# The Benefit of Being Second: An Event Study of Social Media Adoption

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## Abstract

*New technologies are continually being introduced and changing how firms interact with their customers. Because of this rapid rate of change, one of the most fundamental questions a firm faces is deciding whether, and when, to adopt a new technology. This is even more challenging for public social media technologies (e.g., Facebook) that can be adopted by all competitors in a marketplace. Our study uses event study analysis to investigate the impact on firm value of adopting two social media technologies: Facebook and Twitter. We find increased value following the adoption of both Facebook and Twitter, but not all firms experienced an increase in value. Interestingly, it was the second wave of adopters (i.e., those that quickly followed the initial adopters) that benefited more than first movers or later adopters. This study sheds light on strategies for companies considering if (and when) they should invest in new social media technologies and other technologies of the same form – direct-to-consumer technologies and apps offered by a third party that are open to all competitors.*

**Keywords:** Social Media; Social Networking Sites (SNS); Facebook; Twitter; Diffusion of Innovations; Event Study.

## Introduction

The speed at which technology innovations are being introduced continues at an exceptional rate. New technologies are constantly changing not only how individuals interact with each other but also how firms interact with customers (Trusov et al., 2009). Because of this, innovation has become a core challenge for many organizations—with one of the most challenging questions being the decision of whether and when to innovate (Swanson & Ramiller, 2004). The decision to innovate often comes down to the strategic business value provided by the new technology (Oh & Pinsonneault, 2007). Value often accrues to those first adopting a new technology, particularly a technology that can provide a hard-to-copy competitive advantage (Barney, 1991; Santhanam & Hartono, 2003), and as such, often leads to increased firm value (Bharadwaj, 2000; Melville et al., 2004). However, are there advantages to adopting public direct-to-consumer technologies such as social media?

Studies typically focus on technologies that offer hard-to-copy competitive advantages (e.g., Subramani & Walden, 2001), or packages designed to revise internal business processes, hidden from a competitor's view (e.g., ERP adoptions (see Ranganathan & Brown, 2006)). In contrast, public

technologies operated by third party vendors (e.g., social media) are viewable by all competitors; they are inherently open to copying and thus may offer limited competitive advantage (Barney, 1991). Thus, the challenge is determining whether these technologies have value to the firm, and if so, when to adopt them. These technologies may be more dependent on network externalities, i.e. how many external users are engaging with the technology. Prior theory would suggest that if there are competitive advantages, they are fleeting, and thus, first movers might be able to capture some initial value while following firms see little value (Kerin et al., 1992; Lieberman & Montgomery, 1998). However, social media technologies may experience network effects, in that their usefulness increases as more people use them (Trusov et al., 2009), so being a first mover may not be the optimal strategy.

Our research examines whether the adoption of a public social media has an impact on the market value of firms and whether those impacts are affected by the timing of adoption. Specifically, we use an event study methodology to analyze changes in firm value following a firm's adoption of two public social networking sites (SNSs): Facebook and Twitter. Many firms are adopting SNSs because they provide new communication channels to interact with customers (Dong & Wu, 2015; Rosen & Phillips, 2011). Facebook has over 1 billion users[1] and Twitter has more than 320 million.[2] Furthermore, we address a firm's strategic approach to social technologies, which has been suggested as a priority for future strategic information systems research (Merali et al., 2012).

## Background and Hypotheses

Social media enable individuals to interact in ways not seen before (Boyd & Ellison, 2007) which has led organizations to consider social media as a means of engaging customers (Hale, 2010; Holzner, 2009). One social media technology having a large impact on the firm-customer relationship are SNSs such as Facebook and Twitter. SNSs are web-based services enabling individuals to create an online persona (e.g., Facebook profile or Twitter account), create/maintain connections (e.g., friends or followers), and connect/socialize with others (Boyd & Ellison, 2007; Gnyawali et al., 2010). These sites offer individuals and firms a means to present themselves in a digital format, enabling them to provide details concerning themselves and develop a network of relationships (Ellison et al., 2007).

For firms, corporate profiles (or "fan" pages) enable individuals to engage with firms through the SNS (Rosen & Phillips, 2011) and provide value to the firm with an additional customer communication channel (Dong & Wu, 2015; Xia & Zhang, 2010). Users can "like" (Facebook) or "follow" (Twitter) firms creating a new line of communication for firms to conduct targeted marketing to new and existing customers (Holzner, 2009). This enables firms to gain exposure to consumers and create specific content for a targeted market (Hale, 2010). The goal of the current study is to evaluate whether a firm engaging in a public SNS influences firm value. Specifically, we examine the initial entry of consumer-facing firms into SNSs and the impact on the firm value.

Some researchers have argued there is minimal cost to adopting public SNS technologies (e.g. Facebook or Twitter) (Trusov et al., 2009) which suggests that all organizations should adopt SNSs regardless of business value. However, prior research on adoption and implementation concludes that while the initial cost to adopt may be minor, there are often substantial ongoing costs to operate that technology (Goode, 2005; Goode & Stevens, 2000; Irani et al., 2006). Today, more than 75 percent of Fortune 500 firms have a social media presence with multiple staff, whose salaries range from $50,000 to $110,000 or more[3] (Shih, 2015). Adoption of SNSs is often part of a larger strategic plan involving numerous employees implementing these strategies (Hansen & Kein, 2015). In fact, many firms spend $5-10 million a year on social media, both managing external social media sites and advertising (Mohr, 2012; Sweeney, 2012). Thus, while the cost of creating a SNS page for an individual person is minimal, Fortune 500 firms adopt SNSs knowing there are a variety of large initial and ongoing costs, including staff to design/implement the site, monitor customer feedback, create/manage online marketing campaigns, and site maintenance/updating (Mohr, 2012; Sweeney, 2012).

### Business Value of Innovation

Innovation can be one of the most important sources of competitive advantage creating firm value (Dess, 2000; Tushman & O'Reilly, 1996). This is why innovation adoption continues to be a prominent topic in IS research with various theories linking organizational innovation adoption to business value (Melville et al., 2004). Research has examined a range of topics from the approach of innovation adoption (Choi & Chang, 2009; Swanson & Ramiller, 2004) to the diffusion of these innovations (Fichman, 2004; Wejnert, 2002). One prominent theoretical lens is the resource-based view (RBV) of the firm (Bharadwaj, 2000; Melville et al., 2004).

Within IS research, RBV has been used to understand the relationship between innovation as a resource for firms wanting to increase business value (Bharadwaj, 2000; Melville et al., 2004; Teo et al.,

2016). RBV suggests the value of an innovation can be assessed by examining the competitive advantage achieved through the use or adoption of that innovative resource (Barney, 1991). Thus, to understand the link between business value and innovation adoption, researchers have examined technological capabilities and the increased utility from using those resources (Wade & Hulland, 2004). One approach is to examine resources as marketing-based assets (Srivastava et al., 2001), which is particularly appropriate in our case because SNSs are used to manage external relationships with customers (Bharadwaj, 2000; Srivastava et al., 1998). These SNS resources create customer value leading to a competitive advantage over other firms that creates value for the firm (Orlikowski & Lacono, 2001; Srivastava et al., 2001).

Research suggests that the business value of market-based assets such as SNSs can be assessed using shareholder value (Srivastava et al., 2001). Srivastava et. al. (1998) provide a framework that examines four distinct mechanisms by which these assets may create shareholder value: increases in cash flows, acceleration of cash flows, reduction in risks associated with cash flows (i.e. vulnerability and volatility), and increases in expected cash flow from future business. Table 1 below provides a description of each of the mechanisms with an example of how a SNS may act as a market-based asset.

Each of these four mechanisms has the potential to create business value; any one mechanism may be sufficient to create enough business value to make SNS investment profitable (Srivastava et al., 1998). We can assume that firms are leveraging SNSs via one or all of the mechanisms to create value. However, it is difficult to know which of these a firm intends to pursue; therefore, this research does not focus on identifying the mechanism used. Instead, the focus is on the overall impact on firm value when that firm first chooses to adopt a SNS. We expect this value to be reflected through positive investor reaction and in turn, increase business value. This positive reaction will be represented as a positive shift in stock price, or a positive abnormal return, i.e., a return in excess of what the firm would normally expect. If SNS do increase business value, then a positive abnormal return from SNS investment would occur on the date a firm adopts the SNS technology. Such an abnormal return is a gauge of business value by firms experiencing above average returns (Peteraf, 1993; Schoemaker, 1990). We argue that the adoption of a new public SNS will lead to increased firm value as seen through positive abnormal returns. Thus:

> Hypothesis 1a (H1a): Firms will experience positive abnormal returns following the adoption of Facebook.
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> Hypothesis 1b (H1b): Firms will experience positive abnormal returns following the adoption of Twitter.

