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U.S. FINANCIAL SERVICES

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Federal Reserve Bank of Philadelphia

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Robert M. Hunt

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Abstract

A decade after the *State Street* decision, more than 1,000 business method patents are granted each year. Yet only one in ten is obtained by a financial institution. Most business method patents are also software patents.

Have these patents increased innovation in financial services? To address this question we construct new indicators of R&D intensity based on the occupational composition of financial industries. The financial sector appears more research intensive than official statistics would suggest, but less than the private economy taken as a whole. There is considerable variation across industries but little apparent trend. There does not appear to be an obvious effect from business method patents on the sector's research intensity.

Looking ahead, three factors suggest the patent system may affect financial services as it has electronics: (1) the sector's heavy reliance on information technology; (2) the importance of standard setting; and (3) the strong network effects exhibited in many areas of finance. Even today litigation is not uncommon; we sketch a number of significant examples affecting financial exchanges and consumer payments.

The legal environment is changing quickly. We review a number of important federal court decisions that will affect how business method patents are obtained and enforced. We also review a number of proposals under consideration in the U.S. Congress.

JEL Codes: O31, O34, G20

Keywords: Business method patents, financial innovation, payment systems, financial exchanges, *KSR International v. Teleflex*, *eBay v. MercExchange*, *in re Seagate, in re Bilski*

1. Introduction

A decade has passed since American courts made clear that methods of doing business could be patented. Since then, the U.S. Patent and Trademark Office (USPTO) has granted more than 12,000 of these patents; only a small share of those were obtained by financial firms. Some firms, typically those outside the industry, have aggressively asserted their patents and have had some notable successes in obtaining licensing revenues. Even central banks have been sued (see Table 1). We review a number of important instances of such litigation, focusing on the examples of financial exchanges and consumer payments.

If this had been a policy experiment, could we determine today that it was successful? Probably not. Measuring the effects of business method patents on the rate of innovation or innovation inputs is not a simple exercise. We construct measures of research intensity based on the occupational composition of the industry workforce. According to these measures, financial services is more R&D intensive than official statistics suggest, but still lags private industry as a whole. There is considerable variation across industries—financial exchanges and the central bank are more research intensive than credit intermediaries (e.g., banks and thrifts). But there has been no significant change in the R&D intensity of financial industries.

In the long run will the patent system function for financial services the way it has for pharmaceuticals and chemicals (quite well) or more like it has for information and communications technology (ICT)? There are a number of reasons to suspect the more relevant analogy is the one of ICT. First, the financial sector is dependent on ICT for a large share of its inputs. The majority of its R&D is spent on software development and the majority of its R&D workers are programmers and software engineers. Using the definition of Bessen and Hunt (2007), four out of five business method patents are also software patents.

Second, like electronics, a number of financial industries rely heavily on standard setting arrangements. This is particularly true of payment networks and the financial exchanges. For the ICT industries, the intersection of standard setting and intellectual property has proven both complicated and litigation prone (Hunt et al. 2007).

Third, many areas of finance exhibit strong network effects. On the one hand, these may act as important complementary assets, making patents less important. On the other hand, financial networks may be especially vulnerable to hold-up problems. In addition the presence of network effects may complicate the task of calculating reasonable royalties, especially in areas where the innovation is cumulative in nature.

At present, the U.S. patent system is in a state of flux, thanks to developments in the federal courts and in Congress. We will examine these in some detail, since a number of them could mitigate some of the concerns raised about business method patents: that the claimed inventions are not new, are not sufficiently novel to justify awarding a patent, and are being enforced in ways that increase business risk to financial firms. But significant challenges remain. In particular, the boundaries of the rights being granted in some business method patents are not sufficiently clear. Ambiguity over these boundaries creates uncertainty for both the owners of these patents and their competitors.

The remainder of the paper is organized as follows. Section 2 reviews how business methods became patentable in the U.S. and the subsequent trends in patenting behavior. Section 3 explores the question of whether we should think differently about the innovation process and intellectual property in financial services than we do for sectors like manufacturing. Section 4 explores the official measurement of R&D in the financial sector, measurement issues with those data, and an alternative measure based on the occupational composition of financial firms. Section 5 describes some of the patterns in litigation and licensing settlements affecting the financial services. Section 6 reviews a number of important recent federal court decisions likely to affect business method patents. Section 7 examines some relevant aspects of the legislative proposals in the U.S. House and Senate. Section 8 concludes.

2. The Patentability of Computer-Implemented Business Methods

A patent is a grant of the legal right to exclude others from making, using, or selling the patented invention for a limited period of time. If the patent is infringed, the patent owner may sue the infringer to recover lost profits. Sometimes the patent owner is able to obtain an injunction — a court order that prevents the alleged infringer from continuing to make, use, or sell the patented invention. For reasons described below, an injunction is a very powerful legal weapon in patent litigation, perhaps especially so in the context of financial services.

Of course not all inventions qualify for patent protection. The most important requirement that must be satisfied is *nonobviousness*, or the inventive step, as it is called in Europe (Hunt 2004). This requirement precludes patent protection for an invention that would have been obvious to a practitioner in the relevant field at the time it was made. In other words, a patentable invention must be more than a trivial extension of what is already known (the prior art).

As an example, consider one of the patents examined in the Supreme Court decision in *Graham v. Deere*.[1] The claimed invention was a combined sprayer and cap used on bottles of household chemicals. The essential elements of the sprayer had been developed by others, but they had never been assembled in this particular way, which made possible the use of automated bottling equipment. As a result, the product was highly successful. While the Supreme Court acknowledged that long-felt need and commercial success might suggest the invention was nonobvious, in the end it decided otherwise because the differences between the product's design and that of pre-existing products were minimal. We will return to the problem of evaluating the obviousness of combination inventions in section 6.

A. Patentable Subject Matter

In the U.S., assuming the other patentability requirements are satisfied (e.g., novelty and utility), any process, machine, manufacture, or composition of matter, or any improvement of those things can be patented. But the courts have also identified certain

[1] 383 U.S. 101 (1966). The Supreme Court wrote a combined decision for three patent cases. The patent described here was at issue in *Calmar, Inc. v. Cook Chemical Co.*, 336 F.2d 110 (8th Cir. 1964).

categories of subject matter that cannot be patented, for example, laws of nature and abstract ideas.

For at least 80 years, it was commonly believed that these limitations precluded patenting methods of doing business. This view was suddenly upended by the Federal Circuit's decisions in *State Street v. Signature Financial Group* and *AT&T v. Excel Communications* in 1998 and 1999.[2] *State Street* involved a patent on a data processing system that made possible the pooling of assets in several mutual funds into a single portfolio, reducing overhead costs while maintaining the transaction information necessary for allocating gains, losses, and tax liabilities to the original funds. The district court determined that the invention in question was a business method and was therefore unpatentable. But the Federal Circuit concluded that, under U.S. law, there was no such thing as a subject matter exception for business methods.

An important antecedent to the business method decisions was the more gradual change in views about the patentability of computer programs, since the inventions described in most business method patents are implemented via computer. This evolution spanned the years from the 1972 Supreme Court decision *Gottschalk v. Benson* to the 1994 Federal Circuit decision *in re Alappat* (Hunt 2001, Bessen and Hunt 2007).[3]

B. The Effect of *State Street* on Business Method Patenting

Before examining the actual trends in patenting, we must first define terms. In this paper, we present data on the volume of *business method* patents granted. While this includes some financial patents, not all business method patents are *financial patents* and not all financial patents are categorized as a business method (see below).

We focus on counts of business methods for two reasons. The first is clarity, since we rely on the definition established by the U.S. patent office in its classification system.[4] Second, an examination of litigation activity reveals that financial patents are not the only patents that create opportunities or risks to financial firms.

To be explicit, Figures 1 and 2 present data on patents or applications that fall into Class 705, "Data Processing: Financial, Business Practice, Management, or Cost/Price Determination," a relatively new class created in 1997. It refers to patents in this class as "computer-implemented business methods," although one can find examples of inventions in this class that do not require the use of a computer.

The USPTO describes the class as a collection of financial and management data processing areas, including insurance, trading of financial instruments, health-care

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[2] See 149 F.3d 1368 and 172 F.3d 1352, respectively. Since 1982, patent cases are appealed from federal district courts to the Federal Circuit and, from there, to the Supreme Court. For a critical examination of the *State Street* decision, see Menell (2006).

[3] 409 U.S. 63 and 33 F.3d 1526, respectively.

[4] See Hall et al. 2008, Lerner 2008, and Wagner 2008 for their approaches to defining and counting financial patents. While their counts differ from the ones depicted here, in many ways they are qualitatively the same. For example, regardless of the definitions employed, the financial sector has not been a very important source of business method or financial patents.

management, reservation systems, computerized postage metering, electronic shopping, auction systems, and business cryptography.[5] Some examples of these patents are found in Table 2 and others in Hunt (2001).

The *State Street* decision had an almost immediate effect in terms of business method patenting behavior. About 1,000 issued patents were classified in Class 705 in the first five years after that case; grants are currently running at twice this rate (Figure 1).

Between 1997 and 1999, new applications for business method patents in the U.S. tripled, and they have more than tripled since then (Figure 2). Today, about 11,000 new applications for patents on business methods are filed each year, which suggests that there will be significant future growth in the number of patents granted. Over 40,000 of pending applications for business method patents have been published. A number of studies document a similar, but less dramatic rise in applications for business method patents in Europe (Hall et al. 2008, Komulainen 2007, and Wagner 2008). Many of those applications are related to business method patents already granted in the U.S.

An inspection of random business method patents reveals that many are not directly related to the financial industry (there are many patents on postage-metering systems, for example). Nevertheless, half or more of all the patents depicted in Figure 1 fall into categories of technology directly related to the provision of financial services. These are what we call "soft" business method patents. In addition, the vast majority of business method patents (roughly four in five) would also qualify as software patents.[6]

One of the interesting developments is the proliferation of patents on tax avoidance strategies (Herman 2007, Aprill 2006). In the past, these had often been protected as trade secrets, but new regulations substantially reduced the efficacy of this form of protection (Squires and Biemer 2006). At least 60 tax shelter patents have been issued since the early 1990s, and another 86 pending applications have been published (Coggins 2007). There is at least one ongoing infringement suit involving a tax shelter patent.[7]

Classifying the industrial mix of the owners of business method patents can be difficult. Nevertheless, it is clear that when compared with firms in the information, communication, and technology sector (for example, computers, software, and communications equipment), financial institutions are relatively minor players. Very roughly speaking, manufacturers of electronics, computers, instruments, and software account for at least a third, and likely more, of business method patents granted in the last five years.[8] It is likely that, after additional analysis of the lesser known assignees in this class, ICT firms account for a majority of business method patents.

In contrast, and again speaking very roughly, financial firms and providers of consumer payment services account for less than one-tenth of the total. Still, a number of

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[5] For additional details, see http://www.uspto.gov/web/menu/busmethp/class705.htm and USPTO (2000).

[6] See the data appendix for the definitions of "soft" business methods and software patents.

[7] For examples of these patents, see Joint Committee on Taxation (2006).

[8] The leading recipients include IBM, Sony, Hewlett-Packard, Fujitsu, Hitachi, NCR, and Microsoft.

financial institutions have accumulated a dozen or more of these patents and a significant number of pending applications.[9]

C. Why the Lull in Business Method Patenting in 2000-04?

Two factors may explain the deceleration in business method patenting observed in Figure 1. The first factor is the procedural reforms instituted by the patent office in 2001. As part of this process, applications falling into Class 705 were examined by a second experienced examiner—the so-called "second pair of eyes." This significantly lengthened the pendency period for these applications and may have reduced the allowance rate. In 2007, the average time between first and a final action on a business method patent application was 54 months. This compares to an average pendency of 31 months for patents as a whole in 2006.[10] In 2001, 45 percent of patent applications in Class 705 were granted. The allowance rate for business method patent applications fell to a low of 11 percent in 2005 and then recovered slightly to 19 percent in 2006 (Coggins 2007). The overall allowance rate for patent applications in 2006 was 54 percent (USPTO 2007).

Another factor is that, for a time, the patent office attempted to impose an additional requirement for patents on business methods—that the claimed invention must fall into the "technological arts." In principle, this meant that a system (e.g., a computer) implementing a business method was likely patentable, while the method itself might not be (Squires and Biemer 2006). Such a standard has the flavor of the "technical effect" requirement for patentable inventions under the European Patent Convention, but it would seem to conflict with the Federal Circuit's reasoning in the *AT&T* decision. The October 2005 decision *ex parte Lundgren* rejected a separate technological arts test.[11] This led the patent office to issue proposed guidelines on subject matter patentability that explicitly instruct examiners not to use a "technological arts" test when assessing subject matter patentability (USPTO 2005).

D. Acclimation to Business Method Patenting

The patent office has slowly been developing staff with qualifications to examine financial patents. This is not easy, since, in addition to any familiarity with financial services, examiners are required to have advanced training in other technical fields. In mid 2007, the patent office had 68 examiners dedicated to reviewing applications for financial patents. Of these, 32 have either an MBA or a master's degree in finance or

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[9] Among others, these include American Express, Citibank, JPMorgan Chase, Capital One, and Goldman Sachs. Scott and Schreiner (2007) report the following counts: American Express (65), Visa (45), MasterCard (33), First Data (24), Schwab (23), and Capital One (20). American Express has 150 published applications pending; Capital One has 45.

