MEASURING INNOVATION

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ABSTRACT
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This thesis examines the innovation premium metric to determine how well it measures the innovation potential of companies, as determined by investor sentiment. The innovation premium is the proportion of a company's market capitalization that exceeds the net present value of the company's cash flows from its current products in its current markets. Through the use of the annual *Forbes* lists of the World's Most Innovative Companies, a stock analysis is conducted to test the validity of the innovation premium measure. High innovation premium values indicate an increased likelihood of innovation occurring and higher probability of success, but even for companies with the highest innovation premiums, there remains a large risk of failure. This thesis investigates the innovation premium values of both innovative companies and a control group in order to draw conclusions about the validity of the innovation premium metric.

TABLE OF CONTENTS

ABSTRACT.....ii

LIST OF TABLES.....v

LIST OF FIGURES.....vi

Chapter

I. INTRODUCTION.....1

A. Research Overview.....1

B. Innovation Research.....2

C. Defining Innovation.....2

D. The Popular Press Problem.....3

II. LITERATURE REVIEW.....5

A. Proxies and Measures of Innovation.....5

B. Traditional Proxies.....7

1. Innovative Efficiency.....7

2. R&D Spending.....7

C. Price-to-Innovation Adjusted Earnings Ratio.....8

D. Disruptive Innovation Theory.....9

E. Creative Destruction.....10

F. Conclusion.....11

III. METHODOLOGY.....12

A. Innovation Premium.....12

B. Data Collection.....15

C. Research Design.....16

D. Limitations.....21

IV. RESULTS.....23

A. Data Analysis.....23

B. Descriptive Statistics.....23

C. Geography.....26

D. Industries.....27

E. List Changes Over Time.....31

F. Quantitative Comparison.....32

G. Stock Analysis.....34

H. Market Capitalization Analysis.....39

I. Additional Control Group Analysis.....43

V. DISCUSSION.....47

A. Stock Performance Compared.....47

B. Effects of Market Environment.....48

C. Quartile Comparison.....48

D. Risk and Reward.....50

E. Limitations.....51

VI. CONCLUSION.....53

VII. REFERENCES.....55

LIST OF TABLES

Table 4.1 *Forbes'* Top 10 Most Innovative Companies 2011-2013.....24

Table 4.2 Comparison of Control Group and 2011 Most Innovative Companies Lists.....33

Table 4.3 Summary of Stock Analysis for 2011 List.....43

Table 4.4 Basic Characteristics Comparison of Control Group and 2011 List.....44

Table 4.5 Additional Metrics Comparison of Control Group and 2011 List.....44

Table 4.6 Price / Earnings Ratio Comparison of Control Group and 2011 List.....45

Table 4.7 Profit Margin (%) Comparison of Control Group and 2011 List.....45

Table 4.8 Return on Equity Comparison of Control Group and 2011 List.....46

Table 5.1 Average Innovation Premium by Portfolio.....49

LIST OF FIGURES

Figure 4.1 Comparison of Most Innovative Companies Lists by Geography....27

Figure 4.2 Comparison of Most Innovative Companies Lists by Industry....29

Figure 4.3 Visual Comparison of Most Innovative Companies Lists....32

Figure 4.4 Comparison of Stock Price Average Percent Increase 2011-2013....35

Figure 4.5 Comparison of Stock Price Average Percent Increase 2011....36

Figure 4.6 Comparison of Stock Price Average Percent Increase 2012....37

Figure 4.7 Distribution of Stock Price Percent Increase per Company by Portfolio 2011....38

Figure 4.8 Comparison of Market Capitalization Percent Increase 2011-2013....40

Figure 4.9 Comparison of Market Capitalization Increase 2011 by Portfolio....42

INTRODUCTION

In recent years, innovation has become a popular topic in not only academic realms but in the popular press as well. However, despite increasing research and widespread interest in the subject, innovation remains extremely difficult to measure and predict with accuracy. This paper aims to examine the innovation premium method of measuring business innovation and explore its uses and limitations.

This paper will focus on contributing more substance to an already existing measure of innovation that has yet to be comprehensively evaluated. The innovation premium concept is logical and has promising applications for investors and academics alike. This study seeks to fill a gap in the currently available research by "connecting the dots" surrounding the applications and limitations of this relatively new measure of innovation.

Research Overview

In this study, the innovation premium measure will be examined through qualitative and quantitative lenses in hopes of determining whether it is an effective method of measuring innovation potential and likelihood for sustained financial growth, in both the short- and long-term. This paper will use historical innovation premium estimates and stock data to test the measure and draw conclusions about its uses. Using the findings, this paper will investigate what types of companies the

innovation premium is best suited for, distinguish when it works best, and discern more about its possible applications.

Innovation Research

Studying innovation is difficult due to its subjective nature. Innovation manifests itself in business through everything from improved manufacturing processes to additional product features. The inherent difficulty in isolating innovation as a variable adds additional complexity to its measurement. Academically, innovation research is fragmented. The body of research is disjointed due to fundamental differences in methods, definitions, and even differing ideas of what qualifies as innovation research.

Scholars use a variety of proxies and survey methods in an attempt to measure innovation, but these measures are not comparable to each other. This lack of comparability leaves the entire field of research to be more “high level” than expected. Many studies pioneer new methods for measuring innovation, but the result is many different conclusions that do not build upon each other. Without consensus among researchers, the body of knowledge seems to be much wider than it is deep.

Defining Innovation

Innovation is seemingly a broad, almost amorphous topic. Many scholars, authors, and companies have a slightly different definition of innovation and its scope. At the broadest level, the Oxford Dictionary defines innovation as “to make changes in something established, especially by introducing new methods, ideas, or products” ("Innovation," 1989).

Keith Smith (2005) warns in his definition of innovation that "innovation involves multidimensional novelty in aspects of learning or knowledge organization that are difficult to measure or intrinsically non-measurable" (p. 149). These claims have done little to discourage other academics from attempting to more specifically pinpoint specifics of innovation. Langdon Morris (2009), defines *business* innovation specifically as either "increased value in the form of new or improved functionality, reduced costs, a price increase (good for the seller), a price decrease (good for the buyer), better margin for the seller, or some combination of these" (p.193).

However, Elena Cefis and Orietta Marsili (2005) take a different approach by breaking innovation down into two parts: process innovation and product innovation. New products and technologies are especially important in the early stages of a company, but processes are critical to the sustained growth and profitability of firms in more mature stages of development. Steven Kline and Nathan Rosenberg (1986) are known for their chain-link model of innovation that explains similar connections between different stages of the innovation process. Klein and Rosenberg explain, "there is no single, simple dimensionality to innovation" (1986, p. 279). Instead, innovation may be a new process of production, the substitution of materials, the reorganization of production or internal functions for increased efficiency, or an improvement in methods of innovation itself (1986).

The Popular Press Problem

The bulk of new "innovation research" comes from the popular press. In addition to the sheer volume of popular press mentions of innovation, it's important

to note that these are disseminated more frequently and rapidly than academic works.

The mass of popular press articles and books available can cloud the field of innovation and contribute even more subjectivity to its meaning. As the term gains in popularity, “innovation” has lost much of its value as it is used frequently as a catch-all term to express everything from creativity and problem solving to new business development and research. In 2012, *The Wall Street Journal* reported 33,528 mentions of innovation in annual and quarterly reports filed with the Securities and Exchange Commission, representing a 64% increase in usage from five years prior (Kwoh, 2012). While some people are quick to disregard innovation as a trendy buzzword of the moment, trends indicate innovation is becoming increasingly more valued.

LITERATURE REVIEW

Innovation depends on many different factors and, as such, is difficult to isolate and use as a variable. Keith Smith (2005) reasons that "measurement implies commensurability: that there is at least some level on which entities are qualitatively similar, so that comparisons can be made in quantitative terms. An immediate problem is that innovation is, by definition, novelty" (p. 149). Despite the complexity, many methods already exist for estimating innovation.

This paper aims to analyze one such measure of innovation that is relatively new: the innovation premium measure. Three professors, Jeff Dyer, Hal Gregersen, and Clayton Christensen, created the innovation premium measure in an effort to quantify innovation's effect on stock prices. The innovation premium measure gauges the excess value assigned to a company by the stock market that represents investors' expectations of future growth and increased profits.

Inadequate research currently exists regarding the accuracy of the innovation premium measure because it is relatively new. Thus, this study will examine the effects of innovation potential on the stock prices of public companies, analyze the innovation premiums of companies over time, and explore the uses and limitations of this measure of innovation.

Proxies and Measures of Innovation

No perfect measure of innovation exists, so many researchers use approximations. Along with recent increases in the sheer quantity of innovation research available, new methods for approximating innovation have arisen as well. However, researchers need to be aware of relative strengths and weaknesses when using these second-best data sources (Jensen and Webster, 2009).

Proxies allow for the estimation of innovation through the use of related or supportive variables. Jensen and Webster (2009) comment on the diversity of innovation proxies, noting that "some researchers rely on science and technology indicators and bibliometric data on scientific publications, while others have taken advantage of the emergence of new survey based measures of innovation" (p. 252).

Currently there is little consensus among academics regarding how to conceptually compare innovations and which proxy is most effective. In an effort to assess the multitude of available proxies, Hagedoorn and Cloodt (2002) compared over 1,200 companies using a spread of the most common innovation proxies. Their study concluded "there is no major systematic disparity amongst R&D inputs, patent courts, patent citations, and new product announcements" (Hagedoorn & Cloodt, 2002, p. 1375).

In contrast, Kleinknecht, Van Montfort, and Brouwer (2002) conducted a similar study and found the choice of indicator to be far from trivial. The authors compared five innovation proxies and ultimately concluded they "are not substitutable due to individual sources of bias" (Kleinknecht, Van Montfort, & Brouwer, 2002, p. 120). The measurement of innovation performance becomes

even more difficult when comparing proxies across different sectors and industries. This lack of consensus among researchers and diversity of available proxies contribute to the fragmented state of innovation research.

Traditional Proxies

Innovative efficiency and research and development (R&D) spending are two commonly used proxies in academic innovation literature.

Innovative Efficiency

The innovative efficiency proxy uses patents and quantifiable research outcomes to measure how well a firm utilizes each dollar of R&D investment. Laura Cardinal and Tim Opler (1995) examine firm diversification and related links to innovative efficiency. Their findings show no correlation between corporate diversification and innovative efficiency, but the authors do uncover important links between firm organization and innovative efficiency with regard to divisional-level incentive structures. Companies of all sizes vary in innovative efficiency levels, but the differences are more closely tied to incentives than diversification (Cardinal & Opler, 1995).

More recently, Hsu and Hirshleifer (2013) investigated the connections between innovation, innovative efficiency, operational performance, and stock returns. Their empirical analysis determined companies with better innovative efficiency have higher market valuations, stock returns, and operating performance (Hsu & Hirshleifer, 2013).

R&D Spending

R&D spending is one of the most common proxies for innovation across innovation theory literature (Brown & Fazzari, 2009). Data accessibility plays a large role in the prevalence of the R&D proxy. R&D spending amounts for all public companies are made available through mandatory filing requirements and annual reports to stockholders.

