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Investor Reaction to Exploration Versus Exploitation Using an Asorptive Capacity Lens

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INVESTOR REACTION TO EXPLORATION VERSUS EXPLOITATION USING AN ASORPTIVE CAPACITY LENS

by

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ABSTRACT

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by
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In his seminal work, March (1991) points to innovation as a key to a firm's survival. In this dissertation proposal, I seek to build on March's research by leveraging his construct of balancing a focus on improving existing capabilities ("exploitation") while simultaneously creating new competencies ("exploration"). These two approaches to innovation are often viewed as requiring a firm to leverage very different skills. Not only are there differing skills, but the level of risk and potential reward also vary based on a firm's decision to focus on exploration versus exploitation. The reaction of investors to this dichotomy is the focus of my dissertation proposal.

While researching this dilemma, Fitzgerald et al. (2021) found that investors often focus on a firm's explorative initiatives due to the new and unfamiliar natural of these innovations. However, despite this investor focus on exploration, firms concentrating on exploitation tend to experience superior operating results - at least in the short term. Their research goes on to suggest that investor focus on exploration may result in undervaluing firms that focus on exploitation. My study sought to build on their research by exploring two potential moderators (firm size and patent portfolio) and creating several competing hypotheses using Absorptive Capacity as a lens. Utilizing a sample of 3660 patents from 164 unique organizations, empirical results did not find support for the proposed interactions. My study's approach was unique from

Fitzgerald et al. (2021) in several regards. These differences as well as limitations and opportunities for future research are also discussed.

To

Sue, Colin and Quentin

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CHAPTER 1: INTRODUCTION

"Innovation is no longer an option, but a necessity." These words, spoken by Rajiv Sodhi – Chief Operating Officer at Microsoft India – addressed the criticality of innovation in the face of a global pandemic (Press Trust of India, 2020). COVID-19 has forced businesses in most industries to rethink current methodologies and find new, more innovative ways to address unique challenges ranging from supply chain issues to remote work environments to healthcare and vaccine development. Business, government, and society in general, have been forced to find new, innovative ways to meet their needs while protecting themselves in the face of this pandemic.

A strong focus on innovation is, of course, not a new concept. Indeed, in the summer of 2018, the United States Patent and Trademark Office (USPTO) issued its ten millionth patent to Raytheon Company for a tool with applications as diverse as self-driving cars, medical devices and even military uses (United States Patent and Trademark Office, 2018). As Andrei Iancu, Under Secretary of Commerce for Intellectual Property and Director of the United States Patent and Trademark Office stated, the USPTO plays a key role to "inspire greater innovation and further economic growth" (United States Patent and Trademark Office, 2018:1). Patents not only impact our national and global economy but can play a critical role in the financial success of a business, influence future innovation, and even impact the number of competitors entering a given market (Andries & Faems, 2013; Cockburn & MacGarvie, 2011). As such, patents have long been used by researchers to approximate innovation (Bloom & Van Reenen, 2002). Gaining a better understanding of the impacts of leveraging these tools to protect a firm's innovations and intellectual property benefits business leaders and the investment community.

Mr. Sodhi suggests innovation is critical for survival as all of humankind deals with the global threat of COVID-19. In his seminal work, March (1991) similarly points to innovation as a key to a firm's survival. In this dissertation proposal, I seek to build on March's research. While there are many ways to define and measure innovation, I will leverage March's construct of balancing a focus on improving existing capabilities ("exploitation") while simultaneously creating new competencies ("exploration") (Levinthal & March, 1993; March, 1991). These two approaches to innovation are often viewed as requiring a firm to leverage very different skills. The nature of these diverse skillsets creates a significant undertaking for any firm that seeks to be successful at both exploration and exploitation (Benner & Tushman, 2002; He & Wong, 2004; March 1991). Not only are there differing skills, but the level of risk and potential reward also vary based on a firm's decision to focus on exploration versus exploitation. The reaction of investors to this dichotomy is the focus of my dissertation proposal.

The unique nature of exploration and exploitation create an unusual challenge for firms. Past research suggests the tradeoffs between these two approaches could result in different investor reactions. Exploration, while often more expensive and riskier, creates a greater opportunity for long term benefit (Uotila, Maula, Keilm & Zahra, 2009). Additionally, the novelty of explorative research may be more likely to attract the attention of investors than incremental innovation associated with exploitation (Fitzgerald, Balsmeier, Fleming, & Manso, 2021). Meanwhile, exploitation tends to have lower costs and more immediate impact (Piao & Zajac, 2016). Further, patents exploiting past innovations have more value than those exploring new breakthroughs (Hall, Jaffe & Trajtenberg, 2005). Thus, when determining which stocks to purchase, investor decisions may be influenced by a firm's focus on exploration or exploitation.

While researching this dilemma, Fitzgerald et al. (2021) found that investors often focus on a firm's explorative initiatives due to the new and unfamiliar natural of these innovations. However, despite this investor focus on exploration, firms concentrating on exploitation tend to experience superior operating results - at least in the short term. Their research goes on to suggest that investor focus on exploration may result in undervaluing firms that focus on exploitation. I propose to build on their research by exploring two potential moderators and creating several competing hypotheses that consider two primary research questions:

> *Do investors view exploration (exploitation) more positively than exploitation (exploration)? Further, do firm specific characteristics such as firm size and patent portfolio moderate this relationship?*

For the purposes of this study, I will leverage several publicly available datasets in order to acquire patent citations, firm characteristics, and stock price information as well as accounting and financial data. Exploration and exploitation will be determined by looking at self-citations and historically repeated citations. These behaviors suggest a firm is depending on existing knowledge - which is consistent with exploitation (Benner & Tushman, 2002).

Additionally, I will leverage an event study methodology established by Brown and Warner (1985) to determine investor reaction to these patent applications. This approach allows me to calculate a focal firm's expected stock return on a given day and compare it to the actual change in stock price. This lets me to determine if (and how) investors react to the patent application.

My proposed dissertation will contribute to scholarly research on several fronts. First, it builds on a long history of exploring how patents impact firm performance and contribute to overall economic growth and addresses calls for further research in this area (Kline, Williams, & Zidar, 2019; Somaya, 2012). Additionally, it provides further insights into factors influencing investor reactions by exploring the potential moderating effects of a firm's size and patent portfolio.

Another contribution of my research is to build on Cohen and Levinthal's (1990) construct of absorptive capacity. Their theory focuses on how a firm can identify new information and incorporate that knowledge. A firm's absorptive capacity not only allows this identification and incorporation but allows the firm to benefit from this new knowledge. Firms require knowledge in order to build new knowledge (Cohen & Levinthal, 1990). Past researchers have linked absorptive capacity with abnormal returns in other settings such as mergers and acquisitions (Jain, Kashiramka, & Jain, 2018). My proposed lens contributes to this line of research, while building on Fitzgerald et al (2021), by considering how a focal firm's absorptive capacity explains potential abnormal returns in the cases of exploration and exploitation patent applications.

While exploration and exploitation remain critical perspectives in the area of innovation, many questions remain – especially about balancing these two approaches (Almahendra & Ambos, 2015; Luger, Raisch, & Schimmer, 2018). My research will provide insights into the potential advantages of a focus on either approach. By leveraging competing hypotheses, I explore investor reaction to each form of innovation independently.

My proposed research also has significant value from a practitioner perspective. Firms have limited resources at their disposal and therefore, must carefully determine how to allocate

those resources. While both exploration and exploitation have been shown to benefit a firm's financial success, investors may prefer one approach over the other. The potential for one approach to be more appealing to investors is an important consideration on multiple levels. Investor decisions play a critical role in driving stock prices. Further, maintaining a strong stock price has numerous implications for a given firm. Strong stock performance can impact a firm's financing options including access to and cost of capital, as well as the value associated with additional equity offerings. A firm's senior leadership has many additional reasons to understand how investors may react to strategic innovation-related decisions. These leaders are often compensated, at least in part, based on criteria such as firm performance and stock price. They would likely have other personal concerns about stock price as well. A lower stock price makes a firm more vulnerable to a hostile takeover and has a negative impact on investor satisfaction. Either of these occurrences may result in their removal. By providing insights to investor reaction to the innovation strategies of exploration versus exploitation, my research can inform senior business leaders of likely outcomes when they are faced with making this difficult tradeoff.

This dissertation proposal is structured as follows. Following this introductory chapter (chapter 1), I provide a literature review (chapter 2), which is followed by my hypotheses and theoretical support (chapter 3). The document concludes outlining my proposed research methods (chapter 4) and references.

CHAPTER 2: LITERATURE REVIEW

BACKGROUND

The opening remarks of the *U.S. Patent and Trademark Office (USPTO) 2014-18 Strategic Plan* stress the growing importance and use of protections on intellectual property to grow the overall stock of innovation (United States Patent and Trademark Office, 2014). Indeed, there has been increased use of the patent process by innovators. Half of all patents issued in the fifty years after 1963 were issued since 2000 (United States Patent and Trademark Office, 2014). In addition to public and private companies, universities and other organizations have been encouraged to leverage the patent process to protect their innovations as well (Heller & Eisenberg, 1998). An increasing number of patent applications is anticipated - even as the USPTO works to decrease a backlog of over 600,000 unexamined patent applications (United States Patent and Trademark Office, 2014; United States Patent and Trademark Office, 2021).

Firms can not only achieve protection of their innovations through patenting, patents also have the advantage of providing insights about the knowledge that led to their creation in the form of citations. As such, patent counts and citations have long been utilized by scholars as a proxy for innovation (Bloom & Van Reenen, 2002). This data can provide insights to how a firm uses different types of innovation such as exploration and exploitation in their internal development processes. The approaches of exploration and exploitation result in different types of innovative outcomes and require the use different capabilities (March 1991). Further, the lens of absorptive capacity provides valuable insights on the learning capabilities of a given firm. Developing these skills have numerous impacts as protections such as patents can also serve as a means to attract customers and potential investors (Holgersson, 2013). Investor reactions to a firm's innovation approach can be measured utilizing an event study. Event studies allow one to

measure anticipated versus actual investor reaction to different events – including patent application and granted dates (Austin, 1993).

The goal of this chapter is to provide a review of the scholarly work focused on absorptive capacity, exploration and exploitation, patents, and event studies. I begin with a summary of research on absorptive capacity, which is followed by an overview and definition of exploration and exploitation. I then discuss how patent data and citations can be used to proxy innovations and measure exploration and exploitation. Lastly, I review event study literature.

ABORPTIVE CAPACITY

Scholars have long argued that innovation is critical to a firm's long-term success (e.g. Schumpeter, 1942; March, 1991; Danneels, 2002). Innovation creates value for firms in the form of a stronger market and financial position than their peers (Rubera & Kirca, 2012). Therefore, it is important that firms focus on growing their ability to continuously innovate. In their seminal 1990 paper, Cohen and Levinthal introduced the construct of absorptive capacity – which they define as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal: 128). At the very heart of their theory lies the idea that a firm must have prior knowledge in order to absorb new knowledge – which results in increasing its overall stock of knowledge. Much as students depend on their previous knowledge to serve as a foundation to add new knowledge, firms also build on past learning. Without some kind of baseline knowledge or reference, a firm is unable to take in and apply new concepts (Cohen & Levinthal, 1990).

A firm's absorptive capacity not only speeds the innovation process but creates a loop of sorts wherein the knowledge produced by the innovation is added to the organization's absorptive capacity (Kim & Kogut, 1996; Lane, Koka & Pathak, 2002). Thus, absorptive

capacity is the fuel to a firm's innovative engine. It provides firms with the capability to grow its knowledge, which in turn provides the opportunity for new sources of revenue and the ability to absorb even more knowledge.

Absorptive capacity is widely used in various streams of research. In their 2006 review, Lane, Koka, and Pathak note that Cohen and Levinthal's 1990 paper had been used over 900 times in peer reviewed papers since its initial publication. It is not only a popular and well-tested construct in innovation-related research but has applications in areas such as organizational learning and strategic alliances as well (Lane, et al., 2002). Absorptive capacity has been used to measure the effectiveness of international joint ventures and alliances demonstrating the importance of a firm's ability to exchange and absorb knowledge (Jain, et al., 2018; Lane & Lubatkin, 1998; Lane, Salk & Lyles, 2001). Absorptive capacity has also been shown to provide the ability to maximize the benefits that come from the complexity of a firm's product portfolio while minimizing the cost associated with this strategy (Fernhaber & Patel, 2012).

Despite its extensive history, absorptive capacity continues to be re-imaged and re-conceptualized (Marabelli & Newell, 2014; Zahra and George, 2002). In their review, Zahra and George (2002) expand on the construct suggesting that organizations have both the *potential* capacity as they acquire knowledge and *realized* capacity as they leverage that knowledge. They point to four dimensions: acquisition (prior investments, prior knowledge, intensity, speed, & direction), assimilation (understanding), transformation (internalization & conversion) and exploitation (use & implementation) (Zahra & George, 2002:189). Many scholars have built on the potential vs. realized concept further extending absorptive capacity research (Jansen, 2005). Jansen, Van De Bosch and Volberda (2005) are an example of this focus on potential versus realized absorptive capacity. They found that factors including participation and connectedness

of the team at the organizational level can influence a firm's ability to benefit from their absorptive capacity.

Absorptive capacity has been measured in a variety of ways beginning with Cohen and Levinthal (1990), who utilized research and development intensity. In addition to the R&D, a firm's absorptive capacity has been measured with patent citations as well as number of patents (DeCarolis & Deeds, 1999). Other proxies for absorptive capacity include: the number of research communities (Deeds, 2001), R&D personnel investments and staffing (Zahra & George, 2002). In one study, the patenting activity of recently hired engineers was used to show that learning by hiring is yet another effective approach to build a firm's absorptive capacity (Song, Almeida & Wu, 2003).

Not only does absorptive capacity positively impact a firm's ability to innovate, but it also has a positive effect on performance (Tsai, 2001). However, Wales, Parida, and Patel (2013) found an inverted U-shaped relationship between absorptive capacity and firm performance suggesting that a firm might have too much absorptive capacity. This may be due to the cost of increasing absorptive capacity - a concern previously raised by Volberda, Foss and Lyles (2010). The cost of acquiring new knowledge becomes increasingly expensive as firms must seek sources more distinct from their current knowledge base (Wales, et al., 2013).

Similar to the previously discussed challenge of balancing exploration and exploitation, absorptive capacity requires that an organization leverage existing internal knowledge while continuing to seek and acquire additional external knowledge (Cohen and Levinthal 1990, Zahra & George 2002). This creates a similar dilemma for firms as they seek to grow their absorptive capacity.

EXPLORATION VS. EXPLOITATION

Not only is innovation a key to a firm's long-term success, but it is also important to balance the improvement of existing capabilities ("exploitation") as well as develop new ones ("exploration") (Levinthal & March, 1993; March, 1991). Exploration and exploitation have been viewed by researchers as two very separate approaches firms can take towards innovation (Benner & Tushman, 2002; He & Wong, 2004; March 1991). March (1991) theorized that the two approaches require unique skills and are therefore mutually exclusive. As such, firms have difficulty successfully focusing on both exploration and exploitation at the same time.

