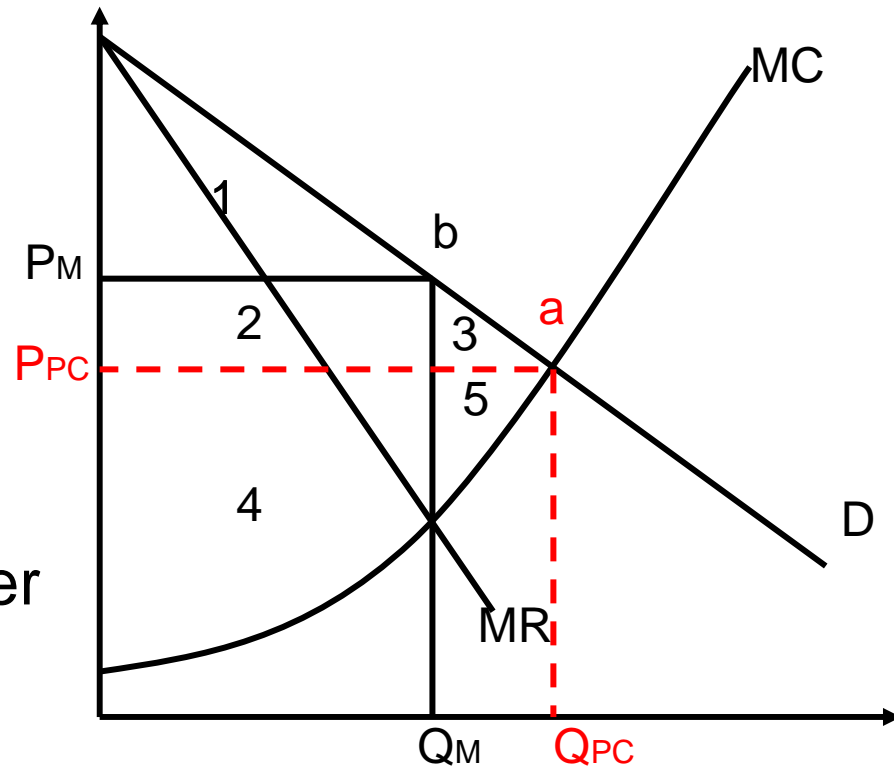
## Surplus under P.C.:

1+2+3 is consumer surplus  
4+5 is producer's surplus

## Surplus under M:

1 is consumer surplus  
2+4 is producer's surplus

Larger producer's surplus  
in M, and greater consumer  
surplus in PC.



By moving from PC to M we have a total loss of surplus that is equal to 3+5.  
This area is called the **deadweight loss**.

- Patents give a monopoly regardless of the R&D cost that the inventor suffered.
- Tragedy of the anti commons

# The quest for the optimal patent

- **Breadth v. length.**

# A description of the patent system

- Patents are issued by patent offices, which examine a set of legal requirements such as novelty, non-obviousness and industrial applicability (in Europe), as well as usefulness (in the USA).
- A patent has two main parts.
- The first one is a specification of the invention. The second part consists of a set of claims, which define what the innovator considers to be the breadth of the invention.

# International treaties

- The Paris convention was signed in 1883. It provided that each of the signatory countries would treat domestic and international patentees equally.
- In 1984 the World Intellectual Property Organization (WIPO) was formed. It introduced a centralized patent procedure.
- Many of WIPO's provisions were incorporated into the GATT agreement, through the Trade Related Aspects of Intellectual Property agreement (TRIPS), which was signed in 1993 by 100 nations. TRIPS established minimum standards for patent protection (e.g. an award period of at least 18 years) and enforced equal rights between domestic and foreign patentees

# The EPO

- In respect to Europe, the European Patent Convention (EPC) was signed in 1978, establishing the European Patent Office (EPO). The EPO discloses applications after 18 months, and the awards last for 20 years.
- First to file
- Disputes mechanism.