However, R&D spending is an imperfect proxy for a number of reasons. The primary limit is the unpredictable nature of R&D spending. Dollars spent on R&D do not necessarily guarantee results. While R&D is a necessary element for product innovation or technological advancement, business innovation can occur on many other levels as well.

Investing in innovation differs from other types investments. For example, a disproportionate amount of expenditures are typically linked to intangible assets such as personnel at innovative companies (Hall, 2010, p. 4). Additionally, Hall (2010) explains limitations of innovation investment using the R&D spending proxy and argues the high uncertainty of returns to innovation affects the ways innovation is financed. Companies treat R&D spending delicately because standard accounting principles dictate R&D activities are treated as expenses on the balance sheet. Not only is R&D spending inherently risky because outputs are uncertain and not all R&D activities can pass a rate of return test, but companies are additionally penalized by accounting standards (Hall, 2010, p. 3).

Price-to-Innovation Adjusted Earnings Ratio

The price-to-innovation adjusted earnings ratio treats R&D costs differently in an attempt to measure a company's investment in innovation. Due to standard accounting principles, price-to-innovation adjusted earnings ratio takes innovation expenses into account in ways market value does not.

Accounting standards dictate research and development (R&D) costs are categorized as expenses, which can diminish the book value of innovative companies. While R&D expenses are no guarantee of future innovative success, R&D spending is a necessary element of innovation. Innovation is not observable in the traditional measures of stock success such as the price/earnings ratio due to its categorization as an expense.

The Price-to-Innovation Adjusted Earnings Ratio is calculated as follows:

$$\textbf{Price-to-Innovation Adjusted Earnings Ratio} = \frac{\textbf{Price per share}}{\textbf{Earnings per share + R\&D per share}}$$

The price-to-innovation adjusted earnings ratio complements highly innovative firms and industries requiring high levels of investment. R&D spending may be an expense in the short-term, but it has the potential for returns in the future. The calculation of the price-to-innovation adjusted earnings ratio helps investors identify firms that place an emphasis on innovation.

Disruptive Innovation Theory

In addition to developing the innovation premium measure, Clayton Christensen pioneered the study of disruptive innovation theory. A "disruptive

innovation" is a product that either creates a new market or redefines market expectations. Disruptive innovation theory insists under certain circumstances, the mechanism of profit-maximizing resource allocation causes well-run companies to become obsolete (Christensen & Raynor, 2003, p. 17). Eventually, disruptive innovations completely displace current technologies. Christensen argues the risk-adjusted R&D costs of anticipated future market needs outweigh those of current market needs (Christensen, 1997). Companies must invest in future innovations despite the disincentives to do so when already enjoying a dominant market position with current products.

Despite their best intentions, some companies fail to see the opportunity in innovation. Through a case study involving disk drive companies in the 1980's, Christensen (1997) demonstrates the threats posed to companies when technological improvement occurs faster than customer demand growth. After years of dominating the market, the three leading disk drive firms were toppled in the early 1980's because they underestimated the advent of minicomputers. The leading companies remained "captive" by their existing mainframe customers while the minicomputer industry grew quickly. New entrants introduced a simpler 8-inch disk drive and began to penetrate the changing market. The larger firms possessed the ability to produce 8-inch disk drives, but didn't do so because their mainframe customers didn't require 8-inch drives. When the "leading" firms recognized the shift in the market it was already too late. Markets that don't exist cannot be analyzed, and seemingly small markets don't solve the growth needs of large companies (Christensen, 1997).

Creative Destruction

Christensen's Disruptive Innovation Theory is connected to Joseph Schumpeter's earlier idea of creative destruction. Joseph Schumpeter (1962) asserts the only constant in free markets is competition, and eventually firms will see a regression to the mean. Schumpeter's theory illustrates that product improvements that enhance existing products destroy the demand for the outdated product, rendering it obsolete. Similarly, a disruptive innovation essentially destroys an incumbent's market advantage.

Scholars postulate creative destruction provides an additional explanation as to why it's so difficult for firms to maintain long-term market dominance. Langdon Morris (2009) states "the term 'creative destruction' gives us a warning, a name, and a general explanation for the waves of change that move continually through the marketplace" (p. 193). Morris identifies connections between creative destruction and innovation through his assertion that "waves of change are themselves created, either intentionally or unintentionally, not by mysterious forces, but as a result of purposeful innovation in the competitive arena of the market" (2009, p.193). Innovation is occurring at increasingly rapid speeds in today's markets and incumbents should rightfully fear the waves of creative destruction that are constantly churning in the distance.

Conclusion

Innovation literature is notably fragmented and diverse. With so many disparate opinions available and varied methods for approximating and measuring innovation, a need for more detailed analysis exists in order to more definitively

determine the merits and limitations of each. With applications to the stock market and roots in disruptive innovation theory, the innovation premium measure represents an intriguing opportunity for in-depth research and analysis. This study seeks to address the holes in the current understanding of the innovation premium measure.

METHODOLOGY

This paper examines the merits and accuracy of a quantitative method for measuring innovation: the innovation premium measure. Innovation premium is the difference between a company's market capitalization and the net present value of its cash flows (Dyer, Gregersen, & Christensen, 2011, p. 57). For example, influential companies like Alexion Pharmaceuticals and Amazon.com have large innovation premiums. Their stock is priced higher than can be accounted for solely by the value of its current businesses. Innovation premium measures the market's predictions about a company's ability to innovate in the future.

Business innovation is a difficult variable to isolate because it depends on a variety of company characteristics. Innovation is defined in this paper as the creation of something original or an improvement in some established product, service, process, business model, method, or idea. Innovation can be engrained in a company's culture, encouraged through research and development investments, purchased through acquisitions, or pursued through a myriad of innovative activities. As a result, many scholars have proposed measures of innovation, but no single measure truly encompasses all of innovation's many facets.

Innovation Premium

The innovation premium measure assumes that markets inherently value innovation. In today's volatile economy, firms must disrupt or be disrupted. Staying

power is difficult to maintain due to the quick pace of innovation. Investors seek to finance companies that will persist and survive cycles of disruptive innovation. The innovation premium measure is intriguing because it relies on market sentiment and investors' predictions for the future. It begs the question: can markets be trusted as an indicator of innovation expertise (past, present, or future)?

Disruptive innovation theory insists under certain circumstances, the mechanism of profit-maximizing resource allocation causes well-run companies to become obsolete (Christensen & Raynor, 2003, p. 17). According to disruptive innovation theory, two types of innovation exist: sustaining innovation and disruptive innovation. Sustaining innovation "targets demanding, high-end customers with better performance than what was previously available" (Christensen & Raynor, 2003, p. 34). In contrast, disruptive innovations "disrupt and redefine market trajectory by introducing products and services that are not as good as currently available products" but appeal to new customers due to other benefits (Christensen & Raynor, 2003, p. 34). Typically, disruptive innovations are simpler, smaller, more convenient, and less expensive (Christensen, 1997, p. 11).

Clayton Christensen, the father of disruptive innovation theory, invented the innovation premium measure with two other professors, Jeff Dyer and Hal Gregersen. In collaboration with *Forbes* and Credit Suisse, the professors rank the most innovative companies in the world annually based on their innovation premium calculations.

Dyer, Gregersen, and Christensen (2011) calculate innovation premium by projecting a company's cash flows from existing business lines and the predicted

growth of those businesses (p. 92). Next, the authors compare the net present value of those cash flows to the current market capitalization of the company. The innovation premium is the difference between the market capitalization and the valuation of the company (expressed as a percentage of enterprise value).

Dyer et al. (2011) use a fade algorithm to determine the predicted growth of publicly listed companies (p. 100). Fade algorithms account for Joseph Schumpeter's theories of creative destruction. Schumpeter (1962) claimed the only constant in free markets is competition, and eventually firms will see a regression to the mean (p. 15). The proprietary fade algorithm is based on three assumptions (Dyer et al., 2011, p. 101). First, the fade algorithm uses a forward two-year consensus estimate of return on investment (ROI) level. Firms with greater profitability and ROI typically continue to have similar performance, but the fade algorithm takes competition into account. The higher the current level of profitability, the quicker the expected decline. Second, the algorithm is based on historical ROI volatility. More volatility indicates a swifter regression to the mean. Third, the fade algorithm factors in a company's reinvestment rate. If a company grows quickly and reinvests greater amounts of its cash, the growth is likely to be unstable and unsustainable (Dyer et al., 2011, p. 101).

Below is the innovation premium theoretical model:

$$\textbf{Innovation Premium} = \frac{\textbf{Total Enterprise Value}\ (\text{Market value of equity + total debt}) - \textbf{Value of existing business}\ (\text{Growth \% determined by fade algorithm})}{\textbf{Total Enterprise Value}} \times \mathbf{100}$$

Data Collection

Forbes' "The World's Most Innovative Companies" lists from 2011, 2012, and 2013 are used as the basis of this research analysis. These lists identify the 100 most innovative global companies based on their ranked innovation premiums for each respective year (except for 2012, in which only 50 companies were ranked). In addition to the innovation premium of each firm, the list also provides a percentage value for each company's 12-month sales growth and 5-year annualized total return.

Publicly available stock data is used to supplement this analysis. Information on the companies was obtained primarily through the Osiris Company Information Worldwide database. The Osiris database is a product of Bureau Van Dijk, a company that specializes in business intelligence and company information. Any additional company financial information has been acquired through their respective stock exchanges, company press releases, or annual shareholder reports.

The Most Innovative Companies lists are compared to each other across 2011-2013 and to a control group. The control group consists of 304 selected companies from Osiris that conform to the specific requirements of the Most Innovative Companies lists. The *Forbes* list requires seven years of available financial data, a market value greater than $10 billion, the exclusion of energy and mining firms (whose stocks are closely tied to commodity prices), and a minimum R&D investment that eliminates banks and other financial services firms from the list. In compiling the control group, these criteria for selection were applied to the Osiris database of public companies and all companies on the three *Forbes* lists were excluded. The 304 resulting companies are similar in size and general

characteristics to the “Most Innovative Companies” and provide a look at a comparable market segment’s performance over the same time period. The control group provides a baseline of comparison for evaluating the “Most Innovative Companies’” financial performance relative to the general market activity. This study seeks to investigate the ability of the innovation premium measure and investor sentiment to predict future business innovation and sustained financial success. Does the market value innovation as an indicator of future stock success and do these firms identified as more innovative by the innovation premium measure live up to expectations and outperform the competition? However, remember that innovation comes with a much higher level of risk that affects companies with high innovation premiums.

Research Design

This study presents an analysis of the innovation premium measure of innovation. This measure is particularly interesting because it uses the difference between market capitalization and net present value to identify whether or not investors believe a company is likely to innovate and increase in value in the future. Many measures of innovation try to quantify innovation through proxies or specific quantitative measures of financial performance, but the innovative premium combines the quantitative measures with market sentiment in a novel way. This study seeks to examine whether the innovation premium measure stands the test of time and actually can be used to comment on the innovative success of companies in a variety of global industries.

First, the range in innovation premiums will be investigated. All three years of data consistently present a large range in innovation premium percentages. For example, in 2011, the range in innovation premium values stretched from 75.1% to 16% for #1 on the list to #100. The large range itself is indicative of certain qualities of the innovation premium measure and the nature of the top 100 Most Innovative Companies relative to the rest of the market.