[10] It is interesting to compare this pendency to the rate for two other categories of applications noted for long delays: computers and software, 42 months, and communications, 44 months (USPTO 2007).

[11] See Appeal No. 2003-2088 (BPAI 2005). This was a 3-2 decision. The case involved an application for a patent, filed in 1993, on a method for compensating company managers to reduce collusion in oligopolistic industries. An economist might regard this as an application for a patent on a solution to an optimal contracting problem.

economics. This is likely the bare minimum level of training required for a person to be able to evaluate an application for a patent on a new financial instrument. The USPTO hoped to have 100 examiners in these sections by the end of the 2007 fiscal year (Coggins 2007). The patent office had a total of about 4,800 examiners at the end of the 2006 fiscal year.

Even financial regulators are becoming aware of the significance of intellectual property issues. In 2004 the federal agencies responsible for oversight of banks, thrifts, and credit unions published guidance on the topic of "Risk Management of Free and Open Source Software," which, among other things, included a discussion of strategies for minimizing the potential for inadvertent infringement of patents that might result from using an open source program that includes proprietary code (FFIEC 2004).

3. Are Financial Services Different?

An important question to ask is whether there are characteristics of the financial sector that might make us think differently about how intellectual property influences decisions and outcomes among financial firms. For example, how do these firms protect their innovations in the absence of patents? Are there special interactions between network effects, which are important in many areas of finance and intellectual property? What challenges does intellectual property pose for standard setting, which is essential for coordinating the interactions of hundreds, if not thousands, of financial institutions acting on behalf of millions of clients?

A. How Do Firms Protect Their Innovations?

Before we focus on the financial sector, it is useful to review what we know about the efficacy of patents in protecting the rents associated with the creation of new products and services. In the theoretical literature, it is commonly assumed that, in the absence of patents, imitation costs are quite low. Thus, in the absence of the temporary monopoly afforded by a patent, an inventor (the first mover) would not be able to recover her R&D costs.

In practice, however, firms employ other means of protecting their innovations. Surveys of manufacturing companies in the 1980s and 1990s report that only a few industries (chemicals and pharmaceuticals) view patents as the primary means of protecting the profits generated by an invention (Mansfield 1986, and Levin et al. 1987, Cohen et al. 2000). Other factors, such as lead time or proprietary knowledge maintained as a trade secret, were typically ranked as more important than patents.

In addition, according to this research, firms in most industries viewed their investments in specific manufacturing capabilities, reputation, brand names, and distribution networks as more important mechanisms than patents for protecting their innovations. Such investments are sometimes described as *complementary assets*. Consider the example of the semiconductor firm Intel. While the firm invests heavily in patents, much of Intel's success is derived from its ability to design and build new factories (which produce only the latest CPU chips) more rapidly than its competitors.

B. Network Effects and Standard Setting in Financial Services

Financial markets often exhibit network effects: Users find that the services provided are more valuable when there are many other users of the service. One obvious example is a financial exchange, where efficiency is often determined by the number of active buyers and sellers of a security.[12] This creates a tendency to concentrate trading of an instrument on just a few (or even one) exchanges. Networks are difficult to start, but once they attain a critical mass, they often enjoy a large market share and generate considerable income.

Network effects also arise from the requirements of interoperability, which is extremely important in financial services. Interoperability is accomplished via standard setting, where industry participants agree on technical features so that their systems can work together. Two examples are the specification of the layout and numbering systems of paper checks and the message formats used by automated clearinghouse (ACH) networks for direct deposit of paychecks and other transactions.

Economic analysis of the interaction between network effects and intellectual property rights is a relatively new field.[13] Much more work, both theoretical and empirical, remains to be done. But there are at least two important implications to consider. First, network effects are an example of complementary assets that may permit financial institutions (or networks) to protect their innovations even in the absence of strong intellectual property rights.

Second, a network can be vulnerable to hold-up by third parties who own patents allegedly infringed by members of the network. In this context, a hold-up means a patent owner could obtain an injunction, effectively shutting down the network. This puts the patent owner in a very strong bargaining position, so strong that he or she may be able to obtain licensing income in excess of the incremental value created by the underlying invention (Shapiro 2006a). An important source of that additional income would be the value of the existing network externalities enjoyed by the network

Consider the case of Research in Motion (RIM), the developer of the BlackBerry device and the builder of the servers and software that make it work. RIM was sued by a patent-holding company, NTP, whose primary investment was its portfolio of patents. RIM, on the other hand, had invested about $1 billion in property, equipment, and R&D. NTP won the case and was eventually granted an injunction that would shut down the RIM network in the U.S.[14] This induced RIM to settle the litigation for about $600 million. Ironically, while NTP was very successful in court, the U.S. patent office, on re-examination, rejected many of NTP's patent claims.[15]

A similar problem can arise with standard setting, since firms have limited options to make technical changes without sacrificing interoperability. Suppose a third party subsequently obtains a patent that is infringed by firms complying with the standard. The patent owner may enjoy considerable bargaining power. This is especially the case when implementing the standard requires significant up-front investments that

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[12] Another important example of network effects in finance is a payment card network (Hunt 2003).

[13] For a thorough analysis of many of the relevant issues, see Farrell and Klemperer (2006).

[14] *NTP, Inc. v. Research in Motion*, Ltd, No. 3:01CV767 (E.D. Virginia 2005).

[15] NTP appealed at least one of those decisions.

firms will be hesitant to abandon simply to avoid infringing the patent.

A key concern here is the effect of such risks on dynamic incentives. Companies may not be aware of all of the patents that may arise and who owns them, at the time they are required to make their investment decisions. The risk of potential hold-up may discourage firms from investing in the first place. Such lost investment would be particularly costly, since it would otherwise enhance the value of the standard and, in turn, reinforce the positive externalities that network effects convey (Hunt et al. 2007). Alternatively, such risk may increase the barriers that must be overcome in order for a standard to become widely adopted.

C. The Example of Financial Exchanges and Investment Banks

Financial exchanges exhibit strong network effects and these are likely to affect the value of intellectual property in these markets and how that IP is used. There are a number of sources of these network effects. First, as noted earlier, the value of an exchange is increasing in market depth or liquidity. The more buyers and sellers there are, the more rapid is the process of price discovery and, typically, the smaller is the spread between bid and ask prices. In addition, a deeper market is able to absorb large orders without generating price changes that work against the interests of the trader (Pagano 1989). Harris (2003) describes these as *order flow externalities*: a participant who offers to trade provides a valuable option to trade for other market participants, but he or she is not compensated directly for providing this benefit.

Second, there are increasing returns associated with using a common clearinghouse for trades. In addition to amortizing certain fixed costs, the practice of net settlement increases the efficiency of clearinghouses that serve more traders.[16] For exchanges that rely on a central counterparty, trading in a single, larger market also allows participants to better economize on the collateral they must pledge (Moser 1998).

Finally, there are issues of interoperability in the systems used by network participants. This has become even more important as financial exchanges have come to increasingly rely upon electronic systems for execution, clearing, and settlement of trades. Interoperability is typically achieved via standard setting. This is accomplished either by technology vendors or by the exchange itself.

Financial exchanges have been an important source of new financial instruments, particularly in the area of derivatives (Caskey 2003, Harris 2003). Other important innovators include investment banks (Silber 1981, Bhattacharya and Nanda 2000, Tufano 2004), who often act as issuers, brokers, dealers, or specialists in these new instruments.[17] The exchanges also make significant investments in improvements in trading technology, but they are not alone. Over the last 20 years other firms have introduced new automated

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[16] Settlement refers to the actual conveyance of cash to sellers and securities to buyers. These are typically performed by settlement agents, which are very often the clearinghouses. Net settlement refers to the practice of adding up each trader's transactions over a given period (usually a day) and making debits and credits on traders' accounts on the basis of these totals. In contrast, under gross settlement, each transaction results in separate debit or credit to the traders' accounts.

[17] For a detailed set of case studies of financial innovation, see Mason et al. (1995).

trading platforms and account for a significant share of trading in some markets (McAndrews and Stefanadis 2000). These organizations are sometimes called electronic communication networks (ECNs).

Studies by Silber (1981) and Caskey (2003) present evidence that an established contract on one exchange enjoys an advantage in terms of liquidity that is often difficult to overcome when a similar contract is introduced on another exchange. Anderson and Harris (1986) argue that regulations that delay imitation by rival firms reinforce first mover advantages, increasing the rents associated with financial innovations.[18] And among investment banks, there is evidence that first mover advantages play an important role in generating sustained profits from the introduction of new financial instruments (Tufano 1989).

Thus it appears that, for at least this part of the financial sector, firms protect their innovations in ways similar to those observed among manufacturing firms. Historically, patents have not been a significant part of the story for these firms, and yet their absence has not prevented them from investing in new products (financial instruments) or the processes (e.g. trading platforms, pricing algorithms) required to offer them. The question is then whether the addition of financial patents to the mix can improve on the existing incentives and thus increase the rate of innovation.

Going forward, there are reasons to think the availability of business method patents could have significant effects for financial exchanges. For one, it is possible there could be synergistic effects if a firm is able to use intellectual property rights to capture the benefits conferred by strong network externalities. For example, if a firm obtains a patent on a popular financial instrument, it may be able to extract some of the value associated with its liquidity in subsequent licensing negotiations. This is more likely to occur if a court finds it difficult to disentangle the incremental contribution of the infringed patent from the other attributes (including network effects) that make a financial product or service valuable. This is a more general concern for combination inventions, which are common in ICT industries (Lemley and Shapiro 2007).

The policy implications of any synergistic effects will depend on the details of the particular cases, but they are likely to be important. For example, it is typical to observe damage awards in patent cases assessed in terms of percentage points of the revenues associated with the infringing product. But the efficiency and liquidity of financial exchanges are often measured in basis points of transaction value. A court-awarded royalty two orders of magnitude larger would likely create very large deadweight losses. A more sensible royalty might be specified in terms of a few pennies a trade. In markets where the annual number of transactions can be counted in millions, or even billions, such a royalty would still be quite lucrative. If the average value of a transaction was large enough, the associated deadweight loss might be more modest.

D. Other Financial Industries

[18] This intuition is formalized in a number of models of sequential innovation. See, for example, Cadot and Lippman (1997) and Chou and Haller (1995).

There are other areas of finance, for example, certain areas of insurance, where at least some participants believe there is a first mover *disadvantage*. The argument here is that the innovating firm incurs the expense required to develop a new product and to obtain the necessary regulatory approvals. If the new product is successful, it is quickly imitated by competitors (Cuypers 2004). This is precisely the intuition that motivates why governments establish patent systems. In such an environment, the availability of patents could lead to more R&D and more innovation. It might also influence *which* firms innovate: the availability of patents may enable entry by new firms that do not own the complementary assets enjoyed by established firms.[19]

Consumer payment systems, including debit and credit card networks, also exhibit strong network effects and rely extensively on investments in ICT. They are excellent examples of systems of technology that have benefited from continuous investment and innovation over several decades (Evans and Schmalensee 1999). And yet there are very few economic studies of how and why these networks innovate. Nearly all of the existing economic literature on payment networks relies on static models to examine a number of antitrust issues (Hunt 2003). One exception is Verdier (2006), who presents a model that examines how pricing and network effects determine investments in network quality and which participants make those investments. The role of patents in this industry has rarely, if ever, been studied.

4. Measuring the Effects of Business Method Patents on Financial Services

It is always difficult to establish a cause-and-effect relationship between a policy change and subsequent economic outcomes. This is especially difficult in this case because there are no systematic data on the frequency or magnitude of financial innovation over time.[20] Ordinarily changes in the number of patents might be used. But in this case it would be impossible to disentangle the increase in the rate of innovation from the increase in the share of innovations that are protected via patents.

Another technique is to attempt to identify the effect of these patents on productivity growth among individual firms or the industry as a whole. For a variety of reasons, this is an especially difficult exercise in financial services and we leave this approach for future research (Moulton 2000). But there is ample evidence that ICT investments have contributed to productivity growth in the banking sector (Berger 2002, Berger and Mester 2003, Humphrey et al. 2006). Thus one channel through which intellectual property has long affected financial firms occurs via its effects on suppliers in ICT industries. As noted earlier, ICT firms account for a large share, if not a majority, of business method patents granted in the U.S.

In terms of private benefits, Boscaljon, Filbeck, and Smaby (2006) find that, among companies in the manufacturing or financial sectors, the announcement of a successfully prosecuted business method patent is associated with an increase in the firm's stock price. They do not test for the effect of these announcements on the stock

[19] This raises a more general point: To assess the effects of changes in the patent system, we should examine the R&D investments of existing firms and changes in patterns of firm entry or exit (Hunt 2007).

[20] For a recent review of empirical studies of financial innovation, see Frame and White (2004)

market prices of competing firms. Nor can we determine solely from this analysis why the value of these firms increased. Such an increase in value may give financial firms an incentive to file for patents, but not necessarily to do more R&D. There are at least theoretical grounds for concern about the likely effects on R&D investments of granting many marginal patents in highly innovative industries characterized by significant technological overlaps among firms (Hunt 2006).

