

CHANGES IN TESTS OF PATENTABILITY AND  
THE EFFECTS ON RETURN TO  
PATENTING OF BUSINESS  
METHOD PATENTS

by

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ABSTRACT

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In the past decade there has been a surge of business method patents granted, due in large part to court cases that have redefined the tests for determining patentability of these inventions. This is of interest for several reasons such as the legality of these patents and their role in promoting innovation. Rather than promoting innovation as desired, they may be used to block rival firms from competing or used as bargaining chips in negotiations. This research focuses on the relationship between firm value and the importance of a firm's patent portfolio. To measure the strength of a patent portfolio it can be found how many patent citations the portfolio has and firms that are cited more often would be deemed more important.

This research finds a weak relationship between patent citations and increased firm value possibly since business method patents themselves may be less valuable than pharmaceutical or chemical patents for instance. It's also observed that the return to a citation is negative after critical court rulings, contrary to economic intuition. Possible reasons for these mixed results are discussed.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Business Method Patents

In the past decade there has been a surge of business method patents granted, due in large part to court cases that have redefined the tests for determining patentability of these inventions. This has been a topic of great interest in the law and economic communities for several reasons such as the legality of these patents and their role in promoting innovation. This research focuses on the relationship between firm value and the importance of a firm's patent portfolio with respect to this class of business method patents. A firm with a relatively strong patent portfolio would be expected to have a higher market value than a firm with a weaker portfolio. To measure the strength of a patent portfolio it can be found how many patent citations the portfolio has, and much the same way as scholarly journals, firms that are cited more often would be deemed more important and hence likely to produce marketable products. It is the intent to better understand if market participants perceive business method patents to be profitable, and to what extent.

Business method patents are of particular interest because, unlike the pharmaceutical or chemical industries, it is unclear how important these patents are in promoting innovation. Business method patents may not be providing incentives for innovation, but rather being used to block rival firms from competing or used as bargaining chips in negotiations. Also, patents on abstract or mathematical ideas are deemed not patentable, but many business method patents walk a thin line in this respect. Lastly, the topic is very current and in fact not even resolved since the Supreme Court heard arguments on what will be a pivotal case in November 2009 with what will certainly be a critical decision released in early 2010.

## 1.2 Patent System

The role of the patent system is to encourage innovation and invention by granting temporary monopoly rights to inventors for their creations. For example, this is particularly beneficial to the pharmaceutical industry where R&D costs are relatively high; however, the end product can easily be reverse engineered and sold by a competing firm, foregoing the R&D costs. Having a patent system gives patent holders a method of recourse given violations of the patent.

The performance of the patent system will also play a large role into the quality of patents that are granted. This is of particular interest with regard to the class of patents categorized as business method patents, which experienced a surge of applications from 1999 to 2001 (Hall). This surge of applications is largely attributable to a decision issued by the US Court of Appeals of the Federal Circuit (CAFC) in the *State Street Bank and Trust v Signature Financial Corporation* case. The patent at hand was a software package used to value mutual funds, and was deemed patentable if the underlying mathematical algorithms were used in the invention. U.S. patent class 705 is defined as “data processing: financial, business practice, management, or cost/price determination” and is regarded as the business method class (USPTO). The four largest groups in this class are (White Paper 1999):

1. Determining who your customers are, and the products/services they need/want
  - 1.1. Operations Research - Market Analysis
2. Informing customers you exist, showing them your products & services, and getting them to purchase
  - 2.1. Advertising Management
  - 2.2. Catalog Systems
  - 2.3. Incentive Programs
  - 2.4. Redemption of Coupon
3. Exchanging money and credit before, during, and after the business transaction
  - 3.1. Credit and Loan Processing

- 3.2. Point of Sale Systems
- 3.3. Billing
- 3.4. Funds Transfer
- 3.5. Banking
- 3.6. Clearinghouses
- 3.7. Tax Processing
- 3.8. Investment Planning
- 4. Tracking resources, money, and products
  - 4.1. Human Resource Management
  - 4.2. Scheduling
  - 4.3. Accounting
  - 4.4. Inventory Monitoring

Hall also points out that while strengthening or expanding a patent system typically leads to an increase in patents, it is not clear if this also leads to an increase in innovation. One explanation for this may be that firms are using the patents as a blocking mechanism against competitors. By holding many patents on obscure inventions, such as algorithms or business practices, a firm's goal may be to restrict its competition, rather than expand its own innovation.