Despite their uniqueness, they are often linked in both research and practice. Focusing on exploitation at the expense of exploration may result in short-term financial gain, but long-term distress as the firm potentially lessens its ability to adapt to changes that take place over the long-term (Benner & Tushman, 2002; Levinthal & March, 1993; March, 1991). As such, Tushman and O'Reilly (1996) proposed that firms need to find the right balance between the two – a concept known as "ambidexterity." They point out that successful businesses grow and prosper over extended periods of time. It is the combination of incremental improvement and developing new innovations that allows a firm the ability to remain successful over time (Lavie, Stettner & Tushman, 2010).

Due to their longevity, these firms not only have to deal with gradual change and enhancements but must also address disruptive technological change as well as changing environments (Tushman & O'Reilly, 1996). Unfortunately, the focus on iterative improvement may hinder a firm's ability to explore the new opportunities that these changes present (Benner & Tushman, 2002). Meanwhile, if a firm chooses to focus on exploration while failing to leverage existing strengths, the results can be equally problematic for the firm's future success

(Levinthal & March, 1993). Hence the proposed balancing act of ambidexterity is critical. Firms must find ways to remain competitive for both the long and near term (Benner & Tushman, 2003). There is still some debate as to what defines the right balance. Factors such as the firm's overall strategy and its external environment also affect the appropriate balance between exploration and exploitation (Lavie, Stettner & Tushman, 2010; March, 1991). These factors will be discussed in greater detail later in this section.

Indeed, firms that are able to strike a balance between exploration and exploitation have been found to have greater sales growth. At the same time, a greater imbalance between the two forms of innovation has been linked to a negative impact on sales (He & Wong, 2004). Despite this strong support for maintaining balance, the challenge associated with doing so in practice has received considerable scrutiny. For example, Christensen (1997) agrees that ambidexterity is critical, but doubts it can be done within a firm. Thus, he suggests that a firm should create separate affiliates to pursue exploration as a means of addressing the challenges of creating a mix with exploitation in a single organization. He later suggests that this approach may be too extreme, but continues to believe that finding the right mix is a challenge (Christensen & Raynor, 2003).

O'Reilly & Tushman (2008) argue that leaders can configure their resources such that their firms can both explore and exploit. Indeed, research suggests that there are some synergies between these seemingly polar approaches giving further support to the idea that ambidexterity, while challenging, is both achievable and beneficial (Andriopoulos & Lewis, 2009). Exploration and exploitation may be more than two unique concepts. They work together to make the most of the advantages of each other. Exploitation allows the firm to maximize the benefits from the firm's exploration activities by further improving on the advances and potentially finding other

ways to leverage them. Meanwhile, exploration ensures that the firm's overall knowledge will continue to grow – creating new opportunities to exploit (Andriopoulos & Lewis, 2009). Cao, Gedajlovic and Zhang (2009) find that both balance and combination of exploration and exploitation work together to produce even greater benefits for firms. By looking at both the relative magnitude and the combined aspect, they provide further support for the value of ambidexterity as well as the argument that there is a synergy between exploration and exploitation such that they are important not only in how they are balanced, but in their combination as well.

There are many tools at a firm's disposal for managing the relationship between exploration and exploitation. For example, firms may focus on developing new innovations by focusing on their internal sources, external sources or some combination of the two (Laursen & Salter, 2006). These are important factors to consider. Research has shown that the more willing a firm is to consider external sources of innovation, the greater their overall innovativeness (Laursen & Salter, 2006).

Exploration – with its emphasis on growth and developing new markets – has been found to have a greater impact on sales, profit and market share growth than exploitation (Auh & Menguc, 2005). It also triggers more attention from investors (Fitzgerald et al., 2021). While most scholars would agree that exploration is critical to the long-term health of the firm, determining the right amount may be a challenging for business leaders. Indeed, too much or too little exploration results in missed opportunity as demonstrated by the inverted U-shaped relationship between exploration and financial performance, using Tobin's Q (Uotila, Maula, Keil, & Zahra, 2009; Belderbos, Faems, Leten, & Looy, 2010). Exploration and exploitation – while both important – can have different effects on products. For example, product quality is

improved when firms exploit their knowledge, but the firm's innovativeness is enhanced when pursuing a more explorative approach. Further, the authors found that the intensity of competition acted as a moderator – where firms are more willing to take an exploration approach when there are experiencing low levels of competitiveness (Molina-Castillo, Jimenez-Jimenez, & Munuera-Aleman, 2011).

USE OF PATENT DATA

Patent data has been a common vehicle for scholars to measure innovation and value creation (Bloom & Van Reenen, 2002; Somaya, 2012). Patents must be "novel and non-obvious" and once granted it gives the holder "'the right to exclude others from making, using, offering for sale, or selling' the invention in the United States or 'importing' the invention into the United States." (United States Patent and Trademark Office, 2015:1) A patent gives a firm the right to legally exclude others from utilizing their patented technology. This protection provides an advantage over their competition. Indeed, the amount of patents in a given product class can drive away potential new entrants (Cockburn & MacGarvie, 2011).

Patenting also improves innovation performance, which, in turn, positively affects financial performance (Andries & Faems, 2013). Not only can firms achieve greater market share, but higher margins as well. This holds true for not only large firms, but for small and medium enterprises as well – even though these firms are less likely to patent innovations then larger firms (Andries & Faems, 2013). This is an interesting phenomena as small firms can especially benefit from an enhanced reputation as a result of patenting (Holgersson, 2013).

Despite the growth in patenting, R&D spending and technological progress have not grown at a similar pace (Boldrin & Levine, 2013). This may be due in part to the fact that not all innovations are patented (Holgersson, 2013). Additionally, factors such as firm size and the type

of innovation (product vs. process orientated) also play into the decision to patent (Somaya, 2012). As patents are public records, which, by definition, undermines secrecy, some innovations go unpatented. Mosel (2012) found an inverted-U relationship between the impact of the innovation and whether or not it would be patented. Small innovations are unlikely to be copied and often not patented. At the other end of the scale, large impact innovations are often protected with secrecy rather than patents. His research found that it is the middle-sized innovations that are most likely to be patented. Another factor in deciding whether to patent an innovation is the reality that it is an expensive proposition for firms to apply for patent protection. Not only are there application fees, but firms often require expert legal advice (Andries & Faems, 2013).

Also, patents may not be as useful in protecting innovation in certain industries compared to others (Cohen, Goto, Nagata, Nelson, & Walsh, 2002). As such, patenting growth varies across industries (Cohen, 2004). National patent policy may also impact activity. For example, the use of patents for strategic purposes such as negotiations varies across countries (Cohen, Goto, Nagata, Nelson, & Walsh, 2002). Arora and Ceccagnoli (2006) found that complementary assets may play a role on patenting propensity. This builds on the idea that innovation is related to the presence of key assets such as marketing and manufacturing capabilities (Teece, 1986).

Use of Patent Data in Research

Despite the various factors that may drive patenting propensity, firms continue to use patents to protect their innovations. Indeed, some firms have entire departments dedicated to the patent process (Mol & Wijnberg, 2011). As such, patent data has become a useful tool for researchers. In his 2012 review, Somaya suggested there are three basic strategies for firms to patent their ideas: propriety (where the firm seeks to create a competitive advantage by using the innovation as a key resource), defensive (where firms attempt to avoid being challenged by

competitors or other firms making claim on their technology) and leveraging (where the firm and then uses the innovation to pursue other revenue opportunities). Patents can also be used to measure the relative innovativeness between firms. Additionally, patents represent an excellent tool for measuring scientific change. This is due not only to its availability, but because patent data provides additional key insights including dates, industry, and inter-relativeness (Griliches, 1990).

Relatedly, researchers have found that firms may use patents in various ways as well. They may see their patents as real options to either exploit or retain, signaling devices to investors and potential partners or as tools to change laws or policies (Levitas & Chi, 2010; Somaya, 2012).

A key aspect of this research is understanding the value of patents. Patents have been found to not only result in greater returns for firms but to even have a negative effect on the patenting firm's rivals (Austin, 1993). When the patents are tied to a product, they are seen as more valuable than an average patent. This phenomenon is further impacted when the patent is announced in the popular press (Austin, 1993). When it comes to more complicated products, it becomes likely the patents required to market the product are held by multiple firms (Cohen, 2004). This makes it more difficult for an individual firm to take key products to the marketplace. When patents inhibit the creation new products by limiting a firm's ability to combine inventions, they can actually undermine and inhibit innovation (Hall & MacGarvie, 2010; Heller and Eisenberg 1998).

Patents have an impact of various aspects of the firm. Hall and MacGarvie (2010) found that there is a positive performance impact for firms that patent important ideas, but there is a negative impact when filing additional patents for inventions of lesser importance. Indeed,

patents have even been used to analyze how firms structure themselves by looking at the subsidiary to which patents are assigned (Arora, Belenzon, & Rios, 2013). Patents can also provide an indication of a firm's internal knowledge - which in turn can impact make or buy decisions (Cassiman & Veugelers, 2006). Companies with strong patent histories have better returns after an IPO as more patents result in better returns (Bessler & Bittelmeyer, 2008). Using this same logic, patents have also been used as a proxy for creativity at the individual level. Higher counts suggest a more creative individual. Further, the patent's characteristics provide insights as to whether the individual's creativity will yield more incremental or divergent outcomes (Audia & Goncalo, 2007).

Role of Patent Citation Information

Quantifying the inventive output of firms by using the patent activity and types of citations has been widely used as a proxy to determine both the importance and influence of the firm's innovations (Hall, Jaffe & Trajtenberg, 2001). This is due in part to their ability to consider factors such as firm, industry, and timing (Roach & Cohen, 2013). Further, patent citations represent a means to examine and understand how various inventions are related to one another (Jaffe, Trajtenberg, and Henderson, 1993).

A key component of the patenting process is identifying the previous patents on which the latest innovation is based. These citations can be a valuable tool in measuring the value of a patent. By considering the number of times a given patent has been cited by other patents, one can determine how influential (and valuable) the original breakthrough was (Hall, et al., 2001). Generally, the more a patent is cited, the more valuable the patent (Harhoff, Narin, Scherer &Vopel, 1999). However, a firm's ability to cite their own previous work (self- citations) can be of greater value than external citations. The authors identify several reasons for this, including

lower risk, lower costs to acquire new knowledge, and quicker entry (Hall, Jaffe, & Trajtenberg, 2005). A review of Japanese semiconductor firms demonstrated that firms tend to focus patent activity in areas where they have previous patents (Stuart & Podolny, 1996). This is also consistent with March and Simon's (1958) landmark work which suggested firms are likely to leverage their current areas of expertise as they seek out new opportunities.

Using Tobin's Q for market value, Hall, et al. (2001) found that weighting patents based on their citation gave a better indication of the firm's value than unweighted consideration. Further, the authors found that firms that were able to build on their previous breakthroughs (measured by citing their own patents) doubled the impact of other patents. Looking at market value provides some insights into how to interpret actions that may not have an impact until several years in the future. Indeed, patents have been shown to have an immediate impact on market value even though there is no immediate impact on productivity (Bloom & Van Reenen, 2002). Patent citations add value in their own right. Patel and Ward (2011) found that citation can increase stock price using the citation date.

While many researchers point to the advantage of self-citations, it can be argued that the more a given patent is cited in other patents applications, the greater the impact of that given patent (Kim, Song, & Nerkar, 2012). As discussed previously, patent citations also provide insights on a firm's focus on exploration and exploitation. Firms that take a more explorative focus tend to have more innovative output (i.e. patents) than other firms (Moreira, Torkomian, & Soares, 2016).

The citations of a given patent provide a proxy for how valuable that patent is (Capaldo, Lavie & Petruzzelli, 2014; Singh, 2008). The age of patents has decreasing value over time (Capaldo, Lavie & Petruzzelli, 2014), however there is some evidence that having "old"

knowledge that is external to a firm's industry may help improve a firm's innovation (Katila, 2002). If a firm seeks exploratory innovation, it must seek to move beyond the firm's existing competencies (Benner & Tushman, 2002).

EVENT STUDIES

An event study is a methodology used to determine the impact of a given event on a firm's value. It allows researchers to determine whether the event (such as a merger announcement or leadership change) has an impact on the firm's stock price (Dutta, 2014). The seminal works by Ball and Brown (1968) and Fama, Fisher, Jensen, and Roll (1969) have created the basis for this well-established approach. One review of this approach identified 565 articles published in five major journals between 1974 and 2000 that utilized event studies to determine a potential abnormal change in stock price (Kothari & Warner, 2007). Event studies are a very commonly used methodology (Peterson, 1989). It has been argued that the event study methodology is "the standard method of measuring security price reaction to some announcement or event" (Binder, 1998:111). In his 1998 review, Binder concluded that the event study methodology is a highly useful means to identify how a given event influences market prices.

At the heart of the event study is the argument that if there is no "news" regarding a given firm, its stock prices should rise (or fall) based on the information about the market as a whole. Thus, the price would vary consistent with other similar firms. If a given firm's price varies in an abnormal fashion, one can deduce that there is unique information impacting the result (Ball & Brown, 1968). This, in turn, informs researchers of the impact and rationale behind different decisions – especially in the short term (Kothari & Warner, 2007). The event study uses a period

of time around the event to estimate what results would have occurred if the event in question had not transpired (Peterson, 1989; McWilliams & Siegel, 1997).

In their original work, Fama, et al. (1969) demonstrated the impact of stock split announcements on the firm's stock price. Austin (1993) focuses on the dates of patents granted in his event study exploring the impact of patents on rival firms. He points out that application dates may not be well publicized impacting the validity of the event study (Austin, 1993: 254).

CHAPTER 3: HYPOTHESIS DEVELOPMENT

While numerous studies have shown that innovation creates value (e.g. Bloom & Van Reenen, 2002), there are still several aspects of this relationship that remain unexplored. A firm's value – driven in part by stock price – has several important impacts on the firm's long-term success. It is a key tool for attracting investors, securing financing, and is often used to evaluate management's success and continued employment. As investors are a key driver of a firm's market value, it becomes critical to understand how they react to specific events and decisions made by the firm's leadership. These insights help firms develop strategies that will maximize the value created when leveraging their limited resources.

If firms need to innovate to prosper, they must choose a path along the exploration/exploitation spectrum. Selecting this path is a challenging endeavor. March (1991) and others (e.g. Benner & Tushman, 2002; Gupta, Smith and Shalley, 2006) argue a firm must place a focus on both exploration and exploitation. However, this is easier said than done, as exploration and exploitation require conflicting approaches and resources (He & Wong, 2004). Just as the firm's leadership must struggle with the balance, investors must evaluate these decisions and react appropriately. Investors may recognize the need for innovation, but the differences between exploration and exploitation would create challenges in this evaluation. Eberhart, Maxwell and Siddique (2004) suggest that while investors react positively to innovation announcements in general, they may, in fact, be underestimating the actual long-term impact of such announcements. Indeed, firms that focus on exploitation are often undervalued (Fitzgerald et al., 2021).