A. R&D Investments in the Financial Sector

If the outputs of financial innovation are difficult to measure, another approach is to examine changes in the inputs, specifically research and development (R&D). The first items to look at, then, are the measures of R&D spending obtained from the National Science Foundation's (NSF) regular survey of private firms. The NSF has published these data for most years since 1958. It began reporting R&D statistics for firms in finance, insurance, and real estate (FIRE) only in 1995 (Figure 3).[21] Its most recent estimate (2005) of R&D spending for this group of industries was only $3 billion, compared with more than $200 billion for all industries.

The NSF generally has not disclosed less aggregated R&D data for this sector of the economy. There is one exception, from Jankowski (2001), which reveals the patterns among different segments, at least as they existed in the late 1990s (Figure 4). Banks/thrifts, securities firms/financial exchanges, and insurance firms collectively had roughly equal amounts of R&D spending. The only obvious trend was among securities firms and the exchanges where R&D appears to have increased dramatically. A possible explanation for the considerable variation over time among real estate/holding companies is that this category may include companies established to license intellectual property, typically manufacturing technology. As an example, the patent holding companies Rambus and Interdigital Communications would be included in FIRE if the industry codes assigned to them by Standard & Poor's (SIC 6794, NAICS 53311) are used (Gallaher et al. 2005).

The NSF reports that the majority (58 percent) of R&D spending in FIRE in 2003 was for computer software.[22] The financial sector's focus on software R&D is consistent with the mix of investment goods it purchases. In 1997, for example, companies in FIRE bought $30 billion in computers and software, making it the largest business customer of the ICT sector (accounting for 19 percent of sales). More than three-quarters of financial-sector investment, excluding structures, was devoted to ICT (Meade et al. 2003). And as we will show in the next section, the software focus is also consistent with the mix of workers' occupations that are most likely to be involved in the development of new products or processes.

It is common to evaluate the research intensity of firms or industries by comparing their R&D spending to some measure of their size, such as sales or employment. According to the NSF data, as a sector, FIRE is significantly less R&D

[21] The obvious peak in 2000 may be due to the very significant efforts of financial institutions to modify their legacy programs to address the century date change problem. It might also be associated with the peak of activity in the dot-com era.

[22] Young (1996) reports that the software share of R&D in financial industries in Canada was 84 percent.

intensive than private industry as a whole (Figure 5). By these measures, the private economy enjoys research intensity more than five times that of FIRE. And while the R&D intensity of the U.S. economy has risen gradually over time, there has been no apparent change in the R&D intensity of this sector.

B. Measurement Issues

It is quite possible that the NSF's estimates for the financial sector do not reflect all of the R&D activity that is actually occurring. The NSF's methodology and the definition of R&D employed are derived from a long tradition of surveying R&D managers at manufacturing firms. In that sector, R&D facilities are relatively easy to identify, and members of senior management know who their R&D managers are. In addition, data on R&D expenditures can be readily compiled from the existing management information systems (MIS) of these firms. All of these factors make it relatively easy to conduct a survey of R&D patterns among manufacturing firms.

But these factors often do not exist among firms in the services sector. For most financial institutions, the terms R&D, R&D lab, and R&D manager are largely foreign concepts. And in many instances, the internal MIS of these institutions do not contain readily accessible data about activities we might describe as R&D.[23] This is evident from an examination of the financial statements of publicly held financial institutions. Since the early 1970s, the Securities and Exchange Commission (SEC) has required public firms to disclose "material" amounts of R&D in their financial statements. And yet, in 2006 only six publicly traded financial firms reported doing or paying for any R&D and the total amount they reported was only $65 million. No publicly held bank or insurance company reported doing any R&D in that year.[24]

At least some scholars, and a number of formal reports, argue that there is a fundamental difference in the composition of R&D in manufacturing and services, and this has implications for its measurement (Jankowski 2001, Gallaher et al. 2005, National Research Council 2005, and OECD 2005). Manufacturing R&D is typically about developing improved materials, designs, or processes and such activities are very likely to fall under the official definitions of R&D used by statistical agencies in the U.S. and abroad. In services, however, improving products or processes often involve purchasing components from manufacturing firms, integrating these into a system, and finding the most efficient way to manage the system to provide benefits to the customer. It is less clear whether these activities would be classified as R&D under the traditional definitions.

Here are some concrete examples of the measurement issues. Several tax-court decisions conclude that research carried out by financial firms does not satisfy the IRS's

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[23] For an extensive discussion of these and other related issues, see Miles (2007) and chapter 3 of the National Research Council's 2005 report. For empirical evidence from Europe, based on surveys and interviews, see Preissi (2000).

[24] These data are from the June 2007 vintage of Standard & Poor's *Compustat*. No bank in that data set reported a positive amount of R&D in the last 20 years. A few insurance companies have done so, but not since 1995.

definition of R&D for the purposes of the federal R&D tax credit. In addition, the instructions for the NSF survey of industrial R&D specifically excludes from the definition of R&D "other nontechnological activities…and research in the social sciences" (NSF 2005).[25] The development of a better credit scoring model or a new derivative contract would likely fall outside this definition.

C. An Alternative: Measuring the R&D Workforce

Other data may shed additional light on both the level and the trend in R&D being performed in the financial sector. To do that, we compare the composition of the workforce in financial services with that of the private economy as a whole. This may be a particularly informative measure for financial services, since 80 percent of R&D costs in this sector consist of wages and fringe benefits.[26] The strategy is to identify those occupations that are most likely to be used for research and to count the number of these workers among financial services firms.

To do that, we rely on the *Occupational Employment Statistics* produced by the Bureau of Labor Statistics. The data are based on a survey that encompasses all full-time and part-time wage and salary workers in nonfarm industries. It does not cover the self-employed, owners or partners in unincorporated firms, household workers, or unpaid family workers.[27] Importantly, in those data, occupations are assigned based on the work performed and the required skills and not necessarily on the worker's education or training.

In those data, we excluded real estate and holding companies from our definition of financial services.[28] We also defined a set of occupations we'll call *research occupations*. This set includes all types of engineers and computer programmers and all scientists (including social scientists) and research managers. It also includes actuaries, mathematicians, operations researchers, statisticians, architects, cartographers, and surveyors. Physicians, teachers, and technicians in any of the above fields were excluded.

Of course, not all workers in these occupations and employed by financial firms are actually engaged in R&D; in fact, most are probably not. But we expect that this is also true of other industries. As long as the ratio of actual R&D workers to our broader measure remains constant over time, the broader measure should accurately capture any trend.

Using the OES and our list of research occupations that we identified for 2005,

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[25] In a table, the NSF instructs respondents to exclude from their R&D measures expenditures in the following fields: personnel research, economics, expert systems, consumer and market research, management and organizational research, actuarial and demographic research, and R&D in law.

[26] That statistic is derived from NSF data for 2002. The comparable share for all private firms is 53 percent.

[27] The 2005 vintage OES, for example, was based on responses from 874,761 establishments, with a response rate of 78 percent (BLS 2007). For additional details see the appendix.

[28] While this means we are omitting bank holding companies, the industry detail in OES does not permit us to distinguish these from other (nonfinancial) holding companies, which accounted for three-quarters of employment in SIC 671 in 1992.

our occupational data identify about 3.2 million *potential research workers* in all industries and about 147,000 in financial services. The occupational composition of those workers in the financial sector is quite different from that for all industries. In financial services, nearly two-thirds of these workers are computer programmers or software engineers (Figure 6), but other engineers are extremely scarce. Actuaries and market and operations researchers represent a third of the total. This is particularly important for thinking about measurement, since these fields are not included in the NSF measures of R&D or R&D workers. For all industries, programmers and software engineers represent a sizeable but smaller share of all potential research workers and the difference is made up by the large presence of engineers (Figure 6). In total, 85 percent of these workers in all industries are in occupations associated with fields included in the NSF survey.

We can compare our measure of potential research workers to the NSF's counts of scientists and engineers engaged in R&D, what we'll call NSF *R&D workers*.[29] In 2005 NSF identified 1.1 million *R&D workers* in all industries (the first column of Figure 7). In other words, for every three workers in the research occupations we identify there was an R&D worker in the NSF counts. In financial services, the NSF identified 30,000 R&D workers, about a fifth of the number of potential research workers in our data (the second column in Figure 7).

The NSF count of R&D workers in the financial sector is likely to understate the actual number. As described in the previous section, this may result from the definition of R&D used or the greater difficulty in identifying where R&D is performed in financial organizations. A very crude estimate of the number of additional R&D workers in finance can be constructed using the relationships between our data and the NSF data for all industries. This requires a strong assumption: that the ratio of these two counts for all industries is an accurate measure of the true ratio in financial services. If this was true in 2005, there may have been an additional 20,000 R&D workers in financial services (see the second column of Figure 7).[30] About half of this amount may be attributable to the higher share of nontechnological occupations among workers involved in developing new products or processes.

D. Industry Patterns

In terms of industries, the OES data were more disaggregated in the years prior to adopting the NAICS industry classification system. In 2001, the final year for which the data were reported using the older SIC system, insurance companies accounted for nearly half (65,000) of all potential research workers in financial industries. Commercial banks accounted for a fifth of the total (about 27,000) and securities firms just over 10 percent (16,000).

Just as with R&D spending, we can create a measure of research intensity by calculating the share of an industry's workforce that falls in our list of potential research

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[29] The NSF measure includes more than scientists and engineers. The instructions for recipients of the survey of industrial R&D indicate it should include "all persons engaged in scientific or engineering work at a level that requires knowledge of physical or life sciences or engineering or mathematics."

[30] Details on these calculations are found in the data appendix.

occupations. According to this measure, there is considerable variation in the average R&D intensity over the 1990s across three-digit SIC industries in the financial sector (Figures 8-10). Interestingly, five of the seven insurance industries enjoyed a research intensity above the average for the sector as a whole (2.7 percent), as did all of the industries related to creating or trading securities and commodities. But this was true of only one of the eight credit intermediation industries — the central bank.

E. Trends in Research Intensity

Figure 11 plots our occupation-based measure of research intensity for the entire financial sector and for all industries.[31] There are several striking patterns. First, the potential research share of the financial workforce is about the same as for private industry as a whole. Second, after 1999, there is a rising trend for the entire economy. The pattern is more mixed in financial services, with increases in some years offset by declines in other years.[32] Nor does this conclusion change when examining trends over time in different segments of the financial services sector

Should we conclude that the financial sector is as research intensive as other parts of the private economy? Probably not. We know from NSF data that, compared with all private industries, financial firms spend significantly less on R&D per research worker.[33] Adjusting for this difference, it would appear that financial services has a research intensity (roughly 1.3 percent) about 40 percent of that found in private industry as a whole. Still, this is 2.5 times higher than reported in the NSF statistics.

What can we conclude? First, the financial sector is likely more research intensive than is reflected in the official R&D statistics. Second, there is no clear trend in the research intensity of this sector. Third, if financial patenting is having an effect, it is not easily discerned in any of the R&D measures presented. Finally, NSF data and our occupation-based measures show that ICT-related innovations (especially software) are important technologies developed and employed in financial services.

5. Patent Litigation Affecting Financial Services

Business method patents are no longer intellectual curiosities. Demand letters are regularly sent, and dozens of financial institutions, their technology suppliers, and even central banks have been sued (see Table 1 for additional examples). In a number of instances, very sizeable licensing fees are being paid.

Lerner (2008) finds that business method patents are litigated at a rate 27 times higher than for patents as a whole. Litigated patents tend to be ones granted to individuals

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[31] The figure was constructed by linking the old SIC to NAICS, but this can only be done at a higher level of industry aggregation.

[32] We should be cautious about interpreting the decline from the level of the late 1990s because it coincides with the BLS's switch to a new occupational taxonomy in 1999.

[33] NSF data for 2003 show that for every dollar of R&D spent per full-time researcher in all industries, financial firms spent less than 40 cents. While some of this disparity may be due to the definitional issues described earlier, it's unlikely they explain the entire difference.

or small firms. But these owners are often not the plaintiffs in these cases; instead the suits tend to be initiated by patent-holding companies. Financial patents acquired by foreigners are much less likely to be litigated. The defendants in these suits are typically large financial firms or exchanges.

There are some notable examples of patent litigation and successful licensing campaigns that involve plaintiffs from outside the industry. Perhaps the most famous example is that of Ronald A. Katz Technology Licensing, which owns, among other things, a portfolio of patents on the technology used by telephone call centers. By one estimate, Katz has obtained $750 million in royalties via more than 150 licensing agreements (Pomerantz 2005, Ambrogi 2007). Licensees include many large financial institutions and their processors, including American Express, Bank of America, Capital One, Equifax, First Data Corporation, Merrill Lynch, Nationwide, OppenheimerFunds, Prudential Financial, T. Rowe Price, Vanguard Group, Wachovia Corporation, and Wells Fargo.