**Table 1. Market-based Asset Mechanisms (Based on Cash Flows)**

| Mechanism | Definition | SNS Example |
|---|---|---|
| Increasing | Strengthening customer relationships through collaboration (Srivastava et al., 1998). | Starbucks introduced an idea blog to encourage customers to share ideas. “My Starbucks Idea” generated over 70,000 ideas with many being implemented (Dong & Wu, 2015; My Starbucks Idea, 2009). |
| Accelerating | Marketing activities, such as co-marketing partnerships, aimed at increasing marketplace response is one potential accelerator of cash flows (Doyle, 2000; Keller, 1993). | Marketing campaigns and promotions targeting SNS “fans” or “followers.” For example, Starbucks actively engages its customers through Twitter by asking them for feedback while publicizing deals. |
| Risk reduction | Lower the vulnerability and volatility of cash flows (Srivastava et al., 1998) which can be done by increasing loyalty (c.f. Kumar & Shah, 2004). | Companies give additional perks for those Facebook users who “Like” a company (e.g., Toys “R” Us regularly has promotions providing giveaways to new “fans” of the site) and SNS-only promotions (e.g., JetBlue offers Twitter only deals called Cheeps for last-minute discount fares (Jones, 2009)). |
| Future Business | Expected future cash flows can come from existing customers (e.g., buying additional products) or through referral to new customers (Srivastava et al., 1998). | An online presence in SNSs allows firms to expand by reaching new customers and new segments without traditional geographical or time limitations (Evans & Wurster, 1997). |

### The Timing of Technology Adoption

While the first question many organizations face is whether or not to innovate, the question that most often follows is when to innovate (Swanson & Ramiller, 2004). Some firms choose to be the first to adopt while others wait. Under the Diffusion of Innovations (DOI) theory, Rogers (1995) suggests technology adoption moves through five stages (in order from earliest adopters to later adopters): innovators, early adopters, early majority, late majority, and laggards. DOI examines the process by which an innovation spreads throughout multiple firms by understanding the point of adoption in an innovation's lifecycle (Choudhury & Karahanna, 2008; Jeyaraj et al., 2006). That is, at which stage during the adoption process does a firm decide to adopt a new technology (Crawford & Di Benedetto, 2008)? DOI suggests that the rate of diffusion is initially slow with those firms that are more inclined to take risks adopting first. Although SNSs may not provide a sustainable competitive advantage (i.e. not rare, unique, or inimitable (Barney, 1991)), these firms gain an initial competitive advantage by choosing to innovate first (Kettinger et al., 1994; Wade & Hulland, 2004). As adoption continues, critical mass is reached where a large number of firms have chosen to adopt (Rogers, 1995). At this point, there would be a minimal competitive advantage to adopting the innovation (Barney, 1991). Thus, time is a key component affecting the initial competitive advantage received from adopting a technology; firms that adopt in the early stages may receive an initial competitive advantage compared to those firms that adopt later (Kettinger et al., 1994).

The link between technology and competitive advantage has led to a greater disparity between the leaders and laggards in various industries (McAfee & Brynjolfsson, 2008). While McAfee and Brynjolfsson (2008) find this to be fleeting, there is evidence to show that first movers and early adopters tend to reap the most benefits (e.g. increased shareholder wealth) compared to laggards adopting new technology. For example, Lee et al. (2000) found timing to have a significant impact on increasing shareholder wealth. Their study found that those firms early in the adoption process (i.e. first and second movers) saw increased shareholder wealth while late movers did not see any significant increases. Furthermore, many firms later in the adoption cycle tend to approach the decision from a "me too" mentality in which adoption is not for a competitive advantage but more to maintain the same level of competitiveness in the market (Fiol & O'Connor, 2003; Rosenkopf & Abrahamson, 1999). Thus, to understand timing and adoption, our research examines those companies in the first half of a technological lifecycle who are more likely to receive an initial competitive advantage, as the technology may still be new or unique. Innovators and early adopters are the opinion leaders that influence those choosing to adopt later in the lifecycle (early majority, late majority, laggards) (Rogers, 1995). Thus, we focus on the innovators choosing to adopt first (i.e. first movers) followed by the early adopters (i.e. fast followers). To understand if subsequent adopters receive an initial competitive advantage resulting in abnormal returns, early majority is included in the analysis. Each group analyzed is discussed in more detail below.

Firms choosing to adopt first (i.e. innovators) would benefit most by receiving first mover advantage (Suarez & Lanzolla, 2007). SNSs have continued to evolve as a technology while gaining market space suggesting that a first mover advantage can exist in this environment, challenging later entrants to overtake first movers (Suarez & Lanzolla, 2007). Furthermore, within certain industries, the first mover might have a greater advantage due to market segment (Carpenter & Nakamoto, 1989). For example, a consumer-focused firm might see a significant first mover advantage over non-consumer-focused firms. These firms create business value by providing a unique service to consumers while building strong customer relationships.

Alternatively, one may suggest that fast followers gain a greater benefit by waiting. Prior research would suggest these firms are making a mindful decision (Swanson & Ramiller, 2004) because technology is not always used in the way developers initially intend it to be used and may take time to build social structures (DeSanctis & Poole, 1994). Business value from a specific technology may not always be obvious in the early stages of adoption and customer preference may have a significant effect on the success of those innovators choosing to adopt (Carpenter & Nakamoto, 1989). In the case of SNSs, the original intent of most was for individuals to create/maintain relationships. When firms entered, the social structure of the technology changed, and the users' preference of using these sites for personal relationships had to change and adapt to the new environment. Thus, the business value for firms may not appear early in the life of these technologies while these social structures are in flux.

Finally, the next group, early majority, may not see any abnormal returns. During this part of the lifecycle, firms must consider timing of entry and the impact of this decision. These firms adopt the technology at the stage in which it is more widely accepted with social structures in place. At this point, a firm's decision to enter may be based on a careful and mindful strategy of deliberately eschewing new

innovations until they have been proven in the marketplace. Conversely, it may be a "me too" approach of following the bandwagon associated with new technologies (Fiol & O'Connor, 2003; Lyytinen & Newman, 2008); as Dilbert's Pointy-Haired Boss notes: "Everybody's doing it. We'd better jump under the bandwagon before the train leaves the station!" (See http://dilbert.com/strip/1994-02-28). In the subsequent paragraphs, we examine timing of adoption for first movers (i.e. innovators) and fast followers (i.e. early adopters) to understand creation of business value for firms compared to others (i.e. early majority) who choose to adopt later (i.e. bandwagon phenomenon).

**Innovators and First Mover Advantage**

First mover advantage has been researched extensively to understand the ideal entry point into new market space. Research has shown clear advantages to being the first mover in a market and in general, being the first provides greater benefits over those moving later, particularly when firms can easily copy each other (Lieberman & Montgomery, 1998; VanderWerf & Mahon, 1997). First mover advantage theory argues that proactive firms entering a market space first may benefit from a temporal competitive advantage (Suarez & Lanzolla, 2007). By entering at the beginning, first movers gain consumer confidence and trust (e.g. the established firm in the market), which can continue even as new entrants emerge and the overall market grows (Mellahi & Johnson, 2000). This is determined by the skill and resources of the firm entering the market and their willingness to take a risk for a higher return (Kalyanaram et al., 1995). First movers learn more quickly and can leverage this knowledge to better develop their skills and resources to stay one step ahead of those who follow (Mellahi & Johnson, 2000). Thus, new market innovators (or first movers) gain substantial advantages over those choosing to adopt later (e.g. early adopters or early majority). This may be particularly true for public SNS technologies whose use can easily be copied by competitors; competitive advantage is fleeting because firms that follow quickly copy the first mover.

Research on IT adoption is generally consistent with prior marketing research in showing that those choosing to adopt first receive the most benefit (e.g., pioneering advantage) from a newly introduced technology (Carpenter & Nakamoto, 1989; Kerin et al., 1992; Lieberman & Montgomery, 1988). For example, firms innovating first in Internet-based consumer services develop strong, emotional ties with their users while establishing sustainable value for their consumers (Liang et al., 2009). These firms often have a vision of what consumers desire in a technology (e.g. SNS) and exceed what later entrants have to offer. Given potential benefits of an innovator, we hypothesize that the first moving innovators will have higher abnormal returns compared to those adopting later in the lifecycle (i.e. the early majority). Thus,

> Hypothesis 2a (H2a): Firms in the innovator group will experience greater abnormal returns from Facebook adoption than those in the early majority group.
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> Hypothesis 2b (H2b): Firms in the innovator group will experience greater abnormal returns from Twitter adoption than those in the early majority group.

**Fast Followers and Mindful Decisions**

Contrary to first mover advantage, some suggest fast followers (i.e. early adopters) who enter the market shortly after the first movers (i.e. innovators) also benefit from early adoption (Hidding & Williams, 2003). Swanson and Ramiller (2004) suggest timing plays a role in adoption with first movers needing to be especially mindful, as little is known about applicability of the innovation. Alternatively, firms who choose to adopt later in the lifecycle (e.g. early majority) may mindlessly adopt based on the increased popularity (i.e. bandwagon phenomenon) (Abrahamson, 1991; Abrahamson & Fairchild, 1999). Thus, timing plays an integral role for a firm's decision to innovate either mindfully or mindlessly.

A fast follower strategy may be appropriate for public SNS technologies that have network effects. Fast followers (i.e. second movers) benefit from decreased risk compared to first movers because more is known about the technology, new social structures from the innovation have stabilized, and a larger network of consumers are using it (Poletti et al., 2011). While innovators are the first to enter the market, fast followers make a mindful decision to enter the market, which involves careful evaluation of the technology (Swanson & Ramiller, 2004). Fast followers adopt the technology once it has become more stable and has been demonstrated to be useful (Hoppe, 2000; Shankar et al., 1998). For example, Yahoo was an early search engine widely used throughout the World Wide Web, yet Google followed and overtook Yahoo. Google was able to capture consumers who were looking for a better alternative to the available search engine (i.e. Yahoo) (Shankar & Carpenter, 2012).

Public SNS technologies are different from many other IT innovations adopted by firms because they are designed by third parties and used by the general public. An individual firm has less control over the technology. SNSs were originally designed for one

purpose, a medium for social interactions with an individual's friends, while firms have adapted them for another purpose, to interact with current and potential customers. This change to the social structures takes time, which is one reason why a fast follower who enters the market later may be more successful.

A second reason fast followers may experience an increase in firm value may be due to the size of the network of users (Kauffman et al., 2000; Schilling, 2002; Shapiro & Varian, 1999). First movers may have moved too soon, before the network of users is large enough to provide substantial value (Poletti et al., 2011). By waiting until the network is larger, fast followers are better able to more quickly capitalize on the value of the technology.

Under DOI, fast followers are categorized as early adopters (those immediately following innovators) and will also see increased abnormal returns compared to those adopting in a later stage of the diffusion curve (i.e. the early majority stage) due to a mindful decision to adopt a technology before being influenced by social pressures to adopt (or bandwagon phenomenon). Thus:

> Hypothesis 3a (H3a): Firms in the early adopter group will experience greater abnormal returns from Facebook adoption than those in the early majority group.
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> Hypothesis 3b (H3b): Firms in the early adopter group will experience greater abnormal returns from Twitter adoption than those in the early majority group.