Not only do the risks and outcomes of exploration and exploitation vary but pivoting from an exploration focus to exploitation activities is a critical, yet perilous challenge. As a

result, I posit that investors will react differently to announcements associated with exploration compared to announcements associated with exploitation. This reaction could be critical as a firm must place enough focus on exploitation to maintain short term success, while also placing enough emphasis on exploration to ensure future success (Levinthal & March,1993).

In this chapter, I develop a model of the impact of the type of innovation (exploration vs. exploitation) and firm characteristics on abnormal returns. Using Cohen and Levinthal's (1990) absorptive capacity as a lens, I hypothesize about the influence a firm's size and patent portfolio have on abnormal returns after pursuing explorative and exploitive innovations. These outcomes are important as they inform practitioners on the potential reaction to their strategic innovation focus and could create a bias toward exploration or exploitation. Additionally, it considers whether investors are considering the criticality of an ambidextrous approach toward innovation and encouraging appropriate strategies. Lastly, this model helps address several seemingly contradictory factors in this research stream.

The model I propose considers how different forms of innovation will impact investor reaction in the form of abnormal stock returns. Further, I consider how firm characteristics moderate this relationship.

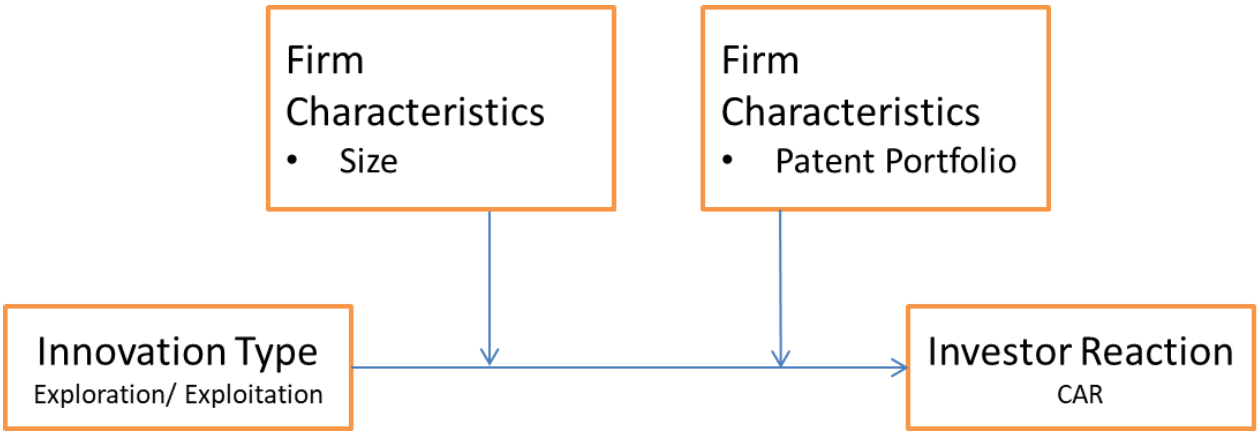

Figure 1: A Model of the Impact of Innovation Type and Firm Characteristics on Abnormal Returns

A firm's ability to balance exploration and exploitation (sometimes referred to as ambidexterity) assists in a firm's ability to gain and process knowledge and improves their effectiveness (Fernhaber & Patel, 2012). Thus, this balance is desirable and associated with positive firm performance (Geerts, Blindenbach-Driessen, & Gemmel, 2010; Rothaermel & Deeds, 2004). However, the unique nature of explorative innovation versus exploitative innovation requires varied inputs and result in varied outcomes. This draws one to my primary research question: Do investors view exploration (exploitation) more positively than exploitation (exploration)? Further, do firm specific characteristics moderate this relationship?

Interestingly, the literature proposes mixed results – with some scholars suggesting outcomes that would likely drive a preference towards exploration and others toward exploitation. This dilemma is important as it impacts firms on several levels, including potential short- and long-term impacts. A firm's absorptive capacity plays a key role in this dynamic. While it can facilitate a shift in innovative approach, it still carries the risk of failure for the firm (Swift, 2015). This suggests that while absorptive capacity is critical to both innovation and the ability to pivot between exploitation over exploration, firms must carefully consider when to focus and when to shift focus. Likewise, investors require a sense that the firm's innovations will bring the appropriate levels of value to justify an investment in the firm.

The interaction between exploration and exploitation is further complicated by the finding that firms with strong exploitation competencies often have strong exploration abilities (Isobe, Makino, & Montgomery, 2004).

Many scholars have argued that firms will often favor exploitation over exploration (Piao & Zajac, 2016). Exploitation ties to absorptive capacity as it represents a firm's ability to leverage its existing knowledge in its ongoing operations and innovations (Van den Bosch,

Volberda, & De Boer, 1999; Zahra & George, 2002.) A firm would want to build on past successes and gain "quick hits" by using existing knowledge to spark improvements, efficiencies and related innovations. While these factors would be important considerations, several other factors may influence management's decisions on which types of innovation to emphasize. Their tactics must also appeal to investors. Firms will seek out approaches that help ensure a significant return if they wish to tap into the capital markets critical to their funding (Levinthal, 1994). The nature of exploitation - with lower risks and shorter payback periods - may appeal to investors. A focus on exploitation would be appealing to investors as they would be more likely to see a quick return on their investment. This would cause investors to respond more favorably to exploitation-related efforts. Even though a focus on exploitation can impact long-term results, as the firm limits their knowledge growth, it may be more desirable than a focus on exploration activity which carries greater risk and potentially longer payback periods (Uotila, Maula, Keilm & Zahra, 2009).

There are additional arguments to support why firms and investors would prefer an exploitation focus. Hall, et al., (2005) found that patents that relied on self-citations (a common method of identifying a patent as exploitive) have greater value than patents relying on external cites. This suggests by focusing on exploitative innovation, firms would create greater value – which in turn would make this approach more appealing to investors.

However, there is also the risk that the easier nature of exploitation may result in too much emphasis on exploitation (Volberda, Foss, & Lyles, 2010). This phenomenon is sometimes referred to as a "competency trap" wherein a firm's focus on exploitation begins to squeeze out exploration (Levinthal & March, 1993; Sirén, Kohtamäki & Kuckertz, 2012). This approach

undermines the need for a balanced, ambidextrous approach and can be damaging to the firm's chances for long term success.

Like exploitation, exploration plays a role in growing a firm's absorptive capacity (Patel, Kohtamäki, Parida, & Wincent, 2015). Additionally, the singular focus on exploitation can result in failure to continue to the development of absorptive capacity (Levinthal, 1994). This exposes the firm to the risk of being unprepared for new advances in their field (Levinthal, 1994). Absorptive capacity is dependent on its "loop-like" nature. New knowledge is critical to fuel the absorptive capacity loop, and exploration results in the insertion of critical external knowledge to the firm. While this infusion of knowledge allows firms to grow their ability to innovate, an exploration focus must be carefully managed. Due to an inverted U-shaped relationship, too much (or too little) exploration undermines performance (Uotila et al., 2009). This creates a dilemma for firms as they try to determine the appropriate mix.

While exploration is risky, ignoring this aspect of innovation is a potentially greater risk. As such, there are numerous reasons for firms (and investors) to favor explorative innovation. Since exploration requires new knowledge to be absorbed and applied, successful exploration suggests that a firm has expanded its capabilities (Phelps, 2010; Rosenkopf & Nerkar, 2001). In other words, the firm has successfully absorbed new external knowledge helping to ensure ongoing success. Also, the short-term nature of exploitation is not as likely to result in higher long term returns as a focus on exploration (Lewin, Long, & Carroll, 1999). This provides a key financial incentive to both firms and investors.

Woolridge and Snow (1990) looked at the reaction to major strategic decisions – including items like major capital investments and joint ventures. They found that, in general, these types of decisions resulted in positive returns. This lends further credence to the idea that

investors will reward a longer-term focus. Sood and Tellis (2009) also challenge the idea that less risky, short-term projects are preferred as a means to increase stock prices. They track returns over the life of innovation projects and find returns are thirteen times greater when considering the life of the project as opposed to an individual innovation event. Thus, firms must be careful to avoid assuming investors will focus exclusively on the short-term. The very nature of explorative innovation – with new, larger leaps – may serve as an enticement to investors as well (Fitzgerald et al., 2021).

Further complicating this dichotomy, exploration has the potential to improve or decrease performance, while exploitation is more likely to maintain past performance trends (Lewin, Long, & Carroll, 1999). This suggests that a firm's efforts to innovate can result in a variety of outcomes, and it is unclear which approach investors might favor. Investors might react positively to both exploration and exploitation. Therefore, one could argue that firms and investors would prefer innovations that are explorative or exploitative. Thus, I suggest two competing hypotheses:

> ***Hypothesis 1A****: Exploitive innovation will generate higher positive abnormal returns compared to explorative innovation.*

> ***Hypothesis 1B****: Explorative innovation will generate higher positive abnormal returns compared to exploitive innovation.*

Firm Characteristics: Size

Certain firm characteristics have been identified as variables that might help predict how a firm's market value might grow over time (Kogan & Papanikolaou, 2012). Amongst these variables, several previous studies have looked at firm size as a potential determinant in the firm's approach to innovation (e.g. Kleinknecht, 1989; Cohen & Klepper, 1996). A firm's size

can have significant impact on its approach to doing business. For example, in the case of a smaller firm, there are several factors that could disadvantage it compared to larger firms - including funding challenges, number of skilled employees and lack of information (Kleinknecht, 1989).

However, when it comes to innovation, firm size impacts a variety of often-contradictory factors. These aspects provide seemingly conflicting insights on whether a firm's investors would respond more favorably to exploration or exploitation activity based on the size of the firm. Rothwell (1983) provides a breakdown of these advantages and disadvantages from the perspective of a small firm as well as a large firm. For example, smaller firms tend to be more challenged both in terms of raising capital as well as scaling their operations (Rothwell, 1983). Further, smaller firms may be disadvantaged in acquiring funding for research activities due to their dependence on banks versus internal funding as well as the impact of the potential risk (Hottenrott, Hall, & Czarnitzki, 2016). The risk of infringing on a larger firm's patent portfolio (Blind, Edler, Frietsch, & Schmoch, 2006) and the application fees and expert legal advice required when patenting further challenge smaller sized firms compared to larger firms (Andries & Faems, 2013). Smaller firms also have less room for error and are at a greater disadvantage at recovering from a strategic error than larger firms. Despite these potential challenges, patenting activity still has a positive impact on smaller firms' innovation and finances (Andries & Faems, 2013).

This is not to say that small firms are entirely lacking advantages. Smaller firms have the ability to quickly respond to market changes in part due to a more streamlined management structure. This structure also provides a more responsive approach to internal communication and problem solving (Rothwell, 1983). While they have less ability to take a significant loss,

smaller firms have more to gain and, in many ways, are better positioned for knowledge transfer and absorption. They possess more streamlined and less bureaucratic processes which allow them to communicate better and respond faster (Lee & Kim, 2016). Also, exploration allows for more significant impact, and one of the key considerations for smaller firms is their ability to grow (Wales, et al., 2013). Another argument in favor of small businesses is the finding that innovation investments in small startups result in greater likelihood of a patent than innovation-related investments in larger firms (Kortum & Lerner, 2001). Small firms have a higher rate of major inventions when compared to large firms, and they tend to grow faster as well (Akcigit & Kerr, 2018). These factors suggest that small firms are not only capable of developing innovative products, but they can successfully patent and sell their inventions and grow their business. Indeed, smaller firms that patent innovations tend to patent more frequently than larger firms (Brouwer & Kleinknecht, 1999).

As Cohen and Levinthal (1990) pointed out, absorptive capacity is more than just taking in external knowledge. It also includes the ability to transfer knowledge within an organization. Smaller firms with their less bureaucracy may be in a better position to increase their absorptive capacity and successfully launch explorative innovations. Further, they are more likely to benefit from such innovations and the relative potential impact of a breakthrough is greater for a smaller firm (Austin, 1993). These factors would make exploration an appealing option for smaller firms and their investors. Indeed, smaller firms hold a higher portion of explorative patents compared to large firms (Nooteboom, Van Haverbeke, Duysters, Gilsing, & Van den Oord, 2007).

Lubatkin, Simsek, Ling, & Veiga (2006) found that small firms that seek an ambidextrous approach often out-perform their peers (at least in the eyes of their CEOs). Rothaermel and Deeds (2004) looked at exploration and exploitation alliances and found that as

the venture grew larger, size was a negative moderator. As smaller firms absorbed new knowledge, they no longer needed a partner and could instead stand alone. Nevertheless, as smaller firms engage in innovative activities, they are not only placing a strain on the financial aspects of the firm but testing the leadership as well (Mc Namara & Baden-Fuller, 2007).

The absorptive capacity of a firm may also influence the decision of whether to focus on exploration or exploitation. Much of the benefit from exploration comes from a firm's ability to absorb and leverage external knowledge. The absorptive capacity of a firm is in part based on the knowledge it has accumulated over time (Mowery, Oxley, & Silverman, 1996). This focus on increased flexibility and change (exploration) stands in contrast to focus on stability or allowing for organizational inertia (exploitation) by building primarily on existing knowledge (Lavie, Stettner, & Tushman, 2010). This places smaller firms at a disadvantage compared to larger firms (Rothwell, 1983). Many smaller firms' innovations represent a highly limited or specialized area. This limits their abilities to absorb more complex external knowledge compared to larger firms (Rocha, 1997). This is further exacerbated by the reality that external knowledge is also critical to allow them to exploit their innovations after their initial breakthrough (Schmidt, 2010). Firms with greater absorptive capacity have a greater ability to leverage external knowledge (Mowery, et al., 1996). Despite these challenges, evidence suggests that in some ways smaller firms are better at innovation than large firms. For example, smaller firms receive more patents per dollar spent on research (Klette & Kortum, 2004). Additionally, as firms grow larger they often dedicate a proportionately lower amount of resources toward innovation – which suggest that smaller firms may be better at major innovations (Cohen & Klepper, 1996; Mansfield, 1981). Thus smaller firms have incentives to focus on exploration and exploitation – and have demonstrated advantages and disadvantages to each area.

While smaller firms have to find ways to overcome these challenges, larger firms are better positioned to deal with the issues facing smaller firms. One key advantage of larger firms is their size, which gives them the opportunity to organize themselves in a fashion that might not be possible for a smaller firm. For example, larger firms have the ability to simultaneously focus on exploration and exploitation by creating separate business units to focus on each area (Lubatkin, et. al, 2006). Larger firms are also better positioned to deal with the financing and scale challenges when compared to smaller firms. Their larger size allows them to more easily attract skilled workers and external resources (Rothwell, 1993). Due to their greater sales, larger firms are able to monetize innovations to result in a greater benefit compared to smaller firms (Nooteboom & Vossen, 1995).