A. Litigation Involving Financial Exchanges

There has been a significant amount of patent litigation involving the American futures and options exchanges. For example, in 1999, the company Electronic Trading Systems sued the Chicago Mercantile Exchange, the Chicago Board of Trade, and the New York Mercantile Exchange.[34] The ECN eSpeed, a developer and operator of electronic trading systems, was also a defendant but it eventually acquired the patent in dispute and continued the case against the exchanges. All three exchanges eventually settled the case. Licensing revenues over the life of the patent were about $50 million (Schaafsma 2004, Young and Corbett 2005).[35]

In another case, the company Mopex threatened to sue the American Stock Exchange (AMEX), arguing that certain exchange-traded funds offered on the exchange infringed its patent on an open-end mutual fund securitization process. In 2000, AMEX sued to invalidate the patent. The patent was eventually declared invalid because of prior art contained in a 1994 Morgan Stanley SEC filing, slightly more than a year before Mopex applied for its patent.[36]

ECNs sometimes sue each other. In 2003 eSpeed sued BrokerTec Global, arguing that the latter's online ordering system for trading U.S. Treasury securities infringed its system and method patent for auction-based trading of fixed-income instruments. These two firms are the dominant platforms for electronic trading of Treasury securities in the secondary market (Mizrach and Neely 2006). A district court rejected eSpeed's petition

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[34] *Electronic Trading Systems Corp. v. The Board of Trade of the City of Chicago*, Civil Action No. 3:99-CV-1016-M (N.D. Texas).

[35] The patent in question (4,903,201) for an automated futures trading exchange was applied for in 1983 but only issued in 1990. It expired in February 2007. The patent was initially assigned to World Energy Exchange; later it was acquired by Electronic Trading Systems and finally by eSpeed.

[36] *American Stock Exchange, L.L.C. v. Mopex, Inc.*, No. 00-cv-05943 (S.D. New York 2003). An invention does not satisfy patent law's requirement of novelty if it is described in print a year or more prior to the application date of a patent. See 35 U.S.C. § 102(b).

for a preliminary injunction in the case. Prior to that hearing, the U.S. government filed a statement of interest, arguing that a preliminary injunction might disrupt the secondary market for Treasury securities (Kellner 2006). ESpeed's patent was subsequently invalidated because of inequitable conduct in its prosecution of the patent application before the patent office.[37]

More recently, the firm Trading Technologies International sued eSpeed for allegedly infringing two patents on a graphical user interface for displaying the market depth of orders for futures contracts (Young and Corbett 2005). In 2007 a jury awarded $3.5 million in damages to Trading Technologies.[38] The company has sued a number of other firms, and several have entered into licensing agreements. In 2004 Trading Technologies made a public offer to the futures exchanges to license its issued and pending patents for a *perpetual* royalty of 2.5 cents per trade (Acworth and Burns 2005).

B. Litigation Involving Consumer Payment Technologies

In the last few years there have been a number of suits alleging infringement of patents on prepaid debit cards and credit cards, among others (see Table 1 for examples). But perhaps the most important example of patent litigation in this area involves the application of new technologies to an old payment instrument: the paper check. Check imaging and exchange technologies are especially important in the U.S. at this time. Banks are in the process of eliminating the physical transportation of paper checks, which is generally required under the traditional law for these financial instruments. The Check Clearing for the 21st Century Act of 2003 (Check 21) permits banks to process check transactions without physically presenting the original check to the issuing bank, so long as certain standards are satisfied.[39] Financial institutions are currently making very large information technology investments in order to take advantage of the efficiencies afforded by this reform.

In January 2006, the company DataTreasury sued 57 banks and other companies that participate in the check image clearing process.[40] The company also sued the Clearing House Payments Co., which operates a check image exchange network. DataTreasury owns at least six patents on processes for creating, processing, and storing digital images of paper checks. In earlier years it had sued a number of institutions and obtained licensing agreements with firms such as JPMorgan Chase, Merrill Lynch, and ATM manufacturer NCR Corporation. More recently, the ATM manufacturer Diebold struck a licensing agreement with DataTreasury in part to assuage bank customers who

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[37] See *eSpeed, Inc. v. BrokerTec USA, L.L.C.* 417 F. Supp. 2d 580 (D. Delaware 2006). The decision was upheld by the Federal Circuit in 2007.

[38] *Trading Technologies International v. eSpeed, Inc*, 1:04−cv−05312 (E.D. Illinois 2007).

[39] Public Law 108-100, 12 U.S.C. 5001. If the issuing bank desires, it may insist on presentment of a "substitute" check, an image of the original carrying certain information and satisfying certain standards set by the Board of Governors of the Federal Reserve System. Substitute checks can be sent electronically and then printed. Substitute checks are the legal equivalent of the original check.

[40] *DataTreasury Corporation v. Wells Fargo & Co.*, No. 2:06-cv-00072 (E.D. Texas).

have grown increasingly concerned about their potential liability for patent infringement (Bills 2007a).

But the DataTreasury patents are not without controversy. In December 2006, the patent office initially invalidated 43 of 50 claims in one of DataTreasury's patents in a re-examination requested by a defendant firm — First Data Corporation — but then reversed itself in 2007 (Bills 2007b).[41] First Data argued DataTreasury's patents were anticipated in a standard (ANSI X9.46-1995) published prior to the application date of the patent. The patents were upheld because no printed copy of the standard could be located in a place that was accessible to the public, which is required to be considered as prior art.

C. Other Litigation

Some other recent cases have resulted in spectacular misfires for the plaintiffs. Eon-Net, L.P. sued 26 companies, including Flagstar Bancorp, for allegedly infringing its patent for extracting data from computer scans of paper documents. In the Flagstar case the alleged infringement arose from its use of purchased software in its e-mortgage business, but the developer of that software had already licensed the patent in dispute. After a year of delay, Eon-Net conceded there was no infringement. The court sanctioned the company (under Rule 11 of Federal Civil Procedure) for failing to undertake the minimum investigation required before filing suit.[42]

In another case, a federal court sanctioned a law firm for filing a frivolous infringement suit against Hypercom, a leading manufacturer of point-of-sale transaction terminals. The law firm Verve LLC had obtained nearly $1 million in licensing income from settlements resulting from suits filed against at least 10 other companies. But Hypercom refused to settle. At trial, the district court concluded that Verve had engaged in an abuse of process and malicious prosecution, in part because Verve had failed to investigate whether there was evidence of infringement prior to filing suit. The court awarded Hypercom $700,000 in damages (Young 2007).[43] Verve's suit before the International Trade Commission was also dismissed on similar grounds.

6. Recent Developments in the Courts

The last year or so of federal court decisions may represent a sea change in the interpretation and application of patent law in the United States. Many of the new precedents will be especially relevant for business method patents; indeed a number of them involved such patents.

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[41] The patent in question was no. 5,910,988, on "a system and method for remote image capture, processing and storage."

[42] The court ordered the plaintiff to pay the defendant's reasonable attorney's fees and costs. See *Eon-Net, L.P. v. Flagstar Bancorp, Inc*., Case No. C05-212 9 (W.D. Washington 2006)

[43] *Verve LLC v. Hypercom Corporation*, 2006 05-CV-0365 (D. Arizona 2006). The patents involved in these cases were owned by a Japanese company, Omron Corp. In a separate settlement, Omron agreed to pay $1.5 million to Hypercom.

A. Patentable Subject Matter

It appears that the exact boundaries of patentable subject matter for business methods are still being explored, in particular when the claimed invention does not make any reference to a machine such as a computer. In a number of recent decisions appealed to the Federal Circuit, the USPTO has argued that, in addition to the requirements set out in *State Street* and *AT&T*, the claimed invention must somehow *transform* something that is either tangible or intangible, such as data or signals (Toupin et al. 2007). This reasoning follows from a line of cases in the 1980s and early 1990s evaluating the patentability of computer programs (Bessen and Hunt 2007).

In one of the appeals, *in re Comiskey*, the application was for a patent on a process for implementing mandatory arbitration. While reaffirming its conclusion in *State Street*, the Federal Circuit determined that some of the claims in the application—the ones that did not involve using a computer or some other communications device—were unpatentable subject matter because they described nothing more than "mental steps." It concluded "…the patent statute does not allow patents on particular systems that depend for their operation on human intelligence alone."[44] The court instructed USPTO to determine whether the addition of a computer to implement the mental steps in remaining claims was obvious, adding that "the routine addition of modern electronics to an otherwise unpatentable invention typically creates a prima facie case of obviousness."

In another appeal, *ex parte Bilski*, the claimed invention is a method for hedging consumption risk for commodities sold at fixed prices.[45] While the method described in the claims could be processed via a machine such as a computer, it was not limited to such an implementation. The patent office rejected the claims and the applicant appealed to the Board of Patent Appeals and Interferences (BPAI), which also rejected the claims. Among other conclusions, the board found the claimed invention was an abstract idea and it was not a process in the meaning of the patent act since it did not transform physical subject matter (a machine, manufacture, or composition of matter).[46]

The case was then appealed to the Federal Circuit in 2007. After oral arguments, the court decided to re-hear the case *en banc* (i.e., before all 12 judges of the court) and solicited amicus briefs on a number of questions. The court explicitly entertained the possibility, however remote, of reversing itself on the patentability of business methods. In the end, it declined to establish a comprehensive subject matter exception for business methods or for computer programs.[47]

Nevertheless, this decision will have important effects on how financial patents are prosecuted and enforced. For example, the court explicitly rejected the "useful, concrete, and tangible" result test for subject matter patentability articulated in the *State*

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[44] 499 F.3d 1365 (Fed. Cir. 2007). The application in question was No. 09/461,742.

[45] One example would be a hedge against unexpected increases in demand for electricity induced by abnormally hot weather.

[46] Appeal No. 2002-2257 (BPAI 2006). The application in question was No. 08/833,89.

[47] *ex parte Bilski*, No. 2007-1130 (Fed Cir).

Street and *in re Alapat* decisions. It also rejected a technological arts test, re-affirming the decision reached by the patent office in *ex parte Lundgren* (see section 2C).

Most important, the Federal Circuit articulated a test for subject matter patentability that relies explicitly on the Supreme Court's reasoning in the 1981 decision in *Diamond v Diehr*.[48] Under this test, the court interprets business methods as a form of process innovation (i.e., not a product). To be patentable, a process must either be tied to a *particular* machine or apparatus or the process must transform an *article* into a different state or thing. The rationale for such a test is that the use of a specific machine or transformation of an article ought to impose meaningful limits on the scope of a patent's claims and thus avoid preempting all potential applications an abstract idea.

Since the claimed invention in question in *Bilski* does not refer to a machine, the court focused only on the transformation part of the test. The essential question, then, was whether a hedging strategy somehow transformed an "article." The Federal Circuit concluded it did not, and elaborated more generally:

> "…transformations or manipulations of...legal obligations or relationships, business risks, or other such abstractions cannot meet the test because they are not physical objects or substances, and they are not representative of physical objects or substances."

It would appear that, after *Bilski*, patent claims to business methods which are not implemented via a machine are less likely to survive a challenge and this may be especially true if the claim itself represents a disembodied financial instrument or investment strategy.[49]

However, *Bilski* does not mark the end of financial patenting in the United States. Most applications for patents on business methods rely on some form of computer implementation and would likely qualify under the first part of the test articulated by the Federal Circuit. In the future, it is likely that more patent claims will be written to either recite a *substantive* machine implementation or a *substantive* transformation of something more physical.[50] This is not unlike the construction of patent claims for computer programs commonly used prior to the Federal Circuit's decision *in re Alapat*.

B. Injunctions

In *eBay vs. MercExchange*, the Supreme Court revisited the question of when the remedies for patent infringement should include an injunction against the defendant, prohibiting further use of the patented invention without the consent of the patent owner. In the original district court decision in 2003, eBay's "Buy it Now" feature was found to

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[48] 450 US 175.

[49] In the two months since this opinion was issued, the BPAI cited *Bilski* in five separate cases involving a rejection of claims for nonpatentable subject matter. It affirmed the examiner's decision in four of them.

[50] This not an entirely trivial requirement. In *Bilski*, the court noted that reciting implementation via a generic computer, or some incidental physical transformation, would not establish the existence of any patentable subject matter, since all relevant applications of the abstract idea could still be claimed. See also *ex parte Rosario Uceda-Sosa*, Appeal No. 2008-1632 (BPAI 2008).

infringe two MercExchange patents that allowed shoppers to purchase items without first participating in an auction. The court awarded damages but no injunction. When MercExchange appealed, the Federal Circuit decided that an injunction was also warranted.[51] The Federal Circuit opinion argued that injunctions should be denied in patent cases only under exceptional circumstances.

The Supreme Court reversed this decision, remanding the case to the district court to determine the appropriateness of an injunction on the basis of the court's traditional four-factor test: (1) A plaintiff must demonstrate irreparable injury, (2) monetary damages are an insufficient remedy for this injury, (3) the balance of hardships favor an injunction, and (4) the public interest would not be disserved by an injunction.[52] In addition, the court concluded that a district court's decision to impose an injunction (or not) may be reviewed on appeal only on the grounds of an abuse of discretion. In a concurring opinion, four of the justices linked the public interest part of its test to concerns about the vagueness and suspect validity of some business method patents. On retrial, the district court applied the Supreme Court's test and again concluded that an injunction was not warranted.[53] EBay purchased the patents in question in 2008.

Relative to the Federal Circuit's position, injunctions will be somewhat harder to come by. This does not mean, however, that injunctions are no longer available. In the 15 months after the *eBay* decision, there were at least 22 district court decisions that awarded a permanent injunction after a finding of patent infringement (Slenkovich 2007).