Therefore, it is of interest to investigate the role the patent system plays in promoting innovation and the effects to competition. Theory suggests a patent system would be a good incentive tool when sunk costs are high and imitations are easy and/or cheap. The most obvious example of this situation is most likely the pharmaceutical industry. Green and Scotchmer (1995) investigate the negative effects of a patent system in industries where innovative advances build on the previous, or are sequential in nature. The initial innovator may experience profit erosion from subsequent innovative products that makes the original research unprofitable. When subsequent products are not in direct competition with earlier products, the initial innovator is only able to collect profits from the social value of the original research and

not from products stemming from the original research. Bessen and Maskin (2006) results are consistent with this, that patent protection in the sequential case described previously doesn't encourage innovation as much as the non-sequential case, and may discourage it.

Hunt (2001) also considers sequential innovation in combination with a standard of patentability, referred to as the non-obviousness requirement in the U.S. or equivalent in meaning to the inventive step requirement used in Europe. Since it is not sufficient for an invention to be only new, the standard of patentability is the degree of which the new invention is innovative from the prior art. Therefore, a low standard of patentability would indicate new inventions are relatively close to the prior art whereas a high standard would indicate new inventions are highly more innovative than the previous. He finds two important conclusions, first as the standard of patentability increases from very low levels so does innovation, however, when the standard is raised from very high levels innovation decreases. This would indicate that there is an optimal standard of patentability that maximizes innovation. This is represented in figure 1.1. Second, in industries that innovate rapidly a relatively higher standard of patentability should be used to maximize innovation.

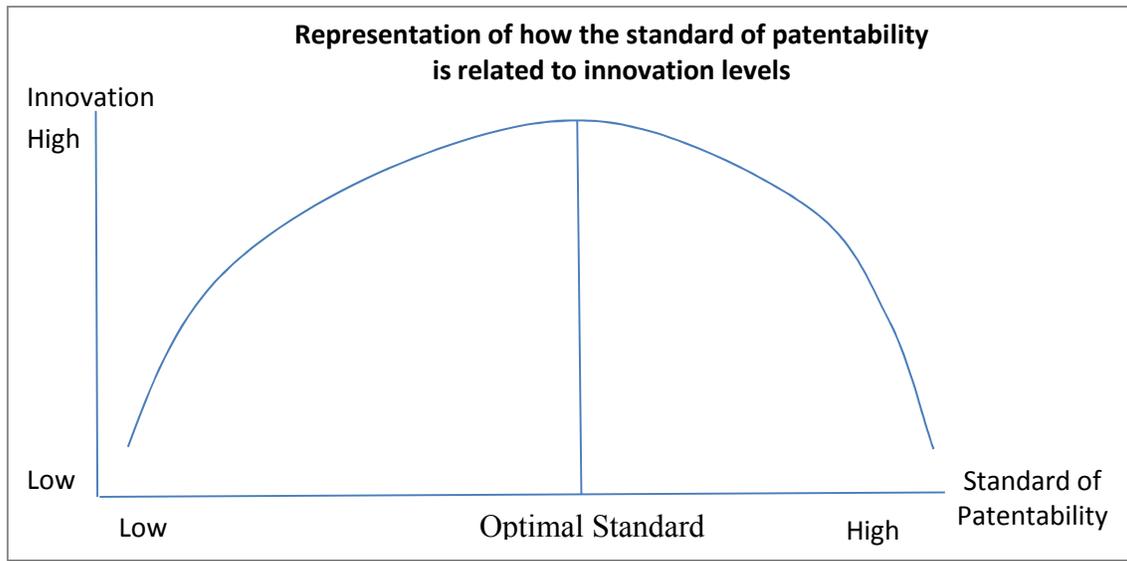


Figure 1.1 Representation of how the Standard of Patentability is related to Innovation Levels.

This theoretical work demonstrates that the effectiveness of a patent system in promoting innovation depends on static and dynamic effects. Static effects, such as a specific standard of patentability, determine the level of innovation by establishing how many (or how likely) an invention is to get a patent. Dynamic effects can be represented by the profit erosion process that can take place in industries with sequential innovation; and in turn not be as innovative.

Mansfield (1986) performed a survey of 100 randomly chosen manufacturing firms (excluding very small firms) across 12 industries, and asked their top R&D executives "What percentage of their products would not have been introduced without a patent system in place". While the estimates could obviously be biased, Mansfield noted "they appear to have been prepared with considerable care". These estimates were greater than 20% for only two industries, Pharmaceuticals (65%) and Chemicals (30%), although all industries reported patenting over half of their eligible inventions. Four industries reported that all of their products would have been developed without a patent system, but still patented at least 50% of their eligible inventions.