## Methodology

### Event Study Methodology

An event study methodology is employed to evaluate the impact of adoption of SNSs on firm value using shareholder returns as a measure of performance (Day & Fahey, 1988). When compared with other metrics of firm performance, such as market share and sales, firm stock returns are preferred because they are forward looking rather than backward looking (Day & Fahey, 1988; Srivastava et al., 1998). A firm's stock price is the expected present value of all future cash flows, while market share and sales are calculated on past or realized cash flows.

Event studies have become a popular and accepted tool in information systems (Dewan & Ren, 2007; Guan et al., 2006; Roztocki & Weistroffer, 2009; Subramani & Walden, 2001; Teo et al., 2016). They have been used to improve the understanding of various topics, such as online channel impacts on performance (Xia & Zhang, 2010), e-commerce (Andoh-Baidoo et al., 2012), investments in IT (Roztocki & Weistroffer, 2006), and IT failures (Bharadwaj et al., 2009). Event studies have also been applied to the current context for understanding the impact of IT investments on the market value of the firm (Dehning et al., 2003; Dobija et al., 2012; Im et al., 2001).

The goal of an event study is to measure the effects of an economic event on the expected future value of the firm, revealed in its stock price. The firm's stock price reflects all public information about that firm, so only unexpected changes to that information can alter the price of the stock (Fama, 1970). As a result, the impact of an event can be measured by examining stock prices surrounding the event. Looking at stock price changes will signal the expectation of the future cash flow from SNSs. Assuming there is no other new information released at the same time as the SNS adoption, the economic impact of SNS adoption can be measured by examining the abnormal stock price changes surrounding that event.

Ultimately, the decision to adopt a SNS lies with management and therefore the timing of their decision to adopt might be a concern. That is, the choice of when to adopt the SNS might be endogenously determined by inside information which only management possesses. While the choice of when to adopt a SNS might be endogenous, this is not the purpose of the current study. We are not interested in the processes by which firms decide when to adopt but rather in testing how the stock market reacts once the firm does adopt. Our research question is investigating the stock market's reaction to new, novel information represented by SNS adoption.

### Data Acquisition

Our target population for this study are firms in consumer-based industries as SNSs are consumer-oriented technologies (Weber, 2009). This population includes firms which have adopted either Facebook or Twitter. To select our sampling frame, two criteria were considered. First, because our dependent variable is stock returns, only U.S. publically traded firms were used. Second, we selected only firms which operate within business-to-consumer (B to C) industries because these firms would use public SNSs primarily to engage existing customers and to reach out to potential ones. The standard industrial classification (SIC) codes were used to screen firms to ones operating in these industries: automobiles, banking, beer, candy and soda, communications, computers, meals and restaurants, oil and gas, personal services, newspapers, retail, and transportation. To identify firms in these industries, all U.S. publically traded firms on all U.S. stock exchanges were obtained from CRSP via Wharton Research Data Services. Of over 6000 publically

traded firms, 840 firms operated within a consumer-based industry (i.e. the SIC codes defined above) and were therefore identified as our sampling frame.

To discern whether investors perceive a firm's adoption of a SNS favorably, abnormal returns surrounding the adoption date of that technology are analyzed. Adoption dates for Facebook and Twitter were found in the following ways. Facebook does not provide the adoption date on fan pages, so the adoption date was established by using the first day the firm published its Facebook page. When first creating a Facebook page, the creator is asked some basic information such as uploading a photo, providing a website, and filling out an "About" section. Once any of this information is entered, it is posted to the Facebook page, marked with a date and made publically available. All posts since profile creation are available in Facebook. To identify the first public post date, we used an automatic user script.[4] This would also be the first time the site is made publically available to SNS users.

Unlike Facebook, Twitter adoption dates can be obtained from Twitter. Twitter adoption dates were identified through the website www.whendidyoujointwitter.com. For any Twitter account, the website will return the date that the account was created. The website searches Twitter's public application programming interface (API), which runs in the background, and returns the date the account was created.[5] This method works for any Twitter account created regardless of usage.

One concern may be that a profile was created, but not utilized until a later date. In other words, a firm creates an online presence within Facebook or Twitter and then never uses it. Some organizations acquire a new technology and then delay actual deployment to a later date (Fichman & Kemerer, 1999). However, we argue that the creation date is appropriate for the "event date" for SNSs because companies adopt external marketing channels with a detailed plan for profile design and campaign strategies before the page is created (Mohr, 2012; Sweeney, 2012). To assess this assumption, we randomly selected 50 firms and found that all 50 made an initial posting on the creation date and followed this with one or more additional posts within a week or less. Thus, we conclude that our methods to identify the creation date are appropriate.

Another concern when using "creation date" for our event date may be how the market would react without a formal announcement of joining a SNS (e.g., a 10K filing would not be required). Announcements about adopting Facebook and Twitter were found for some of the firms. While not all firms formally announced, all firms began using the SNSs on the creation date. The efficient market hypothesis, which is the foundation of modern finance, argues that information spreads quickly and is reflected quickly in firm value (Fama, 1970). If for some unknown reason the efficient market hypothesis does not hold true, we would find no significant results; thus, our approach is conservative. Additionally, as described below, we conducted an analysis of confounding events (i.e. contaminating events that may impact stock price) for all of the firms, and removed those firms in which another event occurred near the creation date. Thus, we are confident that if we find an effect, it can only be attributed to the adoption of the SNS.

### Sample

Of the 840 firms identified during data acquisition, 341 firms had a Facebook page, and 402 firms had a Twitter account (note: only the Twitter account created by the firm was used and not accounts created by the public). Because of estimation requirements for the dependent variable (described later), abnormal returns for 51 Facebook firms and 50 Twitter firms could not be estimated. Also, an additional 47 Facebook firms and 49 Twitter firms were eliminated due to contaminating events which might influence the firm's stock price (see the section below). Therefore, the final testable sample for Facebook contained 243 firms and the final sample for Twitter contained 303 firms (for a complete list of firms, see Appendix A).

### Confounding Events

Firm adoption data was screened to ensure stock market reaction to a firm's adoption of a SNS was not an artifact of other confounding events (e.g., contaminating events, which could influence abnormal returns). For example, a firm might adopt a Twitter account on the same day as an earnings announcement, and therefore its abnormal return might be attributable to the firm's earnings report and not the adoption of Twitter. To control for potential contaminating factors, the final sample was cleaned. Consistent with prior research, contaminating events were defined as any announcement of restructuring, merger and acquisition, dividends, earnings announcements, earnings revisions, new product releases, new debt or equity issuance, executive team changes, or other material changes in operations (e.g., announcement of a new government contract) (Karniouchina et al., 2009). Confounding events were identified through analyzing press releases and SEC regulatory filings (DeFond et al., 2010). The window examined consisted of four days surrounding the event. This is based on suggestions from prior IS research suggesting the window to

examine for confounding events should be larger to ensure these events are controlled for (Konchitchki & O'Leary, 2011). Any firm with a confounding event in this window was removed which is consistent with prior event study research in information systems (Dobija et al., 2012; Teo et al., 2016).

**Independent and Control Variables**

Rogers (1995) describes five categories of technology adopters based on how quickly they decide to adopt that technology. He defines innovators as the first 2.5 percent of adopters of a technology within a population. Early adopters are the next 13.5 percent of adopters of a technology. The next 34 percent of the adopters are called the early majority. The 34 percent of adopters, which follow the early majority, are called the late majority, and the last 16 percent of technology adopters are considered laggards (Rogers, 1995). The focus of our research is on the first three categories: innovators, early adopters, and early majority. Innovators are defined as the first 2.5 percent of firms (21 firms) within our sampling frame to adopt the SNS; early adopters are the next 13.5 percent of firms (113 firms) within our sampling frame to adopt the SNS; and early majority are the remaining firms who have adopted the SNS, but were not within the first 16 percent of firms to adopt it. Firms who would normally be categorized as laggards or late majority are not included in the sample of firms.

Industry and firm specific control variables are included in the analysis (captured via Compustat). Firm level controls include size, return on assets, leverage, growth opportunity, and selling expenses, which are common control variables typically included in event studies (Boyd et al., 2010; Fama, 1998; Im et al., 2001). For instance, one might expect smaller firms to have larger stock price movement after adopting a SNS because SNS adoption might have more incremental value to the small firm relative to the large firm. Similarly, firms which are more profitable relative to their total assets (return on assets), as well as firms which have less debt (leverage) and are therefore less risky, might benefit more from SNS adoption due to their superior financial situation. A list of controls and their definition is included in Table 2.

**Dependent Variable: Abnormal Returns**

Following Campbell, Lo, and MacKinlay (1997), abnormal return is defined as the actual ex-post return of the stock over the event window minus the normal return of the firm over the event window. The normal return is the return that would be expected if the event did not take place. That is, the normal return would be the return that Firm *i* expects at Time *t* given that the firm did not adopt a SNS. As shown in Equation 1, abnormal returns are defined as:

$$AR_{it} = R_{it} - E\,[R_{it} \mid X_t]$$

where $AR_{it}$, $R_{it}$, and $E[R_{it}]$ are the abnormal, actual, and normal returns for Firm *i* in Time *t*. $X_t$ is the conditioning information to determine normal performance in Time *t*. In order to predict normal performance in Equation 2, we utilize the traditional four-factor model that incorporates a firm's sensitivity to market returns, as well as a number of well-documented market abnormalities related to market capitalization, book-to-market ratio (Fama & French, 1996), and momentum (Carhart, 1997):

$$E[R_{it} \mid X_t] = \alpha_i + \beta_i R_{mt} + s_i SMB_t + h_i HML_t + u_i UMD_t + \varepsilon_{it}$$

where

$R_{it}$ is return of Stock *i* at Time *t*,

$R_{mt}$ is return on the market in time (i.e. daily return on CRSP value-weighted index),

$\beta_i$ is a measure of Stock *i*'s sensitivity to market changes,

$\varepsilon_{it}$ is the error term,

$SMB_t$ is the average return for the smallest stocks minus the average return for the largest stocks,

$HML_t$ is the average return on stocks with highest book-to-market ratios minus the average return for the stocks with the lowest book-to-market ratios,

$UMD_t$ is the average return on high-performing portfolios minus the average return on low-return portfolios.