C. Nonobviousness and Combination Inventions

The decision in *KSR International v. Teleflex* is likely the most important Supreme Court opinion on patent cases in more than a decade.[54] While the suit involves a mechanical invention (an adjustable gas pedal with an electronic sensor), the real issue at question was how a court should determine that an invention is obvious and therefore unpatentable.

Courts traditionally assess obviousness from the perspective of a hypothetical person having ordinary skill in the art (the so-called PHOSITA). Especially in recent years, this inquiry relies on information contained in the (written) prior art that might "suggest" an invention that largely consists of a novel combination of pre-existing elements. To avoid the problem of hindsight bias (inventions seem more obvious once we know how they work), beginning in 1982 the Federal Circuit placed limitations on how the prior art could be interpreted to suggest the invention. Unless a piece of prior art actually suggests the combination of ideas from other parts of the prior art, the Federal Circuit has tended to assume that a person of ordinary skill would not find the invention

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[51] At the same time the court invalidated one of the MercExchange patents on obviousness grounds. Shortly thereafter, in March 2005, a USPTO reexamination reached a preliminary finding rejecting the other patent also for obviousness. That decision is under appeal.

[52] See 126 S. Ct. 1837 (2006).

[53] No. 2:01cv736 (E.D. Virginia 2007).

[54] See 127 S. Ct. 1727 (2007).

obvious. At the extreme, all the relevant aspects of an invention must be contained in a single piece of prior art.

Critics argue that this approach implicitly reduces the standard of nonobviousness, since it presumes that a person of ordinary skill in the art has little ability or creativity. Some scholars have argued that the capability of PHOSITA ought to be reasonably related to the observed rate of technical progress in the field. If the standard is too low, the result is less innovation in those industries that ought to be the most innovative (Barton 2001, Hunt 2004, 2007).

A unanimous Supreme Court seemed to agree with this reasoning, reversing the Federal Circuit. The opinion concludes:

> "...In many fields there may be little discussion of obvious techniques or combinations, and market demand, rather than scientific literature, may often drive design trends. Granting patent protection to advances that would occur in the ordinary course without real innovation retards progress and may, for patents combining previously known elements, deprive prior inventions of their value or utility...."

This decision could represent the first substantive tightening of the nonobviousness requirement in U.S. patent law in over 20 years.

KSR will have implications for patents in all fields, but its effects could be especially pronounced for business method patents that would not have been issued on novelty grounds had the prior art been more accessible to examiners (Lerner 2003). For this reason alone, this decision could significantly influence the way financial patents are used in the U.S. It may also affect the number of these patents granted by the USPTO.

Several recent lower court decisions reflect the Supreme Court's reasoning in *KSR*, and a number of patents have been invalidated on obviousness grounds.[55] In one case, the Federal Circuit upheld the patent office's rejection, on re-examination, of two patents that claimed a system of inflation-adjusted deposit and loan accounts.[56] The rejection was based on two pieces of prior art. The first was a book chapter that described how, in the 1950s, Finnish banks would adjust their loan and deposit accounts for the actual inflation that had occurred (Mukherjee and Orlans 1975). The second was a patent granted in 1983 that described how to use a data processor (e.g., a computer) to manage a set of accounts. The combination, then, was deemed to be obvious.

In a separate case, a district court invalidated a patent on a computerized method for securing a loan using future credit card receivables, arguing that the claimed invention was a predictable variation of at least five card programs in existence well more than a year before the application date. This prior art was not considered by the patent office when it decided to grant the patent.[57]

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[55] See, for example, *Leapfrog Enterprises v. Fisher-Price, Inc.*, No. 06-1402 (Fed. Cir. 2007).

[56] See *in re Trans Texas Holdings Corp.*, Nos. 06-1599, -1600 (Fed. Cir. 2007). These patents were the subject of a 1999 infringement case against *Pimco Advisors, L.P.*, which resulted in a settlement.

[57] See *Advanceme Inc v. Rapidpay, LLC, et al.*, Case No. 6:05 CV 424 (E.D. Texas 2007). On appeal, the Federal Circuit concurred with the district court decision.

D. Willful Infringement

The Federal Circuit recently overturned its own precedent regarding the determination of willful infringement. This is an important decision because when a firm is found to willfully infringe a patent, it is likely that a court will award *treble* damages to the plaintiff.[58]

Nearly 25 years ago, the Federal Circuit articulated its definition of willful infringement: when a potential infringer has notice of another's patent rights, he or she has a duty to exercise care to avoid infringing. One way to discharge that duty would be to obtain competent legal advice before engaging in activities that might infringe the patent.[59] This precedent and subsequent cases created two complexities. The first is that it put defendants in the position of disclosing a legal opinion, in order to avoid an allegation of willful infringement, but at the risk of implicitly waiving attorney-client privilege. The second is that the investigation often becomes one of determining the intent of the defendant.

In an August 2007 decision, *in re Seagate Technology*, the Federal Circuit concluded that its earlier precedent on willfulness was the equivalent of imposing a standard of negligence on potential defendants when a standard more akin to *recklessness* would be more appropriate.[60] It reached this conclusion by analogy to precedents established in other cases. For example, federal courts will impose enhanced damages in copyright infringement cases when the defendant demonstrates reckless disregard for the plaintiff's rights.[61] The Federal Circuit concluded that

> "Accordingly, to establish willful infringement, a patentee must show by clear and convincing evidence that the infringer acted despite an objectively high likelihood that its actions constituted infringement of a valid patent …The state of mind of the accused infringer is not relevant to the objective inquiry…the patentee must also demonstrate that this objectively defined risk was either known or so obvious that it should have been known to the accused infringer."

It would appear that establishing willful infringement of a patent, with the attendant prospect of treble damages, is now more difficult. In addition, the Federal Circuit reiterated that it was not necessary for potential infringers to obtain prior advice of counsel in order to avoid a charge of willful infringement and that any waiver of attorney client privilege did not apply to trial counsel.

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[58] Under U.S. patent law, a court is permitted to award damages up to three times the actual harm to the patent owner. See 35 U.S.C. § 284. But the law itself does not specify the circumstances where such an award is appropriate.

[59] See *Underwater Devices Inc. v. Morrison-Knudsen Co*., 717 F.2d 1380 (Fed. Cir.1983).

[60] See Miscellaneous Docket 830 (Fed. Cir. 2007).

[61] The opinion also mentions the recent Supreme Court decision in *Safeco Insurance Co. v Burr*, 127 S. Ct. 2201 (2007), which involved a case under the Fair Credit Reporting Act. Under that law, consumers can recover actual damages resulting from negligent violations and punitive damages if the violations were found to be willful. In this case, the Supreme Court defined willful as reckless behavior.

E. Declaratory Judgments by Patent Licensees

Does agreeing to licensee of a patent imply forfeiting one's right to dispute its validity, or infringement, in court? This is the question in *MedImmune v. Genentech*.[62] MedImmune licensed Genentech's Cabilly II patent in 1997, but it also sought a declaratory judgment, arguing that it did not infringe any *valid* claims of the patent in question. In the lower courts, Genentech sought dismissal of the case, arguing that MedImmune lacked standing to sue, since it was paying royalties and thus did not face a risk of being sued. This argument is sometimes called "the reasonable apprehension of suit" test.[63]

This doctrine poses a tradeoff for any firm contemplating a license of a suspect patent: On the one hand, the firm may want to protect itself from additional and substantial liability if the patent is upheld. On the other hand, it may not want to give up the option to seek invalidation of the patent. But ordinarily, it cannot accomplish both. It must either seek a license and forgo the opportunity to litigate, or decline a license and risk an even larger damage award if it is subsequently found to infringe a valid patent. Those damages could be potentially very large if the firm is found to willfully infringe the patent (see the preceding section). But in an 8-1 decision, the Supreme Court overturned the lower court decisions, citing a similar case before the Supreme Court in 1943.[64]

F. Joint Infringement

In most patent cases establishing literal infringement of a patent requires a showing that the defendant copied every element of a claimed invention (for products) or practices every claimed step in the cases of processes or methods. Infringement can also be established under the doctrine of equivalents, where an alleged infringer practices the claimed invention, but with insubstantial alterations. Still, it must be the case that the defendant is practicing the equivalent of all the claimed elements of the patented invention.[65]

Suppose that every step of a patented process is used, but not all of them by an individual party. When can a plaintiff establish joint infringement of the patent? This exact question arose in an infringement suit involving two patents, owned by BMC Resources, on methods of processing debit transactions without using a personal identification number (PIN) for bill payments.[66] A bill payment service offered by the alleged infringer, Paymentech, contained each of the steps in BMC's patents. However, both parties in the case agreed that several of the claimed steps were performed by other actors (e.g. the merchant, the bank, and the debit card network), and not Paymentech itself.

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[62] See 127 S. Ct. 764 (2007).

[63] See, for example, the Federal Circuit decision in *Gen-Probe Inc. v. Vysis, Inc*., 359 F. 3d 1376 (2004).

[64] *Altvater v. Freeman*, 319 U.S. 359 (1943).

[65] *Warner-Jenkinson Co. v. Hilton Davis Chem. Co*., 520 U.S. 17 (1997).

[66] The patents in question are no. 5,718,298 and 5,870,456.

The case was eventually appealed to the Federal Circuit, which decided that a necessary condition for establishing joint infringement is the existence of a party directing or controlling the actions of the other parties.[67] A classic example, established in previous cases, would be contracting out one or more of the claimed steps to be performed by a third party. In other words, establishing an explicit agency relationship specific to practicing one of the claimed steps would be a clear indication of active control by the principal. But such a relationship was not demonstrated in this particular case.[68]

7. Legislative Proposals

For a number of years, there has been considerable debate over the efficacy of the patent system in facilitating innovation in high-technology industries that tend to innovate cumulatively. Two recent reports, one by the Federal Trade Commission and another by the National Academies, have added weight to these concerns (FTC 2003, Merrill et al. 2004).[69] From this debate there is an emerging consensus in favor of some limited reforms. Other proposals are more controversial.

After several years of stalemate, the House of Representatives passed its version of a patent reform bill (HR 1908) in September 2007. In early 2008, the Senate Judiciary Committee reported its version of the legislation (S. 1145). The two bills are similar but not identical. The bills contain many provisions, and the ones most relevant to the topic of this paper are described briefly here.[70]

A. Publication of Patent Applications

A 1999 law specified that patent applications, in their original form, would be made public 18 months after the date of application. Prior to 1999, pending applications were not disclosed by the patent office. But that law included an exception to the publication requirement for an applicant who stipulates he or she does not intend to file for a patent to protect the same invention in countries that also require that pending applications be published.[71] Both bills would remove this exception. Publication of pending applications is important because it is often the first notice to market participants that an applicant may obtain property rights that could affect their businesses.

B. Prior User Rights

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[67] 498 F. 3d 1373 (Fed Cir 2007). For a discussion of this case, see Truong (forthcoming). See also Lemley et al. (2005).

[68] Paymentech had entered into contracts with several debit card networks, but these were never introduced as evidence in the case. See the district court opinion, No. 3-03-CV-1927 (N D Texas, 2006).

[69] See also Jaffe and Lerner (2004) and Bessen and Meurer (2008).

[70] The description of legislation presented here is based in part on Thomas and Schacht (2007).

[71] *The American Inventors Protection Act*, P.L.106-113, 113 Stat. 1537-44. The particular section referenced here is found at 35 U.S.C. § 122(b).

The 1999 law also imposed a limitation on the enforcement of business method patents against firms that had been practicing what became the patented invention as a trade secret for at least a year or more before the date of the patent application.[72] Such prior users could not be held liable for infringement, nor would they be required to obtain a license from the patent owner in order to continue practicing the invention.

Traditional trade secret law does not offer such protection and for deliberate reasons: it is a way of encouraging individuals and firms to file for patents and thus disclose their inventions.

One of the reform bills would expand the availability of prior user rights for all patents and not just for patents on business methods. Although prior user rights do exist in some other industrialized countries, this would represent a very significant change in U.S. patent law.[73]

C. Calculating Damages for Patent Infringement

The bills contain a number of provisions that might affect how damages for patent infringement are determined. First, the criteria used to determine *willful* infringement would be modified. These proposals have likely been superseded by the recent decision in *Seagate* (see section 6D).

Second, the bills contain language on how damages should be calculated for *combination* inventions. These are products (or services) that embody many inventions, which can complicate the determination of the contribution of a particular patented invention to their total value.

This is a contentious issue in policy circles. On the one hand, in ICT industries such as computers, electronics, and software, there are concerns about royalty stacking. Products in these fields may embody dozens or even hundreds of patented inventions. Some researchers and industry participants suspect that, in such environments, there is a tendency for courts to overestimate the marginal contribution of each invention to the value of the whole (Lemley and Shapiro 2007).[74] But expected trial outcomes may also influence the terms of licensing negotiations. The resulting conflict over the division of profits may reduce the incentive to bring new products to market. Others worry that rules devised to address a problem in ICT industries may have unintended effects for industries such as chemicals and pharmaceuticals, where inventions and the resulting products tend to be more discrete.

D. Opposition Procedures

The bills contain a number of provisions intended to improve the quality of issued patents

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[72] See 35 U.S.C. § 122(b). Currently, a prior user right applies only to a patent on a "method of doing or conducting business," but this phrase is not defined in the act.