Cohen et al (2000) administered a survey of 1478 R&D labs in the manufacturing industry in 1994. They find that among profit protection mechanisms such as patents, secrecy,

lead time advantages, and marketing and manufacturing capabilities, patents tended to be the least emphasized. The most prominent motives for patents were prevention of copying, “patent blocking” or preventing rivals from patenting similar work, and their use in negotiations and lawsuits.

## CHAPTER 2

### LITERATURE REVIEW OF COURT CASES

#### 2.1 Supreme Court Patent-Eligibility Trilogy

The Supreme Court Patent-Eligibility Trilogy is three landmark Supreme Court cases occurring within ten years of each other revolving around the patent eligibility of mathematical algorithms. Abstract ideas and laws of nature are ineligible for patents, such as the Pythagorean Theorem or the General Theory of Relativity. However, machines or processes that make use of such ideas are not ineligible simply on the grounds that they make use of these ideas. At the heart of all three cases will be section 101 of the Patent Act, which reads:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

The first two patent cases discussed are rejected on the grounds that inventors are claiming no new process or machine other than the algorithm. However, the last case is affirmed as patent eligible on the grounds that a new and useful process/machine was created that makes use of an algorithm in the form of computer software.

##### *2.1.1. Gottschalk v. Benson*

*Gottschalk v. Benson* was a 1972 United States Supreme Court case that revolved around the patent eligibility of mathematical algorithms. The patent application claimed a mathematical algorithm for converting binary-coded decimal numerals into pure binary numerals in general computers. The United States Patent and Trademark Office (USPTO) rejected the application on the grounds that the application pointed to an algorithm alone, and no specific machinery or transformation of substances, which had been the case for all previous patents concerning processes. In its brief to the Court the Government asked that no process be deemed patentable unless it claimed a new machine or transformation of substance. The Court

declined to accept those conditions as necessary, but rather that they were indicators of patentability.

The impact of the decision is viewed as affirming that computer software alone is not patentable. Instead, when the software in conjunction with a general computer is the patent claim lower courts have deemed this patentable, because technically the patent claim is a new machine. This ruling also leaves the conditions for process patents ambiguous, as the Court did not define necessary conditions. These conditions will be the matter of debate in further cases.

### *2.1.2. Parker v. Flook*

*Parker v Flook* was a 1978 United States Supreme Court case revolving around the patentability of a smoothing algorithm for updating alarm limits within a reactor. The algorithm used a weighted average of a variable, temperature in this case, to avoid temporary temperature fluctuations from setting off alarm limits. Flook's method was unique only with respect to the algorithm, which the Supreme Court and patent examiner assumed Flook derived. However, Robert Brown had published work on this smoothing algorithm eight years earlier. This case differs from *Gottschalk v. Benson* in containing a specific application, or field-of-use limitation, catalytic conversion of hydrocarbons. The Supreme Court, stating that nearly any mathematical formula could have such a limitation, rejected Flook's claim that the field-of-use limitation made the formula patent eligible. The Court further clarified that a process is not patentable simply because it contains mathematical formulas or laws of nature. Patents involving abstract principles, in this case an algorithm, are patentable if the implementation of the principle is novel and unobvious.

Judge Giles Rich of the United States Court of Customs and Patent Appeals (CCPA) can summarize criticism of the case. The main criticism is that, as the Court noted, the entire case revolves around the construction of section 101 of the Patent Act. Judge Rich states that § 101 was never intended to determine patentability, but rather § 102 and § 103. Section 101 of the Patent Act begins with the statement "Whoever invents or discovers any new and useful

process” and it was on these grounds that the Court rejected the patent. Flook had conceded that the process was not novel and nothing was added other than the smoothing formula. It was the Court’s opinion; specifically Justice John Stevens that Flook had actually not claimed to invent anything that was patentable. Without such a concession as in the Parker v Flook case it is unclear that a patent can be rejected purely on the grounds of section 101, which is seemingly what occurs in Diamond v Diehr.

### *2.1.3. Diamond v. Diehr*

Diamond v Diehr was a 1981 United States Supreme Court case revolving around the patentability of computer software. The process being considered was the curing of synthetic rubber into a mold which depends on several factors, in particular temperature. It is possible to calculate when to open the press based off of the Arrhenius Equation, but before the invention there was no way to accurately measure the temperature without opening the press. The invention involved using thermocouples in the press to measure the temperature, then feeding these values into a computer and using the Arrhenius Equation to determine when to open the press.

