Organizational Signaling of Blockchain Investments: A Patent Filing Event Study

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Abstract

Blockchain technology has seen claims by many practitioners as one of the most disruptive technologies we have seen in decades. Investments in emerging technologies, such as blockchain, focus on innovations that may lead to competitive advantages and subsequently protecting those innovations from competitors through patents. Patents function as a means of signaling to the market the research directions that an organization is exploring along with the potential future value of the patent and related technology. This proposed study examines the market reactions to blockchain-based patents to help organizations determine the anticipated market value of these blockchain-based patents and strategically leverage such events for optimal market reaction.

Keywords

Blockchain Technology, Innovation, Event Study, Emerging Technology

Introduction

Blockchain technologies have made noteworthy strides the last few years despite the significant focus on one of its most popular applications, bitcoin. Originally created to provide the network structure that supports and enables bitcoin's existence, blockchain technology has become much more than just the backbone for cryptocurrencies.

The disruptive potential of blockchain to alter the business world continues to grow, but there appears to be much confusion regarding what blockchain is and what blockchain can do, even among technology proponents. Confusion and limited detailed knowledge of emergent technologies is common in the information technology industry, especially during early hype cycles, leading to some technologies having inflated expectations, such as big data or the cloud (Valdes et al. 2016). As proponents and media continue to provide vague definitions and expected benefits from their initial learnings, the popularity of blockchain has continued to surge and bring with it inflated expectations of a technology we have yet to fully understand (Furlonger et al. 2017).

As companies begin investing in blockchain technologies, stakeholders are also responding to the hype with equally inflated expectations. During 2017, the value of bitcoin rose over 1500% while the stock market responded with unfounded volatility. In an attempt to leverage the blockchain hype in the market, during the middle of December 2017 the Long Island Iced Tea Corp changed its name to the Long Blockchain Corp. The result? A nearly 300% increase in share price the next day, with many wondering how a soft drink company plans to change itself to a technology company (Shapira and Leinz 2017).

This market response to a simple name change is obviously an irrational response and shows how it is not only organizations and those running organizations that are involved with the blockchain craze, but also the market itself. As organizations continue to find novel uses for blockchain technology, one way that they signal to the market their innovation potential is to apply for patents to protect these novel uses. Prior studies (Dos Santos et al. 1993, 2012) have examined these market reactions to a variety of IT-related events. While these events are not always directly rewarded with increased market value, organizations are typically rewarded for trying new tactics and attempting to take risks.
Patent output is one way to measure the level of involvement and investment in a new technology. Studies linking the number of patents to levels of innovation and technological commitment have undertaken multiple replications (Acs and Audretsch 1989; Griffin et al. 2018). Looking at an organization’s patent portfolio has a very clear relationship to potential value for the company and the level of commitment that a company has within that technology (Grimaldi et al. 2018).

Patents act as a broadcast signal of the level of investment in an emerging technology which is made publicly available once a certain point in the patent application process has been reached. Signaling theory (Connelly et al. 2011; Spence 1973) provides us insights into how a company may convey certain information to the market indirectly when there is a high level of information asymmetry between inside and outside stakeholders. As most investors do not have direct, internal information regarding an organization’s investments and direction, the use of patent activity gives the market the opportunity to respond early to potential innovations an organization may produce in the coming years.

As blockchain technologies are still in early development and continuing to evolve as organizations explore their potential, the number of patents filed has continued to increase as organizations find novel and innovative uses for the technology. In this research, we argue that patent applications, or their initial submission to the USPTO, signal a potential innovation and a research area to the market, while patent approvals signal actual innovation the organization has control over. Using these two types of IT-related patent events, we conduct an event study to address the following research question and examine the market reaction to blockchain patents.

Research Question: What are the effects of blockchain-related patent events on firm market value during emergent technology hype cycles?

Potential contributions for this work include (1) a deeper understanding of market reaction to emergent technology hype such as what we are currently seeing with blockchain technologies; (2) identification of organizational signals and their value for outside stakeholders in determining the potential value of organizational investment and innovation during the early stages of these emergent technologies; and (3) strategies and expectations for organizations to signal their organizational innovations through patent-related events to reduce information asymmetry between inside and outside stakeholders. As blockchain technology is a rapidly changing and evolving technology that is not universally understood in the market, due to its early stages of development, this research provides an increased understanding in ways that the market reacts to these potentially over-hyped technologies.

Literature Review

Blockchain

As an emergent technology, there has been limited agreement regarding the exact definition of blockchain; there is, however, some agreement regarding the features of a blockchain and its potential benefits. A blockchain application is a “peer-to-peer system for validating, time-stamping, and permanently storing transactions and agreements on a shared ledger that is distributed to all participating nodes” (Lacity 2018). Blockchain technology refers to the immutable decentralized distributed ledger that allows these peer-to-peer systems, such as bitcoin, to function based on algorithmic trust.