[73] See Denicolò and Franzoni (2004), Shapiro (2006b) and Moschini and Yerokhin (2008) for economic analyses of prior user rights.

[74] See Thomas (2007) for examples from a number of recent decisions.

by increasing the information available to the patent office. That information is likely to come from interested third parties. The general idea is to reduce uncertainty over the validity of patents before they result in very costly trials. The proposal comes in two general forms, depending on whether the intervention occurs before or after a patent is granted. These are often called pre-grant or post-grant oppositions.

In the first instance, third parties would have an opportunity to submit (written) prior art to the patent office before it makes a final decision about the application. In most instances this would occur after the original application is published (see section 7A).

Such a process already exists under current law, but it is little used for a number of reasons. First, any pre-grant opposition from a third party must occur within two months of the publication date of a pending application (Thomas and Schacht 2007), which may very well be the first time that a third party becomes aware of an issue affecting his or her business. Some of the bills would amend the deadline to permit third-party submissions before the date the patent is granted or six months after the patent application is published, whichever is later.

Post-grant opposition procedures are available in some other industrialized countries, and the U.S. has enjoyed a limited version (*ex parte* re-examination proceedings) since 1981. Initially the role of third parties was simply to bring prior art not considered in the original examination to the attention of the patent office. The role of third parties in this process was expanded in 1999. But this *inter partes* re-examination procedure is rarely used, perhaps for strategic reasons: A party using the procedure may not use the argument presented, *or any other argument it could have raised* during the proceedings, as a defense in a subsequent patent infringement case.[75]

One of the patent reform bills would establish a new post-grant review proceeding that third parties could use within a year after a patent was granted (the so-called first window). The other bill would also permit a third party to initiate an opposition proceeding when it has received a notice of potential infringement from the patent owner (the second window).[76] Third parties who unsuccessfully participate in this process would be barred from using the same argument as a defense in subsequent litigation, but they would be permitted to use other arguments they could have raised at the time of the review proceedings.

E. Special Relief for Particular Industries

Two interesting amendments were included in the reform bills reported out of the Judiciary committees. The house bill, for example, would make tax planning methods unpatentable subject matter.[77] The Senate bill contains an amendment intended to preclude patent infringement claims against institutions processing checks in compliance with the requirements of Check 21 (Bills 2007c).[78] But the official cost estimate for the

[75] See 35 U.S.C. § 315(c). The purpose of this restriction is to prevent abuse of the opposition process.

[76] For a more detailed discussion of post-grant review procedures, see Hall et al. (2003).

[77] See Section 10 of H.R. 1908, as reported out of the House Judiciary Committee.

[78] See Section 14 of S. 1145, as reported out of the Senate Judiciary Committee.

bill suggested the affected patent holders would likely sue the federal government for taking private property. Taking into account the likelihood of success, the Congressional Budget Office estimated that the expected cost of compensating the patent holders could be as high as $1 billion (CBO 2008). It is unlikely this amendment will be retained.

Other aspects of the reform proposals seek to more closely harmonize U.S. patent law with that of other countries (e.g., moving to a first-to-file system, eliminating the best mode requirement, and revising grace periods). Another bill introduced in 2007 (HR 34) would create a US District Court patent pilot program to provide training to judges and law clerks in five federal district courts. Patent cases within these districts could then be referred to these judges by other judges who would prefer not to hear patent cases.

8. Conclusions

There is at present very little evidence to argue that business method patents have had a significant effect on the R&D investments of financial institutions. It is possible that the availability of business method patents has encouraged more entry and R&D by start-up firms or more efficient trading of technologies. At present, however, these represent intriguing possibilities and not outcomes that have actually been measured. In short, we still cannot determine whether these patents are creating value for the U.S. economy.

Nevertheless, business method patents are becoming commonplace. Compared with many other patents, they are litigated more often. Some of this litigation has resulted in very large settlements paid by established providers of financial services. These facts, in themselves, don't prove anything. But combined with the lack of evidence suggesting a positive effect on R&D investments, they do suggest that there is likely scope for improving on the current business method patent bargain.

From the standpoint of policy, it is important to ensure that patents are granted only for new and nonobvious business methods and that those standards are rigorous. In this light, the Supreme Court's decision in *KSR* and the debate over the adoption of enhanced opposition procedures appear to be positive developments. The characteristics of financial markets — in particular, network effects and the requirements of interoperability — should affect the choice of appropriate remedies for patent infringement. At least after the *eBay* decision, these factors may influence when a court is willing to grant an injunction or how it will determine the damages resulting from infringement. Each of these changes suggests that we may already be in the process of increasing the benefits and reducing the costs to society of financial patents.

Not all concerns about business method patents are likely to be resolved by these changes. One major concern about business method patents, and software patents more generally, is that their abstractness makes it difficult to determine the actual boundaries of the property rights being granted. Using the jargon of patent law, these patents often suffer from ambiguous "claims." Bessen and Meurer (2008) point out that appeals over the definition of claims in a business method patent occur more than six times as frequently as for (litigated) patents in general. This is problematic because if firms cannot determine what is protected and what is not, instances of inadvertent infringement are more likely to occur.

Consider the analogy to property rights to land. If the boundary lines between

properties are consistently unclear or frequently reinterpreted over time, trespassing on another's property would be more difficult to avoid. Even worse, there may be instances in which a person makes significant improvements to his or her property only to find he or she has built partially on another's land. The result would be more litigation, and this additional risk might deter efficient investments.

The combination of significant technological overlap among firms, elastic patent boundaries, inadequate enforcement of disclosure requirements, and weak patentability standards raises at least the theoretical possibility of perverse outcomes (Hunt 2006). In such environments, firms may obtain more patents but perform less R&D, since the fruits of such efforts would be subject to an innovation tax imposed by rival firms.

Data Appendix

The estimate of business method patents that are more financial in nature is based on counts of patents falling into subclasses of Class 705 based on analysis of patents performed by CHI research in 2001. These subclasses include 1, 4, 7, 10, 16, 26, 30, 33, 45, 53, and 64-80. These exclude many of the patents primarily dealing with cryptography, postage metering, and other technologies less closely related to the provision of financial services.

The definition of software patents used to calculate the software share of business methods is the one specified in Bessen and Hunt (2007). It is based on the following search of the USPTO patent full text database: "SPEC/software OR SPEC/computer AND program ANDNOT spec/antigen OR antigenic OR chromatography ANDNOT ttl/chip OR semiconductor OR bus OR circuit OR circuitry AND ISD/$/$/yyyy AND ccl/705/$."

The analysis of occupational data is based on the Occupational Employment Statistics compiled by the Bureau of Labor Statistics (BLS) (see http://www.bls.gov/oes/home.htm). Since 2003 the survey has been done twice a year (May and November). All the estimates presented here use the May vintage of the data for the years after 2003.

Over the years, the OES has used three different occupational classifications. The most significant change was the adoption of a modified Standard Occupational Classification (SOC) system in 2000. We constructed a crosswalk between each system relying in part on information at the National Crosswalk Service Center. The OES data were compiled using Standard Industrial Classification (SIC) system industries until 2001 and, thereafter, using the North American Industry Classification System (NAICS). We constructed a crosswalk for these industries relying in part on a tabulation by the BLS.

In the text, we suggested a potential undercounting of R&D workers in financial services of about 20,000. This was derived as follows. For all industries in 2005, the ratio of potential research workers to R&D workers identified by the NSF was 2.9:1. Dividing the 147,000 potential research workers in financial services by 2.9 yields about 50,400 jobs, about 20,200 more than found by NSF. If, however, we exclude workers in all industries who were actuaries, operations researchers, market researchers, and social scientists, the ratio of potential research workers to NSF R&D workers falls to 2.5:1. Excluding jobs in those occupations in the financial sector leaves about 98,400 potential research workers in 2005. Dividing this number by 2.5 yields about 39,400 jobs, about 9,200 more than reported in the NSF data.

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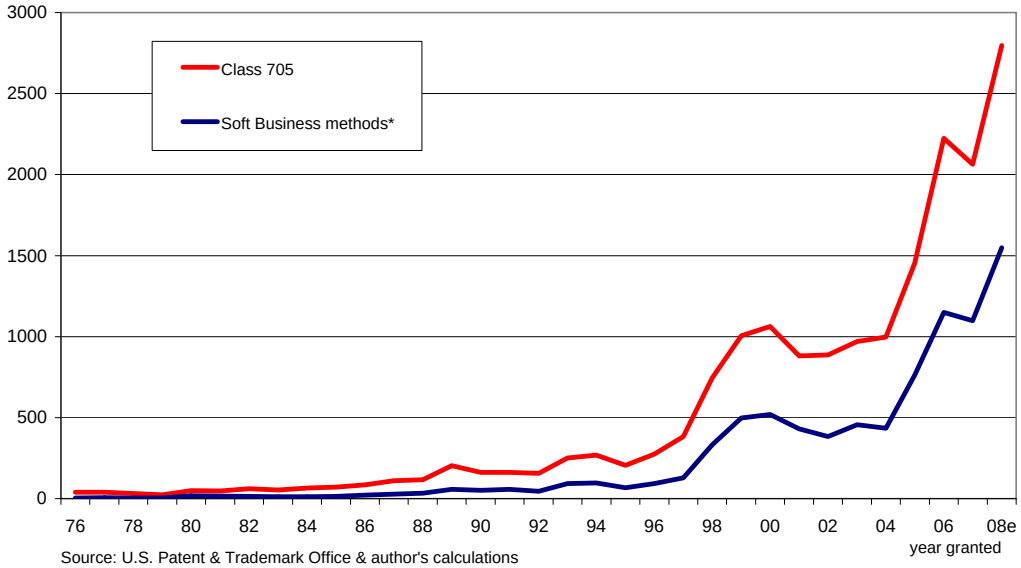
Table 1: Additional Examples of Patent Litigation Affecting Financial Services	
Case/Litigants/Filing Date*	Description
Suits Against Central Banks	
Document Security Systems, Inc. v. European Central Bank, Case T-295/05 (European Ct. of First Instance Aug. 1, 2005).	DSS sued the ECB for infringing its patent on a method of incorporating an anti-counterfeiting feature into bank notes (EP 0455750B1). The ECB took legal action to invalidate the patent in nine countries. The patent was subsequently revoked in the UK and France but upheld in Germany and the Netherlands.
Advanced Software Design Corp. v. Federal Reserve Bank of St. Louis., No. 4:07cv00185 CDP (E.D. Missouri, November 9, 2007).	ASD alleges the defendants (Fiserv and the Federal Reserve Banks of Atlanta, Philadelphia, and St. Louis) are infringing three of its patents (6,233,340; 6,549,624; & 6,792,110) on anti-counterfeiting software that encrypts information from paper checks.
Suits Involving Payment Card Technologies	
Every Penny Counts, Inc. v. Bank of America, No. 2:07-cv-42-FtM-29SPC (M.D. Florida, Jan. 25, 2007); *Every Penny Counts, Inc. v. First Data Corporation, Inc.* No. 8:07-cv-1245 (M.D. Florida, July 17, 2007)	EPC alleges that BoA's "Keep the Change" savings product violates its patent (6,112,191) on a system and method to distribute excess funds from consumer transactions. In a separate case, EPC has sued First Data, American Express, MasterCard, and Visa for infringement of this patent and two others (5,621,640 & 6,876,971).
Card Activation Technologies; Barnes & Noble, No. 1:2007cv01230 (N.D. Illinois, Mar. 2, 2007)	CAT alleges that the defendants are violating its patent (6,032,859) on gift card activation and processing. An attempt to invalidate the patent on grounds of "indefiniteness" was rejected. CAT has four other suits pending against retailers Sears, OfficeMax, Walgreen's, and TJX Companies. It reached a settlement with McDonald's in 2007.
H&R Block Tax Services v. Jackson Hewitt Tax Service, No. 6:2008cv00037 (E.D. Texas Feb. 8, 2008)	H&R Block alleges that the defendant is infringing its patents (7,072,862 & 7,177,829) on a system and method of linking tax refunds and government benefits to a spending card.
Advanced Card Technologies v. UV Color inc., 5:2006cv00957 (W.D. Oklahoma, Sept.7, 2006)	ACT alleged that the defendant had infringed two patents (5,720,158 & 5,921,584) on breakaway plastic card products bearing magnetic stripes, such as phone cards and gift cards. The two firms reached a settlement in 2007. It has obtained 21other agreements to license these patents.