The patent was originally rejected, arguing the computer process was patent ineligible under Gottschalk v. Benson. The Board of Patent Appeals and Interferences of the USPTO agreed with the rejection upon review. The Court of Customs and Patent Appeals reversed the decision citing that a patent was not ineligible simply for containing mathematical algorithms or a computer were involved. The Supreme Court later upheld that decision, repeating that software alone is not eligible for patent protection, but a machine or process that makes use of software is different from one which claims an algorithm in the abstract. The Court did not go as far as to overrule the two previous cases discussed, rather stating that under section 101 of the Patent Act the patent must be considered in its entirety.

## 2.2 Patentability of Business Methods

Up until approximately the 1980’s it had been the position of the USPTO that patents on business methods were not patentable. Two examples for forming this precedent are Hotel

Security Checking Co. v. Lorraine Co. and Joseph E. Seagram & Sons v. Marzell in 1908 and 1950 respectively. However, with the increase of patent applications concerning computer and internet processes for conducting business in the 1980's and 1990's, the USPTO deemed it necessary to adjust how these patents were reviewed. Rather than having patent examiners determine if a particular patent is a method of doing business, these patents were to be reviewed as any other one would. The following two court cases, State Street v Signature Financial and AT&T v Excel are widely regarded as providing the momentum behind the surge of business method patents that were granted.

#### *2.2.1. State Street Bank and Trust v. Signature Financial Corporation*

State Street Bank and Trust v Signature Financial Corporation, also referred to as State Street, is a July 23, 1998 decision of the United States Court of Appeals for the Federal Circuit which changed the landscape of eligibility for business patents. State Street established the precedent that an invention was patent eligible if, in the words of the court, "it produces a useful, concrete and tangible result", in this case a share price. The patent contains a process for pooling together different mutual funds with the intent of lowering operating costs. As an effect, a partnership is created for tax purposes so that the portfolio does not pay any taxes as outlined by the Internal Revenue Service (IRS).

The "produces a useful, concrete and tangible result" test of patentability used in State Street was affirmed on April 14, 1999 in AT&T Corporation v Excel Communication, Inc. However, subsequent cases have led Supreme Court Justices to cast aspersions over business methods. In 2006, a concurring opinion in the case of eBay Inc. v. MercExchange, L.L.C. Justice Kennedy wrote:

An industry has developed in which firms use patents not as a basis for producing and selling goods but, instead, primarily for obtaining licensing fees. ... For these firms, an injunction, and the potentially serious sanctions arising from its violation, can be employed as a bargaining tool to charge exorbitant fees to companies that seek to buy licenses to practice the patent.

The patentability test presented in State Street would eventually be deemed inadequate in the Federal Circuit's 2008 In re Bilski decision.

### 2.2.2. *In re Bilski*

*In re Bilski* is an en banc decision of the United States Court of Appeals for the Federal Circuit (CAFC) made in 2008. The Court affirmed the rejection of a business patent regarding hedging risk in commodity trading and set the precedent that the machine-or-transformation test is applicable for test patent eligibility and not the “produces a useful, concrete and tangible result” test from *State Street*. The patent examiner rejected the patent on grounds that the invention had no specific apparatus, and was merely the use of an abstract idea to solve a mathematical problem. Upon appeal the Board of Patent Appeals and Interferences affirmed the rejection on several grounds, in particular that the claim produced no “useful, concrete and tangible result”.

This case clearly demonstrates the ambiguousness of how to evaluate business patent applications. On the one hand, the patent examiner conducted a machine-or-transformation test, which was the precedent from the Patent-Eligibility Trilogy of the 1970’s, whereas on the other hand the Board of Appeals conducted the test set forth in *State Street*. The Federal Circuit court upheld the rejection of the application, citing the cases of the Patent-Eligibility Trilogy, as well as other cases from the early 19<sup>th</sup> century. The Court went on to reiterate specific limitations addressed earlier in *Flook*, and add that insignificant pre or post solution activity does not make a claim patent eligible.

The Court then expressed its opinions of other patent eliminability tests. The Court, based from earlier Supreme Court opinion, regarded the *State Street* test as inadequate but did not believe it should be overruled. The Court also considered the technological arts test that a patent eligible invention much be technological, and was rejected on several grounds. Primarily that the language is vague and that the machine-or-transformation test is the only appropriate one. The Court did not put forth that business methods are patent ineligible, and should be noted that *Benson* put forth criteria where the machine-or-transformation test fails but is still patentable. The Supreme Court granted certiorari in *In re Bilski* and heard arguments on November 9, 2009 with a decision expected in early 2010.

CHAPTER 3  
RESEARCH METHODOLOGY

3.1 Event Studies

An event study methodology can be used to determine what relationship, if any, exists between changes in patent eligibility (the event) on abnormal stock market returns to firms. There are several reasons why this methodology is relevant given the research question at hand. This methodology has a wide range of applications across many disciplines such as finance, biology, and accounting, providing a large amount of scholarly research for reference. This methodology has also been in practice since about the 1930's providing an extensive time period for advancements and improvements to be made.

