1. Introduction

The value of intangibles has lately been the subject of much attention, both in practice and in academic research. There have been a wide range of studies regarding different types of intangibles such as patents, research and development (R&D), brands, training, knowledge, information, and human capital. The fast growth of knowledge intensive industries and the rapid progress of information technology have led to question regarding how best to represent these intangible assets to investors. The capital stock of U.S. intangibles comprises approximately one half the market values of all US corporations. Private US firms invested at least one trillion dollars in intangibles in year 2000, which roughly equals the gross investment in corporate tangible assets (Nakamura 2003). However, the complications in measuring the present value of such assets, and the ambiguity of their future returns, have made it troublesome for firms to explicitly state the true value of their investment. Conventional accounting rules have not had much success providing a fair demonstration of such investments. For instance, in the case of R&D activities, Standard of Financial Accounting Standards (SAFS) No. 2 requires the immediate expensing of all R&D activities, providing investors with little clarification as to the true value of such investments. The result is a noticeably higher level of information asymmetry among knowledge intensive firms and industries (Boone and Raman 2001). Software capitalization is the only exception to the full expensing rule of R&D (SEAS No. 2). It allows companies to shift some of their software development costs from an expense in the current period to an asset that is amortized over time.

An excerpt from Accounting Standard No. 86 reads:

“*This Statement specifies that costs incurred internally in creating a computer software product shall be charged to expense when incurred as research and development until technological feasibility has been established for the product. Technological feasibility is established upon completion of a detail program design or, in its absence, completion of a working model. Thereafter, all software production costs shall be capitalized and subsequently reported at the lower of unamortized cost or net realizable value.*”

Software development is the core of information systems (IS) construction and the key driver to innovation. The intense competition in this market has forced software development companies to take advantage of any communication tools available to disclose the value of their intangibles. These signals can either be in the form of an accounting strategy, such as capitalizing some part of the R&D costs (an exception to SFAS No 2. only for software development company), or through other means such as filing patents, or informing financial analysts. Naturally each of these approaches has its merits and weaknesses.

Since capitalization has the effect of boosting the valuation of financial performance by shifting the software cost from expenses paid to the investing section of cash flow statements, it can be used to inform the market of future asset development. Because a firm cannot capitalize its software R&D until technological feasibility has been attained, at the point where firms do capitalize these costs they signal the success of their development activities. Capitalization of R&D costs also signals the likelihood that management will soon be able to provide more accurate estimates as to the future benefits of these specific R&D expenditures. Although the benefits of capitalization are fairly well defined, companies must proceed with care when confronted with the choice of whether or not to capitalize software R&D. For example, if a company is overly optimistic about the value of its software, upon future reevaluation they may have to write-down parts of their assets, leading to an

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1 [http://www.fasb.org/summary/stsum86.shtml](http://www.fasb.org/summary/stsum86.shtml)
earnings surprise. As a result, some companies take a more conservative approach and choose not to capitalize their software development costs.

Recognizing R&D expenditures as intangible assets is not the only way to signal information about the future benefits of development costs. There are other types of disclosers, such as filing patents that firms can also employ to communicate the value of their intellectual property. While R&D shows a firm’s commitment in generating knowledge based assets, patents indicate the success in generating such assets. Many software companies file for patents in order to commercialize their inventions, while also signaling their innovation accomplishments to the market. On the other hand since patent protection is not guaranteed, and patent information becomes publicly available upon filing, firms must be prepared to sacrifice secrecy in order to complete the patent process. These requirements can be legally and technically complicated, and their compliance often requires a legal expert’s assistance.

Although patent activity and capitalization have both been addressed separately in the literature, the relationship between these variables and their impact to simultaneously signal firm value has never been studied. To that end, we focus on companies that undertake software development projects, assessing the link between the capitalization of software development cost and successful patent applications as two different means to signal the firm’s valuation. We start by exploring the effect of successfully issued patents and firm’s capitalization on the information asymmetry that exists between the firm and the market, and then extend the investigation to measure the effect on analysts’ forecast error.

2. Prior Literature
There are a few studies that have investigated the factors that influence firm’s capitalization decision. Aboody and Lev (1998) considered attributes such as firm size, software development intensity, profitability, and leverage as the contributing variables in distinguishing between firms that choose to capitalize versus those that rather expense all their R&D costs. They have concluded firms that are smaller, less profitable, more leveraged, and that have a higher ratio of development costs to sales, tend to capitalize more of their software development costs. Kothari et al (2002) study the relative degree of uncertainty of future earnings attributable to current R&D investments and concluded that R&D investments generate future benefits that are far more uncertain than benefits from investments in PP&E. Patent activity is a widely used measurement for protecting technological innovations. Hall and et. al. (2005) have found that patent citation has a noticeable effect on market value. Bloom and Reenen (2002) have also shown that patents have a significant impact on firm-level productivity and market value.