Other Patents Suits Affecting Banking	
LML Patent Corp. v. Telecheck Services. et al. Civ. No. 04-858 SLR (D. Delaware, Mar. 28, 2006) *LML Patent Corporation v. JP Morgan Chase, et al*. No. 2:2008cv00448 (E.D. Texas, November 19, 2008)	In several suits, LML alleged that the defendants (including Nova Information Systems and the Electronic Clearing House) infringed its electronic check conversion patents (5,484,988; 6,164,528; & 6,283,366). This litigation was resolved via settlement agreements in 2006. It also reached a separate licensing agreement with ACH Direct. In November LML sued PayPal and 18 large financial institutions for allegedly infringing its patent on a check-writing point-of-sale system (RE40,220, a reissue of patent no. 6,547,129).
TradeCard v. S1 and Bank of America, 509 F. Supp. 2d 304 (S.D. New York, Sept. 6, 2007)	TradeCard alleged that the defendants infringed its patent (6,151,588) on a system for automated processing of letters of credit and purchase. At trial the patent was invalidated for obviousness.
IMX, Inc. v. LendingTree, LLC, 469 F. Supp. 2d 203 (D. Delaware, Jan. 10, 2007)	IMX alleged that the defendant infringed its patent (5,995,947) on a method and system for making loan applications and placing them up for bid by potential lenders. A jury found there was infringement and awarded $5.8 million in damages. Because it also found the infringement was willful, the damages were increased 50 percent.
Debt Resolve, Inc. v. Apollo Enterprise Solutions, No. 1:2007cv04531 (S.D. New York, May 30, 2007)	Debt Resolve alleged that the defendant was infringing two patents (6,330,551, & 6,954,741) on a computerized dispute resolution system and method by making automated debt settlement offers to consumers in arrears (these patents are co-owned with Cybersettle). The two firms reached a settlement that included a stipulation that Apollo had not infringed the patent.
Patent Suits Related to Insurance	
Lincoln National Life Insurance Co. v. Transamerica Life Insurance Co., No. 1:2004cv00396 (N.D. Indiana, Oct. 21, 2004); __ No. 1:2006cv00317 (N.D. Indiana, Sept. 14, 2006); __ No. 1:2008cv00135 (N.D. Ind. filed May 20, 2008).	Lincoln is involved in several patent suits alleging that Transamerica and several other insurance companies are infringing one or more of its patents (6,611,815; 7,089,201; & 7,376,608) on a computerized method of administering an annuity with minimum payment features.
Other Patent Suits and Settlements	
Cybersettle v. National Arbitration Forum, No. 2007-1092 (Fed. Cir., July 24, 2007).	Cybersettle alleged that the NAF infringed its patent (6,330,551) on a computerized dispute resolution system and method. It prevailed in the district court, but the decision was vacated by the Federal Circuit for erroneous claim construction.

* All citations are subject to the economist's usual measurement error. Other cases are found in the text.

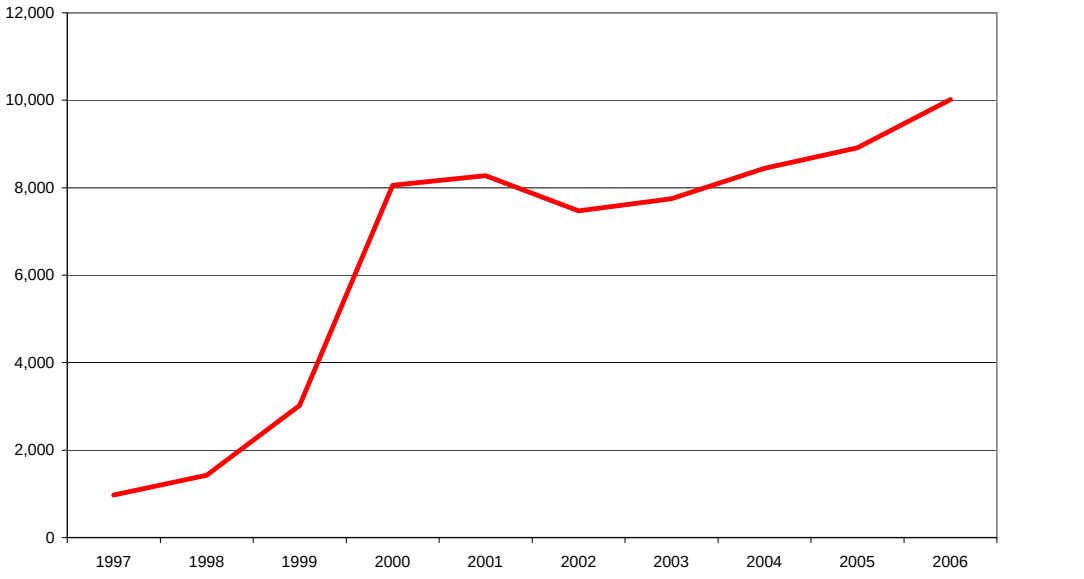
Table 2: A Nonrandom Sample of Business Method Patents Granted in 2008	
Description*	Company[#]
A method and system for predicting changes in interest-rate sensitivity induced by changes in economic factors that affect the duration of assets and liabilities, including core deposits (no. 7,328,179).	McGuire Performance Solutions, Inc.
A method and system for calculating marginal cost curves for electricity generating plants (no. 7,333,861).	NeuCo, Inc.
A method of selecting sector weights and particular securities for a stock portfolio (no. 7,340,425).	First Trust Portfolios
A system and method of calculating prepayment and default risk, loss given default, and default correlations for the purpose of valuing a portfolio of assets (no. 7,340,431).	Freddie Mac
A machine and computer program that enables the pricing of auto insurance based on the risk associated with driving at particular locations and times (no. 7,343,309).	International Business Machines Corp.
A system and method for trading pollution emission allowances (no. 7,343,341).	Chicago Climate Exchange, Inc.
A computer-implemented method of computing price elasticities, choosing from one or more demand models based on goodness of fit (no. 7,343,355)	i2 Technologies US, Inc.
A method of assessing the capital adequacy of an automotive finance company (no. 7,346,566).	Ford Motor Company
A method of creating a customized payment card, based on a consumer's instructions/images, via a website (no. 7,360,692).	AT&T Delaware Intellectual Property, Inc.
A method of sharing the profits generated by a payment card program, in excess of some target, with users of the card (no. 7,360,693).	JPMorgan Chase Bank, N.A
* The author's interpretation, based on the patent's claims or description of the invention [#] Initial assignee on the patent document	

Figure 1: Business Method Patents Issued



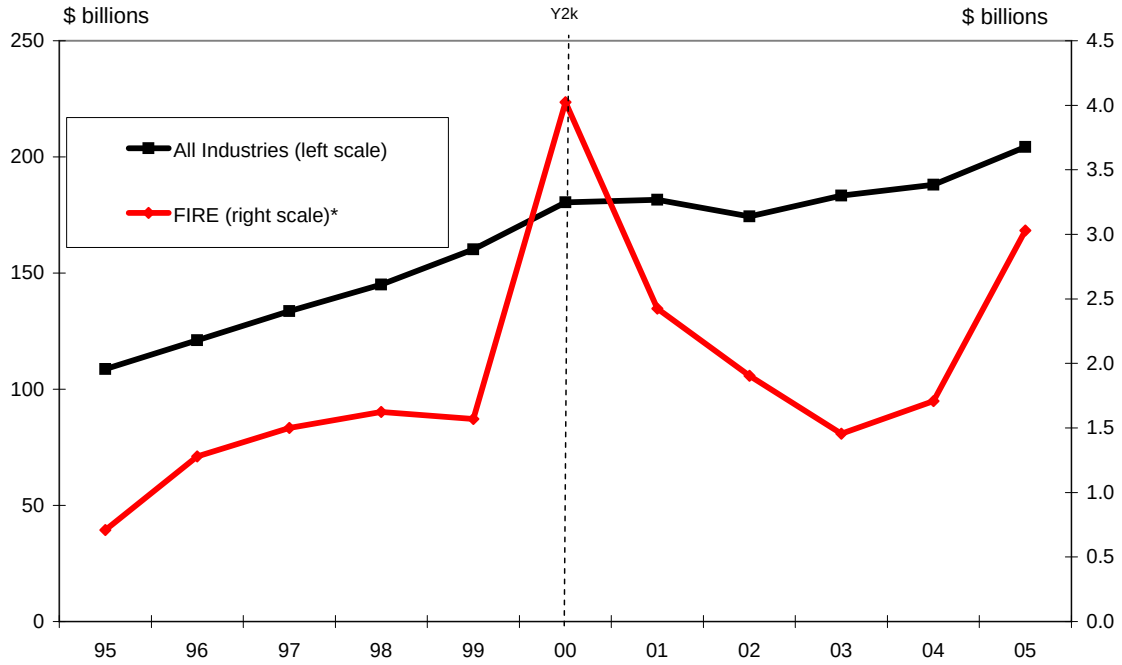
Source: U.S. Patent & Trademark Office & author's calculations
e: The 2008 total is estimated from 5 months of data
*: patents in subclasses 1, 4, 7, 10, 16, 26, 30, 33, 45, 53, and 64-80 of Class 705. See appendix for details.

Figure 2: Applications for Business Method Patents



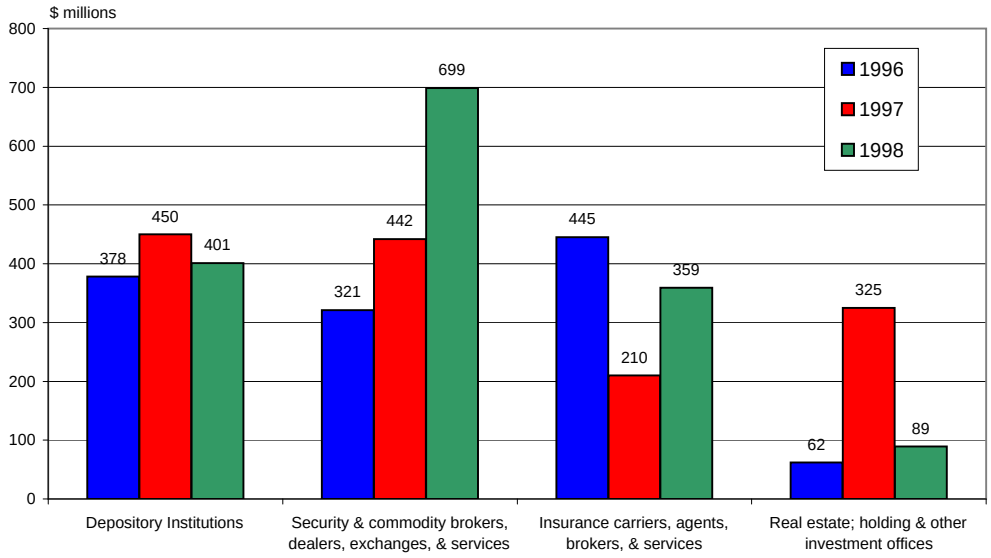
Source: U.S. Patent & Trademark Office

Figure 3: R&D Spending



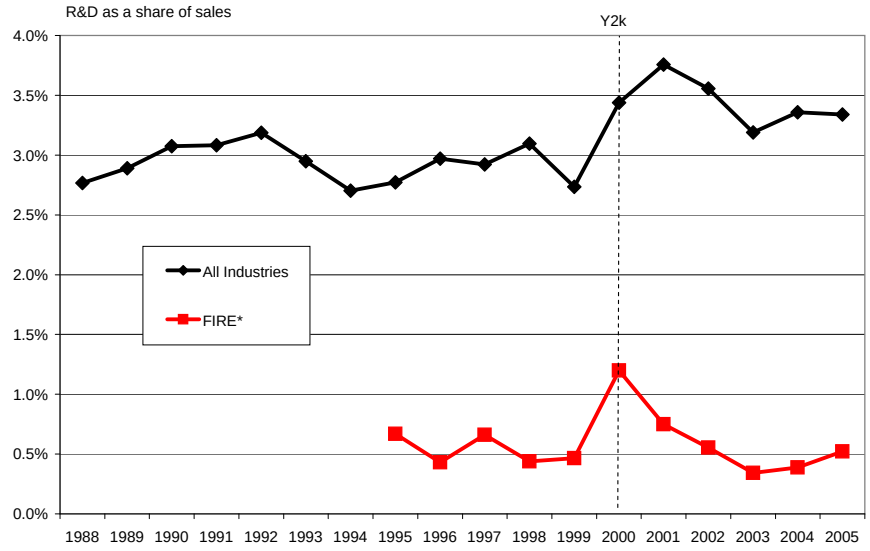
Source: National Science Foundation
*: Finance, Insurance, and Real Estate

Figure 4: R&D Spending by Financial Segment



Source: Jankowski (2001), based on data from the NSF Survey of Industrial R&D
Note: FIRE also includes non depository credit institutions (e.g., finance companies) but data were only disclosed for 1996 ($88 million).