# The US

- **The US is the only country where patent protection is constitutionally found, being based on an exclusive rights clause (Article I.8).**
- **First to invent system.**

## A strengthening of patents in the US

- a) in 1980 Congress passed the Patent and Trademark Laws Amendment (Bayh-Dole), this Act allowed universities to patent any innovations they had created with government funding.
- b) In 1980 the US Supreme Court extended patentability to genetically engineered bacteria (Diamond v. Chakrabarty).
- c) In 1981 the Supreme Court held that software that was part of a manufacturing system or process was patentable (Diamond v. Diehr).

- d) In 1982 Congress passed the Federal Courts Improvements Act. This Act allowed for the formation of a centralized appellate court, the Court of Appeals of the Federal Circuit (CAFC).
- e) In 1984 Congress passed the Semiconductor Chip Protection Act, to protect microchip design.
- f) In 1998 the CAFC upheld a patent on a software system that performs real-time accounting calculations and reporting, which was to be used by mutual fund companies (State Street Bank & Trust Company v. Signature Financial Group). This decision allowed the patentability of business methods.
- To the above one should also add the Drug Price Competition and Patent Restoration Act (Hatch-Waxman Act), and The First American Inventors Protection Act of 1999.

## Some statistics

- **Allison and Lemley (2002):** in the period under study, the patent office issued 147520 patents, a 45.4% increase over the number issued just three years earlier.

- a) On average, each patent in this sample lists 2.26 inventors.
- From these patents 851/1000 patents assigned their rights to a corporate entity and 707/1000 patents were assigned to large entities. Of the 293 patents that were assigned to small entities, 118 were organisations (11 non-profits organisations and 197 small businesses), while individuals prosecuted the remaining 175 patents.

- **b) If one is to examine the size of patent applicants by technology area, most patent applications were filed by big firms, e.g. in software, out of 76 patents, 5 were by individuals, 3 by small business, 2 by non-profits, 10 by small enterprises and 66 by large enterprises.**

- c) On average, these patents spent 2.77 years, in prosecution from the filing of the first US application to the issue date. The range of prosecution varied widely from a low of 1.16 years to 18.15 years. In all, prosecution time has increased, bearing in mind that Alison and Lemley (1998) found a mean of 2.37 years.

- d) Taking a closer look per technology sector, software spends on average 3.15 years in prosecution, pharmaceuticals 4.46 and biotechnology 4.72. Overall, patents in the areas of chemistry, pharmaceuticals, software and biotechnology took significantly longer than average to make it through the PTO.

- e) Each patent made reference to an average of 15.16 total pieces of prior art, the minimum being zero and the maximum number of references being 163. On average, each patent cited 10.34 prior US patents, compared with only 2.44 foreign patents and 2.37 non-patent references.
- f) On average, patents in the sample had 14.87 claims, some patents had as few as one claim and as many as 120.

# Do patents deter innovation?

- **A model of patent protection applied to a single, isolated invention postulates that stronger patents will induce more R&D investment; see Nordhaus, (1969).**

- If one is to look at some modern areas of research, say biotechnology, an interesting pattern emerges where some firms may control key research (and production) technologies, stagnating the research of other equally innovative firms. Heller and Eisenberg (1998) have coined this effect the 'tragedy of the anticommons'.
- Lerner (1994), working on a sample of biotechnology firms, finds evidence that firms choose to redirect their innovative effort to technological areas in which prior art is not under strict patent control by rivals.

- **Gallini (1992) argues, extending patent life may increase an entrant's incentives to introduce an imitation during the patent period. Therefore, it may not much increase the value of a patent or, by the same token, the incentives to research.**

- Lerner conducts an international analysis of the relationship between patent strength and innovation, examining 177 policy shifts in 60 countries over 150 years. Lerner finds some support for an inverted-U relationship between patent strength and innovation. This implies that, strengthening patent protection has a positive effect on innovation if protection is initially low and a negative impact if patent protection is initially high.