Industries and geographies will also be examined as potential patterns may arise that explain the variability in innovation premium values. The *Forbes* Most Innovative Companies lists include companies from all over the world. In 2013, 20 different nations were represented, and only 39% of the companies were American. The geographic patterns of the Most Innovative Companies will be investigated to determine whether the innovation premium measure favors certain regions of the world or different stock markets. Industry diversity also presents possible limitations for the applicability of the innovative premium measure. Business cycles frequently vary depending on the product or service type, meaning that the innovative premium measure may be better suited for some industries than others.

This research will test how well the markets can predict innovative strength and future stock growth by evaluating the Most Innovative Companies' stock prices, market capitalization, and other financial measures. All companies on the three Most Innovative Companies lists are tracked over time and their financial performance analyzed. The annual lists are examined not only by the performance of the list collectively, but also through the creation of quartile portfolios. The annual lists are divided into portfolios of 25 companies each (2011 Portfolio 1: #1

rank - #25 rank, 2011 Portfolio 2: #26 rank - #50 rank, etc.) for intra-list comparison. With such a wide range represented in the innovation premiums of the top 100 companies themselves, the annual lists provide the opportunity for intra-list comparison. Hypotheses regarding expectations for companies with higher innovation premiums to outperform companies with lower innovation premiums are tested using quartile portfolios to judge the validity of the innovation premium measure. Additionally, the lists and quartile portfolios are compared to the performance of the control group.

The percent change in stock price and percent change in market capitalization are two important measures of comparison used in this paper. The percent change in stock price is tracked monthly and calculated over the period for each company individually using its stock price at period-end compared to its stock price at the beginning of the period. The average of the respective annual list or portfolio is calculated using a compilation of those data points for each individual company. The period used varies depending on the annual list in question.

The percent change in market capitalization is calculated by summing the monthly market capitalization (the share price multiplied by the number of shares outstanding at month-end) of each company and comparing the percent change relative to the market capitalization at the beginning of the period. Similarly, the period varies depending on the relevant list.

It should be noted that the annual Most Innovative Company lists were compiled by *Forbes* using the prior year's financial data (e.g. the 2011 Most Innovative Companies list is calculated using fiscal year 2010 data), so in this paper

the calculation of percent change in stock price or percent change in market capitalization actually begins at the start of the prior year and ends at the conclusion of 2013. For example, the average percent change in stock price for the 2011 Most Innovative Companies list is calculated from January 2010-December 2013.

The percent change in stock price helps describe market sentiment and the general market activity of these "most innovative" companies over time and in comparison to the control group. Similarly, the percent change in market capitalization depicts the perceived financial strength of these companies and the change in company value over time.

The innovation premium measure and the *Forbes* lists of the World's Most Innovative Companies emerged in 2011, meaning there is limited data available and options for comparison. The 2011, 2012, and 2013 lists are all discussed and analyzed at length in this paper. However, the 2011 Most Innovative Companies list is favored at times due to more data being available and the ability to look farther into the "future" at 2012 and 2013 data for comparison. The 2011 data allows for the tracking of these innovative companies over a longer time period after the list announcement and the ability to draw more meaningful conclusions about the validity of the innovation premium measure.

The control group is used along with the S&P 500 at times to provide some context for the changes in the stock market occurring over the same time period. While the S&P 500 is representative of the US equities market, the control group consists of global firms similar in size and type to the "most innovative" companies. Also, it should be noted that the S&P 500 includes some of the same companies as

the Most Innovative Companies lists. Therefore, the S&P 500 provides a less meaningful comparison than the control group, but still represents an important slice of the market. These comparisons and controls provide an important validity check for this research. For example, if the control group demonstrates similar stock growth over time to the 100 most innovative firms, innovation may not be an effective predictor of stock success.

Additionally, this report will illustrate the changes in the list over the three year period. Connections and similarities between the lists are monitored. For example, how many of the 2011 Most Innovative Companies are still on the list in 2013 and how much their positions have changed. Though the innovation premium measure is relatively new, the three years of available data provide sufficient information for the analysis of trends among the ranked companies.

Overall, this study aims to increase knowledge of the innovation premium measure of innovation. This research seeks to determine whether companies with higher innovation premiums are better able to withstand market changes and sustain firm growth over time.

Limitations

Several limitations impact this study. Most notably, the *Forbes* annual list of the "Most Innovative Companies" excludes companies with less than 7 years of publicly available financial data. This limit impacts the number of firms considered for the list and excludes a number of dominant technology firms that have only recently filed initial public offerings. Additionally, the study is limited to only public companies. However, this constraint is necessary due to the large amount of

data required for quantitative analysis. Finally, the *Forbes* lists applied a control for size differences. Only companies with a minimum $10 billion market capitalization were considered. This threshold was imposed due to the inherent differences between small and large companies.

The inconsistent nature of the Most Innovative Companies lists themselves is also a limitation, due to the fact that the 2012 list only ranks the top 50 most innovative companies while the 2011 and 2013 lists rank the 100 most innovative companies. This discrepancy makes comparisons across the three lists more difficult due to the fact that the 2012 list is only half as long. Trends are more difficult to spot and the fluctuations of specific companies are harder to track without the intermediate data. Additionally, the range, average, standard deviation, and other descriptive measures of the 2012 list that take the entire list into account cannot be compared to those of 2011 and 2013.

The limited transparency and restricted extent of provided source data is a limitation that affects the scope of this study. The creators of the innovation premium measure collaborated with Credit Suisse HOLT and Forbes Magazine to determine the annual Most Innovative Companies lists. However, they determined part of their methodology to be proprietary and limited the extent of released information. The authors explain their methodology on a high level in their book, *The Innovator's DNA*, and in *Forbes Magazine*, but certain aspects were not described in detail. The proprietary fade algorithm and methods used to evaluate the value of existing businesses and NPV calculations were especially guarded. Additionally, source data was not presented or specified, which precluded this study

from being able to replicate their methodology and test the innovation premium measure of any chosen company. Additionally, it would have been helpful to know the precise date the total returns were calculated as of and other specifics of the source data collection. Due to the fact that this study cannot replicate the authors' methodology, this analysis of the innovation premium measure is limited to the information provided by the three *Forbes* lists of the Most Innovative Companies of 2011, 2012, and 2013.

RESULTS

Data Analysis

The *Forbes* annual lists of the World's Most Innovative Companies provide the opportunity for in depth analysis of the innovation premium measure and innovation's role as a predictor of financial success. If the validity of the measure holds, it can be hypothesized that a higher innovation premium measure indicates a higher likelihood of future firm growth. Since the innovation premium measure is based on market sentiment, it can also be postulated that the measure either favors or is better suited for some particular types of companies and has limitations affecting its applicability.

Before leaping into quantitative analysis of the "World's Most Innovative Companies" and the innovation premium measure, some basic descriptions of the data are required and qualitative aspects of the lists must be examined.

Descriptive Statistics

Even though the *Forbes* lists of the Most Innovative Companies feature only the top 100 companies (or top 50 in the case of 2012) with the highest innovation premium measures, there is a great range from the top of the list to the bottom. Salesforce.com had the highest innovation premium for all three years, and therefore topped the 2011, 2012, and 2013 lists. The Salesforce.com innovation premium measure is 75.1%, 73%, and 72.8% for 2011, 2012, and 2013 respectively.

This large value is notable, especially when compared with #100. In 2011, #100 ConAgra Foods was at the bottom of the list with an innovation premium of only 16%. Two years later, in 2013 the standing of #100, Daikin Industries, had barely improved with an innovation premium of 18.6%. Accordingly, the range for 2011 was 59.1% and the range for 2013 was 54.2%. 2012 differed due to the shorter nature of the list. With only 50 companies listed, the range for 2012 was 44.2%. Salesforce.com held the #1 spot with 73% and General Mills held the #50 spot with a 28.8% innovation premium.

Table 4.1 *Forbes' Top 10 Most Innovative Companies 2011-2013*

2011

2011 Rank	Company	2011 Innovation Premium
1	Salesforce.com	75.1%
2	Amazon.com	58.9%
3	Intuitive Surgical	57.6%
4	Tencent Holdings	52.3%
5	Apple	48.2%
6	Hindustan Unilever	47.7%
7	Google	44.9%
8	Natura Cosmeticos	44.5%
9	Bharat Heavy Electricals	43.6%
10	Monsanto	42.6%

2012

2012 Rank	Company	2012 Innovation Premium
1	Salesforce.com	73.0%
2	Alexion Pharmaceuticals	72.3%
3	Amazon.com	58.3%
4	Red Hat	58.1%
5	Baidu	57.6%
6	Intuitive Surgical	54.0%
7	Rakuten	51.5%
8	Edwards Lifesciences	46.9%
9	Larsen & Toubro	46.1%
10	ARM Holdings	45.4%

2013

2013 Rank	Company	2013 Innovation Premium
1	Salesforce.com	72.8%
2	Alexion Pharmaceuticals	72.3%
3	Vmware	63.7%
4	Regeneron Pharmaceuticals	63.1%
5	ARM Holdings	61.2%
6	Baidu	60.6%
7	Amazon.com	60.2%
8	Intuitive Surgical	53.9%
9	Rakuten	50.7%
10	Natura Cosmeticos	48.5%

The average innovation premium was 28.14% in 2011 and 32.23% in 2013, with respective standard deviations of 10.69% and 12.28%. While the Most Innovative Companies lists feature big winners like Salesforce.com (2011 Innovation Premium: 73%), Amazon.com (2011 Innovation Premium: 58.9%), and Intuitive Surgical (2011 Innovation Premium: 57.6%), these companies have innovation premiums that fall very far from the mean. #1 Salesforce.com is a statistical outlier on all three lists, falling over three standard deviations from the mean. When looking at the innovation premium distributions for 2011, 2012, and

2013, there is a steep decline after the top few companies (see Table 4.1). For example, in 2011, there were three outliers, five companies fell between two and three standard deviations from the mean, ten companies fell between one and two standard deviations from the mean, and 28 remained above the mean but below one standard deviation. All three annual lists are positively skewed.

The increase in the average innovation premium over time is likely due in part to the improved conditions of the stock market overall and improved investor confidence. The 2011 innovation premium measures were calculated using 2010 and 2011 financial data, when the stock market outlook was much less optimistic than in 2012 and 2013. As investors' confidence in the market grew, so did their predictions for innovation and their willingness to pay the innovation premium of these "most innovative" companies. Investors' expectations for these companies to innovate further increased their innovation premium percentages over the years.

Descriptive statistics of the Most Innovative Companies lists are important because of what they indicate about these annual lists compared to other public companies on the market. If the top 100 most innovative companies range from 16%-73%, then it can be inferred that the majority of considered companies on the market must have smaller innovation premiums in comparison. Of course, due to the limitations imposed by Dyer, Gregersen, and Christensen in the creation of the Most Innovative Companies lists, not all public companies were considered for inclusion, so it cannot be deduced that *every* other company has an innovation premium less than 16%. The *Forbes* data only includes companies with higher than $10 billion market capitalization, for example. More data would be needed to draw

conclusions about the market at large, however if the considered slice of the market is indeed indicative of broader trends, then the distribution indicates that there is a very select group of companies for which investors are willing to pay significant innovation premiums to purchase.