Larger firms are not immune from the risks associated with exploration. Larger firms are faced with many disadvantages, including the fact that there may be less benefit for individual contributors than in smaller firms (Nooteboom & Vossen, 1995). Rothaermel and Deeds (2004) found that as firms grow larger, they are more likely to keep their more high-profile projects in-house, which would limit the knowledge they absorb. They are also on the opposite end of the spectrum when it comes to bureaucracy and communication (Rothwell, 1993). Larger firms may actually struggle to absorb new capabilities compared to smaller firms (Mowery, et al., 1996). As firms grow larger, the benefits of their innovations begin to decrease (Ahuja & Lampert, 2001). Indeed, these large firm challenges have allowed smaller firms to be more effective at innovation activities than larger firms (Nooteboom & Vossen, 1995).

These factors suggest that while exploration is important for a firm's long-term success, size matters. However, the impact is less than clear. Both small and large firms have advantages that suggest they can successfully monetize breakthrough innovations that tend to come from

exploration. Yet their strengths are varied when compared to the other. On the one hand, exploration tends to be more inherently risky, and the return on the investment can take a longer time – which suggest a benefit to larger firms. However, the nimbleness and relatively large impact of a major breakthrough suggests a benefit to smaller firms. The size of the firm appears to both positively and negatively impact the likelihood of success in explorative innovation. Thus, I suggest two competing hypotheses:

> ***Hypothesis 2A:*** *The size of the firm will positively moderate the relationship between exploration and abnormal returns such that larger firm size will result in greater abnormal returns compared to smaller firm size.*
>
> ***Hypothesis 2B:*** *The size of the firm will positively moderate the relationship between exploration and abnormal returns such that smaller firm size will result in greater abnormal returns compared to larger firm size.*

Given the less risky – and still critically vital – role of exploitation combined with typically shorter payback periods, one can surmise that exploitation activities will be met with a more positive reaction for smaller firms – which will benefit from any positive impact to a greater extent (Austin, 1993). However, the challenges that come with their scale result in larger firms having more of an advantage in exploitation rather than exploration (Nooteboom et al., 2007). As a firm's size increases, so does the propensity for organizational inertia and focus on exploitation (Lavie et al., 2010). Similar to exploration, there are multiple factors that suggest firm size impacting exploitive innovation. This leads to the following competing hypotheses:

> ***Hypothesis 3A:*** *The size of the firm will positively moderate the relationship between exploitation and abnormal returns such that smaller firm size will result in greater abnormal returns compared to larger firm size.*

Hypothesis 3B: *The size of the firm will positively moderate the relationship between exploitation and abnormal returns such that larger firm size will result in greater abnormal returns compared to smaller firm size.*

Firm Characteristics: Patent Portfolio

Another commonly utilized firm characteristic is a firm's patent portfolio (Ndofor, Sirmon & He, 2011). Patents can be used as a proxy for a firm's technical knowledge, because the patents are themselves a product of a firm's ability to innovate (Hall, Jaffe, and Trajtenberg, 2001). Further, they are a sign of a firm's ability to absorb and grow knowledge (Ndofor & Levitas, 2004). Indeed, firms with larger patent portfolios can be seen as firms that have integrated more knowledge (Nooteboom et al., 2007).

Due to its cumulative nature, absorptive capacity allows the firm to leverage the experiences from past innovations and apply them to new breakthroughs which leads to improved performance results (Patel et al., 2015). The size and make up of a firm's patent portfolio provide insights to the relative impact of these past innovations. A more varied patent portfolio is a sign of a firm with a greater variety of technological resources (Miller, 2004). Lane, Koka and Pathak (2002) argue that a more diverse portfolio results in better performance because of greater absorptive capacity required for such output. It also demonstrates an "ability to develop new knowledge to deal with this incremental technological change" (Ndofor & Levitas, 2004: 696).

Patent citations can also be used to understand the diversity of a firm's innovative output (Patel et al., 2015). Harrigan and DiGuardo (2014) looked at backward citations and argue it presents a better proxy for absorptive capacity – while confirming a positive relationship with future returns. Citations provide insights on whether the firm is absorbing external knowledge or building on existing internal knowledge. The ratio of citations to patents has a direct impact of a

firm's market value "with an extra citation per patent boosting market value by 3%." (Hall, et al., 2005:1). Further, more diverse patent portfolios not only allow a firm to spread risk but expose them to greater possibilities to combine technologies to create new inventions (Appio, De Luca, Morgan, & Martini, 2019).

In this way, patent portfolios can aid firms in their quest to create innovative and profitable products. A large portfolio allows firms to better determine the relative appeal of different technologies they may be considering pursuing (Ernst, 1998). This is due in part to the recognition that the success of a firm's new products is dependent on the knowledge it has gathered through past innovations (Klette & Kortum, 2004). This suggests that firms with larger portfolios should have an advantage in determining which new innovations to patent. Indeed, the value of individual patents is likely influenced by the other patents in the firm's portfolio (Andries & Faems, 2013).

By building a large patent portfolio, firms can leverage their internal knowledge and experiences which increase the likelihood of a successful analysis of new innovations (Ernst, 1998). This results in increasing a firm's absorptive capacity, which allows them to manage diverse technologies while achieving higher profitability (Appio et al., 2019). This impact can be seen in the bottom line as higher patent counts are associated with greater profit and higher market values (Chen & Chang, 2010; Neuhäusler, Frietsch, Schubert & Blind, 2011). Relatedly, citing from within a firm's patent portfolio also increases that firm's market value (Patel & Ward, 2011).

So, it is not surprising that start-ups with strong patent portfolios were more likely to experience both short- and long-term success (Bessler & Bittelmeyer, 2008). Growing one's patent portfolio has the additional benefit of reducing the incentives for competitors to innovate

(Choi & Gerlach, 2017). These factors combine to suggest that firms with a larger patent portfolio are best positioned to identify and monetize new innovations while keeping competition at bay.

This further suggests that a firm's patenting activity would be viewed favorably by investors in both the case of explorative and exploitive patents – as both positively impact the firm's success. As firm with a larger portfolio would be better positioned to leverage their internal knowledge and pursue patents that were most likely to result in success. In the case of both exploration and exploitation, the portfolio size should moderate the relationship such that investors will react more favorably when the firm's current patent portfolio is large relative to peer firms. Thus, it follows:

> ***Hypothesis 4****: The size of a firm's patent portfolio will positively moderate the relationship between innovation and abnormal returns such that a larger patent portfolio will result in greater abnormal returns compared to a smaller patent portfolio.*
>
> ***Hypothesis 5A****: The size of a firm's patent portfolio will positively moderate the relationship between explorative innovation and abnormal returns such that a larger patent portfolio will result in greater abnormal returns compared to a smaller patent portfolio.*
>
> ***Hypothesis 5B****: The size of a firm's patent portfolio will positively moderate the relationship between exploitative innovation and abnormal returns such that a larger patent portfolio will result in greater abnormal returns compared to a smaller patent portfolio.*

CHAPTER 4: METHODS AND DATA

Sample

For the purposes of this study, I will focus on the biotech industry. This industry has an established reputation for patenting new innovations (Sorensen & Stuart, 2000; Wu, Levitas & Priem, 2005). Additionally, as there are numerous ways for a firm to protect its innovations, focusing on a single industry helps ensure sample firms will leverage the patent process more consistently (Basberg, 1987; Levitas, & McFadyen, 2009; Mansfield, 1986).

In order to create a sample that allows me to explore the relationship between explorative and exploitive innovations and abnormal returns, I plan toleverage several publicly available datasets. For much of the accounting and financial data, I will leverage Wharton Research Data Services (WRDS), including their Compustat data files as well as the Center for Research in Security Prices (CRSP) U.S. stock database. The United States Patent and Trademark Office (USPTO) and the University of Virginia's Global Corporate Patent Dataset (Bena, Ferreira, Matos, & Pires, 2017) will provide patent and citation data.

I will also leverage the public dataset created by Kogan, Papanikolaou, Seru and Stoffman (2017) which matches patent data from 1926 to 2019 to the firm in the combined Compustat and CRSP database. This will allow me to link specific patents to firm data outlined in the following paragraphs. In order to be included, firms will have to have data in the CRSP and Compustat datasets during the focal year.

Following the lead of past scholars, I intend to use an event study approach to determine if patenting firms experienced abnormal returns in their stock price related to the patent applications (e.g. Gaur, Malhotra & Zhu, 2013; Starks & Wei, 2013; Travlos, 1987; Uhlenbruck, Hitt & Semadeni, 2006). I will then test my hypotheses using ordinary linear squares (OLS) regression to determine if there were significant abnormal returns (Brown & Warner, 1985; Mc

Namara & Baden-Fuller, 2007). Further, I will address potential issues such as multicollinearity and skewness when the dataset has been created. The detailed methodology for the calculation of each variable is described in the following paragraphs.

Dependent variables

Cumulative Abnormal Returns (CAR): The dependent variable in this study is Cumulative Abnormal Returns (CAR) for the biotech firm in the days surrounding the firm's patent application date. I plan to use the market model methodology established by Brown and Warner (1985) and used by others to measure investor reaction to the announcement of explorative and exploitive patents. One can then calculate the expected stock price change based on the market in general and compare it to the actual change in price for the focal firm.

The expected return for company "i" on day "t" can be shown as:

$$E_{it} = \alpha_i + \beta R_{mt} + \xi_{it}$$

In this example, R_{mt} is market return on day t (Mc Namara & Baden-Fuller, 2007). Having determined the expected return for a given firm on a given day, abnormal returns can be calculated by subtracting the actual return on day t from the expected return. The cumulative abnormal return is the determined by summing the abnormal returns over the event window (Brown & Warner, 1985).

In order to determine expected returns, I will leverage the CRSP database which tracks daily stock market returns. Following past research, my study utilize stock returns 130-30 days prior to the application date of each patent application observed (Gaur et al., 2013).

CRSP will be utilized to determine the actual daily return for each observation. Using this data, I will total the difference between the firm's actual returns and expected returns for the five days (-2, +2) adjacent to the patent application (Gaur et al., 2013). (For any application date not

occurring on a Wednesday, I will need to avoid weekends.) The total of the daily difference between the expected and actual results resulted in the CAR for each patent application.

Independent variables

Explorative and exploitive innovation: Quantifying the inventive output of firms by using the patent activity and types of citations has been widely used as a proxy to determine both the importance and influence of the firm's innovations (Bloom & Van Reenen, 2002; Hall, Jaffe & Trajtenberg, 2001). Patent law requires applicants to cite any prior art (e.g. patents, non-patented research) (Cotropia, Lemley, & Sampat, 2013). As such, patent citations represent a means to examine and understand how various innovations are related to one another (Jaffe, Trajtenberg, and Henderson, 1993). This can be extended to provide insights as to the nature (exploitive vs. explorative) of a given patent (Benner & Tushman, 2002). Building on this research, I will leverage the Global Corporate Patent Dataset - which was assembled through a grant at the Darden School of Business at the University of Virginia. This dataset captures patents issued between 1980 and 2017 (Bena, Ferreira, Matos, & Pires, 2017). Due to a lack of updates to this dataset after 2017, I will limit my sample to patents between 2010-2014. Using these tools, I will develop a variable associated with explorative innovation and a second variable exploitive innovation (Liu, 2014).

Following Benner and Tushman (2002), I will begin by exploring any self-citations (i.e. when the firm cites one of its own patents) on the focal patent. Secondly, I will identify any citations that are owned by another firm and have been cited by the focal firm on their past patents. In both cases, these citations will suggest the firm is depending on their current stock of knowledge in the creation of the new patent because they are relying on previously utilized patents. These citations would be consistent with exploitation. If 80% or more of the citations on

a given patent fall into one of these two categories, the patent will be categorized as exploitive innovation (Benner & Tushman, 2002; Liu, 2014). An explorative patent would be identified similarly. Any patent having 20% or fewer citations in the two categories above would be coded as explorative. In addition to using 80% as the limit for exploitative innovation, I will test for sensitivity by repeating this approach setting the limit at 40, 60, 90 and 100 percent.

Firm Size: As I study the impact of explorative and exploitive innovation on abnormal returns, I consider firm size as a moderator. While there are numerous measures for firm size, I plan to use the natural log of assets as a proxy for firm size based on the frequency of its use in related literature (e.g. Asthana, & Zhang, 2006; Lee & Kim, 2014; Levitas & McFadyen, 2009).

Patent Portfolio: Firms' patent portfolio will be created by using data assembled by in the Global Corporate Patent Dataset (Bena, Ferreira, Matos, & Pires, 2017). This dataset was specifically created to allow researchers to cross-reference firms issued patents by the USPTO with firm specific identifiers found the Compustat dataset. Thus, it will allow me to capture a firm's patent counts while overcoming many of variations in firm naming conventions, including subsidiaries and conglomerates (Bena, et al., 2017).

Control variables

Tobin's Q: Tobin's Q is designed to measure a firm's market value compared to its book value – which provides insights on how investors view the firm. This is a valuable measure on several levels. First, it provides insights on intangible assets such as patents (Kumar, 2011; Villalonga, 2004). It can also provide insight on a firm's performance (Levitas & McFadyen, 2009). Firm performance has been linked to absorptive capacity (Wales, Parida & Patel, 2013). Intangible assets and firm performance can influence investor reactions. As my study considers

both patents and stock market returns, Tobin's Q represents an important control. I will calculate Tobin's Q using Chung and Pruitt's (1994) approximation which can be represented as:

[(Outstanding Common Stock*Share Price) + Value of Preferred Stock + (Short-term liabilities – Short-term assets + Long Term Debt)] / [Firm's Book Value of Total Assets]

All these values are captured at the firm level (Chung & Pruitt, 1994).

Firm Age: Firm age is another important control, as older firms are likely to have more products in development (Rothaermel & Deeds, 2004). Additionally, older firms are more likely to focus on process related innovations, while younger firms tend to emphasize product-based innovations (Kueng, Yang & Hong, 2014). Similarly, older firms are more likely to focus on existing and older technology rather than newer innovations (Sorensen & Stuart, 2000). Firm Age is calculated by the difference between the year of incorporation and the focal year.

R&D Expenses: R&D spending has several potential impacts to this study's results, including Cohen and Levinthal's (1990) seminal work that links R&D to absorptive capacity. Several studies link R&D spending to market value (c.f. Asthana & Zhang, 2006; Griliches, 1981). Additionally, there is a linkage between R&D sending and number of patents awarded (Griliches, Pakes & Hall, 1986). This variable will be calculated using the focal firm's R&D expense the year of the patent filing.

Leverage: A firm's leverage can also impact investor reactions and should be controlled for (Adami, Gough, Muradoglu, & Sivaprasad, 2010). I will measure leverage bydividing the total debt by the total capital of the patenting firm in the focal year (Adami, et al., 2010; Levitas & McFadyen, 2009).

Firm Drugs: New drugs can generate significant margins for the producing firm; therefore, I will also control for recently approved drugs (Chen & Chang, 2010). I will utilize a

unique a dataset with publicly traded biotech drugs from 2010-2019 to determine the count of drug at the focal firm level.

Alliance Partners: As investors have been shown to react to a firm's alliance announcements, I will control for this by leveraging the SDC Platinum database to capture the number of alliances with the patenting firm's (Das, Sen, & Sengupta, 1998). In order to calculate the number of alliances, I will capture the number of alliances formed in the focal year and the four previous years (Yang, Lin, & Peng, 2011).