3. Hypotheses Development
During the innovation stage, projects often face significant risks and technical challenges. An issued patent shows the market that a company has arrived at technologically feasible solutions. Additionally, it is a way for management to signal to the market that the firm has a successful R&D component. Regardless of the firm’s ability to meet the implementation challenges, patents remain an indication of new projects and more R&D investments. Filing for a patent sends a signal that the firm has a successful project, which decreases future uncertainty and diminishes the information gap between the firm and the market. The financial economics literature, however, suggests that stock markets respond to signals only when they contain information that has cash flow implications Kelm et. al (1995) argue that investors interpret later information in the light of prior available information. Thus, although firms may make announcements about specific projects at various times, these announcements will lead to a revision of stock prices only if they carry relevant information that has not been previously disseminated to, or anticipated by, the market. Given that
patents and capitalization each have signaling value, we hypothesize that the presence of both moderates each other’s signaling power.

**Hypothesis I:** The presence of successfully issued patents and the capitalization of software development costs will reduce the information asymmetry between the firm and the market, and their mutual effect moderates their individual signaling power on information asymmetry.

Our next hypothesis links the effect of capitalizing software development costs and successfully issued patents on analysts’ forecast error. Analyst forecasts involve predicting firms’ earnings, which is largely impacted by software development expenses. Since software development expense is calculated by subtracting the software capitalization amount from the software development cost, capitalization of software development cost will result in more difficult earnings predictions. Aboody and Lev (1998) indicate that since the amount capitalized each period is determined by unpredictable success rates, analysts concerned with the size of their earnings forecast are to be expected to view capitalization negatively. They test their hypotheses by controlling for a firm’s size, number of analysts and age of the forecast and find that capitalization of software development cost is positively related to analysts’ relative forecast error. However, this justification does not hold for other types of public signals such as filing for patent. The difference between the analysts’ perception of the firm compared to the public comes from the analysts’ private (idiosyncratic) information. The less analysts depend on publicly available information such as press releases or announcements, the less their forecast will be sensitive to such information. Barron et. al (2002) showed that analyst earnings forecasts for firms with a higher composition of intangibles contain higher proportions of private information relative to common information. That is, analysts following firms with higher levels of intangible assets use their available private information more than their public information. In conclusion, we expect analysts following software development companies to rely more heavily on their private information, and be less influenced by public signals such as patent filing. Consequently we do not expect a significant interaction effect between filling for patents and capitalization of software development cost on analysts forecast error.

**Hypothesis II:** Capitalization of software development cost will increase the forecast error, and the presence of successfully issued patents does not have a strong effect on analysts’ forecast error.

4. Sample and Data, and Measurements
We initially chose 500 computer programming and prepackaged software firms chosen SIC 7370-7372. We excluded those firms that were not involved in software development, non-US companies, and firms that had missing financial reports in SEC filings. For the remaining 260 firms we collected data for years 2000 to 2008. Since Compustat and other similar databases generally aggregate the capitalized software cost and related amortization values, we had to collect these values directly from the SEC filings. However because of the lack of regularity in structure of SEC filings, the automating task of data collection was very difficult and required careful manual cleaning and screening. Our patent data were collected from the United States Patent and Trademark Office (USPTO) homepage. Merging the patent data with the related Compustat data was also a challenging task. USPTO database uses the name of firms instead of a unique identifiers such as CIKnumber. In order to match the patent data with the firms’ financial data, these names would have to be uniquely assigned to their Compustat counterparts. For the rest of the financial related variables we mainly used Compustat database and filled some of the missing values from Thomson One Banker and Mergent Online. We get the analyst information such as reported annual
earnings per share (EPS), analysts EPS forecast, number of analysts following the firm, and the age of the forecast from I/B/E/S database.

**Measurement of dependent and control variables**

Following the literature (Roulstone, 2003) we use the relative bid-ask spread as a proxy for information asymmetry. **Spread** is the absolute value of the bid-ask spread divided by the average of bid and ask. **FE** is the analysts forecast error which is the absolute value of reported annual earnings per share minus the forecast value scaled by end of the year stock price. **Cap** is the capitalized amount of software development cost adjusted by market value at the end of the fiscal year. **42%** (110 out of 260) of the firms in our sample capitalize all or a portion of their software development cost. This value will be zero for firms that do not capitalize any portion of their software development cost. **Patent** is the number of successfully applied patents. Although the patent citation is a commonly used measurement in patent related literature, we chose to use the number of successfully applied patents for the following reasons. Patent citation is a task that progresses gradually and over a relatively long period of time. On the contrary information asymmetry and forecast error are extremely time sensitive. The effect of any changes in firm’s strategy or any news will be reflected in such variables in a short period of time. Moreover it is common for firms to announce the news of their filed patent application as soon as their application has been submitted. They use different channels such as press releases, companies’ announcements, weblogs, and ext. to signal the information to the public. Since our data is collected from 2006 to 2008, it is possible that all applied patents in later years have not gone through yet, to control for such possibility we use a fixed effect model. **Volatility** is the logarithm of stock return volatility, defined as the standard deviation of daily stock returns. The more volatile a firm’s price is, the more uncertain the market is of the short-term cost of holding the stock. We expect firms with higher volatility have a higher forecast error rate. **Profitability** is the net income plus software amortization minus the annually capitalized software divided by sales. We expect firms with higher profitability rate would have more available information and less forecast error rate. **Age** is the interval between the forecast date and earnings announcement date. We expect a smaller forecast error when the forecast date is closer to announcement date. **Turnover** is the annual average of the logarithm of daily turnover. We expect firms with higher turnover rate would have more available information and smaller forecast error rate. **Intang** is the amount of intangible assets of a firm scaled by market value at the end of the fiscal year. In the US setting, it has been shown that analysts make larger earnings forecast errors for firms with higher underlying intangibles (Barron *et al.*, 2002) **Analyst** is the number of analysts following the firm. We expect more information when more analysts are following the firm. **Volume** is the trading volume of the firm, as firms with higher trading volume present analysts with more information to inform investors. **Pricemean** is the annual average of logarithm of daily stock price. Stocks with low prices face higher usual spreads.