Combining Equations 1 and 2 give the standard equation for abnormal returns using the four-factor model to predict normal returns. Thus, abnormal returns are defined as the following (Equation 3):

$$AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt} + \hat{s}_i SMB_t + \hat{h}_i HML_t + \hat{u}_i UMD_t)$$

where $\hat{\alpha}_i, \hat{\beta}_i, \hat{s}_i, \hat{h}_i,$ and $\hat{u}_i$ are estimates of $\alpha_i, \beta_i, s_i, h_i,$ and $u_i$.

These abnormal returns form the basis for the evaluation of stock market reaction to SNSs. Abnormal returns are accessed and extracted using Eventus® software (via Wharton Research Data Services, WRDS). Table 2 summarizes the variables as well as their operationalization.

**Table 2. Variable Operationalization**

| | |
|---|---|
| **Dependent Variable** | |
| *Abnormal Return (AR)* | Actual ex-post return of the stock over the event window minus the return that would be expected if the event did not take place; Four-factor model: $AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt} + \hat{s}_i SMB_t + \hat{h}_i HML_t + u_i UMD_t + \varepsilon_{it})$; see Campbell, Lo, and MacKinlay (1997), Fama and French (1996), and Carhart (1997) for more details. |
| **Independent Variables** | |
| *Innovators (IN)* | Innovators are defined as the first 2.5% of firms to adopt a technology. |
| *Early Adopters (EA)* | Early adopters are the next 13.5% of firms to adopt a technology. |
| *Early Majority (EM)* | The next 34% of the adopters are called the early majority. |
| **Control Variables** | |
| *Firm Size (S) (Im et al., 2001)* | Total assets of Firm *i* in Adoption Year *t* in millions. |
| *Return on Assets (ROA) (Krasnikov et al., 2009)* | Net income divided by total assets of Firm *i* in Year *t*. |
| *Leverage (LEV) (Dewan & Ren, 2011)* | Long-term debt divided by total assets of Firm *i* in Year *t*. |
| *Growth Opportunity (GROW) (Fama, 1998)* | The ratio of the market value of equity to the book value of equity of Firm *i* in Year *t*. |
| *Selling Expenditures (SE) (Morgan & Rego, 2009)* | Selling, general, and administrative expense (SG&A) of Firm i in Year *t* in millions. |
| *Industry (IND) (Bharadwaj et al., 1999)* | Two digit SIC code |

## Analysis

Event studies center all events (i.e. SNS adoptions) at Day *t = 0*. We used a 220-day estimation window (between Days 250 and 30) to estimate the normal or expected return. We use this broad event window to provide a direct comparison with other published studies using event study methodologies. Stopping the estimation 30 days prior to the event is necessary to avoid having any event-related information incorporated into the estimation of the normal return. The event window of interest for abnormal returns is the day that a firm adopts a SNS and the day afterward, or Day *t = 0* and *t = 1* (window: 0, 1). If the stock market is closed on the day that the new adoption is announced, the subsequent open trading day was used. Using a (0, 1) window is consistent with prior research, which indicates that the majority price movement related to an event is incorporated immediately following the event (Karniouchina et al., 2009; Wright & Ferris, 1997).

To evaluate the market's overall reaction to firms which adopt SNSs (Hypothesis 1), mean cumulative abnormal returns (MCAR) are analyzed. The cumulative abnormal return (CAR) is defined as the aggregated abnormal return over the two-day event window (0, 1), or Equation 4:

$$CAR_i = \sum_{t=0}^{t=1} AR_{it}$$

Mean cumulative abnormal returns are then calculated by averaging the CAR for the entire sample of N firms (Equation 5):

$$MCAR = \frac{1}{N} \sum_{i=1}^{N} CAR_i$$

To determine statistical significance of the MCAR, the Portfolio Time-Series crude dependence adjustment (CDA) test will be analyzed. The Portfolio Time-Series (CDA) is a way to handle cross sectional dependence. It estimates the abnormal return variance directly from the time series of observations of average abnormal returns during the estimation period (Brown & Warner, 1980; Brown & Warner, 1985). For robustness, significance will be required in both statistical tests. In general, positive (negative) abnormal returns during the (0, 1) window suggest that investors view the SNS as a profitable (unprofitable) decision that will increase (decrease) future cash flows of the firm.

To evaluate how the rate of adoption affects firm-level abnormal returns (Hypotheses 2 and 3), our independent variables (rate of adoption) and controls (size, return on assets, leverage, growth potential, selling expenses, and industry) are regressed against our dependent variable (abnormal return). In particular, the following general linear model will be estimated for each Firm *i* across both samples (Equation 6):

$$AR_i = \gamma_1 + \gamma_2 IN_i + \gamma_3 EA_i + \gamma_4 S_i + \gamma_5 ROA_i + \gamma_6 LEV_i + \gamma_7 GROW_i + \gamma_8 SE_i + \gamma_9 IND_i + v_i$$

where $AR_i$ is the abnormal return for Firm *i* over the (0, 1) window; $IN_i$ is a dummy variable equal to 1 if Firm *i* is in the first 2.5 percent of firms to adopt the SNS; $EA_i$ is a dummy variable equal to 1 if Firm *i* is in the next 13.5 percent of firms to adopt the SNS; $S_i$ is a measure of the size of Firm *i*; $ROA_i$ is a measure of the firm's return on assets; $LEV_i$ is a measure of the firm's leverage; $GROW_i$ is a measure of the growth opportunities for Firm *i*; $SE_i$ is a measure of the selling expenses for Firm *i*; $IND_i$ is an industry classification variable dividing the firms into 14 industries; and $v_i$ is the error term.

## Results

To assess if the adoption of a new innovation leads to increased firm performance ($H_1$), MCARs are analyzed. In particular, $H_1$ would be supported by a positive and significant MCAR. Separate MCARs are estimated for our two samples (one for Facebook and one for Twitter). Table 3 shows that on average firms significantly benefit from adopting SNSs. Firms which adopted Facebook saw a 1.20 percent ($p < 0.001$ for CDA) abnormal jump in their stock price in the two-day window around the adoption; therefore, H1a is supported. Firms that adopted Twitter experienced a 0.67 percent ($p < 0.01$ for CDA) abnormal jump in their stock price during the same two-day window; therefore, H1b is supported.

**Table 3. Overall Analysis of Abnormal Returns**

| Sample | Sample Size | Event Window | MCAR | Portfolio Time-Series (CDA) |
|---|---|---|---|---|
| Facebook | 243 | (0, 1) | 1.20% | 3.20*** |
| Twitter | 303 | (0, 1) | 0.67% | 2.05* |
| Note: ***p < 0.001, **p < 0.01, *p< 0.05. | | | | |

To examine the effect of the time of adoption on a firm's abnormal returns (H2 and H3), a cross-sectional generalized least squares regression is analyzed. Equation 6 is estimated separately for the Facebook and Twitter samples. Table 4 shows the results from the regression models for Facebook and Twitter (note: the 12 control variables for industry were all found to be not significant and are not reported in the table).

**Table 4. Cross-Sectional Generalized Least Squares Regression Models**

| | Dependent Variables | |
|---|---|---|
| | Facebook CAR | Twitter CAR |
| ***Independent Variables*** | | |
| Intercept | 0.20%<br>(1.38) | 0.39%<br>(0.19) |
| Innovators (IN) | 0.80%<br>(0.47) | -0.32%<br>(-0.26) |
| Early Adopters (EA) | 2.12%*<br>(2.12) | 1.50%*<br>(2.42) |
| ***Control Variables*** | | |
| Firm Size (S) | 0.26%<br>(-0.95) | 0.00%<br>(0.36) |
| Return on Assets (ROA) | -5.30%**<br>(-2.57) | -5.11%*<br>(-1.94) |
| Leverage (LEV) | -1.37%<br>(-0.90) | -2.30%*<br>(-2.24) |
| Growth Opportunity (GROW) | 0.00%<br>(0.14) | 0.00%<br>(-0.66) |
| Selling Expenditures (SE) | 0.00%<br>(0.76) | 0.00%<br>(-0.34) |
| Industry (IND) – all industry dummy variables resulted in p > 0.10 | | |
| Note: ***p < 0.001, **p < 0.01, *p< 0.05.<br>t-values are in parentheses and have been adjusted for heteroscedasticity based on White (1980). | | |

For both samples, the innovator variable is not significant; therefore, H2a and H2b are rejected. However, firms that were early adopters of Facebook had greater abnormal returns than later adopters (early majority) of the technology. On average, early adopters (i.e. fast followers) of Facebook had abnormal returns 2.12 percent ($p < 0.05$) higher than that of the early majority; therefore, H3a is supported. Similarly, firms that were early adopters of Twitter had greater abnormal returns than the early majority. On average, early adopters of Twitter had abnormal returns 1.50 percent ($p < 0.05$) higher than that of the early majority; therefore, H3b is supported. To ensure robustness in our results, alternative estimation periods and benchmarks were calculated (see Appendix B). All alternative evaluations resulted in the similar results for all hypotheses.

## Discussion

Firms are continuously in pursuit of innovations. Public technologies such as social media enable competitors to easily copy any innovation. While adoption may result in value to the firm over time, it is unclear if (a) they provide an initial business value to the firm adopting them and (b) when is the time to adopt to leverage that initial business value. We analyzed firms' adoptions of two public SNSs—Facebook and Twitter. Our findings indicate that firms adopting these public technologies experienced a significant positive increase in firm value, but the increase was not uniform across firms. The time of adoption significantly influenced the value firms initially experienced. Interestingly, it was the fast followers (early adopters) who experienced a large gain in firm value, while the first movers (innovators) and later followers (early majority) did not. The size of this effect (2.1 percent and 1.5 percent) was meaningful as well as significant. Since we studied two separate and distinct public SNSs, it provides reassurance that the pattern and magnitude of the results are consistent (i.e. fast following firms adopting either Twitter or Facebook experienced similar increases in value).