Leveraging the Darden School of Business at the University of Virginia's Global Corporate Patent Dataset, I limited my sample to publicly traded biotech firm patents filed between 2010-2014 (Bena, Ferreira, Matos, & Pires, 2017). I then removed any patents by the same firm that were filed on the same date. This was done to eliminate the potential ambiguity of which patent was influencing results. The resulting dataset contained 3660 unique patents filed by 164 different organizations. Additionally, I incorporated three new controls to those originally proposed Methods Section.

First, I added a control to consider the potential influence of institutional ownership. Institutional owners play a critical governance role which could impact investor reactions and decisions (Dharwadkar, Goranova, Brandes, & Khan, 2008). This was measured by calculating the percent of outstanding shares owned by institutional owners at the end of the focal year.

Secondly, I added a control for liquidity by measuring the bid-ask spread. This measure provides valuable insight into market liquidity. Liquidity has been shown to have several potential impacts on trading including the likelihood of a price change (Cashman, Harrison, Seiler, & Sheng, 2019). For the purposes of this study, I utilized CRSP to calculate the relative daily bid-ask spread using the following formula:

$$Spreadi,t = Et(DailyAski - DailyBidi).$$

$$Midpointi,t = Et\ (DailyAski+DailyBidi\ )/2$$

$$Relative\ Spreadi,t = Et\ (\ Spreadi/Midpointi).$$

The third new control was created by establishing dummy variables at the firm level to account for firm-specific effects. Patents per firm in the sample ranged from 1 to 267, including 10 out of 164 firms with over 100 patents in the sample.

Lastly, I modified the calculations of two of the original controls. R&D expenses were calculated as R&D Intensity dividing expenses by number of employees by R&D expenses rather than simply using expenses as proposed. This change was due to the strong correlation of R&D expenses with other variables including Firm Size and Patent Portfolio. Additionally, Tobin's Q was calculated as (number of outstanding shares of stock*Year-end stock price)/Total assets rather than [(Outstanding Common Stock*Share Price) + Value of Preferred Stock + (Short-term liabilities – Short-term assets + Long Term Debt)] / [Firm's Book Value of Total Assets]. The correlation between these two calculations should have a negligible impact on the findings.

Results

Table 1 shows the descriptive statistics for the dataset, and Table 2a and 2b share the correlations. These tables also highlight multiple dependent (CARS) and independent (Exploitation Percentage) measured at different thresholds. These thresholds were utilized in separate the regression analyses to test each combination's impact on results. Cumulative Abnormal Returns (CARS) were calculated using five unique result windows (-1,+1), (-2,+2), (-

5,+5), (0,+3) and (0,+5) as opposed to only the (-2,+2) window originally proposed. Additionally, rather than using the proposed Market Model Method (described earlier), CARS was calculated using the Daily - with Fama French (Two Step) function capability in Eventus. These results are shared in the accompanying tables. The sample was then retested using the Market Model Method via Eventus - which produced quantitively similar results.

Additionally, exploitation was calculated at the four levels (40%, 60%, 80% and 90%) based on the percentage of self and repeat citations to total citations. For the sake of brevity, I will summarize the results of most combinations while including a few selected detailed results.

Due to the high correlation between size, alliances and patent portfolio, I conducted a variance inflation factor (VIF) analysis for the models examining the effect of Firm Size. The VIF reported that Firm Size, Firm Age and Alliances as well as several dummy variables had inflation factors greater than 10. Removing the controls with highly correlated variables reduced the VIF of Firm Size to below 10 thus addressing multicollinearity without changing my findings.

For the models considering the effect of patent portfolio on CARS, the control for Firm Age and Alliances had an inflation factor greater than 10. Removing these controls eliminated any inflation factors over 6 and had no impact on the F Value of 2.45 with $p < .0001$.

Table 3 reports the results of the OLS Regressions of Exploitation and Size on Cumulative Abnormal Returns. In particular, I report on three combinations. Model 1 considers a (-1,+1) interval for CARS with a 40% threshold for exploitation. Model 2 explores a (-2,+2) interval for CARS with a 80% threshold for exploitation and Model 3 looks at a (-5,+5) interval for CARS at the same 80% threshold for exploitation. All three models provided significant F

Values with p <.0001. The additional 17 models considering CARS and Exploitation the other levels outlined in the Methods Section were also significant. Similarly, the models without the interaction between Size and Exploitation also resulted in significant F values.

I calculated the change in F Value between each of the models with and without the interaction between Size and Exploitation. The F Change was calculated using the following formula (Duke.edu, 2013):

$$F = ((SS_1 - SS_2)/(df_1 - df_2))/(SS_2/df_2)$$

The resulting p-values (0.2944, 0.7339, 0.7668 respectively) were not significant, suggesting the model with interaction is not significantly better than the model without the interaction. Further, comparing the 40 models with and without the interaction resulted in minimal and at times negative R-square change. These results are reported in the accompanying tables.

The hypothesized effects were mostly not supported. The direct effect of exploration/exploitation on CARS had some significant effect on only 8 of the 80 models tested. While Model 1 did suggest a positive effect for the interaction between Size and Exploitation at p <0.1 and a negative effect for exploitation at p < 0.05, the vast majority of the other models (including Model 2 & 3) showed no effect. Thus, hypotheses 2A, 2B, 3A and 3B were not supported. One interesting trend is that as the CARS interval and percent exploitation increased, the significance decreased. This could suggest a connection between investors having a more immediate reaction to more exploratory innovation.

Similarly, Table 4 reports the results of the OLS Regressions of Exploitation and Patent Portfolio on Cumulative Abnormal Returns. Once again, I report on the three same combinations. Model 1 considers a (-1,+1) interval for CARS with an 40% threshold for

exploitation. Model 2 explores a (-2,+2) interval for CARS with an 80% threshold for exploitation and Model 3 looks at a (-5,+5) interval for CARS at the same 80% threshold for exploitation. Once again, all three models provided significant F Value with $p < 0.0001$. The additional 17 models considering sensitivity for CARS and Exploitation were also significant. However, the hypothesized effects were not supported by any of the models. Thus, hypotheses 4, 5A and 5B were not supported.

Additionally, I calculated the change in F Value between a version of each of the models with and without the interaction between Exploitation and Patent Portfolio. Once again, the resulting p-values (0.7227, 0.6549, 0.8409 respectively) were not significant, suggesting the model with interaction is not significantly better than the model without the interaction.

Despite the lack of support in the model, Firm Size and Patent Portfolio show a strong correlation with all five measures of CARS.

Table 1 Descriptive Statistics

	Variable	N	Mean	s.d.	Min	Max
1	CARS (-2,+2)	3660	0.02	0.07	-0.1	0.72
2	CARS (-1,+1)	3660	0.01	0.06	-0.1	0.71
3	CARS (-5,+5)	3660	0.05	0.10	-0.1	0.8
4	CARS (0,+3)	3660	0.01	0.06	-0.1	0.73
5	CARS (0,+5)	3660	0.02	0.08	-0.1	0.76
6	Exploitation at 40%	3660	0.74	0.44	0.00	1.00
7	Exploitation at 60%	3660	0.69	0.46	0.00	1.00
8	Exploitation at 80%	3660	0.63	0.48	0.00	1.00
9	Exploitation at 90%	3660	0.58	0.49	0.00	1.00
10	Firm Size	3660	6.51	2.28	0.25	11.14
11	Patent Portfolio	3660	140.044	194.366	0.00	1090
12	Tobin's Q	3660	3.95	3.64	0.00	76.38
13	Firm Age	3660	20.52	8.11	1.00	107.00
14	R&D Intensity	3657	372.91	237.42	0.00	2715.00
15	New Drugs	3660	0.06	0.27	0.00	2.00
16	Leverage	3660	0.34	2.15	-29.28	25.38
17	Alliances	3660	3.37	5.73	0.00	20.00
18	Liquidity	3659	0.00	0.01	-0.01	0.12
19	Institutional Ownership	3660	0.55	0.35	0.00	1.77

Table 2 Correlations (Part 1)

	Variable	1	2	3	4	5	6	7	8	9
1	CARS (-2,+2)									
2	CARS (-1,+1)	0.63***								
3	CARS (-5,+5)	0.50***	0.35***							
4	CARS (0,+3)	0.54***	0.50***	0.41***						
5	CARS (0,+5)	0.41***	0.35***	0.56***	0.66***					
6	Exploitation at 40%	-0.01	-0.03*	0.01	-0.01	-0.012				
7	Exploitation at 60%	-0.01	-0.03	0.01	-0.02	-0.02	0.87***			
8	Exploitation at 80%	0.00	0.00	0.02	0.01	0.00	0.77***	0.889***		
9	Exploitation at 90%	0.00	-0.01	0.01	0.01	-0.01	0.70***	0.80***	0.90***	
10	Firm Size	-0.15***	-0.11***	-0.28***	-0.15***	-0.21***	0.01	0.00	0.01	0.01
11	Patent Portfolio	-0.08***	-0.07***	-0.13***	-0.11***	-0.12***	0.08***	0.07***	0.06**	0.06**
12	Tobin's Q	0.03	0.01	0.04*	0.00	0.03	0.09***	0.12***	0.13***	0.13***
13	Firm Age	-0.07***	-0.06**	-0.14***	-0.06**	-0.08***	0.09***	0.09***	0.08***	0.07***
14	R&D Intensity	0.07***	0.04**	0.15***	0.03*	0.10***	0.12***	0.13***	0.14***	0.12***
15	New Drugs	0.02	-0.01	0.02	0.00	0.02	-0.10***	-0.10***	-0.08***	-0.07***
16	Leverage	0.02	0.00	0.03	0.01	0.01	0.00	0.00	-0.01	-0.01
17	Alliances	-0.12***	-0.08***	-0.18***	-0.09***	-0.13***	0.01	0.00	0.01	0.00
18	Liquidity	0.1161	0.12076	0.15177	0.11121	0.11751	-0.03	-0.02	-0.02	-0.02
19	Institutional Ownership	-0.11***	-0.09***	-0.20***	-0.12***	-0.16***	0.02	0.01	0.03	0.02

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

Table 2 Correlations (Part 2)

	Variable	10	11	12	13	14	15	16	17	18
1	CARS (-2,+2)									
2	CARS (-1,+1)									
3	CARS (-5,+5)									
4	CARS (0,+3)									
5	CARS (0,+5)									
6	Exploitation at 40%									
7	Exploitation at 60%									
8	Exploitation at 80%									
9	Exploitation at 90%									
10	Firm Size									
11	Patent Portfolio	0.61***								
12	Tobin's Q	-0.15***	-0.14***							
13	Firm Age	0.38***	0.45***	0.10***						
14	R&D Intensity	-0.31***	-0.18***	0.19***	-0.18***					
15	New Drugs	-0.16***	-0.10***	-0.04**	-0.01	0.12***				
16	Leverage	0.04**	0.04**	0.02	0.03**	-0.01	-0.02			
17	Alliances	0.66***	0.59***	-0.19***	0.35***	-0.14***	0.01	0.02		
18	Liquidity	-0.45***	-0.19***	-0.06***	-0.11***	0.12***	0.04**	-0.05**	-0.18***	
19	Institutional Ownership	0.50***	0.28***	-0.01	0.14***	-0.10***	-0.02	0.03	0.21***	-0.30***

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

Table 3 OLS Regressions of Exploitation and Size on Cumulative Abnormal Returns

VARIABLES	MODEL 1 DV: CARS (-1,+1)	MODEL 2 DV: CARS (-2,+2)	MODEL 3 DV: CARS (-5,+5)
Exploitation at 40%	-0.016*		
	(0.007)		
Exploitation at 40% x Firm Size	0.002^{+}		
	(-0.001)		
Exploitation at 80%		-0.005	-0.006
		(0.008)	(0.011)
Exploitation at 80% x Firm Size		0.001	0.001
		(0.001)	(0.002)
Firm Size	0.001	-0.006	-0.004
	(0.001)	(0.004)	(0.005)
Tobin's Q	-0.000	-0.001	-0.001^{+}
	(0.000)	(0.000)	(0.001)
Firm Age	0.002^{+}	0.001	0.003^{+}
	(0.001)	(0.001)	(0.002)
R&D Intensity	0.001	0.001	0.001*
	(0.000)	(0.000)	(0.000)
New Drugs	-0.012^{+}	-0.003	-0.097
	(0.007)	(0.012)	(0.012)
Leverage	0.001	0.001^{+}	0.002*
	(0.000)	(0.001)	(0.001)
Alliances	-0.001	-0.001^{+}	-0.001
	(.001)	(.001)	(.001)
Liquidity	0.967***	0.744*	0.453
	(0.227)	(0.290)	(0.397)
Institutional Ownership	0.001	0.000*	-0.017*
	(0.004)	(0.005)	(0.008)
Intercept	-0.041*	-0.016*	-0.110*
	(0.032)	(0.040)	(0.055)
Observations	3656	3656	3656
F Value	2.45***	2.66***	4.51***
F Change	1.106	0.116	0.073

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

Table 4 OLS Regressions of Exploitation and Patent Portfolio

on Cumulative Abnormal Returns

VARIABLES	MODEL 4 DV: CARS (-1,+1)	MODEL 5 DV: CARS (-2,+2)	MODEL 6 DV: CARS (-5,+5)
Exploitation at 40%	-0.006^{+}		
	(0.003)		
Exploitation at 40% x Patent Portfolio	0.001		
	(0.000)		
Exploitation at 80%		-0.003	-0.001
		(0.003)	(0.005)
Exploitation at 80% x Patent Portfolio		0.001	0.000
		(0.000)	(0.000)
Patent Portfolio	0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.000)
Tobin's Q	-0.001	-0.001^{+}	-0.001
	(0.000)	(0.000)	(0.001)
Firm Age	0.002*	0.002^{+}	0.003
	(0.001)	(0.001)	(0.002)
R&D Intensity	0.001	0.001	0.001*
	(0.000)	(0.000)	(0.000)
New Drugs	-0.012^{+}	-0.003	-0.010
	(0.007)	(0.010)	(0.012)
Leverage	0.000	0.001	0.002*
	(0.000)	(0.001)	(0.001)
Alliances	-0.001	-0.001^{+}	-0.001
	(.001)	(.001)	(.001)
Liquidity	0.946***	0.665*	0.486
	(0.224)	(0.286)	(0.392)
Institutional Ownership	0.001	0.001	-0.017*
	(0.004)	(0.005)	(0.008)
Intercept	-0.047	-0.006	-0.116*
	(0.031)	(0.040)	(0.054)
Observations	3656	3656	3656
F Value	2.44***	2.65***	4.51***
F Change	0.117	0.200	0.404

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

Discussion

This study sought to build on past research regarding investor reactions to a firm's decision to pursue explorative versus exploitive innovation. As exploitation has a relatively low risk and reward compared to exploitation, there is reason to believe investors may respond differently to these approaches. Further, the study considered whether firm specific characteristics such as firm size and patent portfolio moderated these reactions.