Geography

The geographic spread of the three lists is relatively similar, with one noticeable pattern: an increase in globalization and a decrease in the presence of the United States on the list. Each passing year depicts a decline in the number of American companies on the list. As presented in Figure 4.1, the Most Innovative Companies list has gone from 48% American companies in 2011, to 44% in 2012, and 39% in 2013[1]. The other most recurring countries on the list include Japan, France, China, the United Kingdom, and Germany. Despite the decline in American companies, the annual lists are dominated by western, developed nations. 77% of the 2013 list is comprised of North American, European, or Australian companies, compared to 79% in 2011. Only 20% of the 2013 list is Asian companies, compared to 18% in 2011.

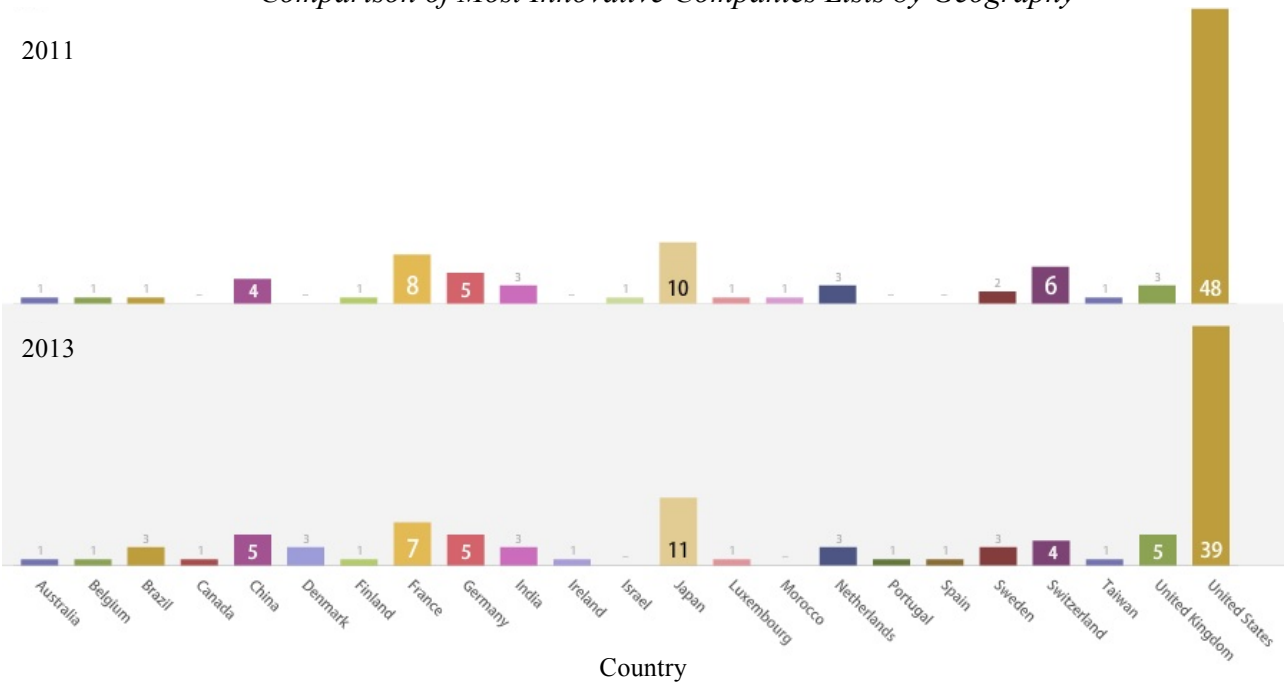
The geographic spread of the Most Innovative Companies lists suggests that despite the increased economic development in regions such as Asia, most investors are unwilling to pay an innovation premium on companies in developing nations. This may be due to increased investment risk associated with foreign investments and the increased volatility of foreign markets. Though some foreign companies have great innovation potential, investors may be more apt to look to foreign

[1] For comparison to 2012: the top 50 companies for 2011 and 2013 are 48% American and 46% American, respectively.

markets for "value" investments. When investors place an innovation premium on a stock it essentially means they are overpaying for it based on its current valuation in expectation that company innovations will lead to an increased future price. The geographic spread of the Most Innovative Companies lists indicates that investors may be more likely to look to Asia, South America, or Africa to invest in intrinsically undervalued stocks instead.

Figure 4.1

Comparison of Most Innovative Companies Lists by Geography



Industries

One hypothesis is that the innovation premium measure is best suited for and favors industries that are most affected by the threat of disruptive innovation. Disruptive innovation creates an "innovate or die" reality in some sectors that evolve more quickly than others. For example, technology firms can be dominant

one day and obsolete the next due to the quick pace of technological advancement, limited product lifespans, and fast rates of new product adoption by consumers. One such example is Blackberry (formerly Research In Motion). At the company's peak in 2008, its market capitalization was $83 billion. Due to underestimating the disruptive impact of the iPhone and related industry-wide innovations, Blackberry launched into a steep decline and now has a market capitalization of only $5.29 billion as of March 2014 (that figure represents just 1.1% of Apple's $473.67 billion market capitalization) (Osiris, 2014). Perhaps the medical industry is similarly moved by disruptive innovation. Biotech firms, pharmaceutical companies, and medical device companies can be affected by disruptive scientific discoveries that can completely change the competitive landscape of the industry.

The *Forbes* Most Innovative Companies lists include companies from a wide range of industries. Each company's Global Industry Classification Standard (GICS) code was used to sort the lists into eight primary industry groups. The GICS industry taxonomy system is developed and maintained by MSCI Inc. and Standard & Poor's. The Most Innovative Companies lists included companies from eight industries: Energy, Materials, Industrials, Consumer Discretionary, Consumer Staples, Health Care, Information Technology, and Telecommunication Services.

As seen in Figure 4.2 below, the breakdown of each annual list by industry reveals Industrials, Consumer Staples, and Information Technology to be the most represented industries across all three lists. Industrials includes companies whose primary businesses involve manufacturing and distributing capital goods, such as building and engineering products, electrical equipment, or machinery. Consumer

Staples refers to companies with businesses related to inelastic consumer goods. This industry grouping includes food, beverages, household goods, and personal care items. The Information Technology industry classification is comprised of technology software and services companies as well as technology hardware and equipment companies (MSCI Inc., 2012).

Figure 4.2 *Comparison of Most Innovative Companies Lists by Industry*

The prevalence of technology companies on the Most Innovative Companies lists is predictable due to market patterns in recent years. Innovation and technological advancement seem to frequently go hand in hand. Information technology companies receive a lot of press and attention for innovation, so it's reasonable to assume many investors are likely to look to the sector when investing in innovation potential. The technology industry has recovered since the recession of 2008 and IPO's have been particularly strong in the sector in recent years. The

National Venture Capital Association announced in the first quarter of 2014 that venture capital-backed IPO's surged in 2013 to the highest level, by dollars, since 2007 pre-recession, led by the internet sector and information technology IPO's representing over 75% of total proceeds (NCVA, 2014).

The Health Care industry increases its representation on the list from 2011 to 2013 and represents 15% of the list in 2013. Additionally, it should be noted that five companies in the 2013 top quartile (Portfolio 1) fall into this industry: four pharmaceutical companies and one medical device company.

The frequency of industrials and consumer staples companies appearing on the list is intriguing. Industrials declined 9% from 2011 to 2013, but still account for 15% the list in 2013. Consumer Staples has more companies on the list (26) than any other industry and increased 4% from 2011 to 2013. Perhaps the stable nature of demand for many industrial and consumer staples products along with general technological advancement (leading to improved processes, cheaper production, and improved product offerings) promoted investor confidence in these industries and boosted the innovation premiums of these companies. Investors may perceive these industries as "safer" investments due to the nature of demand for their products and services. In periods of economic recovery or inflation, growth is expected in these industries because consumers will spend more. In an economic downturn, demand will decrease but persist out of necessity. The high innovation premiums of these industries during the time period examined in this study, 2010-2013, were likely fueled by the overarching climate of economic growth and

recovery. Investors were looking for “safe” investments in areas likely to experience growth.

The hypothesis that the most innovative industries are the ones most threatened by disruptive innovation may hold some weight, but it does not fully explain the distribution of industries across the lists. These industries most affected by disruptive innovation present growth opportunities for investors, driving up the innovation premiums of companies, but at the same time represent significant risk. In addition to the expected high quantity of technology and healthcare firms on the list, there is significant representation by industrials and consumer staples that cannot be explained in the same manner. The prevalence of industrials and consumer staples companies are better explained by the relatively continuous nature of demand for those types of products and the overarching economic climate of the time period being examined.

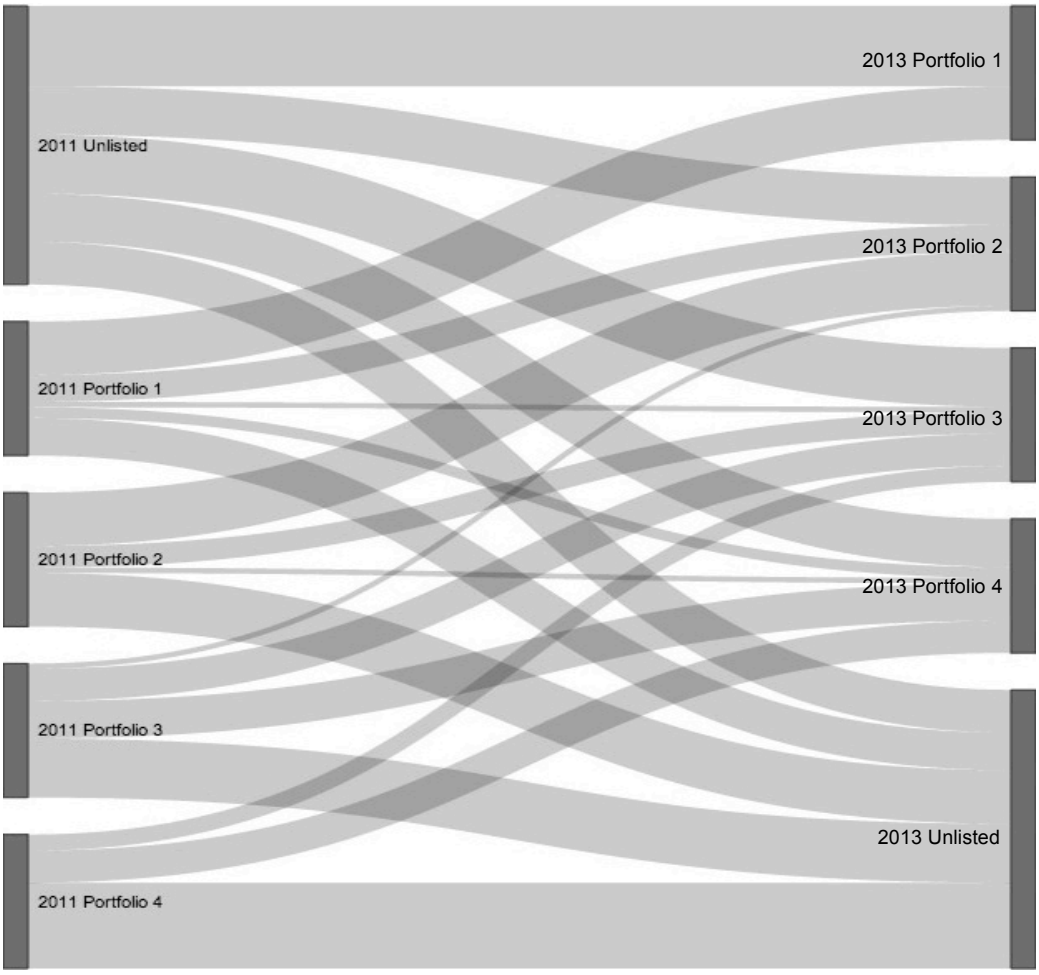
List Changes Over Time

Though there are only two years separating the 2011 and 2013 Most Innovative Companies lists, the lists are considerably different. Fifty-six companies from the 2011 list also appear on the 2013 list, but their positions on the list typically change, sometimes quite drastically. Figure 4.3 below illustrates this point and depicts the changes between the 2011 and 2013 list. For comparison purposes, the 2011 and 2013 lists are divided into four quartile portfolios each. Portfolio 1 for each year contains the companies ranked #1-#25, Portfolio 2 contains #26-#50, Portfolio 3 contains #51-#75, and Portfolio 4 contains #76-#100. As shown in Figure 4.3, the likelihood a company will increase its standing in subsequent years