While bitcoin, the original blockchain use-case, is the most well-known application for blockchain technology, organizations have been exploring blockchain technologies for a variety of unique use cases beyond simple cryptocurrencies. For example, the IBM Food Trust is a blockchain network that is being used to track the provenance of food from farm to store, speeding up the process and reducing the cost of identifying recalled products of infected foods (Kamath 2018). Additionally, LO3 Energy, a solar energy company out of New York uses blockchain technology to run a peer to peer marketplace for users to buy and sell solar energy on a micro-grid utilizing automated processes to buy and sell electrical resources only when needed for its customers (Lacity 2018). These examples are just the tip of the iceberg of innovative uses of blockchain technologies that continue to emerge through organizational innovation which subsequently lead to blockchain-related patent activities.
While blockchain technology is only beginning to gain traction and use beyond proof-of-concepts, the hype surrounding blockchain has continued to grow and attract the interest of many organizations looking to take advantage of it. A report from Gartner (Cearley and Burke 2019) lists blockchain as one of the top ten strategic technology trends for 2019, stating that blockchain is disruptive and changes the way organizations, large and small, can interact with each other by removing friction between them like nothing we have seen before. While there are many organizations exploring the potential of blockchain technologies, we are still very early in the technology hype cycle with early blockchain use-cases such as cryptocurrencies just now entering into the trough of disillusionment after significant hype and inflated expectations. Deeper use-cases and organizational usage of blockchain technologies within the firm are still experiencing the peak of inflated expectations and may be significantly more difficult to relay the true potential value to outside stakeholders due to the limited market knowledge surrounding blockchain.

**Hypothesis Development**

Signaling theory details the effects that a signal (defined as an activity that conveys information) has on other parties. All actions taken by an organization can be seen as signals to outside stakeholders and broadcast information to interested parties, whether intentional or not. When investors are the interested party, the signal is used to evaluate the value of a firm (Spence, 1974; Bergh et al, 2011). For example, when a firm announces that they have a partnership with another firm, or have been subject to an unexpected loss, the market is expected to absorb the information and shift to reflect the new value of the firm (MacKinlay 1997). Similarly, we examine blockchain-related patent events as an indication of organizational investment in these emergent technologies.

When organizations file patents, the public receives a signal about the research interests of the organization. Even though patents sometimes occur as side-effects of normal R&D, they are used as a proxy to measure the innovative output of an organization. When an application for a patent is filed, the information regarding the organization’s investment is provided to the public through the patent office as well as public press announcements. The initial shock to the market will subsequently happen as the signals provide additional information to reduce the information asymmetry between inside and outside stakeholders.

The published application represents potential value for the organization due to these blockchain investments broadcasts to the market the organization’s direction. Reactions to these signals will lead to increased market evaluation due to this new information and potential regarding blockchain technologies and the subsequent market value of the organization shift. Thus, we hypothesize:

**H1:** Blockchain patent publication will result in higher cumulative returns in stock prices than the index.

With patents focusing on emerging technologies, the potential value of this published patent may not be as known and as such may be subject to more speculation and variability in reactions. However, once approved, patents protect actual competitive advantages and proprietary information. Blockchain technology is new and disruptive, so accepted patents will ensure organizations can protect and benefit from these innovations (Grimaldi et al. 2018). The shift from application to acceptance will provide additional signals and shift the potential value of the application into a known value. Thus, we hypothesize:

**H2:** Blockchain patent approval will result in higher cumulative returns in stock prices than the index.

The initial publication of a patent will inform the market of new research interests which may lead to a larger shift due to the incorporation of the potential future value. The publication signal also reveals more information to the market than the approval signal, the effect of the initial publication will also be reflected by the firm’s market value at the later time of approval. However, because approval is a known value it is possible that the market will react more compared to potential value. As the theoretical basis for these arguments indicate both potential scenarios, we examine the following competing hypotheses:

**H3a:** Blockchain patent publication will yield higher cumulative returns than patent approval.

**H3b:** Blockchain patent approval will yield higher cumulative returns than patent publication.
Method

Event Studies

One way to measure market reactions to events such as IT investments, leadership change, or other information dispersal is found in event studies (Chatterjee et al. 2001; Dehning et al. 2003; Dos Santos et al. 1993). Event studies measure the effect that a specific event has on the market value of a firm. The main assumption of the event study is that, when an event occurs, the market will move efficiently and reflect the value of the event almost immediately. Emerging technology is difficult if not impossible to directly measure in value due to the lack of knowledge and understanding in the market during emergent technology hype cycles. Therefore, we utilize event studies as a useful method in examining how the market reacts to signals of organization focus in the technology and subsequently evaluate the future potential of such technologies. If the market sees this investment (and thus this technology) as a poor choice, the value should decrease.