My results at the (-1, +1) interval for CARS with a 40% threshold for exploitation did find a significant ($p<0.05$) results for the direct effect of exploitation – which was negative. Additionally, the interaction between size and exploitation was found to be positive at $p<0.1$. While these results on their own suggest investors may react negatively to exploitative patents with firm size positively moderating that interaction, the lack of significant findings in the 19 other variations of this model demonstrate this conclusion cannot be supported. Similarly, the results of my 20 models examining interaction between patent portfolio and exploitation did not support my hypotheses for this interaction.

My findings did not mirror much of the past research cited which may be due – in part – to several differences in my methodology compared to Fitzgerald et al. (2021). While I chose to measure investor reaction at the patent level, Fitzgerald et al. (2021) considered this at the firm level. Their research included a measure they call "Internal Search Proximity which examines the degree of overlap between patents granted to the firm in year t and the existing patent portfolio held by the same firm up to year $t-1$" (Fitzgerald et al., 2021: 8). Similarly, they looked at a firm's overall patents granted in a given year to determine a focus on exploration versus exploitation – rather than my approach to look at individual patents issued on a given date. It is

also worth noting that they used the patent's issue (granted) date; whereas, I used the filing date as a basis for my event study.

There were other important differences in our research as well. For example, my research focused on biotech industry patents filed between 2010-2014. Fitzgerald et al. (2021) utilized a much broader sample of the NBER patent database spanning several additional industries over a much longer period of time (1976-2006). They also considered advertising expenses. They argued firms spending more on advertising would raise investor awareness of that firm's patenting activity (Lou, 2014). While both studies factored the potential impact of institutional investors, Fitzgerald et al. (2021) sub-categorized institutional investors based on their likely focus on long-term versus short-term returns (Bushee, 1998). These methodology differences likely contributed to the differences in my findings compared to Fitzgerald et al. (2021).

Limitations

As with any research, this study has several limitations. As mentioned above, I utilized a sample of 164 biotech firms for my study. Therefore, it is not generalizable to other industries. Additionally, utilizing the filing date to measure investor reactions makes the assumption that investors are actively monitoring and reacting to a firm's USPTO filings. Future research may want to consider the date of patent-related announcements. Further, as filed patent applications may not result an issued patent, investors may choose to focus on the issue date instead. Another consideration is the impact of other announcements related to the focal firm that occurred in the same window. While I did remove 1379 patents that had the same firm and same filing date, I did not control for other potential announcements. Important firm updates on issues ranging from earning announcements to senior leadership changes could also influence investor reaction to a

given stock. A final limitation is defining exploration/exploitation based on the firm that was awarded a given patent. This approach may overlook innovation that was the result of leveraging knowledge built through alliances as well as the impact of patents that were acquired by the focal firm.

Future Research

While this study found no support for the hypotheses that firm size and patent portfolio moderate investor reaction to different types of innovation, it does suggest some additional paths for future research. As stated previously, one interesting trend is that as the CARS interval and percent exploitation increased, the significance decreased. This could suggest a connection between investors having a different reaction to more exploratory innovation. Future research could explore this apparent trend by determining whether there is a more immediate reaction to certain type of innovation compared to others.

Additionally, several of the control variables including firm age, new drugs, institutional ownership, and especially liquidity had a significant contribution to the model. Past research demonstrates the role institutional ownership can play in corporate governance (Bushee, 1998; Bena, et al., 2017). In light of their relatively large holdings, institutional owners would potentially be highly influential in any change in stock price and may have specific preferences towards the risk versus reward tradeoff between exploration and exploitation. The classification developed by Bushee (1998) might demonstrate a link between institutional owners with short-term versus long-term interests and the similarly situated more short-term nature of exploitation versus the more long-term nature of exploration. A deeper understanding of the role factors such as liquidity, age and recent history of innovation may warrant further study as well. For example,

firms on the higher end of these factors' spectrums may be more likely to achieve success pursuing exploration – as they have demonstrated a history of success – than firms at the lower end. This might suggest their experience results in reducing the relative risk associated with the pursuit of explorative innovation.

Lastly, the Correlation Matrix suggests a few potentially counterintuitive relationships including the lack of significant correlation between New Drugs and Alliances as well as New Drugs and Institutional Ownership. One might consider whether alliances help drive new innovations (e.g. drugs) in only certain settings. Similarly, does the introduction of new drugs attract institutional investors?

This represents several opportunities to further pursue the relationships explored in this study.

Conclusion

In conclusion, while this study did not find significant results, it provided a unique approach to build on past research on investor reactions to different forms of innovation – exploration and exploitation. Gaining a better understanding of this relationship can inform both investors and business leaders of the potential financial impacts to two different approaches to innovation. Hopefully, it will inspire future researchers to explore this relationship and provide new insights.

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APPENDIX

OLS Regressions of Exploitation and Size on Cumulative Abnormal Returns

VARIABLES	MODEL 1 DV: CARS (-1,+1)	MODEL 1a DV: CARS (-1,+1)	MODEL 2 DV: CARS (-1,+1)	MODEL 2a DV: CARS (-1,+1)
Exploitation at 40%	-0.005*	-0.016*		
	(0.002)	(0.007)		
Exploitation at 40% x Firm Size		0.002^{+}		
		(0.001)		
Exploitation at 60%			-0.004^{+}	-0.012^{+}
			(0.002)	(0.007)
Exploitation at 60% x Firm Size				0.001
				(0.001)
Firm Size	0.002	0.001	0.002	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)
Tobin's Q	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Firm Age	0.002^{+}	0.002^{+}	0.001	0.002^{+}
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.000)	(0.000)
New Drugs	-0.012^{+}	-0.012^{+}	-0.012^{+}	-0.012^{+}
	(0.007)	(0.007)	(0.007)	(0.007)
Leverage	0.001	0.001	0.001	0.002
	(0.001)	(0.001)	(0.001)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.968***	0.967***	0.969***	0.970***
	(0.227)	(0.227)	(0.227)	(0.227)
Institutional Ownership	0.001	0.001	0.001	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Intercept	-0.048	-0.041	-0.049	-0.045
	(0.031)	(0.032)	(0.031)	(0.032)
Observations	3656	3656	3656	3656
R-Square	0.0642	0.0646	0.0639	0.0641
R-Square Change		0.0004		0.0002
F Value	2.45***	2.45***	2.44***	2.44***
F Change		1.106		0.679

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Size on Cumulative Abnormal Returns

VARIABLES	MODEL 3 DV: CARS (-1,+1)	MODEL 3a DV: CARS (-1,+1)	MODEL 4 DV: CARS (-1,+1)	MODEL 4a DV: CARS (-1,+1)
Exploitation at 80%	-0.001	-0.001		
	(0.002)	(0.006)		
Exploitation at 80% x Firm Size		-0.001		
		(0.001)		
Exploitation at 90%			-0.001	-0.001
			(0.002)	(0.006)
Exploitation at 90% x Firm Size				-0.001
				(0.001)
Firm Size	0.002	0.002	-0.002	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)
Tobin's Q	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.001)
Firm Age	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.012^{+}	-0.012^{+}	-0.012^{+}	-0.012^{+}
	(0.007)	(0.007)	(0.007)	(0.007)
Leverage	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.961***	0.961***	0.964***	0.964***
	(0.227)	(0.227)	(0.227)	(0.227)
Institutional Ownership	0.001	0.001	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Intercept	-0.044	-0.044	-0.046	-0.046
	(0.031)	(0.032)	(0.031)	(0.032)
Observations	3656	3656	3656	3656
R-Square	0.0629	0.0626	0.063	0.0627
R-Square Change		-.0003		-0.0004
F Value	2.42***	2.40***	2.42***	2.41***
F Change		0.001		0.001

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Size on Cumulative Abnormal Returns

VARIABLES	MODEL 5 DV: CARS (-2,+2)	MODEL 5a DV: CARS (-2,+2)	MODEL 6 DV: CARS (-2,+2)	MODEL 6a DV: CARS (-2,+2)
Exploitation at 40%	-0.003	-0.016^{+}		
	(0.003)	(0.009)		
Exploitation at 40% x Firm Size		-0.002		
		(0.001)		
Exploitation at 60%			-0.003	-0.012^{+}
			(0.003)	(0.007)
Exploitation at 60% x Firm Size				0.001
				(0.001)
Firm Size	0.006^{+}	0.005	-0.006^{+}	0.001
	(0.003)	(0.004)	(0.004)	(0.003)
Tobin's Q	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Firm Age	0.001	0.001	0.001	0.002^{+}
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.003^{+}	-0.003	-0.003	-0.012+
	(0.007)	(0.009)	(0.009)	(0.007)
Leverage	0.001	0.001^{+}	0.001^{+}	0.001
	(0.000)	(0.001)	(0.001)	(0.000)
Alliances	-0.001	-0.001*	-0.001^{+}	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Liquidity	0.745***	0.743***	0.746***	0.970***
	(0.290)	(0.290)	(0.290)	(0.227)
Institutional Ownership	-0.001	0.001	-0.001	-0.001*
	(0.005)	(0.004)	(0.004)	(0.004)
Intercept	-0.019	-0.041	-0.020	-0.045
	(0.040)	(0.032)	(0.040)	(0.032)
Observations	3656	3656	3656	3656
R-Square	0.0737	0.0741	0.0737	0.0740
R-Square Change		0.0004		0.0003
F Value	2.68***	2.68***	2.68***	2.68***
F Change		0.9113		0.7535

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Size on Cumulative Abnormal Returns

VARIABLES	MODEL 7 DV: CARS (-2,+2)	MODEL 7a DV: CARS (-2,+2)	MODEL 8 DV: CARS (-2,+1)	MODEL 8a DV: CARS (-2,+2)
Exploitation at 80%	-0.001	-0.001		
	(0.002)	(0.006)		
Exploitation at 80% x Firm Size		0.001		
		(-0.000)		
Exploitation at 90%			-0.001	-0.001
			(0.002)	(0.006)
Exploitation at 90% x Firm Size				0.001
				(0.00)
Firm Size	0.002	0.002	-0.002	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)
Tobin's Q	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Firm Age	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.012^{+}	-0.012^{+}	-0.012+	-0.012+
	(0.007)	(0.007)	(0.007)	(0.007)
Leverage	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.001)	(0.000)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.000)	(.001)	(.001)
Liquidity	0.962***	0.961***	0.964***	0.964***
	(0.227)	(0.227)	(0.227)	(0.227)
Institutional Ownership	0.001	0.001	0.001	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Intercept	-0.044	-0.044	-0.046	-0.046
	(0.031)	(0.032)	(0.032)	(0.032)
Observations	3656	3656	3656	3656
R-Square	0.0735	0.0733	0.0735	0.0732
R-Square Change		-0.0002		-0.0003
F Value	2.68***	2.66***	2.68***	2.66***
F Change		0.116		0.004

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Size on Cumulative Abnormal Returns

VARIABLES	MODEL 9 DV: CARS (-5,+5)	MODEL 9a DV: CARS (-5,+5)	MODEL 10 DV: CARS (-5,+5)	MODEL 10a DV: CARS (-5,+5)
Exploitation at 40%	-0.001	-0.014		
	(0.004)	(0.012)		
Exploitation at 40% x Firm Size		0.002		
		(0.002)		
Exploitation at 60%			-0.003	-0.014
			(0.004)	(0.012)
Exploitation at 60% x Firm Size				0.002
				(0.002)
Firm Size	-0.001	-0.005	-0.003	-0.004
	(0.004)	(0.005)	(0.005)	(0.005)
Tobin's Q	-0.001^{+}	-0.001^{+}	-0.001^{+}	-0.001^{+}
	(0.001)	(0.001)	(0.001)	(0.001)
Firm Age	0.003^{+}	0.003^{+}	0.004*	0.003^{+}
	(0.002)	(0.002)	(0.002)	(0.002)
R&D Intensity	0.001*	0.001*	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.010	-0.010	-0.010	-0.010
	(0.012)	(0.012)	(0.012)	(0.012)
Leverage	0.002*	0.002*	0.002*	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.453	0.542	0.457	0.458
	(0.397)	(0.397)	(0.397)	(0.397)
Institutional Ownership	0.017*	0.017*	0.017*	-0.016*
	(0.008)	(0.008)	(0.008)	(0.008)
Intercept	-0.114*	-0.106*	-0.117*	-0.111*
	(0.055)	(0.055)	(0.055)	(0.055)
Observations	3656	3656	3656	3656
R-Square	0.1434	0.1435	0.1435	0.1435
R-Square Change		0.0001		0.0000
F Value	4.54***	4.52***	4.54***	4.52***
F Change		0.275		0.221

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Size on Cumulative Abnormal Returns

VARIABLES	MODEL 11 DV: CARS (-5,+5)	MODEL 11a DV: CARS (-5,+5)	MODEL 12 DV: CARS (-5,+5)	MODEL 12a DV: CARS (-5,+5)
Exploitation at 80%	-0.001	-0.006		
	(0.004)	(0.011)		
Exploitation at 80% x Firm Size		0.001		
		(0.002)		
Exploitation at 90%			-0.001	-0.008
			(0.003)	(0.011)
Exploitation at 90% x Firm Size				0.001
				(0.002)
Firm Size	0.003	0.004	-0.003	-0.004
	(0.005)	(0.005)	(0.005)	(0.005)
Tobin's Q	-0.001^{+}	-0.001^{+}	-0.001^{+}	-0.001^{+}
	(0.001)	(0.000)	(0.001)	(0.001)
Firm Age	0.003^{+}	0.003^{+}	0.003^{+}	0.003^{+}
	(0.002)	(0.002)	(0.002)	(0.002)
R&D Intensity	0.001*	0.001*	0.001*	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.010	-0.010	-0.010	-0.010
	(0.012)	(0.012)	(0.012)	(0.012)
Leverage	0.002*	0.002*	0.002*	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.452	0.453	0.455	0.458
	(0.397)	(0.397)	(0.397)	(0.397)
Institutional Ownership	0.017*	0.017*	0.016*	-0.017*
	(0.008)	(0.008)	(0.008)	(0.008)
Intercept	-0.113*	-0.110*	-0.115*	-0.112*
	(0.055)	(0.055)	(0.055)	(0.055)
Observations	3656	3656	3656	3656
R-Square	0.1434	0.1433	0.1434	0.1433
R-Square Change		-0.0001		-0.0001
F Value	4.54***	4.51***	4.54***	4.51***
F Change		0.073		0.119

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Size on Cumulative Abnormal Returns