decreases as the starting position declines lower in the list. No company originating below the first quartile in 2011 appears in the first quartile of 2013. Companies shift between the second, third, and fourth quartiles, but the majority go down in ranking between years. The companies that move from 2011 unlisted to 2013 unlisted were only included on the 2012 list.

Figure 4.3

Visual Comparison of 2011 and 2013 Most Innovative Companies Lists



Quantitative Comparison

As described in the methodology section, a control group has been created for use in comparing the annual Most Innovative Companies lists to the general

market activity for comparable public companies. The control group consists of 304 global companies that adhere to the same selection criteria used to limit the companies considered for the Most Innovative Companies lists. While some differences are expected between the control group and the 100 Most Innovative Companies list, in order to present a fair comparison the two groups should be similar in basic characteristics. The control group and the list of the 100 Most Innovative Companies of 2011 are compared in Table 4.2 in order to provide context for understanding the similarities of the two groups. The two groups vary slightly in each metric, but overall are close enough to provide adequate basis for comparison.

Table 4.2 *Comparison of Control Group and 2011 Most Innovative Companies Lists*

	Control Group Average	100 Most Innovative Companies 2011Average
Total Assets th USD 2011	30,869,918.36	23,219,274.64
Market Cap. th USD 2011	25,235,082.18	33,854,984.82
Number of employees 2011	60,331.75	49,289.89
Enterprise Value th USD 2011	29,698,714.55	34,436,231.50
EBIT th USD 2011	2,877,534.59	2,892,538.81
Total revenues th USD 2011	22,175,009.87	16,110,190.31

Evaluation against an appropriate control group is critical in testing the validity of the innovation premium measure. If the “most innovative” companies do not outperform their allegedly less innovative peers in the market, it would indicate the innovation premium measure is not necessarily tied to financial success.

In addition to a control group comparison, this study performed intra-list comparison by the creation of quartile portfolios for each annual list. The hypothesis was that the stronger quartile portfolios will outperform the weaker

quartile portfolios. Especially when considering the range in innovation premiums within each list, there is expected to be a significant difference between the performance of the quartile portfolios when compared to each other. For example, the average innovation premium of each portfolio for 2011 is as follows:

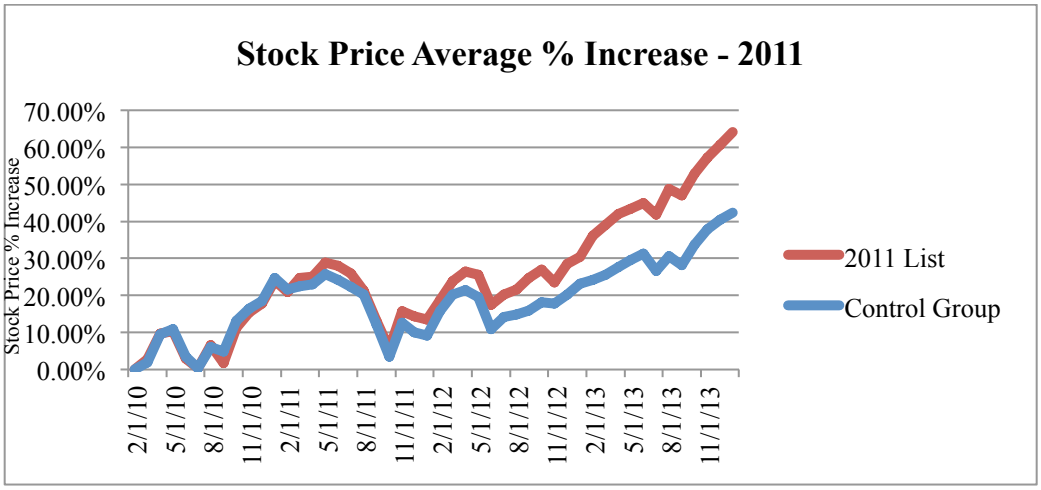
Portfolio	Average Innovation Premium
2011 Portfolio 1	42.46%
2011 Portfolio 2	29.93%
2011 Portfolio 3	22.51%
2011 Portfolio 4	17.65%

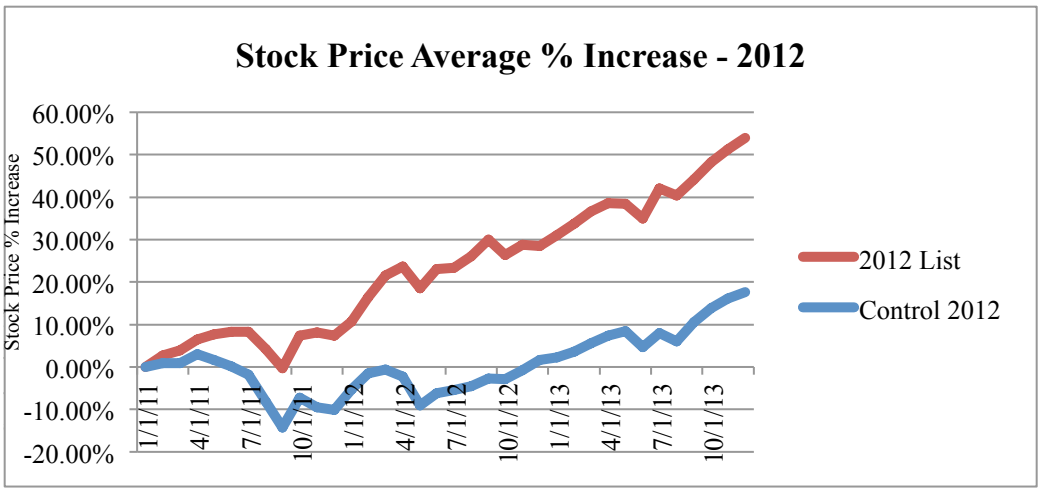
If the innovation premium is an effective predictor of sustained firm success and ability to innovate in the future, it is expected that Portfolio 1 would perform the best due to its higher innovation premium. The sensitivity of the measure and its predictive capabilities in the short- and long-term is tested in this manner.

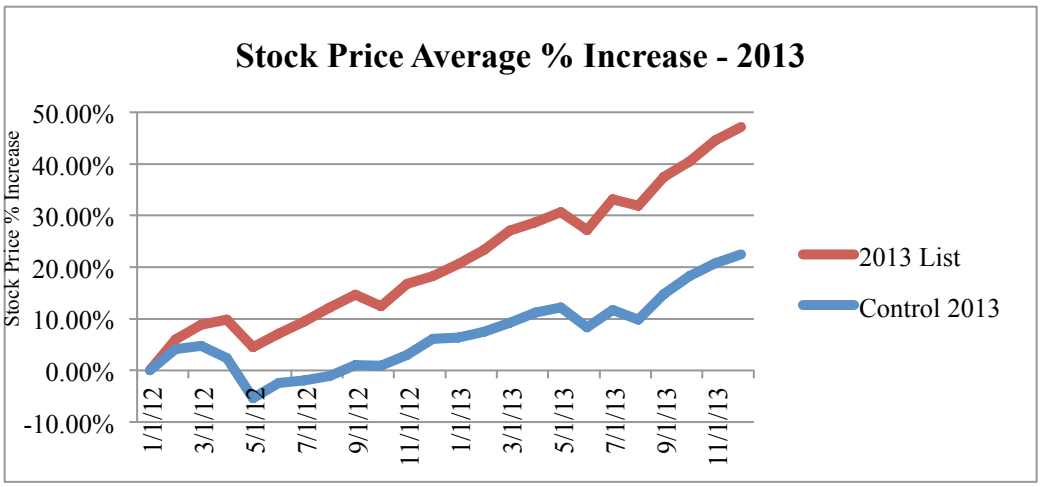
Stock Analysis

The percent change in stock price is compared for all three Most Innovative Companies lists. The graphs in Figure 4.4 exhibit that all three annual lists outperform the control group considerably over the long-term. The short-term is less predictable, as it can take time for the portfolios' growth rates to pick up. The annual Most Innovative Companies lists and the control group feature similar timing and magnitude of increases and decreases on these graphs, however the Most Innovative Companies lists' averages tend to increase at a faster rate and continue that sustained growth over time, given a positive market direction.

Figure 4.4 *Comparison of Stock Price Average Percent Increase 2011-2013*





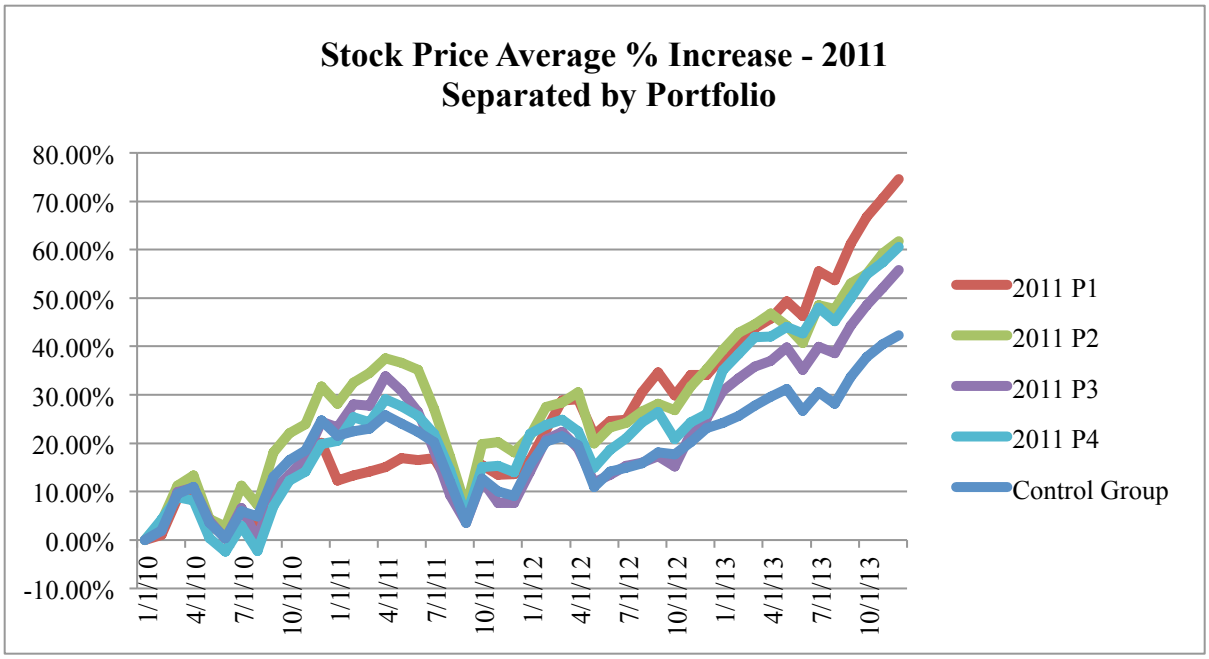


The graph of the 2011 list displays an interesting trend in 2010 and 2011 when the market was more vulnerable to volatility. The 2011 Most Innovative

Companies list and the control group experienced very similar ups and downs during this period, and it was not until June 2012 when the 2011 list began to distance itself from the control group. This indicates perhaps during more unstable periods in the market that the innovation premium measure is less tied to firm success. Companies may be less likely to take innovative risks during these market downturns or uncertain times, resulting in even these "most innovative" firms gravitating back to the mean.