Two potential reasons exist as why fast followers derived more value than first movers. First, the value of SNSs may lie not just in the technology but also in the size of its network of users (Kauffman et al., 2000; Schilling, 2002; Shapiro & Varian, 1999). There appears to be an impact from network externalities enabling fast followers to leverage the impact of the technology. Thus, first movers may have moved too soon, when the technology had too few users to provide business value. By waiting until the technology had a larger network of users, fast followers were better able to capture business value.

A second possible explanation is that SNSs were developed for one purpose and adopted by firms for a different purpose. Technology changes faster than the social structures of use (DeSanctis & Poole, 1994), so first movers moved too soon, before new social structures around the technology (i.e. a tool for firms to communicate with customers) were fully adopted by users. Fast followers entering later in the adoption lifecycle may have adopted at a time in which more individual users were changing their social structures to accommodate SNS use by firms. By waiting until the social structures of use were changing, fast followers were better able to capture business value.

### Implications for Research

We believe that our findings have important implications for future research. First, we contribute to the existing research examining firm-level adoption of innovations by examining the impact of the adoption of public technologies on firm value. The timing of adoption of SNSs and other public technologies has not received much research attention in the organizational adoption of innovations because they are highly visible and easily copied. An individual firm has less control over public technologies as they are controlled by third parties and extensively used by the general public in a variety of instrumental ways that may not be germane to the way in which the firm wants to employ the technology. In this situation, our research shows that fast followers derive more business value from adoption than do first movers and the early majority of adopting firms. More research is needed to better understand the impact of timing on firm value during the adoption of other public technologies.

Second, SNSs are social technologies, which means that network effects may play a significant role in value. With these network externalities, the value of a technology to one user is affected by the number of other users (Kauffman et al., 2000; Schilling, 2002; Shapiro & Varian, 1999). In the case of SNSs, the business value to firms is dependent on the value placed by other users of SNSs. That is, SNSs such as Facebook and Twitter are not valuable to their users (and hence firms) until the network of users has grown to a sufficient level. This provides one potential explanation as to why first movers do not gain business value.

Third, the nature of the industry being examined must be considered in the adoption process. SNSs provide opportunities that may not have the same utility for firms in all industries. By choosing to examine consumer-facing industries, we expand on innovation adoption by suggesting that researchers should focus on specific industries which are relevant to the innovation being adopted. Future research needs to examine whether a similar pattern of abnormal returns (i.e. business value) occurs for other, non-consumer facing industries. An interesting extension to this research would be to examine business value to firms for non-consumer facing social media technologies. For example, LinkedIn is functionally similar in some ways to Facebook but has a different purpose; LinkedIn is more professionally oriented than Facebook.

Finally, as previously mentioned, SNSs have social structures that change more slowly than the underlying technology. It takes some time for the social structures to evolve to the point where a critical mass of users embrace and accept the new social structures, so that firms can capture business value from the new forms of use. Further research is needed to understand how the social structures of SNS and other public Software as a Service (SaaS) technologies affect the business value that firms derive from adopting them.

### Implications for Practice

For firms, our findings suggest that fast followers derive greater initial business value than the firms that are the first to adopt a new social media. Thus, businesses moving first (i.e. first mover) may not derive an initial business value compared to fast followers. While this does not mean first movers will never derive business value, it suggests that firms may want to wait and let other firms innovate, and then follow them once the paths to success (and failure) have been uncovered by the first movers. When a new public social media technology appears, we advise firms to carefully monitor and adopt it once the user base is large enough and social structures support corporate use. One advantage of being a fast follower is that these firms often learn from the mistakes of the first movers and can develop better innovations for customers (Boeker, 1989).

It is unclear the extent to which this implication applies to other public technologies. We suggested that the two social media technologies we studied have network effects and slowly changing social structures around use (as they moved from individual to corporate use). Thus, we believe that this implication applies to other public technologies to the extent that they also have network effects and/or slowly changing social structures. So, a firm choosing to be a fast follower gains more benefits than an innovative first mover because the first mover acts before there is a large user base and before corporate use is widely, socially accepted. Thus, the challenge for firms is deciding when is the appropriate time to enter; that is, when will they be able to take advantage of being a fast follower before the technology enters the early adopter stages of diffusion.

Alternatively, if a firm misses the fast follower stage of adoption, then the question arises about adopting a social media technology or other public technology without knowing if it will provide clear business value for the firm. Consumer demand for company profiles in SNSs may induce firms to adopt this technology out of necessity to compete.

This is caused by consumer expectation set by early adopters that all companies should have an online SNS presence. Thus, once the adoption process enters later stages (after first movers and fast followers), the SNS adoption decision changes from one based on business value creation to one of necessity to remain competitive.

### Limitations

As with any study, this research has limitations. First, our investigation focused only on consumer-oriented firms; results therefore may apply only to firms in these industries. Second, only publically traded U.S. firms were included in our sample, so results may not apply to privately held firms or non-U.S. firms. We limited our study to the earlier phases of the adoption process, which included innovators, early adopters, and early majority. Our focus is on abnormal returns from an initial competitive advantage which, based on prior research, occurs for those early in the adoption cycle with laggards not receiving similar benefits. Third, because we have classified firms into groups (innovators, early adopters, and early majority) based on when they adopted these two technologies, there are inherent time-based limitations. There is a strong correlation between each group and the year of adoption, and since the annual returns differ from year to year, the year of adoption may have influenced the results. Since we are focusing on a 1-3 day time window, we do not believe that the year had systematic effects on the results, but this remains a limitation. Finally, not all firms in our population have adopted Facebook or Twitter, so these technologies have not reached the mature stage of adoption needed to produce a late majority or laggard group of companies. This limits our findings to firms in the early phases of adoption (i.e. innovators, early adopters, and early majority).

## Conclusion

Social media has become an important tool for firms attempting to reach customers. With the increasing number of social media technologies being introduced and the cost to develop a strategy for entering a new technology, firms must decide when the appropriate time to adopt a public social technology is. While this research does not examine the long-term benefits of first movers, we do find that there appears to be a second-mover advantage in social technology adoption.

## Notes

[1] Number obtained from http://newsroom.fb.com/company-info/ as of 12/2015

[2] From https://about.twitter.com/company as of 03/2016

[3] See salaries for social media positions on Indeed.com (Date Searched: 9/27/2015)

[4] The script can be obtained here: http://userscripts.org/scripts/show/87496

[5] For example, Home Depot's Twitter account was created on May 15, 2008. The website www.whendidyoujointwitter.com accesses Home Depot's API (http://twitter.com/users/show/homedepot.xml) and returns the 'created_at' field.

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## About the Authors

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## Appendix A

**Table A 1. Event Study Firms: Facebook**

| Permno | Firm | | Permno | Firm |
|---|---|---|---|---|
| 10147 | E M C CORP MA | | 47466 | NEW YORK TIMES CO A |
| 11038 | NETWORK EQUIPMENT TECHNOLOGIES | | 47677 | CINCINNATI BELL INC NEW |
| 11267 | CATO CORP NEW A | | 47941 | GANNETT INC |
| 11308 | COCA COLA CO | | 49154 | TARGET CORP |
| 11510 | BENIHANA INC A | | 49429 | DILLARDS INC A |
| 11891 | M G M MIRAGE | | 51692 | PIER 1 IMPORTS INC DE |
| 12173 | GENERAL COMMUNICATION INC A | | 52090 | MCCORMICK & CO INC |
| 12188 | HEARUSA INC | | 53225 | WASHINGTON POST CO B |
| 14461 | SONESTA INTERNATIONAL HOTELS CP | | 53866 | FAMILY DOLLAR STORES INC |
| 14541 | CHEVRON CORP NEW | | 55213 | RUBY TUESDAY INC |
| 14593 | APPLE INC | | 55976 | WAL MART STORES INC |
| 14816 | TOOTSIE ROLL INDS INC | | 57330 | FRISCHS RESTAURANTS INC |
| 15560 | RADIOSHACK CORP | | 58683 | SOUTHWEST AIRLINES CO |
| 16600 | HERSHEY CO | | 59555 | HONDA MOTOR LTD |
| 16678 | KROGER COMPANY | | 60628 | FEDEX CORP |
| 17005 | C V S CAREMARK CORP | | 63781 | UNIT CORP |
| 17961 | BRIGGS & STRATTON CORP | | 64020 | LUBYS INC |
| 18403 | PENNEY J C CO INC | | 65429 | SYMS CORP |
| 18570 | BOB EVANS FARMS INC | | 65752 | TEAM INC |
| 19828 | WENDYS ARBYS GROUP INC | | 65875 | VERIZON COMMUNICATIONS INC |
| 24459 | PITNEY BOWES INC | | 66093 | A T & T INC |
| 27633 | RYDER SYSTEMS INC | | 66181 | HOME DEPOT INC |
| 27828 | HEWLETT PACKARD CO | | 66384 | WESTERN DIGITAL CORP |
| 27983 | XEROX CORP | | 70033 | HARLEY DAVIDSON INC |
| 28804 | ALASKA AIRGROUP INC | | 70500 | COCA COLA ENTERPRISES INC |
| 29890 | B P PLC | | 75100 | TIFFANY & CO NEW |
| 30737 | DRESS BARN INC | | 75104 | C B S CORP NEW A |
| 32540 | EMULEX CORP | | 75261 | MCCLATCHY CO A |
| 32803 | HOLLY CORP | | 75320 | UNITED STATES CELLULAR CORP |
| 36468 | SHERWIN WILLIAMS CO | | 75432 | C E C ENTERTAINMENT INC |
| 39087 | SPRINT NEXTEL CORP | | 75489 | STAPLES INC |
| 39731 | GRAY TELEVISION INC A | | 75573 | OFFICE DEPOT INC |
| 40440 | DIEBOLD INC | | 75632 | REPSOL YPF S A |
| 42059 | WEIS MARKETS INC | | 76217 | WET SEAL INC A |
| 43449 | MCDONALDS CORP | | 76282 | AUTONATION INC DEL |
| 45560 | INTERPHASE CORP | | 76360 | GOOD TIMES RESTAURANTS INC |
| 46923 | PRIMEENERGY CORP | | 76568 | SONIC CORP |