- Bessen and Hunt (2003) suggest that, for software, the patent system can even lead to a reduction in R&D, even though the number of patents increases. Specifically, using the software share of a firm's patents as a proxy for the cost of patenting, they find that software patents do substitute for R&D.
- They argue that these results suggest that an economically important reason why firms acquired software patents in the 1990s was related to a **patent thicket strategy**. Such a strategy concentrates on building a strong patent portfolio, one that will prove hard to bypass for any rival. Such a portfolio can act as a significant source of revenue, but above all it acts as a defence against similar portfolios.

# Do patents promote innovation?

- Schankerman and Pakes (1986) using patent data from the UK, France and Germany find that at the aggregate level patent protection is a relatively small component of the incentive structure underlying private R&D investments.
- Schankerman (1998) finds that patent protection is a significant, but not the major, source of private returns to inventive activity and that its importance varies sharply across technology fields.

- **Mansfield et al. (1982), who surveyed 48 (patented and unpatented) product innovations of major US firms in the chemicals, drug, electronics, machinery industry. As it turned out, 60 % of patented innovations were imitated within four years of introduction.**

- Mansfield (1986), asked the R&D executives of 1000 US manufacturing firms to identify the fraction of inventions developed by their firms that they would have chosen to develop had they been unable to patent.
- For electrical equipment, primary metals, instruments, office equipment, motor vehicles, and several other industries, these executives considered patents to be less important than a head start, and accordingly they would have proceeded with 90% of their innovations.
- One reason frequently quoted for this is that for new, rapidly changing technologies, patent information is largely outdated by the time is granted, see Cohen et al. (1998).
- This picture changes if one is to look at **pharmaceuticals and fine chemicals**. Executives in the pharmaceutical industry reported that without patent protection 60% of their new pharmaceuticals would not have been developed, and the reduction in other chemicals would have been about 40%.

- Protection is in the centre of a similar study by Cohen, Nelson and Walsh (2000).
- Their principal finding is that although patents may have increased in importance among firms, they are still not one of the major mechanisms in most industries.
- Nevertheless, patents can act as a barrier to rivals. Specifically, they observe that in addition to preventing imitation the most prominent motives for patenting include the prevention of rivals from patenting related inventions (i.e. **patent blocking**), the use of patents in negotiations and the prevention of suits.
- This latter view is supported by Hall and Ziedonis's work on the semiconductor's industry; see Hall and Ziedonis (2001).

- A second similar use of patents is observed in complex industries such as electronics, where in order to become (or remain) a major competitor, firms often amass large portfolios.
- The fact that, in such industries, the same patents are often used for both blocking and negotiations, suggests that firms not only patent to protect their own technology, but to hold their rivals hostage by controlling technology that they need; see Shapiro (2001).
- To the amassing of patent portfolios for protection one must also add a new trend, one that became evident in the 1990's, where companies use their patent portfolios in a predatory fashion.
- For example, several companies, including Texas Instruments, Intel, and Wang Laboratories approach rivals demanding royalties on old patent awards. For instance, in 1991 Texas Instruments is estimated to have received 257\$ million from patent licenses and settlements because of its general counsel's aggressive enforcement policy; see Rosen (1992).

# Protecting IP property

- The CAFC
- National courts
- Jaffe (2000) observes, that the litigation rate is 1% of all patents.

- Lanjouw and Schankerman (2004) report that, for their data sample, there are (on average) 19 case filings per thousand patents.
- They also find a lot of variation between industries. For example, the lowest rates are found in chemicals (11.80), electronics (15.4), and mechanical (16.9).
- To the authors' surprise, filing rates for pharmaceutical patents are only modestly higher than the average. The rates are much higher for patents in other health, computers, biotechnology, and miscellaneous.