While there is no single procedure for an event study, there is a general guide to developing the model. First, the event must be defined; in this case the event(s) is court rulings that have a significant effect on patentability. Second, an event window must be established. This is a period of time in which securities prices related to the event will be examined. This is typically multiple days, and at minimum includes the day the event occurs. Next, the firms that will be examined must be identified by a shared characteristic; in this case firms holding business method patents will be the main identifying characteristic. It's important to consider any possible biases that may have been introduced through the selection process of the sample.

The abnormal return for firm  $i$  at time  $\tau$  is

$$AR_{i\tau} = R_{i\tau} - E(R_{i\tau} | X_{\tau})$$

where  $AR_{i\tau}$ ,  $R_{i\tau}$ , and  $E(R_{i\tau} | X_{\tau})$  are the abnormal, actual, and normal returns respectively. The actual return is simply firm  $i$ 's return over period  $\tau$ . The normal return is typically modeled by either the constant mean return model or the market model. These two models will be discussed in greater detail in the next section.

Once a model has been selected to represent the normal returns, an estimation window must be selected to estimate the parameters of the chosen model. The estimation window may vary from days to months in length depending on the nature of the event and data availability. The estimation window does not typically include the event period itself since doing so could influence the parameter estimates of the normal returns.

There are several different models that can be used for estimating the normal returns, however only the two most common models will be discussed here, since other methods either offer little improvement over these methods or have fallen out of practice entirely.

#### 1) Constant Mean Return Model

For a given firm, let  $\mu$  be the mean return for the firm. Then the model is:

$$R_i = \mu + \xi$$

Where  $R$  is the current periods return and  $\xi$  is the period's disturbance term with an expected value of 0. While this model is considered one of the simplest models, Brown and Warner (1980, 1985) find that its results are often close to more complex models. This can be attributable to the variance of the disturbance term, which is often not greatly reduced with more complex models.

#### 2) Market Model

This model relates an individual firm's return to that of a market portfolio

$$R_i = \alpha_i + \beta_i R_{mT} + \varepsilon$$

Where  $R_i$  is the firm's return, and  $R_m$  is the market portfolio's return. By eliminating the amount of return to the firm that is attributable to general market movements, the abnormal return variance can be reduced and thus demonstrates an improvement to the constant mean return model. The market portfolio is typically represented by the S&P 500, or any other broad based index.

Assuming a market model to estimate the normal returns, the abnormal return for firm  $i$  at time  $\tau$  is now equivalent to

$$AR_{i\tau} = R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau}$$

These abnormal returns must now be aggregated across time and security to draw conclusions for the event of interest. First, consider an aggregation across time which will be referred to as the sample cumulative abnormal return (CAR). Define  $CAR_i(\tau_m, \tau_n)$  such that  $\tau_n > \tau_m$  and both periods are in the event window. Then  $CAR_i(\tau_m, \tau_n)$  is the sum of all included abnormal returns,

$$CAR_i(\tau_m, \tau_n) = \sum_{\tau=\tau_m}^{\tau_n} AR_{i\tau}$$

In a similar manner the aggregated abnormal returns for a period is:

$$\overline{AR}_\tau = \frac{1}{N} \sum_{i=1}^N AR_{i\tau}$$

Using a similar approach for calculating CAR, the average abnormal returns can be aggregated over the event window as

$$\overline{CAR}_i(\tau_m, \tau_n) = \sum_{\tau=\tau_m}^{\tau_n} \overline{AR}_\tau$$

### 3.2 Patent Citations

Patel and Ward develop a model based off of a creative-destruction hypothesis and how it is relevant to the pharmaceutical industry. The hypothesis states that as new innovations are created in an effort to develop new products, these new products will destroy the usefulness of previous innovations since they are no longer relevant, or up to date. For example, the innovation of the typewriter extended several decades in developed countries until subsequent inventions, i.e. the computer, made the typewriter obsolete. As firms compete to create these innovations, they develop a portfolio of patents in the process. Since innovations are heterogeneous in value, one measure of how this heterogeneity is revealed is by observing patent citations. The empirical test proposed measures the market return and patent citation levels for firms to see what type of relationship exists between these variables.