VARIABLES	MODEL 13 DV: CARS (0,+3)	MODEL 13a DV: CARS (0,+3)	MODEL 14 DV: CARS (0,+3)	MODEL 14a DV: CARS (0,+3)
Exploitation at 40%	-0.003	-0.014^{+}		
	(0.003)	(0.008)		
Exploitation at 40% x Firm Size		0.002		
		(-0.001)		
Exploitation at 60%			-0.004	-0.013^{+}
			(0.002)	(0.007)
Exploitation at 60% x Firm Size				0.001
				(0.001)
Firm Size	0.003	0.002	-0.003	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)
Tobin's Q	-0.001+	-0.001*	-0.001*	-0.001*
	(0.000)	(0.000)	(0.000)	(0.000)
Firm Age	0.001	0.002	0.002	0.002^{+}
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.005	-0.005	-0.005	-0.005
	(0.007)	(0.007)	(0.007)	(0.007)
Leverage	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.001)	(0.001)
Alliances	-0.001	-0.002	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.855***	0.853**	0.858**	0.859**
	(0.250)	(0.250)	(0.250)	(0.250)
Institutional Ownership	0.002	0.002	0.002*	-0.002
	(0.005)	(0.005)	(0.005)	(0.005)
Intercept	-0.063+	-0.56	-0.065+	-0.060+
	(0.034)	(0.035)	(0.035)	(0.034)
Observations	3656	3656	3656	3656
R-Square	0.0691	0.0694	0.0693	0.0695
R-Square Change		0.0003		0.0002
F Value	2.57***	2.57***	2.57***	2.57***
F Change		0.917		0.679

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Size on Cumulative Abnormal Returns

VARIABLES	MODEL 15 DV: CARS (0,+3)	MODEL 15a DV: CARS (0,+3)	MODEL 16 DV: CARS (0,+3)	MODEL 16a DV: CARS (0,+3)
Exploitation at 80%	-0.001	-0.002		
	(0.002)	(0.007)		
Exploitation at 80% x Firm Size		0.001		
		(-0.001)		
Exploitation at 90%			-0.001	-0.001
			(0.002)	(0.007)
Exploitation at 90% x Firm Size				0.001
				(0.001)
Firm Size	0.003	0.003	-0.003	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)
Tobin's Q	-0.001*	-0.001*	-0.001*	-0.001*
	(0.000)	(0.000)	(0.000)	(0.000)
Firm Age	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.005	-0.005	-0.005	-0.005
	(0.007)	(0.007)	(0.007)	(0.007)
Leverage	0.001	0.001	0.001	0.001
	(0.000)	(0.001)	(0.001)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.849**	0.850**	0.850**	0.850**
	(0.250)	(0.250)	(0.250)	(0.250)
Institutional Ownership	0.002	0.002	0.002	-0.002
	(0.005)	(0.005)	(0.005)	(0.005)
Intercept	-0.059+	-0.058+	-0.060+	-0.060+
	(0.034)	(0.035)	(0.035)	(0.035)
Observations	3656	3656	3656	3656
R-Square	0.0687	0.0685	0.0687	0.0685
R-Square Change		-0.0002		-0.0002
F Value	2.56***	2.55***	2.56***	2.54***
F Change		0.089		0.000

+p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Size on Cumulative Abnormal Returns

VARIABLES	MODEL 17 DV: CARS (0,+5)	MODEL 17a DV: CARS (0,+5)	MODEL 18 DV: CARS (0,+5)	MODEL 18a DV: CARS (0,+5)
Exploitation at 40%	-0.004	-0.016		
	(0.003)	(0.010)		
Exploitation at 40% x Firm Size		0.002		
		(0.001)		
Exploitation at 60%			-0.005	-0.010
			(0.003)	(0.009)
Exploitation at 60% x Firm Size				0.001
				(0.001)
Firm Size	0.001	-0.001	0.001	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Tobin's Q	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Firm Age	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.003	-0.003	-0.004	-0.004
	(0.009)	(0.009)	(0.009)	(0.009)
Leverage	0.001	0.001	0.001	0.001
	(0.000)	(0.001)	(0.001)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.309	0.307	0.312	0.313
	(0.307)	(0.307)	(0.307)	(0.307)
Institutional Ownership	-0.010+	-0.010+	-0.010+	-0.010+
	(0.006)	(0.006)	(0.006)	(0.006)
Intercept	-0.034	-0.027	-0.037	-0.035
	(0.042)	(0.043)	(0.042)	(0.043)
Observations	3656	3656	3656	3656
R-Square	0.0802	0.0804	0.0805	0.0803
R-Square Change		0.0002		-0.0002
F Value	2.84***	2.84***	2.85***	2.83***
F Change		0.599		0.135

+p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Size on Cumulative Abnormal Returns

VARIABLES	MODEL 19 DV: CARS (0,+5)	MODEL 19a DV: CARS (0,+5)	MODEL 20 DV: CARS (0,+5)	MODEL 20a DV: CARS (0,+5)
Exploitation at 80%	-0.001	-0.001		
	(0.003)	(0.009)		
Exploitation at 80% x Firm Size		0.001		
		(-0.001)		
Exploitation at 90%			-0.002	-0.005
			(0.003)	(0.008)
Exploitation at 90% x Firm Size				0.001
				(0.001)
Firm Size	0.001	0.001	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Tobin's Q	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Firm Age	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.003	-0.003	-0.003	-0.003
	(0.009)	(0.009)	(0.009)	(0.009)
Leverage	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.305	0.305	0.309	0.311
	(0.307)	(0.307)	(0.307)	(0.307)
Institutional Ownership	-0.011+	-0.011+	-0.010+	-0.010+
	(0.006)	(0.006)	(0.006)	(0.006)
Intercept	-0.032	-0.043	-0.035	-0.034
	(0.042)	(0.032)	(0.042)	(0.043)
Observations	3656	3656	3656	3656
R-Square	0.0798	0.0796	0.0800	0.0798
R-Square Change		0.0002		0.0002
F Value	2.83***	2.82***	2.84***	2.82***
F Change		0.012		0.051

+p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Patent Portfolio on Cumulative Abnormal Returns

VARIABLES	MODEL 21 DV: CARS (-1,+1)	MODEL 21a DV: CARS (-1,+1)	MODEL 22 DV: CARS (-1,+1)	MODEL 22a DV: CARS (-1,+1)
Exploitation at 40%	-0.005*	-0.006^{+}		
	(0.002)	(0.003)		
Exploitation at 40% x Patent Portfolio		0.001		
		(0.000)		
Exploitation at 60%			-0.004	-0.005
			(0.002)	(0.003)
Exploitation at 60% x Patent Portfolio				0.001
				(0.000)
Patent Portfolio	-0.001	-0.001	-0.001	-0.001
	(0.00)	(0.000)	(0.000)	(0.000)
Tobin's Q	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Firm Age	0.002*	0.002*	0.002*	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.012^{+}	-0.012^{+}	-0.012^{+}	-0.012^{+}
	(0.007)	(0.007)	(0.007)	(0.007)
Leverage	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.946***	0.946***	0.947***	0.948***
	(0.224)	(0.224)	(0.224)	(0.224)
Institutional Ownership	0.001	0.001	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Intercept	-0.047	-0.047	-0.049	-0.049
	(0.031)	(0.031)	(0.031)	(0.031)
Observations	3656	3656	3656	3656
R-Square	0.0644	0.0642	0.0641	0.064
R-Square Change		-0.0002		-0.0001
F Value	2.45***	2.44***	2.45***	2.44***
F Change		0.1171		0.1685

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Patent Portfolio on Cumulative Abnormal Returns

VARIABLES	MODEL 23 DV: CARS (-1,+1)	MODEL 23a DV: CARS (-1,+1)	MODEL 24 DV: CARS (-1,+1)	MODEL 24a DV: CARS (-1,+1)
Exploitation at 80%	-0.001	-0.001		
	(0.002)	(0.003)		
Exploitation at 80% x Patent Portfolio		0.001		
		(0.000)		
Exploitation at 90%			-0.001	-0.001
			(0.002)	(0.003)
Exploitation at 90% x Patent Portfolio				0.001
				(0.000)
Patent Portfolio	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.001)	(0.000)	(0.000)
Tobin's Q	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Firm Age	0.002^{+}	0.002^{+}	0.002*	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.012^{+}	-0.012^{+}	-0.012+	-0.012+
	(0.007)	(0.007)	(0.007)	(0.007)
Leverage	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.000)
Liquidity	0.940***	0.941***	0.944***	0.943***
	(0.224)	(0.224)	(0.224)	(0.224)
Institutional Ownership	0.001	0.001	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Intercept	-0.044	-0.044	-0.046	-0.045
	(0.031)	(0.031)	(0.031)	(0.031)
Observations	3656	3656	3656	3656
R-Square	0.0632	0.0629	0.0633	0.0630
R-Square Change		-0.0003		-0.0003
F Value	2.42***	2.41***	2.43***	2.41***
F Change		0.022		0.000

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Patent Portfolio on Cumulative Abnormal Returns

VARIABLES	MODEL 25 DV: CARS (-2,+2)	MODEL 25a DV: CARS (-2,+2)	MODEL 26 DV: CARS (-2,+2)	MODEL 26a DV: CARS (-2,+2)
Exploitation at 40%	-0.003	-0.005		
	(0.003)	(0.004)		
Exploitation at 40% x Patent Portfolio		0.001		
		(-0.001)		
Exploitation at 60%			-0.003	-0.005
			(0.003)	(0.004)
Exploitation at 60% x Patent Portfolio				0.001
				(0.001)
Patent Portfolio	0.001	0.001	-0.001	-0.001
	(0.000)	(0.001)	(0.000)	(0.001)
Tobin's Q	-0.001^{+}	-0.001^{+}	-0.001^{+}	-0.001^{+}
	(0.000)	(0.000)	(0.000)	(0.001)
Firm Age	0.002^{+}	0.002^{+}	0.002^{+}	0.002^{+}
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.003	-0.004	-0.004	-0.004
	(0.009)	(0.009)	(0.009)	(0.009)
Leverage	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Alliances	-0.001^{+}	-0.001^{+}	-0.001^{+}	-0.001^{+}
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.665*	0.665*	0.666*	0.667*
	(0.286)	(0.286)	(0.286)	(0.286)
Institutional Ownership	0.001	0.001	0.001	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)
Intercept	-0.006	-0.006	-0.007	-0.008
	(0.039)	(0.039)	(0.039)	(0.039)
Observations	3656	3656	3656	3656
R-Square	0.073	0.073	0.073	0.0731
R-Square Change		0.000		0.0001
F Value	2.66***	2.65***	2.66***	2.66***
F Change		0.404		0.567

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Patent Portfolio on Cumulative Abnormal Returns

VARIABLES	MODEL 27 DV: CARS (-2,+2)	MODEL 27a DV: CARS (-2,+2)	MODEL 28 DV: CARS (-2,+2)	MODEL 28a DV: CARS (-2,+2)
Exploitation at 80%	-0.001	-0.003		
	(0.003)	(0.003)		
Exploitation at 80% x Patent Portfolio		0.001		
		(-0.001)		
Exploitation at 90%			-0.001	-0.001
			(0.003)	(0.003)
Exploitation at 90% x Patent Portfolio				0.001
				(0.001)
Patent Portfolio	0.001	0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.000)	(0.001)
Tobin's Q	-0.001^{+}	-0.001^{+}	-0.001^{+}	-0.001^{+}
	(0.000)	(0.000)	(0.000)	(0.000)
Firm Age	0.002^{+}	0.002^{+}	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.003	-0.004	-0.003	-0.003
	(0.009)	(0.009)	(0.009)	(0.009)
Leverage	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Alliances	-0.001^{+}	-0.001^{+}	-0.001^{+}	-0.001^{+}
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.664*	0.665*	0.663*	0.664*
	(0.286)	(0.286)	(0.286)	(0.286)
Institutional Ownership	0.001	0.001	0.001	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)
Intercept	-0.005	-0.006	-0.005	-0.005
	(0.039)	(0.039)	(0.040)	(0.040)
Observations	3656	3656	3656	3656
R-Square	0.0728	0.0726	0.0727	0.0725
R-Square Change		-0.0002		-0.0002
F Value	2.66***	2.65***	2.66***	2.64***
F Change		0.200		0.013

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Patent Portfolio on Cumulative Abnormal Returns

VARIABLES	MODEL 29 DV: CARS (-5,+5)	MODEL 29a DV: CARS (-5,+5)	MODEL 30 DV: CARS (-5,+5)	MODEL 30a DV: CARS (-5,+5)
Exploitation at 40%	-0.001	-0.003		
	(0.004)	(0.005)		
Exploitation at 40% x Patent Portfolio		0.001		
		(0.000)		
Exploitation at 60%				-0.005
				(0.005)
Exploitation at 60% x Patent Portfolio			-0.003	0.001
			(0.004)	(0.000)
Patent Portfolio	0.001	-0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Firm Age	0.003	0.003	0.003+	0.003+
	(0.002)	(0.002)	(0.002)	(0.002)
R&D Intensity	0.001*	0.001*	0.001*	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.010	-0.010	-0.010	-0.010
	(0.012)	(0.012)	(0.012)	(0.012)
Leverage	0.002*	0.001*	0.002*	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.486	0.487	0.490	0.491
	(0.392)	(0.392)	(0.392)	(0.392)
Institutional Ownership	-0.017*	-0.017*	-0.017*	-0.017*
	(0.007)	(0.007)	(0.007)	(0.007)
Intercept	-0.116*	-0.116*	-0.119*	-0.120*
	(0.054)	(0.054)	(0.054)	(0.054)
Observations	3656	3656	3656	3656
R-Square	0.1435	0.1434	0.1436	0.1435
R-Square Change		-0.0001		-0.0001
F Value	4.54***	4.52***	4.54***	4.52***
F Change		0.132		0.119

+p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Patent Portfolio on Cumulative Abnormal Returns

VARIABLES	MODEL 31 DV: CARS (-5,+5)	MODEL 31a DV: CARS (-5,+5)	MODEL 32 DV: CARS (-5,+5)	MODEL 32a DV: CARS (-5,+5)
Exploitation at 80%	-0.001	-0.001		
	(0.004)	(0.005)		
Exploitation at 80% x Patent Portfolio		0.001		
		(-0.000)		
Exploitation at 90%			-0.001	-0.002
			(0.004)	(0.005)
Exploitation at 90% x Patent Portfolio				0.001
				(0.000)
Patent Portfolio	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Firm Age	0.002	0.003	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)
R&D Intensity	0.001*	0.001*	0.001*	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.010	-0.010	-0.010	-0.010
	(0.012)	(0.012)	(0.012)	(0.012)
Leverage	0.002*	0.002*	0.002*	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.485	0.486	0.488	0.489
	(0.392)	(0.392)	(0.392)	(0.392)
Institutional Ownership	-0.017*	-0.017*	-0.017*	-0.017*
	(0.007)	(0.007)	(0.007)	(0.007)
Intercept	-0.116*	-0.116*	-0.117*	-0.118*
	(0.054)	(0.054)	(0.054)	(0.054)
Observations	3656	3656	3656	3656
R-Square	0.1435	0.1433	0.1435	0.1433
R-Square Change		-0.0002		-0.0002
F Value	4.54***	4.51***	4.54***	4.51***
F Change		0.040		0.019

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Patent Portfolio on Cumulative Abnormal Returns