Data Collection

We use the online patent database\(^1\) to collect patent applications and approvals. The search yielded more than 1800 patent applications that contain the term “blockchain” in any of their fields. Data from the patents was collected, including patent number, assignee, and the date the application was published. Following data collection, the patents were organized into three categories; those assigned to individuals, those assigned to private companies, and those assigned to companies that are publicly traded or their subsidiaries. Also collected were patents involving bitcoin, the most popular application of blockchain. Many early bitcoin patents made no mention of blockchain, causing the number of bitcoin patents to outnumber blockchain patents until April 2018 when the number of blockchain patents per month began to consistently outnumber bitcoin patents per month as shown in Figure 1. Additionally, we will be collecting and controlling for bitcoin and other cryptocurrency related patents, the press coverage of these patents, the global cryptocurrency market capitalization, and firm-specific attributes (e.g. Industry, age, size, assets, prior patent activity) will help in better understanding the market’s reaction to these blockchain-related patent events.

![Patent Applications by Month](image)

**Figure 1. Patent Applications by Month**

Out of the 1843 patent applications that have been collected, a few companies appear as the top holders of patents. With 163 applications alone, IBM has shown consistent interest in blockchain technologies. Other patent applicants include Mastercard (54), Bank of America (51), and Intel (39). The rate of blockchain-based applications has increased remarkably over the past year, with January of 2019 having 195 patent applications and January 2018 having a total of 37 patent applications.

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1 https://www.uspto.gov/patents-application-process/search-patents
Every approved patent has three dates associated with it. One is the date the application of the patent is filed, known as the application date. **Application date** is used to determine the order a patent was received to help the office establish novelty based on the order of application. The second date is the **publication date** which is the date the application is made known to the public through the USPTO. A patent is published once the novelty of the patent has been established and may take up to 18 months after the application date to become published. **Acceptance date** is when the patent has been approved by the USPTO. The time taken between the application and acceptance of the patent may be an additional signal of the level of complexity and potential innovation of these blockchain-related patents and will examined to determine differences in the market reaction to anticipated (i.e., applications) and realized (i.e. acceptances) innovation. For this study, the actual application date may be irrelevant; if the market does not receive the signal that a patent has been filed via announcement or other means then all information will be unknown until publication date. Therefore, we will capture press reports of patent applications as a potential first patent–related event, the USPTO publication date as a second event, and patent acceptance as a final event.

**Estimation Model**

An event study requires the use of abnormal returns within the stock during the time period. Knowing the abnormal return requires having an expected return. The Capital Asset Pricing Model (CAPM) is among the most commonly used models for the prediction of the stock price of a certain firm, it has been criticized for being unable to capture all market risk and recent event studies use CAPM as well as other market models for robustness (Bose and Leung 2019), to improve our study we will do the same.. This study will use two indexes to control for technology industries. One analysis used to compare investments in these patent-related events will involve the use of the S&P 500 to act as an index amongst the largest 500 companies on the market and the use of the NDTX, an index focused exclusively on the technology industry. Pre-event and post-event estimation windows are used to get the firm’s estimated return during the event period. This estimated return is contrasted to the actual returns of the firm during the event window and the differences between these two are known as the abnormal returns. Statistical tests are run to determine that there is significant difference between the estimated returns and the abnormal returns and conclusions are drawn about the impact of the event. For an outline of the procedure, see Figure 2. Our study uses a pre-event estimation window of roughly 189 days (t_{app-200} to t_{app-11}) and a post-estimation window the same length of time happening after the event (t_{app+11} to t_{app+200}). For robustness, we will be running multiple event length analyses with the largest event window being 23 days (t_{app-11} to t_{app+11}) and the smallest event window of 5 days (t_{app-2} to t_{app+2}). Multiple event windows will be used to determine if the event is just market reaction to a hyped technology or if it reflects the market valuing the company differently.

![Figure 2. Patent Event Timing](image)

**Conclusion**

Blockchain technology is still in its infancy with more patent applications coming in every day and in turn more patents being accepted every day. The increased number of applications over the last year alone demonstrates the rate of interest and innovation is occurring while also distancing blockchain from its history as the backbone of bitcoin. This study will deepen the understanding of market reactions to emergent technologies; determine the effects of patents-related signals that communicate potential value...
in emergent technologies to outside stakeholders; provide organizations with strategic opportunities to signal innovation in emergent technologies through patent-related events.

REFERENCES