| Table A 1 (Continued). Event Study Firms: Facebook | | | | |
|---|---|---|---|---|
| **Permno** | **Firm** | | **Permno** | **Firm** |
| 76592 | DIAGEO PLC | | 80971 | DUCKWALL ALCO STORES INC NEW |
| 76605 | AUTOZONE INC | | 81010 | STRATASYS INC |
| 76655 | TOYOTA MOTOR CORP | | 81133 | TELECOM ARGENTINA S A B |
| 76671 | ANNTAYLOR STORES CORP | | 81294 | WD 40 CO |
| 76695 | PANERA BREAD CO A | | 81481 | DOLLAR TREE INC |
| 76708 | DEVRY INC DEL | | 81654 | BORDERS GROUP INC |
| 76750 | MONRO MUFFLER BRAKE INC | | 81669 | PORTUGAL TELECOM S G P S SA |
| 76795 | ZEBRA TECHNOLOGIES CORP A | | 82287 | CRAY INC |
| 77186 | PERFUMANIA HOLDINGS INC | | 82643 | LEXMARK INTERNATIONAL INC NEW A |
| 77281 | WHOLE FOODS MARKET INC | | 82720 | LEARNING TREE INTERNATIONAL INC |
| 77453 | JACK IN THE BOX INC | | 82830 | NICE SYSTEMS LTD |
| 77516 | MENS WEARHOUSE INC | | 83011 | WILLIAMS SONOMA INC |
| 77530 | STEIN MART INC | | 83604 | S K TELECOM CO LTD |
| 77606 | KOHLS CORP | | 83939 | HOT TOPIC INC |
| 77610 | UNIVERSAL DISPLAY CORP | | 83976 | ABERCROMBIE & FITCH CO A |
| 77669 | FINISH LINE INC A | | 84042 | PENSKE AUTOMOTIVE GROUP INC |
| 77702 | STARBUCKS CORP | | 84203 | FAMOUS DAVES OF AMERICA |
| 77902 | CHEESECAKE FACTORY INC | | 84319 | LITHIA MOTORS INC |
| 77928 | COMPANIA CERVECERIAS UNIDAS S A | | 84416 | COLDWATER CREEK INC |
| 78050 | BOOKS A MILLION INC | | 84555 | OVERLAND STORAGE INC |
| 78082 | SPORT CHALET INC B | | 84576 | CHINA EASTERN AIRLINES CORP LTD |
| 78877 | CHESAPEAKE ENERGY CORP | | 84621 | LOGITECH INTERNATIONAL SA |
| 78900 | NATHANS FAMOUS INC NEW | | 85032 | QWEST COMMUNICATIONS INTL INC |
| 78999 | PACIFIC SUNWEAR OF CA INC | | 85173 | COINSTAR INC |
| 79007 | SHOE CARNIVAL INC IN | | 85232 | B J S WHOLESALE CLUB INC |
| 79103 | O REILLY AUTOMOTIVE INC | | 85333 | DOT HILL SYSTEMS CORP |
| 79299 | PAPA JOHNS INTL INC | | 85348 | YUM BRANDS INC |
| 79411 | PETSMART INC | | 85390 | CHILDRENS PLACE RTL STORES INC |
| 79618 | PIZZA INN INC NEW | | 85421 | CHINA MOBILE LTD |
| 79667 | BARNES & NOBLE INC | | 85445 | INTERMEC INC |
| 79672 | ZALE CORP NEW | | 85452 | AC MOORE ARTS AND CRAFTS INC |
| 79884 | WEST MARINE INC | | 85502 | IDENTIVE GROUP INC |
| 80286 | TRACTOR SUPPLY CO NEW | | 85616 | LAN AIRLINES S A |
| 80432 | AMERICAN EAGLE OUTFITTERS INC N | | 85886 | PC CONNECTION INC |
| 80544 | JOS A BANK CLOTHIERS INC | | 85939 | RED LION HOTELS CORP |
| 80638 | MULTIBAND CORP | | 86209 | HASTINGS ENTERTAINMENT INC |
| 80682 | FERRELLGAS PARTNERS L P | | 86715 | CORINTHIAN COLLEGES INC |
| 80857 | VILLAGE SUPER MARKET INC A | | 86822 | EXTREME NETWORKS INC |
| 80924 | SIRIUS X M RADIO INC | | 86866 | TUESDAY MORNING CORP |
| 80955 | WILLAMETTE VALLEY VINYDS INC | | 86924 | THESTREET COM |

| Table A 1 (Continued). Event Study Firms: Facebook | | | | |
|---|---|---|---|---|
| **Permno** | **Firm** | | **Permno** | **Firm** |
| 87043 | QUANTUM CORP | | 90209 | JACKSON HEWITT TAX SERVICE INC |
| 87055 | COSTCO WHOLESALE CORP NEW | | 90248 | DOMINOS PIZZA INC |
| 87105 | DRUGSTORE COM INC | | 90286 | MCCORMICK & SCHMICKS SEAFOOD RE |
| 87251 | RADWARE LTD | | 90371 | BUILD A BEAR WORKSHOP INC |
| 87339 | PARTNER COMMUNICATIONS CO LTD | | 90387 | NEW YORK & CO INC |
| 87538 | IPARTY CORP | | 90427 | TEXAS ROADHOUSE INC A |
| 88167 | HEALTHSTREAM INC | | 90491 | GREAT WOLF RESORTS INC |
| 88172 | KRISPY KREME DOUGHNUTS INC | | 90657 | VERIFONE HOLDINGS INC |
| 88490 | PETROLEO BRASILEIRO SA PETROBRA | | 90720 | BUILDERS FIRSTSOURCE INC |
| 88494 | TATA COMMUNICATIONS LTD | | 90735 | LINCOLN EDUCATIONAL SVCS CORP |
| 88510 | CALIFORNIA PIZZA KITCHEN INC | | 90808 | EXPEDIA INC DE |
| 88646 | S T E C INC | | 90825 | A C C O BRANDS CORP |
| 88658 | TELUS CORP | | 90865 | KONA GRILL INC |
| 88742 | SHENANDOAH TELECOM COMPANY | | 90896 | CARIBOU COFFEE CO INC |
| 88779 | ICAD INC | | 90969 | DOVER SADDLERY INC |
| 89030 | PRINCETON REVIEW INC | | 90972 | JONES SODA CO |
| 89102 | GRANITE CITY FOOD & BREWERY LTD | | 90983 | PEOPLES BANCORP NC INC NEW |
| 89217 | ADVANCE AUTO PARTS INC | | 91014 | DELIA S INC NEW |
| 89301 | GAMESTOP CORP NEW A | | 91068 | CHIPOTLE MEXICAN GRILL INC A |
| 89353 | JETBLUE AIRWAYS CORP | | 91096 | MORGANS HOTEL GROUP CO |
| 89394 | OVERSTOCK COM INC DEL | | 91099 | NTELOS HOLDINGS CORP |
| 89399 | AEROPOSTALE INC | | 91117 | MORTONS RESTAURANT GROUP INC NE |
| 89413 | BIG 5 SPORTING GOODS CORP | | 91237 | VONAGE HOLDINGS CORP |
| 89449 | KIRKLANDS INC | | 91302 | J CREW GROUP INC |
| 89453 | RED ROBIN GOURMET BURGERS INC | | 91354 | GOLFSMITH INTL HLDGS INC |
| 89540 | DICKS SPORTING GOODS INC | | 91376 | ATLAS PIPELINE HOLDINGS L P |
| 89581 | CHINA TELECOM CORP LTD | | 91391 | WINDSTREAM CORP |
| 89617 | EQUINIX INC | | 91392 | WYNDHAM WORLDWIDE CORP |
| 89641 | SEAGATE TECHNOLOGY | | 91416 | HANESBRANDS INC |
| 89644 | VIRGIN MEDIA INC | | 91507 | SUSSER HOLDINGS CORP |
| 89761 | CYCLE COUNTRY ACCESSORIES CORP | | 91556 | ROSS STORES INC |
| 89896 | JO ANN STORES INC | | 91575 | HERTZ GLOBAL HOLDINGS INC |
| 89904 | BUFFALO WILD WINGS INC | | 91624 | WINN DIXIE STORES INC |
| 89919 | PINNACLE AIRLINES CORP | | 91659 | ALLEGIANT TRAVEL CO |
| 89932 | KNOLOGY INC | | 91683 | SALLY BEAUTY HOLDINGS INC |
| 89973 | UNIVERSAL TECHNICAL INSTITUTE I | | 91727 | TRAVELCENTERS AMERICA LLC |
| 90009 | GLOBAL CROSSING LTD | | 91729 | ZION OIL & GAS INC |
| 90012 | PETMED EXPRESS INC | | 91888 | ARUBA NETWORKS INC |
| 90187 | BLUE NILE INC | | 91926 | DELTA AIR LINES INC |
| 90194 | STANDARD PARKING CORP | | 91937 | METROPCS COMMUNICATIONS INC |

| Table A 1 (Continued). Event Study Firms: Facebook | | | | |
|---|---|---|---|---|
| **Permno** | **Firm** | | **Permno** | **Firm** |
| 91973 | ACORN INTERNATIONAL INC | | 92400 | LUMBER LIQUIDATORS INC |
| 92177 | HHGREGG INC | | 92449 | REEDS INC |
| 92211 | VOLTAIRE LTD | | 92793 | ECOPETROL S A |
| 92293 | TERADATA CORP DE | | 92902 | BRIDGEPOINT EDUCATION INC |
| 92322 | ULTA SALON COSMETICS & FRAG INC | | | |