VARIABLES	MODEL 33 DV: CARS (0,+3)	MODEL 33a DV: CARS (0,+3)	MODEL 34 DV: CARS (0,+3)	MODEL 34a DV: CARS (0,+3)
Exploitation at 40%	-0.003	-0.003		
	(0.003)	(0.003)		
Exploitation at 40% x Patent Portfolio		0.001		
		(0.000)		
Exploitation at 60%			-0.004	-0.004
			(0.002)	(0.003)
Exploitation at 60% x Patent Portfolio				0.001
				(0.000)
Patent Portfolio	-0.001	0.001	-0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	-0.001*	-0.001*	-0.001*	-0.001*
	(0.000)	(0.000)	(0.000)	(0.000)
Firm Age	0.002*	0.002*	0.002*	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.005	-0.005	-0.005	-0.005
	(0.007)	(0.007)	(0.007)	(0.007)
Leverage	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.824**	0.824**	0.827**	0.827**
	(0.246)	(0.246)	(0.246)	(0.246)
Institutional Ownership	-0.001	-0.001	-0.001	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)
Intercept	-0.061+	-0.061+	-0.063+	-0.064+
	(0.034)	(0.034)	(0.034)	(0.034)
Observations	3656	3656	3656	3656
R-Square	0.0694	0.0691	0.0696	0.0694
R-Square Change		-0.0003		-0.0002
F Value	2.57***	2.56***	2.58***	2.57***
F Change		0.022		0.042

+p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Patent Portfolio on Cumulative Abnormal Returns

VARIABLES	MODEL 35 DV: CARS (0,+3)	MODEL 35a DV: CARS (0,+3)	MODEL 36 DV: CARS (0,+3)	MODEL 36a DV: CARS (0,+3)
Exploitation at 80%	0.001	0.001		
	(0.002)	(0.003)		
Exploitation at 80% x Patent Portfolio		0.001		
		(0.000)		
Exploitation at 90%			0.001	0.001
			(0.002)	(0.003)
Exploitation at 90% x Patent Portfolio				-0.001
				(0.000)
Patent Portfolio	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	-0.001+	-0.001+	-0.001*	-0.001*
	(0.000)	(0.000)	(0.000)	(0.000)
Firm Age	0.002+	0.002+	0.002+	0.002+
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.005	-0.005	-0.005	-0.005
	(0.007)	(0.007)	(0.007)	(0.007)
Leverage	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.818**	0.818**	0.819**	0.818**
	(0.246)	(0.246)	(0.246)	(0.246)
Institutional Ownership	-0.002	-0.002	-0.002	-0.002
	(0.005)	(0.005)	(0.005)	(0.005)
Intercept	-0.058+	-0.058+	-0.058+	-0.058+
	(0.034)	(0.034)	(0.034)	(0.034)
Observations	3656	3656	3656	3656
R-Square	0.0694	0.0691	0.0688	0.0691
R-Square Change		-0.0003		-0.0003
F Value	2.57***	2.56***	2.57***	2.55***
F Change		0.009		0.404

+p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Patent Portfolio on Cumulative Abnormal Returns

VARIABLES	MODEL 37 DV: CARS 0,+5)	MODEL 37a DV: CARS (0,+5)	MODEL 38 DV: CARS (0,+5)	MODEL 38a DV: CARS (0,+5)
Exploitation at 40%	-0.004	-0.003		
	(0.003)	(0.004)		
Exploitation at 40% x Patent Portfolio		0.001		
		(-0.001)		
Exploitation at 60%			-0.005	-0.004
			(0.003)	(0.004)
Exploitation at 60% x Patent Portfolio				0.001
				(0.001)
Patent Portfolio	0.001	0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Firm Age	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.003	-0.003	-0.003	-0.003
	(0.009)	(0.009)	(0.009)	(0.009)
Leverage	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.300	0.300	0.303	0.303
	(0.303)	(0.303)	(0.303)	(0.303)
Institutional Ownership	0.010^{+}	0.010^{+}	0.010^{+}	-0.010^{+}
	(0.006)	(0.006)	(0.006)	(0.006)
Intercept	-0.037	-0.037	-0.040	-0.040
	(0.042)	(0.042)	(0.042)	(0.042)
Observations	3656	3656	3656	3656
R-Square	0.0805	0.0802	0.0806	0.0802
R-Square Change		-0.0002		-0.0004
F Value	2.85***	2.83***	2.84***	2.84***
F Change		0.000		0.014

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

OLS Regressions of Exploitation and Patent Portfolio on Cumulative Abnormal Returns

VARIABLES	MODEL 39 DV: CARS (0,+5)	MODEL 39a DV: CARS (0,+5)	MODEL 40 DV: CARS (0,+5)	MODEL 40a DV: CARS (0,+5)
Exploitation at 80%	-0.001	-0.001		
	(0.003)	(0.004)		
Exploitation at 80% x Patent Portfolio		0.001		
		(-0.001)		
Exploitation at 90%			-0.002	-0.001
			(0.003)	(0.003)
Exploitation at 90% x Patent Portfolio				0.001
				(0.001)
Patent Portfolio	0.001	0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Firm Age	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Intensity	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
New Drugs	-0.003	-0.003	-0.003	-0.003
	(0.009)	(0.009)	(0.009)	(0.009)
Leverage	0.007	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Alliances	-0.001	-0.001	-0.001	-0.001
	(.001)	(.001)	(.001)	(.001)
Liquidity	0.296	0.295	0.302	0.300
	(0.303)	(0.303)	(0.303)	(0.303)
Institutional Ownership	0.010^{+}	0.010^{+}	0.010^{+}	-0.010^{+}
	(0.006)	(0.006)	(0.006)	(0.006)
Intercept	-0.035	-0.034	-0.038	-0.037
	(0.042)	(0.042)	(0.042)	(0.042)
Observations	3656	3656	3656	3656
R-Square	0.0802	0.0801	0.0804	0.0803
R-Square Change		-0.0001		-0.0001
F Value	2.84***	2.83***	2.83***	2.84***
F Change		0.130		0.280

$^{+}$p<0.1, *p<0.05, **p<0.001, ***p<0.0001

Curriculum Vitae Kevin J. Walsh

EDUCATION

University of Wisconsin-Milwaukee - Lubar School of Business, Milwaukee, WI
PhD in Management Science
Graduation Date: December 2021
Specialization: Strategic Management Minor: International Business

Dissertation: Investor Reaction to Exploration versus Exploitation Using an Absorptive Capacity Lens

Dissertation Chair: Dr. Edward F Levitas

Marquette University - College of Business Administration, Milwaukee, WI
Master of Business Administration
Graduation Date: May 1997

Marquette University - College of Engineering, Milwaukee, WI
Bachelor of Science in Electrical Engineering
Graduation Date: May 1991
Major: Electrical Engineering Minor: Mathematics

CONFERENCE PRESENTATIONS

Walsh, K.J., Thomas, K., and Towhidi, G. The Impact of CEO Compensation Composition and the Environment on Merger Exposure. *Presented at 2013 Midwest Academy of Management Conference.*

TEACHING EXPERIENCE

Marquette University (August 2015 - Present)

Instructor of Practice – BUAD 1001 Business Day One (Fall 2015 - Present)

- Business Foundations Class for Incoming Freshmen (3-4 Sections/Semester)
- Implemented several new components to make class more interactive
- Overall Instructor Ratings between 5.3-5.9/6.0

Guest Speaker – EMBA Capstone (Fall 2018 - Present)

- Present on the value of reflection
- Facilitate Transfer of Learning presentations

University of Wisconsin-Milwaukee (January 2011 - 2015)

Adjunct Professor – BUSADM 600 Management Analysis (Fall 2013, Spring & Fall 2014, Spring 2015)

- Lubar School of Business Capstone Class
- Prepare and Lead Sections with Approximately 40 Students Each
- Leverage D2L and other Technologies to Enhance Learning Experience
- Overall Instructor Rating
    - Fall 2013: 5.0 / 5.0 and 4.8 / 5.0
    - Spring 2014: 5.0 / 5.0 and 4.8 / 5.0
    - Fall 2014: 5.0 / 5.0

Adjunct Professor – BUSADM 496 International Business (Spring 2015)

- Prepare and Lead One Section with Approximately 45 Students
- Leverage D2L and other Technologies to Enhance Learning Experience

Adjunct Professor – BUSADM 292 Introduction to Entrepreneurship and Small Business Formation (Fall 2014)

- Prepare and Lead One Section with Approximately 50 Students
- Leverage D2L and other Technologies to Enhance Learning Experience
    - Fall 2014: 4.7 / 5.0

Guest Lecturer – BUS ADM 738 Human Resource Management (Spring 2014)

- Topic: “Employee Discipline and Coaching”

Teaching Assistant – BUSADM 330 Organizations (Fall 2011, Spring 2012, Fall 2012, Spring 2013)

- Lead Five Discussion Sessions for 150 Junior/Senior Status Students
- Review and Grade Homework and Projects
- Work Closely with Lead Professor to Design and Modify Course Structure
- Overall Instructor Rating
    - Fall 2011: 4.70 / 5.00
    - Spring 2012: 4.92 / 5.00
    - Fall 2012: 4.90 / 5.00
    - Spring 2013: 4.74 /5.00

Teaching Assistant – BUSADM 230 Introduction to Information Systems (Spring 2011)

- Lead Lab/Discussion Sessions
- Review and Grade Homework, Quizzes and Projects for 125 Sophomores/Juniors
- Part of Team to Roll Out Trial of SAM (**Skills Assessment Manager**) Mechanized Project Review Tool
- Overall Instructor Rating
    - Spring 2011: 4.78 / 5.00

SELECTED WORK EXPERIENCE

Marquette University (August 2015 - Present)

Instructor of Practice (August 2015 - Present)

Director – Executive Education (January 2017-Present)

- Inaugural Director responsible for creating Marquette's initial entry into Executive Education market. Responsible for strategic planning, internal business process design and business development.
- Secured two $1 Million corporate gifts to fund programing efforts.
- Launched non-credit "Bridge to Business for Engineers – Sponsored by Rexnord" offering. Over 141 engineers from 16 companies have participated in the program since 2018. 98% of past participants agree they can apply concepts and would recommend the program to a peer.
- Negotiated and secured two custom program contracts.

AT&T/SBC/Ameritech Corporation (June 1990- November 2010)

Director – Customer Care (August 2008 - November 2010)

- Led an organization comprised of approximately 340 management and non-management employees located in six centers across the nation. The primary organization responsibilities are to process billing inquiries, claims and adjustments for all wholesale products.
- Reduced headcount by over 25% - while managing a 261% increase in claims volume.
- Responsible for resolution of over one million disputes annually and hundreds of millions of dollars in annual billing adjustments. (Exact amount is confidential.)
- Consistently met key objectives including: 98% On-time Claims resolution, 95% Accuracy, Revenue Recovery goals, Budget, Overtime and Regulatory (SOX/251/272) compliance.

Director – Process Design and Implementation (November 2005-July 2008)

- Directed team of 77 management employees throughout the five "Telco" regions that provide 22-state process design and performance improvement support for Wholesale Service Centers. Responsible for the design, documentation and implementation of all ordering and billing processes for Wholesale products - as well as major Wholesale project initiatives.
- Member of Corporate Regulatory Relief Steering Committee and responsible for developing and implementing Wholesale plans.
- Responsible for multiple SBC/AT&T and AT&T/Bellsouth Merger Initiatives - creating standard environments, building business cases and realizing synergy targets.
- Interfaced with IT, Product Management, Network, and the Wholesale Customer Care Service Centers in support of AT&T Wholesale's business goals.
- Supported efforts to improve mechanization and flowthrough in the Service Centers.

Director – Customer Service (September 2004 to October 2005)

- Led team of over 500 Service Representatives and Managers (including 7 Direct Reports) in support of Wholesale customer base. Team was responsible for interacting with customers and processing orders for various services, as well as handling Billing Claims, Order Quality and Service Order Error Correction.

- Managed Annual Budget in excess of $38 million. Ensured proper staffing and overtime.

Director – Local Service Center Technical Support (2000 to 2004)

- Directed team of 35 responsible for process improvement, performance measurement, local mechanization, 271 compliance, release management and technical support efforts for Industry Market's Local Service Centers (LSC) located in the five state Midwest region and their 1100 employees.
- Worked with Regulatory and IT organizations to design and develop measures used to reflect LSC performance. Attended customer "collaborative" sessions and worked with Regulatory to identify and justify numerous proposed measurement changes.
- Led various process improvement initiatives (often partnering with Network and I/T) that resulted in improved performance in over ten different performance measures. One effort alone reduced remedy payments from over $800K per month to less than $5K per month.

UNVERSITY SERVICE

- College of Business Administration New Building Core Team – Committee Member (2020-Present)
- One Step Ahead – Student Organization – Inaugural Faculty Advisor (2020-Present)
- University Upskilling Team – Subcommittee Lead (2020-Present)
- Innovation Alley – Kaleidoscope Subcommittee Lead (2020-Present)
- Faculty Externship Initiative – Committee Member (2020)
- Webinar "The Challenge of Uncertainty - Leadership in Volatile Times" – Facilitator (2020)
- Council for Corporate Engagement – Committee Member (2019-Present)
- Global Consortium of Jesuit Executive and Professional Education – Committee Member (2019- Present)
- Go-Getters – Student Organization – Faculty Advisor (2019-Present)
- Club Golf – Faculty Advisor (2019-Present)
- Faculty Academic Advisor – Undergraduate Students (2016-2019)
- Faculty Academic Advisor – Graduate Students (2020 –Present)
- Center for Principled Entrepreneurship Review Team – Committee Member (2019)
- Dean Search Committee – Committee Member (2019)
- Presidential Task Force on Corporate Engagement – Subcommittee Co-Lead (2018)
- External Relations Committee – Committee Member (2018)
- Summer Business Academy – Committee Member and Instructor (2018)
- Graduate Business Analytics Curriculum Development Committee – Committee Member (2016-2017)

ACTIVITIES - HONORS

- STEM Forward – Future Cities Competition Judge - 2021
- Delta Sigma Pi - 2017 – Present
- National Society of Professional Engineers - 2016- Present
- Academy of Management – 2013 - 2016
- Midwest Academy of Management– 2013 - 2016
- STEM Forward – Future Cities Competition Mentor (2015-2016 and 2017-2018) – Two Time Regional Champion
- UWM Gold Star Teaching Award – Spring 2012, Fall 2012, Fall 2013, Spring 2014; Fall 2014
- Reviewer – Academy of Management 2013 - 2015
- Reviewer – Midwest Academy of Management 2013

- UWM Organizations and Strategic Management Academic Student Research Club – 2010 - 2015
- UWM iPads 4 Education Club – 2012 - 2016
- Registered Professional Engineer in the State of Wisconsin – 1997 - Present
- Lay Eucharistic Minister – 2009 - Present
- Youth Assistant Basketball Coach – 2010 - 2016
- Cub Scout Den Leader – 2010 - 2013
- Youth Baseball Coach – 2008 - 2011
- Selected for “Leading with Distinction Experience” – 2nd Quarter 2009
- Wholesale President’s Award Winner – 2nd Quarter 2006
- AT&T Wisconsin PAC Disbursal Committee – 2005-2010
- Ameritech Information Industry Services Mentor Program 1998-1999
- Ameritech Development Program (New Hire Program) - Class of 1991
- Marquette University Honors Program – 1986-1991