A positive relationship is found to exist in the sense that increased citations to a firm's patent will increase its market value, as well as citations to an area of science where the firm is prominent. The patent methodology used is particularly useful in R & D intensive industries, such as the pharmaceutical industry. While a single patent will likely have a very small effect on market value, numerous citations to a patent is likely to be a stronger indicator of the importance of a patent, and hence its likelihood to be profitable to the firm in the future. Cockburn and Griliches (1988) as well as Lanjouw and Schankerman (2004) have pointed out flaws of this methodology such as the consideration of industry and firm specific conditions, as well as introducing more precise estimates to patent importance. The citation pattern for a specific patent can also be interrupted as "news" about where innovation is headed in the industry, and the level of innovation destruction that is occurring. Since there is likely imperfect information between market participants and the researcher, patent importance will not be observed until after the actual event has occurred. Therefore, the number of future citations to a patent is a good indicator of the current importance of a cited patent. In a similar manner, patent citations that overlook a particular firm that has a large research presence may be an indicator that the firm's technology and innovation is becoming obsolete. This implies the citations are directed towards a competing firm, indicating the competing firm is on the rise.

It has been observed that the number of patents granted has been increasing yearly. Possible explanations for this increase include increased research, increased use of the patent system (possibly attributable to changes in patent law), or decreased standards for acceptable patents. This method has become particularly useful with the increased digitizing of the patent information, allowing this method to be more easily extended to other industries of interest. Analysis of more industries could be beneficial in determining what effect government policy has on patent citation patterns, as well as innovation.

### 3.3 Research Methodology

The amount of intellectual property generated in the form of patents by a firm can be an indicator of future products to be marketed. One measure of the amount of intellectual property

that is being generated is the amount and quality of patents in the firm's portfolio. A large and high quality patent portfolio can be essential to firms since it is a strong indicator of future profit streams for the firm. For example, information of a firm's patent portfolio is often one of the first questions asked by venture capitalists when considering investing in a firm. A strong patent portfolio demonstrates to market participants that the firm has unique ideas and products that could lead to increased profits. Since the majority of patents do not individually lead to marketable products, a measure of patent "importance" will be required to analyze the effects the previously discussed court cases had on patenting. One such measure is observing the number of patent citations to a firm's patent portfolio. A patent portfolio that has many citations would be regarded as having a higher level of intellectual property, and hence a higher probability of producing marketable products, than a portfolio with none or few patent citations. This research focuses on two specific measures of patent "importance" that are differentiated by the timing in which information is revealed to market participants.

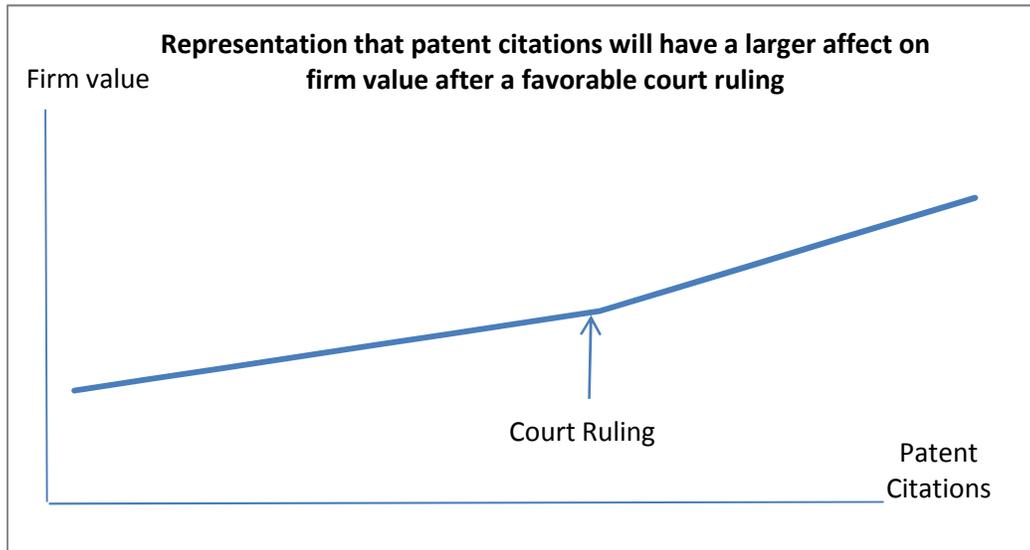


Figure 1.2 Graphical Representation of Research Hypothesis

We first define a patent citation,  $Cite_{ijts}$ , where  $i$  represents the patenting firm,  $j$  represents the citing firm,  $t$  represents the cited patents grant date, and  $s$  represents the citing patents grant date. We then define a measure of all future citations to a firms patent as the sum of the future citations, labeled forward citations, and measured as,  $ForCite_{it} = \sum_j \sum_s Cite_{ijts}$ . In a similar fashion, we define backward citations as the sum of all citations that have already been granted,  $BackCite_{is} = \sum_j \sum_t Cite_{ijts}$ . Therefore, forward citations measure how important a patent will be revealed to be in the future, whereas backward citations measure how important a patent is currently revealed to be. These different patent citation measures can then be used to model a firm's abnormal return as,