**Table A 2. Event Study Firms: Twitter**

| Permno | Firm | | Permno | Firm |
|---|---|---|---|---|
| 10259 | SIGMA DESIGNS INC | | 33099 | IMPERIAL OIL LTD |
| 11038 | NETWORK EQUIPMENT TECHNOLOGIES | | 35238 | PEP BOYS MANNY MOE & JACK |
| 11081 | DELL INC | | 36468 | SHERWIN WILLIAMS CO |
| 11308 | COCA COLA CO | | 39490 | APACHE CORP |
| 11379 | CASUAL MALE RETAIL GROUP INC | | 40440 | DIEBOLD INC |
| 11382 | SAKS INC | | 40539 | T J X COMPANIES INC NEW |
| 11478 | BERRY PETROLEUM CO A | | 42059 | WEIS MARKETS INC |
| 11618 | FASTENAL COMPANY | | 43449 | MCDONALDS CORP |
| 11762 | EATON CORP | | 46922 | RITE AID CORP |
| 11850 | EXXON MOBIL CORP | | 47677 | CINCINNATI BELL INC NEW |
| 11891 | M G M MIRAGE | | 47706 | FEDERAL SIGNAL CORP |
| 12188 | HEARUSA INC | | 49154 | TARGET CORP |
| 12490 | INTERNATIONAL BUSINESS MACHS CO | | 49429 | DILLARDS INC A |
| 14541 | CHEVRON CORP NEW | | 51692 | PIER 1 IMPORTS INC DE |
| 14656 | SUNOCO INC | | 53866 | FAMILY DOLLAR STORES INC |
| 15560 | RADIOSHACK CORP | | 55976 | WAL MART STORES INC |
| 16678 | KROGER COMPANY | | 57817 | NORDSTROM INC |
| 17005 | C V S CAREMARK CORP | | 58683 | SOUTHWEST AIRLINES CO |
| 17671 | BENIHANA INC | | 59010 | GAP INC |
| 18570 | BOB EVANS FARMS INC | | 59089 | BRISTOW GROUP INC |
| 19502 | WALGREEN CO | | 59555 | HONDA MOTOR LTD |
| 21742 | CASEYS GENERAL STORES INC | | 60599 | CENTURYTEL INC |
| 22753 | CHARMING SHOPPES INC | | 60628 | FEDEX CORP |
| 23887 | FRONTIER COMMUNICATIONS CORP | | 61399 | LOWES COMPANIES INC |
| 24459 | PITNEY BOWES INC | | 63773 | TELEPHONE & DATA SYSTEMS INC |
| 27562 | CRACKER BARREL OLD COUNTRY STOR | | 64020 | LUBYS INC |
| 27828 | HEWLETT PACKARD CO | | 65429 | SYMS CORP |
| 27983 | XEROX CORP | | 65752 | TEAM INC |
| 28804 | ALASKA AIRGROUP INC | | 66093 | A T & T INC |
| 29890 | B P PLC | | 66181 | HOME DEPOT INC |
| 30737 | DRESS BARN INC | | 66384 | WESTERN DIGITAL CORP |
| 32540 | EMULEX CORP | | 66739 | SWIFT ENERGY CO |

| Table A 2 (Continued). Event Study Firms: Twitter | | | | |
|---|---|---|---|---|
| **Permno** | **Firm** | | **Permno** | **Firm** |
| 66835 | B T GROUP PLC | | 78045 | MAGNA INTERNATIONAL INC A |
| 67467 | BIG LOTS INC | | 78050 | BOOKS A MILLION INC |
| 68866 | SASOL LTD | | 78082 | SPORT CHALET INC B |
| 70033 | HARLEY DAVIDSON INC | | 78841 | VAALCO ENERGY INC |
| 70332 | ANADARKO PETROLEUM CORP | | 78877 | CHESAPEAKE ENERGY CORP |
| 75100 | TIFFANY & CO NEW | | 78999 | PACIFIC SUNWEAR OF CA INC |
| 75104 | C B S CORP NEW A | | 79007 | SHOE CARNIVAL INC IN |
| 75142 | TELEFONOS DE MEXICO S A B DE C A | | 79103 | O REILLY AUTOMOTIVE INC |
| 75261 | MCCLATCHY CO A | | 79299 | PAPA JOHNS INTL INC |
| 75316 | SOTHEBYS | | 79411 | PETSMART INC |
| 75418 | VODAFONE GROUP PLC NEW | | 79618 | PIZZA INN INC NEW |
| 75432 | C E C ENTERTAINMENT INC | | 79667 | BARNES & NOBLE INC |
| 75489 | STAPLES INC | | 79839 | ITRON INC |
| 75573 | OFFICE DEPOT INC | | 79881 | URBAN OUTFITTERS INC |
| 75632 | REPSOL YPF S A | | 79884 | WEST MARINE INC |
| 75831 | DIGI INTERNATIONAL INC | | 80070 | SUNCOR ENERGY INC |
| 76149 | SAFEWAY INC | | 80089 | GRUPO TELEVISA SA |
| 76282 | AUTONATION INC DEL | | 80286 | TRACTOR SUPPLY CO NEW |
| 76568 | SONIC CORP | | 80432 | AMERICAN EAGLE OUTFITTERS INC N |
| 76605 | AUTOZONE INC | | 80670 | AIRTRAN HOLDINGS INC |
| 76655 | TOYOTA MOTOR CORP | | 80682 | FERRELLGAS PARTNERS L P |
| 76671 | ANNTAYLOR STORES CORP | | 80857 | VILLAGE SUPER MARKET INC A |
| 76673 | RETAIL VENTURES INC | | 80863 | NIPPON TELEGRAPH & TELPHONE COR |
| 76708 | DEVRY INC DEL | | 80955 | WILLAMETTE VALLEY VINYDS INC |
| 76750 | MONRO MUFFLER BRAKE INC | | 81010 | STRATASYS INC |
| 76760 | TELECOM CORPORATION NEW ZEALAND | | 81042 | P T INDOSAT TBK |
| 76795 | ZEBRA TECHNOLOGIES CORP A | | 81049 | VINA CONCHA Y TORO S A |
| 76847 | BON TON STORES INC | | 81103 | ROYALE ENERGY INC |
| 77186 | PERFUMANIA HOLDINGS INC | | 81278 | STRATTEC SECURITY CORP |
| 77281 | WHOLE FOODS MARKET INC | | 81294 | WD 40 CO |
| 77453 | JACK IN THE BOX INC | | 81481 | DOLLAR TREE INC |
| 77462 | MACYS INC | | 81521 | AMERIGAS PARTNERS LP |
| 77516 | MENS WEARHOUSE INC | | 81566 | P C MALL INC |
| 77530 | STEIN MART INC | | 81654 | BORDERS GROUP INC |
| 77584 | BUCKLE INC | | 81655 | DARDEN RESTAURANTS INC |
| 77606 | KOHLS CORP | | 81666 | HAWAIIAN HOLDINGS INC |
| 77637 | FRANKLIN COVEY CO | | 81669 | PORTUGAL TELECOM S G P S SA |
| 77669 | FINISH LINE INC A | | 81741 | SOCKET MOBILE INC |
| 77702 | STARBUCKS CORP | | 82518 | RICKS CABARET INTERNATIONAL INC |
| 77902 | CHEESECAKE FACTORY INC | | 82598 | NETAPP INC |

| Table A 2 (Continued). Event Study Firms: Twitter | | | | |
|---|---|---|---|---|
| **Permno** | **Firm** | | **Permno** | **Firm** |
| 82618 | SANDISK CORP | | 86209 | HASTINGS ENTERTAINMENT INC |
| 82646 | PERUSAHAAN P P P T TELEKOM INDO | | 86715 | CORINTHIAN COLLEGES INC |
| 82720 | LEARNING TREE INTERNATIONAL INC | | 86822 | EXTREME NETWORKS INC |
| 82763 | XATA CORP | | 86839 | OPTIBASE LTD |
| 82830 | NICE SYSTEMS LTD | | 86866 | TUESDAY MORNING CORP |
| 83604 | S K TELECOM CO LTD | | 86924 | THESTREET COM |
| 83939 | HOT TOPIC INC | | 86926 | T W TELECOM INC A |
| 84062 | BJS RESTAURANTS INC | | 87000 | STAMPS COM INC |
| 84084 | HIBBETT SPORTS INC | | 87043 | QUANTUM CORP |
| 84157 | TERREMARK WORLDWIDE INC | | 87054 | PETROHAWK ENERGY CORP |
| 84203 | FAMOUS DAVES OF AMERICA | | 87089 | SCIENTIFIC LEARNING CORP |
| 84319 | LITHIA MOTORS INC | | 87137 | DEVON ENERGY CORP NEW |
| 84375 | TENNECO INC DE | | 87251 | RADWARE LTD |
| 84416 | COLDWATER CREEK INC | | 87339 | PARTNER COMMUNICATIONS CO LTD |
| 84555 | OVERLAND STORAGE INC | | 87540 | PETROBRAS ENERGIA PARTICIPAC S |
| 84588 | VAIL RESORTS INC | | 88167 | HEALTHSTREAM INC |
| 84621 | LOGITECH INTERNATIONAL SA | | 88172 | KRISPY KREME DOUGHNUTS INC |
| 85032 | QWEST COMMUNICATIONS INTL INC | | 88309 | MOBILE TELESYSTEMS OJSC |
| 85173 | COINSTAR INC | | 88411 | TURKCELL ILETISIM HIZMETLERI A |
| 85232 | B J S WHOLESALE CLUB INC | | 88457 | NETWORK ENGINES INC |
| 85333 | DOT HILL SYSTEMS CORP | | 88494 | TATA COMMUNICATIONS LTD |
| 85348 | YUM BRANDS INC | | 88495 | ORIENT EXPRESS HOTELS LTD A |
| 85390 | CHILDRENS PLACE RTL STORES INC | | 88510 | CALIFORNIA PIZZA KITCHEN INC |
| 85394 | PRICESMART INC | | 88542 | LANTRONIX INC |
| 85397 | RADCOM LTD | | 88646 | S T E C INC |
| 85421 | CHINA MOBILE LTD | | 88658 | TELUS CORP |
| 85427 | GROUP 1 AUTOMOTIVE INC | | 88779 | ICAD INC |
| 85445 | INTERMEC INC | | 88807 | NOVATEL WIRELESS INC |
| 85452 | AC MOORE ARTS AND CRAFTS INC | | 88888 | C N O O C LTD |
| 85502 | IDENTIVE GROUP INC | | 88976 | FISHER COMMUNICATIONS INC |
| 85517 | CHOICE HOTELS INTERNATIONAL INC | | 89016 | STATOILHYDRO A S A |
| 85616 | LAN AIRLINES S A | | 89030 | PRINCETON REVIEW INC |
| 85726 | DENNYS CORP | | 89099 | FALCONSTOR SOFTWARE INC |
| 85886 | PC CONNECTION INC | | 89110 | OMNICELL INC |
| 85913 | MARRIOTT INTERNATIONAL INC NEW A | | 89134 | ENCANA CORP |
| 85914 | BEST BUY COMPANY INC | | 89142 | SUREWEST COMMUNICATIONS |
| 85939 | RED LION HOTELS CORP | | 89217 | ADVANCE AUTO PARTS INC |
| 85971 | PAETEC HOLDING CORP | | 89289 | STAGE STORES INC |
| 86128 | MARINEMAX INC | | 89301 | GAMESTOP CORP NEW A |
| 86150 | BEBE STORES INC | | 89353 | JETBLUE AIRWAYS CORP |