Figure 5: Research Intensity



Source: National Science Foundation & Author's Calculations
*: Finance, Insurance, and Real estate

Figure 6: Composition of "Potential Research Workers," 2005

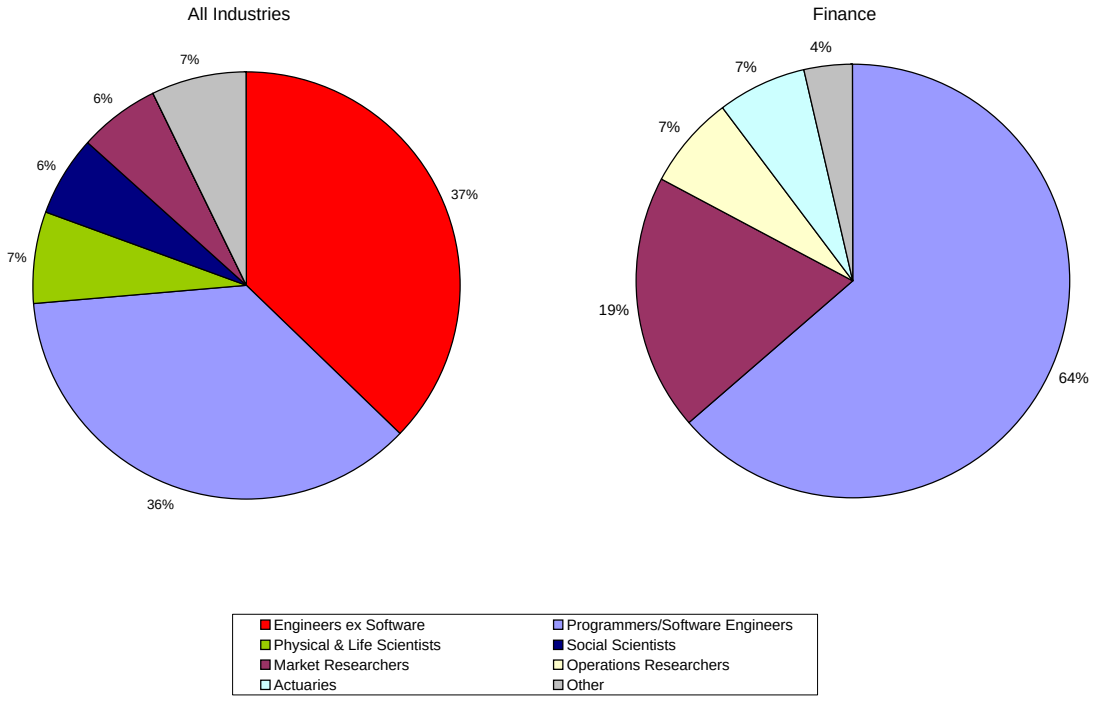
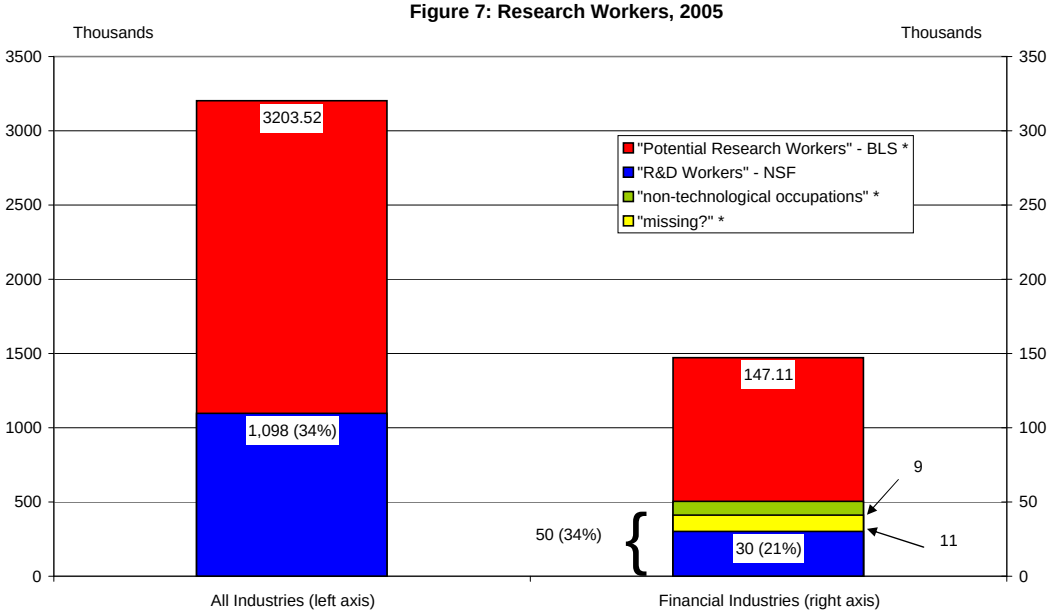


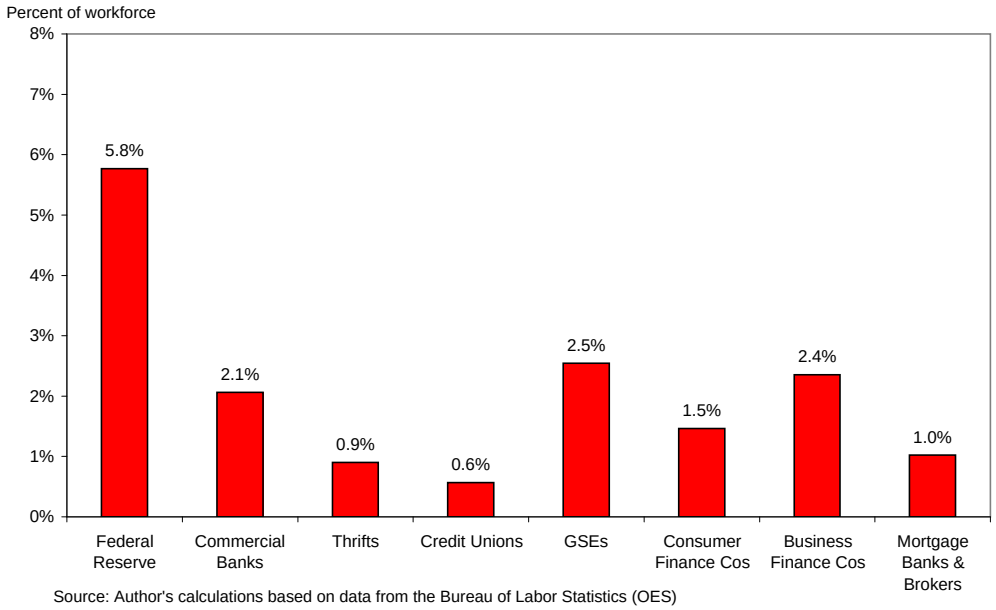
Figure 7: Research Workers, 2005



Source: Author's calculations using data from Bureau of Labor Statistics and National Science Foundation

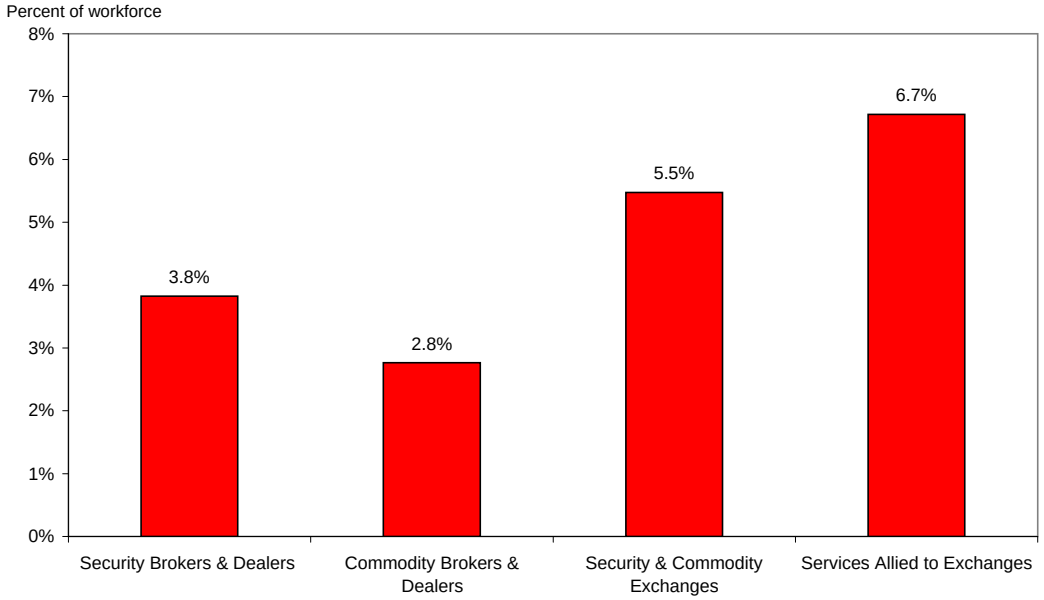
*: See the text for the definition of potential research workers. Note these include workers in "non-technological" occupations, which are associated with fields that are not included in the NSF measures of R&D expenditures: actuaries, market and operations researchers, and social scientists. Estimates of additional financial R&D workers assume the true ratio of NSF R&D workers to potential research workers in financial services is identical to the ratio for all private industries (34%). About half of this amount may result from undercounting R&D workers who are in these "non-technological" occupations. The remainder is categorized as potentially missing. See the appendix for additional information.

Figure 8: Potential Research Workers - Banking, 1990-2001



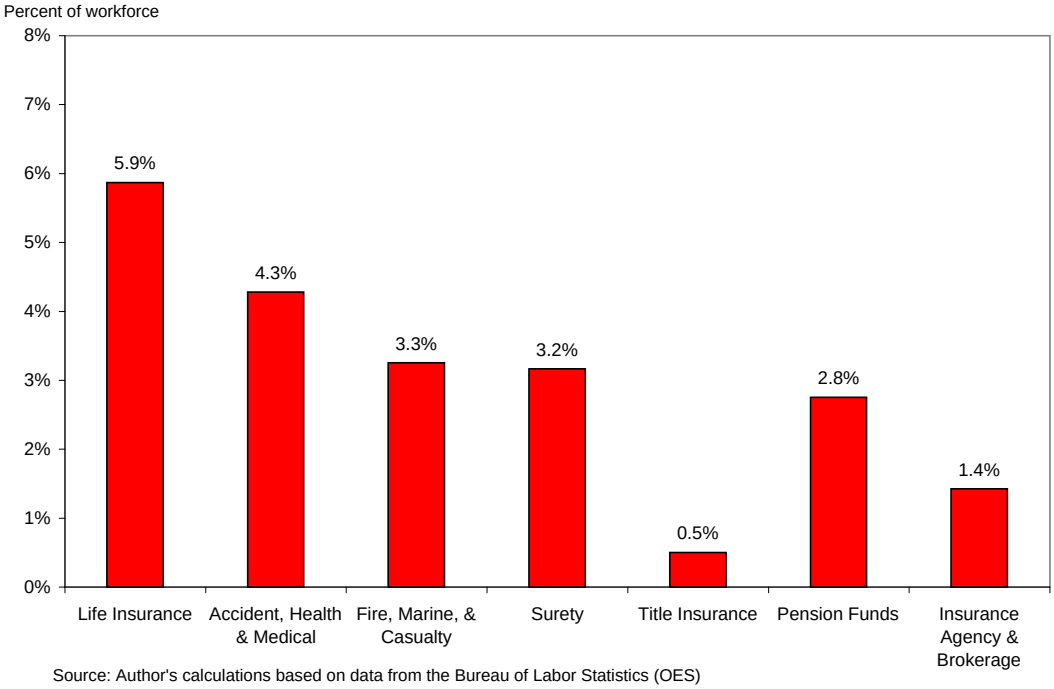
Source: Author's calculations based on data from the Bureau of Labor Statistics (OES)
Note: See text for the definition of potential research workers

Figure 9: Potential Research Workers - Securities & Commodities, 1990-2001



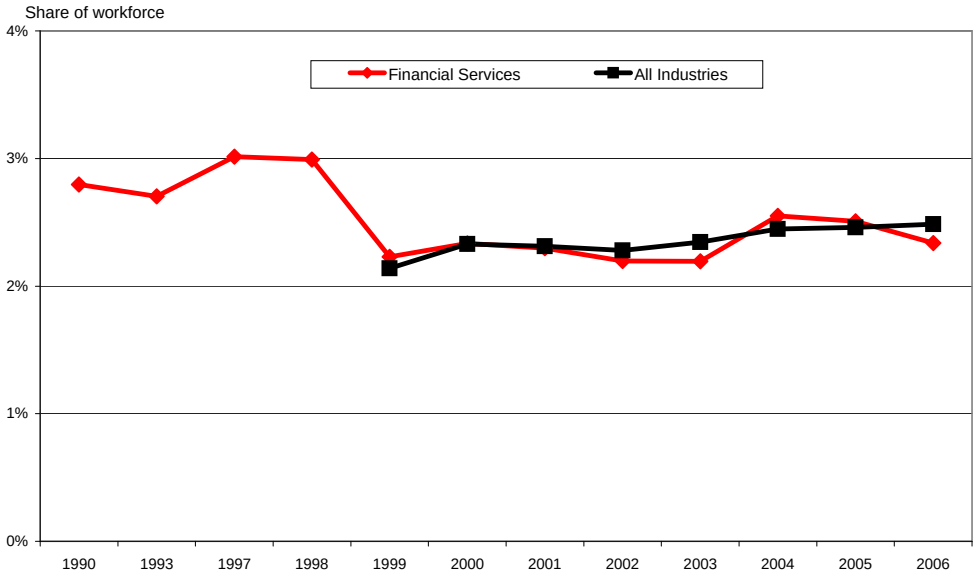
Source: Author's calculations based on data from the Bureau of Labor Statistics (OES)
Note: See text for the definition of potential research workers

Figure 10: Potential Research Workers - Insurance, 1990-2001



Source: Author's calculations based on data from the Bureau of Labor Statistics (OES)
Note: See text for the definition of potential research workers

Figure 11: Potential Research Workers*



Source: Author's calculations based on data from the Bureau of Labor Statistics (OES)
Note: See text for the definition of potential research workers