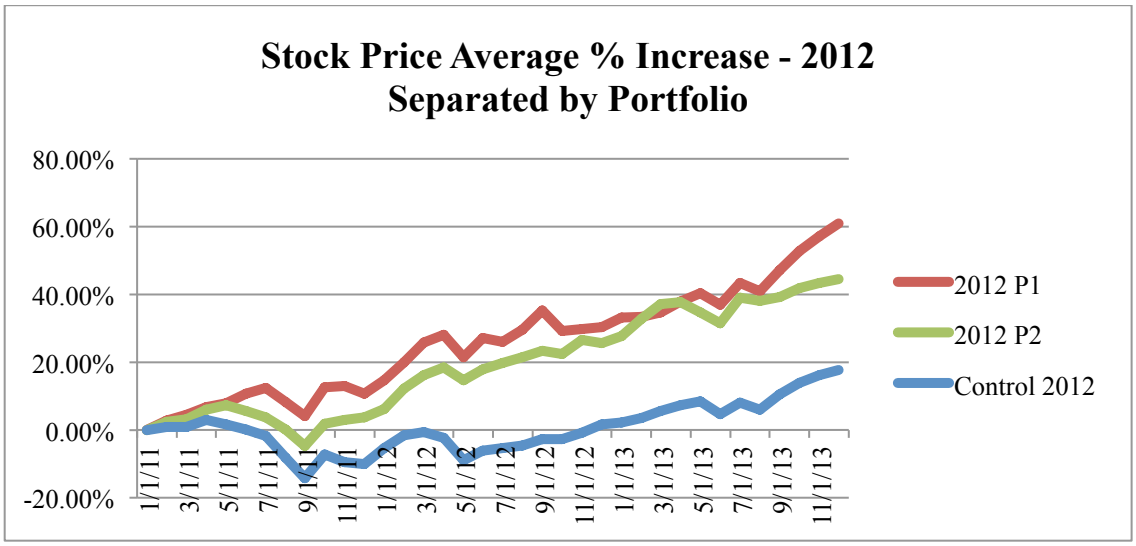
In order to investigate this hypothesis further, the 2011 list is separated by portfolio to track the performance of each quartile (refer to Figure 4.5 below). Interestingly, the separation into portfolios even more distinctly depicts the difference between the observed graph movements in 2010 and 2011 versus 2012 and 2013.

Figure 4.5 *Comparison of Stock Price Average Percent Increase 2011*



In Figure 4.5, as the market goes up and down during 2010 and 2011, all four portfolios are affected similarly. When the market takes its biggest falls, all portfolios and the control decline to approximately the same level, despite previous separations between them (see June 2010 or September 2011 for an example of a "unified decline"). However, after these declines, the four portfolios recover at different rates and separate once again. It's not until the market stabilizes that the portfolios sustain the differences between them. Eventually, Portfolio 1 ends the period with the largest percentage increase in stock value (74.58%), followed by Portfolio 2 (61.71%), Portfolio 4 (60.58%), Portfolio 3 (55.76%), and the control group (42.37%).

Figure 4.6 *Comparison of Stock Price Average Percent Increase 2012*



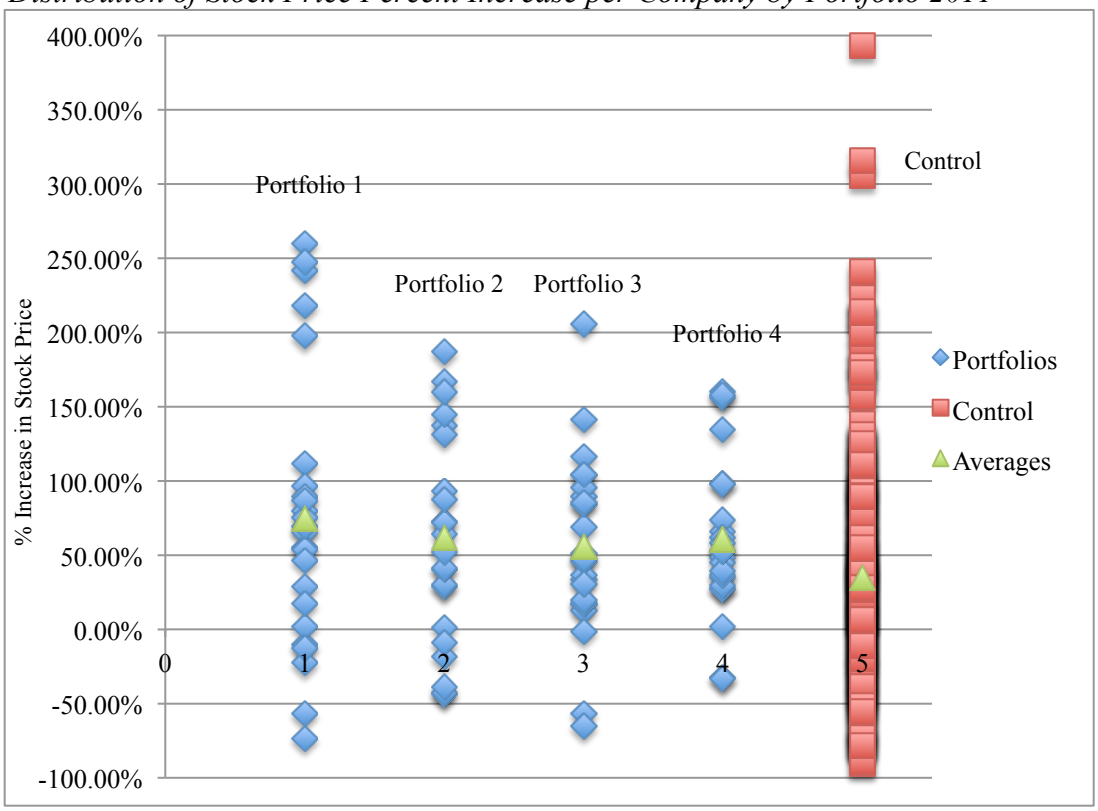
As shown in Figure 4.6, the two 2012 quartile portfolios act similarly when both decline in a similar manner as a reaction to the September 2011 market shock. The two portfolios' growth resumes during 2012, and Portfolio 1 more drastically pulls ahead of Portfolio 2 in 2013, ending the year at 60.92% and 44.53%, respectively.

Instead of simply drawing conclusions based on time period length (short- or long-term), these growth patterns are indicative of a broader possible limitation of the innovation premium measure: it is more accurate in predicting firm success and stock price increases during growth periods of the market.

The graph of the average percent increase in stock price per company over the period only tells the aggregate story. Figure 4.7 below depicts the distribution of the percent increase per company in order to better understand the underlying makeup of each portfolio. As shown in Figure 4.7, the average percent increase of each portfolio is generally boosted by a few exceptional performers and decreased by a few failures, with most companies hovering around the average.

Figure 4.7

Distribution of Stock Price Percent Increase per Company by Portfolio 2011



These portfolios illuminate the inherent risk and reward continuum of innovation. Without the added risk, the large returns would not be realized. Some innovations become blockbuster successes that carry a company, and others fail bringing negative financial consequences. The innovation premium measure predicted the success of Portfolio 1, and indeed it ended with the highest average increase in stock price (74.58%). However, the distribution reveals this is greatly aided by the exceptional success of a few companies driving up the average, rather than the overwhelming success of every company in the portfolio. In Portfolio 1, for example, the stock increases of companies like Starbucks (259.75%), Salesforce.com (247.38%), or Tencent (241.58%) drive up the portfolio average overall and make up for companies in decline like Bharat Heavy Electricals (-73.46%) or Nintendo (-57.08%). Similarly, there are outstanding performers in Portfolios 2, 3, and 4 that provide a comparable boost in their respective average percent stock increases.

Figure 4.7 illustrates an important facet of the innovation premium measure: involved risk. Yes, a high innovation premium measure identifies companies more likely to develop exceptional or disruptive innovations capable of producing blockbuster returns, but this innovation potential also represents ample amounts of risk. In reality, innovation does not always succeed, and even some of the most innovative companies can make very poor innovation choices.