| Table A 2 (Continued). Event Study Firms: Twitter | | | | |
|---|---|---|---|---|
| **Permno** | **Firm** | | **Permno** | **Firm** |
| 89413 | BIG 5 SPORTING GOODS CORP | | 91063 | VIACOM INC NEW B |
| 89453 | RED ROBIN GOURMET BURGERS INC | | 91068 | CHIPOTLE MEXICAN GRILL INC |
| 89508 | CARMAX INC | | 91081 | LINN ENERGY LLC |
| 89617 | EQUINIX INC | | 91096 | MORGANS HOTEL GROUP CO |
| 89641 | SEAGATE TECHNOLOGY | | 91099 | NTELOS HOLDINGS CORP |
| 89644 | VIRGIN MEDIA INC | | 91117 | MORTONS RESTAURANT GROUP INC NE |
| 89704 | INTERCONTINENTAL HOTELS GRP PLC | | 91151 | TIM HORTONS INC |
| 89757 | SEARS HOLDINGS CORP | | 91207 | STARWOOD HOTELS & REST WLDWD IN |
| 89778 | CHUNGHWA TELECOM CO LTD | | 91237 | VONAGE HOLDINGS CORP |
| 89813 | MEDCO HEALTH SOLUTIONS INC | | 91262 | ATLAS AIR WORLDWIDE HOLDINGS IN |
| 89896 | JO ANN STORES INC | | 91354 | GOLFSMITH INTL HLDGS INC |
| 89904 | BUFFALO WILD WINGS INC | | 91376 | ATLAS PIPELINE HOLDINGS L P |
| 89915 | MCGRATH RENTCORP | | 91391 | WINDSTREAM CORP |
| 89919 | PINNACLE AIRLINES CORP | | 91416 | HANESBRANDS INC |
| 89932 | KNOLOGY INC | | 91507 | SUSSER HOLDINGS CORP |
| 89973 | UNIVERSAL TECHNICAL INSTITUTE I | | 91556 | ROSS STORES INC |
| 90012 | PETMED EXPRESS INC | | 91575 | HERTZ GLOBAL HOLDINGS INC |
| 90187 | BLUE NILE INC | | 91605 | CAPELLA EDUCATION CO |
| 90209 | JACKSON HEWITT TAX SERVICE INC | | 91624 | WINN DIXIE STORES INC |
| 90242 | XYRATEX LTD | | 91659 | ALLEGIANT TRAVEL CO |
| 90248 | DOMINOS PIZZA INC | | 91727 | TRAVELCENTERS AMERICA LLC |
| 90286 | MCCORMICK & SCHMICKS SEAFOOD RE | | 91826 | U S AUTO PARTS NETWORK INC |
| 90339 | INTEROIL CORP | | 91888 | ARUBA NETWORKS INC |
| 90346 | TATA MOTORS LTD | | 91907 | SUPER MICRO COMPUTER INC |
| 90371 | BUILD A BEAR WORKSHOP INC | | 91926 | DELTA AIR LINES INC |
| 90387 | NEW YORK & CO INC | | 91937 | METROPCS COMMUNICATIONS INC |
| 90441 | NEWS CORP A | | 91973 | ACORN INTERNATIONAL INC |
| 90657 | VERIFONE HOLDINGS INC | | 92177 | HHGREGG INC |
| 90706 | CITI TRENDS INC | | 92188 | WABCO HOLDINGS INC |
| 90715 | ZUMIEZ INC | | 92211 | VOLTAIRE LTD |
| 90739 | PEOPLES EDUCATIONAL HOLDINGS IN | | 92293 | TERADATA CORP DE |
| 90742 | SILICON GRAPHICS INTL CORP | | 92400 | LUMBER LIQUIDATORS INC |
| 90793 | ROYAL DUTCH SHELL PLC B | | 92449 | REEDS INC |
| 90808 | EXPEDIA INC DE | | 92454 | NEUTRAL TANDEM INC |
| 90825 | A C C O BRANDS CORP | | 92458 | CHINAEDU CORP |
| 90865 | KONA GRILL INC | | 92493 | K12 INC |
| 90896 | CARIBOU COFFEE CO INC | | 92571 | LUCAS ENERGY INC |
| 90969 | DOVER SADDLERY INC | | 92618 | DR PEPPER SNAPPLE GROUP INC |
| 90972 | JONES SODA CO | | 92902 | BRIDGEPOINT EDUCATION INC |
| 90983 | PEOPLES BANCORP NC INC NEW | | | |

## Appendix B

### Robustness Checks

A number of approaches can be taken when assessing abnormal returns during an event study. In the manuscript, we utilize a 4-factor model that incorporates a firm's sensitivity to market returns as well as market abnormalities related to market capitalization, book to market ratio (Fama and French 1996) and momentum (Carhart 1997). We also used an estimation window of 250 days (between days -280 and -30) stopping the estimation window 30 days before the event. However, an alternative approach is to set the estimation window between days to -251 and -1. This can potentially provide different results since the estimation window ends 1 day prior to the event window. Table B1 shows the results from the 4-factor model using a window of -250 and -1.

Results are consistent with our original evaluation of Hypothesis 1 that included an estimation window from -280 and -30. To analyze hypotheses Hypothesis 2 (i.e. innovator returns) and Hypothesis 3 (i.e. early adopter returns, we used equation 6 in the manuscript with the abnormal returns from the new estimation windows displayed above. Results from Table B2 confirm our original analysis results in which early adopters experience greater abnormal returns compared to later adopters of the technology.

Another potential approach from prior studies is to set an estimation window of 120 days (Dewan and Ren 2007; Subramani and Walden 2001). Using both the estimation windows used in the above analysis (-121, -1 and -150,-30), results were consistent with overall abnormal returns for Facebook at 1.08% (CDA = 2.78, $p < 0.01$) and 1.08% (CDA = 2.78, $p < 0.01$) respectively for the windows. Twitter results were consistent as well with abnormal returns at 0.53% (CDA = 1.73, $p < 0.05$) and 0.69% (CDA = 1.94, $p < 0.05$). The subsequent regressions models also showed that for both Facebook and Twitter the Cumulative Abnormal Returns (CAR) were significant for Early Adopters and insignificant for Innovators across both estimation windows.

### Additional Robustness Check

*Prior literature has provided alternative approaches to the 4-factor model used in the current study.*

**Table B1. Abnormal Returns for 4-Factor Model**

| Sample | Sample Size | Event Window | MCAR | Portfolio Time-Series (CDA) |
|---|---|---|---|---|
| Facebook | 243 | (0, 1) | 1.15% | 3.06*** |
| Twitter | 303 | (0, 1) | 0.65% | 1.95* |
| Notes: ***p < 0.001, **p < 0.01, *p< 0.05, one-tail test. | | | | |

**Table B2: Cross-Sectional Generalized Least Squares Regression Models**

| | Dependent Variables | |
|---|---|---|
| | **Facebook CAR** | **Twitter CAR** |
| **Independent Variables** | | |
| Intercept | 4.82% (1.26) | 0.28% (0.14) |
| Innovators (IN) | 0.71% (0.42) | -0.30% (-0.26) |
| Early Adopters (EA) | 2.08%* (2.09) | 1.33%* (2.24) |
| **Control Variables** | | |
| Firm Size (S) | 0.22% (-0.81) | 0.00% (-0.24) |
| Return on Assets (ROA) | -5.30%** (-2.58) | -5.53%* (-2.28) |
| Leverage (LEV) | -1.45% (-0.96) | -2.24%* (-2.28) |
| Growth Opportunity (GROW) | 0.00% (0.15) | 0.00% (-0.72) |
| Selling Expenditures (SE) | 0.00% (0.67) | 0.00% (-0.29) |
| Industry (IND) – all industry dummy variables resulted in p > 0.10 | | |
| Notes: ***p < 0.001, **p < 0.01, *p< 0.05, one-tail test.<br>t-values are in parentheses. | | |

These approaches include the 3-factor model (market returns, market capitalization and book to market ration) (Fama and French 1996), the market model (Agrawal et al. 2006; Chatterjee et al. 2001; Ranganathan and Brown 2006) and the market adjusted model (Agrawal et al. 2006). To ensure results were consistent, analyses were run across all three of these benchmarks using both of the estimation windows used previously (i.e. -250, -1 & -280, -30). The results were not sensitive to benchmarks used with statistical significance occurring across all three benchmarks for both estimation windows. Significance across the benchmarks was consistent for testing $H_2$ and $H_3$ using a cross-sectional GLS regression model for each benchmark.

## Appendix B References


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