5. **Empirical Analysis**

To test for the first hypothesis we follow the literature (Roulston, 2003, Mohd 2005) use the spread as a measurement for information asymmetry. We control for number of analysts following the firm, firm’s trading volume, and the annual average of the daily stock price. We include **Cap** as the capitalization amount scaled by market value of the firm at the end of the fiscal year, number of successfully applied patents, and the interaction term between patent and capitalization as our explanatory variable.
Spread_{it} = \sum_{y=2000}^{2008} \beta_{0y} YR_{it} + \beta_1 Cap_{it} + \beta_2 Patent_{it} + \beta_3 Cap*Patent_{it} + \\
\beta_4 Analyst_{it} + \beta_5 Volume_{it} + \beta_6 Pricemean_{it} + \varepsilon_{it}

Table 2: Regression Estimates of Spread

***Denote significance at a probability level below 0.01
**Denote significance at a probability level below 0.1

Table 2 reports coefficient estimates from this regression. The sign of all variables is consistent with prior literature that higher number of analysts reduces the information asymmetry; higher trading volume provides more information to the market and reduces the information asymmetry. Our result confirms the literature that stocks with low prices face higher usual spreads. The positive sign of the interaction term is consistent with our hypothesis that by increasing the number of patents the signaling power of software capitalization reduces and vice versa. The significant value for capitalization indicates that when the number of patent is zero that is the firm has not applied for any patents, the increase in capitalization value would reduce the information asymmetry. On the other hand the significant value for patent variable indicates that when capitalization amount is zero, the higher number of filed patents would reduce the information asymmetry between the firm and the market.

To test for our second hypothesis we include logarithm of capitalization scaled by market value, number of patents, and the interaction term between patent and capitalization as our explanatory variable. We control for the amount of firm’s intangible assets scaled by market value, firm’s stock return volatility, age of the forecast, and the firm’s profitability and turnover.

\[ FE_{it} = \sum_{y=2000}^{2008} \beta_{0y} YR_{it} + \beta_1 Cap_{it} + \beta_2 Patent_{it} + \beta_3 Patent*Cap_{it} + \beta_4 Volatility_{it} + \beta_5 Profitability_{it} + \\
\beta_6 TurnOver_{it} + \beta_7 Intang {it} + \beta_8 Age_{it} + \varepsilon_{it} \]

Table 3: Regression Estimates of Forecast Error

***Denote significance at a probability level below 0.01
**Denote significance at a probability level below 0.1

As the result in table 3 indicates and consistent with previous literature, we found more profitable firms and firms with higher turnover create smaller forecast error rate. The error rate for firms with higher portion of intangible assets is higher, and the age has a significant effect on reducing the error rate. Our result confirms our hypothesis that capitalization of software development cost will increase the analysts’ forecast error however when the firm does not capitalize, filing for patent does not have a significant effect on analysts forecast error. And as expected, our result does not indicate a significant effect for interaction of filed patents and capitalization of software development cost on analysts forecast error.
6. Concluding Remarks

In this study we examined the relationship between filing a patent and the accounting practice of capitalizing or expensing the software development costs. We found that while filing for patent had a significant effect on reducing the information asymmetry between the firm and the market; it does not display a significant effect on analysts’ forecast error rate. On the other hand while capitalization of software development cost significantly decreases the information asymmetry between the firm and the market, it significantly increases the analysts forecast error rate. We also found that the mutual effect of filing for patent and capitalization of software development cost moderates their individual signaling power on information asymmetry.

Our findings can have important strategy implications for corporations. Reducing the information asymmetry would increase the firm’s valuations as the market usually compensates for uncertainty with lower prices. In this situation, our findings provide valuable insight for managers to apply a targeted signaling strategy. Our results suggest that while the public responds to disclosures of a firm’s activities such as filing for a patent and capitalization of software development costs, analysts concerned with their forecast error rate may not appreciate such disclosures. In such circumstances, where firms decide to capitalize their software development costs, they can complement them with more accurate and detailed information to compensate for the increased analysts confusion.

Capturing the difference in the type of information these two signaling tools provide, and examining the impact of firm conservativeness in their choice of filing for patent or capitalization of software development cost and advancing the endogeneity analysis are the immediate next steps in this research.

References
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