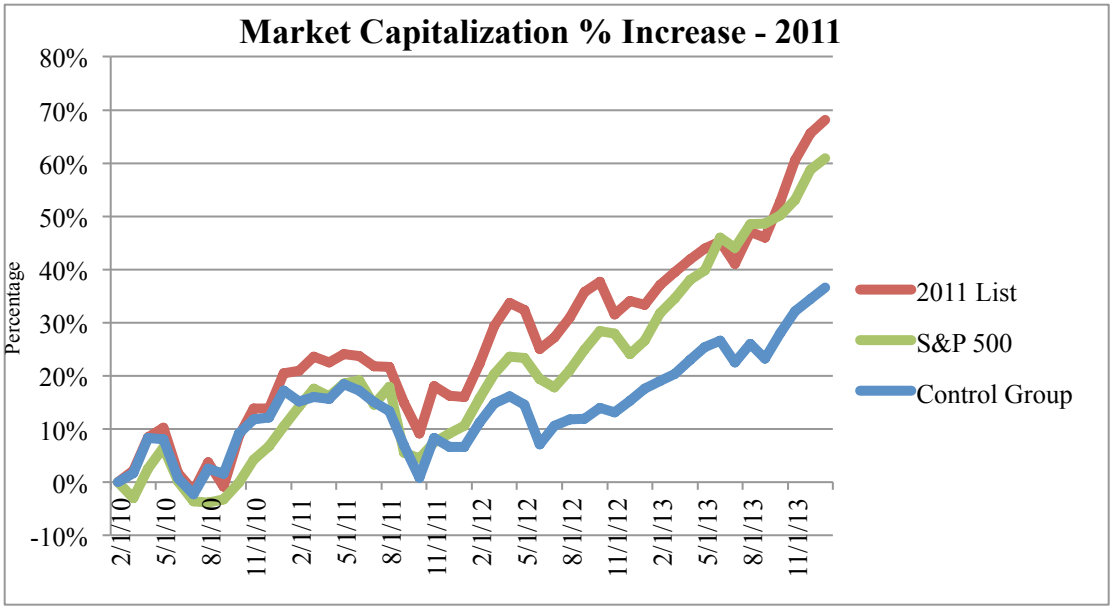
Market Capitalization Analysis

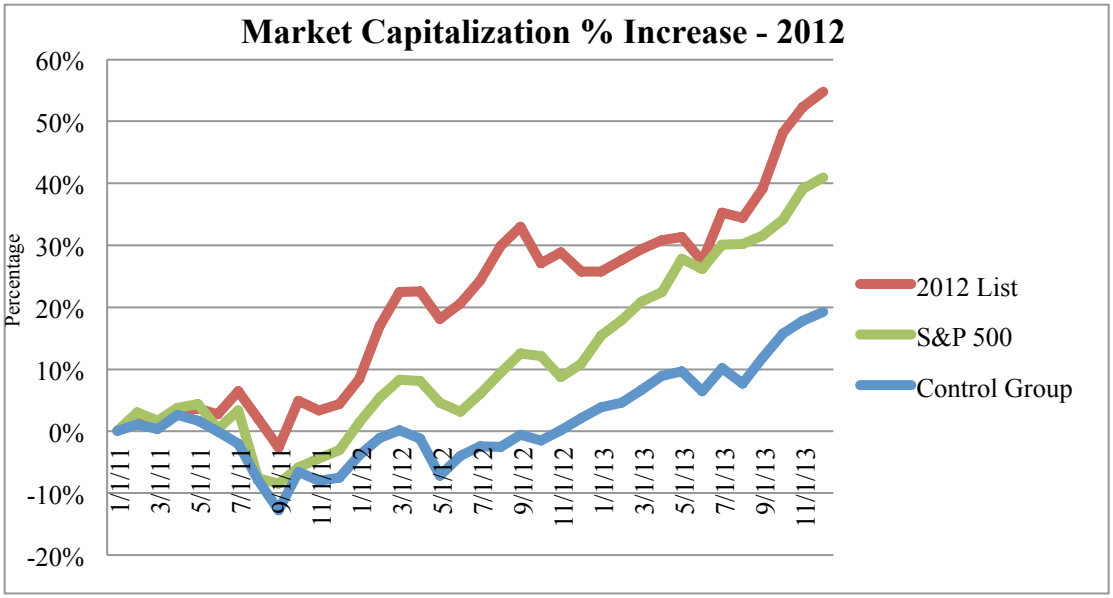
Market capitalization provides a different lens for analyzing the stock performance of the annual Most Innovative Companies lists. While market

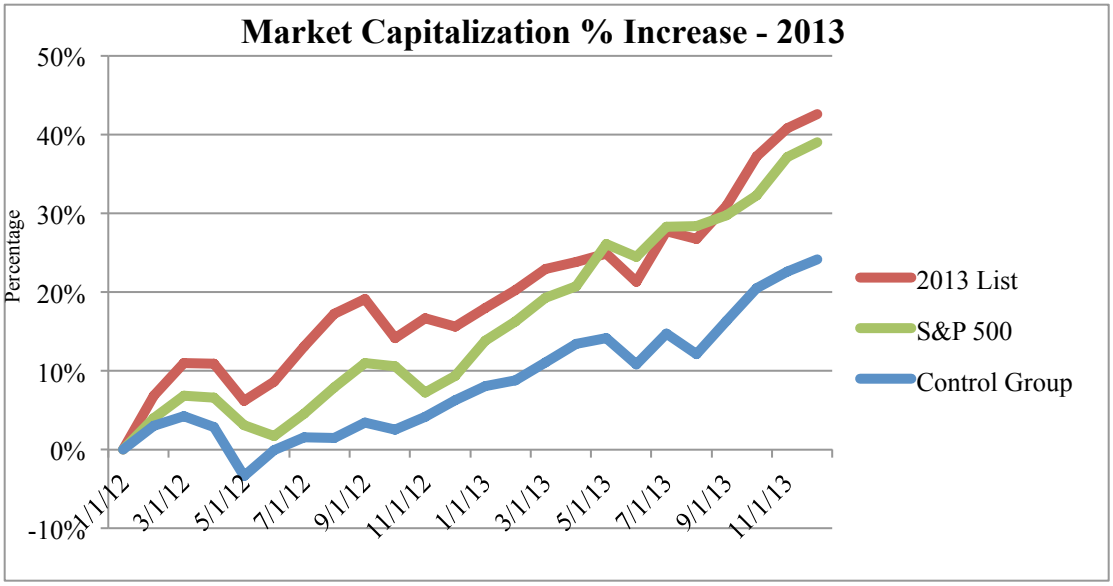
capitalization is also related to investor sentiment and market expectations for growth, this measure is more descriptive than a stock price because it encompasses the value of the company as a whole and can be easily compared.

Figure 4.8 below illustrates the percent change in average market capitalizations of the 100 companies on each of the annual Most Innovative Companies lists. Observable trends are similar to those of the percent increase in stock value graphs previously discussed. Additionally, the hypothesis that the innovation premium measure is more predictive of firm success during growth periods is further supported by the market capitalization data.

Figure 4.8 *Comparison of Market Capitalization Percent Increase 2011-2013*





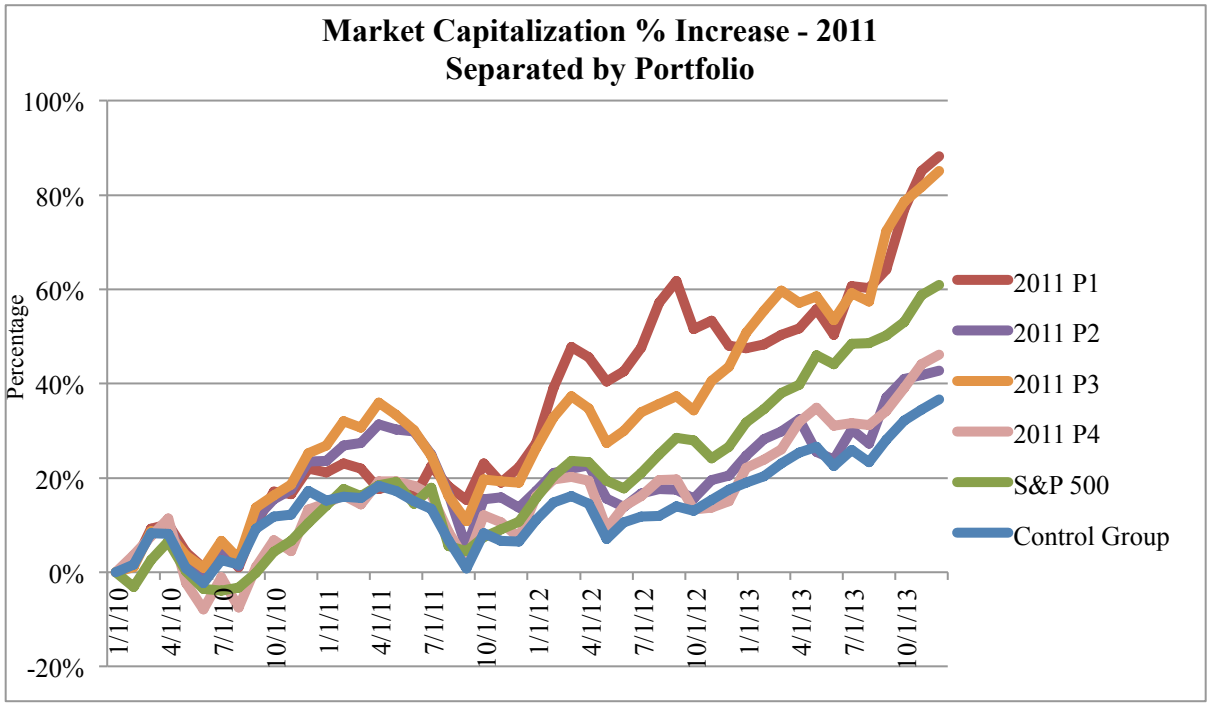


According to the calculated market capitalization data and representative graphs, during market downturns and periods of instability such as 2010 and 2011, there is little disparity between the performance of the Most Innovative Companies lists, the control group, and the S&P 500 index. Additionally, the 2011 and 2012 lists' market capitalization data depicts similar "unified decline" patterns to the change in stock price data. When the market experiences a steep decline, all groups

tend to regress together to approximately the same level. The differences between groups emerge only after the shocks of 2010 and 2011 conclude and stability returns to the market.

Again, the "unified decline" pattern is illuminated below in Figure 4.9 when the market capitalization increase is separated into quartile portfolios. During 2010 and 2011, the shocks reverberated through all portfolios, the S&P 500, and control groups alike. Portfolio 1 only emerges as the leader in 2012 after the market has settled, barely beating Portfolio 3 by 3.11% at the close of 2013 (Portfolio 1 close: 88.22% Portfolio 3 close: 85.11%). Portfolio 3 emerged as a strong performer based on market capitalization. When the portfolios were compared by average stock price increase, Portfolio 3 ranked last among all four portfolios. This illustrates how stock price increase can sometimes be misleading in terms of total firm value.

Figure 4.9 *Comparison of Market Capitalization Increase 2011 by Portfolio*



The 2012 and 2013 lists' market capitalization increases follow expected patterns with Portfolio 1 displaying the greatest increase and all portfolios for both years exceed the increase of the control group.

Table 4.3 *Summary of Stock Analysis for 2011 Most Innovative Companies List*

	2011 Portfolio 1 Average	2011 Portfolio 2 Average	2011 Portfolio 3 Average	2011 Portfolio 4 Average
Stock Price Average % Increase	74.58%	61.71%	55.76%	60.58%
Market Capitalization Increase	88.22%	42.77%	85.11%	46.14%

Additional Control Group Analysis

At the end of each period, the quartile portfolios do not always line up as predicted by the innovation premium measure. However, across the board for both the average percent stock price increase and increase in market capitalization, all quartile portfolios and annual lists as a whole consistently outperformed the control group.

The annual Most Innovative Companies lists outperformed the control group in terms of stock performance and market capitalization growth. However, additional analysis of company financial performance is possible to further analyze whether the Most Innovative Companies in fact outperform the control group based on other factors as well. Recall the discussion of similarities between the control group and the 100 Most Innovative Companies of 2011 List from the beginning of this chapter (Table 4.4 is repeated for reference). A similar comparison was created

in Table 4.5 to analyze an additional set of financial performance indicators. In each table the higher value is highlighted.