$$\begin{aligned} \text{Abnormal Return}_{it} &= \delta_i \\ &+ \sum_{-w}^w \gamma_{0,w} \text{CitationMeasure}_{it+w} + \text{PostCourtRuling} \\ &+ \sum_{-w}^w \gamma_{1,w} \text{CitationMeasure}_{it+w} * (\text{PostCourtRuling}) + \varepsilon_{it} \end{aligned}$$

CitationMeasure is a general term that will be replaced with specific measures of patent citations. PostCourtRuling is a dummy variable used to test the hypothesis that there is a significant change in firm market value after the favorable court ruling, and the interaction is used to test the hypothesis that the return to patenting is significantly different after a favorable court ruling. The abnormal return can be modeled using,

$$AR_{it} = R_{it} - E(R_{it} | X_t)$$

And the normal return is modeled using the market model:

$$R_i = \alpha_i + \beta_i R_{mT} + \varepsilon$$

Making the full estimated model for the abnormal return:

$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mT}$$

It's important to note that while the main event of research interest is individual court rulings, an actual event for using the event study methodology is a patent citation. Each patent citation is

assumed to convey news to market participants, and as patent citations to a specific patent illustrates, the research hypothesis is that the value of patenting will have a larger effect after favorable court rulings. Statistically, a significant  $\gamma_1$  coefficient would provide evidence that the favorable court rulings for business method patents produced a larger relationship between patenting and abnormal returns to a firm. A significant  $\gamma_0$  coefficient would indicate that patent citations do have an effect on a firm's abnormal return.

There are also specific patents during this time period that will have special characteristics worth examining. Earlier court cases that initially granted patents may have their precedents weakened by later cases. By investigating the marginal effect with respect to these firms many firm and industry specific variables can be controlled for.

### 3.4 Data Description

Patent data was obtained from the National Bureau of Economic Research (NBER). In particular, data containing information linking patents to those patents that cite them. This data, when sorted according to the citing patents grant date, is used to construct the backwards citation variable. Data containing information for each patent such as grant date, firm that holds the patent and industry classification of the firm was also collected from NBER. Firms were selected using the patent class classification code of 705, as this represents business method patents. Daily abnormal return estimates, or beta excess returns, were obtained from The Center for Research in Security Prices (CRSP). CRSP calculates these returns using a more complex market model than the one discussed earlier, controlling for factors such as dividend payments, splits, swaps, etc... Fama-French Factors were also collected from CRSP at the monthly level and will be discussed in greater detail in the following chapter.

CHAPTER 4  
RESULTS AND CONCLUSION

4.1 Results

The models estimated include the beta excess return as the dependent variable and are summarized in Table A.1 in Appendix A. The first model includes the measure of backwards citations; dummy variables representing both the State Street and ATT decisions, and these dummies interacted with the backward citations. Since the number of citations is increasing with time the mean number of citations per day is calculated for each year and then subtracted from the backwards citation variable. This difference is the variable representing backwards citations and is used throughout the models.

Consistent with previous research, the coefficient of the citation measure is positive indicating that increased citations will increase firm's beta excess return. However, contrary to previous research this variable is not significant. Previous research has focused on the pharmaceutical industry, which is consistently viewed as benefiting greatly from a patent system and thus may produce a stronger result. For instance, in the manufacturing industry Cohen et al (2000) finds that among profit protection mechanisms such as patents, secrecy, lead-time advantages, and marketing and manufacturing capabilities, patents tended to be the least emphasized. Thus, patent citations related to business method patents may not carry as strong a value as pharmaceutical patents.

The dummy variables representing the favorable decisions of State Street and ATT are both highly significant but opposite in sign. The initial ruling of State Street is estimated to have a positive effect on firm's return whereas the ATT decision is negative and larger in magnitude. Contradictory to the research hypothesis the interaction of these dummy variables with the backwards citation measure is negative but insignificant. This indicates a citation after the court cases lowers firm's beta excess relative to before the court case rather than increasing as

expected. The two court cases were found to be highly correlated with one another, which will lead to the second model.

The second model removes ATT due to high correlation with State Street, which is deemed as the first and most important favorable ruling regarding business method patents. However, the results are relatively unchanged as the backwards citation measure is still positive and insignificant. The net negative effect found in the previous model associated with the court cases seems to be transferred to the State Street decision and remains highly significant. As in the previous model, the interaction between the court case and backward citation measure is negative and insignificant.