- **Lerner (1995) finds that within biotechnology about 6% of all patents end up in litigation.**
- **Lanjouw and Schankerman (1997) estimate that US patents from the early 1980's will, by the time they expire, generate more than one suit for every hundred patents.**

# Size

- **Lanjouw and Schankerman (2004, 1997). find that, having a larger portfolio of patents reduces the probability of filing a suit on any individual patent in the portfolio.**

# Litigation cost

- Merges (1999) points out, the expenses of conducting a patent infringement case can cost from 1\$ million to several millions.
- Lerner (1994) reports that, from July 1989 to June 1990, 1318 patent related suits were initiated in the US Federal Court and approximately 3900 procedures within the US PTO.
- He estimates, based on historical costs, that these cases will involve legal expenditures of about one billion 1991 \$, which should be compared with expenditure on basic research of 3.7 billion by US firms in 1991 (i.e. 27% of expenditures on basic research by firms that year).

- Due to this high cost 55% of small firms and 33% of large firms report that litigation is a deterrent to innovation.
- Along the same lines, Lanjouw and Lerner (2001, 1996) find that preliminary injunctions are a remedy that may be available only to financially strong plaintiffs.

- Bhagat, Brickley, and Coles (1994) examine the market reaction to the filing of 20 patent infringement suits reported in the Wall Street Journal during the 1981-1983 period.
- They find that in the two-day window ending on the day the story appears in the Journal, the combined market-adjusted value of the firms fell on average of -3.1%.
- Lerner (1995), using data on 26 patents suits between biotechnology firms, finds an average fall of -2%. This represents a median loss of shareholder wealth of 20\$ million.

# Startup firms



Table 1: Patents and Applications Held by Startup Companies<sup>67</sup>

Source	Industry	All respondents	Biotechnology	Medical Devices	Software/Internet	IT Hardware†
Population of companies (D&B)						
Companies holding patents/applications (share)		39%	75%	76%	24%	—
Average # patents/applications held (all companies)		4.7	9.7	15.0	1.7	—
Average # filed by company (patent holders only)		8.1	8.5	13.0	5.0	—
Average # from founders (patent holders only)		1.9	2.0	3.0	1.2	—
Average # acquired (patent holders only)		2.1	2.4	3.7	0.9	—
Venture-backed companies						
Companies holding patents/applications (share)		82%	97%	94%	67%	91%
Average # patents/applications held (all companies)		18.7	34.6	25.2	5.9	27.4
Average # filed by company (patent holders only)		15.8	22.9	16.1	7.1	23.6
Average # from founders (patent holders only)		2.5	3.8	3.8	0.7	3.1
Average # acquired (patent holders only)		4.2	9.0	6.5	0.7	3.5

† Available only for *VentureXpert* listed companies.

Figure 1: Capturing Competitive Advantage from Technology, by Industry<sup>109</sup>