Table 4.4 *Basic Characteristics Comparison of Control Group and 2011 List*

	Control Group Average	100 Most Innovative Companies 2011Average
Total Assets th USD 2011	30,869,918.36	23,219,274.64
Market Cap. th USD 2011	25,235,082.18	33,854,984.82
Number of employees 2011	60,331.75	49,289.89
Enterprise Value th USD 2011	29,698,714.55	34,436,231.50
EBIT th USD 2011	2,877,534.59	2,892,538.81
Total revenues th USD 2011	22,175,009.87	16,110,190.31

Table 4.5 *Additional Metrics Comparison of Control Group and 2011 List*

	Control Group Average	100 Most Innovative Companies 2011 Average
Profit Margin (%) % 2011	16.45	18.31
Return on Total Assets (%) % 2011	10.83	13.10
Price Earning Ratio % 2011	15.82	18.51
ROE using P/L before tax % 2011	27.90	30.96
ROA using P/L before tax % 2011	10.83	13.10
ROE using Net income % 2011	19.23	22.41
ROA using Net income % 2011	7.79	9.63
Earnings per share USD 2011	5.50	3.83
Profit margin % 2011	16.36	18.31
Gross margin % 2011	46.92	54.31
Gross Profit th USD 2011	9,111,167.06	8,009,208.61
ROCE using Net income % 2011	11.74	15.24
ROCE using P/L before tax % 2011	15.82	20.21
R&D to sales % 2011	2.00	3.49
Market price - year end USD 2011	53.53	67.84
Price / book value ratio - close 2011	3.01	4.07
Current Assets th USD 2011	11,123,430.08	9,514,463.89

Additional financial metrics provide supplementary data for comparison between the 2011 Most Innovative Companies and the control group. Though the control group and the 2011 list are similar in size and basic characteristics, the 2011 Most Innovative firms, on average, display stronger financial performance for key metrics related to innovation.

Table 4.6 *Price / Earnings Ratio Comparison of Control Group and 2011 List*

	Control Group Average	2011 Most Innovative Companies List Average
Price / earnings ratio - close 2011	15.82	18.51
Price / earnings ratio - close 2012	23.30	21.42
Price / earnings ratio - close 2013	24.61	33.96

For example, the average price/earnings ratio of the 2011 Most Innovative Companies List has increased each year (see Table 4.6), indicating market expectation for growth continues to strengthen with time. Price/earnings ratio is an additional indicator of investor sentiment. It's reasonable to predict that companies with higher innovation premiums will also have high price/earnings ratios.

Table 4.7 *Profit Margin (%) Comparison of Control Group and 2011 List*

	Control Group Average	2011 Most Innovative Companies List Average
Profit Margin (%) % 2011	16.45	18.31
Profit Margin (%) % 2012	13.91	16.87
Profit Margin (%) % 2013	12.84	16.82

Another selected metric, profit margin, is shown in Table 4.7 above. The average profit margin of the 2011 Most Innovative Companies list is consistently greater than the control group average, indicating the 2011 list companies are able to convert a higher percentage of their selling prices into profits.

Table 4.8 *Return on Equity Comparison of Control Group and 2011 List*

	Control Group Average	2011 Most Innovative Companies List Average
ROE using Net income % 2011	19.23	22.41
ROE using Net income % 2012	12.11	21.00
ROE using Net income % 2013	16.61	20.04

In addition, Return on Equity (ROE) is likely higher for companies with higher innovation premium measures. ROE measures profitability based on a company's ability to efficiently generate profit with invested shareholder capital. Investors are willing to pay a premium for companies that more wisely employ capital to maximize returns. Also many innovative companies will have a higher ROE due to increased productivity as a result of more effective use of technology. As depicted in Table 4.8 above, the 2011 Most Innovative Companies list outperformed the control group in terms of ROE each year.

DISCUSSION

The innovation premium measure proved to be a robust topic for research and inquiry. The analytical nature of the measure and availability of the *Forbes* Most Innovative Companies lists for three consecutive years provided a variety of options for comparison, prediction, and analysis. In this section, the most relevant findings are discussed in detail.

Stock Performance Compared

The 100 Most Innovative Companies lists consistently outperformed the control group in long-term comparisons of stock performance. When the stock price increase and market capitalization increase are calculated as a percent change from list inception to the close of 2013, all three annual 100 Most Innovative Companies lists outperformed the control group. For these two stock performance metrics, not only did all three annual lists outperform the control group in aggregate, but every quartile portfolio outperformed the control group as well. The closest the control group came to matching the performance of a portfolio was 2013 Portfolio 4 based on increase in market capitalization. 2013 Portfolio 4 outperformed the control group by only 4.73% (Portfolio 4 close: 28.85%, Control Group close: 24.12%).

It's important to note that four years was the longest time period compared, so conclusions are limited in scope. The 100 Most Innovative Companies of 2011 are tracked the longest, from 2010-2013. (As discussed in the methodology section,

the annual lists were created using the prior year's financial data for calculations. This study takes this consideration into account by beginning each period of comparison on January 1 of the year prior to list creation.) Therefore, use of the word "long-term" is relative in this study. Long-term refers to the period from list inception to the end of 2013.

Effects of Market Environment

The innovation premium measure indicates future innovative and financial success with more accuracy during times of market stability or market growth. Data analysis revealed the innovation premium to be much less effective at predicting which companies would succeed during market downturns or periods of instability. This limit of the innovation premium measure is most observable when tracking the stock performance of the 2011 list during 2010 and 2011, and the 2012 list during 2011. During these periods of decline there is little differentiation between the performance of the quartile portfolios, aggregate list, or control group. Only after the market stabilizes or resumes growing again does segmentation re-occur and the Most Innovative Companies lists resume their accelerated growth. Notwithstanding previous stock performance, large market shocks and downturns over the observed time period tended to affect all groups of companies equally. These occurrences were previously referred to in this paper as periods of "unified decline."

Quartile Comparison

Intra-list comparisons revealed that Portfolio 1 (the top quartile) of each annual list consistently outperformed the other three quartiles in long-term comparisons of stock performance. When the stock price increase and market

capitalization increase are calculated as a percent change from list inception to the close of 2013 and compared by quartile, Portfolio 1 outperforms in both categories for all lists.

However, the three remaining quartile portfolios are much less predictable, and their performance does not appear to follow a pattern based on either the metric or year observed. The differences between the portfolios become less distinct as the lower quartiles are considered. As the differences between the innovation premium values become subtler, the variability increases among the portfolios. Nevertheless, when the descriptive statistics of each annual list are taken into consideration, this outcome is to be expected. The first quartile (Portfolio 1) contains all of the outliers and has a much higher mean innovation premium than the other three quartiles due to the positively skewed distribution of the list (see Table 5.1).

Table 5.1 *Average Innovation Premium by Portfolio*

	2011	2012	2013
Portfolio 1	42.46%	45.64%	49.3
Portfolio 2	29.93%	32.54%	33.3
Portfolio 3	22.51%	n.a.	25.8
Portfolio 4	17.65%	n.a.	20.6

All quartile portfolios substantially outperform the control group. The wide distribution of innovation premiums across the 100 Most Innovative Companies and the reliability with which even the lowest quartiles outperform the control group implies that most companies on the market have very low innovation premiums. For comparison's sake, it's important to highlight that even the 100th Most Innovative

Company likely has an innovation premium much higher than the majority of the control group companies.

The overwhelming success of the first quartile across all three annual lists in terms of both stock metrics helps support the validity of the innovation premium measure. When the strong performance of the first quartile is considered jointly with the assumptions made about the spread of innovation premium values assigned to the market at large (represented by the control group), it's reasonable to conclude that the validity of the innovation premium measure increases for either distinctly high or distinctly low values.

Innovation premium values that fall in the middle are less meaningful because the predictive accuracy of the measure decreases and variability increases. It's important to note that the innovation premium measure is skewed likely due to the nature of innovation itself. Innovative success is not the norm; it is the exception. The success of the innovation premium measure lies in its ability to identify outliers and distinguish probable innovators from non-innovators.

Risk and Reward

Innovation is inherently risky. A high innovation premium indicates an increased likelihood of innovation occurring and higher probability of success, but even for companies with the highest innovation premiums, there remains a large risk of failure. Almost every variable that contributes to innovation is unpredictable. R&D spending, innovation processes, innovation dissemination, and new product adoption rates by consumers are just a few of the many uncontrollable components of business innovation. With so many variables involved and so few guarantees,

innovation is an expensive, risky business activity. However, innovation is absolutely critical for firm survival. Companies who do not innovate will be quickly made obsolete by their competitors. The changing nature of the Most Innovative Companies lists illustrates the difficulty firms have in maintaining market dominance. Very few companies were able to improve their standing on the list over the three years. If a company remained on the list three years later, chances are it moved down in position. Gaining market share requires innovation, but maintaining it requires *repeated* innovation.

Limitations

In some select cases, it appears that historical track records of innovation can lead to overstated innovation premiums that persist for years. Preliminary evidence arose from some analysis done for this study. In the stock return distributions, one group of "big winners" and one group of "big losers" became noticeable on each annual list (as is expected with highly innovative, risk-taking firms). However, a third group of stable and consistent, yet conspicuously mediocre performers rested in the middle. In fact, some of these mediocre performers appear prominently on all three annual lists. One such example is Intuitive Surgical, ranked #4 in 2011, #6 in 2012, and #8 in 2013 despite only a 17.08% increase in stock price over the observed period of 2010-2013. With seemingly middle-of-the-road financial performance, the high innovation premium awarded to Intuitive Surgical makes little sense. However, when 2009 is taken into account, the historical significance becomes obvious. In 2009, Intuitive Surgical released a revolutionary robotic surgical system and the stock price skyrocketed from $126.99 at the

beginning of January to $303.43 at the end of the year. For Intuitive Surgical, Infosys, and other similarly affected companies, high innovation premiums can remain embedded in their stock prices for years even though much of that predicted innovation potential is tied to the past and has already been accounted for by the market.

The potential for past innovations to distort the innovation premium measure denotes an important limitation that requires further investigation beyond the scope of this study. One opportunity for future analysis involves investigating historical track records of innovation and analyzing how innovation premiums assigned to companies in the past continue to affect today's investors. This limitation of the innovation premium measure needs to be better understood so that it can be dependably identified and controlled for.

CONCLUSION

The innovation premium measure is relatively new and little research currently exists on the topic. This study uses both quantitative and qualitative analysis to determine whether the innovation premium measure is linked to the innovative and financial success of companies across the globe.

Overall, this study confirmed the validity of the innovation premium measure. Through examining the stock returns, financial performance, and qualitative aspects of firms on the annual *Forbes* Most Innovative Companies lists, the innovation premium measure of innovative success and financial growth was tested. Stock performance data was used as the foundation for analysis. Change in stock price and change in market capitalization were the primary metrics used to track returns. All three *Forbes* Most Innovative Companies lists considerably outperformed a control group for both metrics. In addition, this study involved intra-list comparison by quartile.

Investigating specific aspects of the innovation premium measure illuminated not only its strengths but its weaknesses and confines as well. However, many limitations impacted the scope of this research. Due to the proprietary nature of innovation premium calculations, the limited availability of data was most restricting.

This study serves to reinforce the existing body of knowledge supporting the innovation premium measure, raise new questions, and deepen the current interpretation of innovation theory. As a relatively uninvestigated method of measuring innovation, the innovation premium measure offers abundant opportunities for original analysis. The conclusions drawn from this study contribute a fresh perspective to the current understanding of the innovation premium measure and highlight opportunities for future research.

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