The third model adds Fama-French factors to the previous model. Fama and French (1992) extend the Capital Asset Pricing Model (CAPM) by including measures of size and book-to-market equity to control for common risk factors in returns. A portfolio is created, Small-Minus-Big Return, which is meant to mimic risk factors related to size by taking the difference between small and big stock portfolios returns that have approximately the same book-to-market equity. Another portfolio, High-Minus-Low, is created to mimic the risk factors related to book-to-market equity in a similar fashion. Using data from 1963-1991 the correlation between the two portfolios is only -.08 demonstrating the effectiveness each factor has in being independent of one another. After adding the Fama-French factors the only difference between model 3 and model 2 is the State Street dummy variable loses significance to the 10% level.

Since economic intuition would suggest that the individual effects of court cases not interacted with patent citations should not have an influence on abnormal returns, an alternative model with the main effect of State Street removed while retaining the interaction was also estimated with no change in coefficient signs, significance levels, or magnitudes. Lags were also considered to investigate the possibility that abnormal returns may not be observed until one or two days after the actual citation occurred and the results remained unchanged.

## 4.2 Conclusion

The main research hypothesis that the return from a citation would increase after favorable court cases was not demonstrated in this research for possibly several reasons.

First, there is always the concern of omitted variable bias. This is likely of minimal concern since the Efficient Market Hypothesis states that all current information is represented in the current price. Perhaps an unobserved event such as a macroeconomic shock or significant law case coinciding with the observed court cases is biasing these unexpected estimates. Further research may include analysis of a control patent class that experienced little variation during this same time period for comparison.

Second, there is a possibility of a specification error with respect to measuring backwards citations. Perhaps using the number of citations as a measure of a firm's patent portfolio is inappropriate for these firms and a different measure should be used. As Cockburn and Griliches (1988) and Lanjouw and Schankerman (2004) pointed out there are flaws of this methodology such as the consideration of industry and firm specific conditions, as well as introducing more precise estimates to patent importance. Due to the small sample size used controlling for industry effects may be difficult, and the use of Fama-French factors is one method to control for firm effects. Perhaps citations from only the largest or most profitable firms are significant whereas citations from smaller firms are not as important. Also, some business method patents may be considered as blocking mechanisms towards competing firms rather than innovative and novel ideas. This misspecification will increase the amount of measurement error in the model and produce less significant results.

Third, perhaps market participants viewed business method patents as not innovative but merely blocking mechanisms to competitors or as bargaining chips in negotiations. In this sense business method patents could be viewed as counterproductive if they resulted in lengthy court appeals over their legitimacy or lawsuits concerning their legality, while producing no marketable products. Also, market participants may have anticipated the eventual reversal of current decisions and incorporated that information into the price long before the actual

reversals. The ruling in State Street was likely uncertain until the actual ruling, whereas later cases contained information with respect to the strength of the case and the likelihood of a favorable ruling. Perhaps the outcomes of later cases was relatively certain to market participants much earlier than anticipated by this research hypothesis.

APPENDIX A

REGRESSION RESULTS

Table A.1: Estimated Models			
	Model Including State Street and ATT Decisions	Model Including Only State Street	Model With Fama French Factors Added
diffbackcite	0.023 (0.02)	0.023 (0.02)	0.023 (0.022)
effectDummyState	0.109 (0.033)***	-0.048 (0.014)***	-0.028 (0.017)*
diffbackciteDummyState	-0.0069 (0.033)	-0.023 (0.021)	-0.023 (0.023)
effectDummyATT	-0.173 (0.032)***		
diffbackciteDummyATT	-0.016 (0.027)		
Small-Minus-Big Return			-1.66 (0.226)***
High-Minus-Low Return			-2.502 (0.252)***
Observations	101321	101321	101321
R-squared	0.00	0.00	0.00
Coefficients and standard errors multiplied by 100 Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%			

APPENDIX B

LIST OF FIRMS

Table B.1 List of Firms

Alcatel	Hitachi	Pitney-Bowes
AT&T	Honda	R. R. Donnelley
Compaq	Honeywell	Sabre
Dallas Semiconductor	IBM	Schlumberger Industries
Diebold	Lockheed Martin	Siemens
Eastman Kodak	Lucent	Sony
Ford	Merrill Lynch	Texas Instruments
Freddie Mac	Micron Technology	Toyota
Gilbarco	Motorola	Unisys
Hewlett Packard	Nippon Telegraph	Xerox

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## BIOGRAPHICAL INFORMATION

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