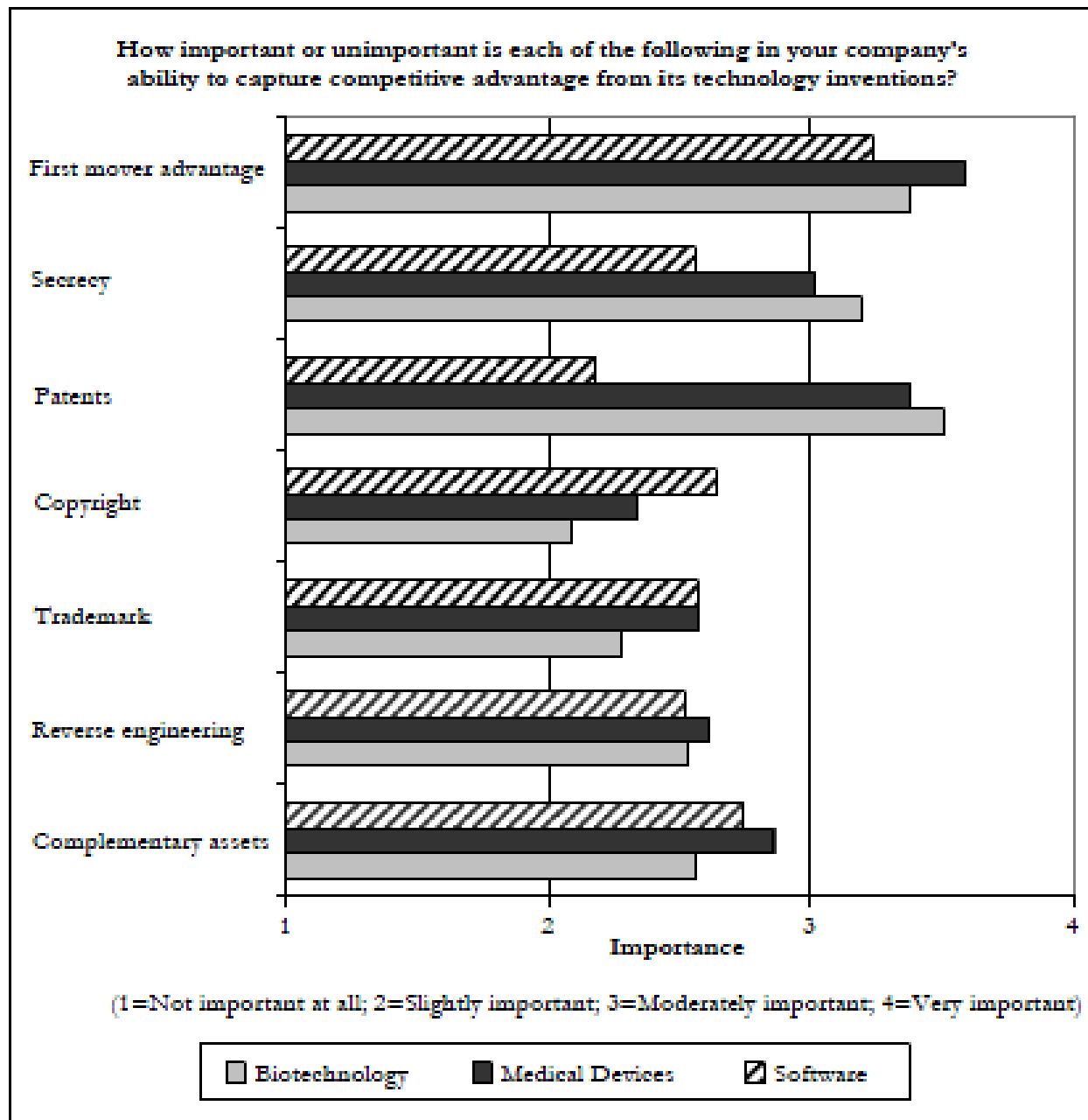
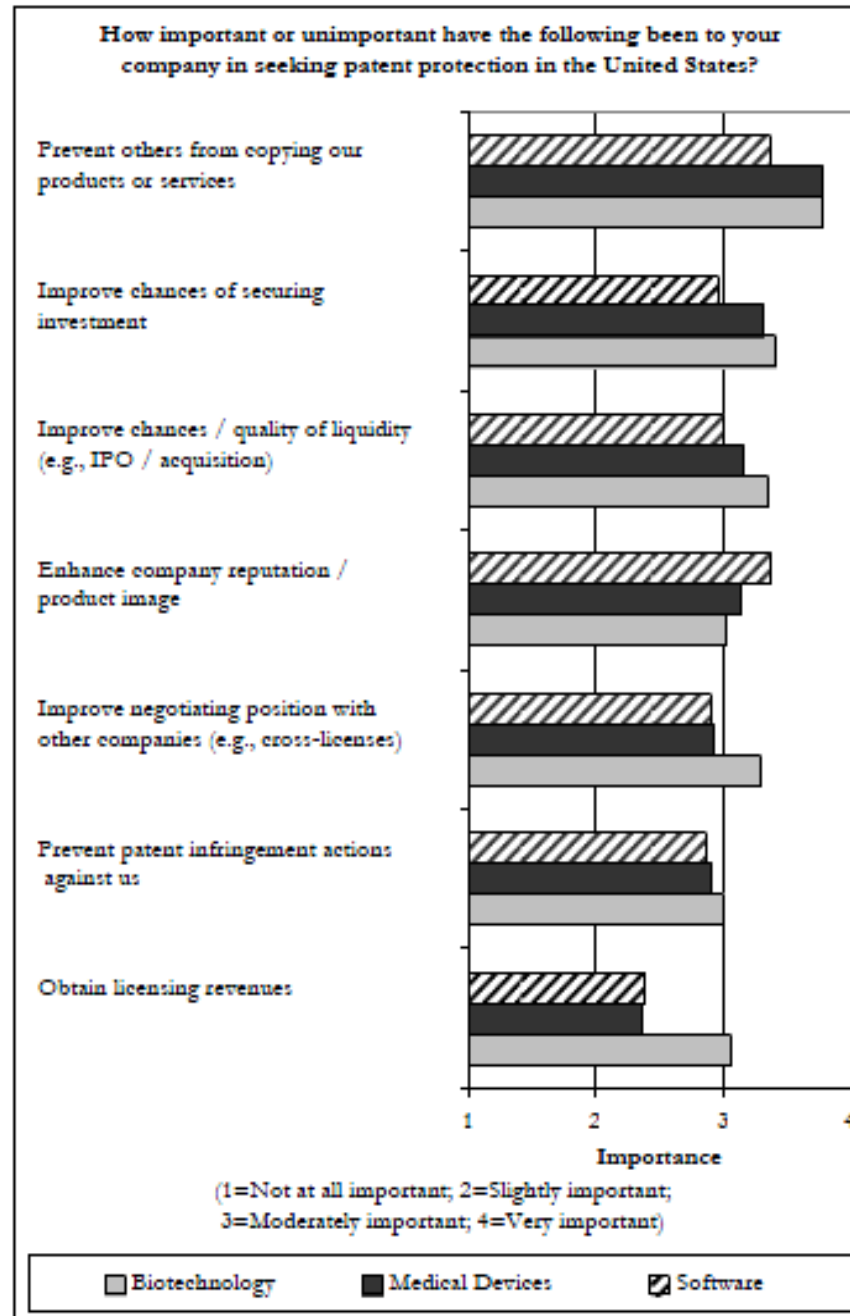
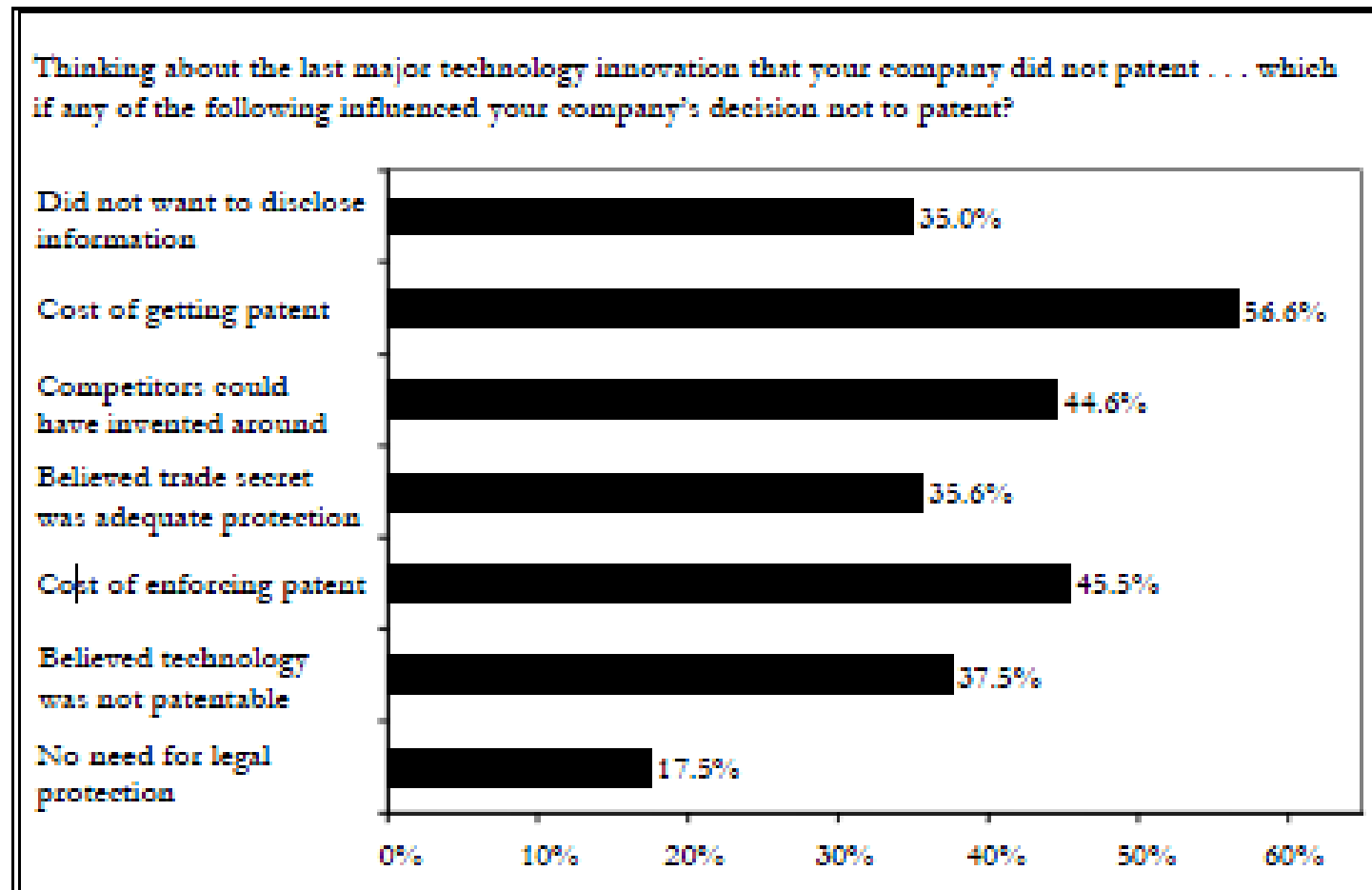


Figure 3: Motivations for Seeking Patent Protection, by D&amp;B Industry



Question asked of those reporting that their company had filed for at least one

**Figure 4: Reasons for Startups to Forgo Patent Protection on Major Technologies**

Respondents were asked to indicate all the reasons that applied (share of respondents indicating that the option influenced the decision is reported).

**Table 2: Reasons for Not Seeking Patent Protection – Selected Industries**

Thinking about the last major technology innovation that your company did not patent . . . which if any of the following influenced your company's decision not to patent?

Reason	All respondents	Biotechnology	Software	Difference	Test of difference
Did not want to disclose	35%	59%	25%	+ 34%	**
Cost of filing	55%	43%	64%	- 21%	**
Ease of inventing around	44%	42%	46%	- 4%	
Trade secret was adequate	36%	49%	29%	+ 20%	**
Cost of enforcing	44%	36%	52%	- 16%	**
Did not believe patentable	38%	28%	42%	- 14%	**
Did not need protection	17%	17%	20%	- 3%	
Total responses	1,057	136	589		

\*\* Differences noted, significant at the 95% confidence intervals. Tests for differences in means were conducted between columns, within rows.